Hacking 10BASE–T Ethernet for Underwater Optical Communication

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1 Introduction

Ethernet is the most widely used local area network protocol for transmitting information between PCs, servers, telephones, sensors, PLCs, and many other machines. It defines physical form for communication signals, topology and materials used to connect devices, and how addressing and routing is done on such a network topology. 10BASE–T Ethernet uses a differential electric signal, on a twisted pair of copper wires, with data clustered in "frames" that contain unique addresses.

To expand on the above sentance:

1. The electric signal is differential to
   (a) Reduce common–mode noise
   (b) Provide transformer isolation between PCs with different earth potential
   (c) (HIGH and LOW logic levels are filtered out, so manchester encoding is used instead).
2. The electric signal operates at 10 MHz, with ???? voltage.
3. The length of twister pair cable is limited by speed of light.
   (a) Time required for a signal to propagate (round trip) between two furthest stations is "slot time".
   (b) Maximum slot time is $51.2\,\mu s$.
4. Two fundamentally different network topologies are allowed.
   (a) Half–duplex mode (CSMA/CD) allows many stations to time share a single cable.
   (b) Full–duplex topology is only two stations are connected to a Tx–Rx cable, but stations (routers) may have many connections to form star network topology.

5. Each station has a unique, 48 bit address for routing data "packets". Packets may be routed to
   (a) Individual MAC address
   (b) A multicast to a group of address determined by software higher up in the computer
   (c) Broadcast to all devices on the immediate topology cable.

2 Getting IEEE Std 802.3

IEEE Std 802.3 is the standard for Ethernet, a collection of communication protocols for local area networks over a shared physical media or a star topology of many private, point–to–point connections. The 802.3 standard is freely available online but is so large it is split into multiple sections. The first section (only 555 pages!) is available at `https://standards.ieee.org/getieee802/download/802.3-2012_section1.pdf`.