Aero services – I-3 to I-4 migration

Issue 2
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1. **Introduction**

The Inmarsat I-3 satellites are approaching their end of service life. Inmarsat has committed to continue a number of services which currently are provided through the I-3 satellite constellation. These services must be migrated onto the I-4 satellites.

The migration is planned to take place during the course of 2018 in order to perform an orderly migration off all but one of the I-3 satellites and ensure a continuation of selected services.

This document provides details on the migration of each of the impacted aero services and actions to be taken to ensure a smooth transition.

**Note:** in this document, Ground Earth Station (GES) will also be used for Land Earth Station (LES) and the generic term ‘Bulletin Board (BB)’ is used to describe the Classic Aero System Table.
2. **I-3 to I-4 migration description**

2.1. **Background**

The migration plan presented here is based on feedback from the consultation with aviation user terminal (UT) manufacturers, carried out since mid-2016. The main purpose of this consultation was to ‘fine-tune’ the migration plan to minimise the impact on terminals with a particular focus on Classic Aero services.

UT manufacturers have provided feedback regarding the content of the system tables and the chronology of the migration based on their experience and knowledge of the terminal behaviour.

2.2. **Service migration overview**

The migration will take place in 4 steps, as listed below.

- **Step 1**: Move of AORW from the 3F5 satellite (54° W) to the 4F3 satellite (98° W) (Completed May 2018).
- **Step 2**: Move of POR from the 3F3 satellite (178° E) to the 4F1 satellite (143.5° E).
- **Step 3**: Move of AORE from the 3F2 satellite (15.5° W) to the 3F5 satellite (54° W).
- **Step 4**: Move of IOR from the 3F1 satellite (64° E) the AF1 satellite (25° E).

The resulting network configuration will consist of three I-4 satellites (4F1 (APAC), 4F3 (AMER), AF1 (EMEA) and one I-3 satellite 3F5 (AORE).

Exact dates and times for each of the migration steps will be provided in separate communication.

<table>
<thead>
<tr>
<th>2017</th>
<th>2018</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q3</td>
<td>Q4</td>
<td>Q1</td>
</tr>
<tr>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
</tr>
<tr>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
</tr>
</tbody>
</table>

- **Step 1**: AORW (SAT ID: 0) on 3F5 (54° W) to SAT ID 0 on 4F3 (98° W)
- **Step 2**: POR (SAT ID 2) on 3F3 (178° E) to SAT ID 2 on 4F1 (143.5° E)
- **Step 3**: AORE (SAT ID 1) on 3F2 (15.5° W) to AORE (SAT ID 1) on 3F5 (54° W)
- **Step 4**: IOR (SAT ID 3) on 3F1 (64° E) to SAT ID 3 on 4F1 (25° E)

*Figure 1*: overview of the I-3 to I-4 migration sequence and timelines
2.3. **Key facts:**

- The SAT IDs and Ground Earth Station (GES) / Land Earth Station (LES) IDs will remain the same for Classic Aero and Swift64 services, although the I-3 satellite longitudes will be amended: effectively the coverage or footprint of the AORW, AORE, IOR and POR will move to the west. In addition, the coverage area of the IOR will change, due to the special footprint of the AF1 (AlphaSat) satellite. The existing I-3 satellite IDs and GES IDs will be hosted on the I-4 satellites so that the I-3s appear as separate satellites to the terminals – in this document these are referred to as “Virtual I-3s on I-4”.

- I-3 GESs operating over the I-4 satellites will use synthesised regional beams mimicking the regional beams on the I-3 satellites and limiting the number of regional beams to about 6/7. The Classic Aero and SBB services currently carried on the I-4s and Alphasat will remain unchanged.

- Classic Aero-H and –H+ services will both be provided on both the Virtual I-3s configuration and the original I-4s.

- Classic Aero-I voice service will be provided in the global beam using Engineering Fallback (EFB) mode.

- The restriction in the ground network which prevents certain terminals logging on to the current Classic Aero I-4 GESs has been removed: the flag has been enabled on the GES to allow all terminals to log onto the I-4 GESs. ESAS updates are in progress to permit all terminal types to be authorised for operation on the I-4 satellites.

- MTSAT bulletin boards will be updated at each step of migration.

2.4. **Migration steps description**

The figures below provide a graphical view of the changing footprints of the 4 ocean regions. The dashed contour is the footprint before the migration. The solid contour is the footprint after the migration. In Annex 3 the combined footprints of all ocean regions are given before and after migration.

2.4.1. **At start of migration**

The pre-migration I-3 constellation consists of 4 I-3 satellites:

- Atlantic Ocean Region – West (AORW) on the 3F5 satellite at 54° W
- Atlantic Ocean Region – East (AORE) on the 3F2 satellite at 15.5° W
- Indian Ocean Region (IOR) on the 3F1 satellite at 64° E
- Pacific Ocean Region (POR) at 3F3 satellite at 178° E
2.4.2. **Step 1: Closure of AORW and migration to AMER**

SAT IDs and GES IDs associated to AORW and services operating have been moved from the 3F5 satellite to the 4F3 satellite.
The resulting configuration information is provided in **Table 1**.

![Table 1: Satellite and GES configuration after step 1](image)

### 2.4.3. Step 2: Closure of POR and migration to APAC

SAT IDs and GES IDs associated to POR and services operating will be moved from the 3F3 satellite to the 4F1 satellite.

![Figure 4: Step 2 - POR migration from 178° E (3F3) to 143.5° E (4F1)](image)

The sequence of events during this second step of the migration is as follows:

1. GES/LESs in POR block the set-up of new calls.
2. Inmarsat will issue updated Bulletin Boards, replacing POR with APAC. Users in POR will then be able to point to IOR or AMER (or APAC if already I-4 capable) to receive the new BB, then re-point to APAC if required.
3. Cease transmission of POR carriers from the (Swift64) NCSs.
4. GES/LESs in POR terminate all remaining calls and re-point their antennas to APAC, or connect their GES/LESs to existing APAC antenna feeds.
5. Activate NCSs for APAC region.
6. Activate GES/LESs for APAC region.
7. Perform test calls.
8. Verify that call monitoring and reporting systems are operational.

The resulting configuration information is provided in Table 2.

<table>
<thead>
<tr>
<th>Satellite Region Configuration, Longitude, Satellite, Satellite ID, GES Location, GES ID (Octal)</th>
<th>Configuration at end of Step 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>PACIFIC OCEAN REGION 176E (77 in hex), 3F3, 2</td>
<td>PACIFIC OCEAN REGION 143.5E (5F in hex), 4F1, 2</td>
</tr>
<tr>
<td>PERTH 202</td>
<td>PERTH 205</td>
</tr>
<tr>
<td>PACIFIC OCEAN REGION 176E (77 in hex), 3F3, 2</td>
<td>PACIFIC OCEAN REGION 143.5E (5F in hex), 4F1, 2</td>
</tr>
<tr>
<td>PERTH 205</td>
<td>PERTH 205</td>
</tr>
</tbody>
</table>

Table 2: Satellite and GES configuration after step 2

2.4.4. Step 3: Move of AORE from 15.5°W to 54°W

SAT IDs and GES IDs associated to AORE and services operating will be moved from the 3F2 satellite to the 3F5 satellite.

![Image](image.png)

Figure 5: Step 3 - AORE migration from 15.5°W (3F2) to 54°W (3F5)

The sequence of events during this third step of the migration is as follows:

1. GES/LESs in AORE block the set-up of new calls.
2. Inmarsat will issue updated Bulletin Boards, defining AORE at 54W, updating the spot-beam map and any changed signalling channels. Users in the old AORE region who are outside the coverage of 54W will then need to point to IOR.
3. Cease transmission of AORE carriers from the NCSs.
4. GES/LESs in AORE terminate all remaining calls and re-point their antennas to 54W, or connect their GES/LESs to existing 54W antenna feeds.
5. AORE (Swift64) NCSs are disconnected from 15.5W feeds and connected to 54W feeds.
6. Re-activate NCSs for the new AORE region.
7. Re-activate GES/LESs for the new AORE region.
8. Perform test calls.
9. Verify that call monitoring and reporting systems are operational.
10. Monitor traffic.

The resulting configuration information is provided in Table 3.

<table>
<thead>
<tr>
<th>Initial configuration</th>
<th>Configuration at end of Step 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATLANTIC OCEAN REGION EAST 15.5W (E6 in hex), 3F2, 1 BURUM 103</td>
<td>ATLANTIC OCEAN REGION EAST 54W (CC in hex), 3F5, 1 BURUM 103</td>
</tr>
<tr>
<td>ATLANTIC OCEAN REGION EAST 15.5W (E6 in hex), 3F2, 1 BURUM 104</td>
<td>ATLANTIC OCEAN REGION EAST 54W (CC in hex), 3F5, 1 BURUM 104</td>
</tr>
</tbody>
</table>

Table 3: Satellite and GES configuration after step 3

2.4.5. Step 4: Closure of IOR and migration to EMEA

SAT IDs and GES IDs associated to IOR and services operating will be moved from the 3F1 satellite to the AF1 satellite.

Figure 6: Step 4 – IOR migration from 64° E (3F1) to 25° E (AF1)
The sequence of events during this fourth step of the migration is as follows:

1. GES/LE斯 in IOR block the set-up of new calls.
2. Inmarsat will issue updated Bulletin Boards, replacing IOR with EMEA. Users in IOR will then be able to point to AMER or APAC (or EMEA if already I-4 capable) to receive the new BB, then re-point to EMEA if required.
3. Cease transmission of IOR carriers from the NCSs.
4. GES/LE斯 in IOR terminate all remaining calls and re-point their antennas to EMEA, or connect their GES/LE斯 to existing EMEA antenna feeds.
5. Activate (Swift64) NCSs for EMEA region.
6. Activate GES/LE斯 for EMEA region.
7. Perform test calls.
8. Verify that call monitoring and reporting systems are operational.

The resulting configuration information is provided in Table 4.

<table>
<thead>
<tr>
<th>Initial configuration</th>
<th>Configuration at end of Step 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDIAN OCEAN REGION</td>
<td>INDIAN OCEAN REGION</td>
</tr>
<tr>
<td>64E (28 in hex), 3F1, 3</td>
<td>24E (10 in hex), AF1, 3</td>
</tr>
<tr>
<td>PERTH 301</td>
<td>BURRIM 301</td>
</tr>
<tr>
<td>INDIAN OCEAN REGION</td>
<td>INDIAN OCEAN REGION</td>
</tr>
<tr>
<td>64E (28 in hex), 3F1, 3</td>
<td>24E (10 in hex), AF1, 3</td>
</tr>
<tr>
<td>PERTH 305</td>
<td>BURRIM 305</td>
</tr>
</tbody>
</table>

Table 4: Satellite and GES configuration after step 4

2.5. **E&E coverage map after migration**

The post-migration E&E services coverage map consists of 4 satellites:

- 3F5 satellite at 54° W
- AF1 satellite at 25° E
- 4F1 satellite at 143.5° E
- 4F3 satellite at 98° W
2.6. **Summary table of the I-3 broadcast information**

The I-4 tables remain unchanged during the migration, only the I-3 system tables will be amended to reflect the change in longitude of the satellites being used to transmit Bulletin Boards.

<table>
<thead>
<tr>
<th>Step</th>
<th>Start of 2018</th>
<th>End of Transition</th>
<th>Start of 2018</th>
<th>End of Transition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>ATLANTIC OCEAN REGION WEST 54W (CC in hex), 3F3, 0</td>
<td>ATLANTIC OCEAN REGION WEST 99W (AE in hex), 4F3, 0</td>
<td>BURUM</td>
<td>LAURENTIDES (503 in hex)</td>
</tr>
<tr>
<td>Step 2</td>
<td>PACIFIC OCEAN REGION 17W (771 in hex), 3F3, 2</td>
<td>PACIFIC OCEAN REGION 143.5E (55 in hex), 4F1, 2</td>
<td>PERTH</td>
<td>BURUM (82 in hex)</td>
</tr>
<tr>
<td>Step 3</td>
<td>ATLANTIC OCEAN REGION EAST 15.5W (15 in hex), 3F2, 1</td>
<td>ATLANTIC OCEAN REGION EAST 54W (CC in hex), 3F3, 1</td>
<td>BURUM</td>
<td>BURUM (44 in hex)</td>
</tr>
<tr>
<td>Step 4</td>
<td>INDIAN OCEAN REGION 64E (20 in hex), 3F1, 7</td>
<td>INDIAN OCEAN REGION 24E (10 in hex), AF1, 3</td>
<td>PERTH</td>
<td>BURUM (291 in hex)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step</th>
<th>Start of 2018</th>
<th>End of Transition</th>
<th>Start of 2018</th>
<th>End of Transition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>ATLANTIC OCEAN REGION WEST 54W (CC in hex), 3F3, 0</td>
<td>ATLANTIC OCEAN REGION WEST 99W (AE in hex), 4F3, 0</td>
<td>BURUM</td>
<td>LAURENTIDES (503 in hex)</td>
</tr>
<tr>
<td>Step 2</td>
<td>PACIFIC OCEAN REGION 17W (771 in hex), 3F3, 2</td>
<td>PACIFIC OCEAN REGION 143.5E (55 in hex), 4F1, 2</td>
<td>PERTH</td>
<td>BURUM (82 in hex)</td>
</tr>
<tr>
<td>Step 3</td>
<td>ATLANTIC OCEAN REGION EAST 15.5W (15 in hex), 3F2, 1</td>
<td>ATLANTIC OCEAN REGION EAST 54W (CC in hex), 3F3, 1</td>
<td>BURUM</td>
<td>BURUM (44 in hex)</td>
</tr>
<tr>
<td>Step 4</td>
<td>INDIAN OCEAN REGION 64E (20 in hex), 3F1, 7</td>
<td>INDIAN OCEAN REGION 24E (10 in hex), AF1, 3</td>
<td>PERTH</td>
<td>BURUM (291 in hex)</td>
</tr>
</tbody>
</table>

**Table 5:** summary table of the I-3 broadcast information changes during each step of the migration

2.7. **Satellite contingency**

After the migration, the contingency plan for each of the satellites now supporting E&E services is detailed below.
Table 6: satellite contingency after completion of migration*

* Note that the I-3 satellites will be available for contingency purposes until they reach end-of-life.

2.8. Network Configuration management

2.8.1. I-4 satellite configuration management

I-4 satellite configuration will be unchanged with identical spot-beam management to that currently in place.

No change to the format of the spot-beam definitions will be needed (i.e. they will continue to be defined as polygons; no centre + radius definitions will be used).

2.8.2. I-3 satellite configuration management

I-3 satellite configuration will be duplicated on I-4 satellites:

- I-3 GES/LES IDs/Sat IDs will remain unchanged
- I-3 PSID will remain unchanged
- Longitude will be amended to reflect the positions of the I4 satellites transmitting bulletin boards

The objective is to recreate a “virtual I-3 satellite” configuration on the physical I-4 satellites to offer a seamless migration to terminals used to operating on the I-3s and thus avoid any manual intervention to terminals post the migration. Using this approach, an I-3-only terminal should be able to operate similarly to the way it operated over physical I-3 satellites to the migration, as long as the terminal in question has received the updated bulletin board with the new longitude information and is able to point towards the correct satellite.
3. Impact of the migration

3.1. Impact on E&E services

Although all efforts have been made to ensure all services are supported a similar way to that prior to the migration, limitations exist in the new satellite configuration.

Information on how each of the services is affected is provided below.

3.1.1. Swift64 services

Swift64 capacity will be provided in all synthesised spot beams on the physical I-4 satellites.

However, capacity for E&E services on these satellites might be constrained by the demands of other I-4 services. Post-migration traffic analysis will be performed to identify those beams where capacity changes are required (either more capacity in case of congestion, or less capacity in case of under-utilisation).

MPDS services will not be transferred to the I-4 satellites:

- MPDS will be supported in each I-3 region until that satellite is migrated. Closure dates for MPDS will be confirmed prior to each migration.
- MPDS service will close in AORE when that region is migrated onto the 3F5 satellite, even though the destination satellite is an I-3.
- No MPDS services will be provided after the end of 2018.

3.1.2. Aero-C services

Aero-C services will be migrated onto the new satellite at the same time as the maritime Inm-C service. Following this they will migration similarly at each migration step. The schedule information will be updated at https://www.inmarsat.com/support/i-3-to-i-4-services-migration/

Migration schedules will be provided in separate communications.

3.1.3. Classic Aero services

For Aero-I customers, voice channels will be supported in global beam instead of spot beams.

Engineering FallBack Mode (EFM) will be enabled on the ‘virtual’ I3 configuration onto physical I4 satellites.

Classic Aero services will be supported globally as shown in the table below:
Table 7: list of Classic Aero services supported by each GES

3.2. Impact on terminals

3.2.1. Overview

3.2.1.1. Swift64 terminals

Category 'B' Swift64 terminals will be supported for a limited period post the first migration. Inmarsat has been working with Swift64 manufacturers for many years to upgrade MES Category 'B' terminals to MES Category 'A' and SBs have been available for a long time, please refer customers to the Honeywell and Cobham portals for more information (also see below). Inmarsat will issue adequate notice before the removal of the Cat B frequency pool.

In the longer term, Cat B Swift64 frequency assignments will be as in per the current SDM (see CN80 dated Feb 2008) and hence will use the same frequency pool as Cat A. Consequently, those terminals, not already compliant to CN80, should be upgraded.

3.2.1.2. Aero-C terminals

The impact of the migration on to Aero-C terminals is described in the guide as available on the Inmarsat website: https://www.inmarsat.com/support/i-3-to-i-4-services-migration/

3.2.1.3. Classic Aero terminals

The issue of older versions of terminals not allowing operations with 19 spot beams (which is standard I-4 operation) has been addressed as follows:
• One UT manufacturer has terminals affected by this issue and is in discussion with the airframer to provide Service Bulletins allowing the upgrade of this small group of terminals to be able to handle the 19 spot beams
• The number of spot beams defined on the “virtual I-3 satellites” will be similar to the number of beams defined on the physical I-3 satellites prior to migration, as described in paragraph 2.8.2 above. It will thus not be necessary for older terminals to support 19 spot beams to operate with the “virtual I-3” satellites.

For terminals capable of handling 19 spot beams, some UT manufacturers recommend that users amend the ORT on the terminal to allow operations with I-4 GES/LESs (please refer to the relevant UT manufacturer portal for further details).

The flag has been enabled on the GES to allow all terminal types onto the I-4 GESs.

3.2.2. **Impact by terminal model and manual intervention**

Although the majority of the terminals will not encounter any issue during migration, as long as they get the updated system tables and record the new longitude information, some may require manual intervention as a either a proactive, corrective or reactive action.

Service Information Letters (SILs) have been issued on the impacted terminals and are available on the terminal manufacturers portals. The link to these portals are given here below. The detailed list of SILs per manufacturers and document references have been provided to partners in previous communications (resp. dated 19th of February 2018, 26th of February 2018, 8th of February 2018, 6th of April 2018).

Additional documents are likely to be released prior to the first migration step and it is advised to check the relevant UT manufacturer portal on a regular basis for updated information.

3.2.2.1. **Cobham**

Any document related to this migration is available on the Cobham portal: https://sync.cobham.com/satcom/

3.2.2.2. **Honeywell terminals**

Any document related to this migration is available on the Honeywell portal: https://myaerospace.com/

3.2.2.3. **Rockwell-Collins**

Any document related to this migration is available on the RCI portal: https://www.shopcollins.com

3.2.2.4. **Thales**

Any document related to this migration is available on the Thales portal: https://www.thalesgroup.com/en/customer-online.
4. **Way Forward**

4.1. **In preparation for the migration:**

   Partners are invited to inform their end users of the content of this Communication and the SILs applicable to them.

   End users are advised to implement the SILs relevant to their fleet.

   Migration information is available on the inmarsat.com website: [https://www.inmarsat.com/support/i-3-to-i-4-services-migration/](https://www.inmarsat.com/support/i-3-to-i-4-services-migration/)

4.2. **During each step of the migration:**

   It is advised to leave the terminal on and connected to the Inmarsat network in order to receive and record the new bulletin boards.

   Partners are invited to monitor closely the performances of their in-service fleet and report any problems to their communications service provider and Inmarsat.

4.3. **After migration**

   Partners are invited to continue to monitor the performances of their in-service fleet and liaise with their communication service provider and Inmarsat if any concern is raised.

   If the terminal was switched off during the migration and has not received an updated bulletin board, partners should refer to the relevant SILs as described in section 3.2.2.

4.4. **Contingency plan**

   Inmarsat will closely monitor the traffic before, during and after each step of the migration.

   In the case where a major issue is found that affects network performance, Inmarsat reserves the right to roll back the network configuration: regular communication will be provided should any issue be observed and no action would be expected from the Partners in case of network roll back.
**Annex 1: Acronyms**

The acronyms shown below are used in this document.

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMER</td>
<td>Americas Ocean Region, operated by I-4 satellite located at 98W</td>
</tr>
<tr>
<td>AORE</td>
<td>Atlantic East Ocean Region, operated by I-3 satellite located at 15.5W</td>
</tr>
<tr>
<td>AORW</td>
<td>Atlantic West Ocean Region, operated by I-4 satellite located at 98W</td>
</tr>
<tr>
<td>APAC</td>
<td>Asia/Pacific Ocean Region, operated by I-4 satellite located at 143.5E</td>
</tr>
<tr>
<td>CIL</td>
<td>Customer Information Letter</td>
</tr>
<tr>
<td>CN</td>
<td>Change Notice</td>
</tr>
<tr>
<td>EMEA</td>
<td>Europe/Middle East Ocean Region, operated by I-4 (AlphaSat) satellite located at 25E</td>
</tr>
<tr>
<td>GES</td>
<td>Ground Earth Station</td>
</tr>
<tr>
<td>IOR</td>
<td>Indian Ocean Region, operated by I-3 satellite located at 64E</td>
</tr>
<tr>
<td>LES</td>
<td>Land Earth Station</td>
</tr>
<tr>
<td>LESO</td>
<td>Land Earth Station Operator</td>
</tr>
<tr>
<td>MEAS</td>
<td>Middle East/Asia Ocean Region, operated by I-4 satellite located at 64E</td>
</tr>
<tr>
<td>NCS</td>
<td>Network Coordination Station</td>
</tr>
<tr>
<td>ORT</td>
<td>Owners Requirements Table</td>
</tr>
<tr>
<td>POR</td>
<td>Pacific Ocean Region</td>
</tr>
<tr>
<td>PSA</td>
<td>Point of Service Activation</td>
</tr>
<tr>
<td>PSID</td>
<td>P-Channel Satellite ID</td>
</tr>
<tr>
<td>SAM</td>
<td>Stand-Alone Mode</td>
</tr>
<tr>
<td>SIL</td>
<td>Service Information Letter</td>
</tr>
<tr>
<td>UT</td>
<td>User Terminal</td>
</tr>
</tbody>
</table>
ANNEX 2: Swift64 LESO information

LESO post-migration:

<table>
<thead>
<tr>
<th>Ocean Region Access Code</th>
<th>Service Provider</th>
<th>AOR-W (hosted on 4F3)</th>
<th>AOR-E (hosted on 3F5)</th>
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*Table 8: LESO covering Ocean Areas post migration*
ANNEX 3: Ocean Region footprints

**Figure 8:** Ocean region footprints before migration

**Figure 9:** Ocean region footprints after step 4 of the migration