IEEE P802.11
Wireless Access Method and Physical Layer Specifications

**Title:** **MAC Layer Fragmentation or Small MTU?**

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**Abstract:**

This submission is intended to clarify some of the potential problems that may arise if the IEEE P802.11 Standard uses an MTU (Maximum Transfer Unit) smaller than the other 802.x standards.
We then reach the conclusion that the standard must support MAC Level Fragmentation to provide the appropriate functionality to the upper layers.

## Introduction

On the January meeting a new issue was risen whether the standard needs to provide MAC Level fragmentation or just to define the maximum frame length supported in such a way that we provide an acceptable level of service to the upper layer protocols.

The purpose of this submission is to show the problem that a typical user may find when trying to add a 802.11 Wireless LAN (without fragmentation) to an existing Ethernet network, the author uses TCP/IP for the examples, but the problems are common to most Network Layer Protocols.

## Maximum 802.11 Packet Length

Assuming a Bit Error Rate of BER, we calculate Packet Error Rate (for a packet of n bits) using the following formula:

$$PER(n) = 1 - ( 1 - BER)^n$$

This gives the following results:

| Packet Length [Bytes] | PER@10-5 | PER@10-4 |
|---|---|---|
| 128 | 1.02% | 9.73% |
| 256 | 2.03% | 18.52% |
| 512 | 4.01% | 33.61% |
| 1500 | 11.31% | 69.88% |

From the above numbers it seems reasonable to choose a maximum packet size of 128 - 256 bytes.

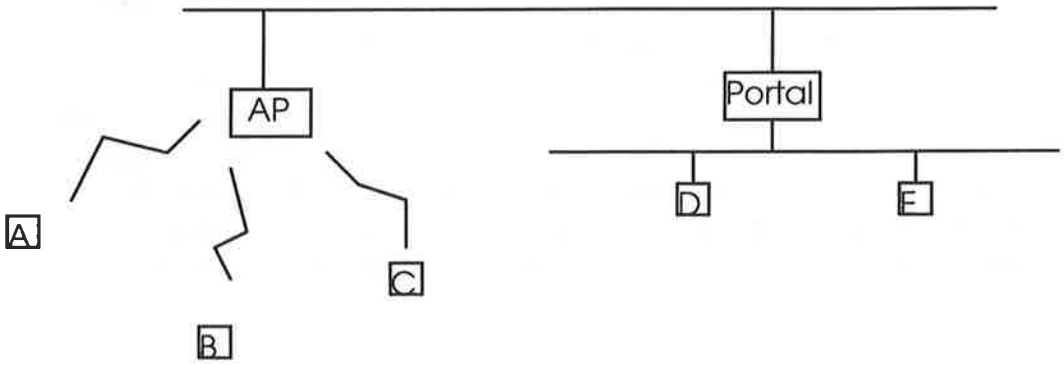
## Fragmentation Options

From the purist point of view fragmentation belongs to the upper layers of the OSI Model, not to the MAC Layer. All the MAC Layer must do is to notify the Network Layer about the Maximum Transfer Unit (MTU).

From the practical point of view, it doesn't work this way, it wouldn't be any problem if users used only Network Layer Routers to connect dissimilar networks (e.g. 802.3 and 802.11), but some users would prefer to use simple MAC Level Bridges to connect the networks at the 802.2 level.

When connecting dissimilar networks through bridges, the connection is completely transparent for the end stations, hence an Ethernet station has no hint whether the station we are willing to address is Ethernet or 802.11. So the station must use the same MTU for accessing other Ethernet Station and a 802.11 station.

The following figures shows a typical 802.11 installation:




The 802.11 stations (A, B, and C) will be connected to Ethernet Stations (D, and E), through the AP and a Portal.
If we assume that the Portal is a MAC Layer Bridge, then station D cannot differentiate between station E (which is also an Ethernet Station) and stations A, B, and C which are wireless.

The user then has 2 choices:
1. Use the minimum MTU across the bridged network, or
2. Let the Bridge perform fragmentation.

Lets analyze the two options:

**Option 1: Use the Minimum MTU**

The user will set on all the stations (including the Ethernet stations), an MTU equal to the minimum MTU across the whole bridged network. In our case this will be the 802.11 MTU (256 bytes).
This will cause stations D and E to use this same MTU to transfer data between themselves, decreasing the wired network performance..

**Option 2: Let the Portal (Bridge) Fragment the packets.**

The user will leave the Ethernet Stations with their regular MTU (1500 bytes), and the 802.11 Stations will use a smaller MTU (256 bytes).
The bridge will be in charge of fragmenting the Ethernet Packets into smaller 802.11 Packets.

This sounds reasonable, but:
Fragmentation is a Network Layer function, depending on the Network Protocol being used, we get then IP fragmentation, DECnet Fragmentation, etc., which is beyond the bridges capabilities.

People may argue, that this is already being done by Bridge vendors (case FDDI to Ethernet), and while this is true, it is definitely not good. In the IP fragmentation case, for example, most bridges just do fragment large packets and that's it (emulating what IP Routers do), but this is not all what a router should do, an IP Router, will first check whether the "Don't Fragment" flag is set, and if it is set, and the packet should be fragmented, it returns an ICMP message (do we expect bridges to send ICMP messages?). Routers also leave hints that the packet crossed through the Router, but Bridges don't, so a user will never know who fragmented the packet, etc.

### MTU Discovery

On the IP world (which the author is familiar with), there is a Standard for MTU Discovery, that would solve the fragmentation issue, each end station would know which MTU to use to reach any other end station.

The problem is that, these MTU Discovery techniques, are used only when the station is transmiting to another "network" which is separated from the current network by a Router.

### A Small benefit: Unique CRC

A small benefit that we get from the fragmentation, is that we may use smaller CRC (16 bit), and by this use a single CRC for all frames either data and control, instead of using an 8-bit CRC for Control Messages, and a 32-bit CRC for Data Messages.

### Conclusion

The author believes that, even while painful, it will be wise, for the sake of easy, and smooth acceptance of the 802.11 standard, to provide MAC Level Fragmentation to allow an MTU similar to the widely deployed 802 Standards (802.3, and 802.5).