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FOR THE SAFETY OF AIR NAVIGATION

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Help

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Abstract*Help*

This Manual provides a high level introduction to the structure and the content of AIXM Conceptual Model (AICM). It also provides insights into some of the most important aspects of the model.

The information is organised in 'AICM concepts'. A 'concept' is a group of aeronautical features, which are logically linked together. For example, the 'aerodrome and runway' concept groups together entities such as aerodrome, runway, declared distances, etc. At the end of every concept, there is a list of Frequently Asked Questions.

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0.9	27/10/2003		First public release of the manual.	All

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Chapter 1. INTRODUCTION

The 4.5 version of the Aeronautical Information Conceptual Model (AICM) is an entity-relationship (E-R) model, documented by diagrams and reports (data dictionary), which provide descriptions, notes, rules, lists of values, etc. for entities, attributes, relationships and domains. These descriptions and notes are, most of the time, concise and limited to one item. They do not provide a higher level view of the underlying modelling concepts in AICM. It could be said that the AICM describe the trees, but not the forest. Thus there is the need for an 'AICM Manual' to describe and comment upon the AICM structure and content at a higher level.

However, the purpose of this manual is to supplement the AICM documentation and not to replace it. When using this document, the reader should always refer to the descriptions, notes and rules provided in the AICM reports and diagrams.

The information in this manual is organised as 'AICM concepts'. The term 'concept' designates a set of entities and relationships that are logically linked together. For example, the 'aerodrome and runway' concept groups together entities such as AD/HP, RWY, RWY centreline, RWY Direction, RWY Declared Distances, etc.

1.1. AICM 'business rules'

The AICM building blocks are entities and relationships. Entities may have attributes and each attribute may have a domain of values. In addition, textual rules may be specified for entities, attributes and relationships. Such rules may correspond to real world constraints that cannot be modelled using only entities, attributes, relationships and domains of values.

AICM plain text rules are explicitly classified in the AICM "Rules" Report as either:

- "technical" - rules meant to avoid data ambiguity
- or "business"
  - rules meant to check data consistency
  - rules that implement ICAO/Regional Standards
  - rules that implement ICAO/Regional Recommendations
  - rules that impose minimal data availability
  - rules that test data plausibility

The most common example of a technical rule is to provide a unit of measurement for values such as length, width, elevation, etc. Obviously, a data set containing an elevation value without a unit of measurement is of no use. An example of a 'data plausibility' rule is that the angle between two route segments cannot exceed 90 degrees.

AICM rules may be enforced at various degrees in a system implementing the model. For example, some rules could trigger only warning messages, while others could trigger error messages and might prevent the data concerned from being stored in the database. Technical rules shall always generate error messages, as it is likely that data sets infringing technical rules are not usable for the receiver.

Chapter 2. GEOMETRICAL ASPECTS OF AICM

2.1. Introduction

Positions are codified in a broadly similar way for all entities in the AICM for which the concept of position is valid. The simplest type of position is a point. More complex types of geometries are centre lines and different kind of areas. This section describes the recurring types of position in a generic way.

2.2. Geometry: Point

2.2.1. Geographic Position

Two attributes directly define the geographic position of a Point in terms of latitude [GEO_LAT] and longitude [GEO_LONG].

Associated with the geographic position is a declaration of the accuracy of that position. The accuracy consists of an accuracy value attribute [VAL_GEO_ACCURACY] and an attribute that defines the units of measurement in which the accuracy value is expressed [UOM_GEO_ACCURACY]. The accuracy value attribute is optional. However, when the accuracy value is defined, the units of measurement of that accuracy value must also be defined. Therefore the UOM_GEO_ACCURACY attribute inherits the optionality associated with the VAL_GEO_ACCURACY attribute in its definition, but is mandatory where the VAL_GEO_ACCURACY is defined. This kind of relationship between values and their units of measurement is common in the AICM.

The CODE_DATUM attribute provides the possibility to specify the Datum on which the geographic position is defined. The attribute can take a value from a constrained list of values defined in the AICM. However, it shall be kept in mind that, according to the provisions of ICAO Annex 15, all geographic coordinates shall be expressed in WGS-84.

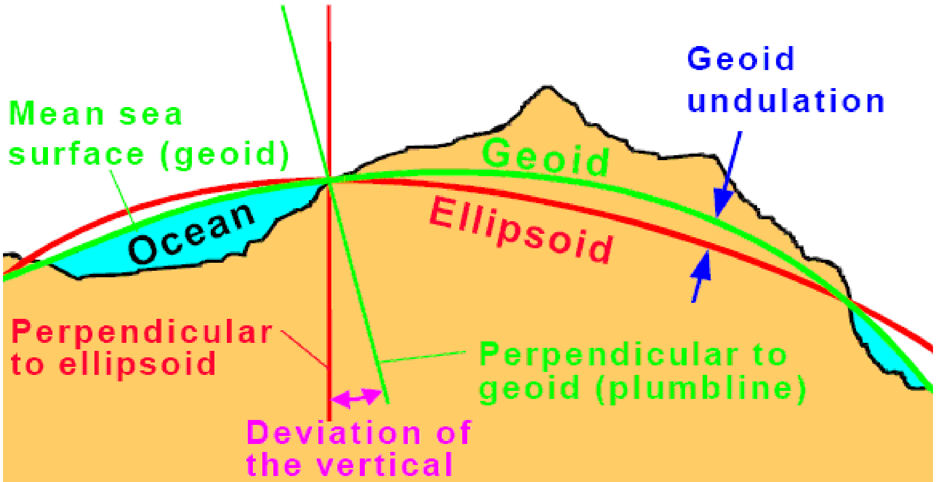
2.2.2. Elevation

A single attribute contains the value of the Point's elevation [VAL_ELEV] and an associated attribute defines the units of measurement in which the position elevation is expressed [UOM_VERT_DIST]. When the VAL_ELEV attribute is populated, the associated units of measurement attribute must also be populated [an identical dependency relationship to that described above for the geographic position accuracy and its associated units of measurement].

Also associated with the Point's elevation is the elevation accuracy attribute [VAL_ELEV_ACCURACY]. This attribute may only be defined when the Point's elevation has been defined. The attribute is defined as the distance from the stated Point's elevation within which there is a stated confidence of the true position falling. The order of accuracy required for aeronautical data, based on a 95% confidence level, is specified in ICAO Annex 11, Chapter 2 and ICAO Annex 14, Volumes I and II, Chapter 2. The units of measurement for this attribute are identical to those of the Point's elevation and cannot deviate as the single vertical distance units of measurement attribute applies to all attributes of the the entity that define vertical distances [VAL_ELEV, VAL_ELEV_ACCURACY and VAL_GEOID_UNDULATION].

A geoid undulation may be specified in relation with the Point's elevation value. The geoid undulation value is defined as a vertical distance separating the geoid and the ellipsoid at that position. Figure 2.1, "Geoid Undulation" shows a schematic diagram of this.

Figure 2.1. Geoid Undulation



2.2.3. Integrity

The integrity of the Point data is ensured by the Cyclic Redundancy Check attribute [VAL_CRC] which contains a CRC value calculated as follows:

- The CRC is calculated using the CRC-32 bit algorithm.
- It is left to implementers[1] of based on this model to decide and notify the specific attributes which are used for the CRC calculations, taking into consideration the requirements of the ICAO Annex 15.
- Each field is concatenated [in the order given] to form a single bit sequence.[2]
- The CRC value stored in this attribute will allow unintended changes made to the attribute values contributing to the original bit sequence to be detected.

The CRC method will not indicate which values have changed, only that a change has occurred. Also, the CRC method does not ensure that data are not changed – merely that the data that are subject to the CRC calculation have not changed since the CRC value was calculated. CRC calculations are a widely used method for monitoring the integrity of data used in many scenarios and circumstances. During the WGS-84 programme, EUROCONTROL commissioned a software tool set to provide geodetic calculation, transformation and integrity tools to member states. This tool set is called the Data Quality Tool Set (DQTS) and includes a generic CRC calculation tool which enables CRC values to be calculated for structured input data.

2.3. Geometry: Area

Areas are closed, two-dimensional shapes of arbitrary geometry described in terms of an ordered series of vertices and paths between those vertices. Each vertex has a position and a path to the next vertex. As the shapes are always closed, the path associated with the final vertex is the path to the first vertex.

[1] In the current EAD implementation (Release 4), the CRC is calculated based only on the following four fields: GEO_LAT, GEO_LONG, VAL_ELEV and VAL_GEOID_UNDULATION

[2] Values that do not exist [according to the model constraints this can only be VAL_ELEV and VAL_GEOID_UNDULATION] form no part of the concatenated data.

The geometry of an area in AICM is in general modelled by two entities, XXX_GEOMETRY and XXX_SHAPE_POINT, where XXX represents the name of the entity whose geometry is being modelled (e.g., RWY_PROTECT_GEOMETRY).

XXX_GEOMETRY contains information common to each of the area's vertices. This information is limited to the units of measurement, the accuracy, the datum and the geoid undulation associated with all of the vertices.

Each of the area's vertices is described by an instance of the XXX_SHAPE_POINT. The entity instance defines:

- The position of the vertex as a latitude and longitude defined on the datum and with an accuracy defined by the VAL_GEO_ACCURACY specified in the associated XXX_GEOMETRY entity instance.
- The elevation of the vertex with an accuracy and geoid undulation defined in the associated XXX_GEOMETRY entity instance.
- The path to the next vertex in the shape, that is with the next NO_SEQ.

(Vertex) Sequence number [NO_SEQ]

The order of the points is given by the NO_SEQ attribute. The vertex with the highest NO_SEQ is implicitly considered to be the last point. There is no explicit 'last point' indication.

(Vertex) Type [CODE_TYPE]

The following path types are considered in the model:

- GRC [Great Circle = line segment for short distances]

  This is the most common type. It is simply a straight line between the current vertex and the next one.

- RHL [Rhumb Line (Loxodromic Line)]

  A line of constant angle with the meridians. The most common used is a parallel of the grid.

- CCA [Counter Clockwise Arc]
- CWA [Clockwise Arc]
- ABE [Arc By Edge]
- FNT [Sequence of geographical (political) border vertexes]

  This is a special case, used for Airspace borders and further detailed in Section 5.3.3, “GEO_BORDER”, where the path between two consecutive vertex is a complex polyline, such as a State border, identified by its name.

2.4. Geometry: Centre Line

A centre line of an AICM entity XXX is described by a series of points that lie on that centre line and a width. The series of points defines a path and (through the elevation of the points) a profile. The data describing each point are contained in an instance of the XXX_CLINE_POINT entity. The width is modelled by the attribute VAL_WID.

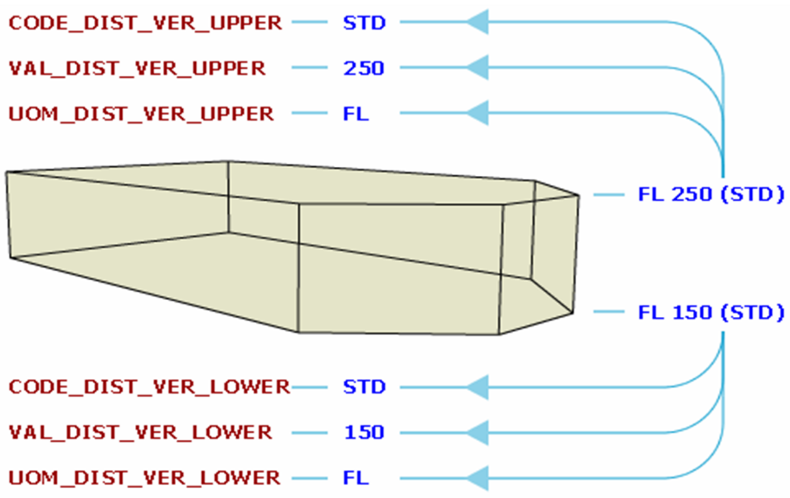
The XXX_CLINE_POINT entity's geometry is a Point, as defined in Section 2.2.

2.5. Vertical Limits

There are a series of attributes that are used to model vertical limits, such the upper and lower limits of the airspace. Logically, the names of these attributes end in either "_UPPER“ or "_LOWER" postfix. Both the upper and lower limits have three attributes defining it:

- VAL_DIST_VER_UPPER/LOWER [the actual value of upper/lower limit]
- UOM_DIST_VER_UPPER/LOWER [the unit of measurement e.g. metres or feet]
- CODE_DIST_VER_UPPER/LOWER [the reference system e.g. 'STD' which references Standard Pressure]

Figure 2.2. Vertical Limits



The reference system may be specified through:

- Real distance
  - HEI [The distance measured from ground (GND)]
  - ALT [The distance from mean sea level (MSL)]
  - W84 [The distance measured from WGS-84 ellipsoid]
- Pressure difference
  - STD [The altimeter setting is set to standard atmosphere].
  - QFE [The pressure corrected to the official station/aerodrome elevation]. An altimeter set to the particular field QFE reads zero when an aircraft is on the ground (strictly the height of the altimeter above the ground).

- QNH [The pressure 'reduced' to mean sea level (MSL)]. An altimeter set to the field QNH reads the elevation of the field when on the ground (i.e., 0 at MSL).

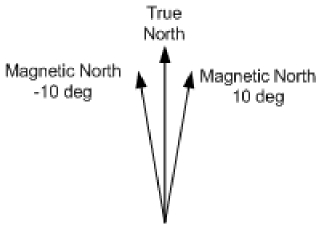
2.6. Magnetic Variation

In AICM the relationship between magnetic variation, Magnetic North and Geographic North is modelled as follows:

- A positive magnetic variation indicates that Magnetic North is East of Geographic North.
- A negative magnetic variation indicates that Magnetic North is West of Geographic North.

This relationship is shown diagrammatically in Figure 2.3, “Relationship between Magnetic Variation, Magnetic North and Geographic North”

Figure 2.3. Relationship between Magnetic Variation, Magnetic North and Geographic North



The AICM convention equates to the rule of thumb: *Variation East, Magnetic Least*

The relationship can be described by the following equation:

Magnetic Bearing = True Bearing – Magnetic Variation

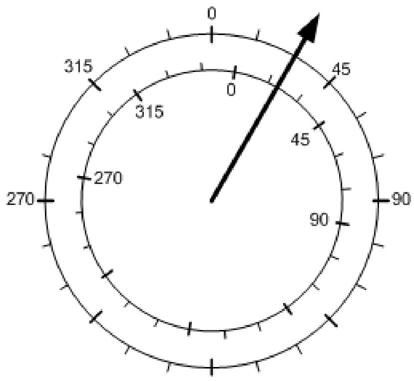
For example if the magnetic variation is defined as 10°, the value is positive – therefore Magnetic North is East of Geographic North in this example.

If a true bearing is defined as 30° the magnetic bearing is calculated as follows, using the supplied equation:

Magnetic bearing	= 30° – 10°
	= 20°

This fulfils the rule “variation east, magnetic least” as the magnetic bearing is less than the true bearing. This case is shown in Figure 2.4, “10° Magnetic Variation Example”.

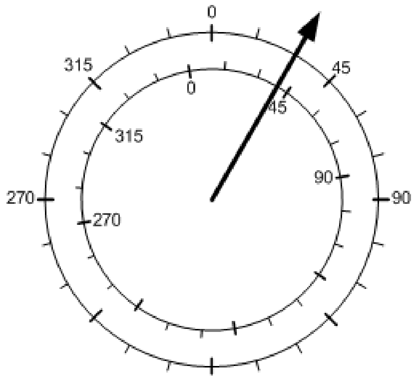
Figure 2.4. 10° Magnetic Variation Example



Magnetic bearing	= 30° – (-10)°
	= 30° + 10°
	= 40°

This case is illustrated in Figure 2.5, “-10° Magnetic Variation Example”

Figure 2.5. -10° Magnetic Variation Example



Chapter 3. TIME SCHEDULES

3.1. Introduction

Working hours, applicability hours, activity hours, operating hours, unmonitored hours etc., further down generally referred to as 'schedules', may be modelled in AICM either by the attributes contained in two main time entities or a combination of them or the relationship to a facility entity.

The common to all facilities TIMETABLE and TIMESHEETS entities express this values using:

1. a coded value or
2. ‘timesheets’ or
3. a combination of the above

3.2. Coded Value

Working hours [CODE_WORK_HR]

Simple and frequently encountered schedules are indicated using a set of predefined codes. The current list contains the following values:

- H24 [continuous service, 24 hours out of 24.]
- HJ [sunrise to sunset.]
- HN [sunset to sunrise.]
- HX [no specific working hours.]
- HO [service available to meet operational requests.]
- NOTAM [activity periods to be published by NOTAM.]

However, most schedules are too complicated to be described by using a simple code. Therefore, a special construction called ‘timesheet’ has been included into the model. A special coded value (TIMSH) indicates that the schedule is expressed using one or more ‘timesheets’.

3.3. ‘Timesheets’ - TIMESHEET Entity

Timesheets are used to model schedules such as:

- MON 10:00 - 18:00;
- MON 10:00 - THU 18:00;
- 08:35 - 17:25 on SAT, SUN and Legal Holidays
- 10:00 - 18:00 on every Monday that occurs between 15 MAR and 15 OCT;
- 15 minutes before sunrise till 15 minutes after sunset
- 15 minutes before sunrise till 15 minutes after sunset or 19:00, whichever is earlier

For this purpose, the TIMESHEET entity have been used in AICM. Some of the attributes of the TIMESHEET entity are discussed later.

Time reference system [CODE_TIME_REF]

This is a mandatory attribute and it indicates the time reference system:

- UTC [Co-ordinated Universal Time] or
- UTCW [UTC adjustable for summer time].

UTCW means that the hours contained in the timesheet are expressed in UTC, as applicable during winter time. This is considered to be the period between the end of one daylight saving time period and the start of the next one. During the summer time - daylight saving time - the values must be decreased by one hour.

Local times would have to be converted to 'UTCW'. For example, if something starts at 10:00 LT all year around and this corresponds to 09:00 UTC in winter, then it will start at 08:00 UTC in summer, which is exactly the definition of ‘09:00 UTCW’.

Yearly start/end date [DATE_VALID_WEF/TIL]

These two attributes are intended to allow for modelling schedules that are repetitive every year, such as ‘15 May to 15 November’. This is typical for small aerodromes, which have different opening hours from late autumn until early spring, due to poor meteorological conditions.

The two attributes are mandatory. This means that when the schedule specified in the timesheet is valid all year long, the yearly start date [DATE_VALID_WEF] must take the value ‘01-01’, while the yearly end date [DATE_VALID_TIL] has the value ‘31-12’.

The list of allowable values for yearly start/end dates also contains two specials:

- SDLST [Start of Daylight Saving Time.]
- EDLST [End of Daylight Saving Time.]

When either the yearly start or end dates are ‘SDLST’ or ‘EDLST’, the value "UTCW" cannot be used for the time reference system. Combinations between SDLST/EDLST and UTCW would be either wrong or superfluous. Therefore, they are forbidden.

"On day" or "start day/end day" [CODE_DAY and CODE_DAY_TIL]

If only a start day [CODE_DAY] is specified and no end day is given [CODE_DAY_TIL is empty], then the start day is also the end day. The start and end times contained in the timesheet [TIME_WEF/TIL, CODE_EVENT_WEF/TIL, TIME_REL_EVENT_WEF/TIL, CODE_COMB_WEF/TIL] must be considered as both occurring on the start day, for example, MON from 07:30 till 16:00.

If both a start day [CODE_DAY] and an end day [CODE_DAY_TIL] are specified, then the whole time period between the start day and start time until the end day and end time is covered by the timesheet. The start time [TIME_WEF, CODE_EVENT_WEF, TIME_REL_EVENT_WEF, CODE_COMB_WEF] refers to the start date, while the end time [TIME_TIL, CODE_EVENT_TIL, TIME_REL_EVENT_TIL, CODE_COMB_TIL] refers to the end date, for example, MON 07:30 till FRI 16:00.

The list of allowable values for days contains the following:

- MON [Monday.]
- TUE [Tuesday.]
- WED [Wednesday.]
- THU [Thursday.]
- FRI [Friday.]
- SAT [Saturday.]
- SUN [Sunday.]
- ~~MOFRI [Monday to Friday.] - which is equivalent to MON, TUE, WED, THU and FRI~~
- WD [Working day.] - which is any day except Saturday/Sunday/Legal Holidays
- PWD [the day preceding a working day.]
- AWD [the day after a working day.]
- LH [Legal Holiday.]
- PLH [the day preceding a legal holiday.]
- ALH [the day after a legal holiday.]
- ANY [Any day.]

3.4. Combination of a Coded Value and One or More "Timesheets"

It is allowed to specify both a coded value (CODE_WORK_HR) and one or more related TIMESHEETs. The interpretation to be given to such combinations depends on the value of CODE_WORK_HR, as indicated later:

- H24 - excluding the periods specified in the related TIMESHEET(s);
- HJ - excluding the periods specified in the related TIMESHEET(s);
- HN - excluding the periods specified in the related TIMESHEET(s);
- HX - within the periods specified in the related TIMESHEET(s);
- HO - within the periods specified in the related TIMESHEET(s);
- NOTAM - within the periods specified in the related TIMESHEET(s);
  Note

  there is no implicit activation if both TIMESHEET(s) and the coded value 'NOTAM' are specified; in the absence of a valid NOTAM, the corresponding timesheet(s) is/are considered as not active;
- TIMSH - as specified in the related TIMESHEET(s).

3.5. Frequently Asked Questions

1. **How is it possible to express "each day from 10:00 - 13:00" using a timesheet?**

   ~~There is no "each day" coded value [CODE_DAY]. The possibility of defining a special domain value - "ANY" - for any day was considered.~~ "Each day of the week" may be specified by using the "ANY" coded value:

   - ANY 10:00-13:00

   However, there are not many schedules in aviation that are the same each day. The concept of ‘working day’ and ‘legal holiday’ are much more frequently used. ~~Also, adding ‘ANY’ to the list of values would require some special checks to be done, for example, that only the start day could take the value ‘ANY’, not the end day.~~

2. **What is the meaning of a Timesheet when CODE_DAY=CODE_DAY_TILL?**

   CODE_DAY_TILL corresponds to the next week.

   Example: TUE 17:00-TUE 09:00 covers from Tuesday 17:00 until the next Tuesday at 09:00.

3. **How would "SAT/SUN/HOL CLSD" be expressed?**

   In principle, timesheets are used to express working hours only. It is assumed that any other time, not covered by the timesheet, is closed, not applicable, not working, etc.

   In this example, the working hours would then be the opposite of the closure hours:

   WD, 00:00-24:00 Local time (which means all working days).

   However, considering the rule given for combinations between coded values and timesheets, the same schedule could also be expressed as follows:

   coded working hours [CODE_WORK_HR] = 'H24' + 3 timesheets:

time reference	yearly start date	yearly end date	on or from	start time	until	end time
UTCW	01-01	31-12	SAT	00:00		24:00
UTCW	01-01	31-12	SUN	00:00		24:00
UTCW	01-01	31-12	HOL	00:00		24:00

   This means ‘H24, except for SAT, SUN, HOL 00:00-24:00 LT’.

   Note the timesheets indicated above are valid only if there is no difference between local time and UTC. For timesheets with a difference between local time and UTC see the answer to the Question 4, below.

4. **How would local times be expressed?**

   Local times must be converted to UTCW.

   For example, every Monday 10:00-17:00 LT in Belgium (UTC+1) would be expressed as:

   coded working hours [CODE_WORK_HR] = 'TIMSH' + 1 timesheet:

time reference	yearly start date	yearly end date	on or from	start time	until	end time
UTCW	01-01	31-12	MON	09:00		16:00

A special situation occurs for "all day". For example, every Monday 00:00-24:00 LT in Belgium (UTC+1) would be expressed as:

coded working hours [CODE_WORK_HR] = 'TIMSH' + 1 timesheet:

time reference	yearly start date	yearly end date	on or from	start time	until	end time
UTCW	01-01	31-12	SUN	23:00	MON	23:00

5. **How do you map in AICM the simple activation codes used in ARINC 424?**

- C -Active continuously, including holidays

  In AICM, this would be expressed with a coded value CODE_WORK_HR = 'H24'.

- H -Active continuously, excluding holidays

  This is done by using one timesheet with:

  - CODE_DAY='WD' (working days)
  - TIME_WEF=00:00 (from 00:00)
  - TIME_TILL=24:00 (till 24:00)

Again difference between local time and UTC must be taken into consideration (this example assumes that there is no difference).

6. **Is the purpose of the TXT_RMK_WORK_HR field to contain a verbalisation of the timesheets associated to a particular entity ?**

No. TXT_RMK_WORK_HR offers the possibility to record in words special timesheets, which do not fit in the structure of the TIMESHEET entities, for example, an aerodrome that is closed every Sunday when it rains.

7. **Has any work been done on algorithms for verbalising timesheets entries?**

No, or at least not as part of the AICM modelling activity.

The following list contains some hints for how to use the given time reference for such an algorithm:

1. UTC hours to be verbalised as UTC hours, without any conversion (10:00 UTC would be verbalised as 10:00 UTC)
2. UTC hours to be transformed into local time. The difference between local time and UTC would need to be used as a parameter.

   For example, if the time is specified as UTC 10:00, in Switzerland local time it would be 11:00(12:00)LT, the time in brackets being for summer;
3. UTCW hours to be verbalised as UTC: 10:00 UTCW would have to be formatted as 10:00(09:00)UTC, the time in brackets being for summer;

4. UTCW hours to be verbalised as UTC, mentioning only the winter time hours: 10:00 UTCW will become 10:00 UTC (This implies that a textual remark exists in the target document indicating that UTC hours have to be adjusted in summer time by subtracting one hour).

5. UTCW hours to be verbalised as LT: 10:00 UTCW would have to be formatted as 11:00(LT), same for winter/summer.

8. How do I convert SR/SS into actual hours?

More generally, the problem is related to the content allowed for some attributes of the TIMESHEET entity. Activity hours may be specified by using references to natural events such as 'sunrise', 'sunset' or to calendar conventions such as 'holiday' and 'working day'. In order to actually use such schedules, when performing calculations as necessary to analyse a flight plan or to generate a PIB, it is obvious that these timesheets must be converted to actual UTC values.

The actual UTC value of a sunrise, for example, will depend on the geographical location and on the time of the year. There are discrete and analytic solutions to this problem ('discrete' and 'analytic' should be taken in their mathematical meaning!).

1. The analytic solution would be to use a mathematical algorithm in order to compute the UTC value corresponding to the sunrise/sunset. An example of such an algorithm can be found at "http://www.hamiltonlabs.com/userguid/samples/sunrise.htm". Of course, a good astronomy manual should contain a more detailed analysis of the problem and could provide a more accurate algorithm.

2. The discrete solution would be to use tables containing the sunrise/sunset hours for each location of aeronautical interest. Examples of such tables can be found in the State AIPs, but they are usually published only for the main airports in that State. For the particular situation of a P, R or D area, such a solution could be less appropriate because such areas are not mandatory situated around an aerodrome.

9. How to indicate 'First Monday of each month'?

In principle, it is not possible to express 'First Monday of each month' using AICM Timesheets. However, it is possible to create 12 timesheets, each covering the first seven days of each month and having CODE_DAY=MON. There will be only one Monday in the first seven days and this one will be the one when the Timesheet is active. For example, the ones for January and July will look like below:

time reference	yearly start date	yearly end date	on or from	start time	until	end time
UTC	01-01	07-01	MON	09:00		11:00
...						
UTC	01-01	07-07	MON	08:00		10:00
...						

10. How to record 'maintenance times' for a navaid?

In the current AICM, there is no relationship between navaids and Timetable to indicate 'maintenance times'. The two relations that exist indicate 'operating hours' and 'un-monitored hours'. Therefore, in the current AICM, the maintenance times can only be recorded as Remarks to Working Hours.

11. **How do I indicate which days are Legal Holidays in my State?**

The SPECIAL_DATE entity has been used to model this aspect.

12. **How to record "floating" Public Holidays, such as 'Easter Monday'?**

There are a number of Public Holidays that fall on a different day every year.

There is no direct support in the SPECIAL_DATE entity for this concept of "floating" dates. Instead, the exact date for each year can be encoded distinctly. For example, the Easter Mondays for 2006 and 2007 can be encoded as:

CODE_TYPE	CODE_DAY	CODE_YEAR	TXT_NAME	TXT_RMK
HOL	17-04	2006	EASTER MONDAY	
HOL	09-04	2007	EASTER MONDAY	
...				

Chapter 4. AERODROME AND RUNWAY

4.1. Introduction

An Aerodrome is defined as follows:

> (ICAO) A defined area on land or water (including any buildings, installations and equipment) intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft/helicopters.

The AICM includes entities to describe all aspects of the aerodrome as contained within a State AIP. The AD_HP entity serves as a root for the information related to a particular aerodrome and is the basis of the explanatory text contained within this document section.

This chapter of the manual mainly considers Aerodromes and partially ignores Heliports. This firstly corresponds to the Aerodrome CODE_TYPE attribute value of 'AD'.

4.2. Aerodrome

The root aerodrome entity AD_HP, is identified by a set of mandatory and optional attributes and has associated relationships to other entities of the concerned aerodrome. The following is a description of several specific to AD_HP entity or common attributes.

Coded Identifier [CODE_ID]

The coded identifier will, in general, be identical to an existing code assigned to that Aerodrome/Heliport, but where necessary an artificial code may be assigned. The rules according to which this identifier should be formed are as follows:

1. If the AD/HP has an ICAO four letter location indicator, this one will become the CODE_ID for Aerodrome/Heliport;

2. If the AD/HP does not have an ICAO four letter location indicator, but it has an IATA three letter code, which is unique world-wide, then this one could be used as CODE_ID for Aerodrome/Heliport; Note that this rule is mainly intended for United States and Canada, where the 3-letter IATA code prefixed by the letter "K" can be used as AD/HP Identifier in AIXM.

3. If the AD/HP does have neither an ICAO four letter location indicator nor a world-wide unique IATA three letter code, an artificial generated code could be used. This will contain a group of letters and a number. Common practice in this circumstance is to concatenate the two letter code of the State being responsible for the Aerodrome/Heliport with a positive integer relating to the Aerodrome/Heliport, in the range between 0001 to 9999.

ICAO Code [CODE_ICAO]

Where rule 1 of the Coded Identifier derivation rule set is satisfied the Aerodrome ICAO code will be used as the Aerodrome Coded Identifier – in this circumstance the Aerodrome CODE_ICAO and CODE_ID attributes will contain identical values.

The Aerodrome CODE_IATA may or may not have a value in these circumstances.

IATA Code [CODE_IATA]

Where rule 1 of the Coded Identifier derivation rule set is not satisfied, but rule 2 is – i.e. the Aerodrome has an IATA code associated with it, but does not have an ICAO location indicator associated with it – the CODE_IATA and CODE_ID attributes will be identical.

The Aerodrome CODE_ICAO will not have a value in this circumstance.

4.2.1. Aerodrome geometry: Point

The AD_HP entity's geometry is a Point, as defined in Section 2.2, "Geometry: Point".

The latitude and longitude of the Aerodrome are the coordinates of the Aerodrome Reference Point. However, the elevation is not the elevation of the Aerodrome Reference Point. The Aerodrome elevation is instead defined, according to ICAO, as the vertical distance to the highest point on the landing area of the Aerodrome from Mean Sea Level.

4.2.2. Aerodrome Transition Altitude

The transition altitude for an Aerodrome is codified in two attributes:

VAL_TRANSITION_ALT
: The value of the transition altitude.

UOM_TRANSITION_ALT
: The units of measurement in which the transition altitude value is expressed.

The rationale for including the transition altitude rather than the transition level is to provide parity with the ICAO AIP content requirements (Annex 15, Appendix 1).

4.2.3. Aerodrome Address

The address and contact details for the Aerodrome are modelled by the AD_HP_ADDRESS entity, each instance of which stores a part of the complete set of contact details for the Aerodrome.

AD_HP_ADDRESS

This entity represents a set of attributes that associate a single type of contact element to one or several address element values.

CODE_TYPE

The attribute CODE_TYPE defines the type of address contained in the associated TXT_ADDRESS attribute value. The permitted types of address are as follows:

- POST [postal address].
- PHONE [telephone number].
- FAX [fax number].
- TLX [telex address].
- SITA [Société Internationale de Télécommunications Aéronautique].

- AFS [Aeronautical Fixed Service address].
- EMAIL [Electronic mail address].
- URL [Uniform Resource Locator (for the World Wide Web)].
- RADIO [Radio frequency].

4.3. Runways

Instances of the RWY entity are used to describe each physical runway at an Aerodrome. An Aerodrome may have an arbitrary number of physical runways associated with it, each of which has up to two runway directions defined. All other runway facets are described with respect to a runway direction, for example stopways and protection areas; runway direction obstacles; approach lighting; declared distances and runway lighting.

Designator [TXT_DESIG]

This attribute represents the textual designator of the runway, used to distinguish physical runways at an Aerodrome that has more than one. The attribute value should reflect the local convention for physical runway naming at the Aerodrome. In particular it is not necessary to concatenate the runway direction names to form the physical runway name, but this is not prohibited.

Example runway designator values could be: 09/27, 02R/20L.

4.3.1. Runway Centre Line

The centre line of a physical runway instance is described by a series of points that lie on that centre line. The data describing each point are contained in an instance of the RWY_CLINE_POINT entity.

The RWY_CLINE_POINT entity describes a geographic position and an associated elevation using the concepts described previously for the Aerodrome position data [cf. Section 2.4, “Geometry: Centre Line”].

Each physical runway should have at least two centre line points defined for it, one at each end of the runway surface. Any number of additional, intermediate points may be defined – this allows the profile of the runway centre line to be expressed in the required level of detail. This is shown in Figure 4.1, “Simple Runway Gradient [Two Centre Line Points]” and Figure 4.2, “Detailed Runway Gradient [Many Centre Line Points]”.

Figure 4.1. Simple Runway Gradient [Two Centre Line Points]

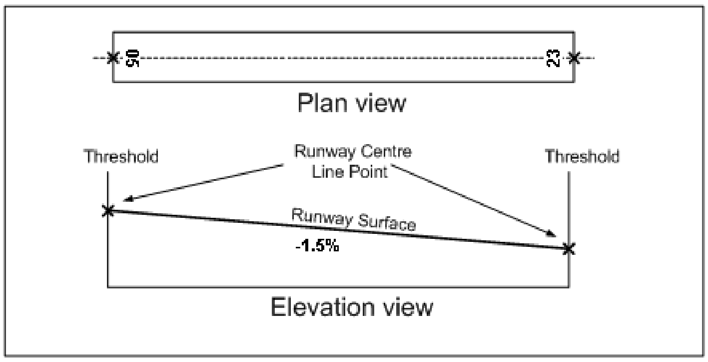
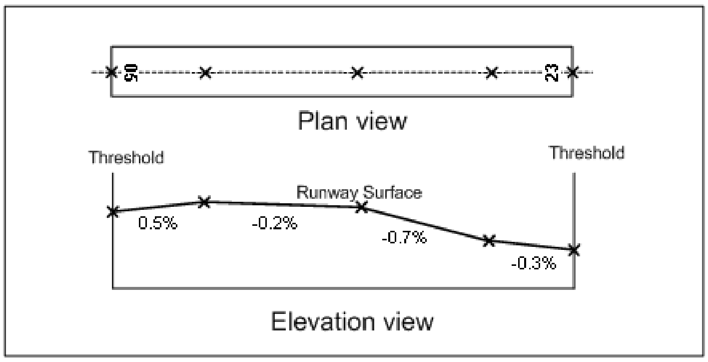


Figure 4.2. Detailed Runway Gradient [Many Centre Line Points]



4.3.2. Runway Profile

The RWY entity TXT_PROFILE attribute contains a textual description of the runway profile. This is provided in addition to the detailed profile definition of the runway profile codified using the runway centre line model described in the previous paragraph.

Profile Description [TXT_PROFILE]

This attribute represents the textual description of the runway profile contained in the State AIP as described in ICAO Annex 15, AD 2.12, Item 7, starting from the thereshold with the lower runway direction designation number .

Example text from a fictional AIP could be as follows:

0.5% 500m

-0.2% 1500m

-0.7% 1000m

-0.3% 400 m

4.4. Runway Direction

For each physical runway definition at least one and a maximum of two runway directions must be defined. Each runway direction is represented by an instance of the RWY_DIRECTION entity.

Minimum Eye Height Over Threshold [VAL_MEHT]

The VAL_MEHT attribute may be used to specify the cockpit height over the threshold given the type of visual approach slope indicator system used for the runway direction, as specified in the CODE_TYPE_VASIS attribute. As such the VAL_MEHT may only be specified for a runway direction when the CODE_TYPE_VASIS is specified for that runway direction.

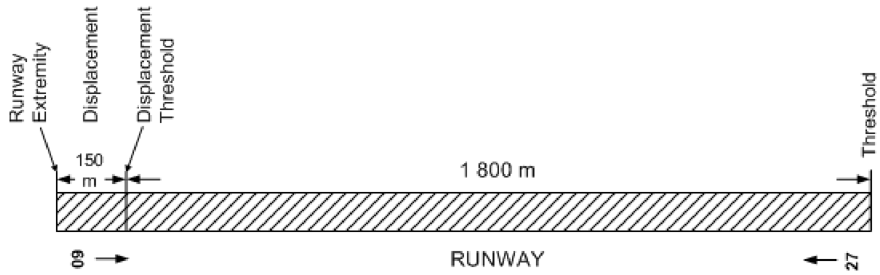
Where a VAL_MEHT value is specified a corresponding units of measurement declaration must be made using the UOM_MEHT attribute.

Relationship to: Centre Line Point

Each runway direction has a relationship to a centre line point defined for the physical runway [represented by a RWY entity] that represents the threshold of that runway direction.

The threshold centre line point for a runway direction is not necessarily one of the end points defined for the physical runway entity, as illustrated in Figure 4.3, “Physical Runway and Direction Thresholds” which shows a displaced threshold for runway 60.

Figure 4.3. Physical Runway and Direction Thresholds

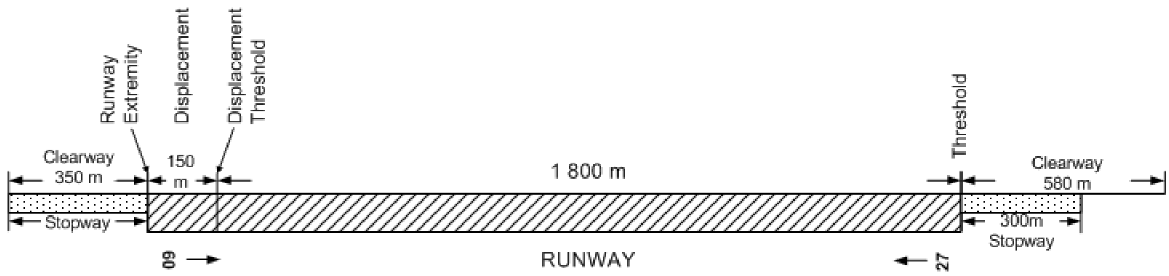


4.4.1. Stopways and Runway Protection Areas

Stopways and runway protection areas are related in so far as they both define areas associated with a runway direction. A stopway is described by a single entity SWY, whereas runway protection areas are described by a group of entities linked by the RWY_PROTECT_AREA entity. The more complex definition of runway protection areas allows them to be defined with arbitrary geometry rather than simple rectangles. The runway protection area entity model also allows different protection areas to be expressed using the same entity definitions, including clearways and ILS protection areas.

Figure 4.4, “Stopways and Clearways” is taken from ICAO Annex 14 and shows the relationship between clearways and stopways.

Figure 4.4. Stopways and Clearways



Runway Protection Area

A runway protection area is an area in the vicinity of a runway provided to protect aircraft during manoeuvring, take-off and landing operations. The AICM associates protection areas with a runway direction, and each runway direction can have multiple protection areas associated with it. However, each runway protection area may be associated with only one runway direction definition.

Runway protection areas are closed, two-dimensional shapes of arbitrary geometry described in terms of an ordered series of vertices and paths between those vertices. Each vertex has a position and a path to the next vertex and, as the shapes are always closed, the path associated with the final vertex is the path to the first vertex.

The RWY_PROTECT_AREA entity defines general characteristics of the protection area independent of the shape's geometry. The CODE_TYPE attribute defines the type of protection area described by the entity instance, with possible values as follows:

- CWY [Clearway].
- SAFE [Runway End Safety Area].
- OFZ [Obstacle Free Zone].
- OFS [Obstacle Free Surface].
- ILS [ILS Protection Area].

The VAL_LEN and VAL_WID attributes are used to describe rectangular [or virtually rectangular] protection areas. These values correlate with the information that is provided in the AIP for protection areas. In contrast the detailed geometry that may be represented by the entities described below is not described in the AIP.

The geometry of the runway protection area is modelled by two entities, RWY_PROTECT_GEOMETRY and RWY_PROTECT_SHAPE_POINT.

The concepts used in the AICM model relating to the construction of areas using vertex entities are discussed in detail in Section 2.3, “Geometry: Area”.

Stopway

A stopway is defined as follows:

> (ICAO) A defined rectangular area on the ground at the end of a take-off run available prepared as a suitable area in which an aircraft can be stopped in the case of an abandoned take-off.

Stopways are modelled in the AICM using the SWY entity, instances of which are defined for one and only one runway direction entity instance.

The SWY entity allows stopway dimensions to be described only in terms of length and width, thereby limiting the geometry of a stopway to a rectangle in line with the ICAO definition of a stopway reproduced above. The attributes VAL_LEN and VAL_WID define the dimensions of the stopway and the units of measurement for both the length and width are defined in a single attribute, UOM_DIM [Units of Measurement [Horizontal Dimension]].

The remaining SWY attributes define the physical composition and status of the stopway using an attribute group similar to that used to define the physical characteristics of a runway using the RWY entity[3]. The profile of the stopway can be described, in text, using the SWY entity TXT_PROFILE attribute.

4.4.2. Runway Direction Obstacles

Aerodrome Obstacles are modelled by the OBSTACLE entity which contains attributes to describe the type, location and height of obstacles. Obstacle instances are linked to a runway direction by the RWY_DIRECTION_OBSTACLE entity. This linkage implies that the linked obstacle has significance for aeronautical operations on that runway direction.

The RWY_DIRECTION_OBSTACLE augments the basic OBSTACLE definition with contextual information related to the interaction of the obstacle with the particular runway direction. A single OBSTACLE definition may relate to many RWY_DIRECTION_OBSTACLE instances.

[3]RWY attributes that describe the strip and offset are not used in the SWY model as they are not applicable to stopways.

4.4.3. Runway Direction Approach Lighting

The approach lighting system deployed for a particular runway direction at an Aerodrome is modelled in the RWY_DIRECTION_ALS entity. The entity describes the type and characteristics of the approach lighting system.

Examples of approach lighting system types that are listed in AICM include:

- ICAO CAT I precision approach lighting system.
- ICAO CAT II precision approach lighting system.
- ICAO CAT III precision approach lighting system.
- ICAO CAT II and III precision approach lighting system.
- Simple approach lighting system ~~(for non-instrument RWY)~~.
- Circling guidance lighting system.
- Visual alignment guidance system.
- Etc.

Standard and recommended practices for the design of approach lighting systems can be found in ICAO Annex 14, Volume 1, Section 5.3.4.

4.4.4. Runway Direction Declared Distances

Conventional distances for a runway direction are modelled by the RWY_DIRECTION_DECL_DIST entity. Conventional distances encompass the following:

- ASDA, Accelerate-Stop Distance Available.
- LDA, Landing Distance Available.
- TODA, Take-Off Distance Available.
- TORA, Take-Off Run Available.

The Annex 14 recommended relationships between these distances for a runway direction for various runway configurations are shown in Figure 4.5, “Declared Distance Relationships”:

- Diagram A shows a configuration where a runway is not provided with a stopway or clearway and the threshold is located at the extremity of the runway.
- Diagram B shows a configuration where a runway is provided with a clearway.
- Diagram C shows a configuration where a runway is provided with a stopway.
- Diagram D shows a configuration where a runway has a displaced threshold.
- Diagram E shows a configuration where a runway has a displaced threshold and is provided with a clearway and a stopway.

Figure 4.5, “Declared Distance Relationships” is taken from ICAO Annex 14, Volume 1, Attachment A, Figure A-1.

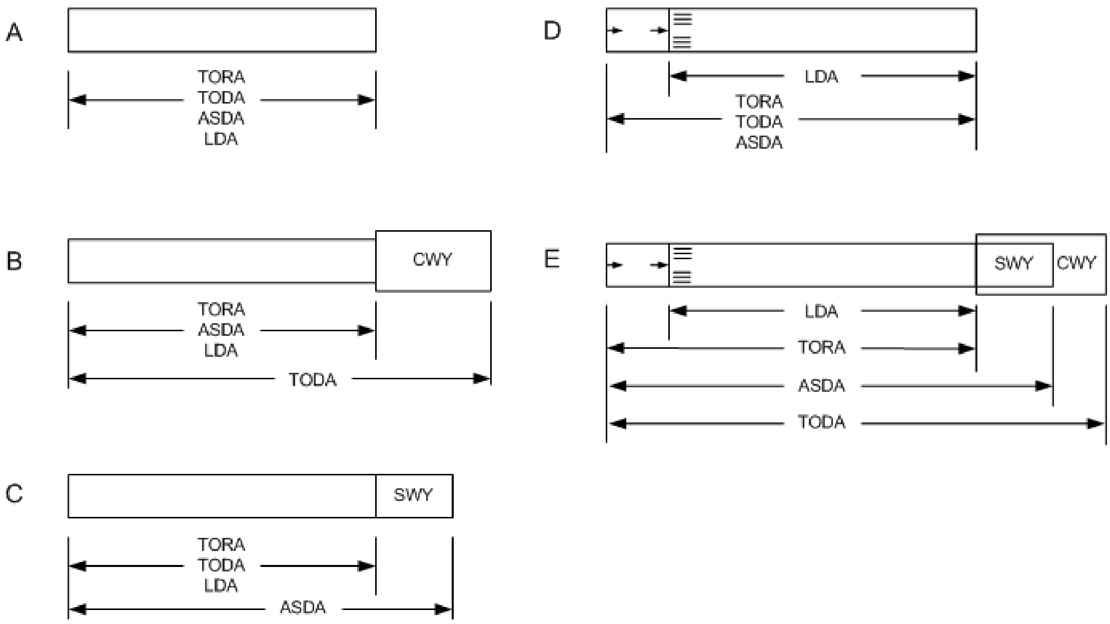
In addition to these usual values, the AICM domain contains a special value which allows it to record the value of a displaced threshold (DPLM), if applicable.

Each runway direction declared distance entity instance is valid for a specified time period, day, night, or day and night [CODE_DAY_PERIOD].

Each distance may optionally be associated with a taxiway defined for the Aerodrome. This means that multiple distances of the same type may be associated with a runway direction, each associated with a different taxiway.

It is worth mentioning that the taxiway intersection is not explicitly mentioned. Only the taxiway is associated. Therefore there is no explicit data driven check that the taxiway intersects with the runway direction. The current model does not contain a detailed description for taxiway intersections. The TWY_INTERSECTION entity is just a placeholder for further work.

Figure 4.5. Declared Distance Relationships



4.5. Taxiways

Taxiways are defined as follows:

> (ICAO) A defined path at an aerodrome/heliport established for the taxiing of aircraft/helicopters and intended to provide a link between one part of the aerodrome and another, including aircraft/helicopter stand taxi lines, apron taxiways, rapid exit taxiways, air taxiways etc..

Within the AICM they are modelled as a surface with a defined width, following a centre line defined by a series of centre line points. The entity TWY defines the taxiway instance in general and a number of associated TWY_CLINE_POINT entity instances define the path and profile of the taxiway centre line.

Taxiway designators are stored in the TEXT_DESIG attribute of TWY entity instances. As with runway designators, the local naming convention used at the Aerodrome is used to specify the name, but the name must be locally unique.

4.6. Aprons, Gates and Stands

4.6.1. General

The Apron, Gate and Stand information modelled in the AICM is generally equivalent to that contained within the Aircraft Parking and Docking Chart and Section AD 2.8 from a State AIP.

4.6.2. Aprons

Aprons are defined as:

> (ICAO) A defined area, on a land aerodrome/heliport, intended to accommodate aircraft/helicopters for purposes of loading and unloading passengers, mail or cargo, and for fuelling, parking or maintenance.

In the AICM, aprons are modelled using the APRON entity and the APRON_GEOMETRY entity. The APRON_GEOMETRY entity defines the shape of the apron in terms of vertices defined by APRON_SHAPE_POINT entities. The concepts used in the AICM model relating to the construction of areas using vertex entities are discussed in detail in Section 2.3, “Geometry: Area”.

Apron Name [TXT_NAME]

The TXT_NAME attribute of the APRON entity stores the textual name of the apron. The local naming convention in use at the Aerodrome should be used to name the aprons. Sometimes, this information may be found on Parking/Docking charts inside the AIP. Usually, either geographical directions (North, South, etc.) or letters/digits (A, B, C1, C2, etc.) are used.

However, some Aerodromes may have a single apron which does not have an explicit name. In this circumstance it is recommended that the generic name "APRON" is used.

4.6.3. Gates and Stands

Gates and stands are modelled as named aircraft parking positions on an apron. The GATE_STAND entity encapsulates the information defining a gate or stand in the AICM.

The information modelled by the GATE_STAND entity is primarily that contained within an Aerodrome’s Aircraft Parking and Docking Chart and Table AD 2.8, Aprons, taxiways and check locations/positions data from a State’s AIP.

The GATE_STAND entity is modelled as a geographic position and associated elevation with standard concepts of accuracy and integrity applied.

(Gate/Stand) Type [CODE_TYPE]

This defines the type of gate or stand the entity instance represents. Permissible values are as follows:

- NI [Nose-in parking position].
- ANG-NI [Angled nose-in parking position].

- ANG-NO [Angled nose-out parking position].
- PAR [Parallel (to building) parking position].
- RMT [Remote parking position].
- ISOL [Isolated parking position].
- UKN [Unknown type of parking position].

Description of Restrictive Use [TXT_DESC_RESTR_USE]

This is a full textual description of restrictions in the use of the gate/stand. Examples of use include defining aircraft types that are permitted to use the gate/stand or aircraft types that are not permitted to use the gate/stand.

4.7. Frequently Asked Questions

1. **Which Obstacles should be included as RWY_DIRECTION_OBSTACLE entity instances?**

   The same criteria as for Table AD 2.10 of the AIP apply.

2. **What is the meaning of the relationship 'under the responsibility of ORG_AUTH'?**

   Usually, this indicates that the related ORG_AUTH is responsible for the management of the Aerodrome. The concept of 'airport management' is not applicable to all Aerodromes world-wide. Therefore, the more general terminology 'under the responsibility of' was preferred for the name of the relationship. The related organisation/authority may be of any type, including 'State' or 'International Organisation'.

3. **What about two different fire fighting category values?**

LZIB AD 2.6 ZÁCHRANNÁ A HASIČSKÁ SLUŽBA **LZIB AD 2.6 RESCUE AND FIRE FIGHTING SERVICES**

1	Požiarna kategória letiska AD category for fire fighting	CAT 7: O/R, CAT 8: do 2 HR CAT 7: O/R, CAT 8: in 2 HR

   Currently, it is possible to record just one value. Therefore the lower category should be recorded as 'default value' (CODE_CAT='A7' in this example). The following text should then be recorded in the Remarks field: "CAT 7: O/R, CAT 8: in 2 HR".

4. **How can you record a taxiway that has different strengths or surfaces?**

Rolovacia dráha Taxiway	Šírka Width	Povrch Surface	Únosnosť Strength
A	24,4 m	betón Concrete	PCN 48/R/A/X/T medzi APN a TWY D between APN and TWY D
			PCN 54/R/A/X/T medzi RWY 04 a TWY D between RWY 04 and TWY D

   As a rule, the most constraining (lowest) value should be recorded in the SURFACE_CHARACTERISTICS entity instance associated with the taxiway. ~~CODE_STRENGTH and~~

~~TXT_DESCR_STRENGTH attributes.~~ The details (i.e. that a part of the TWY has a higher strength) should be recorded in the TXT_RMK attribute. ~~There are then two options:~~

- ~~either recording the details (i.e. that a part of the TWY has a higher strength) in the TXT_RMK attribute~~
- ~~or specifying the same thing in the TXT_DESCR_STRENGTH attribute, as a "Note: - ...". The format of this field allows free text annotations to be introduced as in the following example: '50/F/A/Y/U Note: - The reported PCN is subject to a B747-400 all-up mass limitation of 390 000 kg".~~

~~The text after "Note: -" is not structured. If the text is simple, such as "Note: - PCN 54/R/A/X/T between RWY 04 and TWY D", then it may be recorded here. If the situation is more complicated, then the TXT_RMK field should be used.~~

5. **Is the ARINC 424 concept of a recommended Navaid (for airports and airways) represented in AICM?**

There is no "recommended Navaid" for Airports and Airways in this model. The only place where a "recommended Navaid" may be specified is for Procedure Legs.

6. **How are displaced threshold positions indicated in AICM?**

In the first place, the value of the displacement can be recorded using a RWY_DIRECTION_DECL_DISTANCE of type DPLM [Threshold Displacement].

Secondly, in addition to the 'operational' threshold, the position of the physical runway threshold may be recorded using the RWY_CLINE_POINT.

Each (physical) RWY has two RWY_DIRECTIONS and each RWY_DIRECTION has a mandatory relationship with one of the points on the centreline of the RWY. If there is a displaced threshold, then that point will not be the first or the last by sequence number. The physical thresholds are always the first and the last points by sequence number.

For example, the RWY_CLINE_POINT entity could have four instances associated with one RWY: P1, P2, P3 and P4.

Suppose the RWY is named "09/27" and has two directions named "09" and "27".

If RWY_DIRECTION "09" has a relationship with point "P1", which is the first (by sequence number), then there is no displacement.

If RWY_DIRECTION "27" has a relationship with point "P3", which is not the first or last by sequence number, this indicates that there is a displacement of the threshold.

It can also be envisaged that the TXT_RMK attribute in the RWY_CLINE_POINT entity is used to indicate that a point is a displaced threshold.

7. **How can the ARINC latitude and longitude of a runway be determined in AICM?**

In ARINC the runway is equivalent to the AICM concept of runway direction. The latitude and longitude of a runway direction are recorded in the RWY_CLINE_POINT table as a threshold.

8. **Must the CODE_ICAO always be set for an Aerodrome?**

No, if there is no ICAO code, the CODE_ICAO field should be left empty. It is not a good idea to define your own "ICAO codes".

9. **Is the AD_HP entity GEO_LAT/GEO_LONG attribute value always equal to the ARP of the AD/HP?**

   Yes.

10. ~~**If CODE_TYPE is "AD" or "AH" why is CODE_TYPE_MIL_OPS mandatory?**~~

    ~~This is to support charting products as they have a different symbol to denote civil and military AD/HP instances.~~

11. **In some States' AIP the reference temperature for an AD/HP is stated by month – is this supported by the AICM?**

    No. A modification would be required to the AICM model to allow, for example, a list of reference temperatures, one per month.

Chapter 5. AIRSPACE

5.1. Introduction

An airspace is a generic entity representing variously 'regions' (ICAO and otherwise), 'areas', 'zones', 'sectors' (elementary and/or consolidated) etc, as used in and by air traffic services, including those of the European Flexible Use of Airspace (FUA) concept, special regulated and client defined airspace and all sorts of 'limited' airspace.

In AICM every airspace is modelled by an AIRSPACE entity identified by a combination of mandatory and optional attributes. Also this entity has associated relations to other entities that describe the geometry, multipurpose construct, related authority of the airspace, etc.

The following subsections of this section will give examples of several AIRSPACE entity attributes that define the type, codification, class, vertical and horizontal limits of the airspace.

Type [CODE_TYPE]

The list of airspace types is predefined and contains values such as:

- FIR
- UIR
- TMA
- CTR
- SECTOR
- P [Prohibited Area]
- D [Danger Area]
- R [Restricted Area]
- TSA [Temporary Segregated Area (FUA)]
- etc.

Coded identifier [CODE_ID]

The coded identifier is limited to a maximum of 10 characters. ~~It starts with a country code (for example, EB for Belgium), followed by other alphanumeric characters.~~ There are specific reccomendations on how to construct the coded identifier for each type of airspace. The rules proposed in this manual have been derived from ICAO SARPS and from the current practice in the world of aeronautical information databases. They are based on the idea that airspace structures may be broadly regarded as belonging to two categories:

~~In general, the airspace types considered by this model may be regarded as belonging to two categories:~~

- airspace used for ATS/ATM service provision (for example, FIR, TMA, CTR, SECTOR, etc.)

- airspace reserved for or affected by special activities, also known as 'special use airspace' (for example, P, D, R Areas, TSA, protected, ADIZ, BIRD, etc.)

For the first category, the coded identifier is derived from the ICAO Location Indicator of the centre providing the service in that airspace. For example, the coded identifier of BRUSSELS CTA FIR is EBBU, which is the ICAO Location Indicator for Brussels ACC/FIC. The following rule is proposed:

Rule A – ATS airspace structures

For airspace of type:

- FIR [Flight Information Region]
- UIR [Upper Flight Information Region]

The coded identifier shall be the one published in ICAO DOC 7910; if none, then the location indicator of the related FIC shall be used.

For airspace of type NAS (National Airspace Structure - usually, the assembly of all FIR and UIR belonging to one State) the coded identifier shall be the nationality letter(s) of the state concerned. For example: Belgium is EB, France LF, Germany ED, Russia U.

For airspace of type TMA, CTR and the like, the following possibilities should be envisaged, in this order:

For airspace of type:

- CTA [Control Area]
- OCA [Oceanic Control Area]
- UTA [Upper Control Area]
- TMA [Terminal Control Area]
- CTR [Control Zone]
- OTA [Oceanic Transition Area]
- RAS [Regulated airspace] with activity ‘traffic zone’ or ‘ATS’

The coded identifier of the airspace shall be allocated by applying the following algorithm:

1. use the location indicator (as listed in ICAO DOC 7910) of the ATC centre which provides air traffic control services in the airspace (for example GALICIA TMA = 'LEST', based on SANTIAGO TACC and DOC 7910);
2. if there is no major ATC centre providing services in the airspace or if it does not have a location indicator but there exists a location indicator associated with the name of the airspace, then use that one as coded identifier (for example, Lisboa CTR = ‘LPPT’, based on the ICAO Location Indicator for “Lisboa, Portugal (Madeira and Açores)”
3. use the location indicator of one major airport situated within the airspace. For example, LFBD (Bordeaux/Merignac airport) is used for AQUITAINE TMA.

4. if no relevant ICAO Location Indicator can be identified, then create a 4 letter code using the first two letters of the country code and the last two letters so that they are not duplicating another airspace identifier of the same type (for example, Dolsko TMA = ‘LJDK’.

Rule B – Special use airspace

For the second category (airspace affected by special activities), ~~the coded identifier is composed following the ICAO rules~~ there already exists ICAO rules for P, D, R areas:

> *The identification shall be composed of a group of letters and figures as follows:*
>
> - *nationality letters for location indicators assigned to the State or territory, which has established the airspace*;
> - *a letter P for prohibited area, R for restricted area and D for danger area as appropriate*;
> - *a number, unduplicated within the State or territory concerned*.

~~A similar composition rule is applied for airspace of type TSA, CBA, etc. For this purpose, the letter used in the 3rd position is:~~

The rule may be extended in order to become applicable to all similar airspace types.

The coded identifier of special use airspace shall be composed of a group and letters and figures as follows:

- nationality letters for location indicators assigned to the State or territory, which has established the airspace;
- a letter[4]
  - P - for Prohibited Areas (P)
  - R - for Restricted Areas (R), including the AMC manageable ones (R-AMC)
  - D – for Danger Areas (D), including the AMC manageable ones (D-AMC)
  - V – for other activities of dangerous nature (D-OTHER)
  - T - for Temporary Segregated Areas (TSA)
  - T – for Temporary Reserved Area (TRA)
  - C - for Cross Border Areas (CBA)
  - E - for Reduced/Prior Co-ordination Airspace Procedure (RCA)
  - ~~M - for Military Training/Exercise Area (MIL)~~
  - ~~O - for Oil Field (OIL)~~
  - Z - for Air Defence Identification Zone (ADIZ)

[4]The type and the coded identifier are two separated attributes in the model. Theoretically, the coded identifier should not contain a reference to the type. For example, the danger area EB D 100 should have CODE_ID = 'EB100'. However, in order to strictly apply the ICAO rule and for compatibility with existing systems, it is acceptable to include a letter corresponding to the airspace type in the identifier.

- ~~B - for Bird Migration Area (BIRD)~~
- X – for airspace protected from specific air traffic (PROTECT)
- S - for other regulated airspace, not otherwise covered (RAS) ~~for Aerial Sporting/Recreational Area (SPORT)~~
- W – for Warning Areas (W)
- A – for Alert Areas (A)

- a number, unduplicated within the State or territory concerned

5.2. Airspace Parts

There are situations when an airspace is made of several parts. Each part is described as an airspace volume with a defined horizontal border and specific vertical limits. Sometimes, they are named 'sectors', although this word does not have the same meaning as for an 'ATC Sector'.

Such airspace parts are modelled using the 'PART' airspace type. For airspace used for ATS provision, it is possible to be more specific by using dedicated types, such as: TMA Part (TMA-P), FIR Part (FIR-P), CTA Part (CTA-P), etc. The conceptual difference is that an airspace of type 'PART' is always used as component in an airspace aggregation - see Section 5.3.4, "Airspace with derived geometry ~~Associations~~". An airspace of type 'PART' has only a geometrical significance.

On the other side, an airspace of type 'TMA/FIR/CTA/etc.-PART' is not necessarily used to define the geometry of a composite airspace, but rather to indicate some specific characteristics of a subsection of a larger airspace. For example, that a specific ATS Unit provides services in that airspace part or that a part of an FIR is delegated for ATS purpose to a neighbouring State.

Typically, the name of such airspace parts is based on the coded identifier of the parent airspace and includes a number (1, 2, 3, etc.), a letter (a, b, c, etc.) or a geographical direction (East, West, North, etc.). For example Ljubliana TMA 1 and Ljubliana TMA 2. In such situations, a digit (1, 2, 3, etc.) or a letter (a, b, c, E, W, N, etc.) should be added in the 5th position, abbreviating the official designation of that part. For example, Ljubliana TMA 1 will have as coded identifier 'LJLA1', while Ljubliana TMA 2 will have as coded identifier 'LJLA2'.

Recommended abbreviations: S – South; N – North; E – East; W – West; C – Centre; L – Lower; U – Upper;

Examples:

- Brussels CTA EAST ONE – 'EBBUE1'

For airspace of type CLASS [portion of airspace having a specific class], the coded identifier shall be based on the coded identifier of the parent airspace, followed by '_' and by a letter corresponding to the class.

Examples:

- 'LJDK_E' as coded identifier for the airspace of type CLASS which corresponds to the portion of Dolsko TMA between 2500 FT and 7500 FT and which has the airspace class E.

For P, D, R areas and the like, where the coded identifier ends with a number, if the part is also identified with a number, then a separator character ('-') should be added before the digits of the part, for example, EDR11-1, EDR11-2. This is necessary in order to avoid confusion between EDR11-1 (part 1 of Restricted Area 11 in Germany) and EDR111 (Restricted Area 111).

As a general recommendation, airspace of type PART should not get a value for the NAME attribute.

5.3. Airspace Geometry

There are two main ways to describe the geometry of an airspace:

- by specifying a horizontal border and vertical limits;
- by using 'airspace ~~associations~~ with derived geometry'.

Horizontal borders are modelled using the AIRSPACE_BORDER, the AIRSPACE_BORDER_VERTEX and the AIRSPACE_CIRCLE_VERTEX entities. In addition, the description might refer to a political or geographical border, as explained in Section 5.3.3, “GEO_BORDER”.

5.3.1. Vertical Limits

The vertical limits are modelled using the attributes with names ending in "_UPPER" and "_LOWER".

VAL_DIST_VER_UPPER

The airspace upper limit is modelled using a set of three attributes:

- VAL_DIST_VER_UPPER for the numerical value;
- UOM_DIST_VER_UPPER for the units of measurement (for example, metres or feet);
- CODE_DIST_VER_UPPER for the reference system (for example, 'ALT' for an altitude, in which case the reference is MSL - mean sea level).

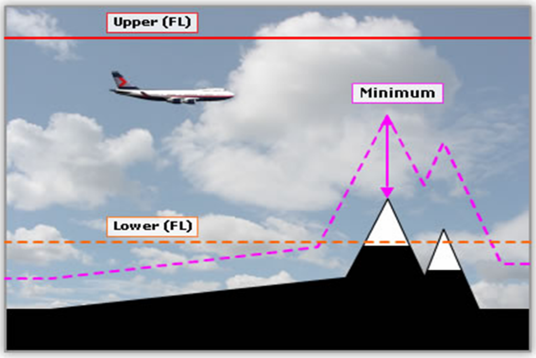
VAL_DIST_VER_LOWER

The airspace lower limit is modelled using VAL_DIST_VER_LOWER, UOM_DIST_VER_LOWER and CODE_DIST_VER_LOWER.

VAL_DIST_VER_MNM

Apart from lower and upper limits, an airspace may also have a "minimum limit". For example, Salzburg CTA has as its lower limit "11500 FT MSL but at least 2000 FT GND". This means "MNM LIMIT" = 2000 FT GND, which is modelled using the following set of attributes: VAL_DIST_VER_MNM, UOM_DIST_VER_MNM and CODE_DIST_VER_MNM.

Figure 5.1. Minimum Limit



A similar situation can occur with the "maximum limit", which is modelled by the ..._DIST_VER_MAX attribute group.

5.3.2. AIRSPACE_BORDER ~~and AIRSPACE_BORDER_VERTEX~~

The horizontal border of an airspace is modelled using the AIRSPACE_BORDER entity, which actually consists of a sequence of AIRSPACE_BORDER_VERTEX or a single AIRSPACE_CIRCLE_VERTEX.

AIRSCAPE_BORDER_VERTEX

Every vertex contains the geographical position (latitude/longitude) of one border point and the type of path towards the next point. Airspace borders are always closed shapes. Therefore, the last vertex contains the type of path to the first point.

(Vertex) Sequence number [NO_SEQ]

The order of the points is given by the NO_SEQ attribute. The vertex with the highest NO_SEQ is implicitly considered to be the last point. There is no explicit 'last point' indication.

It should be noted that in an implementation of the AICM, NO_SEQ could be left out. For example, it could be replaced with a self-relationship, thus having a pointer towards the previous point. Similarly, the AIXM-XML Schema definition does not contain a sequence number for each airspace vertex. The order of the airspace vertex elements in the XML file gives their order in the airspace border description.

(Vertex) Type [CODE_TYPE]

The following path types are considered in the model:

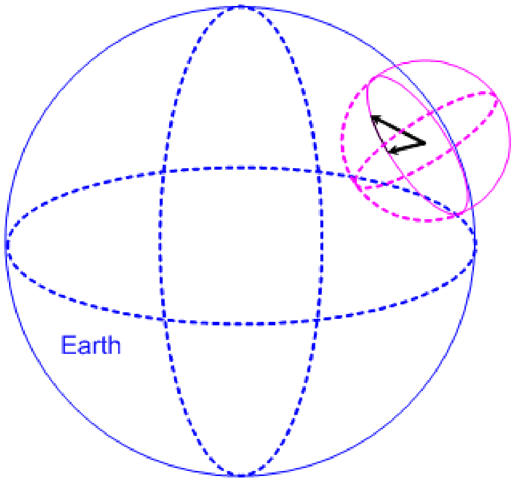
- GRC [Great Circle = line segment for short distances]

  This is the most common type. It is simply a straight line between the current vertex and the next one.

- CCA [Counter Clockwise Arc]
- CWA [Clockwise Arc]
- ABE [Arc By Edge]

The 'CCA', 'CWA' and 'ABE' coded values describe arcs of circle that are used in the definition of airspace borders. Typically, there are no clear statements in State AIPs about how arcs and circles, when used as (part of) airspace borders, should be interpreted.

One possible interpretation is that such arcs were drawn using a map (into a specific projection, which is not mentioned). Thus, they would represent points of equal distance from the arc centre, on that specific projection. Of course, such arcs are not real arcs on the surface of the Earth or in another projection.



Another interpretation is that arcs represent points on the surface of the Earth (Ellipsoid or Geoid) situated at equal distance from a given point (the centre). In specific projections, such arcs would be represented as irregular shapes (very likely not arcs).

When used as part of airspace borders, such arcs usually have a radius comprised between 1 NM and 200 NM. For an arc with a radius of 100 NM, the difference in projection between the two interpretations given above is significant. Therefore, it is necessary to state how arcs and circles have to be interpreted. It is desirable to avoid problems associated with map projections and also to avoid the complicated calculations implied by using an ellipsoid as representation for the Earth.

For the purpose of this model, it is assumed that arcs and circles represent points on the surface of the Earth (approximated as a sphere) situated at equal distance from an arc centre. This arc centre is also a point on the surface of the Earth sphere.

- ~~CIR [Circle]~~

  ~~In this case, there is only one vertex. Similarly to vertex of type arc, the latitude [GEO_LAT] and longitude [GEO_LONG] correspond to a position on the edge and not to the centre of the circle. The position of the centre is indicated using the GEO_LAT_ARC and GEO_LONG_ARC attributes.~~

  ~~However, it is expected that systems implementing this model will use the position of the centre and the radius value as circle definition and will ignore the position of the vertex. Therefore, it is allowed to use as GEO_LAT and GEO_LONG the values of the GEO_LAT_ARC and GEO_LONG_ARC respectively.~~

  ~~The same interpretation as for arcs is given with regard to what a circle means on the surface of the Earth.~~

- RHL [Rhumb Line (Loxodromic Line)]

  This is used especially when a part of a border is along a parallel or a meridian.

- FNT [Sequence of geographical (political) border vertexes]

  This special value indicates that between the current vertex and the next one there is not just one segment, but a portion of a geographical border. The border is specified by the relationship between the AIRSPACE_VERTEX and the GEO_BORDER entities.

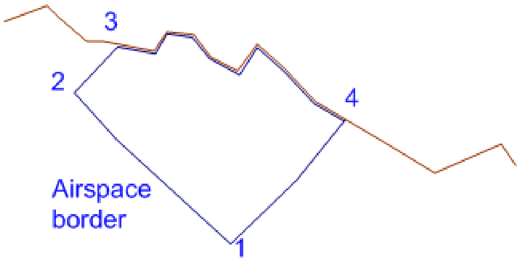
AIRSPACE_CIRCLE_VERTEX

This entity is dedicated to modelling airspace borders which consist in a full circle and is described with a single vertex. The latitude of centre [GEO_LAT_CEN] and longitude [GEO_LONG_CEN] correspond to the centre of the circle. The value of the circle radius and its units of measurement are specified with VAL_RADIUS and UOM_RADIUS respectively.

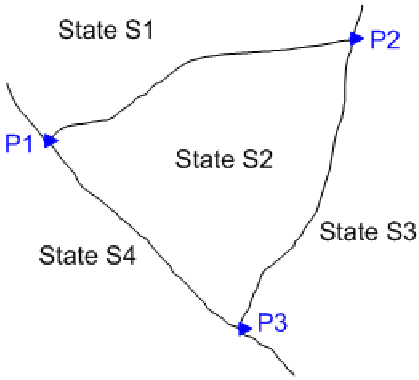
The same interpretation as for arcs is given with regard to what a circle means on the surface of the Earth.

5.3.3. GEO_BORDER

Very often, airspace borders are made up using portions of State borders or coastlines. Making this situation explicit in the model has many advantages. For example, a database implementing this model would have a significantly smaller size. State borders are made of hundreds of small segments, which no longer need to be copied on every airspace border that includes a portion of the State border.



Geographical borders considered in the current model are coastlines and political borders between States. Such borders are always modelled as open shapes, with a sequence of minimum two vertex.



In the case of the example shown above, the airspace border would be described as follows:

seq. no.	type	geo_border name	latitude	longitude	etc.
1	GRC		lat1	long1	
2	GRC		lat2	long2	
3	*FNT*	*S1-S2*	lat3	long3	
4	GRC		lat4	long4	

In the example:

- the type of the vertex with sequence number '3' is 'FNT', which means that the path between this and the vertex with the next sequence number ('4') is a part of a geographical border;
- only the identifier of the related geographical border is mentioned (‘geo_border name’ in this example). The first and the last point of the geographical border that are actually used in building up the airspace border are not explicitly indicated. **It is the task of an application using this model to correctly identify these points**. However, there is a constraint in the model which ensures that the task of such an application is not impossible: the positions of airspace vertex '3' and '4' must be situated within 1" (approx. 30 metres) from the geographical border.

5.3.4. Airspace with derived geometry ~~Associations~~

The AIRSPACE_DERIV_GEOMETRY entity is a dedicated construct, which serves to model situations where the geometry of an airspace is derived from the geometry of another airspace ~~multipurpose modelling construct, which serves to realise the different 'two-way associations' which may exist between airspace of the same and/or different types~~.

For example:

- To describe the geometry of an airspace (referred to as 'child') as an aggregation ~~combination~~ (Boolean operations) of a number of other ('parent') airspaces. An airspace described as the child of one aggregation ~~association~~ may in turn be the parent in other associations;
- To indicate that two airspaces have exactly the same horizontal border, such as an FIR and an UIR situated exactly above it; this is modelled using the relationship named "*based on the same horizontal extent as*".
- ~~To indicate that the activation or working hours of two airspaces may not overlap.~~

~~Association type [CODE_TYPE]~~

~~The following types of airspace association are considered in the current model (domain CODE_TYPE_ASSOC_AS):~~

- ~~BOM [Bill of Material structure]~~
- ~~ABOVE-BELOW [Associated AIRSPACEs are above/below each other]~~
- ~~TIME-DIST [Working (activation) hours of associated AIRSPACEs must not overlap]~~

Airspace aggregation

The ‘child’ airspace is made up of (more) ‘parent’ airspace. The expression ‘is made up of’ is to be considered in a relatively broad sense. For such airspace associations, the attributes CODE_OPR and NO_SEQ are mandatory.

For example, if an airspace A results from the union of airspaces B and C from which airspace D is subtracted, the following occurrences of the AIRSPACE_AGGREG_COMP ~~AIRSPACE_ASSOCIATION~~ are necessary:

- B as parent, A as child, ~~CODE_TYPE = 'BOM',~~ CODE_OPR = 'BASE', NO_SEQ_OPR = 1;
- C as parent, A as child, ~~CODE_TYPE = 'BOM',~~ CODE_OPR = 'UNION', NO_SEQ_OPR = 2;

- D as parent, A as child, CODE_TYPE = 'BOM', CODE_OPR = 'SUBTR', NO_SEQ_OPR = 3.

In addition, the airspace A will not need to have a related AIRSPACE_BORDER. Its geometry is completely defined by the 'bill of material' association described above.

It should be noted also that the airspace used as 'parent' in the association could be itself the result of another association, which is in turn the result of a previous association, and so on... However, if there are too many levels, the resulting airspace geometry could become difficult to manage for some applications. Therefore, it is recommended that not more than 2-3 levels of association are used in practice.

Same horizontal extent as another airspace

The ‘child’ airspace has exactly the same horizontal border, which is defined only for the ‘parent’ airspace. As mentioned before, this type of association is useful in order to 'reuse' the horizontal of an FIR for an UIR which is situated exactly on top of it.

Another application of this type of association is modelling vertical layers of airspace class within a given airspace. Every such 'layer of class X' would be declared as an airspace of type 'class' (CODE_TYPE='CLASS') and would be related with the main airspace through "based on the same horizontal extent as" the child of an airspace association of type 'ABOVE-BELOW' with the airspace concerned.

Airspace association

Simple airspace associations are modelled by the AIRSPACE_ASSOCIATION entity. This type of association could be used to model, for example, various sector configurations within a controlled area, which are activated at different times.

5.4. Frequently Asked Questions

1. **What is the difference between the ICAO Location Indicator [CODE_LOC_IND] and the coded identifier [CODE_ID] of an airspace?**

   If an airspace has a unique location identifier listed in ICAO DOC 7910, then there is no difference: the ICAO location identifier should be used as the coded identifier. However, very few airspaces, mainly FIR and UIR, would have an ICAO Location Identifier. Very frequently, it is even 'assumed to be' an ICAO Location Indicator for the airspace, because it is mentioned for the ATS unit providing air traffic control services in that airspace.

   For example "EHAA": according to DOC 7910, it represents "Amsterdam ACC/FIC", not Amsterdam FIR. However, almost any AIS system uses "EHAA" for Amsterdam FIR, because Amsterdam ACC is responsible for providing air traffic control services in the area.

   In addition, sometimes there are two or more FIRs linked to the same ATS centre and thus have the same ICAO Location Identifier. For example, there exist "New York FIR" and "New York Oceanic FIR". ICAO Doc 7910 contains "KZNY" = "New York (ARTCC) RONKONKOMANY". However, in some AIS databases, the two FIRs are recorded as:

   - KZNY = New York FIR
   - KZNO = New York Oceanic FIR ("KZNO" is not listed in ICAO Doc 7910)

   In this situation, having two different attributes in the model, one for the airspace identifier and one for the ICAO code, would allow for the following data to be recorded:

- FIR "New York" with coded identifier KZNY and ICAO Code = "KZNY"
- FIR "New York Oceanic" with coded identifier KZNO and the same ICAO Code = "KZNY"

As "KZNO" does not exist in ICAO Doc 7910, it is possible to "invent it" and use it as airspace code.

This approach is supported by the current practice of the US NOTAM Office, which specifies KZNY as FIR identifier in NOTAMs issued for either "New York" FIR or "New York Oceanic" FIR.

2. **Is it correct to say that an airspace is either defined as "built from other airspace" (using derived geometries ~~associations~~) or as "built from a horizontal border and vertical limits"?**

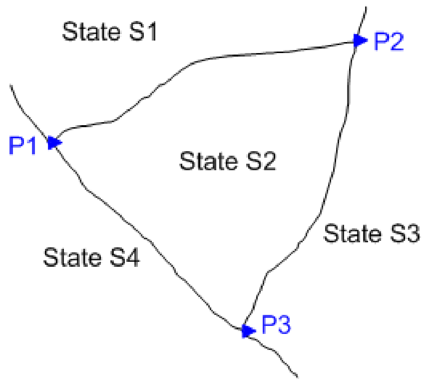
Yes.

3. **Is it correct to say that the CODE_TYPE of a vertex indicates the type of segment to the next vertex?**

Yes.

4. **How to encode an airspace border that is completely defined by geographical borders?**

This is frequently the situation for FIR borders that are based uniquely on the political borders between States, for example, an FIR that has a border like the one shown in this figure.



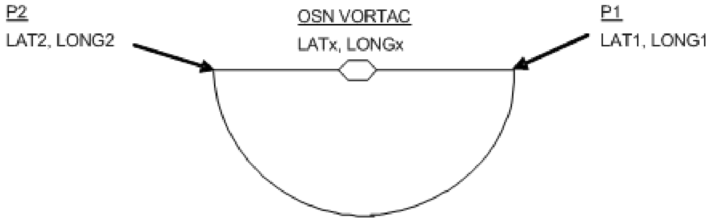
In this example, the horizontal border of the airspace should be described using 3 vertices of type 'FNT'. A prerequisite is to know the geographical coordinates of the points of intersection between State borders: they have to be explicitly mentioned as vertex points.

seq. no.	type	geo_border name	latitude	longitude	etc.
1	FNT	S1-S2	lat P1	long P1	
2	FNT	S2-S3	lat P2	long P2	
3	FNT	S2-S4	lat P3	long P3	

5. **How would the following border be represented "8NM South of OSN VORTAC from R-090 to R-270"?**

It is possible to relate an airspace vertex with a Significant Point, which provides either the position of the vertex or the position of the centre, in the case of an arc.

~~The current model does not allow airspace borders to be described using references towards significant points such as a VORTAC. The horizontal border of the airspace would have to be described using geographical coordinates.~~



The situation represented in the figure could be encoded as follows:

seq. no.	type	geo_border name	latitude	longitude	latitude for arc (centre)	longitude for arc (centre)	using as centre	etc.
1	CWA		LAT1	LONG1	LATx	LONGx	*OSN, LATx, LONGx*	
2	GRC		LAT2	LONG2				

6. **How would an airspace border made of a full circle be represented?**

For example, an airspace defined as a circle of 50 NM, centred in the point of coordinates 175425S, 0310706E.

You should use the specific entity AIRSPACE_CIRCLE_VERTEX for a full circle.

~~As explained at Section 5.3.2, “AIRSPACE_BORDER and AIRSPACE_BORDER_VERTEX ”, for a circle, the latitude/longitude of the vertex indicates a position on the edge of the circle. This is so it is consistent with the description of arcs: the vertex is a point on the edge of the arc. A circle is considered as a particular type of arc, which extends 360 degrees.~~

latitude of centre	longitude of centre	datum	radius	unit of measurement [radius]	geographical accuracy	unit of measurement [geographical accuracy]	etc.
175425S	0310706E	WGE	50	NM			

7. **How do I describe that the lower vertical limit is 'GND'?**

This is done by setting CODE_DIST_VER_LOWER='HEI', VAL_DIST_VER_LOWER='0' and UOM_DIST_VER_LOWER to 'M' or 'FT'. The same mechanism is used for 'SFC' (surface).

8. **How do you describe an 'unlimited' UPPER limit?**

The convention considered by this model is to use 'FL 999' (STD) for UNL upper limits.

9. **How do you describe an 'unspecified' LOWER and/or UPPER limit?**

If only the upper limit is unspecified, the three corresponding attributes may be left empty.

If both are unspecified, as the corresponding attributes are optional, they may be left empty. However, this will create a conflict with a rule specified for the Airspace entity, which indicates that an airspace, for which both the lower and the upper limit are not specified, must be the result of an airspace aggregation.

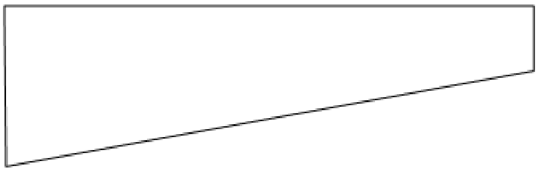
As explained in the introduction (see Section 1.1, “AICM 'business rules'”), rules may be enforced at various degrees in a system implementing the model. For example, some rules could trigger only warning messages, while others could trigger error messages and might prevent data concerned from being stored in the database. This particular rule is expected to be implemented as a warning only, which may be ignored.

10. **Are there any limitations when using airspace aggregations?**

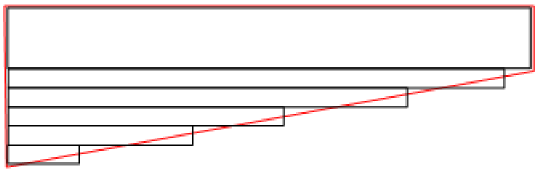
Theoretically, there are no limitations. However, a long chain of airspace aggregations might become very difficult to interpret and represent in a spatial model. Therefore, it is recommended not to create such long chains. Not more than 2-3 levels of aggregation should be used in practice.

11. **How do I describe an airspace having a slope as a lower limit?**

For example, because of the Alps, Swiss airspace is sometimes vertically shaped like this:



The model cannot handle slopes as the lower limit of airspace. Therefore, such airspace would have to be described using an aggregation of ‘layers’ that approximate the real shape of the airspace. Each such layer would have CODE_TYPE='PART'.



12. **How are "traffic zones" modelled?**

Such 'airspace types' are modelled using an appropriate combination of CODE_TYPE and CODE_ACTIVITY attributes of an AIRSPACE entity.

Aerodrome traffic zones (ATZ) are usually published in AIP ENR 2.1 or AD 2.16 - ATS Airspace. Therefore, they are modelled as 'regulated airspace':

- CODE_TYPE = ‘RAS’
- CODE_ACTIVITY = ‘TFC-AD’
- TXT_LOCAL_TYPE = ATZ
- TXT_NAME = the name of the airspace. For example: “ Arlanda traffic zone".
- TXT_RMK = "For the protection of Aerodrome traffic, only aircraft landing/taking-off from the aerodrome are allowed to penetrate in the ATZ. Overflying aircraft shall keep clear from the ATZ." (for example)

Helicopter traffic zones are ussualy published in AIP ENR 5.3 - Other Activities of a Dangerous Nature and Other Potential Hazards. Therefore, they are modelled as D-OTHER airspace type.

- CODE_TYPE = ‘D-OTHER’ (other activities of dangerous nature)

- CODE_ACTIVITY = TFC-HELI
- TXT_LOCAL_TYPE = HTZ
- TXT_NAME = the name of the airspace, if any.

13. How to describe airspace classes on a route segment?

The current model makes a distinction between *routes* (entities EN_ROUTE_RTE and RTE_SEG) and *airways* (entity AIRSPACE, CODE_TYPE = AWY). An airway is the airspace 'corridor' surrounding a series of consecutive route segments.

The class is by definition an attribute of airspace. Therefore, the current model considers that airspace classes indicated on routes (AIP ENR 3.x) should be recorded on corresponding AIRSPACE instances of type AWY (airway). Airspace instances of type 'AWY' have a relationship 'consisting of' one and only one RTE_SEG.

As for any other airspace, it is mandatory for AWY to have defined geometry (usually a corridor, considering the centreline and the width). This also enables modelling the precise limits of the airway and special situations with regard to the airspace classification.

See for example M185 in UK AIP: "An area of Class A controlled airspace, base FL 55, upper limit FL 245, bounded by straight lines joining: 520045N 0004724E - 515548N 0010705E - 515426N 0004840E - 520045N 0004724E, is part of M185."

14. How to describe delegated airspace?

Many countries have areas where the responsibility of providing ATS is delegated to an ATS unit in adjacent FIR. In most cases, the delegated airspace is a small portion of the national FIR. Such delegated airspace may be described using airspace of type FIR-P (part of an FIR) and an associated "authority responsible for airspace" (AUTH_FOR_AIRSPACE) with CODE_TYPE = ‘DLGT’.

15. How to describe multiple airspace classes?

The current model allows to record information about different class values in different portions of a given airspace. A special airspace type 'CLASS' is foreseen for this purpose.

Let’s assume that we have a TMA with the following two classes:

Nw Milligen TMA A Class B : FL 195 - FL 065 Class E : FL 065 - 1500 AMSL

It is recommended to create three airspace instances:

instance	Type	code id	name	code class	lower	upper
airspace 1	TMA	EHxxA	New Milligen – A		1500 AMSL	FL 195
airspace 2	CLASS	EHxxAE		‘E’	1500 AMSL	FL 065
airspace 3	CLASS	EHxxAB		‘B’	FL 065	FL 195

Airspaces 2 and 3 should be declared as having a geometry derived form the geometry of airspace 1 (“**based on the same horizontal extent as**” airspace 1).

Chapter 6. SIGNIFICANT POINTS

6.1. Introduction

A significant point is defined by ICAO as "a *specified geographical location used to define an ATS route, the flight path of an aircraft or for other navigation/ATS purposes*". This includes ‘designated points’ and ‘Navaids’ such as VOR, NDB, TACAN, DME, MKR.

The SIGNIFICANT_POINT entity could be seen as a 'placeholder' for a VOR, DME, designated point, etc. At a conceptual level, it simplifies the model by significantly reducing the number of relationships. However, in an implementation, it might disappear and be replaced with direct relationships to the entities that are included in the 'significant point' concept.

Designated points are discussed below, while Navaids are presented in a separate chapter (Chapter 7, *NAVAIDS*).

6.2. Designated Points

The 'designated point' definition is derived from the significant point definition, by difference: any significant point **not marked by the site of a radio navigation aid** is modelled as DESIGNATED_POINT.

Every DESIGNATED_POINT must have a coded identifier and a specified geographical position (latitude, longitude, datum). It is also mandatory to specify the

CODE_ID

This is the coded identifier of the designated point. The most common examples are ICAO 5 letter name code designators, but the CODE_ID could be shorter than 5 letters.

CODE_TYPE

The most common type is 'ICAO', which means a designated point which has an identifier fulfilling the ICAO requirements for 5-letter name code designators.

If CODE_TYPE='ICAO', then CODE_ID should be unique world wide.

The second type, by order of importance is 'ADHP', which is encountered for designated points used in the context of an aerodrome/heliport. For example, the waypoints of an RNAV procedure, which have designators which are not unique worldwide and do not fulfil the ICAO requirements for 5-letter name code designators.

Also, some reference locations of an aerodrome/heliport may be used as points in an instrument approach procedure. These locations can be:

- the runway threshold: one instance of RWY_CLINE_POINT,
- the FATO threshold one instance of FATO_CLINE_POINT,
- or the TLOF center: one instance of TLOF.

In some areas, the aerodrome reference points (ARP) may be used as designated points for the definition of a route segment. The ARP location is modeled in the AD_HP entity. The AICM approach is to model the ARP as a designated point, related to the corresponding Aerodrome/Heliport through the relationship “the reference point of”.

If CODE_TYPE='ADHP', then CODE_ID should be unique in the context of the related AD_HP.

Another type of designated point is 'COORD', which is used for points not having a proper designator, but which are published by their coordinates. In addition, their latitude/longitude position is a full or half degree value. A special convention for creating the CODE_ID of such points was developed for FMS and is re-used in this model.

The last type of designated point is 'OTHER', used when none of the other types is appropriate. The use of this type should be avoided. It was introduced mainly in order to cover internal needs of systems using this model.

6.3. Angle Indication

An angular reference from a navigation aid of type VOR, NDB or TACAN, which occurs at a given position (usually, a SIGNIFICANT_POINT), is modelled by the ANGLE_INDICATION entity. It essentially has a single attribute describing the angle VAL_ANGLE_BRG as well as the optional attribute for textual remarks, common to all entities in the AICM.

Bearing Indication [VAL_ANGLE_BRG]

The bearing represented by this attribute is the angle between the Navaid providing the bearing and the significant point or checkpoint associated with the angle indication entity instance.

The bearing is measured clockwise from True North or Magnetic North [0 degrees] up to ~~but not including~~ 360 degrees. For example East is 90 degrees, South 180 degrees and West 270 degrees.

Each angle indication entity must be associated with one of each of the following:

- A Navaid from which a bearing can be taken.

  A relationship with an instance of either:

  - a VOR [VOR], or
  - a TACAN [TACAN], or
  - an NDB [NDB].

- A defined point.

  A relationship with an instance of either:

  - a significant point [SIGNIFICANT_POINT], or
  - a navigation system checkpoint [NAV_SYS_CHECKPOINT].

6.4. Distance Indication

A distance indication from a navigation aid of type DME or TACAN, which occurs at a given position (usually, a SIGNIFICANT_POINT), is modelled by the DISTANCE_INDICATION entity. The actual distance is modelled with two attributes (value and units of measurement), as well as the optional attribute for textual remarks, common to all entities in the AICM.

Declared Distance [VAL_DIST]

The distance represented by this attribute is the distance from the Navaid associated with this entity instance and the significant point or checkpoint associated with this entity instance. The units of measurement of the declared distance value must be specified in the UOM_DIST attribute.

Each distance indication entity must be associated with one of each of the following:

- A Navaid from which the distance is measured.

  A relationship with an instance of either:

  - a DME [DME], or
  - a TACAN [TACAN].
- A defined point.

  A relationship with an instance of either:

  - a significant point [SIGNIFICANT_POINT], or
  - a navigation system checkpoint [NAV_SYS_CHECKPOINT].

6.5. Frequently Asked Questions

1. **What about ‘waypoints’?**

   According to the ICAO Annexes, the definition of a way-point is: "a specified geographical location used to define an area navigation route or the flight path of an aircraft employing area navigation". Thus, a way-point is strictly related to RNAV routes. Therefore, the more general term ‘designated point’ is used in this model in order to model points that have an official (5 letter) designator, have specified coordinates and do not mark the position of a Navaid. This includes, but is not limited to, ‘waypoints’ as many designated points are used for purposes other than defining an RNAV route.

2. **How do I indicate that a significant point is 'FIR BDRY'?**

   This is modelled using the ‘Significant point in airspace entity’. The domain of the CODE_TYPE attribute contains the following list of values:

   - EN [Entry point]
   - EX [Exit point]
   - EE [Entry/Exit point]
   - IN [Situated within the airspace]
   - B [Situated on the border of the airspace]

   A significant point, which is annotated as 'FIR BDRY' in the AIP, will have CODE_TYPE='B'.

3. **How do I indicate that a significant point is an RVSM entry/exit point?**

This is considered to be a characteristic of a point when used as the start or end of a route segment. Therefore, it is modelled using the CODE_RVSM_START and CODE_RVSM_END attributes of the RTE_SEG entity.

4. **What about 'abeam' waypoints?**

'Abeam' waypoints are usually specified in AIPs as a bearing/distance from a Navaid in the area. They are used for charting or navigation purpose. Considering the current trend towards the generalisation of RNAV, the approach adopted by this model is that such points will be replaced with real designated points, with an identifier and a given latitude/longitude position.

Until then, the latitude/longitude will have to be calculated from the existing data. The type of such points should be recorded as 'OTHER'. There is no specific attribute indicating that the latitude/longitude values have been calculated. Instead, the VAL_GEO_ACCURACY attribute should be used, by providing an estimation of the accuracy of the calculated position. Very likely, the imprecision of such calculations is larger than 1NM, in which case the position itself should not be specified with a precision below minute level.

A coded designator will also have to be created. The current practice is to use the coded identifier of the reference Navaid and the distance from the Navaid, in two digits.

The bearing and distance values, which define the position of the point, are modelled using the DISTANCE_INDICATION and ANGLE_INDICATION entities.

5. **How is the identifier of points given by coordinates (type 'COORD') constructed?**

Designated points of type COORD do not have a published identifier, for example NAT entry/exit points; they are published only as coordinates (for example 4600N, 00700E). The AICM mandates that every Designated Point has an identifier, therefore a 5-letter/digit identifier is derived using the ‘FMS’ rules described below.

The following identifier composition rules apply only to points that have longitude values expressed in whole degrees and latitude values expressed in either whole or half degrees.

A single character is used, depending on the latitude/longitude values:

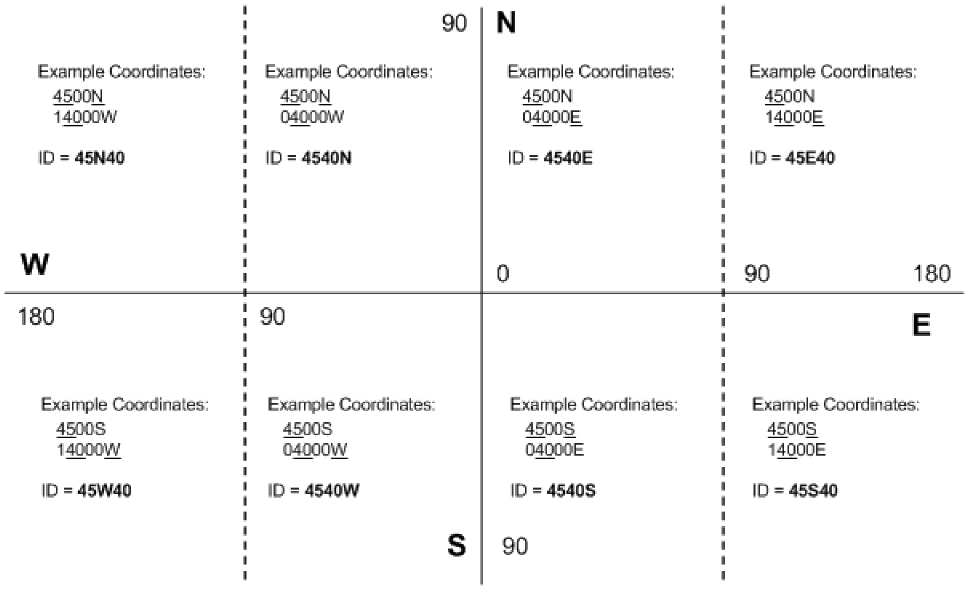
1. 'N' for points with North latitude and West longitude
2. 'E' for points with North latitude and East longitude
3. 'S' for points with South latitude and East longitude
4. 'W' for points with South latitude and West longitude

The position of this character is dictated by the latitude and longitude values:

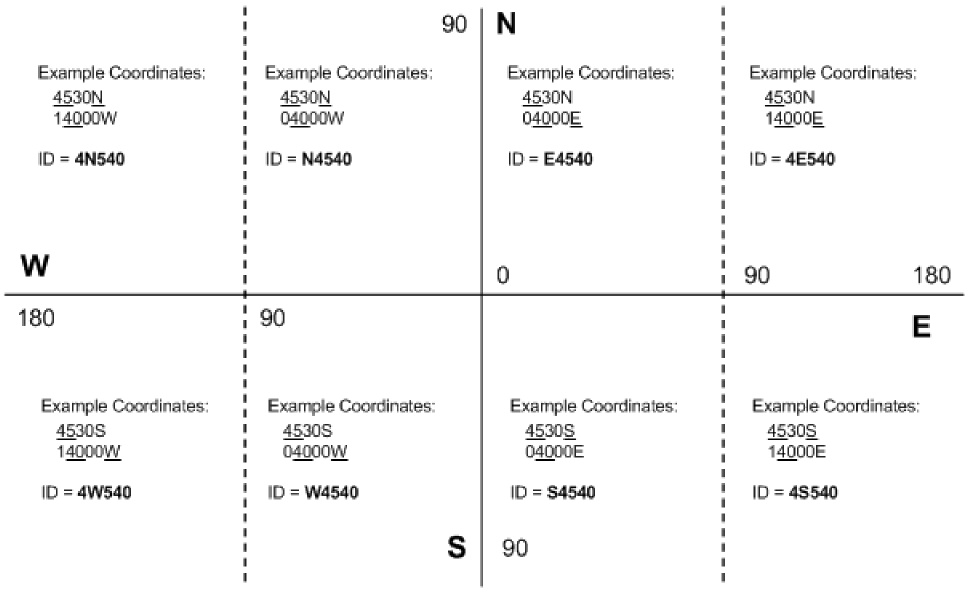
1. if the latitude value was expressed as **full degrees**, then the character is situated:
   - in the 5th position for longitude values smaller than 100 degrees
   - in the 3rd position for longitude values greater than or equal to 100 degrees.
2. if the latitude value was expressed as **half degrees**, then the character is situated:
   - in the 1st position for longitude values smaller than 100 degrees

- in the 2nd position for longitude values greater than or equal to 100 degrees.

The following diagram shows the composition of identifiers for ‘COORD’ type Designated Points having latitude and longitude values expressed as **full degree values** for a range of latitudes and longitudes:



The following diagram shows the composition of identifiers for ‘COORD’ type Designated Points having latitude values expressed as **full degree values** and longitude values expressed as **half degree values** for a range of latitudes and longitudes:



6. **Could the entity SIGNIFICANT POINT be seen as a redundant entity?**

The SIGNIFICANT POINT entity does not need to be included in a physical database design. It is included in AICM as a convenient way of grouping together entities having similar relationships.

The VOR, DME, MKR, TACAN, NDB entities and DESIGNATED_POINT entity have many similar relationships. The SIGNIFICANT_POINT entity has been used as a convenient way of indicating this.

Consider, for example, the AD_HP_NAV_AID entity used to indicate which Navaids are located at a particular aerodrome. The VOR, DME, MKR, TACAN and NDB are connected to the AD_HP entity through the SIGNIFICANT_POINT entity. If the SIGNIFICANT_POINT entity was removed, all these Navaid entities would just have to be related directly to the AD_HP_NAV_AID entity and no information would be lost. The SIGNIFICANT_POINT is more a view than a true entity, it is used to group together Navaids and designated points in order to facilitate the description of the very similar relationships maintained by these entities.

Chapter 7. NAVAIDS

7.1. Introduction

The Navaids Concept includes portions of the AICM model that represent eight distinct Navaid types. Each Navaid type is detailed individually in this document, but where Navaid types have been represented using similar model representations; common concepts are highlighted and referred to from individual discussions where appropriate.

The description of this concept is organised into sections as follows:

- DME
- VOR
- NDB
- TACAN
- Markers
- MLS
- ILS
- Special Navigation Systems

In general single navigation aids are modelled with a mandatory entity containing attributes that describe the physical characteristics of the Navaid with optional associated entities containing timesheet information and limitations of the Navaid, where applicable. DME, VOR, NDB and TACAN fall into this category of Navaids.

Markers are modelled using a simplified version of the general approach, described in the previous paragraph, in which there is no provision to specify limitations of the marker beacon.

The modelling approach used for MLS and ILS is similar due to the inherent component based nature of each system. That is each are built up from multiple components, each modelled individually – either specifically for the Navaid type or as links to other Navaid entities.

Special Navigation Systems are global systems, possibly with a network of local stations. They may be ground based; satellite based or a combination of the two where local stations are used to augment the system availability or precision. Currently existing systems, such as LORAN and DECCA, are under the control of a single State. In future, this area of the model might need further work in order to model all the necessary information for GNSS systems with local or wide area augmentation systems.

7.2. DME

A DME is defined as follows:

> UHF distance measuring equipment, operating on the interrogation-answer principle. The time required for the round trip of the signal exchange is measured in the airborne DME unit and translated into distance.

The characteristics of a single DME are, in the main, encapsulated by the DME entity. The DME entity contains attributes to describe the following three broad categories of information:

- The location of the DME.

  The location of the DME is expressed using position group attributes as described inSection 2.2, “Geometry: Point”. These attributes describe the geographical location and elevation of the DME as well as the accuracy of the position values. The values are also integrity protected.

- The working hours of the DME.

  Working hours are modelled using a relationship to a combination of a coded value and optional instances of a timesheet entity.

- DME specific characteristics.

  This group of attributes describe the DME and its configuration. Included in this group are attributes describing the DME type, the emission type emitted by the DME, the DME displacement and its channel or ghost frequency.

The core DME entity is optionally associated with timesheet entities and limitation entities to fully describe a DME and its operational restrictions.

7.2.1. DME Working Hours

Working hours are modelled using a combination of a working hours code attribute [CODE_WORK_HR] in the TIMETABLE entity and optional timesheet entity instances [TIMESHEET] as described in Chapter 3, *TIME SCHEDULES*, mandatory related to a DME entity instance.

Reference for vertical limit [CODE_DIST_VER_*]

This defines the reference used for the corresponding vertical distance value. Similarly to other attributes having the same name, two series of values are defined:

- Measured Distance:
  - HEI [The distance measured from GND].
  - ALT [The distance measured from MSL].
  - W84 [The distance measured from WGS-84 ellipsoid].
- Pressure Altitude:
  - QFE [A reading of 0 on the altimeter setting which occurs on GND]
  - QNH [Altimeter setting gives field elevation on GND (~ 0 at MSL)].
  - STD [The altimeter setting is set to standard atmosphere].

A number of links to other entities from the DME entity are defined in the AICM. These model a range of both optional and mandatory relationships between DME entity instances and instances of other entities. These relationships are described in the following paragraphs from the point of view of DME entity instances in defined scenarios.

Relationship to: Unmonitored hours

This is a relationship modelling the schedule according to which the navaid service is un-monitored.

Relationship to: Responsible Authority

This relationship indicates which Organisation or Authority is the owner of the Navaid and, implicitly responsible for its maintenance. The most general type of authority is a State, when more precise information is not available. However, this relationship may be used to more accurately model the exact organisation responsible for the maintenance of the DME.

Relationship to: Collocation

A DME entity may be collocated with a VOR. Collocated VOR and DME Navaids are usually referred to as VOR/DME. There are certain ICAO rules with regard to the relative distance between the VOR and the DME, frequency pairing and coded identifier. They are mentioned as rules on the relationship. A DME [and VOR] may only maintain a single collocation relationship at a time, which means that it is not possible to collocate a VOR with two different DMEs.

Relationship to: Significant Point

A DME instance may be used as a significant point. If it is, it must be related to one and only one significant point entity instance. See Chapter 3, *TIME SCHEDULES* for more information about the AICM significant point concept.

Relationship to: MLS

A particular DME may be defined as a part of an MLS. A single DME can be part of more than one MLS, however a DME can equally be a part of zero MLS. The relationship is purely optional from the point of view of a DME entity instance.

Relationship to: ILS

Where a DME forms part of an ILS the relationship is modelled in the same way as the DME/MLS relationship described above. However, ILS need not have a DME associated with them, therefore the relationship is optional in both directions.

Relationship to: DME Usage Limitation

Navaid limitations [NAVAID_LIMITATION] (see Section 7.6, “Navaid Limitations”) might be associated to a DME through instances of DME usage limitation entity [DME_USAGE_LIMIT]. Navaid limitations are grouped under instances of DME Usage Limitation entity. Each group should contain the same type of navaid limitations and limitations should only be related to the DME instance.

7.3. VOR

A VOR is defined as follows:

> A VHF omnidirectional radio range beacon. A short-range, very-high-frequency omnidirectional beacon which provides an indication in the aircraft of the bearing of the beacon, or left-right track indication.

The AICM approach to the modelling of VORs is identical to that used to model DMEs, as described in the previous section. The main VOR entity [VOR] contains attributes to describe the following three broad categories of information:

- The location of the VOR.

  The location of the VOR is expressed using position group attributes as described in Section 2.2, "Geometry: Point" These attributes describe the geographical location and elevation of the VOR as well as the accuracy of the position values. The values are also integrity protected.

- The working hours of the VOR.

  Working hours are modelled using a combination of a working hours code attribute [CODE_WORK_HR] in the TIMETABLE entity and optional timesheet entity instances [TIMESHEET] as described in Chapter 3, *TIME SCHEDULES*, mandatory related to a VOR entity instance.

- VOR specific characteristics.

  This group of attributes describe the VOR and its configuration. Included in this group are attributes describing the VOR Identifier, VOR type, the emission type emitted by the VOR, the station declination and the magnetic variation of the station.

The core VOR entity is optionally associated with timesheet entities and limitation entities to fully describe a VOR and its operational restrictions.

As with the DME entity model, VORs are involved in a number of defined relationships with other entities. The following paragraphs describe the VOR relationships from the point of view of a VOR entity instance in each of the scenarios.

Relationship to: Unmonitored hours

This is a relationship modelling the schedule according to which the navaid service is un-monitored.

Relationship to: Responsible Authority

A VOR entity instance must be under the responsibility of an organisation or authority and must be linked to one and only ORG_AUTH entity instance. The most general type of authority is a State, when more precise information is not available. However, this relationship may be used to more accurately model the exact organisation responsible for the maintenance of the VOR.

Relationship to: Collocated DME

A VOR entity may be collocated with a DME. In this case both the VOR and DME must be related to each other, and only to each other, to form the collocation relationship. A VOR [and DME] may only maintain a single collocation relationship at a time.

A VOR may also be collocated with a TACAN - the same relationship exists as described with a DME, above.

Relationship to: Significant Point

A VOR instance may be defined as a significant point. If it is, it must be related to one and only one significant point entity instance. See Chapter 3, *TIME SCHEDULES* for more information about the AICM significant point concept.

Relationship to: Angle Indication

An angle indication is defined as an angular reference from a radio navigation aid, in this case a VOR.

A VOR entity instance can form part of an angle indication through a relationship with an instance of the ANGLE_INDICATION entity. The definition of ANGLE_INDICATION [see Section 6.3, “Angle Indication”] is such that the angle indication is based on a VOR and each VOR may be used to define more than one angle indication [many angles defined from the same VOR].

Relationship to: VOR Usage Limitation

Navaid limitations [NAVAID_LIMITATION] (see Section 7.6, “Navaid Limitations”) might be associated to a VOR through instances of VOR usage limitation entity [VOR_USAGE_LIMIT]. Navaid limitations are grouped under instances of VOR Usage Limitation entity. However, each group should contain same type of navaid limitations and limitations should only be related to the VOR instance.

~~7.3.1. VOR Limitation~~

~~VOR limitations are modelled in the same way as DME limitations, as described in . Identical entity structures and rules governing their use and interpretation are used.~~

7.4. NDB

An NDB is defined as follows:

> A Non-directional radio beacon. A low or medium frequency radio beacon which transmits signals whereby the pilot of an aircraft properly equipped can determine bearings and 'home in' on the station.

NDBs are modelled in a similar way to both DMEs and VORs in AICM. The main entity [NDB] contains attributes to describe the following three categories of information:

- The location of the NDB.

  The location of the NDB is expressed using position group attributes as described in Section 2.2, “Geometry: Point”. These attributes describe the geographical location and elevation of the NDB as well as the accuracy of the position values. The values are also integrity protected.

- The working hours of the NDB.

  Working hours are modelled using a combination of a working hours code attribute [CODE_WORK_HR] in the TIMETABLE entity and optional timesheet entity instances [TIMESHEET] combination as described in Chapter 3, *TIME SCHEDULES*, mandatory related to a NDB entity instance.

- NDB specific characteristics.

> This group of attributes describe the NDB and its configuration. Included in this group are attributes describing the NDB Identifier, NDB class, the emission type emitted by the NDB, ILS locator position and the magnetic variation of the station.

The core NDB entity is optionally associated with timesheet entities and limitation entities to fully describe a NDB and its operational restrictions.

As with the DME entity model, NDBs are involved in a number of defined relationships with other entities. The following paragraphs describe the NDB relationships from the point of view of an NDB entity instance in each of the scenarios.

Relationship to: Unmonitored hours

This is a relationship modelling the schedule according to which the navaid service is un-monitored.

Relationship to: Responsible Authority

A NDB entity instance must be under the responsibility of an organisation or authority and must be linked to one and only ORG_AUTH entity instance. The most general type of authority is a State, when more precise information is not available. However, this relationship may be used to more accurately model the exact organisation responsible for the maintenance of the NDB.

Relationship to: Collocated Marker

An NDB instance may be collocated with a marker [MKR entity]. In this case both the NDB and marker must be related to each other, and only to each other, to form the collocation relationship. An NDB [and marker] may only maintain a single collocation relationship at a time.

Relationship to: Significant Point

An NDB instance may be defined as a significant point. If it is, it must be related to one and only one significant point entity instance. See Chapter 6, *SIGNIFICANT POINTS* for more information about the AICM significant point concept.

Relationship to: Angle Indication

An angle indication is defined as an angular reference from a radio navigation aid, in this case an NDB.

An NDB entity instance can form part of an angle indication through a relationship with an instance of the ANGLE_INDICATION entity. The definition of ANGLE_INDICATION [see Section 6.3, “Angle Indication”] is such that if the angle indication is based on a NDB, each NDB may be used to define more than one angle indication [many angles defined from the same NDB].

Relationship to: NDB usage limitation

Navaid limitations [NAVAID_LIMITATION] (see Section 7.6, “Navaid Limitations”) might be associated to a NDB through instances of NDB usage limitation entity [NDB_USAGE_LIMIT]. Navaid limitations are grouped under instances of NDB Usage Limitation entity. However, each group should contain same type of navaid limitations and limitations should only be related to the NDB instance.

~~7.4.1. NDB Limitation~~

~~NDB limitations are modelled in the same way as DME limitations, as described in . Identical entity structures and rules governing their use and interpretation are used.~~

7.5. TACAN

A TACAN is defined as follows:

> A UHF Tactical Air Navigation beacon. A navigation system developed by military and naval forces providing, as far as the navigating pilot is concerned and for suitably equipped aircraft, the same indication as a VOR/DME system.

TACANs are modelling in a similar way to each of the Navaid types discussed previously in this section. The main entity [TACAN] contains attributes to describe the following three categories of information:

- The location of the TACAN.

  The location of the TACAN is expressed using position group attributes as described in Section 2.2, “Geometry: Point”. These attributes describe the geographical location and elevation of the TACAN as well as the accuracy of the position values. The values are also integrity protected.

- The working hours of the TACAN.

  Working hours are modelled using a combination of a working hours code attribute [CODE_WORK_HR] in the TIMETABLE entity and optional timesheet entity instances [TIMESHEET], as described in Chapter 3, *TIME SCHEDULES*, mandatory related to a TACAN entity instance.

- TACAN specific characteristics.

  This group of attributes describe the TACAN and its configuration. Included in this group are attributes describing the TACAN Identifier, TACAN channel, the emission type emitted by the NDB, the station declination and the magnetic variation of the station.

The core TACAN entity is optionally associated with timesheet entities and limitation entities to fully describe a TACAN and its operational restrictions.

As with the DME entity model, TACANs are involved in a number of defined relationships with other entities. The following paragraphs describe the TACAN relationships from the point of view of an TACAN entity instance in each of the scenarios.

Relationship to: Unmonitored hours

This is a relationship modelling the schedule according to which the navaid service is un-monitored.

Relationship to: Responsible Authority

A TACAN entity instance must be under the responsibility of an organisation or authority and must be linked to one and only ORG_AUTH entity instance. The most general type of authority is a State, when more precise information is not available. However, this relationship may be used to more accurately model the exact organisation responsible for the maintenance of the TACAN.

Relationship to: Collocated VOR

A TACAN instance may be collocated with a VOR. In this case both the TACAN and VOR must be related to each other, and only to each other, to form the collocation relationship. A TACAN [and VOR] may only maintain a single collocation relationship at a time.

Relationship to: Significant Point

An TACAN instance may be defined as a significant point. If it is, it must be related to one and only one significant point entity instance. See Chapter 6, *SIGNIFICANT POINTS* for more information about the AICM significant point concept.

Relationship to: Angle Indication

An angle indication is defined as an angular reference from a radio navigation aid, in this case a TACAN.

A TACAN entity instance can form part of an angle indication through a relationship with an instance of the ANGLE_INDICATION entity. The definition of ANGLE_INDICATION [see Section 6.3, "Angle Indication"] is such that if the angle indication is based on a TACAN, each TACAN may be used to define more than one angle indication [many angles defined from the same TACAN].

Relationship to: Distance Indication

A distance indication is defined as a distance from a radio navigation aid, in this case a TACAN.

A TACAN entity instance can form part of a distance indication through a relationship with an instance of the DISTANCE_INDICATION entity. The definition of DISTANCE_INDICATION [see Section 6.4, "Distance Indication"] is such that the distance indication is based on a TACAN station and each TACAN station may be used to define more than one distance indication [many distances defined from the same TACAN].

Relationship to: TACAN Usage Limitation

Navaid limitations [NAVAID_LIMITATION] (see Section 7.6, "Navaid Limitations") might be associated to a TACAN through instances of TACAN usage limitation entity [TACAN_USAGE_LIMIT]. Navaid limitations are grouped under instances of TACAN Usage Limitation entity. However, each group should contain same type of navaid limitations and limitations should only be related to the TACAN instance.

TACAN Usage Limitation has an additional code indicating which TACAN component is subject to the limitations grouped in it. Allowable values are:

- DIST [Distance indicator].
- AZMT [Azimuth indicator].

~~7.5.1. TACAN Limitation~~

~~TACAN limitations are modelled in the same way as DME limitations, as described in . Identical entity structures and rules governing their use and interpretation are used.~~

~~However, an additional attribute is defined for the TACAN limitation entity [TACAN_LIMITATION], CODE_COMPONENT.~~

~~*Component [CODE_COMPONENT]*~~

~~This is a code indicating which TACAN component is subject to the limitation. Allowable values are:~~

- ~~DIST [Distance indicator].~~
- ~~AZMT [Azimuth indicator].~~

7.6. Navaid Limitations

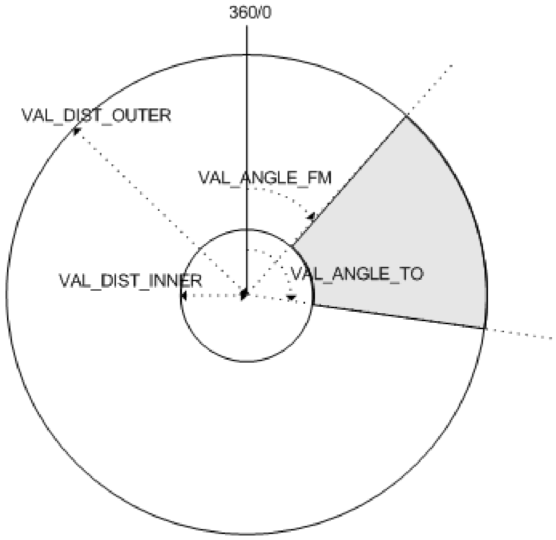
Navaid limitations are modelled as volumes of airspace described in sectors centred on the navaid in which certain limitations in the navaid performance are defined. All navaid limitations of the same type and related to the same navaid are grouped together. These groupings are represented with four entities: VOR_USAGE_LIMIT, DME_USAGE_LIMIT, NDB_USAGE_LIMIT and TACAN_USAGE_LIMIT.

Each instance of the limitation entity [NAVAID_LIMITATION] associated with a navaid through a limitation group [XXX_USAGE_LIMIT] describes a single sector and with a single type of limitation where XXX corresponds to one the following: VOR, DME, NDB or TACAN.

Each volume is a radial sector emanating from the navaid location. The geographic shape of each radial sector is modelled in terms of the start and end angles (VAL_ANGLE_FM and VAL_ANGLE_TO) and the inner and outer distances from the navaid (VAL_DIST_INNER and VAL_DIST_OUTER). A single attribute contains the units of measurement for the horizontal distance measurements, UOM_DIST_HORZ – this mandates that the horizontal distances are defined in the same units for a particular entity instance.

A series of descriptions and associated figures shows the way in which these attributes are used to describe various sector shapes:

- A simple sector is described by the VAL_ANGLE_FM and VAL_ANGLE_TO parameters.

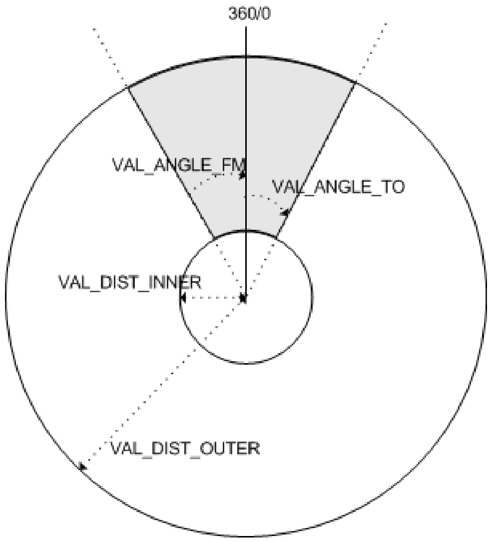


  VAL_ANGLE_FM defines the angle that describes the leading edge of the sector – the edge at which the sector volume begins. VAL_ANGLE_TO defines the angle to the end of the sector volume. In this case VAL_ANGLE_FM is assumed to be less than VAL_ANGLE_TO.

  Two horizontal distances are defined, VAL_DIST_OUTER and VAL_DIST_INNER, each defining the radius of a circle, centred on the navaid. The circle defined by VAL_DIST_INNER is the edge at which the limitation starts [when moving away from the navaid]. VAL_DIST_OUTER describes the edge at which the limitation stops. Therefore the two values together describe the extent of the limitation in terms of distance away from the navaid .

  The part played by each of the four attributes discussed in defining a simple sector is shown in the accompanying figure with the sector described by the four attributes shaded.

- Sector including 0/360 degree boundary [VAL_ANGLE_FM > VAL_ANGLE_TO].



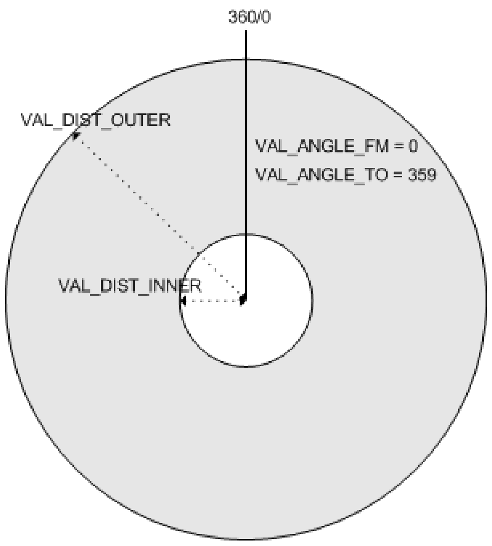
When the value of VAL_ANGLE_FM is greater than the value of VAL_ANGLE_TO, VAL_ANGLE_FM is the angle from the start of the limitation sector to 360° and VAL_ANGLE_FM is the angle from 0° to the end of the limitation.

The leading edge of the limitation [moving in a positive direction around the navaid] is therefore at an angle of 360°-VAL_ANGLE_FM. The internal angle of the sector itself is given by VAL_ANGLE_FM+VAL_ANGLE_TO.

As described above the VAL_DIST_INNER and VAL_DIST_OUTER values are used to describe the extents of the limitation horizontally from the navaid.

The figure [right] illustrates this case, with the shaded area representing the sector described by the four attributes.

- Full circle limitation.

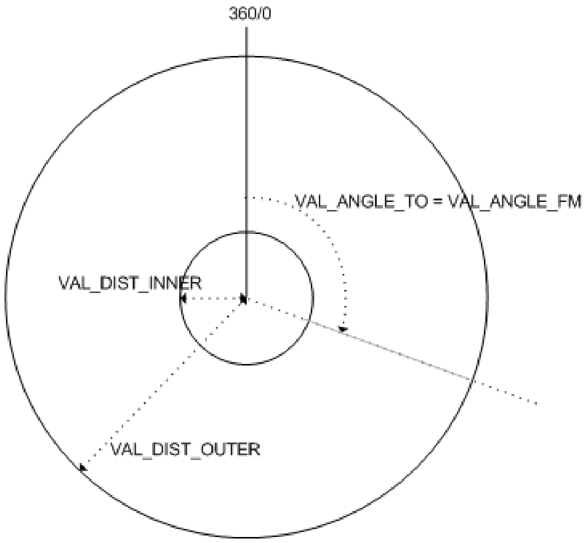


Where the navaid limitation is defined for the entire area surrounding a navaid, between two lateral distances from the navaid, the case shown in the figure [left] is true.

The limitation is defined in a full circle centred on the navaid.

In order to describe this situation VAL_ANGLE_FM is set to 0° and VAL_ANGLE_TO is set to 359°.

- Limitation defined at a single angle.



When a limitation is defined at a single angle this is modelled as a zero width sector. The VAL_DIST_INNER and VAL_DIST_OUTER attribute values have identical use as in the previous cases.

In order to define a zero width sector VAL_ANGLE_TO and VAL_ANGLE_FM are both set to the angle of the limitation.

A visual representation of this case is shown in the accompanying figure, right.

The vertical components of the sector volume are defined using upper and lower containment limits, modelled by the VAL_DIST_VER_LOWER and VAL_DIST_VER_UPPER attributes. In each case two corresponding attributes are used to define the units of measurement and type of vertical distance measurement used. These values are modelled using UOM_DIST_VER_* and CODE_DIST_VER_* [where * is LOWER or UPPER].

7.7. Markers

A marker is defined as follows:

> A marker beacon serving to identify a particular location in space by means of a 75MHz transmitter which transmits a directional signal to be received by aircraft flying overhead.

In the AICM markers are modelled in a similar way to DME, VOR, NDB and TACAN entities, but no provision has been made to allow limitations to be defined. Therefore a marker is defined using a main marker entity [MKR] and a combination of a coded value and an optionally associated timesheet entity.

The main marker entity [MKR] contains attributes to describe the following three categories of information:

- The location of the marker.

The location of the marker is expressed using position group attributes as described in Section 2.2, “Geometry: Point”. These attributes describe the geographical location and elevation of the marker as well as the accuracy of the position values. The values are also integrity protected.

- The working hours of the marker.

  Working hours are modelled using a combination of a working hours code attribute [CODE_WORK_HR] in the TIMETABLE entity and optional timesheet entity instances [TIMESHEET] as described in Chapter 3, *TIME SCHEDULES*, mandatory related to a MKR entity instance.

- Marker specific characteristics.

  This group of attributes describe the marker and its configuration. Included in this group are attributes describing the following:

  - Marker Identifier.
  - Marker class.
  - Position on the centreline of a runway.
  - Marker frequency.
  - True bearing of the minor axis of the marker beacon.

The core MKR entity is optionally associated with timesheet entities to fully describe a marker and its operational restrictions.

As with the other Navaid types modelled in the AICM, markers are involved in a number of defined relationships with other entities. The following paragraphs describe the marker relationships from the point of view of an marker entity instance in each of the scenarios.

Relationship to: Unmonitored hours

This is a relationship modelling the schedule according to which the navaid service is un-monitored.

Relationship to: Responsible Authority

A marker entity instance must be under the responsibility of an organisation or authority and must be linked to one and only ORG_AUTH entity instance. The most general type of authority is a State, when more precise information is not available. However, this relationship may be used to more accurately model the exact organisation responsible for the maintenance of the marker.

Relationship to: Significant Point

An NDB instance may be defined as a significant point. If it is, it must be related to one and only one significant point entity instance. See Chapter 6, *SIGNIFICANT POINTS* for more information about the AICM significant point concept.

Relationship to: ILS

A MKR entity instance may be part of an ILS definition. An optional relationship exists that allows one or more MKR instances to be related to [part of] a single ILS entity instance. However, each MKR entity instance must be related to a maximum of one ILS entity.

7.8. ILS

An ILS is defined as follows:

> A radio aid to navigation intended to facilitate aircraft in landing by providing lateral and vertical guidance including indications of distance from the optimum point of landing.

The AICM models ILS as its two constituent components – the localizer and the glide path related by a main ILS entity which contains general attributes relating to the ILS as a whole.

The following entities and relationships define the core ILS model:

- ILS

  Defines only the ILS category [CODE_CAT] and allows an ILS system-level remark to be stored [TXT_RMK].

- ILS_LLZ

  Models the localizer part of the ILS. Each ILS entity instance must have a corresponding localizer [ILS_LLZ] instance associated with it. The localizer provides the lateral component of the guidance system. Relationships to either a coded value or a combination of it and instances of a common timesheet entity allow the working hours and/or unmonitored hours of the localizer to be defined.

- ILS_GP

  Models the glide path component of the ILS. Each ILS entity may have a corresponding glide path entity [ILS_GP] instance associated with it. The glide path provides the vertical component of the guidance system. Relationships to either a coded value or a combination of it and instances of a common timesheet entity allow the working hours and/or unmonitored hours of the glide path to be defined.

Also, the ILS entity has a number of relationships with other entities [outside of the ILS entity group]

Relationship to: Unmonitored hours

This is a relationship modelling the schedule according to which the ILS Localizer or Glidepath components are unmonitored.

Relationship to: Markers

An ILS entity instance may include one or more marker instances, that is the marker instances are part of the ILS. Each marker may be a part of only one ILS. However, each ILS may have multiple markers associated with it.

Relationship to: DME

An ILS instance may be related to a single DME entity instance. This relationship is optional. Each DME instance may be part of one or more ILS definitions [entity instances].

Relationship to: Runway Direction

An ILS entity instance must relate to a runway direction [RWY_DIRECTION] entity instance or a FATO direction [FATO_DIRECTION] entity instance. However, a runway direction or FATO is optionally related to an ILS instance [a runway direction or FATO direction does not have to have an ILS associated with it].

7.8.1. Localizer

The ILS localizer is the lateral guidance component of the ILS. Each ILS must include one and only one localizer component. In AICM the localizer is modelled as a separate entity [ILS_LLZ] to the ILS entity to reflect the componentized nature of the ILS architecture.

The ILS_LLZ entity has attributes that fall into 3 categories, described as follows:

- Position Group.

  A position group attribute set as described in Section 2.2, “Geometry: Point” that describes the location of the ILS localizer instance. Attributes to describe the geographic position, the elevation and to provide data integrity of the location data are defined.

- The working hours of the localizer.

  Working hours are modelled using a combination of a working hours code attribute [CODE_WORK_HR] in the TIMETABLE entity and optional timesheet entity instances [TIMESHEET] as described in Chapter 3, *TIME SCHEDULES*, mandatory related to a ILS_LLZ entity instance.

- Localizer specific attributes.

  Specific attributes allowing the characteristics of the localizer instance to be described, as follows:

  - The coded identifier of the localizer [CODE_ID].
  - The frequency of the localizer [VAL_FREQ, UOM_FREQ]. The value supplied will be subject to plausibility checks based on the rules expressed in ICAO Annex 10, Volume 1, section 3.1.3.2. – ILS localizer frequency value must be between 108 MHz and 111.975MHz.
  - The localizer emission type [CODE_EM].
  - A description of the localizer beam in terms of magnetic and true bearing [VAL_MAG_BEARING, VAL_TRUE_BEARING], course width [VAL_WID_COURSE] and its usability in the back course sector [CODE_TYPE_USE_BACK].
  - The magnetic variation [VAL_MAG_VAR] and Magnetic variation date [DATE_MAG_VAR].

7.8.2. Glide Path

The ILS glide path is the vertical guidance component of the ILS. Each ILS may include one and only one glide path component, but the relationship is optional – some ILS may not include a glide path component. In AICM the glide path is modelled as a separate entity [ILS_GP] to the ILS entity to reflect the componentized nature of the ILS architecture.

The ILS_GP entity has attributes that fall into 3 categories, described as follows:

- Position Group.

  A position group attribute set as described in Section 2.2, “Geometry: Point” that describes the location of the ILS glide path instance. Attributes to describe the geographic position, the elevation and to provide data integrity of the location data are defined.

- The working hours of the localizer.

  Working hours are modelled using a combination of a working hours code attribute [CODE_WORK_HR] in the TIMETABLE entity and optional timesheet entity instances [TIMESHEET] combination as described in Chapter 3, *TIME SCHEDULES*, mandatory related to a ILS_GP entity instance.

- Glide path specific attributes.

  Specific attributes allowing the characteristics of the localizer instance to be described, as follows:

  - The frequency of the glide path [VAL_FREQ, UOM_FREQ]. The value supplied must be as specified in ICAO Annex 10, Volume 1, 3.1.6 given the corresponding ILS localizer frequency. As an additional plausibility check the value must correspond to the requirements in ICAO Annex 10, Volume 1, section 3.1.5.2. – ILS glide path frequency value must be between 328.6 MHz and 335.4 MHz.

  - The ILS glide path emission type [CODE_EM].

  - The ILS glide path slope [VAL_SLOPE]. A plausibility rule will be applied to this value to ensure that it is between 1° and 5°; the ICAO Annex 10 recommendation [Volume 1, 3.1.5.1.2.1] is for a slope of 3°.

  - The reference datum height [VAL_RDH, UOM_RDH].

7.9. MLS

An MLS is defined as follows:

> A precision approach and landing guidance system which provides position information and various ground-to-air data. The position information is provided in a wide coverage sector and is determined by an azimuth angle measurement and a range (distance) measurement.

An MLS is modelled in a broadly similar way to an ILS in the AICM. A top level entity represents the MLS [MLS] as a whole to other entities in the AICM and related component entities represent the component parts of the MLS instance [MLS_ELEVATION and MLS_AZIMUTH].

The range measurement is provided by a related DME instance [see Relationship to: DME, below].

7.9.1. MLS entity

The MLS entity defines general characteristics of an MLS instance. The following key attributes define the general characteristics of an MLS deployment:

- CODE_ID [Identification]. The coded identification of the MLS.

- CODE_CAT [Category]. The MLS category.

- CODE_CHANNEL [Channel]. The channel on which the MLS is operating.

Each MLS entity instance must be associated with one or more MLS azimuth component entity instances [MLS_AZIMUTH]. Also, each MLS entity instance must be associated with one and only one MLS elevation component entity instance [MLS_ELEVATION]. These entities are described in the following sections.

Relationships to either a coded value or a combination of it and instances of a specific timesheet entity allow the working hours and/or unmonitored hours of the components part of an MLS to be defined.

Also, the MLS entity has a number of relationships with other entities [outside of the MLS entity group].

Relationship to: Unmonitored hours

This is a relationship modelling the schedule according to which the MLS Azimuth or Elevation components are unmonitored

Relationship to: DME

An MLS entity instance must be related to one and only one DME [modelled by an instance of the DME entity]. Each DME may be associated with one, more than one or no MLS as appropriate.

Relationship to: Runway Direction

As for the ILS entity, an MLS entity instance must relate to a runway direction [RWY_DIRECTION] entity instance or a FATO direction [FATO_DIRECTION] entity instance. However, a runway direction or FATO is optionally related to an MLS instance [a runway direction or FATO direction does not have to have an MLS associated with it].

7.9.2. MLS Azimuth Component

The AICM defines the MLS Azimuth component as:

> A component of an MLS consisting of a Super High Frequency (SHF) transmitter and associated equipment, radiating signals in a volume of airspace served by the MLS, thereby furnishing azimuth indications to aircraft approaching the runway or back azimuth indications to aircraft departing from the runway or performing a missed approach procedure.

At least one (but more than 1 is permitted) azimuth component must be associated with each MLS defined in the AICM.

Working hours are modelled using a combination of a working hours code attribute [CODE_WORK_HR] in the TIMETABLE entity and optional timesheet entity instances [TIMESHEET], as described in Chapter 3, *TIME SCHEDULES*, mandatory related to a MLS_AZIMUTH entity instance. .

The MLS Azimuth entity contains a standard position attribute set including geographic position, elevation and integrity attributes, as defined in Section 2.2, “Geometry: Point”.

Additional information contained in a MLS azimuth entity instance is defined as follows:

- The type of azimuth capability given by the azimuth component, either forward or backward [CODE_TYPE].

- The bearing of the azimuth beam towards the azimuth antenna, both true bearing [VAL_TRUE_BRG] and magnetic bearing [VAL_MAG_BRG].
- The angles of proportionality and coverage are stored in two sets of two attributes, left and right for each angle type [VAL_ANGLE_PROP_RIGHT, VAL_ANGLE_PROP_LEFT, VAL_ANGLE_COVER_ RIGHT and VAL_ANGLE_COVER_ LEFT].
- The Magnetic variation [VAL_MAG_VAR] and Magnetic variation date [DATE_MAG_VAR].

7.9.3. MLS Elevation Component

The MLS elevation component can be defined in an analogous way to the MLS azimuth component as follows:

> A component of an MLS consisting of an SHF transmitter and associated equipment, radiating signals in a volume of airspace served by the MLS, thereby furnishing elevation indications to aircraft approaching the runway.

One and only one elevation component must be associated with each MLS defined in the AICM.

Working hours are modelled using a combination of a working hours code attribute [CODE_WORK_HR] in the TIMETABLE entity and optional timesheet entity instances [TIMESHEET], as described in Chapter 3, *TIME SCHEDULES*, mandatory related to a MLS_ELEVATION entity instance.

The MLS elevation entity contains a standard position attribute set including geographic position, elevation and integrity attributes, as defined in Section 2.2, “Geometry: Point”.

Additional information contained in an MLS elevation entity instance is defined as follows:

- The nominal glide path angle for the MLS installation [VAL_ANGLE_NML].
- The value of the lowest elevation angle authorized for an MLS approach [VAL_ANGLE_MNM].
- The value of the span angle of the elevation transmitter signal between the lower and the upper limits [VAL_ANGLE_SPAN].

7.10. Aerodrome Navaids

The operational relationship between Navaids and aerodromes is modelled using an intermediate entity [AD_HP_NAV_AID] to maintain the relationship between SIGNIFICANT_POINT instances (representing the Navaids) and AD_HP entity instances (representing the aerodromes).

The AD_HP_NAVP_AID entity allows a many to many relationship to exist between Navaids and aerodromes. For example, a Navaid entity instance may be related to more than one aerodrome and an aerodrome entity instance may be related to more than one Navaid.

7.11. Frequently Asked Questions

1. **How can an ILS magnetic variation be recorded?**

LLZ 22 ILS CAT I (2° E (2000))	OKR	108,3 MHz	H24	480931,30N 0171146,87E		221°27,6' MAG, 3 228 m FM THR RWY 22

Rather than the magnetic variation, the model allows for both the true and the magnetic bearing of the ILS Localizer to be recorded (see attributes VAL_MAG_BRG and VAL_TRUE_BRG in the ILS_LLZ entity).

2. **How are locators modelled?**

Locators are modelled in AICM as 'low powered NDB used as an aid for final approach' (NDB instances with CODE_CLASS = 'L').

3. **What is the meaning of the relationship for Navaid unmonitored hours ?**

Apart from working hours, for many Navaids it was usual to indicate in the AIP the hours when their functioning is unmonitored, thus the risk to have a wrong indication being higher than during the monitored period. However, the number of unmonitored Navaids is constantly decreasing. This relationship was kept in the model for the sake of completeness.

Chapter 8. ROUTES

8.1. Introduction

The following structure is used when modelling (en-route) routes:

- Each route is identified by a 'route header' (entity EN_ROUTE_RTE) which is used to group together all the segments of that route;
- Each route must consist of one or more segments (RTE_SEG) and:
  - must start at one and only one, and end at one and only one significant point (SIGNIFICANT_POINT). A significant point may be a Navaid (VOR, DME, TACAN, NDB, MKR) or a designated point.
  - may be used according to one or more 'route segment usage conditions' (RTE_SEG_USE). Each route segment usage condition contains a type of usage and may contain a list of levels and a list of time periods when that particular usage is applicable (for example, CDR 1, FL 200 - FL 400, MON 07:00 - FRI 17:00).

8.2. EN_ROUTE_RTE

Designator [TXT_DESIG]

This is the official designator of the route, as published in the national AIP. The route designator has to be compliant with the rules defined by ICAO Annex 11, Appendix 1, section 2. In essence, it consists at most of 6 uppercase characters and ciphers. 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. There are restrictions with regard to the characters that may be used at different positions.

Area Designator [TXT_LOC_DESIG]

This second designator, not published by States, is specific to the model. It was necessary to introduce it in order to distinguish between routes with the same official designator, situated in different regions of the world. For example, more than one airway R1 exists in the European region:

- R1 KEF-HN is a local route in Iceland.
- R1 NELSO-KORUL is a route between the Canary Islands and Spain.
- R1 GOLEN-GUR is a route between Germany and UK.
- R1 WKL-SERBI is a route within the Russian Federation.

As this route ‘sub-designator’ is not published by States, it is necessary to recommend a certain rule for its composition:

- TXT_LOC_DESIG should contain the ICAO country code of the first significant point of the route, a separator (‘-‘), and the ICAO country code of the last point on the route.
- This implies a certain direction for (international) routes. For the sake of uniformity, routes should be described from South to North: the starting point should be south of the end point.
- Applied to the example above, in a system implementing this model:

- R1, KEF-HN should be described as starting at KEF (KEFLAVIK, 635913N) and ending at HN (HORNAFJORDUR-HOFN, 641609N) and have TXT_LOC_DESIG = "BI-BI";
- R1, NELSO-KORUL should be described as starting at NELSO (314058.49N) and ending at KORUL (445006.83N) and should have TXT_LOC_DESIG = "GC-LE";
- R1, GOLEN-GUR should be in fact described as GUR-GOLEN: starting at GUR (GUERNSEY, 492613.45N), ending at GOLEN (540335.00N) and should have TXT_LOC_DESIG = "EG-ED".

8.3. Route Segments

A route is modelled as a sequence of segments, each defined by a start and an end significant point.

8.3.1. Sequence Number

There are no sequence numbers for route segments, as there are in ARINC 424 for example. As the start point and end point are explicit relationships for every route segment, the order of the segments can be deduced without the need for a sequence number.

There are advantages and disadvantages for this modelling choice. The main argument in favour of this decision was that a sequence number is not a characteristic of the segment, as published by States. Sequence numbers for route segments are not published in the national AIP.

Having explicit start and end points for every segment and not having a sequence number has an interesting side effect:

- it is possible to have routes with multiple branches, each branch being active at a certain time of the week, for example.

A system implementing this model could either exploit this capability or forbid it. From a real world point of view, the concept of alternate routes could be modelled easily using this capability.

The major drawback of having explicit start and end points for every route segment is that characteristics of start/end significant points have to be modelled twice. For example, the type of ATC report (compulsory / on request) for a given point is present both on the segment having that point as start and the segment having that point as end. Rules are then added in order to ensure consistency. However, this was considered less penalising than using sequence numbers.

8.3.2. Implicit Direction

As every segment is defined 'from' a start point 'to' an end point, it has an implicit direction. This direction should be consistent with the direction of the route, as discussed in Section 8.2, “EN_ROUTE_RTE”. The start point of a route should also be the 'from' point of the first route segment and the end point of the route should be the 'to' point of the last segment.

~~A rule was included in the model to enforce consistency between the general direction of the route and the implicit direction of every segment: "*route segments of the same Route must be consecutive, i.e. the end point of one must be the start point of the next*".~~

~~The rule mentioned above will also spot missing segments (gaps).~~

The implicit direction of a route segment is relevant when specifying the usage restrictions, using the entity RTE_SEG_USE, as explained in Section 8.4, “Route Segment Usage”.

To enforce consistency and coherence of route segments, the following rules are defined in the EN_ROUTE_RTE entity:

- The route should not have gaps: not more than 2 significant points should be the start or the end of a single segment of the same route.
- The route should not have branches: no significant point should be the start or end of more than two segments of the same route.
- The related route segments should be described in order: no significant point should be the start of more than one segment of the same route; no significant point should be the end of more than one segment of the same route.

8.3.3. Characteristics of a Route Segment

Type [CODE_TYPE]

The type of the route, from a navigation point of view, may be currently described using one of the following coded values:

- CONV [Conventional route]
- RNAV [Area navigation route]
- DCTATS [DCT or ATS]
- TRUNK [Trunk route]
- POLAR [Polar route]
- SSN [Supersonic route]
- TACAN [TACAN route]
- ADV [Advisory route]

This list has been compiled using as its source the AIPs of different States. The most common types are CONV (conventional navigation, such as VOR defined routes) and RNAV routes. The other types have been included for completeness. For example, 'DCTATS' is intended to model routings that are provided by ATC instruction, such as DCT flights between two points. They are not real routes, published by the States and having designators, but could be eventually assumed to be, if appropriate for a certain application.

8.3.4. Levels

Each route segment has a lower and an upper limit defined for this segment (in RTE_SEG). In addition, it may have a minimum limit and an additional value which overrides the minimum limit in certain areas.

8.4. Route Segment Usage

For a particular route segment, its usage with regard to direction, timetable, cruising levels and whether or not it is subject to Flexible Use of Airspace (FUA) are defined by the RTE_SEG_USE entity and associated entities.

8.4.1. RTE_SEG_USE

Availability of the Route Segment [CODE_RTE_AVBL]

This is a code indicating the availability of the route and whether it is covered by the Flexible Use of Airspace concept. The range of permissible values is limited to the following:

- NONFUA [the route segment may be flown according to its timetable.]
- CDR1 [Conditional Route type 1].
- CDR2 [Conditional Route type 2].
- CDR3 [Conditional Route type 3].
- SPEC [Special use].
- CLSD [Closed].

Special use is used to designate segment usage definitions that do not fit into the standard definition framework specified here. Details can be provided in the TXT_RMK attribute.

Sequence Number [NO_SEQ]

More than one condition may be defined for a route segment with the same route availability code value and CODE_DIR. The NO_SEQ is used to distinguish these route segments from each other.

8.4.2. Working Hours

A standard relation to a combination of a working hours coded value and optional instances of an timesheet entity (as described in Chapter 3, *TIME SCHEDULES*) is used to model the times where a route segment usage definition is applicable.

8.4.3. Levels

Levels associated with a route segment usage entity are defined using instances of the RTE_SEG_USE_LVL entity.

Each RTE_SEG_USE_LVL entity instance can describe one of three route level types:

- A single level.

  Single levels are represented using the VAL_DIST_VER_LOWER, UOM_DIST_VER_LOWER and CODE_DIST_VER_LOWER. Other attributes are unused for single levels and there is no relationship to predefined levels [PREDEFINED_LVL_COLUMN].

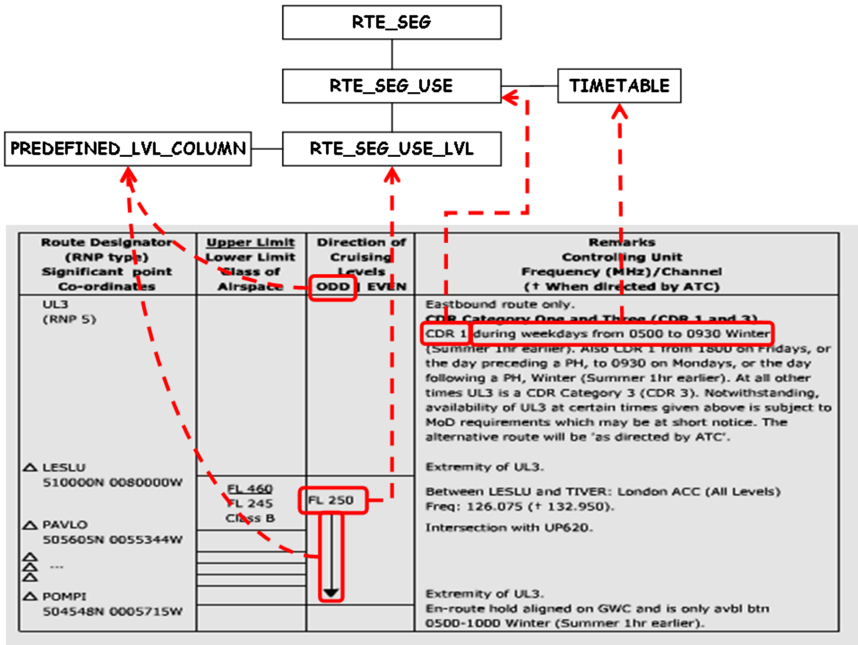
- A level band.

  A level band represents a band of airspace limited by two cruising altitudes/levels within which ‘free vertical movement’ may be permitted. Within the AICM, level bands are represented using the VAL_DIST_VER_LOWER, UOM_DIST_VER_LOWER, CODE_DIST_VER_LOWER attributes to specify the lowest cruising level/altitude and the VAL_DIST_VER_UPPER, UOM_DIST_VER_UPPER, CODE_DIST_VER_UPPER attributes to specify the uppermost cruising level/altitude. As before there is no relationship to predefined levels [PREDEFINED_LVL_COLUMN].

- Series of levels

  For a series of levels a mandatory relationship exists to a predefined level column entity instance which identifies the series of levels associated with the route segment usage. The upper and lower limits of the series are represented using the VAL_DIST_VER_LOWER, UOM_DIST_VER_LOWER and CODE_DIST_VER_LOWER to represent the lower limit and VAL_DIST_VER_UPPER, UOM_DIST_VER_UPPER and CODE_DIST_VER_UPPER to represent the upper limit.

Figure 8.1. Mapping between model and AIP Route table



8.5. Routing Restrictions

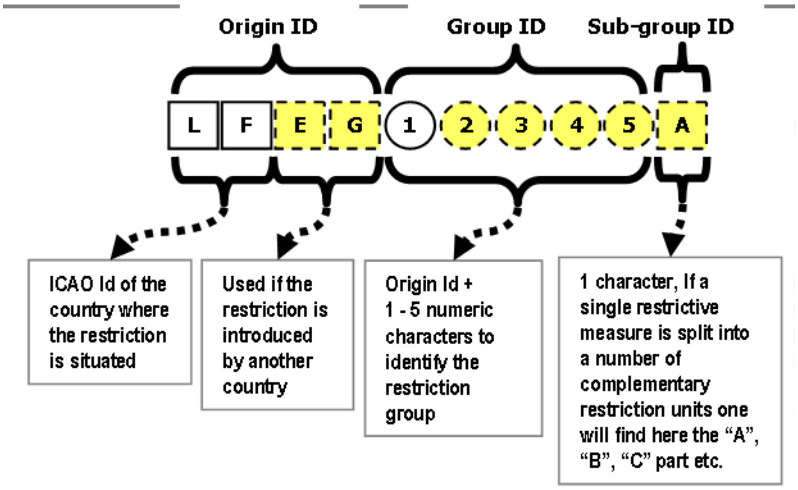
Traffic flow or routing restrictions as those contained in the 'Route Availability Document' (RAD) published by EUROCONTROL/CFMU are not modelled at the level of the route or of the route segment. They are modelled using the TFC_FLOW_RESTR and other related entities.

Traffic Flow Restriction [TFC_FLOW_RESTR] is defined through the following attributes and relations:

Identifier [CODE_ID]

It is the unambiguous identification of the restriction.

Figure 8.2. Components of Restriction Identifier



Examples:

- **LF1** for a restriction geographically related to France.
- **LFEG12345** for a restriction geographically related to France but requested by the UK.
- **LA10** for Albania.

Restriction Type [CODE_TYPE]

It is the code indicating whether the restriction is one of the following.

- F [Forbidden]
- M [Mandatory]
- C [Closed for cruising]

If restriction type is mandatory, than the restriction must have a relation to a a flow routing [TFC_FLOW_RTE].

Operational Goal [TXT_OPR_GOAL]

It corresponds to the operational goal to be achieved achieve through this restriction. It allows all parties involved to understand why the restriction is introduced.

Example:

- To increase the capacity of the North/South flow in Central France the number of flights on the UG21 which is perpendicular on this flow is restricted.

Textual Description [CODE_ID]

It is a textual description of the restriction, which is supposed to facilitate the validation of the codification of the restriction. Working hours are modelled using a combination of a working hours code attribute [CODE_WORK_HR] in the TIMETABLE entity and optional timesheet entity instances [TIMESHEET], as described in Chapter 3, *TIME SCHEDULES*, mandatory related to a TACAN entity instance.

Example:

- EPL UG21 CHALA forbidden if not departing Reims FIR and for destination Bordeaux FIR or LFLC.

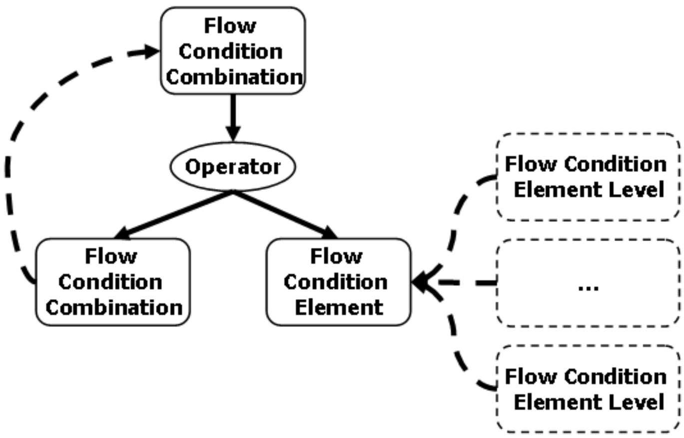
Relationship to: Timetable [Timetable]

This relationship might be used to define the time frame during or outside which a restriction is applicable. Working hours are modelled using a combination of a working hours code attribute [CODE_WORK_HR] in the TIMETABLE entity instance and optional timesheet entity instances [TIMESHEET], as described in Chapter 3, *TIME SCHEDULES*.

Relationship to: Flow Conditions Combination[FLOW_COND_COMBINATION]

Restriction is defined by flow conditions combination [FLOW_COND_COMBINATION]. It can consist out of one single or several elements [FLOW_CONDITION_ELEMENT]. For each separate element, an altitude range can be specified through Flow Condition Element Level [FLOW_COND_ELEMENT_LEVEL] which narrows down vertically where the restrictive measure applies. The following figure illustrates the construction of combination of flow conditions.

Figure 8.3. How to Construct a Flow Condition Combination



In other words, flow conditions combination is an expression which consists of two operands and one operator. Operands can be either elementary flow condition or flow conditions combination. Operator indicates the type of operation between these two operands. The applicable operators are as follows:

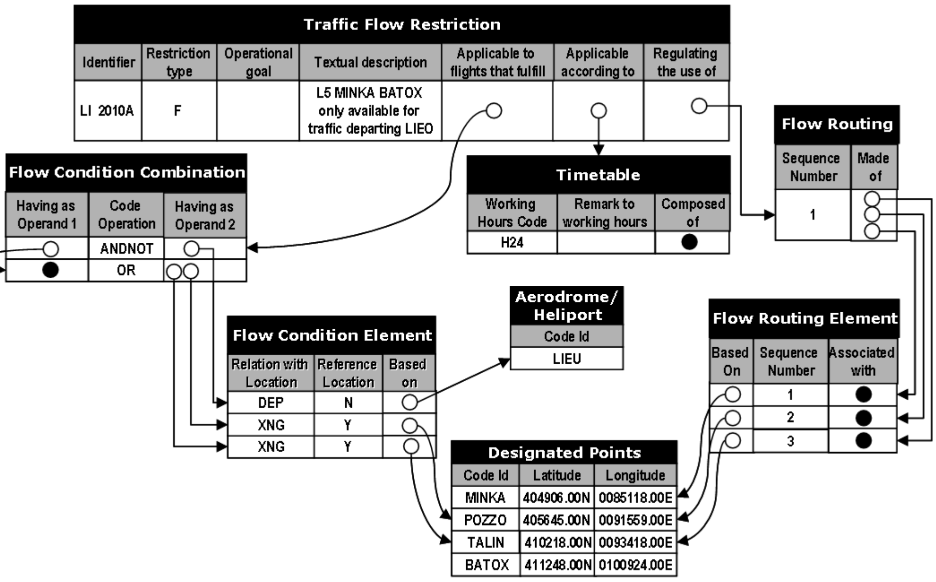
- AND [Logical Opeator And]
- ANDNOT [Logical Operator Ant Not]
- OR [Logical Operator Or]
- SEQ [Sequence Operator]
- NONE [No operation]

The **NONE** operator is a special operator and it indicates the current flow condition has only one operand. The **SEQ** operator is used to construct sequences (e.g., sequence of significant points).

Relationship to: Flow [TFC_FLOW_RTE]

The restriction might be regulating the use of one or more flow routing [TFC_FLOW_RTE]. The instances of TFC_FLOW_RTE contain a sequence of traffic flow routing elements (points, route portions or airspace) that must or must not appear in the specified order in the flight plan of an aircraft fulfilling the conditions of the related restriction.

Figure 8.4. Sample Traffic Flow Restriction



8.6. Frequently Asked Questions

1. **What if a VOR/DME is the start/end point for a route segment?**

   VOR and DME are modelled as distinct Navaids in AICM. They may be collocated, which is specified by the 'collocation' relationship between the DME and VOR entities. A route segment, which is defined in the AIP as starting/ending on a VOR/DME, is normally assumed as using the VOR as significant point. In general, there is no significant difference between the coordinates of the VOR and the coordinates of the DME. However, according to the ICAO Annex 10 (Volume 1, section 3.5.2.6.1.), the coordinates might be different:

   - less than 30 metres if the VOR is located at an aerodrome/heliport
   - less than 80 metres if the VOR is located at an aerodrome/heliport and has CODE_TYPE='DVOR';
   - less than 600 metres if the VOR is not located at an aerodrome/heliport.

2. **How have FUA elements been modelled in the AICM?**

   From the AICM perspective, FUA elements have been considered as follows:

   1. 'static' aspects, currently described in AIPs (such as the fact that a route segment is CDR 1, 2 or 3) are attributes of the entities concerned;

2. ‘dynamic’ information (such as the daily availability of a CRD route), published by CRAM messages is currently not modelled.

3. **What about 'weekend' routes?**

   They are modelled as NONFUA, but with a specific set of working hours. This is one of the reasons why the code 'NONFUA' was used for routes which are not CDR 1/2/3, rather than 'PERM(anent)'.

4. **Is forward/ backward equivalent to odd/even as defined in the AIPs?**

   No, forward/backward is equivalent to the little arrow that appears in the ENR 3.x tables in the AIP, to indicate the direction of flight which is concerned by odd/even. Odd/Even in AICM are indicated by the related Predefined Level Columns (East Levels are 'odd', West levels are 'even'). See Figure 8.1, “Mapping between model and AIP Route table”.

Chapter 9. SID/STAR/IAP

9.1. Introduction

The SID, STAR and IAP AICM concept models terminal area routes and procedures:

- Standard Instrument Departures [SID].
- Standard Instrument Arrivals [STAR].
- Instrument Approach Procedures [IAP].

Each terminal procedure type is modelled using a group of related entities to define the specific properties of the route type and usage restrictions.

Each procedure is associated with an aerodrome [AD_HP instance] and a runway direction [RWY_DIRECTION] associated with that aerodrome.

The nominal flight path is described using the Path and Terminator concept, based on the content of the ARINC 424 Specification. It is an industry standard for procedure codification. Procedure legs for all of the terminal procedure types are described by the same fundamental building block entity [PROCEDURE_LEG].

9.2. Standard Instrument Departures

ICAO defines a SID as follows:

> A designated instrument flight rule (IFR) departure route linking the aerodrome or a specific runway of the aerodrome with a specified significant point, normally on a designated ATS route, at which the en-route phase of a flight commences.

In the AICM a SID is modelled using instances of the following entities:

- a main entity that describes the general properties of the SID,
- a SID usage entity that contains instances related to the SID entity defining the availability of the SID and
- a number of entities related to each SID usage entity instance describing time schedules associated to particular SID usage definitions.

Relationship to: Procedure Legs [PROCEDURE_LEG]

SIDs are made up of procedure legs [instance of PROCEDURE_LEG] ordered by the procedure leg NO_SEQ attribute value [see Section 9.5, “Procedure Legs”. ~~In the current version of the model,~~ The relationships between a SID and its constituent procedure legs is optional ~~mandatory and a SID cannot be defined without accompanying procedure leg detail. This is likely to be changed in the future version~~.

Relationship to: Runway and FATO Direction [RWY_DIRECTION, FATO_DIRECTION]

Each SID may be defined for either a runway direction [RWY_DIRECTION] or a FATO direction [FATO_DIRECTION], although the relationship is optional. If a SID is associated with a runway direction then it cannot be associated with a FATO direction and vice versa. A SID may also exist without being related to a specific RWY_DIRECTION or FATO_DIRECTION. However, the relationship to an Aerodrome is mandatory.

Relationship to: Minimum Sector Altitude Group [MSA_GROUP]

Each SID is optionally associated with a set of minimum sector altitude. A particular MSA group can apply to many SIDs. The description of the related MSA is usually provided on the AIP chart depicting the SID, in a graphical form.

9.2.1. SID

The SID entity defines the general properties of a SID.

Designator [TXT_DESIG]

Each SID must have a textual designator defined for it, for example KOGAL1A which is a SID ending at designated point KOGAL.

ICAO Annex 11, Appendix 3 states that successive versions of a SID are identified by incrementing the digit in character 6 of the designator, from 1 through 9.

Type [CODE_TYPE_RTE]

This is a mandatory attribute describing the type of SID, in terms of:

- O [Engine Out SID].
- C [Conventional SID].
- R [RNAV SID].
- F [FMS SID].

As for most of the other attributes, the current list of values is based on the ARINC 424 Specification. In the next edition of the model, some of these lists of values are likely to be modified. The updated lists of values will take into consideration the Guidance Material for the Design of Terminal Procedures for Area Navigation, published by the EUROCONTROL Navigation Domain.

Aircraft Category [CODE_CAT_ACFT]

This is a code indicating the class of aircraft for which the SID has been designed. Based on the provisions of the ICAO PANS-OPS (DOC 8168), permitted values in AICM are as follows:

- A [Category A].
- A20 [Category A with 2% climb gradient ability].
- A30 [Category A with 3% climb gradient ability].
- A35 [Category A with 3.5% climb gradient ability].
- B [Category B].
- C [Category C].

- D [Category D].
- E [Category E].
- H [Category H - helicopter].
- AB [Categories A and B].
- ABC [Categories A, B and C].
- ABCD [Categories A, B, C and D].
- BCD [Categories B, C and D].
- CD [Categories C and D].
- CDE [Categories C, D and E].
- DE [Categories D and E].

Transition Identifier [CODE_TRANS_ID]

This is a code used to identify a branch of a SID, as described in ARINC 424, 5.11.

It is an optional attribute. In AICM, it is not mandatory to split a SID into a RWY transition part, a common part and an en-route transition part. However, for compatibility reasons with ARINC 424, this attribute can accommodate the 'transition identifier' value. Typically, it is the coded identifier of a significant point or of a RWY direction.

One could say that this should be in fact a relationship, not a simple attribute. This was a modelling choice. The purpose of this attribute is only to distinguish (uniquely identify) between the parts of a SID. Even a sequence number would be sufficient. Therefore, the option to keep it as an attribute was made. This offers a minimal compatibility with ARINC 424 (more than just a sequence number), without over-complicating the model by adding a relatively important number of relationships.

Required Navigation Performance [CODE_RNP]

This is a code indicating the required navigation performance for an aircraft to fly the SID.

Description [TXT_DESCR]

This is a textual description of the SID, as published in words in the State AIP.

Communications Failure Description [TXT_DESCR_COM_FAIL]

This is a textual description of the communications failure procedure for the SID.

9.2.2. SID_USAGE

Each SID might ~~must~~ be related to one or more SID_USAGE entity instances to describe the supported usage of the SID with regards to a timetable and whether it is subject to the flexible use of airspace [FUA] concept.

The SID has a standard time schedule model as used elsewhere in the AICM comprising either a TIMETABLE entity attribute [CODE_WRK_HR] or a combination of it and instances of the TIMESHEET entity (see Chapter 3, *TIME SCHEDULES*).

SID FUA Usage [CODE_RTE_AVBL]

This defines the usage of the SID in terms of the FUA concept. The options available to describe the FUA usage of the route are as follows:

- NONFUA

  The SID is not subject to FUA - the SID may be flown according to its associated timetable(s). This is the case for most, if not all, of the SIDs currently existing in the ECAC Area. However, it is likely that SIDs subject to conditional usage, according to the Flexible Use of Airspace (FUA) concept, might exist in future. Thus there is a need for the other values.

- CDR1

  The SID is a type 1 conditional route.

- CDR2

  The SID is a type 2 conditional route.

- CDR3

  The SID is a type 3 conditional route.

- SPEC

  The SID is a special type of route that does not conform to standard conditional route types, for example routes which are closed during some time periods, but still may be used for landings on a specified aerodrome and flights that may be performed below the minimum level of the route in order to arrive at a specified aerodrome. Details can be provided using the TXT_RMK attribute.

- CLSD

  The SID is closed and cannot be used.

9.3. Standard Instrument Arrival

ICAO defines a STAR as follows:

> A designated instrument flight rule (IFR) arrival route linking a significant point, normally on an ATS route, with a point from which a published instrument approach procedure can be commenced.

In the AICM STARs are modelled in a very similar way to SIDs, as described in the previous section. A STAR is modelled using the following entities:

- a main entity that describes the general properties of the STAR [STAR],
- an optional STAR_USAGE entity that contains instances related to the STAR entity defining the availability of the STAR and

- a number of entities related to STAR_USAGE entity instance describing the time schedules associated to particular STAR usage definitions.

The actual legs of the STAR can be ~~are~~ modelled through optional references to instances of PROCEDURE_LEG - see Section 9.5, “Procedure Legs”, Procedure Legs. In general, each of the STAR entities and their attributes are directly comparable with the SID entities, therefore only differences are highlighted in this section.

A level of indirection between the STAR entities and associated runway and FATO directions for STARs is provided that is not provided in the SID model. This allows a many to many relationship to be formed between STARs and their associated runway and FATO directions – for example a particular STAR can be associated with more than one runway direction and a runway direction can be associated with a number of STARs. This is achieved by an intermediate entity between STAR and both RUNWAY_DIRECTION and FATO_DIRECTION – namely RUNWAY_DIRECTION_STAR and FATO_DIRECTION_STAR.

Relationship to: Procedure Legs [PROCEDURE_LEG]

STARs are made up of procedure legs [instances of the PROCEDURE_LEG entity] ordered by the procedure leg NO_SEQ attribute value - see Section 9.5, “Procedure Legs”. ~~In the current version of the model,~~ The relationship between a STAR and its constituent procedure legs is optional. ~~mandatory and a STAR cannot be defined without accompanying procedure leg details. This is likely to be changed in the future version.~~

Relationship to: Runway and FATO Direction [RWY_DIRECTION, FATO_DIRECTION]

Each STAR must be defined for either a runway direction [RWY_DIRECTION] or a FATO direction [FATO_DIRECTION], although the relationship is optional. If a STAR is associated with a runway direction then it cannot be associated with a FATO direction and vice versa.

This relationship is made via RUNWAY_DIRECTION_STAR and FATO_DIRECTION_STAR as described in the introduction.

A STAR may also exist without being related to a specific RWY_DIRECTION or FATO_DIRECTION. However, there is a mandatory relationship to an Aerodrome, which means that it may be used for any RWY/FATO direction at that aerodrome/heliport.

Relationship to: Minimum Sector Altitude Group [MSA_GROUP]

Each STAR is optionally associated with a set of minimum sector altitudes. A particular MSA group can apply to many STARs. The description of the related MSA is usually provided on the AIP chart depicting the STAR, in a graphical form.

Relationship to: Aerodrome [AD_HP]

Each STAR must be associated with an AD_HP entity instance to define which aerodrome the STAR is for.

9.3.1. STAR

The attributes associated with each entity and their interpretation is identical to those described for SIDs, apart from CODE_TYPE_RTE which has a STAR specific value range.

Type [CODE_TYPE_RTE]

This is a mandatory attribute describing the type of STAR, in terms of:

- C [Conventional STAR].
- R [RNAV STAR].
- F [FMS STAR].

As for most of the equivalent SID attributes, the current list of values is based on the ARINC 424 Specification. A future update of the list of values will take into consideration the Guidance Material for the Design of Terminal Procedures for Area Navigation, published by the EUROCONTROL Navigation Domain.

9.4. Instrument Approach Procedures

ICAO defines an IAP as follows:

> A series of predetermined manoeuvres by reference to flight instruments with specified protection from obstacles from the initial approach fix, or where applicable, from the beginning of a defined arrival route to a point from which a landing can be completed and thereafter, if a landing is not completed, to a position at which holding or en-route obstacle clearance criteria apply.

As for SIDs and STARs, the AICM models IAPs as:

- a main entity that describes the general properties of the IAP [IAP],
- an optional IAP_USAGE entity that contains instances related to the IAP entity defining the availability of the IAP and
- a number of entities related to the IAP_USAGE entity instance describing time schedules associated to particular IAP usage definitions.

The actual legs of the IAP can be ~~are~~ modelled through optional references to instances of PROCEDURE_LEG - see Section 9.5, “Procedure Legs”. In general each of the IAP entities, and their attributes, are directly comparable with SID and STAR entities. Only differences in the definition or interpretation of the entities and attributes are highlighted in this section.

In addition to the common terminal area route structure, the AICM IAP model includes an entity which represents obstacle clearance altitudes and obstacle clearance heights [OCA_OCH]. IAP entity instances may ~~must~~ be associated with one or more OCA_OCH, depending on the type of approach (straight-in/circling and the aircraft category). This is based on the ICAO PANS-OPS. A procedure which may be used by several aircraft categories might have individual OCA/OCH values for each such aircraft category.

Relationship to: Procedure Leg [PROCEDURE_LEG]

IAPs are made up of procedure legs [instances of the PROCEDURE_LEG entity] ordered by the procedure leg NO_SEQ attribute value - see Section 9.5, “Procedure Legs”. ~~In the current version,~~ The relationship between an IAP and its constituent procedure legs is optional. ~~mandatory and an IAP cannot be defined without accompanying procedure leg details. This is likely to change in future editions.~~

Relationship to: Aerodrome/Heliport [AD_HP]

Each IAP must be associated with an AD_HP entity instance to specify for which aerodrome the IAP is defined.

Relationship to: Runway Direction, TLOF Direction and FATO Direction [RWY_DIRECTION, TLOF_DIRECTION, FATO_DIRECTION]

Each IAP must be defined for either a runway direction [RWY_DIRECTION], a TLOF direction [TLOF_DIRECTION] or a FATO direction [FATO_DIRECTION]. The relationship is optional for compatibility with ARINC 424, where an instrument approach procedure may be related to an aerodrome/heliport, without being linked to a specific RWY/FATO direction. If an IAP is associated with a runway direction then it cannot be associated with a TLOF direction or FATO direction; if associated with a TLOF direction it cannot be associated with a FATO direction or runway direction and so on.

Relationship to: Minimum Sector Altitude Group [MSA Group]

Each IAP is optionally associated with a set of minimum sector altitudes. A particular MSA group can apply to many IAPs. The description of the related MSA is usually provided on the AIP chart depicting the STAR, in a graphical form.

9.4.1. IAP

Type [CODE_TYPE_RTE]

This is the type of route that the entity instance represents, one of the following values:

- B [LLZ Backcourse].
- E [RNAV, GPS Required].
- F [Flight Management System (FMS)].
- G [Instrument Guidance System (IGS)].
- H [Helicopter to runway].
- I [Instrument Landing System (ILS)].
- J [LAAS-GPS/GLS].
- K [WAAS-GPS].
- L [Localizer Only (LOC)].
- M [Microwave Landing System (MLS)].
- N [NDB].
- P [Global Positioning System (GPS)].
- R [Area Navigation (RNAV)].
- T [Tacan].

- U [Simplified directional Facility (SDF)].
- V [VOR].
- W [MLS, Type A].
- Y [MLS, Type B and C].

This list of values is based on ARINC 424 and is likely to be updated in future editions of the model.

Missed Approach Procedure Description [TXT_DESC_MISS]

This is a textual description of the missed approach procedure for the IAP.

9.4.2. OCA_OCH

The ICAO definition of the OCA and OCH used as the basis of the AICM representation is as follows:

> The lowest altitude or height above the elevation of the relevant runway threshold or aerodrome elevation as applicable, used in establishing compliance with appropriate obstacle clearance criteria.

An IAP instance may be associated with one or more OCA_OCH entity instances. Each OCA_OCH entity instance represents the basis for the obstacle clearance criteria for a particular aircraft category/approach procedure combination.

The entity defines one or both of the following:

- OCA

  Altitude referenced to mean sea level and in the units specified by the UOM_DIST_VER attribute value, or

- OCH

  Height referenced to the location specified by the CODE_REF_OCH attribute value.

Aircraft Category [CODE_CAT_ACFT]

This is the category of the aircraft subject to the specified OCA/OCH.

Approach Procedure Type [CODE_TYPE_APCH]

This is a code indicating the type of procedure to which the specified OCA/OCH is applicable. Allowable values are as follows:

- STA [straight-in non-precision approach].
- STA1 [straight-in CAT I approach].
- STA2 [straight-in CAT II approach].
- STA3A [straight-in CAT III A approach].
- STA3B [straight-in CAT III B approach].

- STA3C [straight-in CAT III C approach].
- CA [circling approach].

OCA [VAL_OCA]

This is the value of the obstacle clearance altitude in units specified by the value of UOM_VER_DIST. One or both of the OCH and OCA must be specified.

OCH [VAL_OCH]

This is the value of the obstacle clearance height from the reference point defined in CODE_REF_OCH. One or both of the OCH and OCA must be specified.

OCH Reference [CODE_REF_OCH]

This is a code that defines the reference point for the OCH value [if specified]. The attribute is set using the following rules:

- The threshold elevation, or
- For non-precision approaches
  - the aerodrome elevation, or
  - the threshold elevation if it is more than 2 m (7 ft) below the aerodrome elevation.
- For circling approaches
  - The aerodrome elevation.

9.5. Procedure Legs

A procedure leg is defined in the AICM as a segment of a SID, STAR or IAP with a specific type of flight path and termination of that flight path. Each procedure leg is codified as an instance of the PROCEDURE_LEG entity.

The design of the PROCEDURE_LEG entity is based on the concepts used in the ARINC 424 specification, Attachment 5, Path and Terminator. However, unlike ARINC 424, the AICM does not make any assumptions about the performance of aircraft over and above those made in ICAO DOC 8168 - OPS/611 (Aircraft Operations).

An exhaustive description of the PROCEDURE_LEG entity is outside the scope of the current manual. The reason for that is the need to harmonise AICM with the Guidance Material for the Design of Terminal Procedures for Area Navigation, published by the EUROCONTROL Navigation Domain. This harmonisation is likely to take place in the next release of the AICM.

Guidelines and examples of codification for RNAV terminal procedures published by ECAC States are in preparation. They will be included in a future release of the manual. It is important to stress that, based on guidelines issued by the EUROCONTROL Navigation Domain, the AICM Manual will only contain information on the codification of RNAV procedures. Conventional procedures are outside the scope of the AICM Manual.

9.6. Frequently Asked Questions

1. **Is it mandatory to include Procedure Legs when encoding a SID/STAR/IAP?**

   No, it is only an optional relationship.

   ~~According to the current model, yes. However, this is an unnecessary restriction and will be removed in the future release of the model. It should be possible to provide the encoding of the rest of the SID/STAR/IAP data, without mandating the codification of the related PROCEDURE_LEG instances.~~

   ~~Until this change to the model is implemented, a simple solution is to provide just one procedure leg of type IF (initial fix) and no other data for it.~~

2. **How to specify OCA/OCH for alternative climb gradient**

   According to PANS-OPS (ICAO DOC 8168): "The OCA/H for the nominal 2.5 per cent must always be published on the instrument approach chart. If additional gradients are specified in the construction of the missed approach procedure, they and their associated OCA/H values must be published as alternative options."

   Figure 9.1. OCA/OCH

OCA (H)		A	B	C	D
Straight-in approach	MISSED APP GR 2.5%	1000' (636')			
	MISSED APP GR 4%	564' (200')			

   In the current model, OCA/OCH values for alternative climb gradients can only be specified as textual remarks. It is recommended that the following textual remark is used to specify the OCA/OCH values for such situations:

   "Alternative OCA(H) - xxx FT (yyy FT) for z% Missed Approach gradient"

   For example, the OCA/OCH values specified in the table below should be recorded as follows:

   - ABCD, STA 1, 1000 FT (VAL_OCA), 636 FT (VAL_OCH), THR
   - Include in Remark: “Alternative OCA(H) - 564 FT (200 FT) for 4% Missed Approach gradient”

     It is not necessary to specify that the 1000 FT value is for 2.5%, as this is the nominal PANS-OPS value.

3. **How to specify OCA/OCH values for ILS GP Inoperative**

   The CODE_TYPE_APCH value "STA" [straight-in non-precision approach] should be used for this purpose, in association with an ILS procedure. In addition, the text "GP Inoperative" should be included in the Remarks field.