



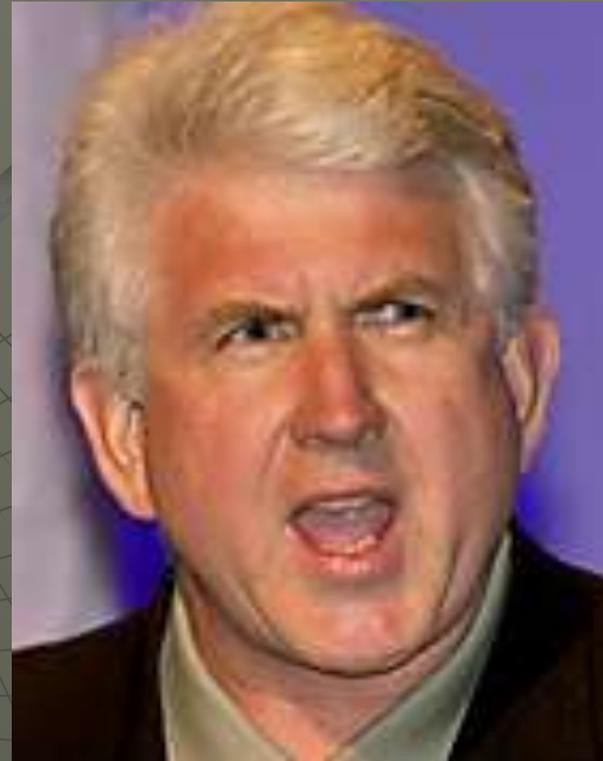
10 Gigabit Audio and Video Networking

Steve Lampen
Multimedia Technology Manager
Belden

Who are these Guys?



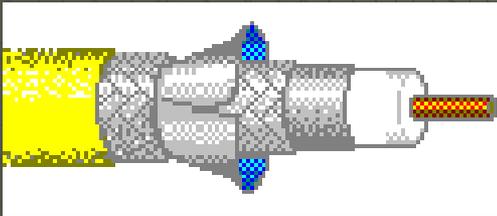
Norm Abramson



Bob Metcalf

A Short History of Networking

- ◆ Ethernet®
 - May 23, 1973
 - Packetized data
 - Robert Metcalf & David Boggs
 - 1 Mbps
- ◆ Thicknet 50Ω
 - 26 pF/ft., 99 pF/m
 - Thinnet 50Ω
 - Cheapnet 52Ω



A Short History of Networking

- ◆ Arcnet
 - 93 Ω coax, 13.5 pF/ft. (44pF/m)
- ◆ IBM
 - Type 1, Type 1A, Type 2
 - Token ring
 - Twisted pairs
 - ◆ 22 AWG
 - ◆ 150 Ω , 8.5 pF/ft. (28pF/m)
- ◆ UTP
 - Levels

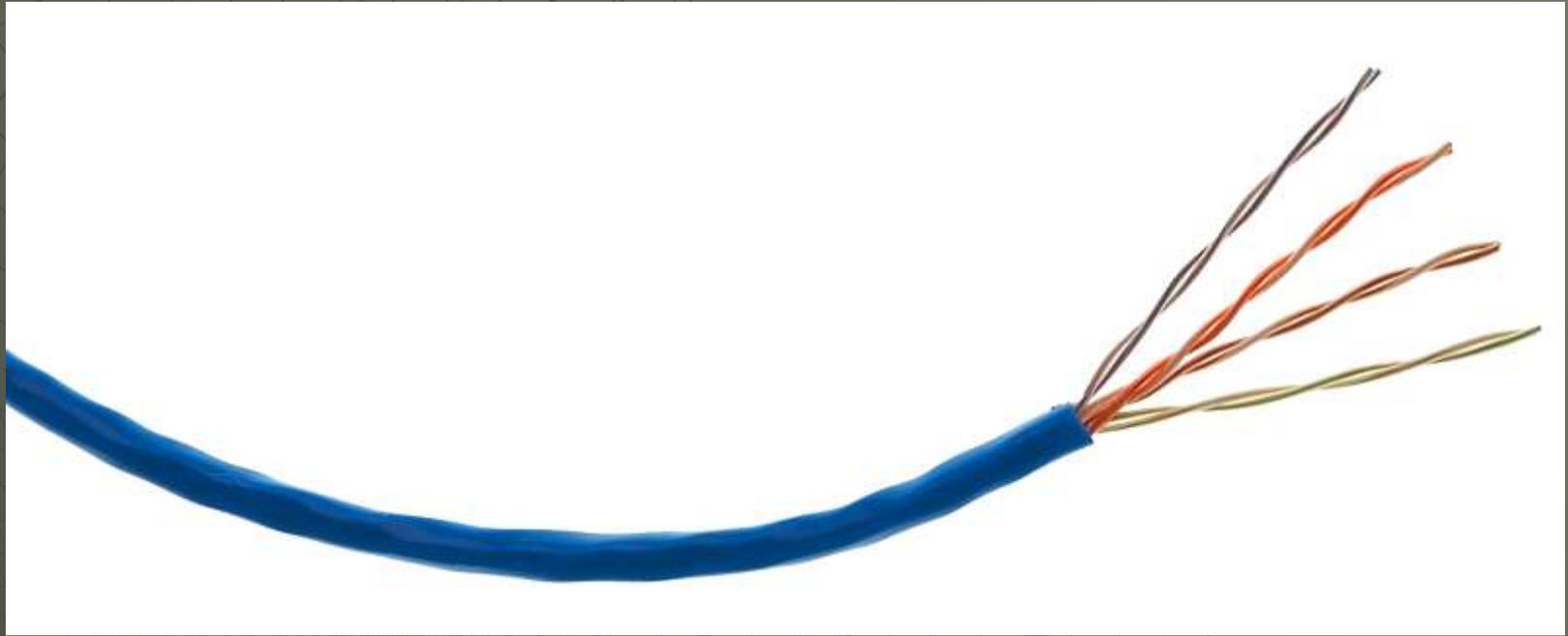
A Short History of Networking

◆ EIA/TIA 568

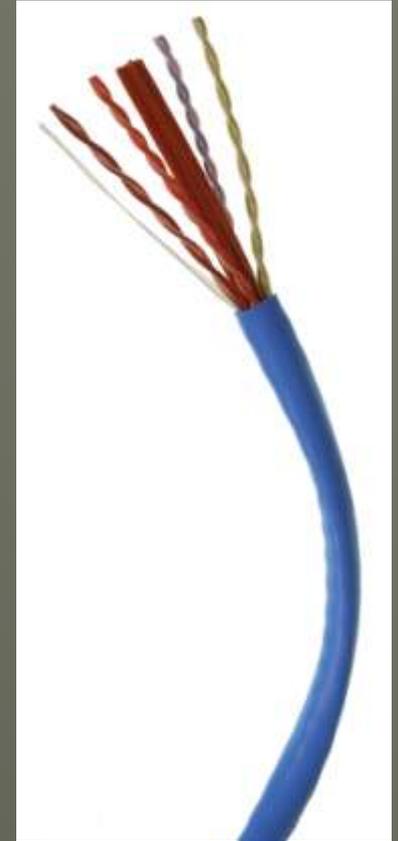
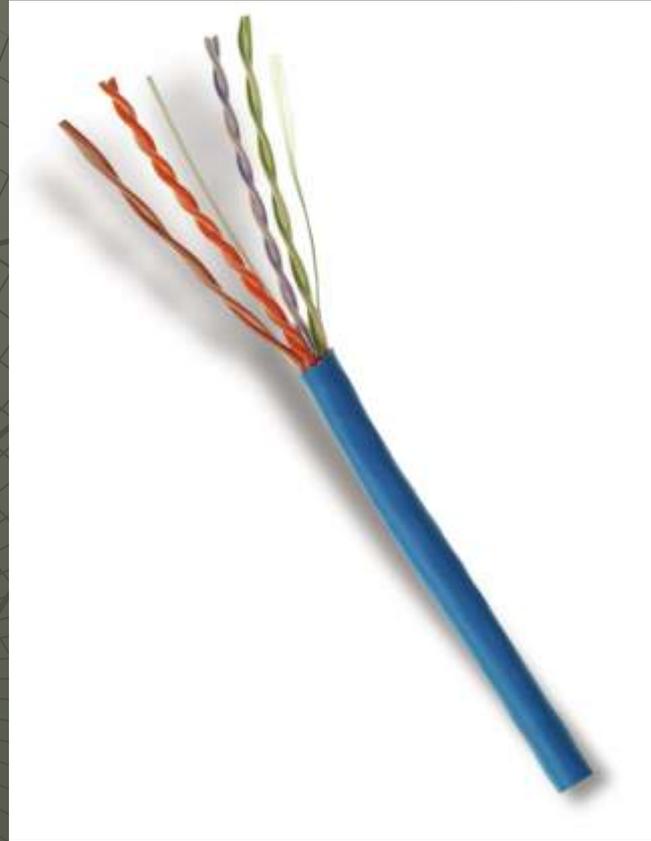
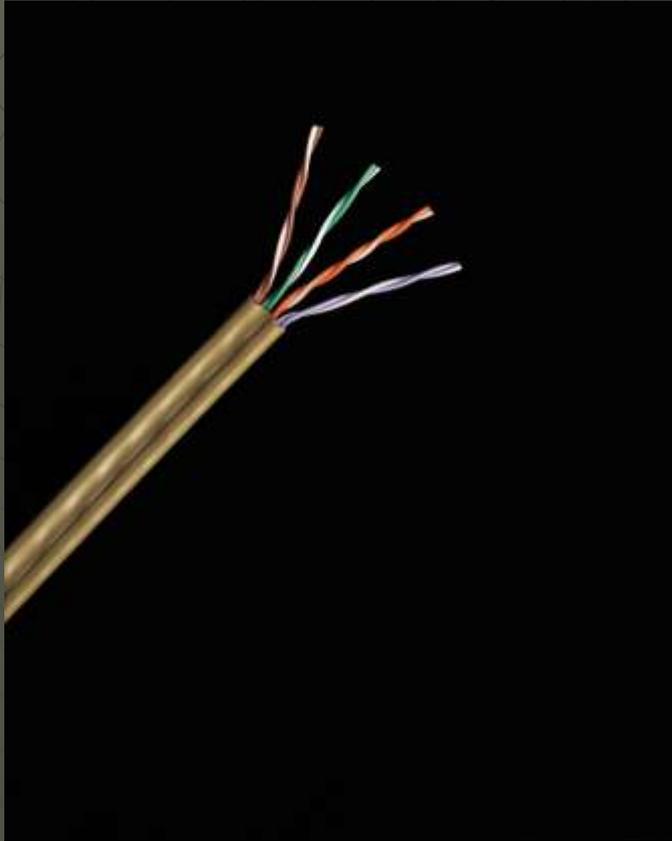
- Categories (“Moore’s Law?”)

- ◆ “Cat 1” – POTS
- ◆ “Cat 2” – any data delivery
- ◆ Cat 3 – 16 MHz
- ◆ Cat 4 – 20 MHz
- ◆ Cat 5 – 10/100 MHz/10Mbps/100Mbps

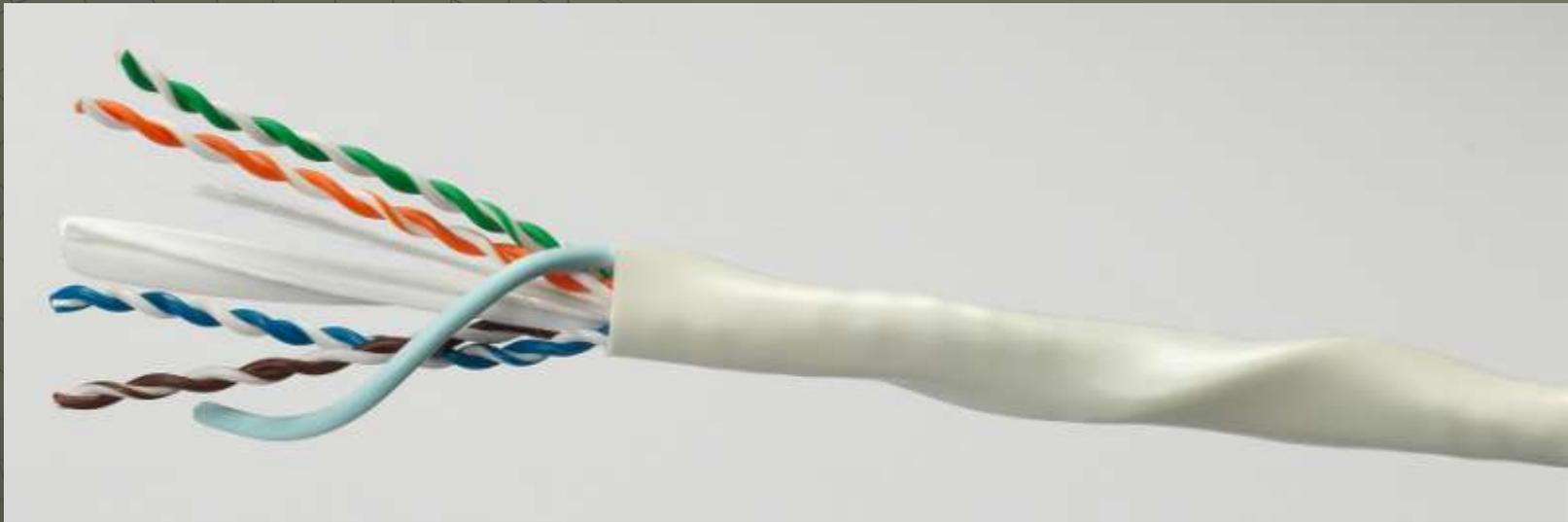
Cat 5e – 100 MHz/1000 Mbps(÷4)



Cat 6 – 250 MHz/1000 Mbps (÷4)



Cat 6a – 500 MHz/10 Gbps (÷4)



Augmented Category 6

- ◆ 500 MHz per pair
 - Belden 625 MHz
- ◆ Duplex
 - Each pair transmits and receives
 - ◆ Makes filtering and noise control critical
 - 10 gigabit throughput
 - ◆ Serious number crunching
 - ◆ Bandwidth vs. complexity

Problems with 10gig

- ◆ Everything in the path is critical
 - Cable
 - Connectors
 - Patch cords
 - Patch panels
- ◆ Every interaction is critical

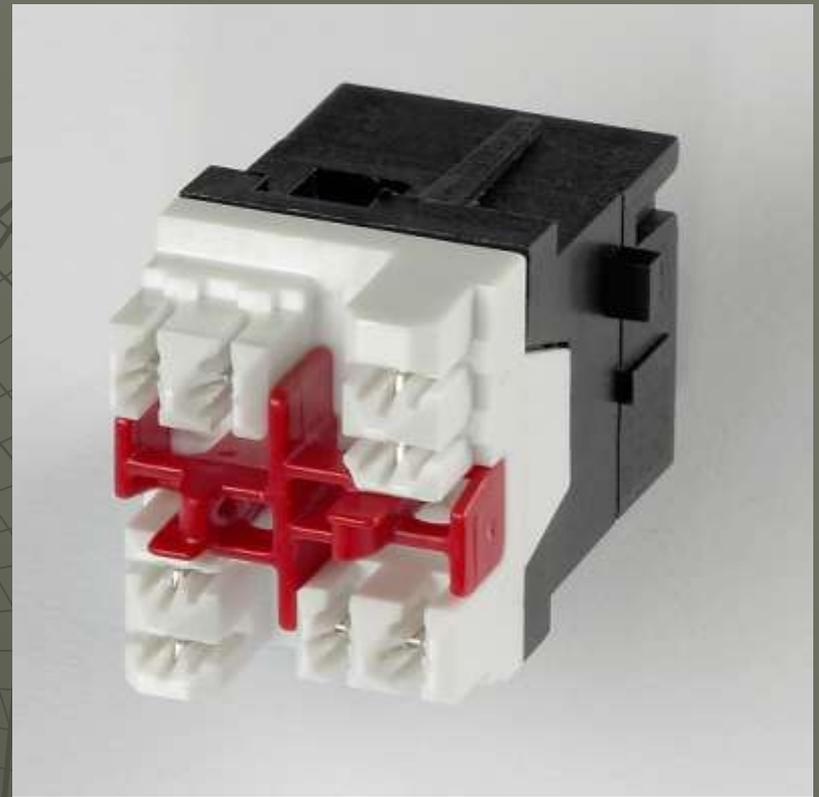
10gig Interactions

- ◆ Pair-to-pair crosstalk
 - Spread pairs apart
 - Put a divider in-between pairs
- ◆ Cable-to-cable crosstalk
 - “Alien Crosstalk”
 - 10gig limit of Cat 6 ~55m
 - Belden’s solution

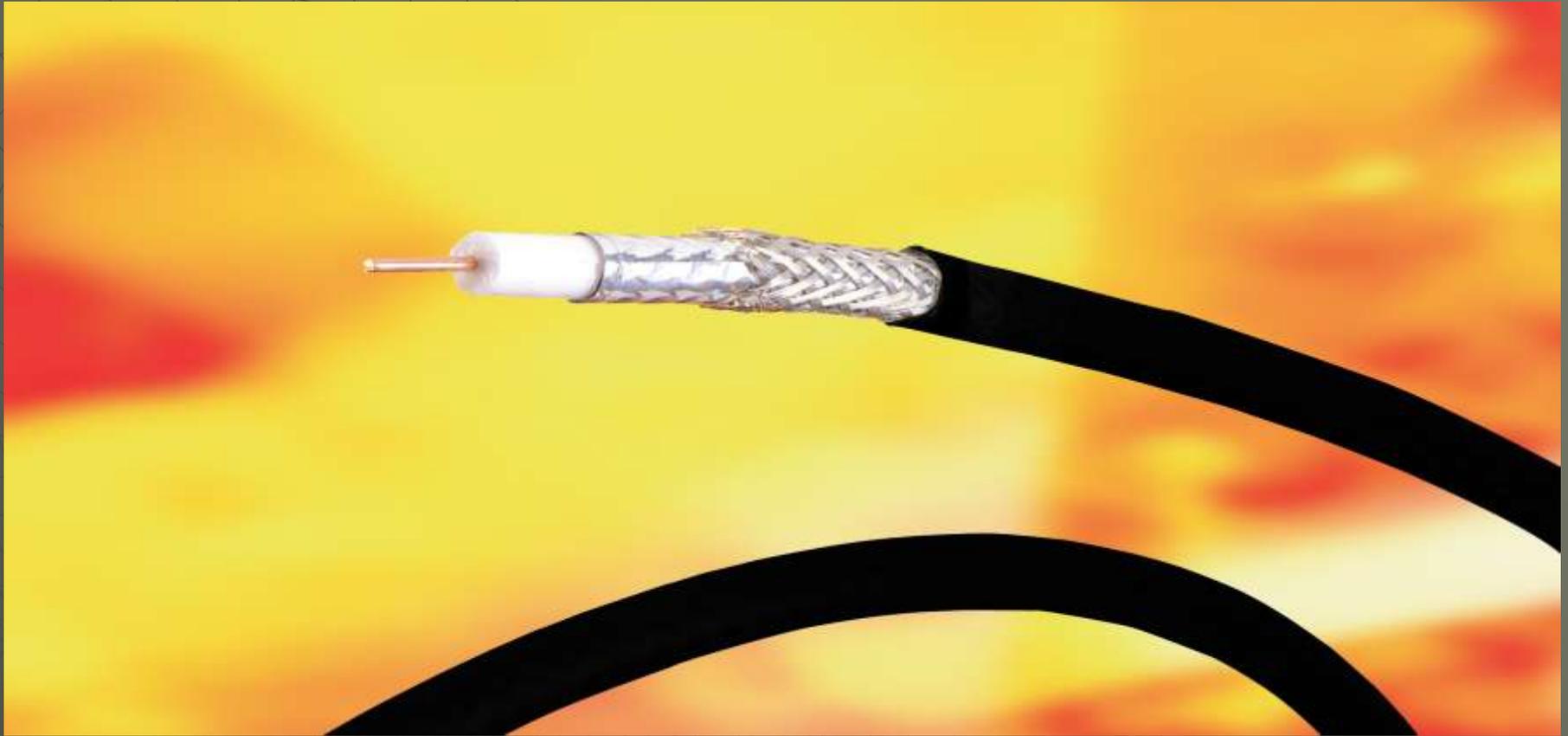
Other Improvements

- ◆ Crosstalk at the jack
- ◆ Belden solution
 - All pairs at right angles
- ◆ Impedance stability
 - Bonded pairs
 - Special twist ratio “lay length”

10G RJ-45



A Blast from the Past...



A Blast from the Past....

- ◆ 500 MHz x 4 = 2 GHz
- ◆ Easy for coax
 - 1694A tested to 4.5 GHz for 1080p/60
- ◆ 100m of 1694A (328 ft.)
 - 500 ft. (152m) demonstrated.

What Do I Do with a 10gig Pipe?

- ◆ SMPTE DC-28 (video)
 - "Give us a 10gig Pipe"
 - ◆ Animation
 - ◆ File transfers
 - ◆ HD video
 - 1080i/60
 - 1080p/24
 - 1080p/50
 - 1080p/60
 - ◆ 1.5 GHz clock
 - ◆ Coax tested to 4.5 GHz

Networked Video

Product	Company	Type	Storage
Avid	LANshare	100baseT	5 TBytes
EtherneTV	Vbrick	100baseT 1000baseT	3.2 TBytes
K2	Thompson/Grass Valley	100baseT 1000baseT Dual/1GbaseT	Expandable

GigE Video Routers

- \$930 million during 2008
 - In-Stat/MDR analyst Gerry Kaufhold
 - (www.instat.com).
- To support
 - advanced audio compression
 - Advanced video compression
 - HDTV
 - local ad insertion
 - network PVR
 - switched broadcast
 - games-on-demand
 - future services

OK, So what about Audio?

- ◆ Digital audio
 - Data, just slower
 - Files, just smaller
- ◆ You have to save it somewhere
- ◆ Everyone wants “fast”
 - 640k is enough memory for anybody.
 - There’s a world market for maybe 5 computers.
 - Speed limit: 35 MPH (56kph)

Networked Audio

Product	Company	Type	Channels	Top Specs
CobraNet	Peak Audio	100baseT	128	96 kHz 24-bit
EtherSound	Digigram	100baseT	64	48 kHz 24-bit
MaGIC	Gibson	100baseT	32	48 kHz 24-bit
E Snake	Whirlwind	100baseT	64	48 kHz 24-bit
Ethernet Audio	360 Systems	100baseT	2	48 kHz 16-bit
IQ Net	Crown	100baseT	128	96 kHz 24-bit
Axia	Telos	100baseT	"100's"	48 kHz 24-bit
ASI 2416	Audio Science	100baseT	16	48 kHz
Wheatnet	Wheatstone	100baseT	64	48 kHz 24-bit
ESX I/O	Lab X Tech	100baseT	64	96 kHz 24-bit
???	VTG	100baseT	16	48 kHz 24-bit

GigE Networked Audio

Product	Company	Type	Channels	Top Specs
Axia	Telos	1000baseT	"100's"	48 kHz 24-bit
MaGIC	Gibson	1000baseT	320	48 kHz 24-bit
EtherSound	Digigram	1000baseT	256 x 256	48 kHz 24-bit
??	Allen & Heath	1000baseT	??	??
X-4	SNS	1000baseT	1.6TB SAN	??

You Heard it Here First

- ◆ First Yottabyte Server (10^{24} bytes)
 - A trillion trillion bytes
 - 150,000 Tbytes per person
 - Probably a pair of mirrored servers
 - Data never dies!
 - ◆ Antarctica
 - Nice and cold
 - ◆ Siberia
 - Nice and cold
 - They will continually write and re-write
 - ◆ Do you care where your stuff is stored?
 - Skill set
 - ◆ Ice climbing
 - ◆ Computer programming



www.belden.com

9,000+ pages of information

1,000,000+ hits per week

6,000 products

37 factories

8,000 employees

Samples: 1-800-BELDEN-1