To: Industry Canada, FCC, NTIA, CITEL PCCIII, USJTG 4-7-8-9, MPT, Australia, China. Head of delegations ITU-R WP8B JRG8A-9B

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Subject: Liaison statement on the compatibility between IEEE 802.11a and radars in the Radiolocation and Radionavigation service in the 5250-5350 MHz and 5470-5725 MHz bands.

This document is a position paper from the following working groups of the IEEE Project 802, the Local and Metropolitan Network Standards Committee:
[IEEE Working Group 802.11 for Wireless Local Area Networks, and]
[IEEE Working Group 802.15 for Wireless Personal Area Networks.]

1. Introduction

IEEE 802 would like to get information on characteristics of the radars used in the 5 GHz range.

The issue of sharing between RLANs and radars appears to be one of the key elements in the ITU-R work related to WRC-03 agenda item 1.5. Therefore, it seems necessary to provide additional guarantees on the efficiency of RLAN Dynamic Channel Selection (the IEEE 802.11 term for Dynamic Frequency Selection (DFS)) in order to facilitate sharing between RLANs and the other users in this spectrum. ERC 72 provides some parameters and we are looking for further information to assess the suitability of the DFS.

This document gives some general principles of the DFS mechanism and requests information on radars in use in the 5 GHz band in order to identify more precisely the ability of RLANs to detect radar signals.

2. General principles of the DFS mechanism.

The DFS is mainly based on received signal strength (idle channel RSS) measurements during idle channel conditions. Access Points (AP) can make the measurements themselves and/or request mobile terminals (MT) to make measurements. The measurements can be done on the channel in use or on another frequency.

Interfering signals can be detected by measuring the received signal strength within a specified time window at intervals and comparing it to a predefined threshold value. If the measurement is made as a result of data errors being detected, this threshold is set to depend on the required C/I and therefore on the data rate, RF power setting in the AP. In case the idle channel RSS is lower than the threshold, the reason for the error is most likely fading. If on the other hand the idle channel RSS is higher than the maximum allowed value (-30 dBm), it means receiver compression was the reason. This compression may occur because of a strong interference source such as a radar transmitter. Alternatively, a specific threshold could be set for a specified time window to make measurements and report results to a control entity in higher layer software. RLAN devices therefore are capable of detecting the presence of interfering transmitters and taking appropriate action to move to another channel.

In annex 1, we present a DFS algorithm, which by utilising the above measurement and signalling fulfils the DFS requirements. The IEEE 802.11h specification defines the protocol required to communicate DFS information between devices. This assures a common behaviour of all IEEE 802.11h implementations.

However, DFS implementation is vendor specific and will not be standardised but the desired behaviour will be verified during certification testing.

3. Applicability of DFS regarding compatibility with radars.

Due to the high RF power level emitted by radars, it is assumed that the most likely direction of interference will be from radars into RLAN receivers.
Therefore, the key element to enable compatibility between radars and RLANs is the ability of IEEE 802.11 LANs to detect radar signal. In order for IEEE 802.11h to detect radar signals, the receiver has to be able to recognise the signature of different radars.
In order to have a more precise view on the requirements to be fulfilled by DFS, IEEE 802 would like to get information on characteristics of the radars used in the 5 GHz range. In particular, IEEE 802 took note of the radar parameters given in the ERC Report 72 and would like to be informed on the validity of these data and on eventual updates.
Furthermore, in addition to the characteristics given in tables 6.6 and 6.7 of this ERC report, other characteristics are required such as:

- **scan rate,**
- **pulse rise/fall time,**
- **antenna patterns.**

IEEE 802 is looking forward to receiving your response and will be pleased to establish close co-operation on this matter.

With best regards,

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ANNEX 1 : Example implementation of a DFS algorithm from ETSI BRAN HIPERLAN/2

In this chapter we present a DFS algorithm, which by utilising the above measurement and signalling fulfils the DFS requirements. The HIPERLAN/2 RLC specification defines the protocol required to communicate DFS information between devices. This assures a common behaviour of all HIPERLAN/2 implementations.

However, DFS implementation is vendor specific and will not be standardised but the desired behaviour will be verified during certification testing.

At start up the AP performs a full DFS measurement and selects a random frequency from the eligible channels. It then enters the *Normal Operation* state and begins broadcasting its beacons. This allows mobile terminal to detect its presence and to associate themselves with the AP.

The DFS algorithm can be described with a state machine with four states: *Normal operation, Channel DFS test, Full DFS measurement* and *Frequency change*. Figure 1 presents the state machine.

Normal operation state consists of the normal tasks: send and receive traffic. This is carried on, until either a measurement timer expires or uplink error rates and signal strengths indicate interference. In case the timer expires, state is changed to *Channel DFS Test*. If interference is detected, state is changed to *Full DFS measurement*.

Channel DFS Test state tarts with the AP broadcasting AP_ABSENCE. The AP measures the interference on the used frequency. AP decides on the basis of the results, whether the own channel is good enough to continue operation. If it is OK, state is changed back to *Normal operation*, otherwise it is changed to *Full DFS measurement*.

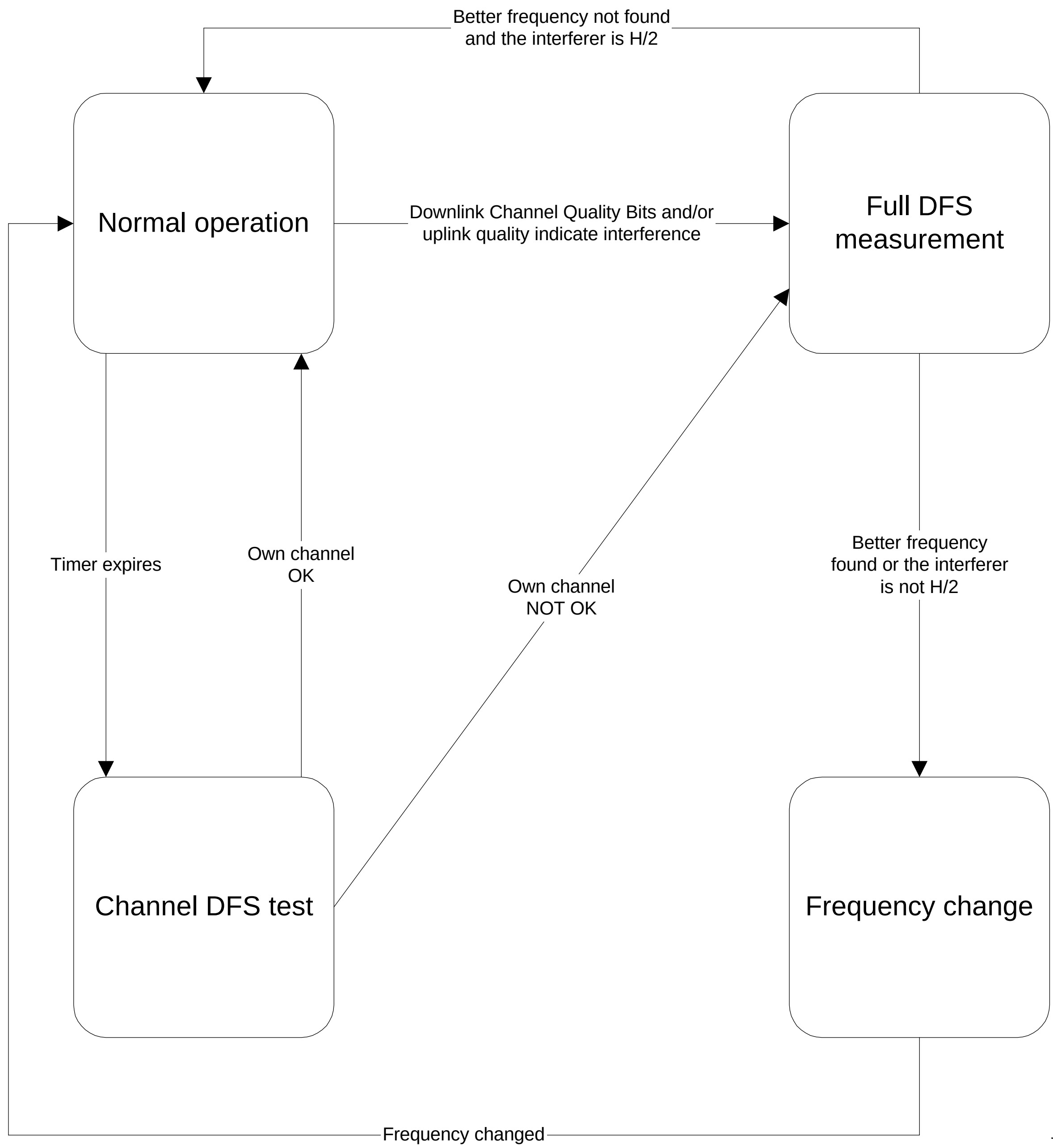

Figure 1: DFS algorithm state machine.

In *Full DFS Measurement State*, the AP first determines the frequency to be measured. Then it broadcasts AP_ABSENCE goes through a procedure to measure all channels. This may involve reports requested from mobile terminals. It decides, which frequency is the best, i.e. has no interference at all, or if such a frequency can not be found, then a frequency, where H/2 traffic is detected. If own frequency is best, operation continues normally by returning to state *Normal operation*, otherwise state is changed to *Frequency change*.

In *Frequency change* state the AP wakes all the sleeping mobiles and broadcasts a CHANGE_FREQUENCY message, which tells all the MTs what is the new frequency, and when operation there starts. After the frequency has been changed, the state returns to *Normal operation.*

This algorithm distributes the APs evenly to all available frequencies, and thus lowers the interference level caused on a single frequency band.

It also assures that HIPERLAN/2 devices do not operate co-channel with any strong interferer, including radar systems.