IEEE 802.11
Wireless Access Method and Physical Layer Specifications

title: **Comments on Document IEEE P802.11/92-127r1**

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Introduction

This contribution focuses on certain FHSS parameters which have recently undergone revision since the original publication of the referenced document. Specifically, the parameters of channel switching time and hop rate are discussed.

Channel Switching Time

Document IEEE P802.11/92-127r1 (Nathan Silberman, California Microwave) specifies a channel switching time of 300 µsec maximum. Previous versions of this document set this maximum at 100 µsec.

Document IEEE P802.11/93-4 (François Le Maut, IBM) makes a case for the 300 µsec maximum: "It seems that in order to maintain the PHY at a reasonable cost it will be wise to consider up to 300 microseconds."

In making the case for a longer (i.e. 300 μsec vs. the previous 100 μsec) channel settling time, there seems to be an implication that vendors may freely choose the level of performance their system will achieve, independent of the choices made by other vendors of 802.11 compliant products. While in fact this is obviously true, it does not follow that such product-to-product variance can be tolerated and still maintain *interoperability*.

This point was raised in the March 1993 PHY subcommittee discussions, and a counter-argument was offered that interoperability *is* possible, as the channel switching time can be negotiated among all stations participating in "the network." The author does not agree with this line of reasoning, for two reasons:

1) Negotiation of a channel settling time can only occur in an environment in which *all stations in the network* are capable of "hearing" all other stations in the network. Therefore, in order to support different channel switching times *and* interoperability, it will be necessary to generate "negotiation sessions" on a periodic basis, performed under fixed "worst case" conditions, so that all stations can indicate the degree of performance of which they are capable. Such negotiation will always result in *all* stations in the network having to reduce their performance to that of the "least capable" station, both during negotiation and all subsequent operation.

2) Since any given station may "wander" into or out of the radio range of one or more other stations in a network, such negotiation would have to occur with sufficient frequency to ensure that a newly arriving station would not suffer an inordinately long wait before being able to "join" the network. Furthermore, due to the likelihood of hidden stations in any given network, negotiation may prove to be arduous, as steps must be taken to ensure that *all* stations have had an opportunity to communicate their performance limits to all other stations in the network.

It is believed that a channel settling time of 300 μsec is quite conservative, and that it is not in the best interests of the committee to choose a performance limit which, in many environments, will limit network operation to such a "worst case." During the March 1993 meeting of the PHY subcommittee, the author heard several participants comment to the effect that 300 μsec is unnecessarily conservative. One particular comment, which may be instructive, was offered by Peter Chadwick (GEC Plessey), who said, "It is generally accepted that it takes 40 to 60 cycles of the reference oscillator for a synthesizer to achieve lock...". This comment was offered with respect to a discussion of choice of hopping channel center frequencies However, the author observes that the same line of reasoning would suggest that a 1 MHz reference oscillator should be capable of channel settling times of less than 100 μsec.

Furthermore, the author believes that although a reduction in performance from 100 μsec channel settling time to 300 μsec may reduce costs, is not necessary in order to achieve reasonable costs. It is therefore suggested that the channel settling time be re-examined, with the objective of arriving at a more aggressive "standard" channel settling time.

Hop Rate

In the March 1993 PHY meetings, there was a discussion of the "hop rate" specification. A range of 2.5 to 40 is stated in document 93/127r1. Discussion of this in the March meeting brought the group to accept a range of 2.5 to 200 hops per second.

The 2.5 hops per second limit is mandated by the Federal Communications Commission in the United States, so this has not been controversial. However, the "faster" limit of 200 hops per second was arrived at somewhat informally (i.e. no strong objections were raised during the meeting).

It is not clear to the author whether the PHY shall control hopping without the involvement of the MAC. If the MAC is not involved, then it is certainly within the purview of the PHY subcommittee. However, if this is the case, then arriving at an upper limit on hop rate is ill advised in the absence of an agreed method of hop synchronization. According to Larry Van Der Jagt (PHY subcommittee chairman), no FHSS PHY proposals have been discussed in detail; all discussion to date has focused on the "template document" (currently 93-127r1). The current limit of 200 hops/second seems arbitrary at this time.

If the MAC *is* involved in control of hopping, then the PHY subcommittee should involve the MAC subcommittee in this decision.

While not yet proposed before the committee, there exists the possibility that a combination of frequency hopping with MAC-layer error control coding may result in substantially better performance in the presence of interference than may be achieved by implementing frequency hopping as a straightforward "adherence to the rules" at the PHY layer alone. This concept will be discussed further by way of submissions to future meetings. The choice of a maximum hop rate of 200 hops/second would likely have an adverse impact on the applicability of such a scheme. It is believed that there is insufficient information before the committee to decide on a maximum hop rate at this time. Therefore, it is proposed that the selection of a "maximum hop rate" be deferred until the committee has had an opportunity to consider the frequency hopping mechanism in some detail.