Frequency Protection of the Czech Weather Radar Network

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1. Introduction

The European Commission Decision No 2005/513/EC on the harmonized use of radio spectrum in the 5 GHz frequency band for the implementation of Wireless Access Systems including Radio Local Area Networks (WAS/RLANs) was adopted in the Czech legal system in September 1st, 2005. Only few weeks later (September 16th) the first RLAN interferences on one of the Czech Hydrometeorological Institute's (CHMI) C-band radar occurred (Fig. 1). The source of jamming signal was identified by the Czech Telecommunication Office (CTO - regional telecommunication authority) one month later. It was identified as Motorola Canopy Point-to-Point radio system that was 40 km away from the radar site.

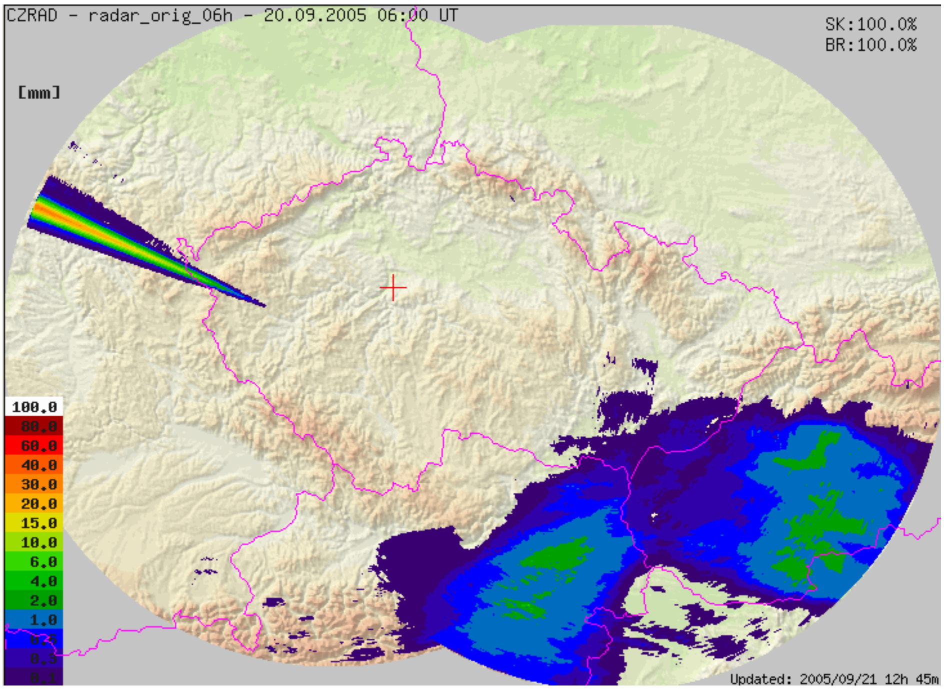


Fig. 1: First case of RLAN interferences in Czech Republic (20th September2005 – 6h precipitation sum).

2. Frequency site protection and localization of RLAN devices

Nowadays we continually observe about 15 – 20 relatively strong RLAN interferences on the CHMI radars (Novák 2007), see Fig. 4 and 5. The CHMI closely cooperates with the CTO on protection of Czech weather radar measurements since the beginning of the RLAN disturbance. The CHMI also participates on international frequency protection activities of EUMETNET-OPERA and EUMETNET-EUMETFREQ (indirectly via EUMETNET-OPERA). The most important outcome of these activities is continually increased protection of "meteorological" band 5600-5650 MHz (new ETSI EN 301893 standard, onboard aircraft RLAN devices,…), into which Czech weather radars were retuned (Novák et al., 2008).

The cooperation with the CTO was even intensified in 2009, when we started to use the 5 GHz 802.11a compatible radio (Fig. 2a) connected to the output of the radar antenna to find an ESSID identification string, MAC address and azimuth of the jamming signal (Fig. 3). The measured information is shared with technical experts from the CTO (Fig. 2b) to increase the success of finding sources of the jamming signals.

(a) (b)

Fig. 2: The 5 GHz RLAN radio with LAN RJ-45 connector and UHF N-connector on the rear side - MikroTek (a); CTO monitoring vehicle with the 5 GHz antenna on the roof (b)

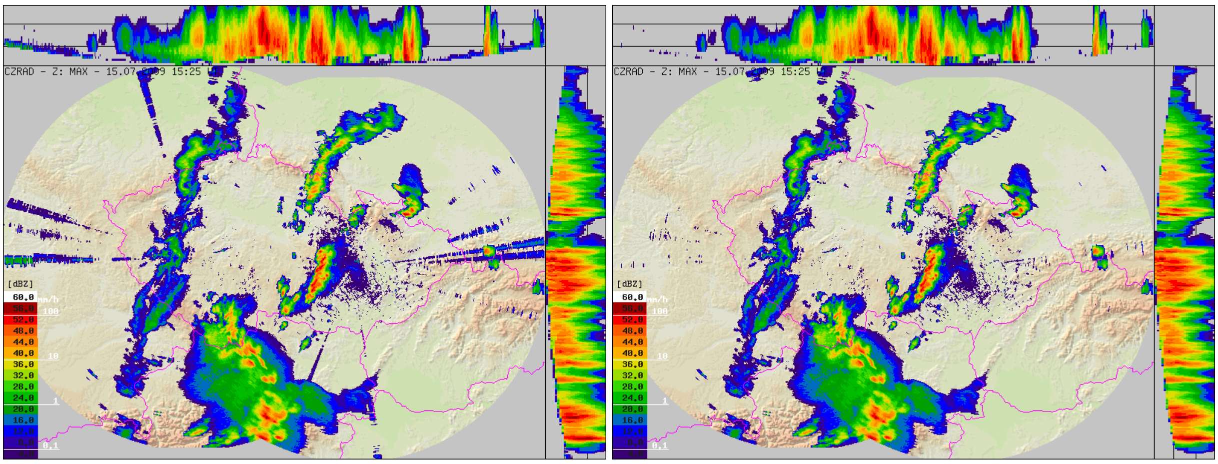
A	B	C	D	E	F	G	H	I	J
azimut	n	ATTR	MAC ADDRESS	SSID	BAND	FREQ	LEVEL	RADIO-NAME	DATE
42	1	A B R	00:80:48:50:8F:18	bajanet-slh	5ghz	5640	-91	Sektor sumvald	23.3.2010
45	1	A B R	00:0B:6B:DE:7A:17	UU51	5ghz	5640	-92	000B6BDE7A17	23.3.2010
75	1	A B R	00:0B:6B:D8:FB:94	To2L	5ghz	5640	-90	000B6BD8FB94	23.3.2010
80	1	A B R	00:15:6D:54:8A:1C	DL51	5ghz	5640	-91	00156D548A1C	23.3.2010
101	1	BPR	00:0B:6B:4D:E1:CB		5ghz	5640	-91	000B6B4DE1CB	23.3.2010

Fig. 3: Output of RLAN measurement being provided to the CTO, table contains a MAC address, SSID and azimuth of jamming RLAN devices.

3. Using the software RLAN removal algorithm

Although the CTO is able to localize a lot of the RLAN devices a lot of them still disturb Czech weather radar measurements. Therefore new software algorithm was implemented to remove false targets related to the RLAN jamming out of the polar volume data.

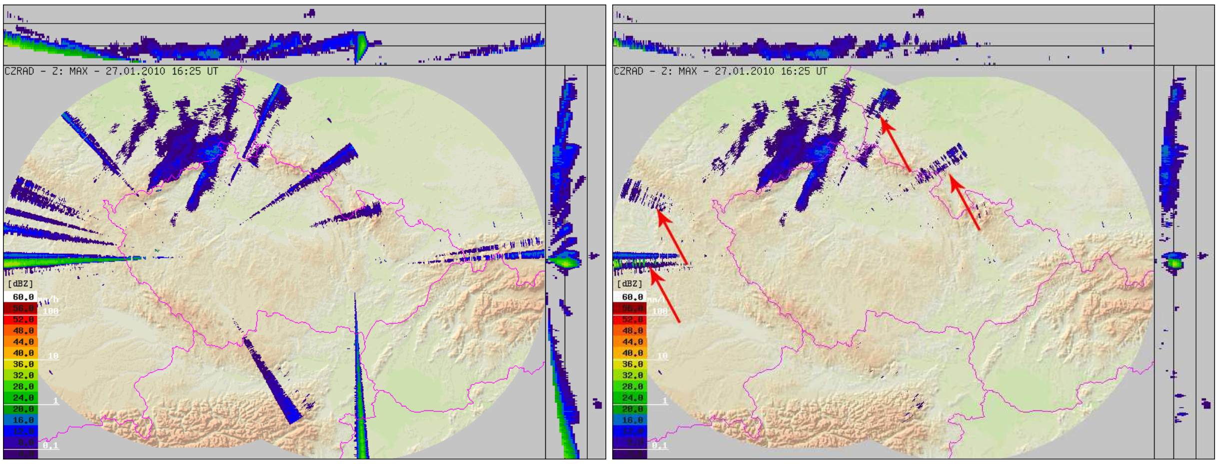
The RLAN removal algorithm corrects the 3 lowest polar reflectivity PPIs (0.1° - 0.9°). It works ray by ray. In each ray it goes through all range bins and search for potential RLAN disturbed range bins that in <-3°,+3°> azimuth interval have sharp peak (in both directions there has to be a bin with a reflectivity below 4dBZ and difference between this bin and center bin has to be higher than 10 dBZ). If there is more than 20 % of potential RLAN disturbed range bins in the ray than such ray is marked as disturbed by RLAN and affected bins are cleared. Reflectivity is removed only if it is below 40 dBZ. This can prevent removal of small but strong convective storm cells that lay in direction of RLAN jamming. There is not done any azimuthal interpolation to recover removed bins.



(a) (b)

Fig. 4: Czech weather radar composite of maximum reflectivity (15th July 2009 15:25UTC) without applied RLAN removal algorithm (a) and with applied RLAN removal algorithm (b).

Using this algorithm in our volume radar data processing, we can reduce the number of visible RLAN interferences (Fig. 4 and 5). The algorithm is tuned to prevent removing the real weather targets, therefore in some cases (multiple RLANs are very close in azimuth or in the RLAN ray is combined with a weather targets) not all the RLAN interferences are removed (red arrows in Fig. 5).



(a) (b)

Fig. 5: Czech weather radar composite of maximum reflectivity (27th January 2010 16:25UTC) without applied RLAN removal algorithm (a) and with applied RLAN removal algorithm (b).

4. Conclusions

Interference of RLAN devices is serious problem for Czech weather radar network measurements. To prevent these interferences the CHMI closely cooperates with national telecommunication authority as well as with EUMETNET-OPERA and EUMETNET-EUMETFREQ on international level.

To improve radar products, the CHMI developed software RLAN removal algorithm that is able at least partially clear RLAN echoes from radar products.

Acknowledgment

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