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TITLE OF THE INVENTION (180 characters max)

Interoperability Methods For IEEE 802.11a And HIPERLAN

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Interoperability Methods
For IEEE 802.11a and HIPERLAN

Matthew Sherman

Jan. 14, 2001

Background of the Invention

Wireless data transmission is a rapidly growing field. One increasingly popular form of such transmission is wireless local areas networks (WLANs). A number of standards currently exist for WLANs. However they tend to be fragmented and largely incompatible. There is desire for a worldwide standard that would allow a single device to function virtually anywhere in the world providing high-speed connectivity.

Recently, bands have opened up that hold that promise between 5 and 6 GHz. Wireless standards are being developed to utilize those bands. One such standard is HIPERLAN/2 (High Performance Radio Local Area network Type 2), which is of European origin [1-3]. Another such standard is IEEE 802.11a, which originate primarily in the US [4-5]. Japan is developing standards similar to both those in the US and Europe. Both the US and European standards profess similar levels of performance, and use very similar waveforms to communicate. However, the two standards are currently incompatible – Particularly at the Media Access Control (MAC) layer. As such a large push has developed to create a single hybrid standard, or provide some means for the two standards to easily interoperate.

Methods for Interoperation of HIPERLAN and 802.11a systems are being contemplated in which systems conforming to both standards might share one common channel. A MAC frame structure has been proposed to support this application. The proposed structure contemplates a super frame with an 802.11 phase and a HIPERLAN/2 phase (see FIG. X). The super frame has a length of 2^k X 2 ms, where k is an integer. Duration of the 802.11 beacon plus the 802.11a phase is set at n X 2ms. The HIPERLAN/2 phase comprises m x 2ms. The sum of m and n would be 2^k.

While this is an interesting approach it does have some drawbacks. For one, the approach presumes the 802.11 terminals can be prevented from transmitting during the HIPERLAN phase. Currently, no mechanism exists within the 802.11 standard to allow this. It is possible that new mechanisms could be introduced into newer versions of the standard, and be supported by future generations of 802.11 stations. However, the problem would be best addressed if the solution were somehow compatible with current generations of terminals. It is the purpose of this disclosure to present such solutions.

Summary of the Invention

This application builds upon prior work for developing interoperability between the HIPERLAN and 802.11a standards. It builds upon mechanisms suggested in a prior application, to increase the interoperability possible between the two standards. Specifically, it introduces mechanisms to prevent 802.11 terminals from transmitting during time periods allocated to HIPERLAN, so that a single channel can be shared between the two standards. It also improves upon the protection available by suggesting a "super frame" format where HIPERLAN transmissions are offered the highest level of protection possible within 802.11, which is that within the 802.11 Contention Free Period (CFP).

Brief Description of Drawings

See slide set titled "Proposed HIPERLAN 802.11 Compatibility Frame".

Detailed Description of Invention

It has been suggested that a Superframe structure can be developed that allows 802.11a stations (STA) to share a single channel with HIPERLAN/2 stations. One such proposal is shown in figure X. The problem is that there is nothing in the proposal that would force 802.11a STA to cease transmissions during the HIPERLAN phase of the Superframe. The 802.11a STA would view the HIPERLAN phase as a part of the 802.11 Contention Period (CP), and would normally be free to transmit during the CP. 802.11 STA have a mechanism call the Network Allocation Vector (NAV) that can be set to prevent the STA from transmitting. However, the NAV is set only under very specific conditions that do not exist at the time the HIPERLAN/2 frames need to seize the medium.

A prior application includes an 802.11 mechanism that can be used to cause the NAV to be set while the HIPERLAN/2 transmissions occur. The mechanism is called there an Enhanced CTS (ECTS). If the HIPERLAN/2 phase is proceeded by an ECTS with the duration field properly set prevent transmissions during the desired frame, then a working Superframe structure can be developed consisting of

Beacon, 802.11 phase, ECTS, HIPERLAN/2 phase.

The Superframe would then repeat, with a Beacon following the HIPERLAN/2 phase. The Superframe structure would be constructed such that its total length would be 2^k times 2 milliseconds (msec), where k is an integer. The 802.11 Beacon period (time between Beacons) would be selected to be identical to the Superframe length. The HIPERLAN/2 phase would be n times 2 msec, and the 802.11 phase (which actually would include the Beacon and ECTS) would be m times 2 msec, where $m+n = 2^k$. For greater coverage, an Enhanced RTS (ERTS) followed by CTS could be used instead of the ECTS.

While this scheme could work, it does have one important drawback in that 802.11a STA that are hidden from the STA sending the ECTS would not set their NAV's, and might transmit during the HIPERLAN/2 phase of the superframe. This would interfere with the operation of the HIPERLAN/2 STA. To fix this, a different approach can be used where the HIPERLAN phase is buried in the Contention Free Period (CFP) of 802.11. The CFP occurs with a regular period, and all 802.11 terminals set their NAV's during the CFP. To realize such a super frame the following sequence:

CFP_Beacon, 802.11 Broadcast, 802.11 CFP, HIPERLAN/2 phase, CF_End, 802.11 CP

Here, CFP_Beacon is a Beacon starting a CFP. Not all Beacons need start a CFP. However, the CFP must recur every integral number of Beacons. The inference is that the Beacon period must be a sub multiple of the super frame size (which is still 2^k time 2 msec). Now however, 3 phases really exist. The first would consist of the CFP_Beacon, 802.11 Broadcast, and 802.11 CFP. This would need to be an integral number times 2 msec, and that number will be specified as l for this application. The HIPERLAN/2 phase would remain at n times 2 msec, and the CF_End, 802.11 CP would have to be m times 2 msec. The sum $l+m+n$ must be 2^k.

Note that Broadcast traffic must immediately follow a beacon which is why it is located as such. The HIPERLAN/2 phase will be viewed by 802.11 terminals as part of the CFP, and accorded protection accordingly. The CFP's maximum length is determined by a variable regularly broadcast in Beacon messages. It should be set very close to the full length of the superframe. To relinquish the time to the CP, when the CF_End is sent, all terminals will automatically reset their NAV's. Normal CP transmissions would then occur. Note that additional Beacons might occur during the CP that does not start a new CFP. The existence of these Beacons may make it easier to handle broadcast traffic, and 802.11 power saver terminals, but is not a requirement.

There may be some concern about Beacon jitter since this may result in jitter in the superframe. HIPERLAN/2 is not very tolerant of jitter. However, by utilizing the ECTS mechanism (or more likely an ERTS) jitter before the Beacon can be controlled. Alternatively, the Access Port (AP), which is a special STA, which provides access to a Distribution Service (DS) for the medium among other things, could just broadcast dummy traffic just prior to Beacon transmission if desired preventing other traffic from seizing the medium. Also, while it is unlikely to be needed, an ECTS could still be transmitted prior to the HIPERLAN/2 phase if desired to further assure that no 802.11 STA are active during the HIPERLAN/2 phase.

References:

[1] TS 101 761-1, Broadband Radio Access Networks (BRAN); HIgh PErformance Radio Local Area Network (HIPERLAN) Type 2; Data Link Control (DLC) Layer - Part 1 - Basic Data Transport Function, ETSI Project BRAN, 2000

[2] TS 101 761-2, Broadband Radio Access Networks (BRAN); HIgh PErformance Radio Local Area Network (HIPERLAN) Type 2; Data Link Control (DLC) Layer - Part 2 - Radio Link Control (RLC), ETSI Project BRAN, 2000

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[4] IEEE, "Reference number ISO/IEC 8802-11:1999 (E) IEEE STD 802.11, 1999 edition. International Standard [for] Information Technology-Telecommunications and information exchange between systems-Local and metropolitan area networks-Specific Requirements- Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications", 1999.

[5] IEEE, "Supplement to STANDARD [for] Information Technology-Telecommunications and information exchange between systems-Local and metropolitan area networks-Specific requirements-Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications: High-speed Physical Layer in the 5 GHz Band," IEEE Std 802.11a-1999, September 1999.

Proposed HIPERLAN / 802
Compatibility Superframe F

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