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ASSEMBLY — 41ST SESSION

TECHNICAL COMMISSION

Agenda Item 33: Other issues to be considered by the Technical Commission

USE OF MICROWAVE LINKS FOR NAVIGATIONAL AIDS MONITORING AND TRANSFER OF ATS SURVEILLANCE DATA

(Presented by Saudi Arabia)

EXECUTIVE SUMMARY

This paper provides an overview on microwave line of sight (LoS) Links and its use by the air navigation service provider in the kingdom of Saudi Arabia (Saudi Air Navigation Services (SANS)) to monitor navigational aids at certain aerodromes and to transfer air traffic services (ATS) surveillance data for the provision of approach service within Jazan TMA. The paper also describes the methodology used by the air navigation service provider in the kingdom of Saudi Arabia (SANS) to validate the solutions proposed by the Telecommunication operators of microwave links.

<i>Strategic Objectives:</i>	This paper relates to the Safety and Air Navigation Capacity and Efficiency Strategic Objectives.
<i>Financial implications:</i>	Without any financial implications
<i>References:</i>	Annex 10 — <i>Aeronautical Telecommunications</i> Volume I — <i>Radio Navigation Aids</i> , Volume II — <i>Communication Procedures including those with PANS status</i> , Volume III — <i>Communication Systems</i> and Volume IV — <i>Surveillance and Collision Avoidance Systems</i> ; Doc 4444, <i>Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM)</i> Doc 9426, <i>Air Traffic Services Planning Manual</i> Doc 9718, <i>Handbook on Radio Frequency Spectrum Requirements for Civil Aviation including Statement of Approved ICAO Policies</i> MIDANPIRG/19 Final Report, Section §5.8.38.

1. INTRODUCTION

1.1 The monitoring of radio navigation aids, in the kingdom of Saudi Arabia, is conducted by the air navigation services provider (Saudi Air navigation Services (SANS)) at operational and technical levels as required by General Authority of Civil Aviation (GACA) Regulation Parts 171 and 173. In general, available ground network and wired connections, between the navigation aid site and ATS TWR and technical rooms are used to automatically monitor the status of each navigation facility.

1.2 However, at some domestic and regional aerodromes and at certain remote sites, connectivity challenges are faced for the deployment of wired connections for navigational aids monitoring due mainly to aging ground wired network infrastructure which requires substantial investment for the renewal and replacement of existing cables. To overcome these limitations, the air navigation services provider in the kingdom of Saudi Arabia (SANS) initiated an engineering program to explore the best sustainable and cost-effective solution. The focus was on the use of available technologies to build wireless access.

1.3 The worldwide interoperability for microwave access (WiMAX) technology was elected as the best candidate option to provide connectivity between facility sites and local network to support the monitoring of certain navigational aids at aerodromes with low to medium traffic levels and for the transfer of surveillance data for the provision of Jazan approach service effective since 24 February 2022.

1.4 The deployment of this solution is based on point-to-point microwave line of sight (LoS) links (A link that connects two terminal stations that conveys either unidirectional or bidirectional traffic) setting using two main nodal stations, each one at the edge of the link path, without obstacles in the propagation path that could cause blocking or diffraction, and using antennas with high directivity, also named narrow-beam antennas.

1.5 Moreover, the air navigation services provider in the kingdom of Saudi Arabia (SANS) identified the microwave LoS links as a quick and low-cost solution for access and transit network as its rollout is fast and offers deployment of flexible connectivity for the deployment for CNS/ATM facilities. One of the key characteristics of microwave LoS link is the mobility with the possibility of moving physically the equipment used for microwave LoS link which provides further benefits for its use in the case of disaster recovery, emergency situations, or as temporary backup system where the wired networks (e.g fiber-optic cables) have broken down requiring the application of contingency arrangements.

2. OVERVIEW ON MICROWAVE LINKS USED IN SAUDI ARABIA

2.1 Based on the acceptance issued by the General Authority of Civil Aviation (GACA) of the kingdom of Saudi Arabia, the air navigation services provider (SANS) defined a structured-methodology and design procedures for the implementation of microwave LoS links. The Telecommunication providers of microwave links are selected based on their experience and infrastructure within the target areas. For each critical microwave link, two telecommunication providers are selected with an adequate level of redundancy, different frequency band, and frequency plans for the repeaters. The main phases and activities for setting a new microwave LoS link can be summarized as follows:

- **Phase 1 Preliminary Studies.** This phase includes the following activities:
 - a) analysis of the specifications and study of the application for which the link will be designed (Navigational aids monitoring and transfer of surveillance data). This activity involves an evaluation of the technologies upon which the link will be designed (TDM, IP, Ethernet) in relation to the capacity requirements of the application and the possible restrictions arriving from the network that the link is going to belong;
 - b) coordination with the third-party providers (Telecom operators) to assess their capabilities and solutions;
 - c) study of the frequency band (in many cases, this is a specification that cannot be modified as it is proposed by the third-party providers (COM operators)). The frequency band must be approved and assigned by Saudi Communications and Information Technology Commission (CITC) based on Wireless Access Systems, including Radio Local Area Networks (WAS/RLAN);
 - d) equipment selection and specification studies. Analysis of the capacities provided by different manufacturers and models, base band and multiplexing options, system upgrade and extension possibilities, diversity and redundancy schemes allowed, etc.;
 - e) study of the availability and error performance objectives and the allocation of a portion to the Microwave link in relation to the network where the system will be installed and used. This task is based on reference values found in ITU-T and ITU-R Recommendations for availability and error performance objectives (Cross check with the values proposed by the operator of the radio link considering the experience in previous designs on the specific geographic area); and
 - f) first analysis of the link radio route and terrain profile. This first path analysis identifies the number of hops (link section between two radio Stations either between a nodal and a repeater station or between repeater stations) and the candidate sites for intermediate repeater stations if those are required.
- **Phase 2 Detailed Link Design submitted by the Telecom operator of the link.**
 - a) design of an initial frequency plan. This activity will propose the radio channel arrangements in each one of the hops of the link;
 - b) detailed study of the radio network route. Intermediate repeater station choice and calculations associated with terrain profiles (antenna heights, clearance criteria, etc.);
 - c) assignment of error performance objectives to the different sections (hops) of the radio link and analysis of the system threshold values;
 - d) link budget design in each one of the link hops. Evaluation of system margins and preliminary decision about the use of diversity and redundancy techniques; and

- e) interference analysis. Study of intersystem interferences and optimization of the radio channel plan. Discussion and Decision about the need for special antennas that might mitigate interference problems in complex frequency reuse scenarios.

- **Phase 3 Installation and Testing.**

- a) inspection of path obstacles and relevant spots in the field/locations. Site redesign and antenna height recalculation if necessary and
- b) equipment setup and installation. System tests to evaluate Background Bit Error Rates (BBERs), system threshold checks, identification of unexpected interference problems, etc.

3. CONCLUSION

3.1 The implementation of microwave LoS links can support various CNS/ATM applications associated with the transfer of information and data. It allows the ATS providers to overcome limitations in the ground wired network infrastructure and introduce cost-effective solutions that deliver high speed data communication and maintain dedicated links at a reliable and high-quality for data transfer. The use of Microwave LoS links for navigation aids monitoring and Surveillance data transfer should be subject of special considerations to ensure proper integration and comply with real time monitoring requirements.

3.2 The Microwave LoS links can also support the setting of sustainable solutions as backup links where wired network infrastructure breaks and allow identification of contingency arrangements that may include moving of equipment associated with the Microwave LoS links when an evacuation of an ATS facility is needed.

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