**Summary**

The ICAO Surveillance Panel (SP) (renamed) started to work in 2015, taking over from ASP (Aeronautical Surveillance Panel). Various subjects of interest for operational ATCOs are discussed within the SP: The development of the next-generation airborne Safety Net - ACAS-X. Additional to this, several sub-groups and working groups of the Surveillance Panel are of high importance for IFATCA: The Airborne Surveillance Working Group (AIRB WG), where airborne surveillance applications are handled. A recent development is the creation of the Ground-Based Safety Net Sub-Group (GBSN-SG), a newly created specialist sub-group, tasked to draft the future Ground-Based Safety Net Manual of ICAO. In there, a lot of activities have occurred during the last 12 months. Finally, the airborne Safety Net TCAS II is still in need of monitoring regarding its performance (and its safety). This fine-tuning work is also part of the tasks handled by the Surveillance Panel. And, finally ATS-surveillance systems such as Mode-S or ADS-B continue to show performance issues and/or technical shortcomings that are detected. They require fixes or additional fine-tuning. The required coordination work and the proposals for implementation do all pass via the SP.

1. **Introduction**

1.1 During the last year the Aeronautical Surveillance Panel (ASP) was renamed to become the ICAO Surveillance Panel (SP). The SP had several meetings in the past 12 months (since the last IFATCA annual conference of 2015, held in Sofia). Apart from the panel core business that is handled by the Aeronautical Surveillance Working Group, there are two particular working groups where IFATCA (and so the operational ATCOs) are represented, they are:

- The AIRB WG (Airborne Surveillance Working Group) that is discussing airborne surveillance matters, including the use of CDTIs (Cockpit Displays of Traffic Information). These screens are displaying ADS-data via cockpit displays. Part of the AIRB-work is related to the use of airborne surveillance applications and ultimately (one day) possibly the implementation airborne separations (including self-separation);

- The GBSN-SG (Ground-Based Safety Net Sub-Group), a newly founded sub-group of the SP is tasked to produce the new ICAO-Manual regarding Ground-Based Safety Nets (handling namely STCA, MSAW, APM and APW).
More information regarding the GBSN-SG and the drafting of the future Ground-Based Safety Net Manual of ICAO will be provided later in this report.

1.2 Since the last annual IFATCA world-conference I was able to attend the first SP-Panel meeting (the start-up meeting of the Surveillance Panel) held in Montreal, as well as two GBSN-SG meetings, held as well in Canada. For the last 12 months, the AIRB WG was rather quiet, as no pressing work-items were identified. It must be said that many ICAO-States have slowed down their airborne surveillance activities. It appears as if the development and then the implementation of airborne separation projects (or procedures based on airborne surveillance/assistance) get a much lower priority, than before.

2. Discussion

2.1 A subject of high interest for the Surveillance Panel is the next-generation airborne Safety Net (SN), called ACAS-X. This new airborne anti-collision system is currently under development by the FAA (under the NEXTGEN-program). The FAA and NEXTGEN keeps the SP-members continuously informed about the progress made in the development of ACAS-X. Progress for ACAS-X system is made through development-step that are called “Runs”. And the FAA and the MIT Lincoln Lab are currently closing in on the final steps of the ACAS-X development. At the writing of this report (January 2016), Run 15 is under scrutiny. It might well be that this run is the last (and final) development step of ACAS-X.

2.2 ACAS-X will take advantage of new technologies, including the significant advances that software- and computer-programming has made in the last decades (e.g. dynamic programming and/or the application of the logic plot-concept, based on probabilistic dynamic-computing). The advanced algorithms and the new analytical methods of today enable the development of totally new systems. Systems that are able to make critical decisions in uncertain and dynamic environments, while maintaining their safety (but also their efficiency). This is a huge progress compared to the current TCAS-II airborne Safety Net, a system that starts to become “old” (as developed in the 1980s). TCAS II is dependent on the reception of active surveillance data. The CAS-logic (Collision Avoidance System - Software) of TCAS II is then performing a forward-computing of the active surveillance data received. All this is based on a so-called "rule-based pseudocode", a combination of deterministic rules, as well as heuristics. TCAS II and its CAS-software is comparing dozens and dozens of stored rules of predictable encounter geometries. If an intruder (or several intruders) are coming too close, the logic then choses the best solution (a course of action) and an evasive action, called RA is then posted in the cockpit (to issue such an escape manoeuvre).

2.3 ACAS-X is expected to be many times superior to TCAS II - superior in performance and capabilities, and so ultimately we will see a net gain in safety. Another clear advantage of ACAS-X will also be the simplicity of making changes or enhancements (if required). This change process was always very tedious and as well “heavy” (and complex) with TCAS II. Nevertheless, a report to IFATCA Conference would be incomplete by failing to mention as well that the new technologies and sophisticated software programming methods employed for the ACAS-X Logic have also their issues (and their shortcomings). This means that many challenging problems and many safety issues must be solved by the ACAS-X designers. The big challenge will be to make a
maximum use of the advantages and the new technological possibilities of ACAS-X, but to keep the disadvantages and the drawbacks of the new technology to an absolute minimum.

2.4. The switch-over (transition period) from TCAS II to ACAS-X will be a very long process, as this will only occur very gradually (possibly over a time period of 10 to 15 years). So, the two airborne Safety Nets (SN) must be able to function along-side flawlessly, in order to permit a safe transition, the issues of interaction between TCAS II and ACAS-X are also part of the current ACAS-X development. ACAS-X has 4 planned subsystems, or “variants”, planned to be developed by the FAA in order to accommodate all expected (and needed) operational uses, they are:

**ACAS-XA** will be a one to one replacement of the current TCAS II. So for large aircraft using active and passive surveillance. The advisories (e.g. TA and RA) will be exactly the same as for TCAS II;

**ACAS-XO** is planned for Special Operations, such as for instance for closely spaced approaches or for formation flights. And the alerts for this ACAS-X variant are expected to be not only general, but also procedure specific (with reduced warning times);

**ACAS-XP** is for General Aviation (GA) use, including VFR-flight, employing passive squitters (e.g. ADS-B out). This variant is planned to have only a very reduced alarm-set;

**ACAS-XU** is planned for Unmanned Aircraft (UA) employing a multitude of technologies, including radar, electro-optical or infra-red detection methods. Of particular interest will be interactions between several UAS (RPAS), as evasive-manoeuvres are planned to occur not only vertically, but also horizontally;

2.5. So far, the main developments of NEXTGEN regarding ACAS-X are centred around ACAS-XA, but also to a certain extent regarding ACAS-XO (Special Operations). Some, rather small (and initial) developments have also occurred in regards to ACAS-XU. The European SESAR-program (SESAR stands for Single European Sky ATM Research) is linked to all these ACAS-X activities by performing peer-reviews (independent checks and verifications regarding the safety). So far SESAR was working mainly on peer verifications and on cross-checking the ACAS-X anti-collision logic (passed to them by the FAA). And also - to a certain extent - on the development of encounters-models, in particular for the specificities of the European airspace. The development of various encounter-models (for different areas and regions) is not only of importance for the performance (and the safety) of this next generation airborne anti-collision system in a given airspace (e.g. for the European airspace). But this work will also help to achieve the required certifications (at the end of the development). ACAS-X is expected to become fully integrated into the ICAO SARPS (as TCAS II currently is), and this can only happen, if independent (and multiple) verifications and a solid certification process is passed beforehand.

2.6. The FAA and NEXTGEN have the following planning for ACAS-X (situation end of the year 2015): The operational flight tests were finished in 2015 and the current development step of ACAS-X is - as said earlier - “Run 15”. Currently it looks as if Run
15 could be the final development step of ACAS-XA, but this is not (yet) fully confirmed. During the operational test-flights a total of roughly 150 scripted scenarios were flight-tested. These flights test results were reviewed and the conclusions and the results were finalized. The completion of the evaluation of the ACAS XA logic is expected to be closed at latest by 2017. And the development of MOPS (Minimum Operational Performance Standards), approved by RTCA and EUROCAE are expected to be finished at latest by 2018.

2.7. One curiosity of ACAS-Xu (for UAS or RPAS, Remotely Piloted Aircraft Systems) is that also horizontal evasive manoeuvres are planned. ACAS Xu will be the first CA (Collision Avoidance) function to be designed - and so be tailored-made - explicitly for the needs and problems of the UAS (RPAS) community. The system will have traditional TCAS II active interrogations available, but this will be supplemented with (validated) ADS-B replies (GNSS-data squitted out). New features of ACAS-Xu will be the passive CA-manoeuvre coordination techniques, permitting to operate without active Mode-S surveillance (e.g. working on ADS-B-out only). The idea behind this all is to coordinate between various UAS/RPAS the required vertical or horizontal manoeuvres that will help to avoid a conflict, and so ultimately a collision. The interesting part is that the evasive manoeuvres will not only be RAs (Resolution Advisories), but also have very gentle manoeuvres occurring well before any TA or RA will be triggered. So, well before entering the anti-collision layer. Needless to say that this all will be very challenging, requiring a lot of design- and testing activities.

2.8. Despite all the progress made in the development of ACAS-X, the monitoring and handling of detected deficiencies of TCAS II is still continuing. TCAS II (Version 7.1) is not only an improved TCAS II having integrated hybrid surveillance (this, as ADS-B data is fed into system), but also got many improvements of the anti-collision logic (e.g. an improved reversal logic for avoiding the Lake of Constance mid-air scenario, where a Master-aircraft was flown opposite to the TCAS RA sense shown in the cockpit). Recently, TCAS Version 7.1 has shown in Europe several strange behaviours, including the triggering of ghost or spurious (false, unnecessary) TCAS RAs. All these spurious TCAS RAs have been reported for the Airbus A318, A319, A320, A321-family aircraft and for aircraft equipped with a Honeywell TCAS II (with Version 7.1). These false nuisance (or spurious) TCAS RAs were generated in situations where the other aircraft, the intruder was crossing the track of an TCAS II equipped aircraft at a distance between 5 to 7 nautical miles. It was determined that the TCAS II active tracking has (for these particular crossing constellations) to pass through different azimuths of detection. This activity requires a switching of the TCAS-antenna positions (in order to keep the active surveillance active and fully alive). During these antenna switching processes (using the various antennas sitting along the airframe), a change of the data-source must occur. And it was found out that also passive surveillance (ADS-B) is at this moment fed into CAS-system (during these antenna-changes). During these switches small and minor “jumps” of the position data do occur, and that these little jumps - when computed to closing-in speed - can generate high variations in speeds, that are maybe not very realistic, but nevertheless taken as real by the CA-logic of TCAS II produced by Honeywell. The manufacturer has by now developed (and certified) a software fix that is (at this very moment) being implemented via a simple software update. So, this problem should be a thing of the past in a very near future (as the software upgrades are being implemented by the airlines and the aircraft operators of these airframes affected by this issue).
2.9. The monitoring of Mode-S and - transponder functions is another permanent task of the Surveillance Panel. Japan has discovered that the Boeing 787 “Dreamliner” fleet was facing issues, mainly delays in detection and acquisition by radars. Subsequent studies performed by the Japanese confirmed that the delay in acquisition and detection by several SSR ground systems - mainly around airports in Japan was due to the much lower than normal power output of these transponders (fitted to the Boeing 787 fleet). Later, French authorities reported that the same issue was also present in Europe. It is rather strange that this happens, as all Mode-S transponders fitted to the Boeing 787 fleet are all in full compliance with the relevant ICAO SARPs and MOPS requirements. The inquiry concluded that the problem does not lie with the transponders, but with the tuning and the set-up of the ground-radar systems (which didn’t detect correctly weaker transponder signals). The SP-Panel of ICAO has therefore decided to propose a CP (Change Proposal) to ICAO that will make changes to ICAO document 9924 "Aeronautical Surveillance Manual", a Manual where all aeronautical surveillance systems are defined and where specifications are set (applicable standards and performance requirements). In the view of the SP, it must be ascertained that all ATC-ground systems are able to detect instantly (without delay) all the Mode-S transponders that are in range. This must be guaranteed even at the minimum power-output of these transponders (transponders meeting the defined performance requirements of the relevant ICAO SARPs and all the MOPS that are applicable and published).

2.10. For the safe integration of RPAS (Remotely Piloted Aircraft Systems) discussions are continuing at ICAO-level. A rather new development is a proposal to use a SSR- conspicuous code (general Mode-A code) for RPAS that are operating in a lost link situation. This is often called “lost C-2 Link” (C2 stands for “Command and Control”). A proposal is currently studied in Montreal that foresees the use of emergency code A7400 as the official ICAO-code for such a UAS-contingency situation – C2 Lost Link. The UK (United Kingdom) has announced to ICAO that this proposal is not acceptable, as Squawk A7400 is currently used in the UK as a general code for Marine Protected Areas (MPA). But there is good news, as in late 2015 it was communicated that the UK might have found a solution: it consists of freeing-up A7400 for the international RPAS-use. This would require that (possibly) and exchange of Squawk A7300 and A7400 in the UK. This move could then speed-up the use of A7400 for RPAS lost link situations globally, via official ICAO procedures. The final decision is expected to occur in early 2016, but certainly not before April or May 2016.

2.11. For the last 5 years (or so) the testing and development of a phase modulation technique for ES (Extended Squitter) Mode-S Transponders is progressing. This all is linked to the ADS-B system and the possible performance enhancements of that system. The TSG (Technical Sub-Group) of the Surveillance Panel has the lead in this matter, but it must be said that the FAA and its Technical Center in Atlantic City (New Jersey) are the main contributors for this development. Although it is widely accepted that the implementation of this technology would be very beneficial for many States (especially those having high-density traffic), it must as well be acknowledged that the changes required (to make this new technology available) are also very challenging. Phase Modulation will enhance the data throughput and – capacity. Current estimates go as far as a tripling of the data-throughput via the employment of this new technology. The FAA has confirmed that basically a software change would implement this technical change, once all is developed and certified. But many aircraft will need nevertheless serious hardware changes or upgrades (additional cabling and as well an upgrade of legacy equipment).
2.12. The monitoring of Mode-S and of transponder performance is another task of the ICAO SP. A new change proposal was finalized recently that is related to erroneous Flight - or Aircraft ID (ARCID) transmitted in flight. Some flights were not correctly reporting their aircraft identification (ARCID) after take-off (once being airborne). Despite the fact that this concerns only a few flights, it must nevertheless be said that this can be very disruptive for ATC, in particular if the blip (or track) correlation is performed via the ARCID-feature (so far mainly in Europe this is already the case). Monitoring has shown that controllers were requesting via R/T that the pilots do change the wrong aircraft identification (once airborne). And then these operators were surprised to find out that the change of the aircraft identification (that was announced as done correctly by the crew), was not always shown at their ATC-displays (as it should). It was discovered that the problem is that some of the ATC-ground interrogators were not correctly tuned (as they should be). All ground interrogators and antennas are required to look (or search) for changes of the ARCID (at all time). They must do this systematically (and continuously), as only this ascertains that the eventual changes made to an ARCID (in flight, during the operation of an aircraft) are shown immediately (and without delay) at the CWPs (Controller Working Positions). A Surveillance Panel initiated change proposal (CP) is now in the ICAO-pipeline to add (or to enforce) this requirement to the basic features of all ground antennas and – interrogators. Making sure that all Mode-S ground stations and all ATC-surveillance systems working on Mode-S perform this check for eventual ARCID-changes systematically.

2.13. Related to the Mode-S performance monitoring is the correct handling of ICs (Interrogator Codes) of Mode-S antennas. This feature is needed so that a selective (and so direct) link between the Mode-S Transponders in range, and the various Mode-S antennas sitting on ground gets established (and is then maintained). There is a requirement that each Mode-S antenna (or interrogator) has a distinctive IC – an Interrogation Code. Only via this distinctive code set on ground can the airborne Mode-S Transponders distinguish which antenna is interrogating them. This particular feature permits as well that co-called direct surveillance contracts can be concluded (after the All-Call and the establishment of initial contact). The Surveillance Panel has found out that there is a lack of coordination of Interrogator Code Allocation between the various ICAO-regions and -states. This can have several serious safety implications, as the uncoordinated allocations of IC-codes might create perturbations, additional garbling and go as far as a total loss of surveillance data (between radar heads using the same IC-code). It must be said that IC-codes are very limited in number, as currently only 15 II (Interrogator Identifier) are available - due to the fact that ICs are only 4-bit coded (which is rather limiting). A change in the relevant ICAO Annexes and – Standards has permitted the use of so-called SIs (Surveillance Identifier Codes), where additional data bits were added (to increase the number of possibilities). This required not only changes in the ground infrastructure, but well as changes to the airborne equipment (the transponders). This change is by now fully implemented and so is running in operations. This all has given the possibility to use additional 63 SIs, which has brought a considerable extension of the possibilities to use safely the Mode-S technology, even in high-density airspace. Nevertheless, the need to coordinate and to harmonise these IC - and SI-codes internationally cannot be stressed enough. The SP has discussed ways to ensure this with the least possible effort (but in an efficient and safe manner).

2.14. Of great interest for operational Air Traffic Controllers is the work of the GBSN-SB (Ground-Based Safety Net Sub-Group) for the production of a new ICAO-Manual for Ground-Based Safety Nets. At ICAO Air Navigation Conference 12 (ANC12), back in
2013 the ICAO-Member States had accepted a proposal made by several European States and Eurocontrol to draft a new ICAO-Manual on Ground-Based Safety Nets. This will be a new Manual (started from scratch). The following 4 ground-based Safety Nets were chosen for the initial edition of the GBSN-Manual of ICAO:

- STCA (Short Term Conflict Alert)
- MSAW (Minimum Safe Altitude Warning)
- APW (Area Proximity Warning)
- APM (Approach Path Monitor)

The time-frame allotted to this task is very tight, as the final draft (for further actions and then publication by ICAO) is April/May 2016. So, more or less by now (when IFATCA is holding its annual Conference in Las Vegas).

2.15. It was recognized by the SP-panel members that this extensive drafting task is not easy and that the timeframes allotted to this project will require swift actions. And the subject as such will require contributors that are having specialist knowledge in the matter of Safety Nets. This is the reason why it was decided to create the Ground-Based Safety Net Sub-Group (GBSN-SG), a sub-group that was created and immediately tasked to push forward the drafting of this new ICAO-manual. One of the major difficulties was (at the start of this new sub-group, back in early 2015) that the initial draft provided by Europe and Eurocontrol needed to be modified. This, as the table of content (TOC) and the information provided in the initial draft was way too much European-centred. The international and global outreach was missing, or didn’t get the required attention and priority. It is hoped (and expected) that several actions undertaken the GBSN-SG in November and December 2015 will show its merits and benefits by now (March 2016). At this very moment a final draft version is expected to be circulating for consultation, as the final GBSN-SG meeting (a 3 days meeting) is planned to be held in Langen/Frankfurt (Germany) in April 2016. IFATCA and IFALPA are both part of this Safety Net Sub-Group, and both Federation are also part of the internal drafting process that is lasting since December 2015. It can be said that IFATCA has excellent Policy in the matter of Safety Nets, in particular for STCA and MSAW. These policies are well developed and this all helps our work and the participation within the GBSN-SG of ICAO.

2.16. ASTAF, the Airborne Surveillance Task Force was a Task Force under the ASP-Panel. ASTAF was instrumental in drafting and publishing the first ICAO Manual, numbered 9994 “Manual on Airborne Surveillance Applications”. ASTAF continues to work under the umbrella of the Surveillance Panel. The Task Force has by now been upgraded to a full Working Group and its name has changed, as it is now called AIRB WG, or Airborne Surveillance Working Group. Since all the work related to the production of the new Ground-Based Safety Net Manual has been removed from the scope of the AIRB-WG (ex-ASTAF), the frequency of the meetings was reduced considerably, it has even stopped since mid-2015. This was also necessary as the additional work of the GBSN-SG had to be shouldered by many members of the GBSN-SB. Currently, no further meeting is planned for the AIRB WG, as most ICAO-States have considerably slowed down all their work related to airborne surveillance applications. One subject that seemed to be very promising (using Airborne Surveillance and airborne cockpit CDTIs), was IM (Interval Management). But – as said earlier - several States as for instance the FAA have advised ICAO that the development of IM is currently not progressing very fast, as all these programs have been slowed down. So, there is no immediate need
that ICAO is working on this subject. Additional to this, several members of the Working Group (including IFATCA and IFALPA) have as well questioned the business case and operational relevance of IM. This, as the expected investment in equipment and also the anticipated/expected operational procedures for IM seem to be “very heavy” and also rather time-consuming (e.g. R/T load). So far, the answers to all these questions were put on hold, and so a lot of progress regarding IM can be reported.

3. Conclusions

3.1 The Surveillance Panel had a very busy and very active last year. Especially the Ground-Based Safety Net Sub-Group was very busy. The production of the future Ground-Based Safety Net Manual of ICAO, after some initial difficulties is now progressing very well. IFATCA and its SP-panel representative is giving this activity a very high priority (top priority)

3.2 The Aeronautical Surveillance Working Group (where the normal Surveillance Panel activities are handled) continued to work, and the SP has by now made several important CPs (change proposals) to ICAO for action and then implementation. These CPs concern issues of Mode-S, transponders performance and/or the ADS-B system. All these CPs concern issues where problems were detected and/or where fine-tuning is required (improvement of system performance or of the safety)

3.3 IFATCA continues to work (via its representative) actively in the various working groups and sub-groups of the Surveillance Panel. It is of utmost importance that IFATCA continues to remain active and “visible” within the SP, as many problems and issues concern the work of operational ATCOs and/or the safety of the aviation and the ATC-system as a whole.

4. Recommendation

It is recommended that;

4.1 This paper is accepted as information material.