

## Modem Overhead With Ethernet Interfaces (HDLC)

A number of Comtech EF Data modems with Ethernet interfaces convert Ethernet packets to a constant rate continuous stream for transmission using an HDLC wrapper. The overhead introduced by the HDLC conversion process is defined, and is useful for estimating throughput for the CDM-700, CDM-710G and SLM-5650 modems. Routers also use HDLC to convert packets for transmission over EIA-530, HSSI or other serial interfaces. The throughput is essentially the same, only the encapsulation process has migrated from the router to the modem.

Two issues affect throughput.

- 1) Ethernet throughput at 100% utilization ranges from 76.2% to 98.6% of the line rate (10/100/1000 Mbps), and this is before HDLC. This is due to several factors:
  - Preamble = 64 bits
  - Interpacket Gap = 96 bits
  - Packet size = 64 to 1518 bytes (up to 1632 in CDM-700)

The Preamble and Interpacket Gap are normally excluded by test equipment, and they are also excluded from throughput and frame size calculations.

- 2) Below is a description of the HDLC overhead:

Deterministic Overhead: When the modem receives an Ethernet packet it adds a start flag to the beginning of the frame and appends a 2 byte CRC to the end. Although deterministic it depends on the length of the packet.

$$\text{Deterministic Overhead} = \frac{[1 \text{ byte (0x7E start flag)} + 2 \text{ bytes (CRC)}]}{[N \text{ bytes (payload)} + 14 \text{ bytes (Ethernet header)} + 4 \text{ bytes (Ethernet CRC)}]}$$

$$\text{Deterministic Overhead} = 3/(N+18)$$

Probabilistic overhead: The HDLC protocol stuffs a zero whenever five 1s in a row occur. Assuming each bit in the Ethernet frame is equally likely a 1 or 0, the probability of stuffing a 0 into the stream is:

$$P(\text{stuffing } 0) = 1/62 = 1.6129\%$$

The stream is further bounded in the event no 0s are stuffed to 0% minimum and 20% maximum if the frame consists of all 1s. The estimated overhead is:

Payload (N)	Frame Size (N+18)	Deterministic OH	Probabilistic OH	Total OH
46	64	4.69%	1/62 = 1.61%	6.30%
512	530	0.57%	1.61%	2.18%
1500	1518	0.20%	1.61%	1.81%

$$\text{Total OH} = 3/(N+18) + P(\text{stuffing } 0) = 3/(N+18) + 1/62$$

$$\text{Throughput} = (\text{Modem Data Rate}) * (1 - \text{Total OH}).$$

For example, at a data rate of 10 Mbps and 1500 byte payload:

$$\text{Throughput} = 10 * (1 - 0.0181) = 9.82 \text{ Mbps}$$

The throughput estimate is consistent with measured results.

For further information, email [mweigel@comtechedata.com](mailto:mweigel@comtechedata.com).



2114 W 7<sup>th</sup> St  
Tempe AZ 85281 USA  
[www.comtechedata.com](http://www.comtechedata.com)  
+1 480 333 2200