International Civil Aviation Organization

MIDANPIRG Communication, Navigation and Surveillance Sub-Group

Eleventh Meeting (CNS SG/11)
(Muscat, Oman, 16-19 May 2022)

Agenda Item 4: CNS planning and implementation in the MID Region

DATA LINK CAPABILITIES & INTRODUCTION OF CPDLC/DCL SERVICES

(Presented by Saudi Arabia)

SUMMARY

This paper provides an overview on Saudi Air Navigation Services (SANS) ATS data link capabilities set through the new ATM system, VHF Ground Stations supporting VDL and ACARS services, and partnership agreement signed with leading Datalink Service Provider (SITAONAIR). The paper also provides information on the introduction of CPDLC service with Jeddah FIR and Departure Clearance (DCL) at Madinah, Jeddah, Riyadh, Dammam, Abha, and Gassim Towers through automated assistance for requesting and delivering clearances, with the objective of reducing pilot and Controller workload.

Action by the meeting is in paragraph 5.

REFERENCE(S)

ICAO Annex 10 Volume II & III.
ICAO Annex 11;
Doc 4444, PANS-ATM
Doc 9694, Manual of Air Traffic Services Data Link Applications
Doc 10037, Global Operational Data Link (GOLD) Manual
ICAO MID eANP. https://www.icao.int/MID/MIDANPIRG/Pages/MID-eANP.aspx.

1. INTRODUCTION

1.1 The Controller Pilot Data Link Communications (CPDLC) is defined as means of communication between air traffic controller and pilots, using data link for ATC communications. CPDLC allows direct exchange of standardized (pre-formatted) messages between a controller and a pilot, as an alternative to voice communications. In addition, it supports automation by using and processing the exchanged data by onboard and ground systems with error detection and reporting capabilities.

1.2 The CPDLC messages are displayed at air traffic Controller Working Positions (CWPs) and on the flight deck visual display, using specific interfaces and communication subnetworks. The ATM system based CPDLC application provides air-ground data communication for the ATC service. It enables a number of Data Link Services (DLS) to exchange communication and clearance/information/request messages, which correspond to voice phraseology employed during the provision of air traffic control services.

1.3 The CPDLC application provides the following capabilities:

- the air traffic controllers can issue ATC clearances (level assignments, lateral deviations/vectoring, speed assignments, etc.), radio frequency assignments, and various requests for information;
- the pilots can respond to messages, to request/receive clearances and information, and to report information;
- provide error detection, alerting and correction where appropriate; and
- a "free text" feature to exchange information not conforming to defined formats.

1.4 The CPDLC requirements are covered under several ICAO provisions which mainly include: Annex 10, Volume II & Volume III Part 1 Chapter 3, and Annex 11. The CPDLC operational requirements are detailed under ICAO Doc 4444: PANS-ATM and message set are described in Appendix 5 of Doc 4444. Manual of Air Traffic Services Data Link Application (Doc 9694), and the Global Operational Data Link (GOLD) Manual (Doc 10037) are the main guidance material on ATS data link services, including Data Link Initiation Capability (DLIC), and Controller-Pilot Data Link Communications (CPDLC).

2. OVERVIEW ON AVAILABLE DATA LINK CAPABILITIES.

2.1 Saudi Air Navigation Services (SANS) has deployed a state-of-the-art modular, advanced, and integrated Surveillance, Flight Data Processing and Display System based ATM system for the provision of ACC/APP/TWR air traffic control from Riyadh and Jeddah Area Control Centers (ACC), Dammam and Abha Approach Control Centers (APP) and thirteen Local and Remote TWRs. The ATM system comprises also of Training/Simulation/Test facilities and was designed to meet the requirements of ICAO Aviation System Block Upgrades (ASBU) framework defined under Global Air Navigation Plan (GANP), and to further enable easy expansion in order to meet any future upgrading of ICAO ASBU blocks, current, and future ATM needs within Jeddah FIR under various traffic loads, multiple internal terminal areas, and interfacing with local and neighboring ATS facilities.

2.2 The new ATM system is composed of several sub-systems supporting specific functions, which include Air-Ground Data Link applications (ADS-C, CPDLC, Departure Clearance (DCL)) and services for aircraft-controller interoperability. The system is currently compliant with the following data link ASBU elements: COMS-B0/1 (CPDLC (FANS 1/A & ATN B1) for domestic and procedural airspace, COMS-B0/2 (ADS-C (FANS 1/A) for procedural airspace), COMS-B1/1 (PBCS approved CPDLC (FANS 1/A+) for domestic and procedural airspace), COMS-B1/2 (PBCS approved ADS-C (FANS 1/A+) for procedural airspace).

2.3 The Air-Ground Data Link Processing (AGDLP) redundant server-based function is in charge of data link applications (ADS-C, CPDLC, DCL) between aircraft and controllers and ensures the data communication with the air-ground networks infrastructure supplied by SITAONAIR as Datalink Service Provider (DSP).

2.4 With respect to CPDLC, the AGDLP is providing the following features:

- **ATS Facilities Notification/Contract Management (AFN/CM) Manager.** It allows addressing capability for data link applications between aircraft and ground. The AFN/CM application provides the capability to establish a logon between ATS ground and aircraft systems and peer ATS ground systems. The status of aircraft logged/de-logged is conveniently displayed to the Controller;
- **Controller Pilot Data Link Communication (CPDLC) Manager.** It allows exchange data messages between Controller and pilot. The CPDLC application provides the capability to establish, manage and terminate dialogues initiated by the pilot or by the Controller;
- **Departure Clearance (DCL) Manager.** It provides automated assistance for requesting and delivering departure clearances through the data messages exchange

between tower personnel and pilot.

- **FANS(*) Communication Interface.** It contains the ground-end system communications interface for the ACARS network (FANS equipped aircraft).
- **Additional features**. It includes:
  a) management of aircraft addresses or message conversion and formatting;
  b) assignment of messages to the appropriate Situation Data Display (SDD), Flight Data & Flow Management Display (FDD), Tower Flight Strip Display (TFSD), Flight Data Processing (FDP) and Surveillance Data Processing (SDP);
  c) monitoring of the status of data link connection to each flight and the operational procedures concerning specific flights; and
  d) validation of the received messages, e.g., check the Cyclic Redundancy Check (CRC), format of the messages, etc. An illustration on the main Air-Ground Data Link Processing functions is given in **Appendix A**.

2.5 The AGDLP interfaces with the Aircraft Communications Addressing and Reporting System (ACARS) network of Data Link Services managed by SITAONAIR for exchanging ADS-C, CPDLC and DCL with aircraft. The interface with ACARS is supporting the data type that is compliant with the following standards: FANS 1/A AFN, CPDLC and ADS-C messages according to FANS 1/A RTCA DO-258A/EUROCAE ED-100A and DCL messages according to FANS 1/A EUROCAE ED-85A.

2.6 To support the deployment of Datalink services within Jeddah FIR, SANS signed partnership agreement with SITAONAIR where SANS make available its VHF Data link Mode 2 (VDL Mode2) infrastructure: equipment (VHF Ground Stations (VGS), ground network, supporting systems (routing and monitoring) to be used by SITAONAIR for the provision of VHF Data Link Mode 2 (VDL Mode 2) service to airlines and aircraft operators that are customers of SITAONAIR AIRCOM(**) services. SANS and SITAONAIR agreed on responsibility sharing for the deployment, operating, and maintaining of the datalink infrastructure serving Jeddah FIR as illustrated in **Appendix B**.

2.7 The VHF ground stations (VGS) include both VDL and Plain Old ACARS (POA) radios, and are deployed using existing VHF communications infrastructure (Remote Communication Air/Ground (RCAG) used for en-route COM services), Remote Transmitter/Receivers (RTR) used for APP service, and ATC TWRs. The current available coverage of VGS is illustrated in **Appendix C**. The agreement signed between SANS and SITAONAIR covers the deployment of additional 15 VGS to extend the Data Link Services (DLS) within Jeddah FIR.

2.8 The agreement between SANS and SITAONAIR has also defined target performance metrics for the ATS AIRCOM Datalink Service provision which covers:

- VHF Datalink Service Availability (VHF-ASA) with a performance target of 99%;
- ATS AIRCOM Uplink Success Rate (ATS-USR) with a performance target of 96%;
- Satellite DataLink Service Availability (SAT-ASA) with a performance target of 99%; and
- Uplink Deliver Time (ATS-UDT60, UDT120, UDT360 - means the percentage of delays within 60,120,and 360 seconds) with a performance target of 95%.

(*) *FANS means communications using future air navigation system applications including Air Traffic Services Facilities Notification (AFN), Controller-Pilot Datalink Communications (CPDLC), and Automatic Dependent Surveillance-Contract (ADS C) over ACARS.*

(**) *AIRCOM means the service provided by SITAONAIR on a global basis to support the exchanges of messages using the ACARS protocols between aircraft and ground-based systems, regardless of whether such messages support Airlines Operational Communications (AOC) or ATC applications, and regardless of whether such messages have been using Plain Old ACARS VHS stations, VDL Mode 2 stations or satellite services.*

3. INTRODUCTION of CPDLC AND DCL SERVICE WITHIN JEDDAH FIR

3.1 Under the enhancement of the ATS applications, SANS initiated an implementation program to introduce CPDLC service within Jeddah FIR and Departure Clearance (DCL) at Madinah, Jeddah, Riyadh, Dammam, Abha, and Gassim Towers through automated assistance for requesting and delivering clearances, with the objective of reducing pilot and Controller workload and clearance delivery delays. The new services were subject of formal consultation and coordination with the main airspace users to gather their views and feed-back on the overall data link services within Jeddah FIR and their expectations on the introduction of CPDLC and DCL services.

3.2 The CPDLC and DCL services will be provided as an alternative means of communication for non-urgent or time-critical voice communications. The ATC VHF voice communications are immediately available for intervention to address non-routine and time-critical situations. Time-criticality is mainly determined by the following factors: ATC traffic situation, end-to-end performance (systems and flight crew/controller response time) and recovery time. The airspace users should be aware that while a voice communication/response is generally expected in seconds there is latency of CPDLC that depends on the end-to-end system.

3.3 The CPDLC and DCL messages and applications are implemented in accordance with GACA requirements, ICAO Annex 10, Vol. II, III, and Annex 11 provisions and PANS-ATM procedures published under ICAO Doc 4444. The Global Operational Data Link (GOLD) Manual (Doc 10037) is the primary guidance material that was considered in the development of ATS data link operational requirements.

3.4 CPDLC services are available from FL 150 and above within Jeddah FIR to all equipped aircraft with ATN VDL Mode 2, FANS1/A and FANS1/A+. The following CPDLC services are provided:

- Data link initiation capability;
- ATC clearances and instructions; and
- ATC communications management.

3.5 Regarding CPDLC messages, they are classified according to uplink and downlink categories and have associated urgency, alerting, and response attributes. The CPDLC application will have the following primary functions:

- the exchange of Controller-pilot messages with the ATS unit with which an aircraft has an active CPDLC connection is referred to as the current data authority (CDA);
- the transfer of data authority involving current and next data authority (NDA). The ATSU with an inactive CPDLC connection is referred to as the NDA;
- the messages are generated and sent in a time-ordered sequence to specific recipient (Pilot/Controller);
- the messages are delivered in the order that they are sent;
- supporting up to 64 active (unfinished) CPDLC messages exchanged between the ground system and each one of the aircraft linked with the ground system; and
- Recording of the CPDLC history information.

3.6 The CPDLC message set definition follows the documents of Interoperability Requirements Standard for FANS (EUROCAE ED-100A) and Minimum Operational Performance Standards for ATC Two-Way Data Link Communications (RTCA/ DO-219) for FANS-1/A. SANS's ATM system is able to receive, process and respond to messages defined in ICAO Doc 4444 and Doc 10037. It reacts proactively to some CPDLC uplink messages, such as Cleared Flight Level change, updating the trajectory calculation, flight plan information and flight data-block accordingly.

3.7 The Departure Clearance (DCL) function is integrated in the System for FANS 1/A+ equipped aircraft and performed by the Air-Ground Data Link Processing (AGDLP) and the FDP functions as explained under §2 of this paper. The DCL function is implemented in accordance with the standards: ED-85A specifications and DCL dialogue is carried out using the Tower Electronic Flight Strips. The Air Traffic Controller can check the status of the DCL dialogue by means of a color background in the corresponding field of the Tower Electronic Flight Strips and DCL dialogue setting (manual or automatic mode) can be managed from the ATC TWR Supervisor's position.

3.8 The DCL message types and contents exchanged between aircraft and ATC TWR, are set in accordance with the standard ED-85A, and comprise the following:

- Departure Clearance Request (RCD), Downlink – RCD.
- Departure Clearance Uplink (CLD), Uplink – CLD.
- Departure Clearance Readback (CDA), Downlink – CDA.
- Flight System Message (FSM), Uplink – FSM.

3.9 For the introduction of CPDLC and DCL services, SANS developed Safety Risk Assessment for each application, operational procedures, and transition plan covering:

1) coordination with airspace users to share information on the introduction of CPDLC and DCL and ways and means to report issues and concerns on services;
2) final checks on operational and technical readiness for the introduction of CPDLC and DCL services;
3) amendment to KSA AIP to provide details on the new services;
4) initial operational trial period of 15 days starting on 1st July 2022 to capture major issues. A go/delay will be taken based on the outcome of this trial; and
5) post-implementation assessment over a period of 180 days to assess CPDLC and DCL data link performance in Jeddah FIR and selected aerodromes through detailed analysis of delivery performance on the following areas of interest: uplink performance, downlink performance, message reject rate, and system availability.

3.10 The results and outcome of the assessment and analysis of CPDLC and DCL data link performance will be shared through MID CNS SG during the upcoming meetings.

4. CONCLUSION

4.1 Controller-pilot data link communication (CPDLC) and Departure CLearance (DCL) provide means of communication between the controller and pilot, using data link for ATC communication. These applications include a set of clearance/information/request message elements which corresponds to the phraseologies used in the radiotelephony environment. Standard voice radiotelephony will remain the primary means of ATC communications at all times. Any failure event concerning CPDLC and DCL will lead to a reversion to voice operation.

4.2 The introduction of CPDLC and DCL services have been identified by SANS as ATS data link services that will achieve the following benefits:

- Less communication on the ATC frequency;
- Increased of airspace and ATC sector capacities;
- More pilot requests can be dealt with simultaneously;
- Reduced probability of miscommunication/misunderstanding (e.g. due call sign confusion); and
- Safer frequency changes, hence reduction of loss of communication events.

4.3 The Implementation of CPDLC and DCL services are intended as supplementary means of communication to the use of voice communication and will be used in the context of non-time-critical communications. The procedures related to CPDLC and DCL operations, flight planning, transfer between data authority, type of messages and their composition, phraseology, and switch to voice communications will be described under KSA AIP GEN 1.5 and AD 2.20 section for each aerodrome where DCL is introduced.

4.4 The use of CPDLC and DCL is not mandatory in KSA and is conducted at the discretion of ATC and the pilots concerned. In order to use the CPDLC and/or DCL services, pilots shall file the respective aircraft equipage in their flight plan (FPL 2012 format), field item 10 with the appropriate J codes and field 18, as defined under ICAO Doc 4444, Appendix 2.

4.5 Where urgent or time critical communications are required, voice communications must be used. Voice read back is not required for any CPDLC and DCL instructions. In cases where uncertainty arises as a result of a data link message, communication shall revert to voice.

5. ACTION BY THE MEETING

5.1 The meeting is invited to:

a) note the information provided in this paper;

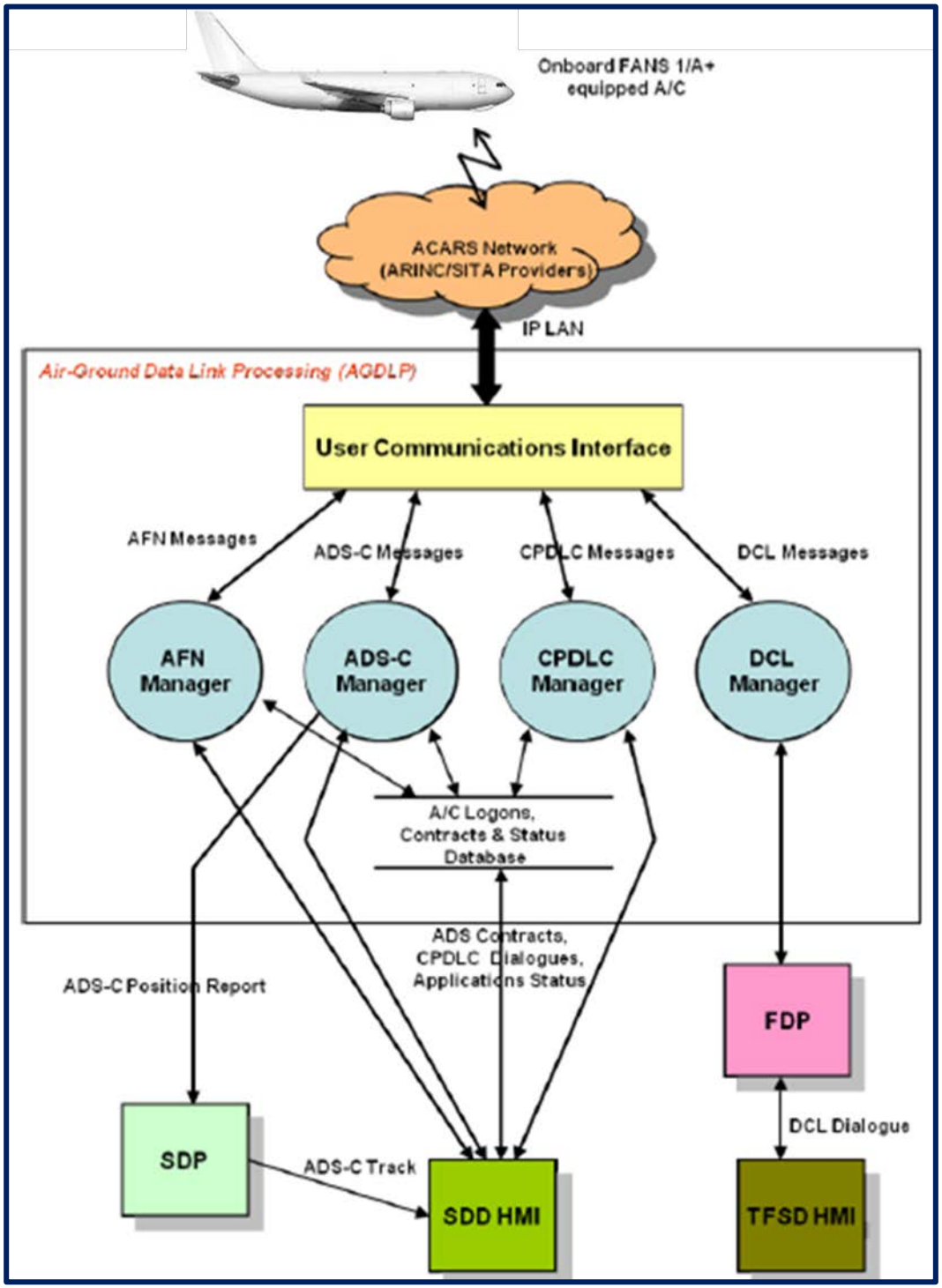
b) encourage MID States to share information on their experience related to introduction of Data Link Services (DLS);

c) invite ICAO MID office to organize a webinar or workshop on ATS datalink services and RCP/RSP implementation; and

d) discuss the proposal to establish a task force or AG to draft a proposal for amendment to ICAO MID supplementary procedures and guidance material on data link services.

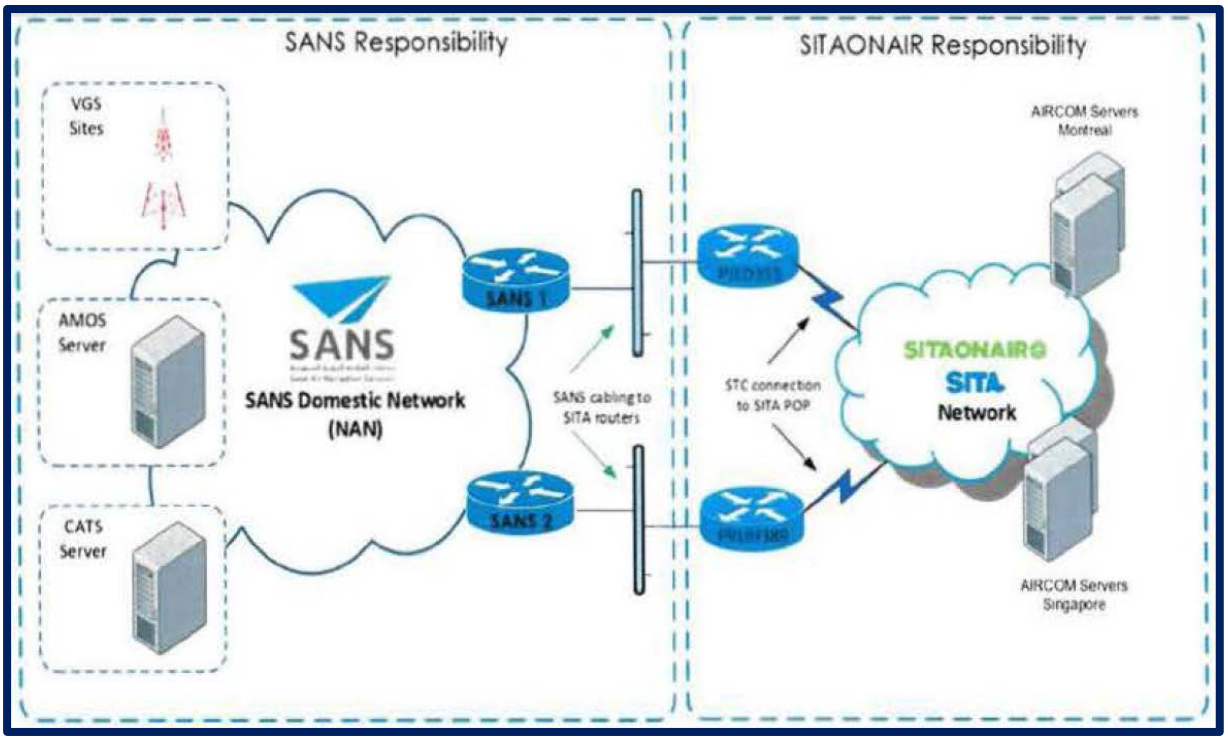
APPENDIX A

ILLUSTRATION ON THE MAIN AIR-GROUND DATA LINK PROCESSING FUNCTIONS PROVIDED BY THE ATM SYSTEM DEPLOYED BY SANS



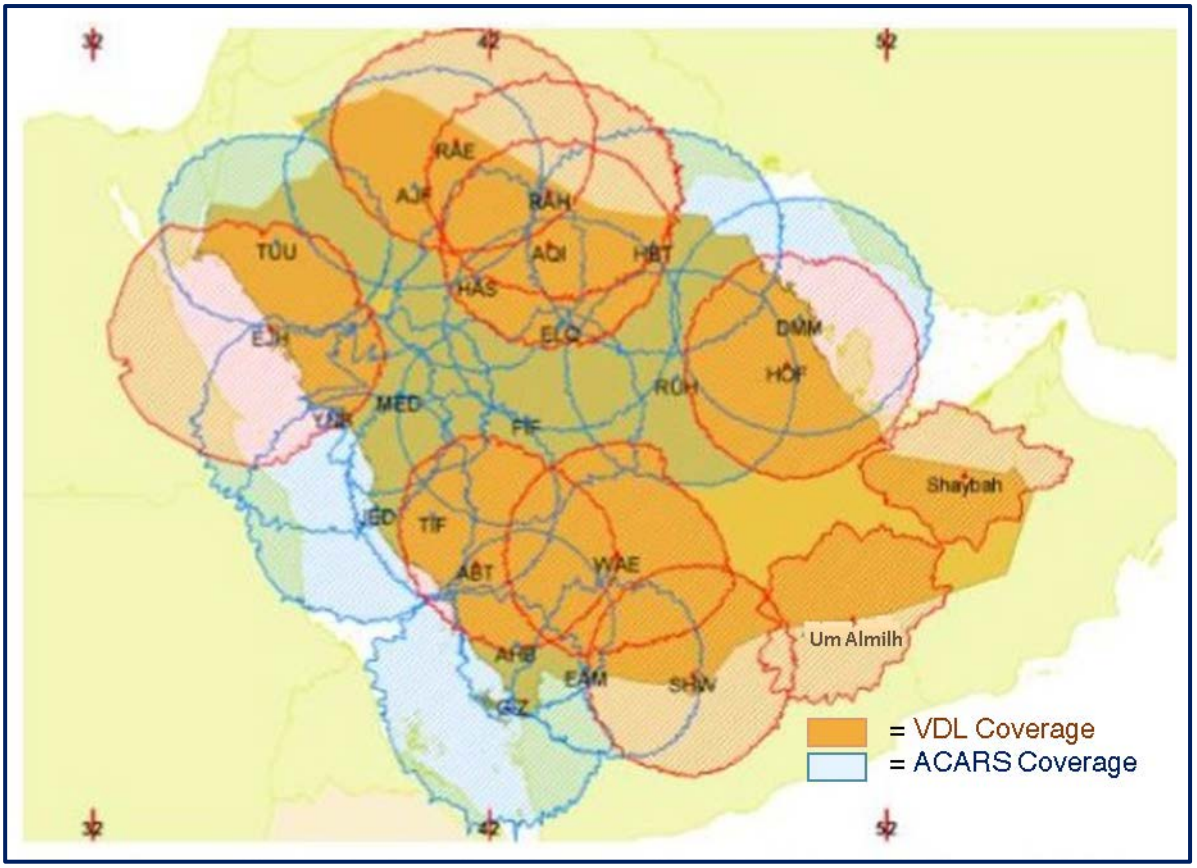
APPENDIX B

RESPONSIBILITIES SHARING BETWEEN SANS AND SITAONAIR FOR THE DEPLOYMENT, OPERATING, AND MAINTAINING OF THE DATALINK INFRASTRUCTURE SERVING JEDDAH FIR



APPENDIX C

CURRENT VGS COVERAGE USED FOR DATA LINK SERVICES WITHIN JEDDAH FIR



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