

# Interference measurement and localization at major events

## 7<sup>th</sup> World Meeting of Families with Pope Benedict XVI as an example of how the IDA-3106 can be used

Two parts of the 7<sup>th</sup> World Meeting of Families were held at Milan's Aeroporto di Bresso on 2<sup>nd</sup> and 3<sup>rd</sup> June 2012. According to press reports, there were around one million visitors present on the site at the peak time during the Mass celebrated by Pope Benedict XVI.

This Application Note describes typical interference problems, their analysis and their localization, using this major event as an example.

### Event location

Milan's city airport, "Aeroporto di Bresso", is used mainly by tourist flights as well as being home to the Milan Aviation Club. It covers an area of 790,000 m<sup>2</sup>. Since the airport is operational and capable of handling a large number of pilgrims, there is no need for any modifications that might have a negative impact on the environment. Using the airport as the meeting venue fulfilled all the required safety criteria and allowed all the necessary security checks to be made. A rescue helicopter is also stationed on the site and there are several hospitals in the vicinity.

### Safety

To ensure the safety of all participants – pilgrims, VIPs, organizers and their service providers – various organizations set up base camps on the neighboring site belonging to the Italian Red Cross. These were the fire brigade, civilian police (Polizia di Stato), military police (Carabinieri) and the forestry police authority (Corpo Forestale dello Stato). As well as the radio services used by these professional security organizations, other communications tasks were assigned to volunteer civil defense bodies, including the amateur radio association ARI (Associazione Radioamatori Italiani).



**Figure 1: Hundreds of thousands pay rapt attention to the stage at the event at Bresso.**



**Figure 2: Large scale security and rescue services presence at Bresso airport.**

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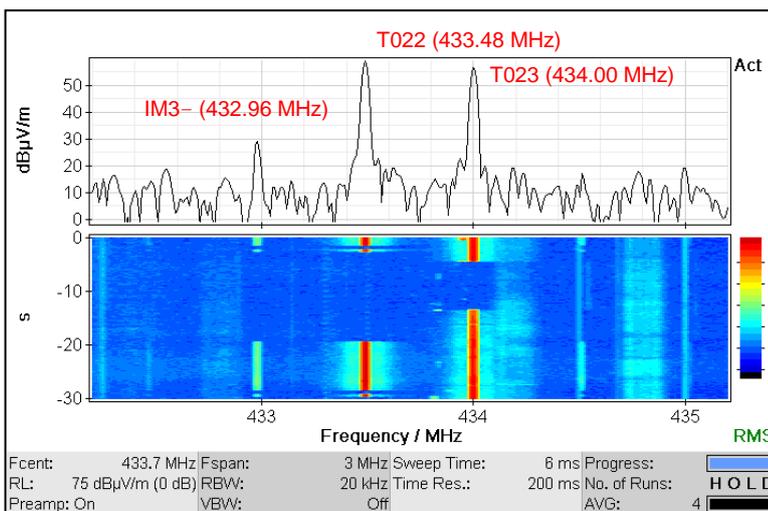
## General situation

All the participants were committed to strict radio discipline by keeping exchanges short, limiting transmitter power, and so on. Nevertheless, interference occurs, particularly at moments of stress for the participants. Intermodulation problems occur despite a sophisticated radio channel assignment plan.

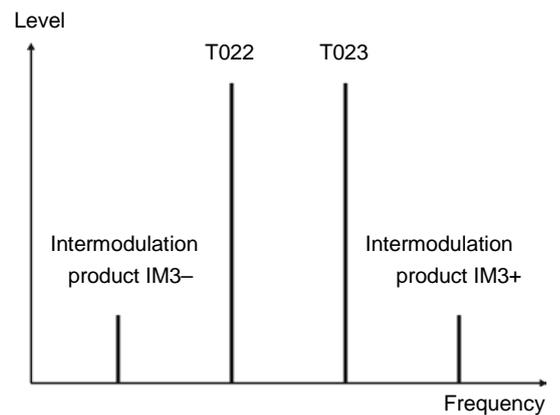
## Specific example

The ARI (Associazione Radioamatori Italiani) uses 432,95 MHz for communications. Time and again, this channel is impaired by a neighboring channel, which is not easy to identify. With IDA-3106 MAX trace we found the intermittent interferer in spectrum at 432.96 MHz (figure 5).

Analysis of the spectrum and an understanding of how 3<sup>rd</sup> order intermodulation occurs leads to two radio services that both only transmit for a maximum of 20 seconds at a time in accordance with the constraints imposed by radio discipline. The spectrogram clearly shows the time correlation between the interferer (432.96 MHz) and the two services on channels T022 (433.48 MHz) and T023 (434.00 MHz). Since the interference only occurs briefly at the exact time when both T022 and T023 are transmitting simultaneously, indirect localization of the interference source from the frequencies causing the interference is the easiest course.



**Figure 3: The close proximity of different radio services means that intermodulation can be expected.**



**Figure 4: The 3<sup>rd</sup> order intermodulation products occur principally at the frequencies**

$$f_{T023} + (f_{T023} - f_{T022})$$

$$f_{T022} - (f_{T023} - f_{T022})$$

**Figure 5: Spectrum and spectrogram of the 433 MHz band showing the two strong emitters in channels T022 and T023 along with the intermodulation product IM3-**

Therefore, we only need to concentrate on the two emitters on channels T022 and T023 rather than trying to localize the interferer at around 432,96 MHz. Using Horizontal Scan and taking cross bearings quickly locates the two emitters (figure 6). Both belong to different emergency services that have set up their transmitting equipment close to each other without any coordination. Apparently, mutual coupling occurs in both transmission paths, leading to the intermodulation products as a result of non-linearities.



**Figure 6: Taking cross bearings on the emitter on channel T022 locates the source of interference.**

The cause of the problem is thus identified, so corrective measures can be taken. In this particular situation, only a reduction in the transmitted power will help. Technically, of course, steeper channel cutoff filters would be advantageous. Still, this technical effort can be spared by appropriately instructing personnel and by placing the transmitters further apart to avoid similar interference occurring at future events.



**Figure 7: Emitter location on an aerial photograph of the site transmitted to the security services**

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