European and North Atlantic Office

NORTH ATLANTIC COMMUNICATIONS, NAVIGATION AND SURVEILLANCE GROUP (NAT CNSG)

TENTH MEETING

(Paris, France, 24-28 March 2014)

Agenda Item 2: Data Link performance monitoring and analysis, including trials and operations. Reports by States, industry and DLMA.

a) FANS-1/A performance by FIR, media type, operator, aircraft type, GES.

SUGGESTED VHF REGION DEFINITION CHANGES TO IMPROVE ACARS PERFORMANCE

(presented by DLMA)

SUMMARY

Avionics that are configured to use VHF subnetworks in areas that have only intermittent VHF subnetwork coverage may experience poor ACARS performance in those areas. As introduced in NAT CNSG/9 WP/15, some avionics offer a means to mitigate this problem. In response to NAT CNSG/9 Task 9-11, this IP provides additional detail and encourages aircraft operators to consider reconfiguring their capable avionics.

1. Introduction

1.1. Aircraft operators typically configure their data communications avionics to prefer very high frequency (VHF) subnetworks over satellite communication (SATCOM) subnetworks.

1.2. Some avionics also have a geographic region definition capability that permits aircraft operators to configure the avionics to prefer specified subnetworks in defined geographic regions. Specified subnetworks may include the VHF, SATCOM, and/or high frequency data link (HFDL) subnetworks. Geographic regions (for example, for Japan, South America, and Europe) may be defined as a set of latitude/longitude-based rectangles.

1.2.1. Figure 1 below is an extract from a presentation that Japan Airlines (JAL) delivered at the September 2013 Airlines Electronic Engineering Committee (AEEC) Data Link Users Forum (DLUF) which illustrates an example of geographic regions defined as a set of latitude/longitude-based rectangles.

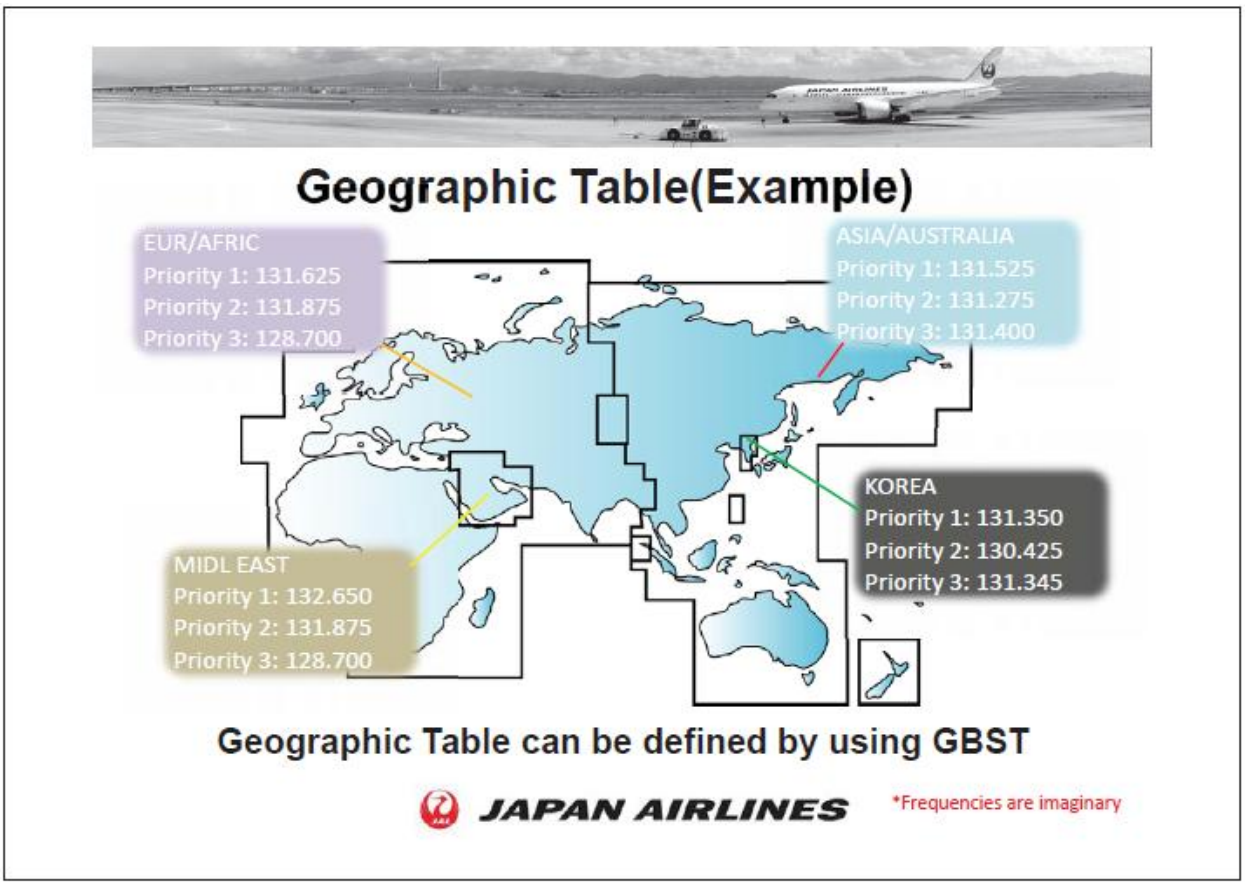

Figure 1

1.3. In areas of the world that have only intermittent VHF subnetwork coverage, avionics that are configured to prefer VHF subnetworks over SATCOM subnetworks switch from SATCOM to VHF and then back from VHF to SATCOM when the aircraft passes an isolated VHF ground station. The time required for these transitions, especially when they occur repeatedly during a short period of time, adversely affects Aircraft Communications Addressing and Reporting System (ACARS) performance for Future Air Navigation System (FANS) operation.

1.3.1. Potential partial mitigations to this issue by amending the ACARS protocol to reduce the time required for transitions between VHF and SATCOM are being discussed in the AEEC Data Link Systems Subcommittee (DLK).

1.4. In some cases the aircraft passes through only the outer edge of the coverage area of an isolated VHF ground station. This allows the avionics to establish a link to the VHF subnetwork but the avionics may not be able to successfully send operational downlink (for example, FANS downlinks) due to the tenuous and temporary nature of the link. Unsuccessful operational downlink attempts also adversely affect ACARS performance for FANS operation.

1.5. Examples of areas of the world in which the DLMA has seen these performance problems include the North Pacific in the vicinity of the Aleutian Islands and the Kamchatka Peninsula, in the South Pacific in the vicinity of New Caledonia and Vanuatu, and in the North Atlantic in the vicinity of Bermuda and the Azores. Here is the sequence of events for a flight that occurred in one of these areas which resulted in submission of a FANS Problem Report:

- 1822Z: Aircraft established first VHF link with GroundStation_1 (GS_1)
- 1822Z-1824Z: AirTrafficServicesUnit_1 (ATSU_1) performed AFN address forwarding to AirTrafficServicesUnit_2 (ATSU_2); eight attempts at uplinking AFN acknowledgement from ATSU_2 over VHF failed before successfully uplinking it over SATCOM

- 1822Z-1825Z: ATSU_2 established CPDLC connection as NDA; seven attempts at uplinking CPDLC connection request over VHF failed before successfully uplinking it over SATCOM
- 1823Z: Aircraft indicated (over SATCOM) that it lost first VHF link with GS_1 after 50 seconds
- 1825Z: Aircraft established second VHF link with GS_1
- 1825Z-1826Z: Seven attempts at uplinking ADS-C request from ATSU_2 over VHF failed before successfully uplinking it over SATCOM
- 1826Z: Aircraft indicated (over SATCOM) that it lost second VHF link with GS_1 after 30 seconds
- 1837Z: Aircraft established third VHF link with GS_1
- 1846Z: Aircraft indicated (over SATCOM) that it lost third VHF link with GS_1 after 8 minutes 29 seconds

2. Discussion

2.1. The DLMA suggests that aircraft operators with capable avionics consider reconfiguring the avionics to exclude areas of the world with only intermittent VHF subnetwork coverage from their VHF region definitions in order to continuously use SATCOM in those areas.

2.2. Figure 2 below illustrates the North Pacific and surrounding regions with the following elements:

2.2.1. The **orange** areas represent imaginary VHF subnetwork coverage that is not intended to be representative of any actual communications service provider (CSP).

2.2.2. The **purple** areas represent relatively large latitude/longitude-based rectangles that coarsely define areas in which the avionics are configured to prefer VHF subnetworks. These rectangles are grouped into sets that define nominal “N_AMERICA”, “ASIA”, “GUAM”, and “HAWAII” geographic regions.

2.2.2.1. For VHF Digital Link (VDL) Mode 0/A operation using the “Plain Old” ACARS (POA) protocol, each geographic region may be configured to indirectly use a desired CSP by specifying use of that CSP’s VDL Mode 0/A frequencies.

2.2.2.2. For VDL Mode 2 operation using the ACARS Over Aviation VHF Link Control (AVLC) (AOA) protocol, each geographic region may be configured to directly use a desired CSP by specifying use of that CSP (which is explicitly identified in each VDL Mode 2 Ground Station Information Frame [GSIF]).

2.2.3. The **teal** areas and line represent a nominal route between eastern Asia (for example, Tokyo or Hong Kong) and the southeastern United States (for example, Memphis or Atlanta).

2.2.4. The **red** stars indicate portions of the nominal route where ACARS performance problems may occur for the reasons described in sections 1.3 and 1.4.

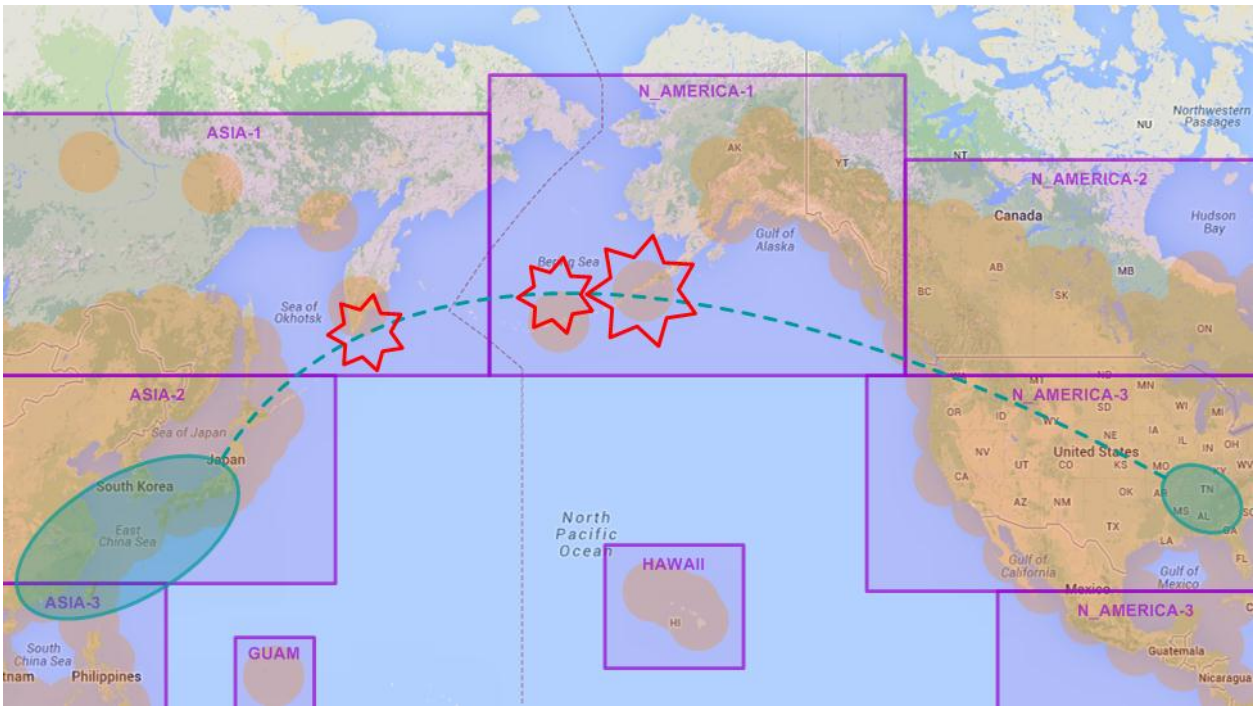

Figure 2

2.3. In contrast, Figure 3 below illustrates the same North Pacific region but with the following differences:

2.3.1. The **purple** areas represent smaller latitude/longitude-defined rectangles that more finely define areas in which the avionics are configured to prefer VHF subnetworks. Compared to the corresponding areas in Figure 1, the geographic regions that these rectangles compose are reduced in size in order to exclude areas with only intermittent VHF subnetwork coverage.

2.3.2. Presuming that the avionics are configured to prefer VHF subnetworks over SATCOM subnetworks, the **red** stars that indicated portions of the nominal route where ACARS performance problems may occur in Figure 1 are no longer present because the avionics continuously use SATCOM in those areas.

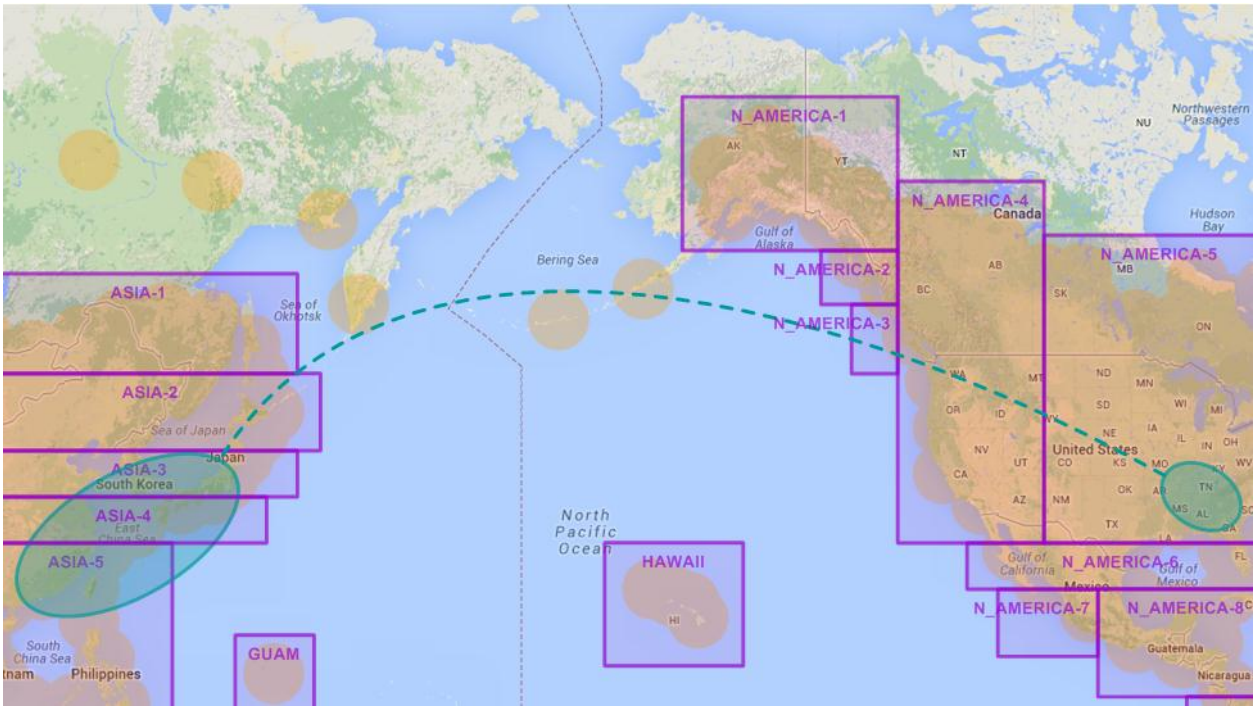

Figure 3

2.4. If aircraft operators reconfigure their avionics as discussed in this paper, then the avionics will admittedly not use VHF in every possible case, but the DLMA expects that the changes will have a positive overall effect because ACARS performance would improve for both air traffic services (ATS) and airline operational communications (AOC) / airline administrative communications (AAC) purposes.

2.4.1. The DLMA anticipates that reconfiguring the avionics to use SATCOM in areas that have only intermittent VHF subnetwork coverage would prevent issues such as FANS Problem Report (PR) 1174-GS, which was submitted due to a particular aircraft operator's poor ACARS performance in the North Pacific. After investigating this PR, the Central Reporting Agency (CRA) attributed the poor performance to multiple time-consuming transitions between VHF and SATCOM. These transitions are one of the issues for which this paper recommends a potential solution.

2.4.2. PR 1209-MM, PR 1219-SN, PR 1230-MM, and PR 1244-MM are other PRs to which use of VHF subnetworks in areas of intermittent coverage appears to have been at least a contributing (if not primary) factor.

2.4.3. Figure 4 below depicts Automatic Dependent Surveillance – Contract (ADS-C) reports that were delivered via SATCOM but were delayed by more than 90 seconds with **orange** arrows. Notably, these arrows generally lie at the approximate edges of relevant VHF ground station coverage areas (also shown in **orange**).

Figure 4

2.5. The DLMA recognizes that aircraft operators would make any decisions to reconfigure their avionics as discussed in this paper on an area-by-area basis in the context of their route structure, planned diversion airports, applicable Minimum Equipment List (MEL), and other relevant considerations, including actual VHF subnetwork coverage offered by their contracted CSPs. Aircraft operators would ideally define the VHF regions to match areas of reliable VHF subnetwork coverage in order to minimize any unintended adverse consequences.

2.5.1. Another option that aircraft operators may consider (instead of reconfiguring their avionics) is implementing flight crew procedures to disable VHF subnetwork use in known problem areas. For example, some avionics permit the flight crew to temporarily place the VHF radio normally used for data communications into voice communications mode.

2.6. Additionally, the DLMA suggests that aircraft operators who are considering reconfiguring their avionics (or implementing flight crew procedures) as discussed in this paper contact the associated aircraft manufacturers and/or avionics suppliers to understand the precise avionics capabilities available to them. Older avionics may not support geographic region definition, and even newer avionics may impose certain restrictions (for example, the number of latitude/longitude-defined rectangles that may be used to define a geographic region). Also, some avionics may allow the aircraft operator to perform the reconfiguration themselves (for example, through defining and loading a revised aircraft operator-modifiable database), while other avionics may be less flexible.

3. Action by the meeting

3.1. The NAT CNSG is invited to note the information presented in this paper.

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