Progress in Mitigation of WLAN Interference at Weather Radar

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I. Wireless/radio local area networks (WLAN/RLAN) [1]
- are widely used.
- co-exist in traditional frequency bands of weather radars (WR), and
- their signals often contaminate weather radar observations:
  - significant false echo
  - “precipitation” in fair weather
  - superimposed with true echo
  - distortions in measurements and in identification
  - weak background
  - ambiguity in ambient noise power (calibration)

Management of WLAN/RLAN interference in WR is a diverse activity:
1. enforcement of standards, e.g. dynamic frequency selection (DFS),
2. localization of individual sources in daily operations, authorization,
3. quality control of radar observations and mitigation of effects.

All these call for good understanding of the WLAN/RLAN ‘noise’

II. WLAN input to the radar receiver in a controlled set-up (Ref. [2])

- D-link DAP-2553 access points (AP)
- Wireless distribution system (WDS) at channel 48 (5240 MHz)
- CW RF generator at 389 MHz (Agilent E4407B) as local oscillator
- RF spectrum analyzer (Agilent E4407B)
- UDP or TCP/IP data traffic generated between the Radar PC and a PC using Linux software.
- Permit: 7.8dBm Preceived: -85dBm
- Mimos a stationary antenna & AP9100m

![Diagram of the set-up for the characterization of WLAN/RLAN interception in controlled conditions.](image1)

III. Basics of the WLAN/RLAN complex ‘noise’

Recall: complex voltages from precipitation echo and additive thermal noise are Gaussian distributed random variables; the powers are Rayleigh distributed

**WLAN (IEEE802.11.a,g):**

I. Orthogonal Frequency Division Multiplexing (OFDM) -> flat spectrum

II. Standard packet structure [2]: a multiple of symbol times of 4 ms with a minimum length of 20 ms.

802.11n: an extension from 802.11a,g.

III. Request for Send/Clear for Send and other overheads in time

> bursts of 20µs + Nx4µs with variable idle times (throughput ~50% max)

![Diagram of the packet frame structure in the standards of IEEE 802.11a,g.](image2)

IV. Tests for a non-Rayleigh component in time series

- pulse-to-pulse checks for anomalous spikes (Ref. [7])
- χ²-test for the hypothesis of Rayleigh distributed pulse powers

An operational approach: for each received channel and gate

![Diagram of the block diagram for the characterization of OFDM interference as a non-Rayleigh component in the received voltages.](image3)

V. Conclusions

- OFDM interference are distinct from Rayleigh distributed precipitation echo and thermal noise;
- spikes in pulse time series can be recognized, flagged and removed in real-time;
- Rayleigh components appear recoverable within OFDM transmissions upto ~70% of the maximum throughput.

![Diagram of the correlation coefficients for the OFDM interference in laboratory and at radars.](image4)

Bibliography:

[1] IEEE 802.11a™ Wireless Local Area Networks, the Working Group for WLAN Standards

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