Loss of communications events and ATC communications system availability

According to EUROCONTROL the number of interceptions of commercial aircraft by national militaries has increased this year. Around 90% of these events were due to a loss of communications between the aircraft and Air Traffic Control (ATC) on the ground.

However, the vast majority of loss of communications events are a result of human error or procedural issues, attributable to the depth of safety engineering that goes into ATC communications systems. What Air Navigation Service Providers (ANSPs), aviation equipment manufacturers and system integrators do to prevent ground stations being the source of such events?

Availability

The main benchmark used to discuss the reliability of a communications channel is the system availability. That is the operational availability of a channel expressed as a percentage.

Much of the aviation community aims for five nines or 99.999% availability of any one channel, meaning there is less than 5 minutes and 15 seconds of operational downtime per year. As the 99.999% figure is interested in whether the channel is available for use or not, the 5 minutes includes all scheduled and unscheduled maintenance downtime. However, the availability figure does not account for failures that do not stop the operator using the channel.

Redundancy

The way the system designers provide a basis for such high availability is to include redundancy at every stage of the system. Operators work in a building with A and B controller positions, which are connected to A and B voice switching systems, connected via A and B ground networks, with A and B radio sites at the other end.

To increase redundancy, each of these systems may be of completely different design such as having an IP based A system with an analogue B system from different suppliers. Where the same transmission medium is used in A and B legs then there may also be crossover points at the network boundaries allowing the A switch to operate an A radio site over the B ground network. The use of A and B systems with crossover points allows multiple single pieces of equipment to fail before there is any loss of service on a channel.

Maintainability

Even with appropriate redundancy in a system, maintenance is still required for both routine upkeep and mitigation of the occasional component failure. The design of ATC systems ensures that maintenance minimises the impact on the availability of each channel. The requirement for preventative maintenance of equipment is reduced as much as possible by the use of stable long lifetime components. This is supported by the use of continuous built in test (BIT) routines that alert maintainers of any issues before they become a loss of service incident.

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Preventative maintenance is scheduled during quiet hours or overnight shut down periods, with A and B legs maintained at separate times to provide a continuous service where possible. Parts with a fixed service life, such as batteries and cooling fans, are replaced to a schedule rather than on failure to ensure continuous service.

The combination of redundant system design and well planned maintenance outlined above means that ATC communication systems are very rarely the cause of loss of communications events.

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