Impact of Frame Expansion on Existing IEEE 802.3 Networks

Pat Thaler

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Agilent Technologies

Overview

Clock skew limitations

- Repeaters
- Physical Layers

CRC Error coverage

Jabber

Clock Skew

Any device that retimes the signal to a local clock uses elasticity buffering to deal with clock skew.

Clock skew is the difference in frequency between the external and local clocks.

Maximum frequency difference is 0.02%

Clock skew causes a delta in the duration of the frame in the two clock domains.

For 1518 byte frame, worst case clock skew duration delta is:

1518 * 8 bits/byte * 2 * 0.01 / 100 = 2.4288 bits

Clock skew and elasticity buffer size

Since buffering can't be done for fractional bits, generally the minimum elasticity buffer is 3 bits.

Exception: for Manchester coding (used for 10 Mbit/s Ethernet), a repeater could theoretically buffer half bit symbols or 2.5 bits. It is unknown whether any repeater does this.

Repeaters are constrained in the amount of buffering they can provide because of delay limits. 10 Mbit/s repeaters are required to delay the start of frame no more than 6 bits when they have completed sending the preamble.

Clock skew

Elasticity buffer size in bits	Bytes over 1518 tolerated
2.5	44.5
3	357
6	2232

CRC Error Coverage

Ethernet relies on the CRC providing a Hamming distance of 4 as a protection against undetected errors.

Ethernet CRC provides a distance of 4 to greater than 64,000 bits (8000 bytes).

References:

- Guy Castagnoli, Stefan Braeuer and Martin Herrman; "Optimization of Cyclic Redundancy-Check Codes with 24 and 32 Parity Bits", IEEE Transact. On Communications, Vol. 41, No. 6, June 1993.
- RFC 3385

Jabber

Jabber limits transmission length from the transmitter or receive length at the receiver. In 10 Mb/s repeaters, Jabber lock-up protection will break up transmissions exceeding a threshold.

Minimum jabber or jabber lock-up protection limits:

10BASE5:	<25 Kbytes
Other 10 Mbit PHYs:	<6.25 Kbytes
10 M repeater	< 5000 bytes
100 M repeater	< 5000 bytes
1 G repeater	< 10000 bytes

Conclusions

Clock skew severely limits the additional bytes that can reliably be used on legacy equipment.

Clock skew plus delay requirements limit the frame expansion on some types of compliant equipment.

Minor expansion of frame size does not significantly affect error detection.

Minor expansion of frame size does not existing jabber requirements.