Wireless LAN MAC Protocol: PHY Layer transparency

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ABSTRACT

In this contribution we propose a complement and an update to the Medium Access Control Protocol presented in [1] and [2]. The focus is placed on the PHY layer transparency. Specifically we describe how the MAC protocol can be adapted in a straightforward manner to address several PHY layers (Infra-red, Spread Spectrum Direct Sequence, Spread Spectrum Frequency Hopping, and multi-channel spectrum).

This contribution addresses the Issue 24.7 related to PHY support by MAC (see [3]).

INTRODUCTION

The Medium Access Control Protocol that IBM has proposed for wireless LANs has been described along with the assumption that the underlying PHY layer was based on Slow Frequency Hopping Spread Spectrum.

For instance the first element of the MAC frame, known as **G**, is described in [1] as the interval during which the transmitter carrier *frequency* is changing. Another example can be found in [2] where is described the control information carried in the header **AH**, the second element of the MAC frame. Indeed this control information specifies, among other things, the next *frequency* to be used in the Slow Frequency Hopping pattern.

Obviously, it is clear that the proposed MAC protocol is also very well suited for PHY layers others than the Slow Frequency Hopping Spread Spectrum. This statement was first done in [1] (see the Introduction section), and then in [2] as an answer to the Criteria #7: *Transparency to PHY layer.*

The purpose of this new contribution is to further explain how the MAC protocol we have proposed can very easily be adapted to cope with the specificities of any underlying PHY layer.

DESCRIPTION

Besides the Slow Frequency Hopping Spread Spectrum PHY layer, we will consider the following optional PHY layers:

- Direct Sequence Spread Spectrum, as proposed in [4]. This scheme relies on a *code* division technique to achieve cell isolation.

- Infrared PHY layer, assuming diffuse emission. This scheme can provide cell isolation if the infrared spectrum is split into several *subchannels*, each cell using a single subchannel.
- If the PHY layer is based on allocated RF spectrum that can be divided into several *subchannels* (as described in [5]), then each of these subchannels could be based either on Slow Frequency Hopping or on Direct Sequence Spread Spectrum technique.

From the previous list, it becomes clear that some piece of information is needed by the PHY layer to ensure cell isolation: either the next *frequency* to use, or the next *code* to use, or the next *subchannel* to use.

We propose to extend the control information carried in the AH Header (see [2]) as follows:

- If the PHY layer relies on a Slow Frequency Hopping Spread Spectrum scheme:

```
► TA = Length of Period A
:
► NET_ID = Network Id
► NEXT_FREQ = Next frequency to be used in the SFH pattern.
:
```

Figure 1. **Control information of AH Header - SFH SS case**

- If the PHY layer relies on a Direct Sequence Spread Spectrum scheme:

```
► TA = Length of Period A
:
► NET_ID = Network Id
► NEXT_CODE = Next code to be used in the DSSS scheme.
:
```

Figure 2. Control information of AH Header - DS SS case

- If the PHY layer relies on a subchannel split.

```
► TA = Length of Period A
:
► NET_ID = Network Id
► NEXT_CHNL = Next subchannel to be used.
:
```

Figure 3. Control information of AH Header - Multiple subchannels case

> **Note:** The use of subchannels and of Spread Spectrum techniques are not exclusive: so the associated pieces of control information can be merged in a same AH header.

As far as the **G** time period is concerned, one can clearly sate that the use (and therefore the duration) of this interval is related to the PHY layer. According to the various PHY layers previously listed, the G time period is used as follows:

- If the PHY layer relies on a Slow Frequency Hopping Spread Spectrum scheme:

G is the interval during which the PHY layer hops from one *frequency* to another one, as specified in the AH header. The duration of the G interval corresponds to the time required to change frequency.

- If the PHY layer relies on a Direct Sequence Spread Spectrum scheme:

  G is the interval during which the PHY layer changes from one *code* to another one, if the AH header specifies a new one. The duration of the G interval corresponds to the time required to change code. One can expect that this duration is smaller than the one corresponding to frequency change. For all the cases where the code is not to be updated, the G interval can be used to ease and secure the frame synchronization among all the members of a given cell.

- If the PHY layer relies on a subchannel split.

  G is the interval during which the PHY layer changes from one *subchannel* to another one, if the AH header specifies a new one. The duration of the G interval corresponds to the time required to change subchannel.

A new parameter can be added to the control information of the AH Header to define if the G interval is required, and a second new parameter can also be introduced to specify the G interval duration, in order to match various radio specifications.

CONCLUSION

In this contribution, we have further specified how the MAC protocol that was described in [1] and in [2] can be easily extended to address the specificities of various underlying PHY layers, such as Slow Frequency Hopping Spread Spectrum, Direct Sequence Spread Spectrum and Infrared.

BIBLIOGRAPHY

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