
Encapsulation and Framing

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(some brief comments)

Definitions

- **Encapsulation**

The technique used by layered protocols in which a layer adds header information to the protocol data unit (PDU) from the layer above.

Used to identify the Start (and End) of packet – may add protection.

- **Framing**

The definition of delimiters and contents for the protocol data unit (PDU).

Defined for Ethernet and unchanged (in essence) for 15 years.

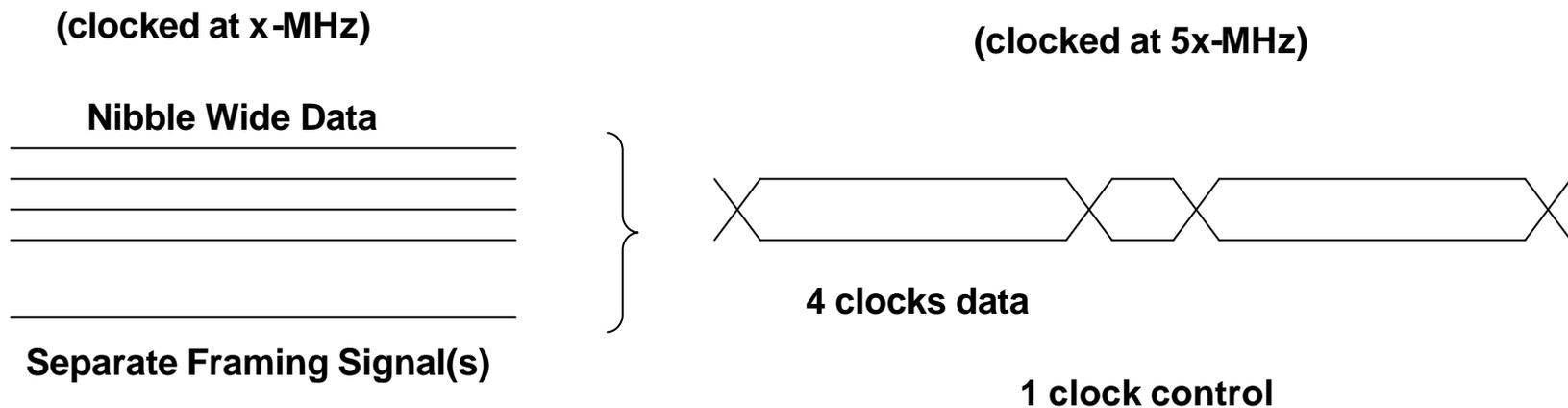
- **Encapsulation != Framing**

In general the two are completely orthogonal.

The MAC should not be able to detect the encapsulation.

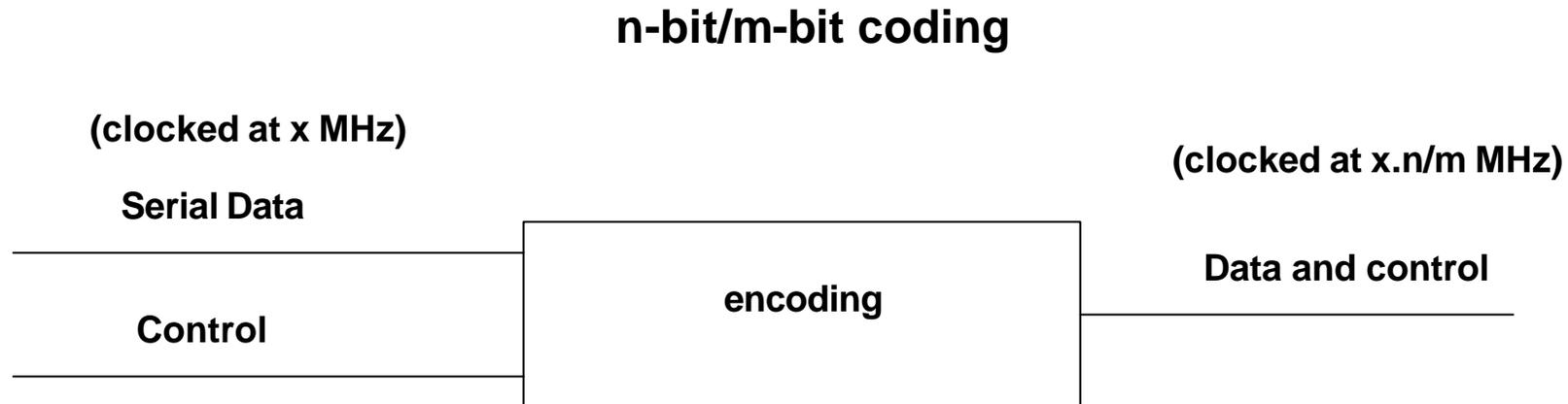
Encapsulation Basics

Example system



- Encapsulation achieved by clocking faster (25% overhead)
Very fragile, susceptible to corruption, very hard to synchronize.
- Nobody would use this system in real life!

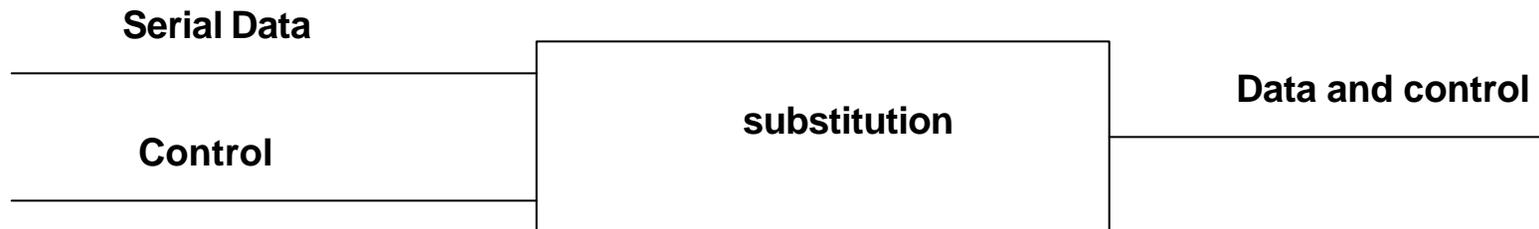
Encapsulation Options (1)



- **N consecutive bits of data are encoded as an m bit codeword**
 - 2^n data codewords plus control codewords must be defined out of a possible 2^m
 - Codewords may be chosen to add protection against framing errors
 - Control codewords may also carry data if required
- **Multiple variants used for Ethernet**

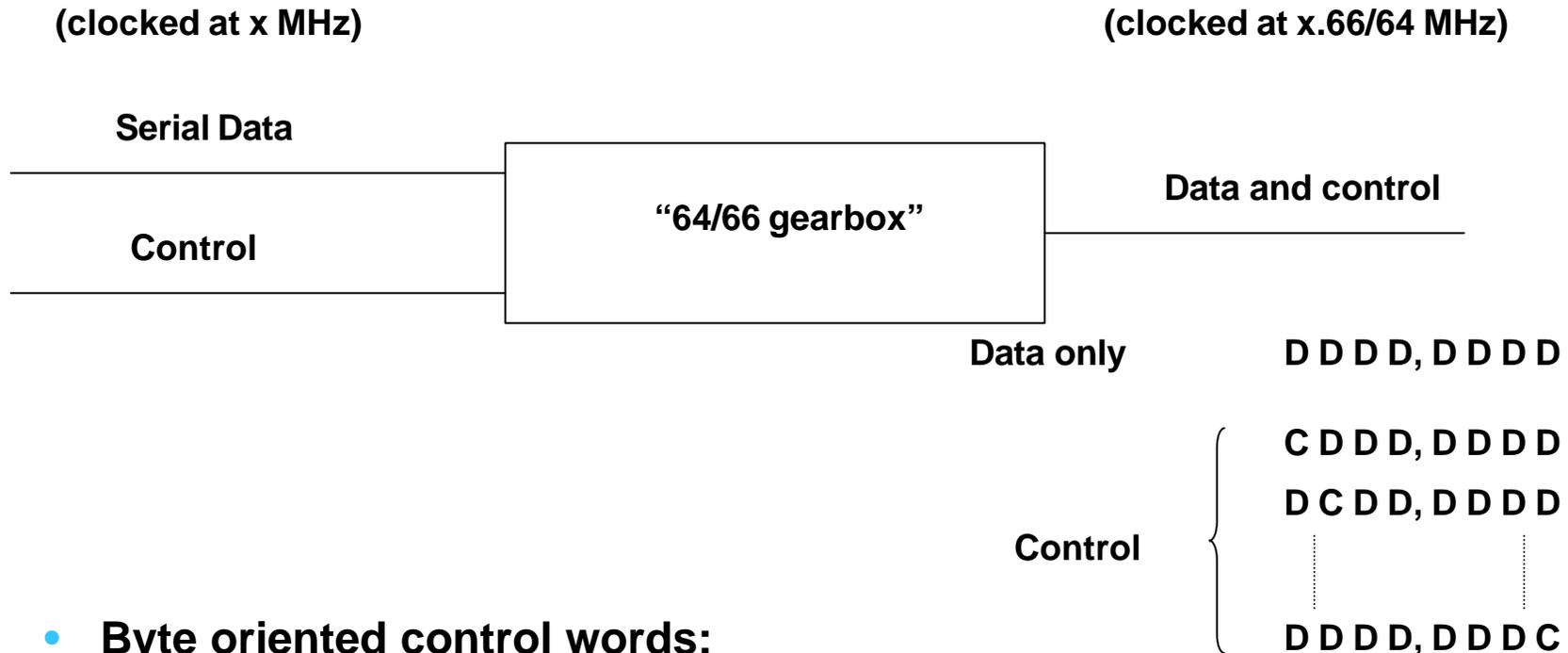
Encapsulation Options (2)

Substitution Codes



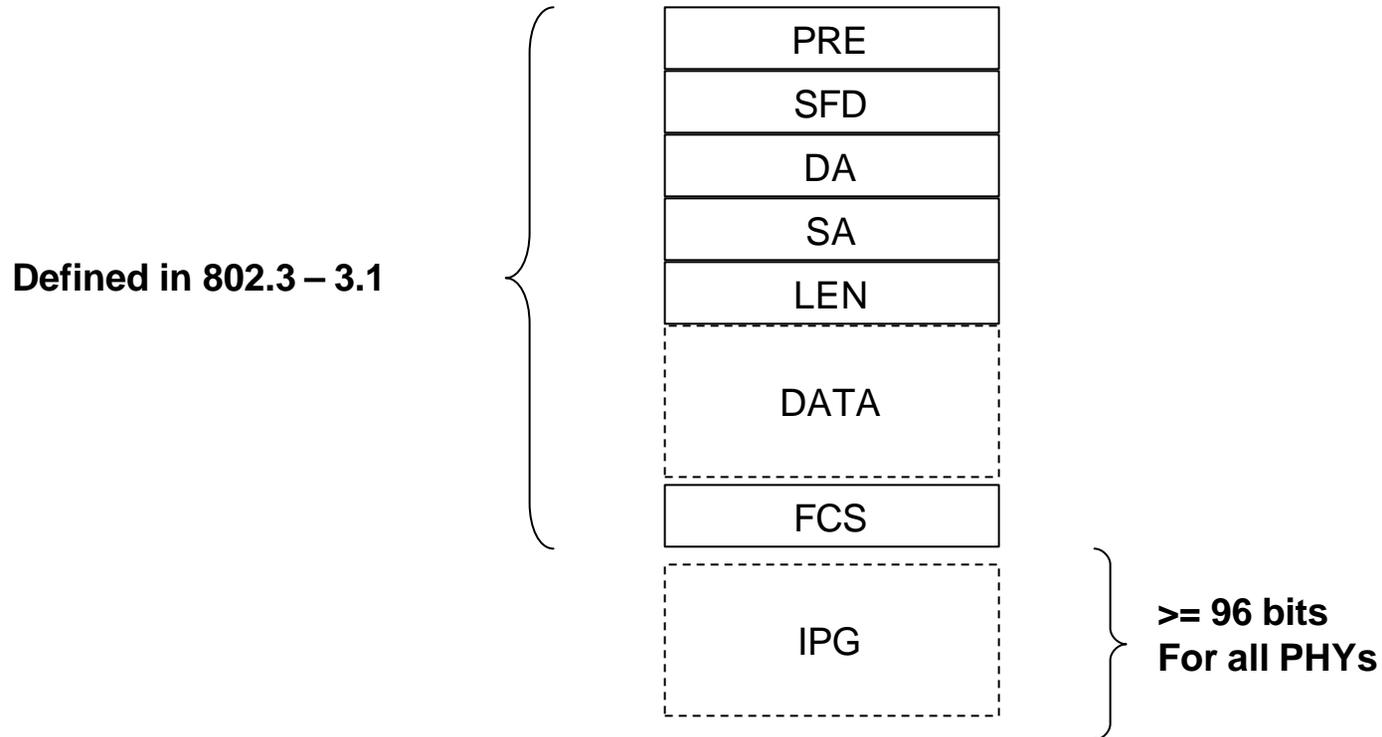
- Define an escape codeword, substitute occurrences of matching patterns in data stream
 - Very simple coding in use for more than 30 years
 - Causes data dependant variation in bit rate
 - May also be susceptible to framing errors
- Popular in modem standards

Encapsulation 64b/66b



- **Byte oriented control words:**
 - 2^{64} data only codewords
 - 2^{59} codewords for each control code
 - As used for 10Gig Ethernet
- **Overhead = 2/64 (~3%) + at least 1 byte per frame (SOP)**

Ethernet Framing



- Framing is performed by the MAC
The PHY cannot change the framing

Why not ditch the useless part?

- **Neither preamble nor IPG is required for full duplex system**
Remove these parts to gain a (frame length dependant) increase in b/w
- **More than 100,000,000 MAC devices already installed**
MAC must see unchanged framing
- **High density (integrated MAC) silicon supports QOS**
Constant Bit Rate algorithms assume Ethernet framing preserved
- **No Ethernet has changed this frame format (including IPG)**
What is Ethernet?

In Conclusion

- **Encapsulation**

 - Low overhead, fixed overhead – already defined for Ethernet.

 - 64b/66b is the clear choice.

 - Add CRC16 to increase protection (per Barry's analysis).

- **Framing**

 - Preserve the whole Ethernet frame format – including preamble and IPG.

 - Supports all existing MAC devices.

- **Encapsulation + Framing**

 - Very similar to 10GigE.