



AudioSoft

White Paper

Aural Environment (Ambient) Recording: Solutions to ICAO Requirements for ATC

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Executive Summary

Following the Überlingen accident in July 2002, there has been a key change in the policy of the International Civil Aviation Organisation (ICAO), that **“Air traffic control (ATC) units be equipped with devices that record background communication and the aural environment at controller work stations from 1 January 2010”**.

This white paper explains the changes in ICAO legislation, the reasons behind these changes and assesses how you can adhere to such standards. This white paper outlines the options for aural environment¹ recording and recommends the best solution.

Audience

This white paper is relevant to:

- ▶ Those responsible for the operation of the recording system at any airport
- ▶ Those affected by or effecting changes in legislation for ATC recording

¹ Note that the terms “aural environment” and “ambient” recording can be used interchangeably. For the purposes of this white paper “aural environment” will be used as per ICAO terminology.

Step 1: Understand the need for aural environment recording

Mandated requirements and recommendations are being continually updated to improve airport safety by the International Civil Aviation Organization (ICAO) [5]. ICAO is the body that sets the standard in Air Traffic Control safety². Although Air Traffic accidents are as low as one in two million, this safety figure can only be achieved using thorough investigations into accidents and near-misses.

Air Traffic incidents can place an immense amount of stress upon all those involved and it may be difficult to precisely remember the course-of-action taken. For many years, the aural environment of the aeroplane cockpit has been recorded to aid in accident investigation, bringing significant benefit to air traffic accident investigators, who are then able to piece together the precise course of events.

Currently it is an ICAO requirement that all ground-to-air and ground-to-ground conversations are recorded. However, this does not preserve the interaction within the Air Traffic Control room, between one ATCO and another, between ATCOs and supervisors or managers, the sound of equipment (such as alarms) or any mobile phone conversations. This can be described as the aural or ambient environment. Its relevance stems from an air traffic accident:

In July 2002, an air traffic incident near Überlingen, Germany resulted in a mid-air collision between a Boeing B757-200 and a Tupolev TU154M. There were 71 fatalities.

Following the Überlingen accident, the BFU investigation [2] stated in Safety Recommendation No. 09/2004 that "to improve the investigation of future accidents and incidents ICAO should require ATS units – in addition to present regulations – to be equipped with a recording device that records background communication and noises at ATCO workstations similar to a flight deck area microphone system."

In order to understand why this recommendation has been made it is necessary to read ICAO's response to comments [1], which state that "*the Secretariat acknowledges that much of the material required for investigative purposes is available through, for example, recordings of ATC communications and surveillance data. Witness statements and interviews with persons involved in an accident or incident may also provide important information with regard to unrecorded events and communications; however, in unfortunate circumstances word may stand against word as to exactly what transpired at a given moment. This would include exchange of verbal information that takes place between controller/supervisor, controller/maintenance engineer and between controller/controller. The recording of background communication and the aural environment at controller work stations may contribute to a better understanding of the sequence of events leading to an accident or incident.*"

The Überlingen accident is one of several recent high-profile incidents whose investigation may have benefited from aural environment recording, allowing the interaction within the Air Traffic Control room to be preserved without question.

There has therefore been a key change in the policy of the International Civil Aviation Organisation (ICAO), that "**Air traffic control (ATC) units be equipped with devices that record background communication and the aural environment at controller work stations from 1 January 2010**".

Section 2 explains this requirement.

² ICAO legislation applies to all states listed in [4]. In some cases, local legislation stipulates further requirements or recommendations. Please consult AudioSoft or your local representative for specific local requirements.

Step 2: Correctly interpret the ICAO legislation

It should be noted that, from [1], *“the original proposal in AN-WP/7957 suggested an applicability date of 1 January 2012; during the preliminary review by the Commission, it was agreed that this date should be brought forward to 1 January 2010”* and that the recorder should be *“capable of retaining the information recorded during at least the last twenty-four hours of operation”*.

With those amendments, the ICAO legislation is based upon the BFU report [2], which states that the aural environment recording should be *“similar to a flight deck area microphone system”*.

The United Kingdom Civil Aviation Authority is one of the prominent leaders in the field of flight deck voice recording, defining its specification as [6]:

“Each cockpit voice recorder shall have a minimum of four channels and shall be installed with inputs as follows:

- a) for the first channel, from each microphone and headset used at the first pilot station,*
- b) for the second channel, from each microphone and headset used at the second pilot station, or if this station is not required, from each microphone on the flight deck that is used with the passenger address system if its signals are not recorded on another channel,*
- c) for the third channel, from the cockpit mounted area microphone,*
- d) In respect of installations in aeroplanes, for the fourth channel, from each microphone and headset used at the third crew member station, or if this station is not required, from each microphone on the flight deck that is used with the passenger address system if its signals are not recorded on another channel.”*

It is AudioSoft’s interpretation that this translates to Air Traffic Control as follows:

- a) and b) translate to both the recording of the ATC Officer’s ground-to-air communication and the recording of the ATC Officer’s ground-to-ground communication
- c) translates to recording of the Controller Workstation Position (CWP) through a mounted area microphone
- d) can be interpreted as recording of additional channels if possible

An entry level solution to meet this requirement (or c from the above) is to upgrade your existing audio recorder (which will already record a and b) to capture an extra audio channel for each CWP, with microphones placed as near as sensibly possible to the ATCO’s sitting position. These recordings need to be kept for just 24 hours, though longer is preferable, e.g. 30 days of recording as per all other audio channels. Leading recording solutions allow for different compression ratios to be used on a per-channel basis, giving flexibility in storage options.

A future-proof solution is to allow additional audio channels for microphones to be placed not only at CWP’s but also throughout the air traffic control room and to also allow for video recording to fully preserve the interaction between the air traffic controllers and allow for a faithful record that will greatly assist any investigatory work. Synchronised replay of data is key to any investigation and leading recording products can provide the solution to audio (both ground-to-air, ground-to-ground telephony and aural environment), video, radar and/or screen recording in a single system with the ability to synchronise any or all channels on replay.

When the Überlingen accident occurred the Air Traffic Control Officer on duty was working between two adjacent Air Traffic Control stations. [3], a report commissioned by Eurocontrol as an independent review of the BFU report, states that *“a subsequent analysis of the accident should be conducted to identify the cognitive and perceptual cues that helped the controller to identify the potential conflict”*. This can be achieved in future investigations through synchronised replay of both

video and audio from the Air Traffic Control room, both of which can be recorded through a single recorder using advanced recording systems.

Whilst there are reservations about recording video in an air traffic control room, there are clear advantages that this can bring in an investigation, particular one such as Überlingen, where the controller had to move between two workstations and switch attention between multiple displays.

To summarise, a single microphone placed at each ATC workstation will be sufficient to meet ICAO legislation. In most cases this can be achieved easily by adding additional channels to your existing audio recording system. However, advanced recording systems can allow for recording of a greater number of channels for improved investigations, video recording, and a single-solution system that allows synchronised replay of these and radar and/or screen recordings. This is preferable to multiple recording systems and the problems that such a set-up brings, requiring additional training, additional maintenance and support and difficulties in synchronising the data on replay. A single solution will allow for a swift and effective investigation that is not blurred by doubt and will aid in preventing similar tragedies from happening again.

Section 3 explains the upgrade options that should be considered to meet the recommendation and how to future-proof your airport.

Step 3: Upgrade

If you have an existing audio recording system that is fully compliant with ICAO requirements for audio recording:

- ▶ Upgrade your recorder to stay compliant with this ICAO recommendation for recording of the aural environment.
- ▶ A future-proof solution is to allow additional audio channels for microphones to be placed not only at CWP's but also throughout the air traffic control room and to also allow for video recording to fully preserve the interaction between the air traffic controllers and allow for a faithful record that will greatly assist any investigatory work.

If you are going to replace your audio / audio recording system:

- ▶ Discuss with your audio recording system supplier the number of audio channels that will need recording and what features will allow incidents to be recreated faithfully with ease.
- ▶ Recognise that if your airport uses radar then it will also be necessary to comply with ICAO legislation on radar recording. Ask AudioSoft for the free white paper "Solutions to New ICAO Radar Recording Requirements for ATC" and discuss how best you can satisfy these requirements.
- ▶ Consider that leading recording products can provide the solution to audio (both ground-to-air, ground-to-ground telephony and aural environment), video, radar and/or screen recording in a single system with the benefit of synchronisation.

Note that the voice switch manufacturer may provide an ICAO compliant voice switch, with microphones integrated into the desk at the CWPs, thus presenting the voice switch with feed from the aural environment in the same way that audio channels are currently presented. In this case, it remains to increase the channel count of the audio recorder as required; typically this is between 10-20% but is dependent on the existing number of channels and the number of CWPs (including spare seats, training seats, etc). For reliability and the routine maintenance of equipment, it is recommended that channels be recorded twice for redundancy (as per best practice).

If upgrading to record the aural environment using a system independent of the voice switch, points to consider are:

- ▶ How to position the microphones for best quality of recordings
- ▶ To use good quality microphones appropriately (e.g. button microphone for a desk-mount, boundary microphone for ceiling-hanging)
- ▶ Whether or not to use a pre-amp
- ▶ Whether or not to use Automatic Gain Control

AudioSoft can advise on each of the above issues; please contact your Key Account Manager for more information.

One final consideration is that it may be inappropriate or even unlawful to use the recordings in the same way that phone or radio recordings are used. Local legislation may apply and so it is imperative that access rights on the recorder can be set on a per-channel basis, thus ensuring that aural environment audio data is only accessible to users with the highest or specific aural access rights. If in doubt, speak to your recording system supplier.

Summary

Following the Überlingen accident in July 2002, there has been a key change in the policy of the International Civil Aviation Organisation (ICAO), that *“Air traffic control (ATC) units be equipped with devices that record background communication and the aural environment at controller work stations from 1 January 2010”*.

This is an important change that will aid air traffic incident investigators in establishing the precise course of events that occurred prior to an incident.

An entry level solution is to upgrade your existing audio recorder to capture an extra audio channel for each Controller Workstation Position, with microphones placed as near as sensibly possible to the ATCO's sitting position. These recordings need to be kept for just 24 hours.

A future-proof solution is to allow additional audio channels for microphones to be placed not only at CWP's but also throughout the air traffic control room and to also allow for video recording to fully preserve the interaction between the air traffic controllers and allow for a faithful record that will greatly assist any investigatory work. Leading recording products can provide the solution to audio (both ground-to-air, ground-to-ground telephony and aural environment), video, radar and/or screen recording in a single system with the benefit of synchronisation.

References

1. International Civil Aviation Organization (ICAO), "AN-WP/8041 Appendix A: Summary of replies to state letter AN 13/1.8, AN 13/13.5, AN 6/1.2-04/93"
2. Bundesstelle für Flugunfalluntersuchung (German Federal Bureau of Aircraft Accidents Investigation), "Investigation Report", AX001-1-2/02, May 2004
3. United Kingdom Civil Aviation Authority, "Cockpit Voice Recorder Systems", ISBN 1 904862 73 X, Specification No. 11, Issue: 3, 13 August 1983
4. International Civil Aviation Organization (ICAO) Contracting States, http://www.icao.int/cgi/goto_m.pl?icao/en/howworks.htm .
5. International Civil Aviation Organization (ICAO) website, www.icao.int .

Glossary

ATC: Air Traffic Control

ATCO: Air Traffic Control Officer

CWP: Controller Working Position

ICAO: International Civil Aviation Organisation

SRG: Safety Regulation Group

UKCAA: United Kingdom Civil Aviation Authority