

I can't see GIFs

T1?

- 24 phone calls on 1 line
- Or, 24 data lines
- Trunking and switching
- 1.544 Mb/s
- Originally encoded with Alternate Mark Inversion (AMI)
- Later encoded with Bipolar Eight-Zero Substitution (B8ZS)
- Theory called for it to be replaced with T2 and T3, actually went DS3.
- Sold per-channel

Upgrading T1 broke the computers

- Upgraded ISP customer from 12-channel to different 24-channel T1
- Everything worked!
- Except... customer can't see GIFs on any of the computers
- How do you describe this problem?

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RIDICULOUS

How to troubleshoot?

- Hardest part: take the problem seriously
- Figure out the unique elements of this problem
- Examine every layer, see where it breaks.
 - Physical?
 - Datalink?
 - Network?
 - Transport?

What is a GIF?

- GIF: Graphics Interchange Format
- Bitmap, created by CompuServe in 1987
- Patent-encumbered LWZ compression

What makes GIF unique?

- All graphics packets are large.
- All graphics packets contain lots of stuff.
- TCPdump a GIF file being downloaded by customer.
- Odd observation: GIFs contain lots of all-zero packets

Ping Format

ICMP packet

	Bit 0 - 7	Bit 8 - 15	Bit 16 - 31
IP Header (20 bytes)	Version/IHL	Type of service	Length
	Identification		<i>flags and offset</i>
	Time To Live (TTL)	Protocol	Checksum
	Source IP address		
	Destination IP address		
ICMP Payload (8+ bytes)	Type of message	Code	Checksum
	Quench		
	Data (<i>optional</i>)		
(8+ bytes)	Quench		
	Data (<i>optional</i>)		

OK, let's see if it's all-zero packets

```
# ping -G 1500 -h 256 -p 00000000000000000000 customersite
```

```
PATTERN: 0x00000000000000000000
```

```
PING mwl.io (45.63.79.193): (0 ... 1500) data bytes
```

```
8 bytes from 45.63.79.193: icmp_seq=0 ttl=56
```

```
264 bytes from 45.63.79.193: icmp_seq=1 ttl=56
```

```
520 bytes from 45.63.79.193: icmp_seq=2 ttl=56
```

```
776 bytes from 45.63.79.193: icmp_seq=3 ttl=56
```

```
1032 bytes from 45.63.79.193: icmp_seq=4 ttl=56
```

```
<...silence...>
```

This is about defining the problem

- “I can’t see GIFs” is weird and stupid
- “I can’t pass large all-zero packets” is a well-defined issue
- Moral: break the problem down by layers and assume nothing
- Always look deeper, with every tool you have
- Read standards
- Study the basic tools
- Result: 23 channels of b8zs T1, 1 channel of AMI