EUROPEAN ORGANISATION FOR THE SAFETY OF AIR NAVIGATION

EUROCONTROL

# European Mode S Station Coverage Map Interface Control Document

SUR/MODES/EMS/ICD-03
(form. SUR.ET2.ST03.3113-SPC-01-00)

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EUROPEAN AIR TRAFFIC MANAGEMENT PROGRAMME

# DOCUMENT IDENTIFICATION SHEET

## DOCUMENT DESCRIPTION

**Document Title**

European Mode S Station Coverage Map Interface Control Document

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| **PROGRAMME REFERENCE INDEX:** SUR/MODES/EMS/ICD-03 (form. SUR.ET2.ST03.3113-SPC-01-00) | **EDITION:** 1.16 |
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**Abstract**

**Keywords**

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| Mode S | SSR | Monopulse | Radar |
| Surveillance | Datalink | Station | PILOT |
| Cluster | ATN | GDLP | SCN |
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**CONTACT PERSON:** Nicolas EERTMANS | **TEL:** 3363 | **UNIT:** DIS/SUR

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The following table identifies all management authorities who have successively approved the present issue of this document.

| AUTHORITY | NAME AND SIGNATURE | DATE |
|---|---|---|
| Author | L Honet<br>Laurent HONET | 09.05.2005 |
| Mode S System TF Chairman | Eric POTIER | 18.05.2005 |
| Mode S Programme Manager | John LAW | 10 June 2005 |

## DOCUMENT CHANGE RECORD

The following table records the complete history of the successive editions of the present document.

| EDITION | DATE | REASON FOR CHANGE | SECTIONS PAGES AFFECTED |
|---|---|---|---|
| 1.11 | 15 March 1999 | POEMS Contract Amendment baseline. | |
| 1.12 | 29 January 2001 | New European Mode S template. New reference. POEMS clarifications included. | |
| 1.13 | 19 April 2001 | Released Issue. References Updated. | Chapter 2 |
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| 1.15 | 27 April 2005 | Proposed issue following review by MSTF#22. | - |
| 1.16 | 9 May 2005 | Released Issue | - |
| | | | |
| | | | |

# TABLE OF CONTENTS

# EXECUTIVE SUMMARY

The present document describes the European Mode S Station Coverage Map Interface Control Document.

# CHAPTER 1

# INTRODUCTION

## 1.1 General

[MAP-1.] The purpose of this document is to define a common interface to import the Solution List Entries (coverage maps, Interrogator Code and reference to a Radar Parameter Set) to be used by all European Mode S ground stations.

[MAP-2.] The interface defined in this document describes the format and the media, which will be used between the map tool (System Map Generator & System Map Extractor) and the Mode S ground stations and associated tools.

**NOTE**: It is foreseen in the European Mode S functional specification that the ground station is to be delivered with the interface for such maps.

[MAP-3.] Each suppliers' European Mode S ground station can use a different type of internal coverage maps, because that is an implementation issue.

[MAP-4.] The cluster state is defined in a solution list entry. The interface described in this document includes for each solution list entry;

1. System Maps, which are geodesic maps (latitude/longitude) sub-divided into horizontal cells from approx. 5 NM by 5 NM and an associated vertical extent. In this way, the following types of maps are defined to describe in each cell volume;
    - 1.1. Surveillance map, defining which ground stations will carry out surveillance;
    - 1.2. Lock-out map, defining which lock-out method will be applied by the station.
    - 1.3. Data-link map, defining where the ground stations could provide full data link services;
2. II/SI code : The prime Interrogator Code;
3. Radar Parameter Set Reference, to define a reference to a set of ground station dependent parameters, some of which can be sectorised, like power, alternate II/SI code (see annex B), Interrogation pattern etc.

[MAP-5.] The Mode-S stations in a cluster are possibly provided by different suppliers. The common definition of coverage maps is required in order to ensure compatibility between Mode S ground stations with respect to knowledge about each others coverage. In order to apply the TASP processing efficiently and to reduce the corresponding network load as described in the intersite co-ordination ICD, it is important that two Mode S ground stations locate, with the accuracy described later in this document, an aircraft in the corresponding area.

## 1.2 Map Tool

[MAP-6.] A map tool (System Map Generator Extractor Tool, SMGET) will allow the generation of a Solution List Entry.

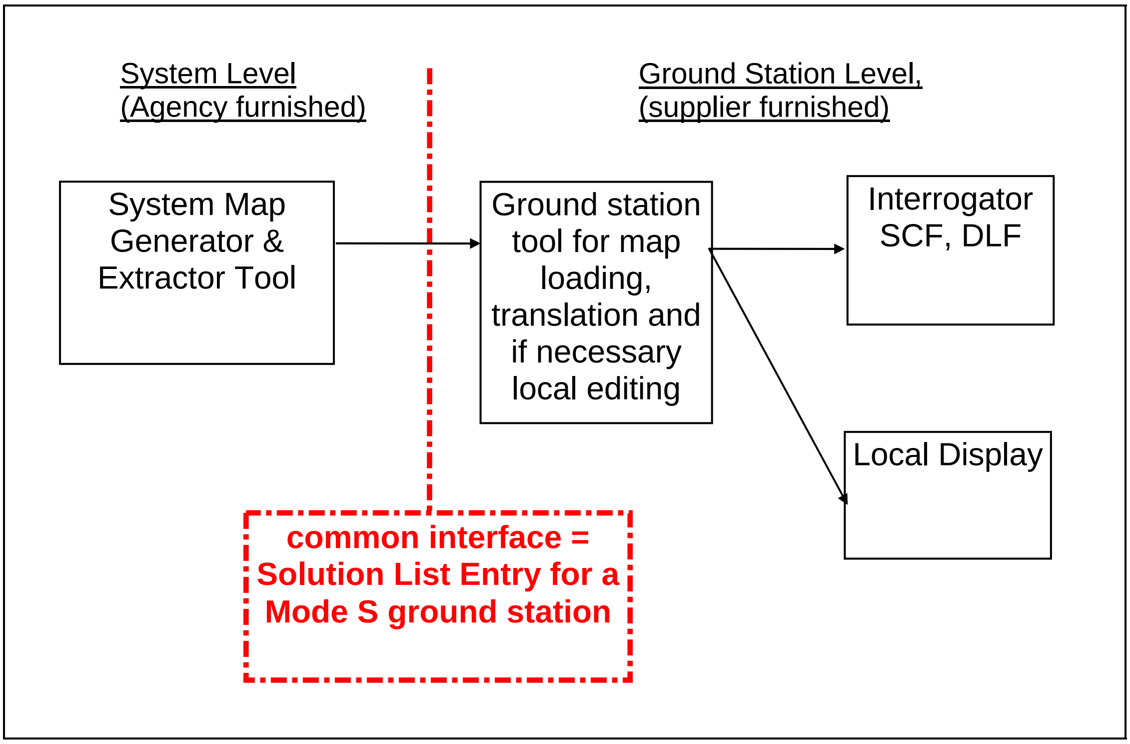


**Figure 1: Map Tools**

[MAP-7.] The maps will be generated using the ground station screening files (see [Ref3]) to which intentional corrections may be applied in order to take into account specific technical and operational requirements.

[MAP-8.] The map tool will allow extraction of a part of the maps in order to provide a file with data sufficient (including information for all ground stations with overlapping coverage) for a Mode S ground station.

[MAP-9.] The map tool will allow the manual association of a prime II/SI code, System Maps and a Radar Parameter Set reference for each cluster state of the Mode S stations.

# CHAPTER 2

## REFERENCED DOCUMENTS

[Ref.1.] Coverage map definitions for POEMS interrogators DA255D006/1.3

[Ref.2.] European Mode S Station Surveillance Co-ordination Interface Control Document, SUR/MODES/EMS/ICD-01, version 2.06, 9 May 2005

# CHAPTER 3

## DEFINITION OF THE PRINCIPLES USED FOR THE COMMON MAPS USED IN THE SOLUTION LIST

[MAP-10.] The interface described in this document shall allow transmitting a cluster description, a list of cluster states as well as the list of corresponding system maps. The cluster description and states shall be grouped in a single cluster file. Each system map shall be in a separate system map file. For size considerations, a specific version of the cluster file will be produced for each station, and each station will only be provided with the relevant system maps. This makes possible to have different views of the coverage maps from each station.

**NOTES:**

1. A cluster can contain up to 6 ground stations. In distributed mode, the state is chosen in function of the availability of stations, which leads to up to 64 different possible configurations. In order to keep a common numbering of the states at the level of the cluster, states numbers 0-63 are reserved for distributed modes. All stations are assigned a node reference number (0-5) which corresponds to the corresponding bit in the 6 lower bits field of the state number. States 1,2,4,8,16 and 32 are all stand-alone states for the stations 0, 1, 2, 3, 4 and 5 respectively[1]. As each station only gets the states relevant to them, each station will only get up to 32 distributed state descriptions, stand-alone state included.
2. Further states, numbered from 64 to up to 127, can be defined for use in centralized operation only. Centralized states do not need to all have a different topology. The centralized states will be numbered sequentially and the content of the bits of the state number has no meaning in relation to the cluster topology.
3. All states can be set by the cluster controller, including the distributed states. In the case the state is invalid (0, distributed states not existing because of smaller cluster size or not relevant to the station and undefined centralized state), the station shall fallback to its stand-alone state.

[MAP-11.] The cluster file shall contain the following data:

1. A cluster description, listing the nodes of the cluster, their reference number, their geographical position and their addresses.
2. A solution list, listing the different states in which the cluster can operate and which are relevant to the station, with, for each state:
    - 2.1. A state number. The solution list entry number is the state number for the cluster, equivalent to the 7 low order bits of the data item I017/360. In the distributed modes (0-63), the state number bitmap also defines the cluster topology.

[1] The stand-alone state for the station n corresponds to the distributed state number $2^n$.

2.2. A list of II/SI codes for the ground stations to use in the state, one code per station.

2.3. A reference to the system map used in the state. Practically speaking, this is a pointer to a system map file described hereunder.

2.4. A reference to a Radar Parameter Set. It is assumed that this set is manufacturer specific and contains the following data: Lock-out Override Indication, Power, Interrogation Pattern and, optionally, alternate II/SI code. The data shall be defined for each sector as defined by the manufacturer.

**NOTES:**

1. The philosophy behind the current coverage map design is the following. Coverage maps are elaborated at the cluster level, using the System Map Generator and Extractor Tool. Radar Parameter Sets (RPS), apart from the II/SI code, are later elaborated and assigned to corresponding states at the local station level, after coverage map loading. Therefore, the RPS reference value is only relevant if the ground station parameters have already been defined at the corresponding station level. When generated by the extractor tool, the reference may be empty (special value, see data item table). The station may also simply reference parameters through state numbers. This is left as an implementation issue.

2. The above II/SI list allows for different codes for each station in a cluster. This is done for flexibility reasons, even though this mode of operation is not currently considered.

3. The reference number of the local station can be retrieved through its SAC/SIC or X25 address.

Identification in distributed mode through the state number (0-63)

| State Number | II/SI codes list | Pointer to map | Pointer to parameters |
|---|---|---|---|
| 0 (000000) | ... | ... | ... |
| ... | ... | ... | ... |
| 63 (111111) | ... | ... | ... |
| 64 | ... | ... | ... |
| ... | ... | ... | ... |
| 127 | ... | ... | ... |

up to 64 distributed states (0-...)

up to 64 additional centralised states (64-...)

Identification in centralised mode through state number (0-127)

[MAP-12.] Each system map shall contain:

1. A surveillance map, defining which ground station shall carry out surveillance.

2. A lock-out map, defining which lock-out method shall be applied by the station; no lockout; lock-out or intermittent lock out.

3. A data-link map, defining where the station could provide data link services.

[MAP-13.] For the cluster, the System maps shall be described by;

1. The common grid, which shall be based on a splitting of the geographical area covered by ground station in cells defined in latitude and longitude. That generates a 2D grid. A typical value for the latitude width of each cell ($\Delta$L) will be $\Delta L=0.0833^o$. A typical value for the longitude width of each cell ($\Delta$G) will be $\Delta G=0.1253^o$. These values $\Delta$L and $\Delta$G are chosen in order to have a cell size of approximately 5NM by 5NM around the Paris latitude. These values shall not be assumed to be ever fixed.

2. The origin of this grid shall either be chosen as constant for the region or as a constant for one cluster only.

**NOTE**: For each cell the surveillance responsibility, the lockout method and type and the data-link service are each defined in different altitude bands defined between a minimum altitude and a maximum altitude. This allows to define only one altitude band for each map (surveillance radar1, surveillance radar2..., lockout, data-link) in each cell, which is an accepted limitation, which will slightly simplify the creation of such map.

[MAP-14.] Whatever the real internal map format, the Mode S ground stations shall use the principles applied for the Mode S System Maps. The Mode S ground station objective shall be to locate, with the precision specified in the following paragraph, aircraft in the map in order to determine its own activities and in order to maintain the probability of detection in the common coverage with the adjacent sensors.

[MAP-15.] System Maps define parameters to be used by the processing (e.g. lockout or no lockout, the presence of another ground station implying co-ordination or not, datalink coverage, etc.).

In these System Maps, border is defined as the limit separating geodesic cells, in which different parameters are defined, e.g. lockout/no lockout.

The distance between aircraft and border is defined as the distance between the aircraft position in WGS.84 co-ordinates and the closest point of the border (as previously defined) at the flight level of the aircraft.

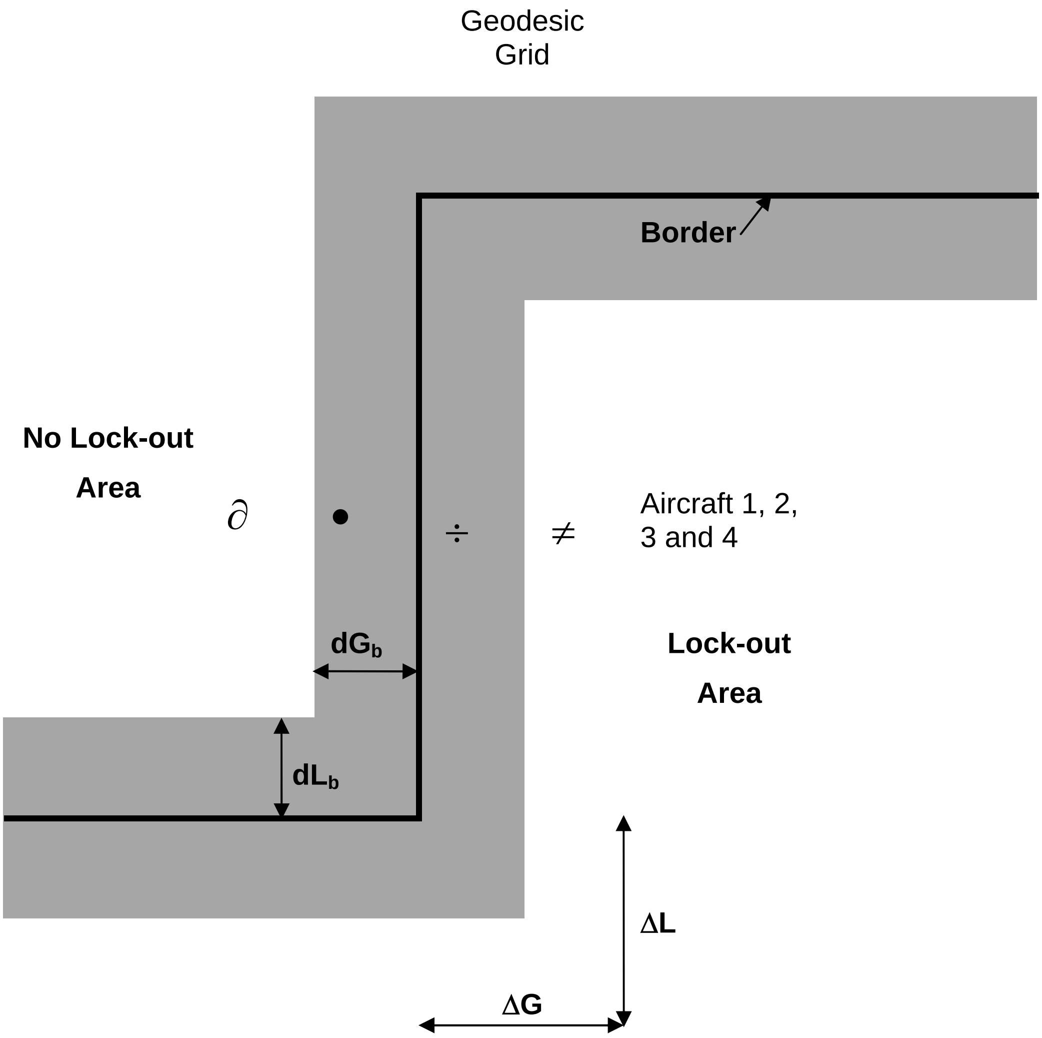


**Figure 2a. Accuracy Requirements (Example)**

**Horizontal View**

If the aircraft is closer than delta longitude ($dG_b$) or delta latitude ($dL_b$) to the border, then the system can use parameters from one side or the other side of this border, else the parameters to be used are the parameters as defined within the system map cell on the aircraft side of the border.

In the example of figure 2a, aircraft 1 shall not be locked out, aircraft 2 and 3 could be locked out or not and aircraft 4 shall be locked out. Aircraft in the grey area could have the attributes of both sides of the border.

[MAP-16.] The altitude band for the map will be specified in multiples of 200 ft with respect to WGS84 ellipsoid of the earth. The aircraft flight level will depend on the barometric pressure and give a value with respect to the surface of the earth.

On the boundary of cells, where the altitude band changes say from 0-20.000 to 0-40.000, inaccuracies appear in the horizontal plane due to different shaped and sized horizontal grids. See figure 2b (the curving of the earth has been ignored in the example).

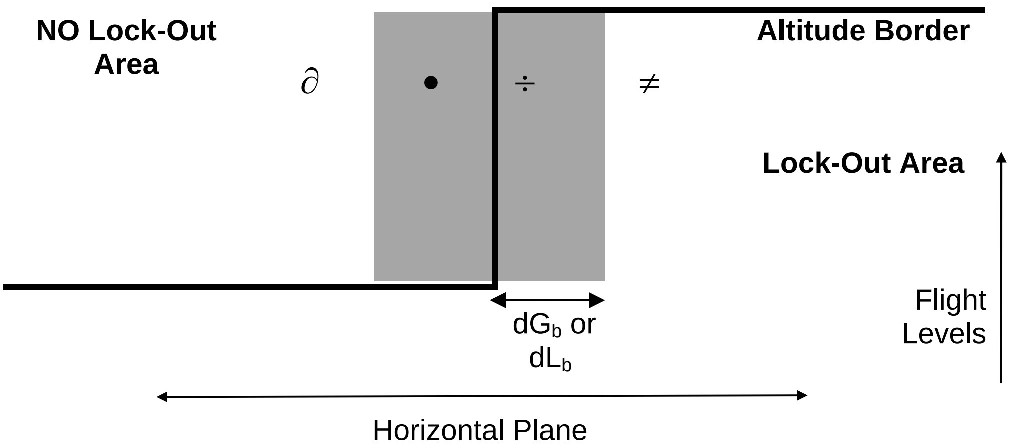


**Figure 2b: Accuracy Requirements**

**Vertical Plane**

In the example of figure 2b, aircraft 1 shall not be locked out, aircraft 2 and 3 could be locked out or not and aircraft 4 shall be locked out. Aircraft in the grey area could have the attributes of both sides of the border.

**NOTE**: The document [ref1] gives a description on how a ground station can locate with sufficient accuracy an aircraft in such cells.

[MAP-17.] The definition of the solution list entries and the coverage of all ground stations shall be stored in files, which can be used by all ground stations.

**NOTE**: It is up to the design of the Mode-S station how these maps are processed and stored locally. The input map could be translated to geodesic coordinates, to local Cartesian cells, to a local polar cell representation or a local vector representation.

[MAP-18.] Only during test and installation phases shall the local map editing tools allow modifications of the System maps. During the operational phase, modifications shall be made in the common map format so that all stations are aware of those modifications.

[MAP-19.] A cluster may use a single system map file for different states. It should be noted that for these clusters, for some states, the system map file would contain references to stations which are not present in that state.

This shall not cause a problem with interfaces or surveillance co-ordination, station shall simply ignore coverage map entries relating to stations which are not present.

[MAP-20.] A station only requires to be programmed with its own surveillance, lockout and datalink responsibilities, as well as with the overlapping surveillance responsibilities of other cluster sensors.

Consequently, a station shall be able to process a system map that is an extract of a larger cluster map and that is limited to the station's surveillance responsibility extent.

# CHAPTER 4

# MAP FORMAT

## 4.1 General

The main objective of this format is to allow the transfer of a cluster coverage to Mode S ground stations and tools.

## 4.2 Format

### 4.2.1 General rules

[MAP-21.] This paragraph defines the order under which data are stored in a map file and how to interpret the data stored in the file.

[MAP-22.] The maps shall be transferred by binary file using big endian coding for the numbers, i.e. most significant bytes first. All bit positions within a one-octet field shall be numbered right to left from zero (least significant bit) to seven (most significant bit).

[MAP-23.] The file structure will be described using the following conventions:

| | |
|---|---|
| a **::=** <b> <c> | Item a **consists of** item b followed by item c. |
| a ::= <b> **<c>** | The brackets around c indicate that c is decomposed elsewhere in the file structure |
| a ::= **<*b*>** <c> | The italics for b indicate that b is defined in the data-item table in paragraph 4.2.3. |
| a ::= **1:3** (<b><c>) | Data item a consists of 1, 2 or 3 times data item b each time followed by c. |
| a ::= **<number of entries>** (<b><c>) | Data item a consists of a variable number of paired data items b and c. The number of times item b and c are repeated will be coded in separate data item “Number of entries”. |

### 4.2.2 File structure

Two types of files are used to describe cluster properties and corresponding coverage maps. One file type defines the properties of the cluster the other file defines the system maps used for a given state (entry in the solution list). The coverage maps files are expressed in absolute latitude / longitude grid cells as follows;

coverage map files ::= <cluster file> **1:128**[2](<system map file>)

#### 4.2.2.1 Cluster File Definition

cluster file ::= <cluster header> ***<number of node descriptions>*** (<node description>) <map cross ref>

**NOTE**: The number of node descriptions is between 1 and 7 and coded in the data item "number of node descriptions".

cluster header ::= *<cluster format magic number>< cluster format version><checksum>*<file header>

file header ::= <version number><modification date>*<comment>*

version number ::= *<main version><sub version>*

modification date ::=*<cluster modification date> <local modification date>*

node description ::= < identification>< position>

**NOTE**: The identification can be a cluster controller identification or a ground station identification

identification ::= *<name> < node reference number> <SIC-SAC code> <Network addresses>*

**NOTES**:

1. The valid node reference numbers for the ground stations are 0:5.
2. The node reference number for the cluster controller will be fixed to the value 6.

position ::= *<WGS84 latitude> <WGS84 longitude> <WGS84 height>*

**NOTES**:

1. Since category 17 uses geodesic coordinates for track data message, a ground station only needs to know its own position, which is a Site Dependent Parameter.
2. The reason for including positions in the cluster file is for the external users.

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[2] Note that this number is purely theoretical. Normally, only half of the distributed states are transferred (i.e., 32 at most) and centralised states will be much less than the allowed 64.

3. The position is also included for the cluster controller. The use of the position in case of a cluster controller depends on the design of the cluster controller.

map cross ref ::= ***<number of solution list entries>***(<solution list entry>)

**NOTE**: The number of solution list entries is between 1 and 128 and coded in the data item “number of solution list entries”.

solution list entry ::= <*solution list entry number*> <prime II/SI code list> <*map ref*> <*Radar Parameter Set reference* >

**NOTE:** The solution list entry number is the state number for the cluster, equivalent to the 7 low order bits of the data item I017/360. For state numbers lower than 64, the 6 low order bits define the topology.

prime II/SI code list ::= ***<number of mode-S stations>*** (<*node reference number*> <*II/SI code*>)

**NOTES**:

1. The number of mode-S ground stations is between 1 and 6 and coded in the data item “number of mode-S stations”.
2. Prime II/SI codes are defined here, alternate codes (if present) are defined in the Radar Parameter Set.

### 4.2.2.2 System Map File Definition

system map file ::= <map header> <*map ref*> <map body>

map header ::= <*map format magic number*><*map format version*><*checksum*><file header>

map body ::= <grid definition><coverage grid>

grid definition ::= <grid origin> <*delta grid latitude*> <*delta grid longitude*> <*number of latitude rows*> < *number of longitude columns*>

grid origin ::= <*WGS84 latitude*> <*WGS84 longitude*>

coverage grid ::= ***<number of deltas>***(<cell definition>)

**NOTE**: The total number of cells in a map is number of latitude rows times number of longitude columns. The actual number of encoded cells may be lower than the total number of cells because cells are only encoded when they differ from the previous one (hence the name “deltas”). See [MAP-22.] and next.

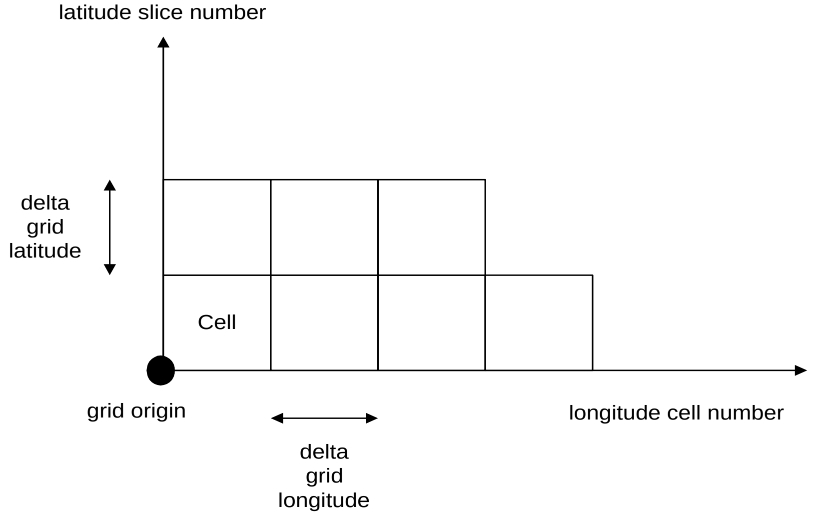



**Figure 3: Map Definition**

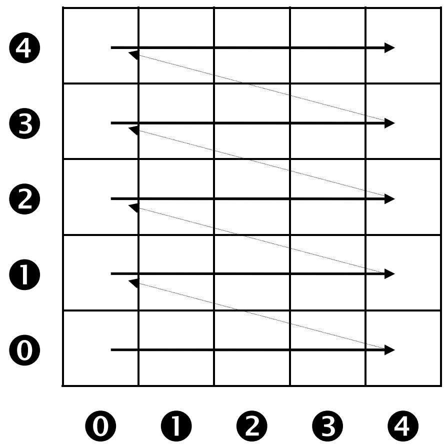
cell definition ::= <*latitude slice number*><*longitude cell number*><cell content>)

cell content ::= ***<number of altitude bands>*** (<*node reference number*> <*map type*> <*low altitude*> <*high altitude*>)

**NOTES**

1. The number of altitude bands is between 1 and 8 and coded in the data item “number of number of altitude bands”.
2. The number 8 is determined as follows, up to 6 different altitude bands for surveillance for the 6 different mode-S ground stations belonging to the cluster, and 2 altitude bands for the local lock-out map and local datalink map. Indeed, a station only has to know about the others surveillance responsibilities to operate surveillance co-ordination.

[MAP-24.] The map shall be encoded sequentially South to North (increasing slice numbers), and, for each slice, West to East (increasing cell numbers).



[MAP-25.] Responsibility shall be encoded for a cell only if it has changed with regard to the previous cell on the same slice. Therefore, the absence of responsibility *information* for a ground station in a cell does not mean it has no responsibility for this cell, it merely means the responsibility has not changed.

[MAP-26.] If all characteristics for a cell remain unchanged, the cell itself shall not be encoded.

[MAP-27.] For each slice, responsibilities shall be initialised to “no responsibility”. Responsibilities in the cells of the slice remain empty until otherwise encoded later in the slice. This way, there is no absolute need to encode the first cell of each slice if it is not covered by any ground station. If no cell is encoded for a complete latitude slice, it means that no ground station in the cluster has coverage in that latitude range.

[MAP-28.] Responsibilities shall be cleared by setting the low altitude and high altitude to the same value. If a responsibility is not cleared before the end of the slice, it is assumed to remain valid until the easterly extent of the map.

**Example:**

In the following simplistic example, ∅ denotes no surveillance responsibility, A means surveillance responsibility for A and so on for B. To keep the example simple, altitude values and other types of responsibilities have not been considered. Cells for which something need to be encoded are grayed.

The first and the last rows contain no surveillance responsibility information. Consequently, nothing need to be encoded as this is the default status.

In the second row, A starts to have surveillance responsibility in the second cell. This responsibility ends in the fourth cell where B starts to be responsible. The responsibility of B is cleared in the last column.

Note that in the third row, third column, one only needs to encode the information relative to the additional responsibility of B, as the one of A remains unchanged.

| | | | | | |
|---|---|---|---|---|---|
| ❹ | ∅ | ∅ | ∅ | ∅ | ∅ |
| ❸ | ∅ | **A** | **A** | ∅ | ∅ |
| ❷ | ∅ | **A** | **A,B** | **B** | **B** |
| ❶ | ∅ | **A** | **A** | **B** | ∅ |
| ⓿ | ∅ | ∅ | ∅ | ∅ | ∅ |
| | ⓿ | ❶ | ❷ | ❸ | ❹ |

The following table shows in bold what has to be encoded for each cell. What is implied but not explicitly encoded is in italics.

| | | | | | |
|---|---|---|---|---|---|
| ❹ | | | | | |
| ❸ | | **respA** | *respA* | **clearA** | |
| ❷ | | **respA** | *respA*<br>**respB** | **clearA**<br>*respB* | *respB* |
| ❶ | | **respA** | *respA* | **clearA**<br>**respB** | **clearB** |
| ⓿ | | | | | |
| | ⓿ | ❶ | ❷ | ❸ | ❹ |

### 4.2.3 Data Items

The following formats will be used in the table;

Byte: An unsigned integer with a value between 0 and $2^8$-1.

Integer: An unsigned integer with a value between 0 and $2^{16}$-1.

Number: A signed integer (2's complement) of the indicated size.

Date: A fixed length string of characters (ASCII) containing the date and time in the following format "DDMMYYYYHHMMSS";

String: A variable length string of characters (ASCII) where the first byte contains the length of the remaining string.

| **Field Name** | **Unit** | **Format** | **Size in Bytes** | **Definition** |
|---|---|---|---|---|
| cluster format magic number | - | Byte | 3 | 0x434c55 ("CLU") |
| cluster format version | - | Byte | 1 | 0x01 |
| map format magic number | - | Byte | 3 | 0x4d4150 ("MAP") |
| map format version | - | Byte | 1 | 0x02 |
| checksum | - | Byte | 4 | Algebraic addition of the contents of all the bytes in the file, past the checksum. Sum is computed as an integer summation of 8-bit values. (Value 0:$2^{32}$-1) |
| main version | - | Byte | 1 | Main version as generated by the system tool. (Value 0:255) |
| sub version | - | Byte | 1 | Sub-version as generated by a local tool allowing site adaptation for testing, evaluation and trouble shooting. Initially set to 0. (Value 0:255) |
| cluster modification date | - | Date | 14 | Date and time of creation by the system tool. |

| Field Name | Unit | Format | Size in Bytes | Definition |
|---|---|---|---|---|
| local modification date | - | Date | 14 | Date and time of the last local modification. Same as previous item if no local modification. |
| comment | - | String | 1+ 0:255 | Data which can contain a short description of the maps included in the file. |
| number of node descriptions | | Byte | 1 | The number of nodes in the cluster including the cluster controller. (Value 1:7) |
| name | - | String | 1+ 16:16 | The name of the ground station or cluster controller right padded with blanks (16 bytes in total) |
| node reference number | - | Byte | 1 | The reference number of the ground station in the cluster Value 0:5. The value 6 shall be reserved for the CC. |
| II/SI code | - | Byte | 1 | The prime interrogation code used for the ground station (see annex B).<br>In order to distinguish between II and SI codes, the II/SI byte will be encoded as follows: Bit 7: Spare, Bit 6..4: CL and Bits 3..0: IC. |
| Radar Parameter Set reference | | Byte | 1 | A number pointing to a set of ground station parameters as defined in the previous sections.<br>(Value 0:255, 255 means no reference set) |
| SIC-SAC code | - | Byte | 2 | The system area code (SAC, first) and system identification code (SIC, second) as defined in the ASTERIX standard |

| Field Name | Unit | Format | Size in Bytes | Definition |
|---|---|---|---|---|
| Network addresses | - | String | 1+<br>40 \| 80 \|<br>120 \|160 | The network addresses of the ground station or cluster controller chains, encoded as specified in Annex C.<br>The addresses smaller than 40 bytes will be left-adjusted and the remainder of the 40 bytes long sub-string will be filled with spaces.<br>The specified addresses are used for sensor co-ordination. Each ground station needs to know the addresses of all other ground stations in the cluster.<br>The first part of the addresses shall be used by chain A and the last part by chain B. |
| WGS84 latitude | 1/100” | Number | 4 | Latitude of the ground station or the latitude defining the origin of the map.<br>(Value: -32,400,000: 32,400,000) |
| WGS84 longitude | 1/100” | Number | 4 | Longitude of the ground station or the longitude defining the origin of the map.<br>(Value: -64,800,000: 64,800,000) |
| WGS84 height | 1 meter | Number | 4 | The height of the ground station with respect to the WGS84 Ellipsoid.<br>(Value -500:9000 meters) |
| number of solution list entries | - | Byte | 1 | The number of solutions list entries.<br>(Value 1:128) |

| Field Name | Unit | Format | Size in Bytes | Definition |
|---|---|---|---|---|
| solution list entry number | - | Byte | 1 | The identification of the entry in the solution list (Value 0:127) |
| map ref | - | Byte | 1 | The identification of the set of map definitions. The byte defines the map number. (Value 0:127) |
| number of mode-S stations | - | Byte | 1 | The number of mode-S stations in the cluster. (Value 1:6) |
| delta grid latitude | 1/100” | Number | 4 | Constant latitude width of each cell of the map |
| delta grid longitude | 1/100” | Number | 4 | Constant longitude width of each cell of the map |
| number of latitude rows | - | Byte | 1 | The number of latitude rows (slices) in the map. (Value 1:255) |
| number of longitude columns | - | Byte | 1 | The number of longitude columns in the map (or number of cells in a latitude slice). (Value 1:255) |
| number of deltas | - | Byte | 2 | The total number of encoded cells. (Value 0:65025) |
| latitude slice number | - | Byte | 1 | Latitude slice number, counting from the defined south latitude to north (Value 0:254) |
| longitude cell number | - | Byte | 1 | Longitude cell number, counting from the defined west longitude to east from. (Value 0:254) |

<table>
<tr><th>Field Name</th><th>Unit</th><th>Format</th><th>Size in Bytes</th><th>Definition</th></tr>
<tr><td>number of altitude bands</td><td>-</td><td>Byte</td><td>1</td><td>Number of altitude band records described in the cell description that will follow. At the most one surveillance for each ground station plus one lockout and one datalink.<br>(Value 1:8)</td></tr>
<tr><td>map type</td><td></td><td>Byte</td><td>1</td><td>For each map a bit is reserved, which has the following meaning:</td></tr>
<tr><td colspan="5">bit 0 = SR, the SuRveillance service of the ground station(s):<br>• 0 means the current altitude band record does not affect surveillance responsibility,<br>• 1 means the ground station(s) have to perform surveillance in the altitude band of the cell currently described<br>bit 1 = DL, the Data-Link service of the ground station(s):<br>• 0 means the current altitude band record does not affect datalink responsibility,<br>• 1 means that full data-link service may be provided as authorised through the GDLP or the Local User Interface (when a GDLP is not connected) in the altitude band of the cell currently described.<br>bit 2-3 = LO, the LockOut responsibility type of the ground station(s);<br>• 0 means the current altitude band record does not affect lockout responsibility,<br>• 1 means normal lockout is applied in the altitude band of the cell currently described,<br>• 2 means intermittent lockout as defined for this ground station is applied in the altitude band of the cell currently described</td></tr>
<tr><td>low altitude</td><td>200 feet</td><td>Byte</td><td>1</td><td>Minimum altitudeof responsibility.<br>(Value 0:255, 0 means no lower limit shall be applied, which includes negative values)</td></tr>
</table>

| **Field Name** | **Unit** | **Format** | **Size in Bytes** | **Definition** |
|---|---|---|---|---|
| high altitude | **200 feet** | Byte | 1 | Maximum altitude of responsibility.<br>(Value 0:255, 255 means no upper limit shall be applied). |

# CHAPTER 5

# MEDIA

## 5.1 Physical media

[MAP-29.] The media that shall be used for cluster map archiving and exchange between the map tool (System Map Generator & Extractor Tool) and the Mode S ground stations and associated tools are CD-ROMs and floppy disks.

### 5.1.1 CD-ROM characteristics

[MAP-30.] The medium used shall be CD-ROM or CD-RW. Multisession CD-ROMs shall be recognised as well.

[MAP-31.] Logical formatting and file directory structure shall conform to ISO9660, optionally with High Sierra or RockRidge extensions.

[MAP-32.] The Mode S station associated tools shall be able to read from the above media. The System Map Generator & Extractor Tool shall in addition be able to write to such media.

### 5.1.2 Floppy disks characteristics

[MAP-33.] The medium used shall be 3.5 inch double-sided, high density micro floppy disks.

[MAP-34.] Logical formatting and file directory structure shall conform to MS-DOS FAT12.

[MAP-35.] The Mode S station associated tools and the System Map Generator & Extractor Tool shall be able to read from and write to such floppy disks.

## 5.2 Logical organisation

[MAP-36.] Each medium (floppy, CD-ROM) shall contain the data in files located in directories. File naming shall be restrained to 8+3 characters for maximal compatibility.

### 5.2.1 Directories

[MAP-37.] Each Mode S map is made of 1 cluster file and up to 96 system map files. Each Mode S map shall be stored in a different directory located at the highest level on the medium.

#### 5.2.2 File naming

[MAP-38.] The directory names shall be restrained to 8+3 characters. The name of the directory shall reflect its contents. One way to achieve this is to use the following format: “MXXXXYYY.ZZZ”, where XXXX (4 chars) stands for the SAC (first) and SIC (second) codes in hexadecimal, YYY for the main version number and ZZZ for the sub version number, as defined in 4.2.3.

[MAP-39.] The cluster file shall be named “cluster.dat”, while all system map files shall be named “sysmp***XXX***.dat”, where ***XXX*** matches the map reference number. Numbers smaller than 100 will have leading zero[s] (i.e. “sysmp001.dat”, not “sysmp1.dat”).

#### 5.2.3 Textual information

[MAP-40.] At the highest level, an ASCII file named “INDEX.TXT” shall contain a textual description of each directory contents.

In each directory, a “README.TXT” file may provide additional information about each particular data set.

### 5.3 Electronic transfer

In order to ease fast transfer of large data set, the map tools and the Mode S station associated tools should be able to access, directly or indirectly, map data transferred as attachments to e-mails or through ftp.

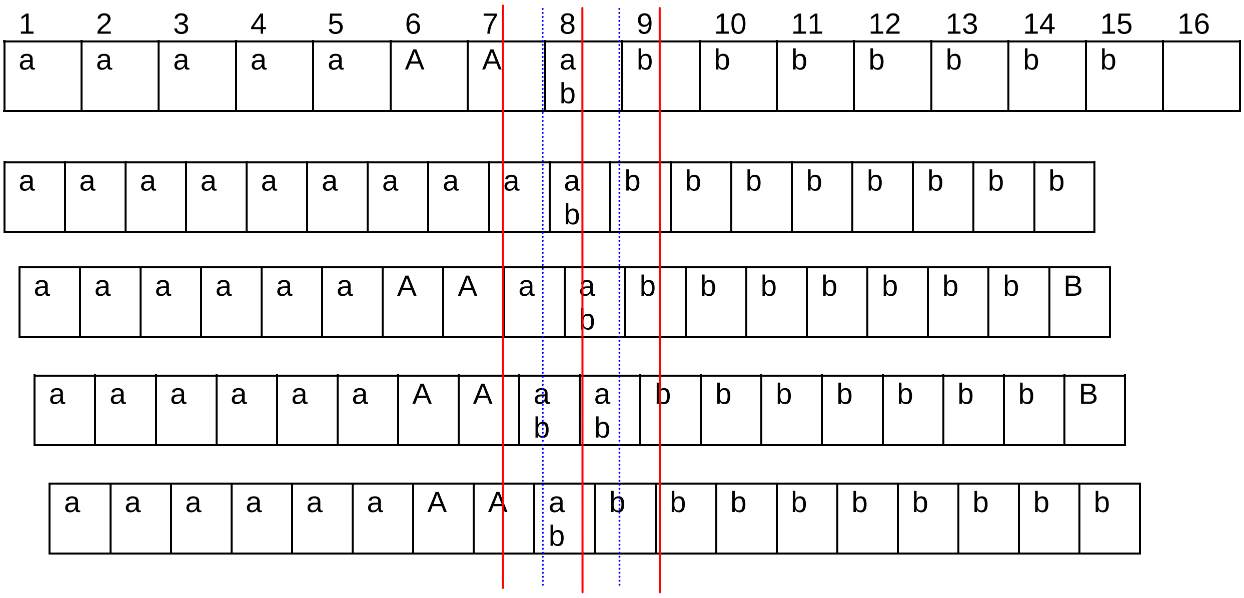
In such a case, Mode S maps should be archived -using an archive format such as the zip format- prior to transfer. If multiple maps are to be archived together, the index file should be included and the directory structure preserved. It is acceptable to transfer only one map by just archiving a directory content, but the archive should be named after the directory, in this case.

# ANNEX A

## EXPLANATION OF THE REQUIREMENTS FOR CELLS

The following one dimensional diagram is used to explain why accuracy requirements are defined as they are;

The first row represents the grid common to all ground stations. For the European Mode S ground station, it has been defined as a 3D latitude/longitude map. Here it is defined as a grid which is 1 unit wide.




The last three rows show three different local ground station grids, where the local cell size is smaller (0.8 unit) than the common grid cell size. The letters a and b indicate a set of properties for that cell. It might mean surveillance coverage for ground station A, but it could also means lock-out responsibility for that cell. The dotted and blue vertical lines indicate a change of property in the common grid. The solid and red vertical lines indicate the allowed error margin on both sides of the blue line.

The requirement for translation is:

*The inaccuracy caused by the incompatibilities between the common and internal coverage maps should not exceed X units with respect to the cell boundaries of the common geodesic grid. X shall be less than half the minimum cell size of the common geodesic grid. This value shall include localisation errors of the track itself.*

The allowed error in the example will be 0.5 unit as indicated by the red and solid vertical lines.

Translation from the common grid to the local grids could be based on the following rules;

- The local cell adapts the property of the common grid if the amount of overlap between the local cell and the property in the common grid is more than 50%.

- The local cell grid size should be smaller than the common cell grid size.

The result of these rules would be that;

1. Errors between the common grid and the local grid does not exceed half the grid size.

2. The sequence of attributes is maintained, in the example going from left to right the set of properties will always be a->ab->b.

# ANNEX B

## ALTERNATE II/SI CODE

Mode-S stations are using Interrogator code (II/SI) in order to perform the different mode-S protocols. This interrogator code can be either II (interrogator Identifier, 0-15) or SI code (Surveillance Identifier, 1-63). In a European Mode S ground station, it could be possible to have a prime II/SI code and an alternate II/SI code. The European Mode S ground station can use only one II/SI code (the prime II/SI code) or two II/SI codes (the prime II/SI code and an alternate II/SI code in a pre-defined sector).

# ANNEX C

## NETWORK ADDRESSES ENCODING

The purpose of this annex is to define the encoding policy to be applied to the various types of network address of the ground station or the cluster controller: X.25 DTE address, TCP over IPv4 address and port number or TCP over IPv6 address and port number.

The following convention shall be used to encode and differentiate DTE and IP addresses.

### X.25 –SCN connections

X.25 DTE addresses shall be encoded as previously or with an optional prefix “X25:” appended to them.

Examples:

“0207457941404 “ or “X.25:0207457941404”.

### TCP/IPv4 connections

IPv4 TCP/IP addresses shall be encoded using the classical decimal IPv4 notation (decimal dotted notation) “IPv4:x.x.x.x:portnumber” (x = 0..255, portnumber=0..65535).

Example:

“IPv4:193.221.179.1:10000”

### TCP/IPv6 connections

A full IPv6 address following the IPv6 notation (“[X:X:X:X:X:X:X:X]:portnumber”, with X representing a 4 hexadecimal digits group), requires more than 40 characters (i.e. 47 characters like this example: “[2001:0120:0000:0000:0000:0000:0102:1111]:10000”.

In order to fit into the 40 characters string of the Network addresses field as defined in section 4.2.3, the IPv6 notation will be used but with a slight modification: the colon “:” will not be used to separate each 4 hexadecimal digits group. This restriction implies that the complete IPv6 address shall be encoded. In that sense, the standard IPv6 rule to omit any 4 digit group “0000” in the network address and thus to reduce the network address shall not be applied in the Network addresses field.

Example:

“[20010120000000000000000001021111]:10000”