*International Civil Aviation Organization*

**Ninth Meeting of the Surveillance Implementation Coordination Group (SURICG/9)**

*Bangkok, Thailand, 7 – 10 May 2024*

**Agenda Item 6:** Report on surveillance ground system and avionics performance monitoring and improvement in compliance

# GUIDANCE ON MANAGEMENT OF 1030/1090 MHz UTILIZATION

(Presented by Singapore)

**SUMMARY**

This information paper presents the works that is being undertaken by the Surveillance Panel to manage the 1030/1090 MHz utilization.

## 1. INTRODUCTION

1.1 The utilization of the 1030/1090 MHz frequencies has greatly increased in certain areas of the world. If no action is taken, the situation will reach an unacceptable level that will result in harmful corruption or loss of information to the aeronautical surveillance and collision avoidance systems.

1.2 The total or partial loss of this data will affect the ATM systems and aircraft to-aircraft systems resulting in an increase in the probability of mid-air collisions, disruption to Air Traffic Services, and a reduction in airspace efficiency.

1.3 There are several applications currently competing for channel time on the 1030/1090 MHz frequencies. It must be ensured that the spectrum capacity is being utilized in the most efficient way to preserve the performance of current systems and to consider future applications that require an increase in capacity.

## 2. DISCUSSION

2.1 The Surveillance Panel therefore established the Surveillance Spectrum Focus Team (SSFT) in September 2019 to look into the overall issue of 1030/1090 MHz utilization, including the impact of evolving systems that will potentially share the 1030/1090 MHz link (e.g. RPAS, new ACAS versions, military IFF, Electronic Conspicuity devices for General Aviation) contributing to the spectrum load. It also covers examining techniques and capabilities that could be considered to reduce 1030/1090 MHz congestion.

2.2 The SSFT will develop specific solutions, which can be transferred into Proposals for Amendment for Annex 10 Volume IV or change proposals for ICAO Manuals.

2.3 Annex A identified issues related to 1030/1090 MHz spectrum load and possible mitigations. It also contains information to affected ICAO documents and specific aspects like regulation and already available standards. All this material is considered as a basis to formulate appropriate text for ICAO SARPs and guidance material. Annex A is a “living document” and will be continuously updated to provide a comprehensive database.

2.4 States are urged to follow the guidance and SARPs and guidance materials produced to keep the frequency utilization healthy.

## 3. ACTION BY THE MEETING

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

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# Annex A 1030/1090 MHz Spectrum Utilization Analysis List

| Issue # | Priority Status | Problem description | Possible mitigation(s) | Affected Document(s) | Affected Section(s) | Remarks / Limitations | Proposal for SARPs and Guidance Material | Regulatory aspects |
|---|---|---|---|---|---|---|---|---|
| 001 | LOW | Mode A/C utilization | (1) Reduction of Mode A/C transmissions from transponders | Annex10V4 | 3.1.1.7.9.2 | This means the reduction of the maximum Mode A/C reply rates by decreasing the limit for the reply limiting function in the standard. Requires MOPS and SARPS changes | Implement a change from 500 to 2000 to only 500 (?) | |
| | | | (2) Guidance for the correct calculation of minimum necessary interrogation rates | Doc 9924 | Annex? | **SSFT-AI-20/004**<br>**SSFT-AI-20/007** | Introduce a common formula | |
| 002 | CLOSED | | | | | | | |
| 003 | MED | Too high or also insufficient number of all-call replies due to unclear interpretation of all call IRF for “paired interrogation “ | Clarify the meaning/number of IRF for “paired interrogation “ | Annex10V4 | 3.1.2.11.1.1 | Limit of 250 for A/C/S and “paired” interrogations seems insufficient for “paired” (125+125).<br><br>**SSFT-AI-20/006** | | |
| 004 | CLOSED | | | | | see issue 021, CP004 and CP005 | | |
| 005 | CLOSED | | | | | see CP005 | | |
| 006 | CLOSED | | | | | see CP006 | | |
| 007 | CLOSED | | | | | see CP007 | | |
| 008 | CLOSED | | | | | | | |
| 009 | CLOSED | | | | | see CP009 | | |
| 010 | MED | Unnecessary (re-) extractions of BDS registers | (1) BDS extraction and information distribution in Mode S radar clusters | Doc 9924 | | Data distribution by radar data networks for unclustered radars. | Provide guidance on efficient extraction of BDS registers. Combine it with issue #11 to give guidance on disallowing WAM extracting BDS, use of ADS-B, and explain the longer-term solution of Phase Overlay. | |
| | | | (2) closed | | | see CP010 | | |
| | | | (3) closed | | | see CP010 | | |
| | | | (4) closed | | | see CP010 | | |

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|---|---|---|---|---|---|---|---|---|
| 011 | MED | Active extraction of EHS BDS registers by WAM systems causing high transponder occupation | Candidate: Phase Overlay | Annex10V4 | 6.3, new 6.3.6 or new note in 6.3.4 | Definite statements in the standard necessary (not allowed in high density areas, only below 2% occupation, use of passive methods, etc.) | Recommend that MLAT should not extract BDS registers | |
| 012 | CLOSED | | | | | | | |
| 013 | HIGH | Misaligned Surveillance and Lockout Coverage in Mode S radars | Both coverage maps should be aligned to minimize the area of all-calls without lockout. A corresponding output power should be chosen. | Doc 9924 | Appendix H, J | Check that the use of the "Datalink Map" feature is addressed. Validate which TSG WP is providing this guidance. **The WP does not address this specific issue** | | |
| 014 | HIGH | Generation of unused XPDR replies due to unnecessary high interrogator output power | The interrogator output power shall be adjusted to the surveillance coverage | Doc 9924 | Appendix H, J | See issue 013<br>Validate which TSG WP is providing this guidance. | | |
| 015 | CLOSED | Too many interrogation-reply cycles caused by high IRF | (1) closed | | | see CP005 | | |
| | | | (2) removed | | | Covered by issue 001 (1) | | |
| 016 | MED | Implementation of new collision avoidance logic(s) by use of Mode S Extended Squitter messages (e.g., ACAS-X for UAS and sUAS) | (1) Require Extended Hybrid Surveillance<br>(2) Limit interrogation-reply for certain new entrants 3) Discourage the use of Passive Coordination | Annex10V4 | | Impact of use of additional ADS-B messages for collision avoidance, i.e., high spectrum use due to raised squitter rates. | | |
| 017 | MED | Implementation of RPAS detect and avoid (DAA) systems operating on 1030/1090 MHz | (1) Require Extended Hybrid Surveillance<br>(2) Limit interrogation-reply for certain new entrants<br>(3) Discourage the use of Passive Coordination | Annex10V4 Other Docs? | | RPASP needs to update A10V6 and guidance material | Is being resolved by DAA MOPS and SARPS? | |
| 018 | LOW | Utilization of military Mode 5 on regular basis | Monitoring is recommended, Coordinate with military authorities | Doc 9924 | | Current studies/simulations and tests show a negligible impact to the civil 1030/1090 MHz environment. | No proposal on SARPS and Guidance Material Check existing guidance is sufficient for this purpose | This is state responsibility |
| 019 | CLOSED | | | | | Covered by issue #022 | | |

| Issue # | Priority Status | Problem description | Possible mitigation(s) | Affected Document(s) | Affected Section(s) | Remarks / Limitations | Proposal for SARPs and Guidance Material | Regulatory aspects |
|---|---|---|---|---|---|---|---|---|
| 020 | LOW<br>In Progress | Discrepancy in understanding of the use of PARROTs and test equipment due to the split of requirements in SARPS and Guidance Material | All essential requirements should be in one document | Annex10V4<br>Doc 9924<br><br>Doc 8071V3 | 2.2.5.1<br>Appendix D, 2.7.3, 2.7.4<br>2.3 | This can lead to only a limited application of requirements to such equipment and consequently cause interference. | Merging of existing texts in one document, preferably Doc8071.<br><br>**SP5-ASWG18-WP12** | |
| 021 | LOW<br>In Progress | SSR/Mode S transponder unavailability due to high mutual suppression bus activity caused by other onboard equipment | | Doc 9924 | Appendix M, 8.5 | General: what is the MSB load today? Input to Doc9924 table M-1 and M-2?<br>Should new systems (e.g., LDACS) cause unexpected load? | What is the amount of additional load that can be accepted? | |
| 022 | HIGH<br>In Progress<br>(2) | Interference from aviation and non-aviation or non-ICAO systems adjacent to 1030/1090 MHz | (1) Better selectivity of 1030/1090 devices | Annex10V4<br>Doc 9924 | | Currently defined limits seem not sufficient to guarantee good resilience. | A TSG Action Item exists to define out-of-band rejection. | |
| | | | (2) Provision of interference tolerance criteria (ITC) | Doc 9924 | Appendix M | The development of ITC and SARPS acceptance nearly complete. | See for A10V4 PfA<br><br>**SP5-ASWG18-WP05** | |
| 023 | NO | RPAS C2-Link implementation and operation in the L-band adjacent to 1030/1090 MHz | Monitoring is required Issue #022 will help | | | See ICAO state letter AN 7/67.1.119/52, consider states responses<br>Might be overcome by RPAS SARPS. Clarification is required. | | |
| 024 | CLOSED | | | | | see FIN024 (1) and CP024 (2) | | |
| 025 | LOW | Lack of guidance material for 1030/1090 MHz environment and surveillance system performance models | Add modeling GM to Doc 9924 | Doc 9924 | Appendix M | Start with compilation of TSG papers presenting modelling results. Proprietary methods that cannot be shared may limit the depth of material that can be added to any GM. | Development of a performance metric and threshold matrix | |
| 026 | CLOSED | | | | | Covered by issue #032 | | |
| 027 | LOW<br>In Progress | High number of All-Call interrogations in the cone of silence of Mode S radars | Develop provisions and guidance to avoid unnecessary high transponder reply rates | Annex10V4<br>Doc 9924 | | Information can be found in<br>**SP-ASWG14-WP/13**<br>**SP-ASWG17-WP/23** | A WP is anticipated for TSG/18 | |
| 028 | LOW | Excessive interrogations, mostly from (military) mobile platforms causing XPDR replies up to the edge of reply capacity. | | Doc 9924 | | Mode A/C is covered by issue #001<br>Mode S, Interrogator Code=0<br><br>(Note: NATO guidance is under | Guidance for the use of II=0, Monitoring is recommended | |

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|---|---|---|---|---|---|---|---|---|
| | | | | | | development) | | |
| 029 | LOW | ATCRBS Replies to Low-Level Mode S Interrogations | | | | It is suggested that further analysis be conducted, see for more details **ASWG TSG WP14-26** | | |
| 030 | LOW<br>In Progress | Ground interrogators during maintenance cause high transponder reply rates | | Annex10V4<br>Doc 9924 | Appendix D, M | Antenna windmilling or interrogating while the antenna is not rotating | Guidance material and SARPS should be developed<br><br>**SP5-ASWG18-WP16** | |
| 031 | LOW | CW interference on 1030 MHz causes high transponder reply rates | | Annex10V4<br><br>Doc 9924 (DO-181F, ED-73F) | 3.1.1.7.8.1 and 3.1.2.10.1.1.4 | Recently detected issue, XPDR load was caused by an antenna test facility.<br>Requires MOPS and SARPS changes (?) | Guidance material should be developed<br><br>**SP-ASWG17-WP/14**<br>**SP-ASWG17-WP/15** | |
| 032 | MED<br>In Progress | Interference Consideration is outdated and requires updating for new transponder, ADS-B MOPS, and modern surveillance environment | Review applicability of current Appendix M material and propose changes and additions | Doc 9924 | Appendix M | | **ASWG TSG WP17-21**<br>(WP update at TSG/18) | |

**Agreed solutions or changes to SARPs and/or Guidance Material**

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|---|---|---|---|---|---|---|---|---|
| | FIN | Inconsistency of RF measurement methodologies and results reporting | Add RF measurement guidance material to Doc 9924 | Doc 9924 | Appendix M | | **CPASM/19** | **Doc 9924 3rd Edition 2020** |
| 006 | FIN | Use of uncertified transponder or NT/ES devices for small UAS | Add guidance material to Doc 9924 | Doc 9924 | Appendix S, section 1 to 3 | | **State Letter SP44/2-19/77** | **Doc 9924 3rd Edition 2020** |
| 024 (1) | FIN | High number of Mode A/C/S All-Call replies (DF11) due to P4 misinterpretation of the XPDR near MTL | Complete removal of long P4 processing from the XPDR | Annex10V4 AMD 90 | 3.1.2.1.5.1.1.1 | The long/wide P4 is not used in civil radars. | | **Annex10V4 AMD 90 Effective date 01/01/ 2020** |
| 012 | FIN | High number of All-Call replies (DF11) due to non clustered operation of radars | Networking radars into clusters (national/international) | Doc 9924 | Appendix J, sections 4, and 8 | Central and distributed cluster modes are available and already in operational use | Cluster description already **available in Doc 9924**. | Could be mandated based on national or regional regulations |
| | CP | Increase in ADS-B squitter rates to introduce MOPS Version 3 | Removal of the reply to long/wide P4 in ADS-B version 3 transponders | Annex 10V4 | 3.1.2.8.9.1.2 | This supports the ADS-B MOPS Version 3 and keeps the equilibrium of 1030/1090 MHz utilization. | **CPA10V4/38** (For approval at SP/5) | |
| | CP | Demand on increasing ADS-B squitter rates to introduce new services or provision of additional information | The implementation of Phase Modulation and its use for all new defined ADS-B messages. | Annex10V4 | 3.1.2.8.9.1.2 Note 1 | The implementation will occur over a longer period. In the current text proposal, it is only a note (recommendation). | **CPA10V4/38** (For approval at SP/5) (see also CP010-4) | |
| 002 | CLOSED | Too many Mode A/C replies | Removal of Mode A/C only transponders from the fleet | | | Since this is a very long process, it might be necessary to implement technical solutions before. Concern will be addressed by Issue #001 | | Can only be done by state regulators. |
| 004 | CP | Mode S Transponder unavailability | Removal of Mode A/C/S All-Call interrogations | Annex10V4 | 3.1.2.5 | | **CPA10V4/39** (For approval at SP/5) | |
| 005 | CP | Too many replies issued by Mode S transponders | Introduction of a Mode S reply limit function | Annex10V4 | 3.1.2.10.3.6 | Proposed is a threshold of 180 replies per second | **CPA10V4/39** (For approval at SP/5) | |

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| 007 | CP | Uncoordinated and/or excessive use of 1090 MHz Reduced Performance Devices on small or unpowered aircraft | Guidance Material for the use of Reduced Performance Devices | Doc 9924 | Appendix S, section 4 | Supplement to the already existing guidance on small drones. | **CPASM/26** (For approval at SP/5) | |
| 008 | CLOSED | ACAS interrogations in high density areas | Implementation of ACAS-II V7.1 Extended Hybrid Surveillance | | | This might be limited to highdensity areas (criteria need to be defined). SP provided a new standard for ACAS-II Version 7.1 Extended Hybrid Surveillance or newer. It is the responsibility of state regulators to determine if it should be implemented | | Can only be done by state regulators. Perhaps only as an upgrade to existing ACAS-II version 7.1 installations. |
| 009 | CP | ACAS interrogations in high density areas | Implementation of ACAS-Xa and Xo | Doc 9863<br>Annex10V4 | All sections<br>Section 4<br>3.1.2 | SP/3 (Sep 2018) approved technical provisions for AXAS-Xa and Xo | **CP9863/18** (in progress) **CPA10V4/37** (AMD 91) **CPA10V4/39** (For approval at SP/5) | Not mandatory |
| 010 | CP | Unnecessary (re-) extractions of BDS registers | (2) Passive use of ADS-B information instead of active extraction by radars | Annex10V4 | 3.1.2<br>5.2.3 | Use of ADS-Wx AIREP messages: many of the EHS purposes are served by the ADS-Wx AIREP parameters. | **CPA10V4/39** (For approval at SP/5) | Not mandatory |
| | | | (3) Basic Dataflash solution | Annex10V4 | 2.1.5.2<br>3.1.2.6.10.3 | The Basic Dataflash solution is defined in the in the new version of the MOPS. The implementation will occur over a longer period. | | |
| | | | (4) Phase Overlay | Annex10V4 | 3.1.2 | Phase modulated BDS content in a regular downlink message. | | |
| 022 | CP | Interference from aviation L-Band systems adjacent to 1030/1090 MHz | (2) Provision of interference tolerance criteria (ITC) | Annex10V4 | 2.3 (new) | Proposed is an I/N -10dB | Draft CP in working paper **SP5-ASWG18-WP05** | |
| 024 | CP | Misinterpretation of P4 pulses close to MTL causes high rates of DF11 | A raised P4 amplitude compared to P3 in Mode A/C interrogations | Annex10V4 | 3.1.2.4.1<br>Table 3-11 | | **CPA10V4/39** (For approval at SP/5) | |

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