IP-Tube T1/E1 Bandwidth Utilization

The encapsulation of T1/E1 data into IP/UDP packets for transmission over ethernet adds overhead due to the Ethernet, IP, and UDP headers – a total of 44 bytes. This 44 byte overhead should be taken into account when considering ethernet bandwidth utilization.

NOTES:

- A DS0 is a 64 Kbps Voice/Data circuit.
- A Full T1 circuit is configured for 24 DS0s. The T1 signal is divided into frames, with one byte (8 bits) allocated for each configured DS0 and 1 framing bit for a total of 193 bits per frame = (24 * 8) + 1.
- A Full E1 circuit is configured for 31 DS0s. The E1 signal is divided into frames, with one byte (8 bits) allocated for each configured DS0 and 1 framing/signaling byte (8 bits) for a total of 32 bytes or 256 bits per frame.

The Tube Frames-per-Packet (FPP) setting controls the number of T1/E1 data frames to be encapsulated in a single IP/UDP packet. Increasing FPP reduces the effect of this 44 byte overhead. The encapsulation overhead can be expressed as a ratio of (Data + Overhead)/(Data) and can be used to calculate the ethernet bandwidth utilization for a given T1/E1 configuration.

((((#DSO's * 8) + TubeFraming) * FPP) + 352) / ((#DSO's * 8) * FPP)

where:

- DS0's is the number of 64 Kbps channels configured on T1/E1 interface
- Tube Framing is **0** for Transparent, **1** for T1Framed, **8** for E1Framed
- FPP is the configured Frames Per packet
- 352 = number of bits in the 44 byte overhead

T1/E1	#DSOs	T1/E1 BW (Kbps)	Tube Framing	FPP	UDP Pkt Size (Bytes)	Overhead Ratio	% Ovrhead	IP B/W (Kbps)
T1	24	1536	1	8	237	1.23	23.4%	1,896
T1	24	1536	0	8	236	1.23	22.9%	1,888
T1	24	1536	1	16	430	1.12	12.0%	1,720
T1	24	1536	1	32	816	1.06	6.3%	1,632
T1	24	1536	1	40	1009	1.05	5.1%	1,614
fT1	12	768	1	16	238	1.24	24.0%	952
fT1	6	384	1	16	142	1.48	47.9%	568
fT1	2	128	1	16	78	2.44	143.8%	312
E1	32	2048	8	12	440	1.15	14.6%	2,347
E1	32	2048	0	12	428	1.11	11.5%	2,283
E1	32	2048	8	16	572	1.12	11.7%	2,288
E1	32	2048	8	32	1100	1.07	7.4%	2,200
fE1	16	1024	8	16	316	1.23	23.4%	1,264
fE1	8	512	8	16	188	1.47	46.9%	752