International Civil Aviation Organization

MIDANPIRG/19 & RASG-MID/9 Meetings

(Saudi Arabia, 14-17 February 2022)

Agenda Item 5.8: CNS

Use of Wireless Links for Navigational Aids Monitoring and transfer of Surveillance Data

(Presented by Saudi Arabia)

SUMMARY

This paper provides an overview on Microwave Line of Sight (LOS) Links and its use by Saudi Air Navigation Services (SANS) to monitor navigational aids at certain aerodromes and to transfer surveillance data for the provision of approach service in Jazan. The paper also describes the methodology used by SANS to validate the solutions proposed by the operators of Microwave LOS links.

Action by the meeting is in paragraph 4.

REFERENCE(S)

ICAO Annex 10 Volume I, II, III & IV.

Doc 9750, Global Air navigation Plan

Doc 9718, ICAO Handbook on Radio Frequency spectrum for Civil Aviation.

ICAO MID eANP. https://www.icao.int/MID/MIDANPIRG/Pages/MID-eANP.aspx

1. INTRODUCTION

1.1 As defined by ICAO, an aeronautical telecommunication network enables the exchange of information among users or CNS/ATM systems that can be either fixed or mobile. Independently of the mobile or fixed nature of the target CNS/ATM system (receiver), the signals involved in the communication process transport digitized information that is associated with final services such as voice, ATS messages, video, or any aeronautical data. Every network is composed of two basic components: network nodes and transmission systems. The network nodes provide the control, access, security, aggregation/multiplexation, switching, signaling management, interfacing with other networks, and routing functions.

1.2 The aeronautical transmission systems enable the transport of signals either from the user CNS/ATM systems to the network nodes or between different nodes of the network. The transmission systems can be based on different delivery media. Usually, the transmission media have been divided into wireless systems, where the information is delivered by means of electromagnetic waves that propagate through the atmosphere, and systems based on transmission lines (physical network), where the electric or optical signals propagate through a closed medium. The metallic transmission of electric signals uses lines/network that usually are copper pairs or coaxial cables, whereas the optical signals are sent over glass fiber cables.

1.3 ICAO Annex 10 defines an aeronautical radio link of the Fixed and Mobile Service as any radiocommunications link between two stations based on the propagation of signals through the atmosphere at assigned frequencies. The Microwave line-of-sight (LOS) links are a subgroup of the Fixed Service. Microwave LOS links are composed of point-to-point systems between two terrestrial stations that transmit and receive signals taking advantage of the propagation of waves through the lower part of the atmosphere (troposphere).

1.4 The Microwave links operated in LOS condition for monitoring of navigational aids and surveillance data are using 5.8 GHz under specified availability and quality conditions. These systems are in practice referred as microwave links (MW links), LOS microwave, fixed service radio links, or simply radio links.

1.5 To overcome any limitation of ground infrastructure, the Microwave LOS links have inherent advantages that are a consequence of wireless propagation without the need of having a physical carrier that connects transmitter and receiver. This advantage is major in remote areas and within areas with irregular orography (mountain areas), zones where deploying a network system (cables) is difficult, areas where physical access is a challenge, and cases where common infrastructures are not developed or not available for use.

1.6 Moreover, the microwave LOS links are usually the solutions with lowest cost in the case of access and transit network if the network rollout requires fast and flexible connection deployments for CNS/ATM facilities. The possibility of transporting physically the equipment of a microwave LOS link provides further benefits for its use in the case of emergency situations, natural disasters, or temporary backup system in severe damages suffered by fiber-optic link cables requiring the application of contingency arrangements.

1.7 Considering these advantages, Saudi Air Navigation Services (SANS) opted for **the deployment of microwave LOS links to support the monitoring of certain navigational aids at aerodrome with low to medium traffic and for the transfer of surveillance data at Jazan approach** that will be effective on 24 February 2022.

1.8 The deployment of these solutions is based on point-to-point microwave LOS links (A link which 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. The main topology has a shape of ring where the nodes are connected with links that form a ring. Any destination node of a ring can be reached following two paths, clockwise and counterclockwise direction. An illustration on the Microwave LOS link network topologies deployed by SANS is attached to this paper.

2. OVERVIEW ON THE DESIGN OF MICROWAVE LOS LINK SYSTEMS

2.1 Saudi Air Navigation Services has defined a structured- methodology and design procedures for the implementation of microwave LOS links. The main phases and activities 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 and its compatibility for which the link will be designed (Navigational aids monitoring and transfer of surveillance data). This activity involves an evaluation of the transport 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. This analysis will identify the solution to be deployed which is divided into options:
     1) Microwave Links solution owned and maintained by SANS
     2) Microwave LOS Links that will remain under the responsibility of a third-party i.e Telecom provider.

  b) Selection of third-party provider based on an assessment of the capabilities and proposed solutions. For Microwave LOS links proposed by telecom providers, the experience and infrastructure within the target areas are key factors in the selection. For critical Microwave LOS links, two Telecom providers are selected with adequate level of redundancy, different frequency band and frequency plans for the repeaters.

c) Study of the frequency band. 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 equipment specification studies. Analysis of the capacities provided by different manufacturers and models, base band and multiplexation 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 MW 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.
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 were required.

- **Phase 2: Detailed Link Design submitted by the 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 and associated obstacle evaluation. 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.
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, Testing, Operation, and Maintenance.**

a) Inspection of path obstacles and relevant spots in the field/locations. Site redesign and antenna height recalculation if necessary.
b) Equipment setup and installation. System tests to evaluate background bit error rates (BBERs), system threshold checks, identification of unexpected interference problems, etc.
c) Link operation and maintenance.

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 any limitation in the ground infrastructure and introduce effective solutions with lowest cost in the case of access and transit network if the network rollout requires fast and flexible connection deployments for CNS/ATM facilities.

3.2 The Microwave LOS links can also support the definition of sustainable solutions for redundancy of network infrastructure and identification of contingency arrangements that include transport of equipment associated with the Microwave LOS links when an evacuation of and ATS facility is needed. The meeting is invited to consider the following conclusion and decision:

DRAFT MIDANPIRG CONCLUSION:19/XX: Usage of wireless connections/links for CNS/ATM applications

That States:

a) share information on the implementation of wireless connections/links for CNS/ATM applications and its potential use for the implementation of Performance-based Communication and Surveillance (PBCS) applied to the provision of ATS.

b) support MID CNS SG in the development of guidance material on the usage of wireless connections and links for the transfer aeronautical information and data to support the provision of ATS.

DRAFT MIDANPIRG DECISION:19/XX: Development of Guidance material on wireless connections/links for CNS/ATM applications

That CNS SG develops guidance material on the usage of wireless connections and links for the transfer of aeronautical information and data to support the provision of ATS.

4. ACTION BY THE MEETING

4.1 The meeting is invited to:

a) note the information provided in this paper;
b) discuss and adopt the proposal for conclusion and decision provided under paragraph 3.2 of this paper.

— END —

Attachment - Microwave LOS link network topologies deployed by SANS