10 Tips to Avoiding Downtime

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Tip 1

- **Know your threats and what they cost**

Infonetics 2003 – Greatest Threats

- **Network products (2-3 year life cycle)**
- **Security products**
- **Cables and connectors (10-15 year life cycle)**
- **Servers**
- **Applications (5 year life cycle)**
- **WAN and Internet connectivity**
- **E-commerce**

Gartner says that 20% of all IT expenditures are for things that DON'T work

Fortune 1000 Published Data

Industry	Rev $ Millions	Revenue / Hour
Motor Vehicles and Parts	523,222	251,548,798.10
General Merchandisers	471,419	226,643,798.10
Petroleum Refining	432,627	207,993,605.80
Commercial Banks	414,970	199,504,711.50
Specialty Retailers	352,989	169,706,442.30
Diversified Financials	315,214	151,545,288.50
Telecommunications	309,455	148,776,250.00
Insurance: P&C Stock	298,206	143,368,076.90
Utilities: Gas and Electric	277,869	133,590,865.40
Health Care	261,366	125,656,682.70

Annual revenue / 2080 hour per year = Revenue assumptions per hour

Employee Costs

(National Avg. Wage $33,252.09 *1.4 / 2080 = weighted hour rate)

# Employees	Hourly Salary Cost	15% down/one hour	INDUSTRY
2,915,457	$65,251,474	$9,787,721	General Merchandisers
1,945,251	$43,537,056	$6,530,563	Specialty Retailers
1,706,609	$38,195,968	$5,729,398	Motor vehicles and Parts
1,293,584	$28,951,983	$4,342,798	Commercial Banks
1,242,655	$27,812,130	$4,171,820	Food and Drug Stores
1,176,568	$26,333,023	$3,949,953	Food Services
997,801	$22,332,000	$3,349,800	Health Care
976,678	$21,859,242	$3,278,886	Telecommunications
960,200	$21,490,444	$3,223,567	Aerospace and Defense
721,848	$16,155,836	$2,423,375	Food Consumer Products

# of Employees * Weighted average Wage / 2080 Hours per year

Revenue Per Hour Per Employee

Rev/hour	# Emp	Rev/hour/emp	INDUSTRY
$49,845,865	50,489	$987	Insurance: Life, Health (mutual)
$11,484,855	12,528	$917	Pipelines
$207,993,605	287,698	$723	Petroleum Refining
$76,945,528	107,612	$715	Wholesalers: Health Care
$48,083,653	116,666	$412	Energy
$41,628,557	114,474	$364	Whsle: Electronics/Office Equipment
$26,844,567	80,836	$332	Homebuilders
$9,290,288	28,751	$323	Real estate
$66,264,038	211,534	$313	Insurance: Life, Health (stock)
$20,634,903	67,105	$308	Mining, Crude-oil production

Annual rev / 2080 hrs / Number of employees = Revenue per hour per employee

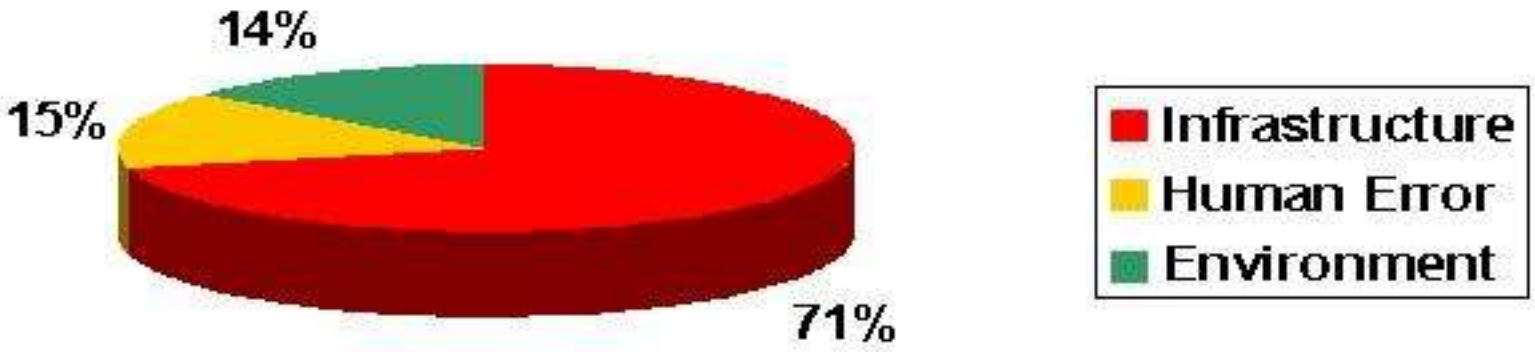
Salary and Revenues Combined 15% of Workforce Down for One Hour

Salary + Rev - 15% Down	INDUSTRY
$43,784,291	**General Merchandisers**
$43,461,717	**Motor vehicles and Parts**
$34,268,504	**Commercial Banks**
$32,164,896	**Petroleum Refining**
$31,986,529	**Specialty Retailers**
$25,595,324	**Telecommunications**
$24,800,090	**Diversified Financials**
$23,493,798	**Insurance: P&C (stock)**
$22,198,302	**Health Care**
$21,711,759	**Utilities: Gas and Electric**

Formulas

- Revenue Per Hour
  - **Total revenue / 2080 hour work year**
- Revenue Per Employee Per Hour
  - **Total Revenue / Number of Employees / 2080**
- Salary Expense per Hour (weighted)
  - **Average hourly wage * 1.4 (to include overhead) / 2080**
- Salary Expense Plus Lost Revenue
  - **Total revenue per hour + weighted salary expense per hour * % of workforce down at any given time (we used 15%)**

What Causes Network Downtime?



Source: Sun Microsystems/Gartner

The infrastructure: Hardware (25%), software (25%) and the network cabling system (21%) were the root causes for 71% on network downtime.

Downtime Costs / Component

Combined -15%	Industry	Hardware 25%	Software - 25%	Cabling - 21%	Other
$43,784,291	General Merch.	$10,946,072	$10,946,072	$9,194,701	$12,697,444
$43,461,717	Motor Veh. &Parts	$10,865,429	$10,865,429	$9,126,960	$12,603,897
$34,268,504	Commercial Banks	$8,567,126	$8,567,126	$7,196,385	$ 9,937,866
$32,164,896	Petroleum Refining	$8,041,224	$8,041,224	$6,754,628	$9,327,819
$31,986,529	Specialty Retailers	$7,996,632	$7,996,632	$6,717,171	$9,276,093
$25,595,324	Telecommunications	$6,398,831	$6,398,831	$5,375,018	$7,422,643
$24,800,090	Diversified Financial	$6,200,022	$6,200,022	$5,208,018	$7,192,026
$23,493,798	Insurance: P&C	$5,873,449	$5,873,449	$4,933,697	$6,813,201
$22,198,302	Health Care	$5,549,575	$5,549,575	$4,661,643	$6,437,507
$21,711,759	Gas and Electric	$5,427,939	$5,427,939	$4,559,469	$6,296,410

Cost over Life of System

Combined	Industry	3 Years Hardware	5 Years Software	10 Years Cabling
$ 43,784,291	General Mchdse	$32,838,218	$54,730,363	$91,947,011
$ 43,461,717	Vehicles/ Parts	$32,596,287	$54,327,146	$91,269,605
$ 34,268,504	Commercial Banks	$25,701,378	$42,835,630	$71,963,858
$ 32,164,896	Petroleum Refining	$24,123,672	$40,206,120	$67,546,281
$ 31,986,529	Specialty Retailers	$23,989,896	$39,983,161	$67,171,710
$ 25,595,324	Telecommunications	$19,196,493	$31,994,155	$53,750,180
$ 24,800,090	Diversified Financial	$18,600,067	$31,000,112	$52,080,189
$ 23,493,798	Insurance: P&C	$17,620,348	$29,367,247	$49,336,975
$ 22,198,302	Health Care	$16,648,726	$27,747,877	$46,616,434
$ 21,711,759	Utilities	$16,283,819	$27,139,698	$45,594,693

Based on One Hour down per year per component – 15% workforce down

The Cost of a Slow Network

Calculate network slow cost:

Cost = **P** x **W** x **E**

P = Total Number of hours lost **P**roductivity per year (weekly minutes/60 x 52)

W = Average hourly **W**age

E = Number of **E**mployees on the network

Company A:

Number of Employees: 500
Average Hourly Wage: $15.00
Hours of Productivity Lost per Year: 30
Network Slow Cost = $225,000.00

Company B:

Number of Employees: 1,000
Average Hourly Wage: $18.00
Hours of Productivity Lost per Year: 52
Network Slow Cost = $936,000.00

Company C:

Number of Employees: 5,000
Average Hourly Wage: $20.00
Hours of Productivity Lost per Year: 20
Network Slow Cost = $2,000,000.00

What Causes Slow Response

- Environmental conditions
  - Temperature and humidity variations
  - EM and RF interference
- High network traffic
- Outdated, slow PCs, NICs
- Poor installation
  - Inferior patch cords
  - Damaged cable due to pulling, bending
  - Too many splices
  - Poor cable management
- Inferior network cabling

ROI and TCO considerations

- **Life cycle and life expectancy**
  - **Cabling 10-12 years with proper system**
  - **Electronics 2-3 years**
  - **Applications 5 years**
- **Life cycle is shortened dramatically with under performing systems**
- **TCO is altered with each new device or move, add or change**
- **Additional labor costs and material costs for replacement increase TCO and lower ROI**
- **Greatest impact to TCO and ROI is through downtime**

Dell's Comments

"**Cat-6 is the ideal cabling system for new installations.Cat-6 provides twice the headroom of Cat-5e by providing more than twice as much usable bandwidth (250 MHz vs. 100 MHz)"**

Cat-6 also reduces the opportunity for errors to occur by providing added safety margin for non-ideal network installations and unforeseen environmental factors which can improve the operational effectiveness of the network. This improvement can translate to marked increases In productivity.

The Gigabit Ethernet Alliance recommends that all new cable installations for Gigabit Ethernet be at least Cat-5e, though Cat-6 is highly recommended for cable system planners who are looking for extra bandwidth headroom.

Cisco's Comments

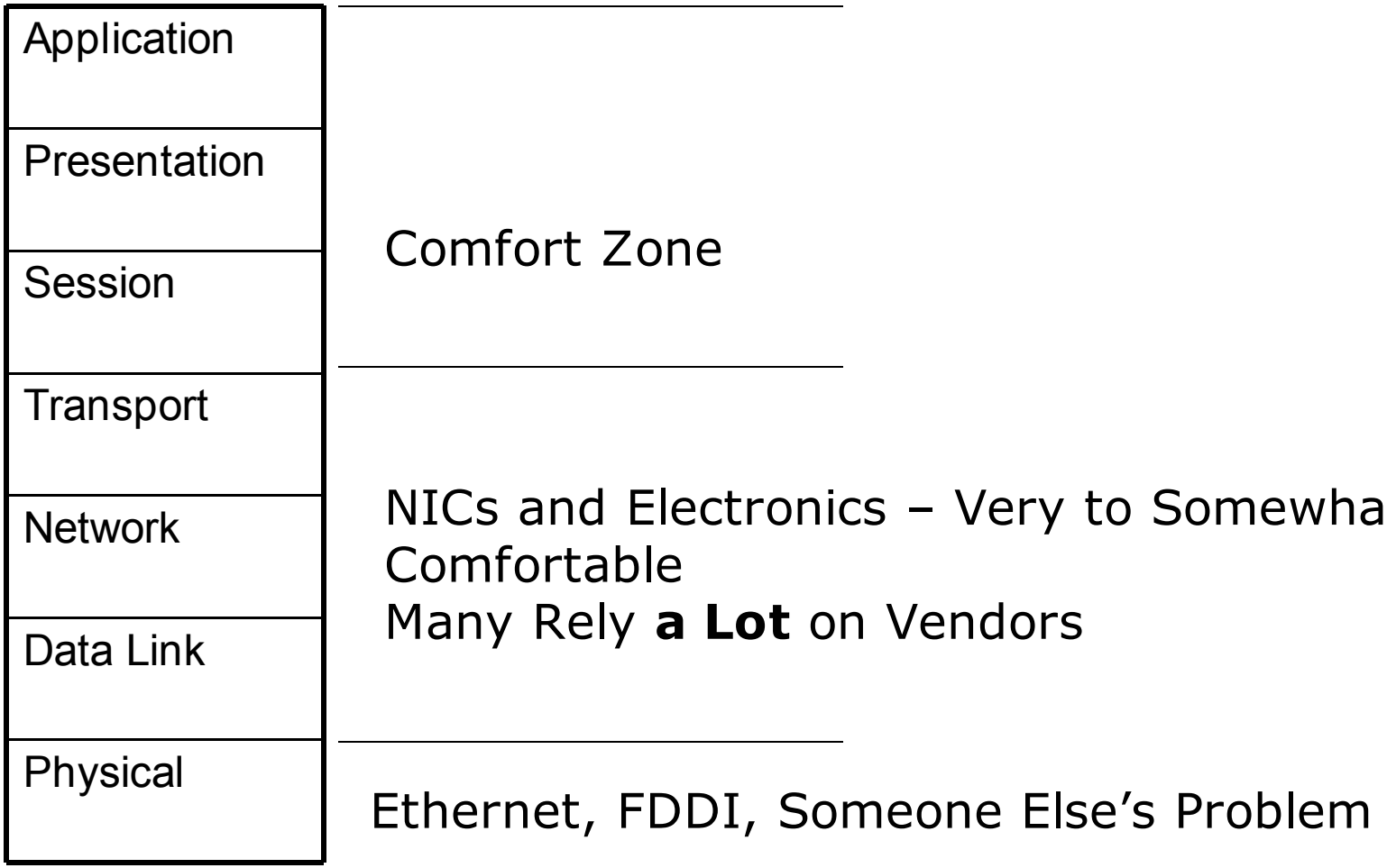
- **Quality cabling and connectivity are key to optimal return loss and performance.**

- **Part of any business decision to deploy IP telephony must include a full network assessment of voice requirements and data network capability. A mismatch between data network capacity and voice system requirements will assure failure; a properly planned data network infrastructure will be critical to success.**

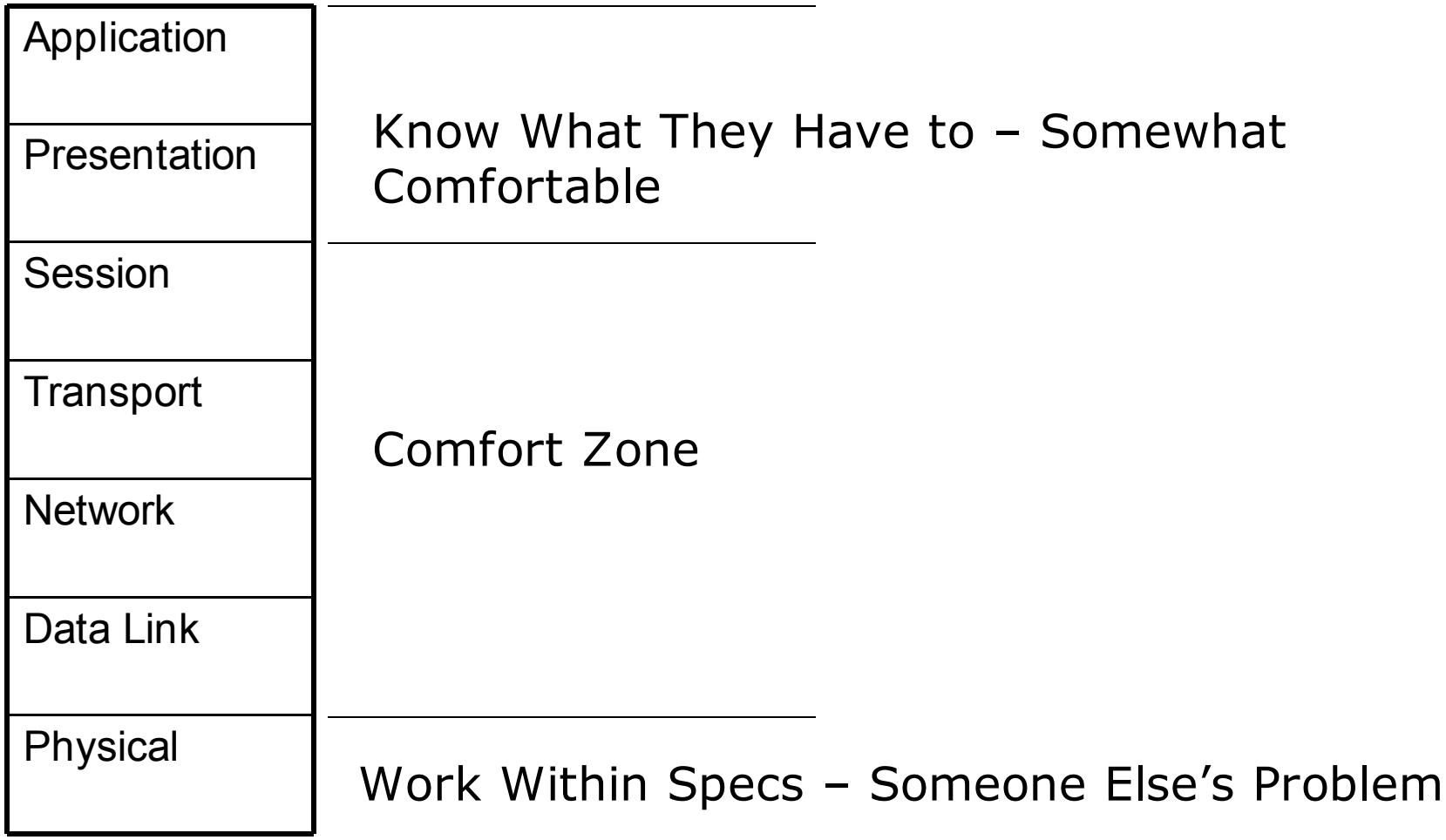
Tip 2

- **Understand Comfort Levels and Comments**
- **Be date sensitive**

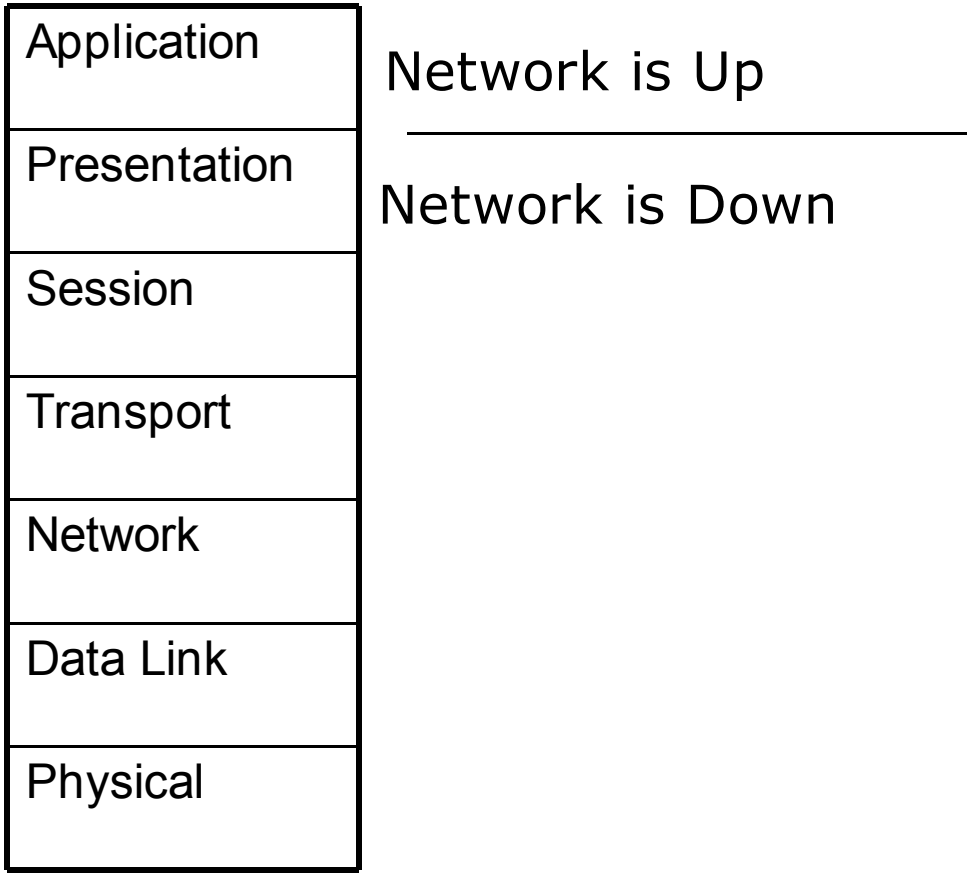
Network Administrator Views of a Network



Electronics VARs



End-User's View



State of the Network

- Networks have grown out of need rather than planning
- Generally rely on cable installers for operability
- Rarely re-visit infrastructure
- Fix problems with faster hardware and electronics
- Only have a general idea of the Physical Layer
- Do not understand the problems that a poor infrastructure creates
- Have cables run as needed by whoever is available
- Have the "if the plug fits - it will run" mentality
- Cabling is binary – it runs or it doesn't
- More companies are self installing

Tip 3

- **Check things out!**
- **Check them ALL out!**

10-Point Inspection

- **Adherence to standards**
- **Closet clean-up**
- **Documentation**
- **SNMP or other monitoring and testing**
- **Identification of weak links**
- **Re-certify questionable links**
- **Labeling**
- **Speed reports**
- **IP address listings**
- **Monitor reports (bandwidth and throughput)**
- **Replace home-made patch cables**

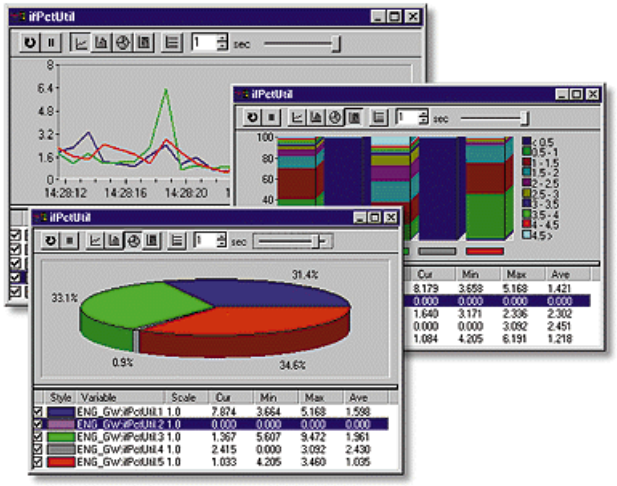
Tip 4

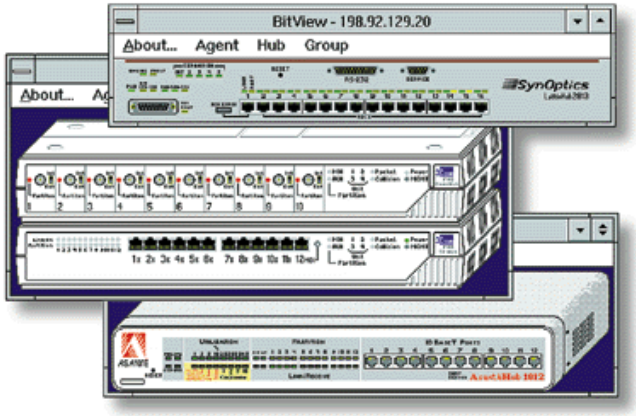
- **Monitor it**

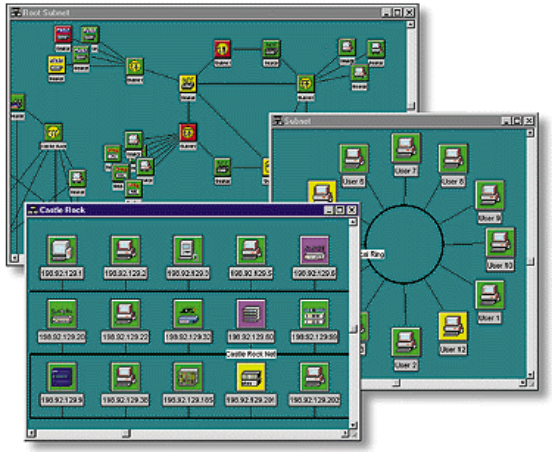
Monitoring Techniques

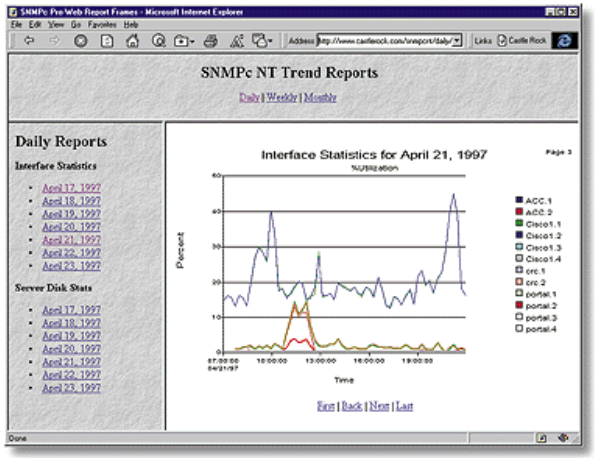
- **Downtime only**
- **Traffic analysis**
- **Bandwidth analysis**
- **NOC**
- **VLAN monitoring**
- **Firewall monitoring**

Sample Views - SNMP









Tip 5

- **Autodiscovery once per quarter**

Actual Audit Data

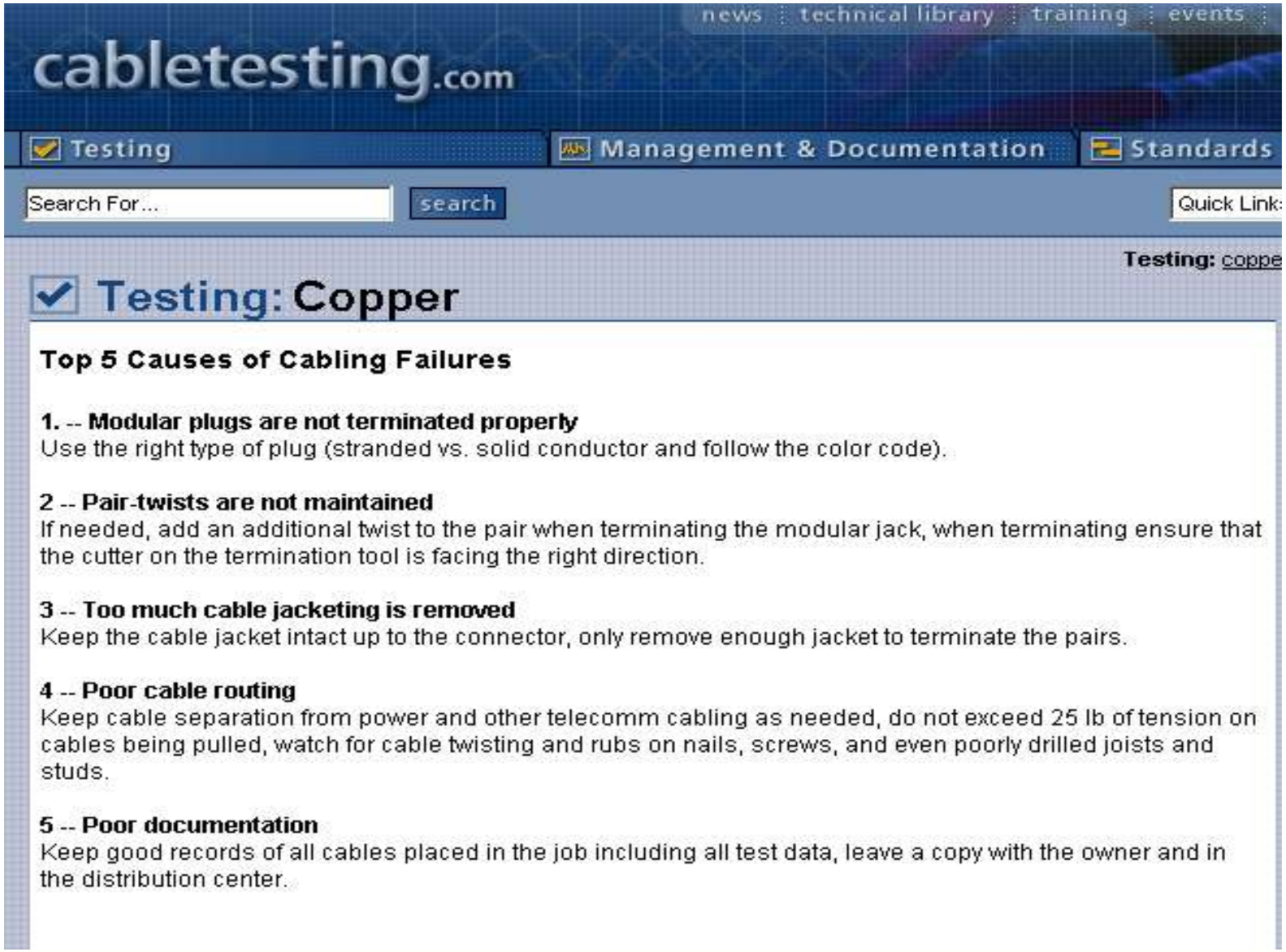
Node	Index	Mtu	Speed	In Octets	Errors
192.168.1.91	23	1514	200000000	3,609,426,192	[illegible]75,445
192.168.1.9	11	1514	200000000	3,116,050,917	[illegible]61,862
192.168.2.11	7	1514	200000000	2,841,840,312	[illegible],507,894
192.168.1.92	6	1514	200000000	619,369,476	2,302,031
192.168.2.11	5	1514	200000000	2,099,071,371	4,227,351
192.168.1.94	22	1514	200000000	1,274,947,502	3,155,459
192.168.1.104	1	1514	200000000	2,490,061,169	5,247,177
192.168.1.97	2	1514	200000000	742,847,434	3,437,434
192.168.1.14	3	1514	200000000	162,306,489	8,258,906
192.168.2.11	4	1514	200000000	1,130,881,154	7,166,234
192.168.1.124	6	1514	200000000	54,190,705	11,145,670
192.168.1.114	15	1514	200000000	445,094,503	1,315,031
192.168.1.105	18	1514	200000000	152,346,003	6,514,778
192.168.2.11	16	1514	200000000	1,077,239,333	1,913,864
192.168.2.11	2	1514	200000000	3,455,568,628	14,413,615
192.168.1.108	21	1514	200000000	266,461,364	1,789,253
192.168.1.102	9	1514	200000000	50,564,444	3,115,889
192.168.1.101	10	1514	200000000	53,670,114	1,112,455
192.168.2.11	15	1514	100000000	159,618,694	1,109,967

Sample Traffic Reports

Descr	Type	Mtu	Speed	AdminStatus	OperStatus	LastChange	InOctets	InUcastPkts	InNUcastPkts
RMON:10/100 Port 12 on Unit 3	ethernet-csmacd	1500	10000000	up	up	0 days 00:00:00.00	345401	3182	4
RMON:10/100 Port 11 on Unit 3	ethernet-csmacd	1500	10000000	up	up	0 days 00:00:00.00	404421	3783	54
RMON:10/100 Port 14 on Unit 3	ethernet-csmacd	1500	100000000	up	down	0 days 00:00:00.00	434473	5568	0
RMON:10/100 Port 20 on Unit 2	ethernet-csmacd	1500	10000000	up	up	0 days 00:00:00.00	556080	6378	14
RMON:10/100 Port 20 on Unit 3	ethernet-csmacd	1500	10000000	up	down	0 days 00:00:00.00	1654484	25725	0
RMON:10/100 Port 21 on Unit 3	ethernet-csmacd	1500	100000000	up	down	0 days 00:00:00.00	1825932	12183	594
RMON:10/100 Port 18 on Unit 3	ethernet-csmacd	1500	10000000	up	up	0 days 00:00:00.00	2410064	35264	22
RMON:10/100 Port 1 on Unit 1	ethernet-csmacd	1500	10000000	up	up	0 days 00:00:00.00	3025791	30217	154
RMON:10/100 Port 13 on Unit 3	ethernet-csmacd	1500	100000000	up	down	0 days 00:00:00.00	3286190	15590	288
RMON:10/100 Port 22 on Unit 2	ethernet-csmacd	1500	100000000	up	up	0 days 00:00:00.00	3670341	34243	111
RMON:10/100 Port 17 on Unit 3	ethernet-csmacd	1500	100000000	up	up	0 days 00:00:00.00	7571338	59699	884
RMON:10/100 Port 18 on Unit 1	ethernet-csmacd	1500	10000000	up	up	0 days 00:00:00.00	8032729	82629	863
RMON:10/100 Port 4 on Unit 1	ethernet-csmacd	1500	100000000	up	up	0 days 00:00:00.00	8573696	60418	880
RMON:10/100 Port 23 on Unit 3	ethernet-csmacd	1500	100000000	up	up	0 days 00:00:00.00	11632971	123401	1831
RMON:10/100 Port 10 on Unit 3	ethernet-csmacd	1500	100000000	up	up	0 days 00:00:00.00	12174382	74196	3996
RMON:10/100 Port 7 on Unit 3	ethernet-csmacd	1500	100000000	up	down	0 days 00:00:00.00	12519801	65711	1317
RMON:10/100 Port 1 on Unit 2	ethernet-csmacd	1500	100000000	up	up	0 days 00:00:00.00	16016432	170952	9254
RMON:10/100 Port 18 on Unit 2	ethernet-csmacd	1500	100000000	up	up	0 days 00:00:00.00	22191430	169213	2442
RMON:10/100 Port 5 on Unit 2	ethernet-csmacd	1500	100000000	up	up	0 days 00:00:00.00	31527755	405777	1275
RMON:10/100 Port 6 on Unit 3	ethernet-csmacd	1500	100000000	up	down	0 days 00:00:00.00	36257934	106499	410
RMON:10/100 Port 6 on Unit 1	ethernet-csmacd	1500	100000000	up	up	0 days 00:00:00.00	45599632	150009	490
RMON:10/100 Port 12 on Unit 1	ethernet-csmacd	1500	100000000	up	up	0 days 00:00:00.00	47351921	124792	627
RMON:10/100 Port 6 on Unit 2	ethernet-csmacd	1500	100000000	up	up	0 days 00:00:00.00	50580659	259789	4540
RMON:10/100 Port 19 on Unit 3	ethernet-csmacd	1500	100000000	up	down	0 days 00:00:00.00	51265238	181036	1308
RMON:10/100 Port 3 on Unit 1	ethernet-csmacd	1500	100000000	up	up	0 days 00:00:00.00	54741397	304837	1517

Samples Continued

Speed	OperStatus	InOctets	InUcastPkts	InNUcastPkts	InDiscards	InErrors	InUnknownProtos	OutOctets	OutUcastPkts	OutNUcastPkts	OutDiscards	OutErrors
0	up	2513987073	38268704	13378146	0	719	0	2513987073	38268704	13378146	0	719
100000000	up	36251735	156456	4226	0	1	0	1759936231	357970	14327444	1	0
100000000	up	70868504	214589	5333	0	21	0	1619359327	400656	12568411	1	0
100000000	up	14212655	164790	123	0	0	0	1832442750	412064	14234252	0	0
10000000	down	259456	2914	0	0	0	0	42676499	16254	352309	1	0
100000000	down	5361241	6061	44	0	0	0	16849918	9461	124769	0	0
100000000	down	116587271	219574	3679	0	5	0	352588755	289674	1569230	0	0
100000000	up	20119151	261307	217	0	0	0	1864472396	618752	14313781	0	0
100000000	down	301491	3466	0	0	0	0	43862046	16427	348476	1	0
100000000	down	3999742	17850	163	0	0	0	31911669	25252	140950	1	0
100000000	down	729876	5943	349	0	1	0	20592364	12011	129684	1	0
10000000	down	0	0	0	0	0	0	2025798	80	19027	0	0
100000000	down	0	0	0	0	0	0	0	0	0	0	0
100000000	down	5039462	62824	305	0	2	0	226920733	105281	1004990	0	0
100000000	down	2223114	7360	158	0	0	0	21222034	14129	124150	1	0
100000000	down	1315305018	4817826	2283	0	16	0	2147060921	2518178	4935622	0	0
100000000	up	0	0	0	0	0	0	1057951134	113731	9138081	0	0
100000000	down	26690749	148705	22165	0	10	0	601549472	247878	3892068	0	0
100000000	down	0	0	0	0	0	0	0	0	0	0	0
100000000	up	85943766	307785	4839	0	11	0	1426659275	527858	9266943	0	0
100000000	down	0	0	0	0	0	0	0	0	0	0	0
100000000	down	0	0	0	0	0	0	0	0	0	0	0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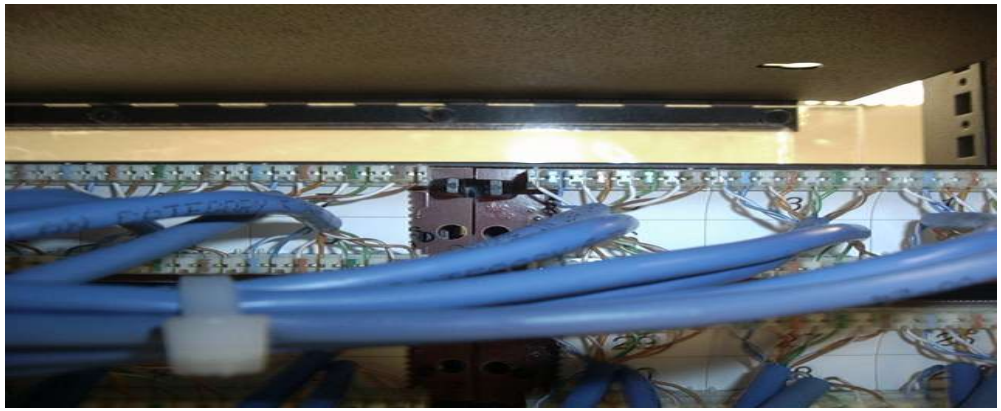
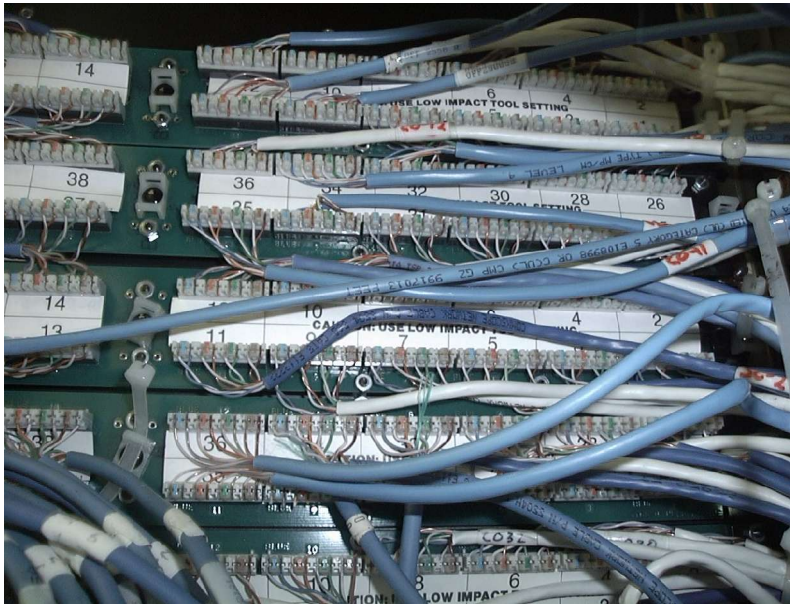
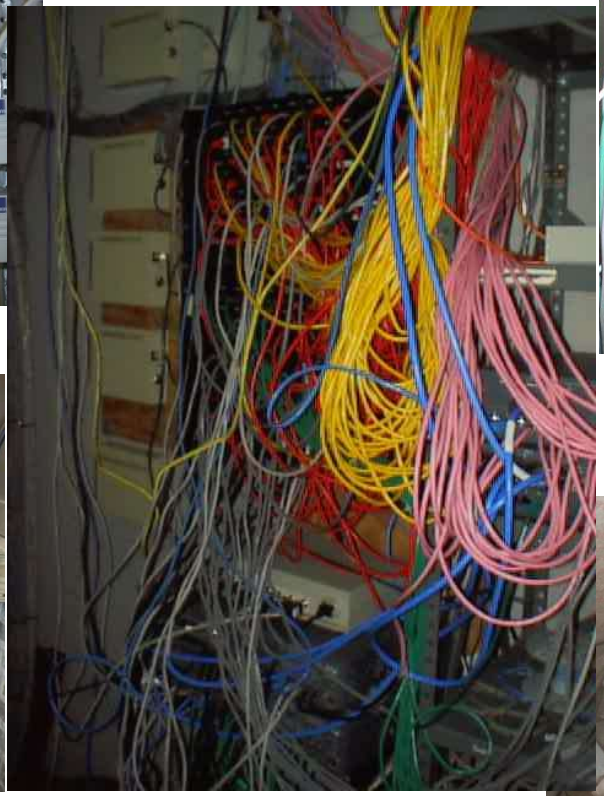
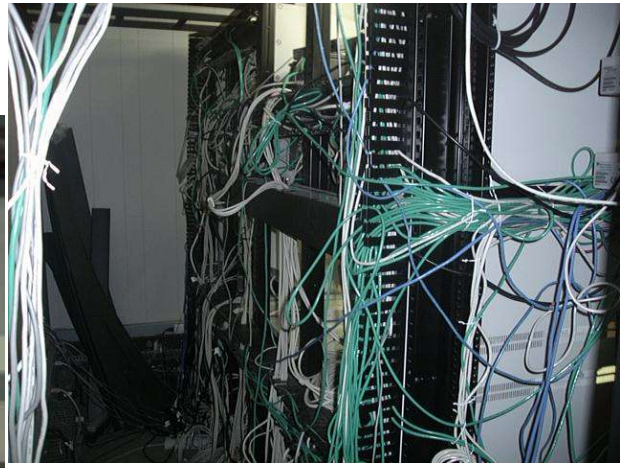
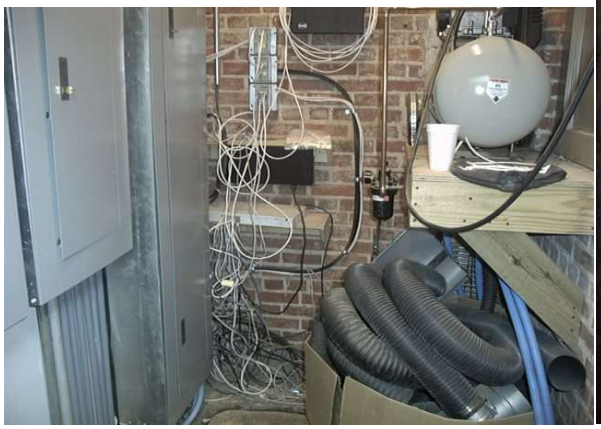
Top 5 Causes of Cabling Failures
1. -- Modular plugs are not terminated properly
Use the right type of plug (stranded vs. solid conductor and follow the color code).
2 -- Pair-twists are not maintained
If needed, add an additional twist to the pair when terminating the modular jack, when terminating ensure that the cutter on the termination tool is facing the right direction.
3 -- Too much cable jacketing is removed
Keep the cable jacket intact up to the connector, only remove enough jacket to terminate the pairs.
4 -- Poor cable routing
Keep cable separation from power and other telecomm cabling as needed, do not exceed 25 lb of tension on cables being pulled, watch for cable twisting and rubs on nails, screws, and even poorly drilled joists and studs.
5 -- Poor documentation
Keep good records of all cables placed in the job including all test data, leave a copy with the owner and in the distribution center.

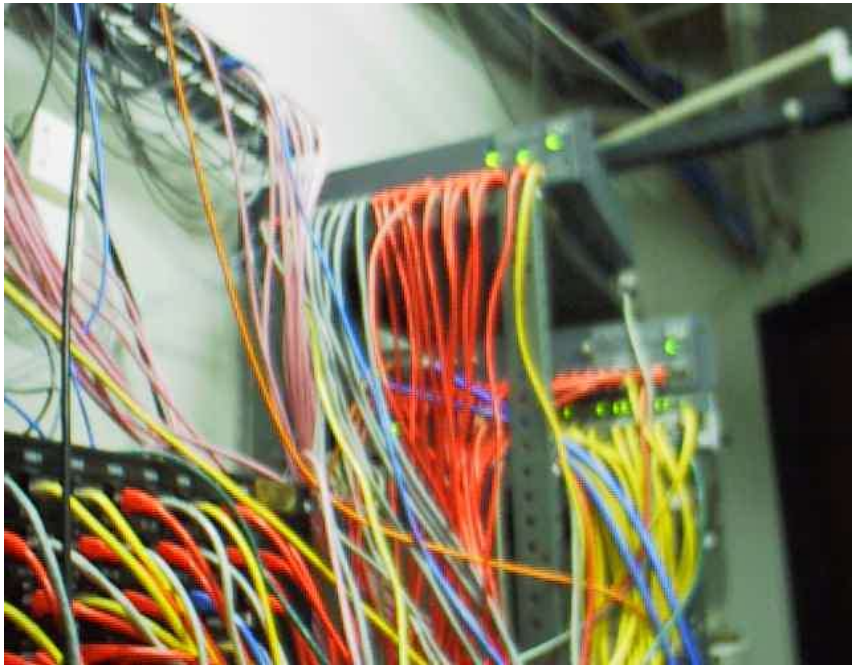


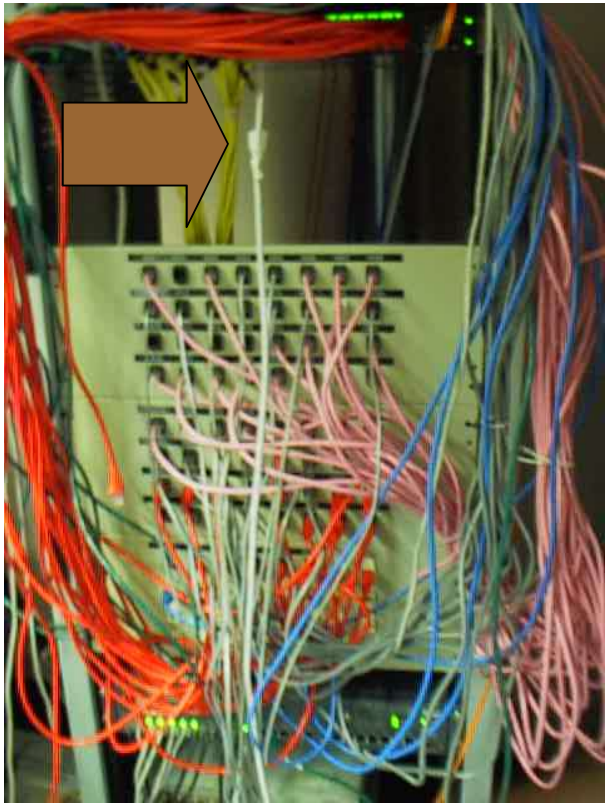

USE LOW IMPACT TOOL SETTING

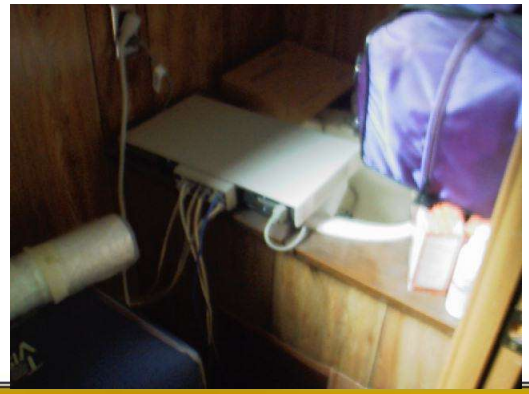






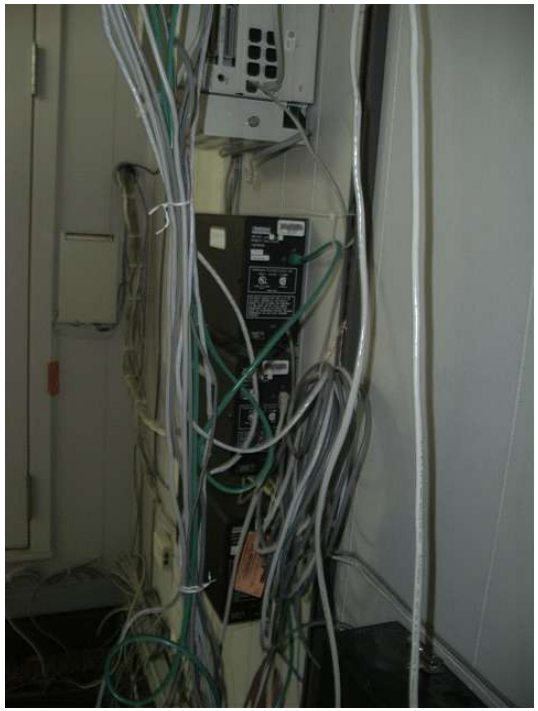


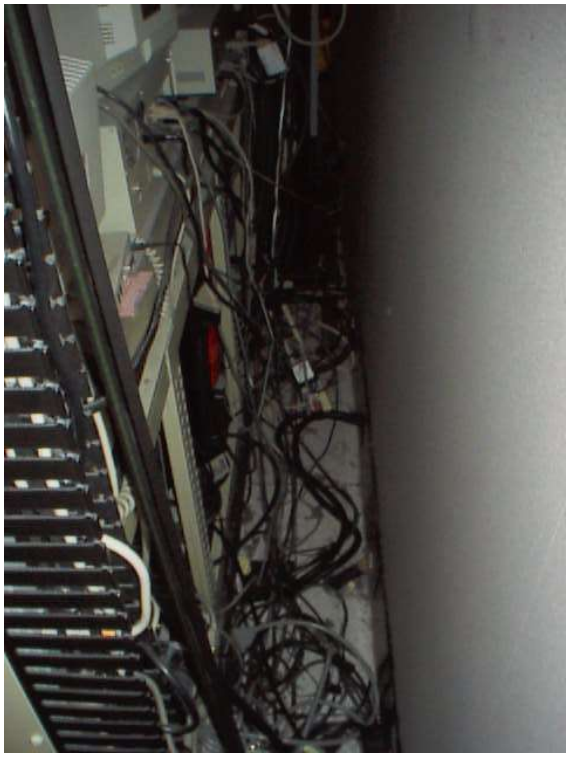




Electrical cont'd.

Data cables should be run to front
Power cables should be run to back

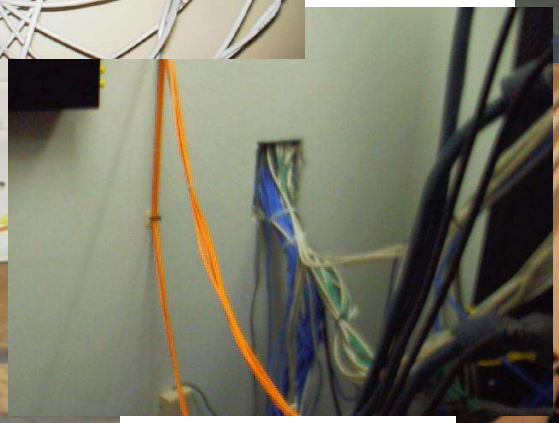
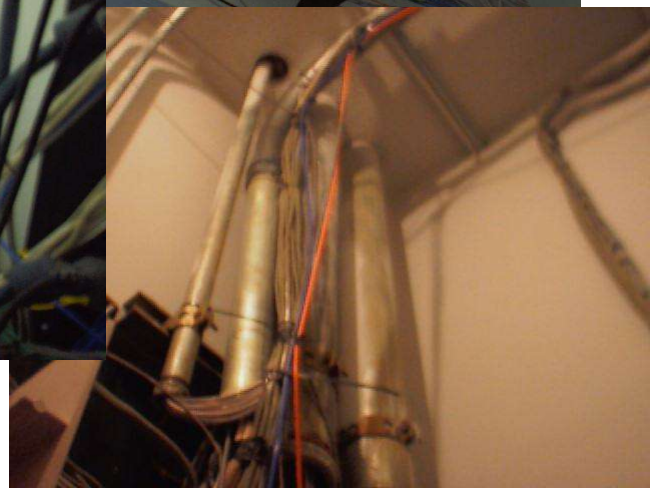


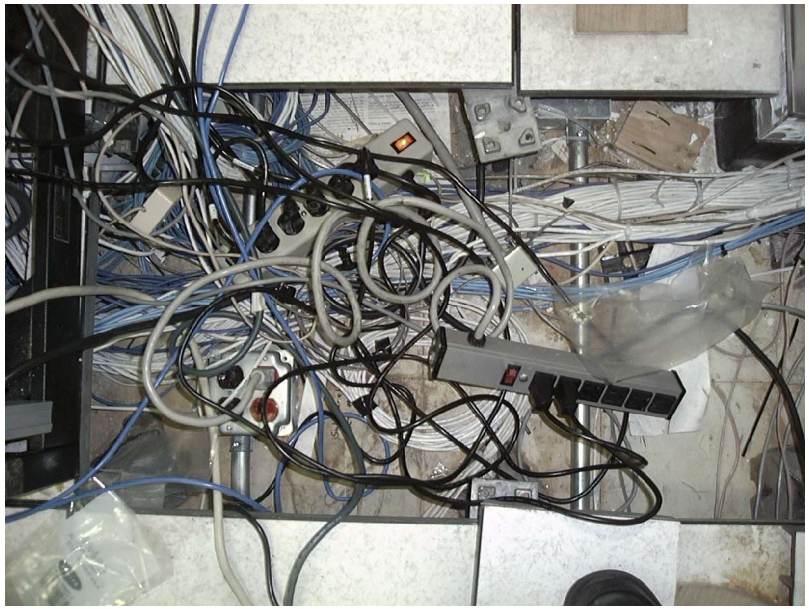


Is the cable properly supported and bend radii observed?



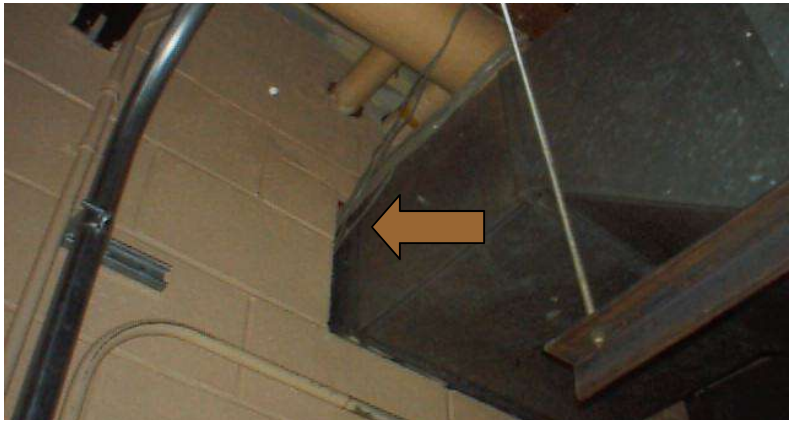


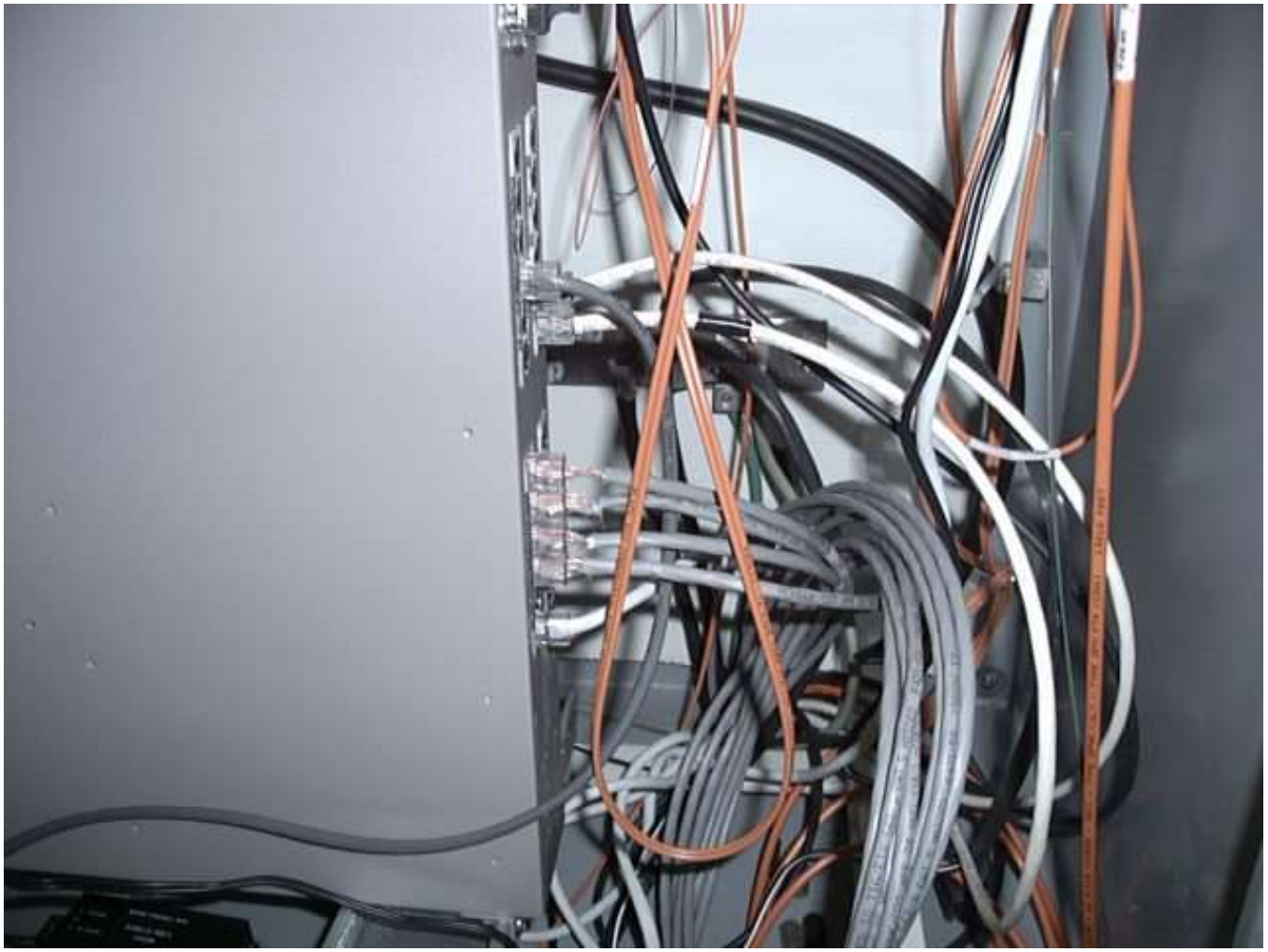


No Separation of power
Abandoned cable must be removed
Hazardous area
Noisy area
Code violations

Is the Cable Integrity Maintained?



Multiple Problems



Tip 6

When you have actionable data – act on it.

Top Offenders

- Improperly terminated cables
- Improperly terminated patch cords
- Lengths exceeded specified maximum
- Cabling was improperly or not labeled (troubleshooting problems)
- Cables run over fluorescent lighting causing interference
- Electronics and closets in poor locations (humidity, EM, RF)
- Cables bunched to tightly causing the pairs to be flattened
- Cables tied to electrical conduits or run too close to Power panels
- Cabling that did not pass testing due to various issues
- Closet Spaghetti
- CAT3 Cables terminated to CAT 5 – 100M switches
- Bent fiber exceeding bend radius
- Cables not to spec
- Racks not Grounded

Top Protocol Issues

- Extra protocols/All protocols being activated on the workstations
- Ports forced to 10-Mb half duplex no longer needed
- Packet over-runs
- Unknown protocols
- Retransmissions
- Routing loops or VLAN errors
- Mystery devices or devices that should not be there
- High bit error rates

Results

- **Cabling was replaced with CAT6 in most areas**
  - **Older runs were to short to be corrected**
  - **Cabling was too damaged to function**
- **Fiber runs were replaced where needed**
- **Cables were recertified to current specifications**
- **Data errors decreased, BER decreased and throughput increased**
- **Upon correcting network errors – traffic INCREASED**
- **ERP was added and VoIP became functional without additional electronic needs – COVERGENCE**
  - **Electronic vendor was suggesting more switches/routers**

Tip 7

- **Understand where technology is going**
- **Know who is spending money on what**
- **Know what can you learn from them**
- **Best way to check vendor non-references**

Where is it going?

- Outsourcing
  - **Moving IT functions in whole or in part to another company**
  - **Virtualization**
- Government mandated upgrades
  - **U.S. – HIPAA**
  - **U.S. – Sarbanes-Oxley**
  - **Telco upgrades**
- Hardware and Software
  - **Data Centers**
  - **SAN/NAS**
  - **New applications and upgrades**

Where is it going?

- Services
  - **Audits – Technology and security**
  - **Planning**
  - **Implementation and integration**
- New technology
  - **Gigabit to the desktop requires electronics upgrades**
  - **VoIP/IP telephony**
  - **Video, CCTV and IP surveillance**
  - **Wireless – Wi-Fi and WLAN**
  - **High Density**
- Infrastructure

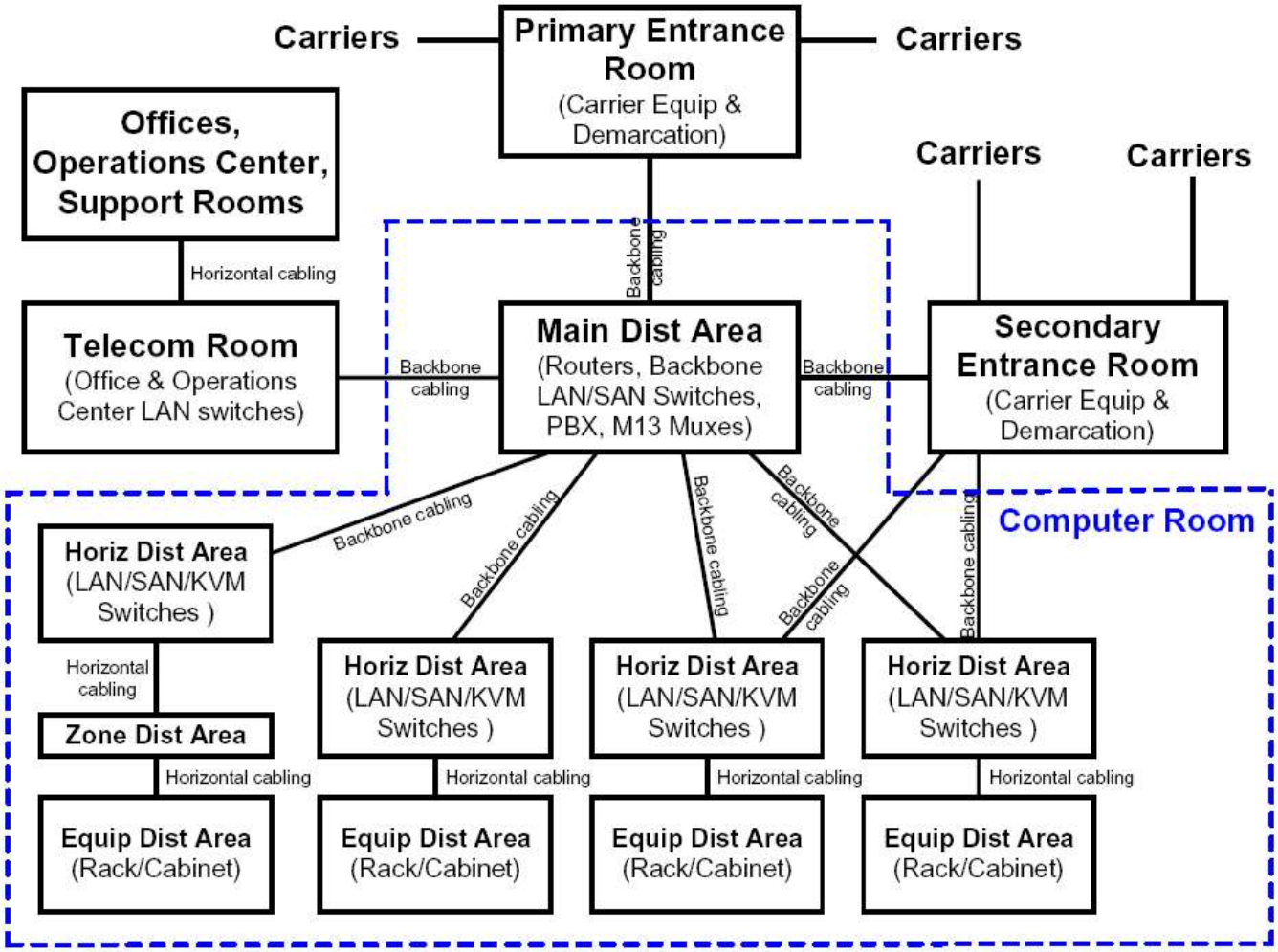
Tip 8

- **Keep up with the standards**
- **Keep up with the codes**

TIA 942 – Data Center Standard

- **Sets up "hot zones" for equipment**
- **All horizontal cables should be run and terminated accommodating growth so that it does not have to be revisited**
- **Fire, life, safety, power and lighting considerations**
- **Distribution areas and telecommunications rooms**
- **Equipment placement**
- **Cabling systems, cabling pathways and spaces**
- **Security and other included systems**

TR 942 Design Considerations

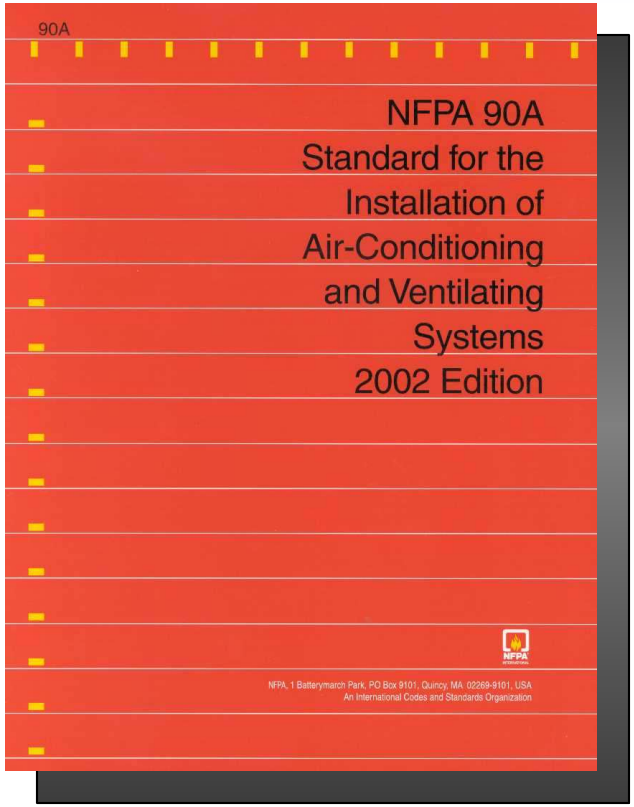


TIA 942 – Data Center Standard

- **Redundancy**
  - **N – Base requirement**
  - **N+1 redundancy**
  - **N+2 redundancy**
  - **2N**
  - **2(N+1)**
- **Tiers**
  - **Tier 1 – Basic data center**
  - **Tier 2 – Redundant components**
  - **Tier 3 – Concurrently maintainable**
  - **Tier 4 – Fault tolerant**

Tiers – What do they Mean?

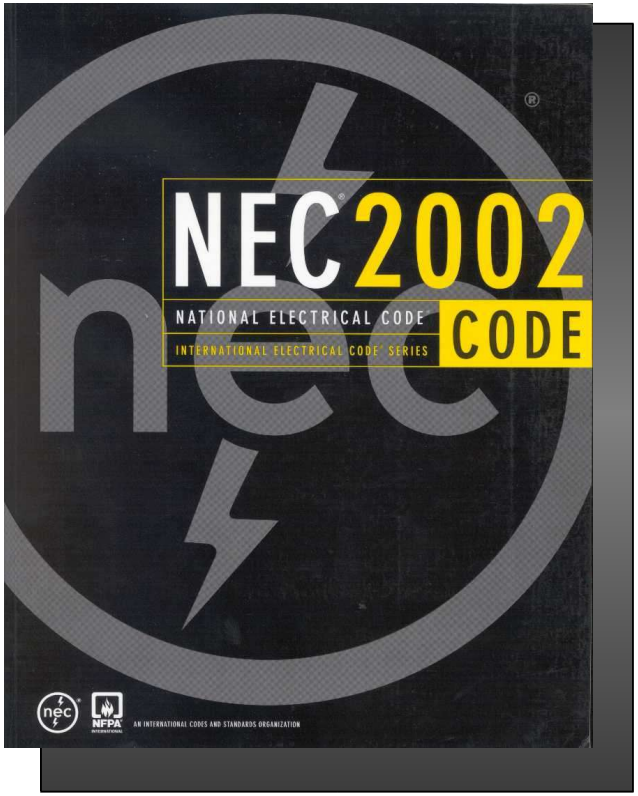
	TIER 1	TIER II	TIER III	TIER IV
Delivery Paths	1	1	1 Active/1 Passive	2 Active
Redundant Components	N	N+1	N+1	2(N+1) or S+S
Support space to floor ratio	20%	30%	80-90%	100%
Ultimate Watts/ft^2	20-30	40-50	100-150	150+
First year deployed	1965	1970	1985	1995
Annual IT Downtime due to Site	28.8 hrs	22.0 hrs	1.6 hrs	0.4 hrs
Site availability	99.671%	99.749%	99.982%	99.995%
Power Support	UPS	UPS + Gen	UPS + Gen	UPS + Gen
Critical Path Support Requires	Shutdown	Shutdown	Auto	Auto
Redundant Components	Maybe None	Systems	Systems and Power some others	All
Cost per square foot	$450	$600	$900	$1,100+
Based on information from the Uptime Institute				



NFPA 90A - Standard for Air Conditioning and Ventilation Equipment:

- Sets requirements for flame, smoke and fuel load
- 4.3.10.2.6 -- "All materials exposed to the airflow shall be non-combustible or limited combustible and have a maximum smoke developed index of 50…"
- Combustible cables allowed as *exception* (CMP, etc.)
- Requires listing of limited combustible cable

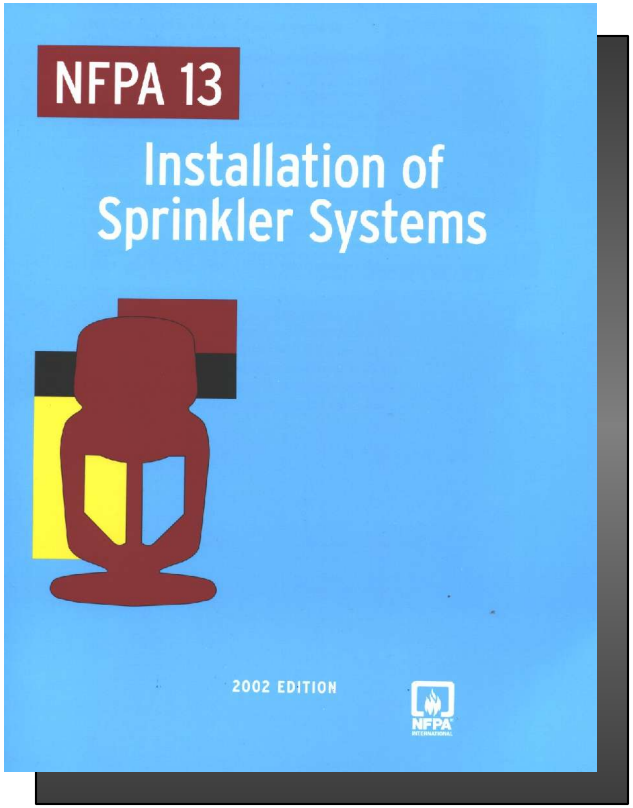
NFPA 90A is responsible for plenum spaces in buildings.



NFPA 70 - National Electrical Code (NEC):

- Does not currently include LCC
- Should correlate with NFPA 90A requirements
- Article 645 permits type CM cable under raised floors in computer rooms under certain conditions
- Requires removal of abandoned cable

NPFA 70 is responsible for plenum cable products and applications



NPFA 13 sets the requirements for sprinklers in buildings

- In sprinklered buildings, use of combustible cables in concealed spaces, including plenums, requires installation of sprinklers in these spaces.
  - Use of limited combustible cable does not require sprinklers in these spaces.
  - Options:
    1. Sprinklers in concealed space
    2. Cable in conduit
    3. LCC cable (cost effective)

Shared Media Applications

- **Wi-Fi/WLAN**
  - **Shared channel to switch**
  - **Supports 10-20 users per access point**
- **VoIP or IP Telephony**
  - **Some implementations use switch inside phone**
  - **Shared media to network switch**
  - **HIGH bandwidth demands due to quality needed for voice**

Powered (PoE) Applications (IEEE 802.3af)

- Power provided over cabling channel
- Can be mid-span (injected power within channel) or end-span (in switch)
- Gigabit / end span applications allow for power to transmit on data pairs
- 10/100 mid span allow power to be provided on non-data pairs
- 500mA absolute limit, peak allowable current 450mA with a 50mA safety margin (guardbands)
- Port voltage of 44V – Maximum 48V
- Most resistive allowable cable (20 ohms round trip)
- Cable drops an additional 7V when maximum current is flowing and arrives at powered equipment as 37V
- 37V*350mA = 12.95W (maximum power to a powered device (PD)
- PSE (Power Source Equipment) must detect if attached device is standard or powered and drop power if not needed

802.3af (continued)

- **Endspan PSE (at Switch) can operate at 10/100/1000 Alternative A or B or Both**
- **Midspan 10/100 only – Alternative B Only**

Conductor	Alt. A (MDI-X)	Alt. A (MDI)	Alt. B (All)
1	- V port / Data	+ V port / Data	Data
2	- V port / Data	+ V port / Data	Data
3	+ V port / Data	- V port / Data	Data
4			+ V port
5			+ V port
6	+ V port / Data	- V port / Data	Data
7			- V port
8			- V port

Devices using PoE

- **Wireless Access Points**
- **VoIP phones**
- **Video Cameras**
- **Bluetooth devices**
- **Biometric Panels**
- **Healthcare devices**
- **Fire Life and Safety devices**
- **Building Automation Systems**
- **Etc.**

Wi-Fi (Wireless Fidelity) WLAN

802.11a	802.11b	802.11g	HiperLAN /1	HiperLAN/ 2	WiMAX (802.16) Still in development
54Mb/s	11Mb/s*	6,12,24 or 54Mb/s*	20Mb/s	Up to 54Mb/s	Up to 70Mb/s
5-6GHz	2.4GHz	2.4GHz	5GHz RF	5GHz RF	2-11GHz or 10-66GHz

Ultrawide Broadband (802.15.3a) 480Mb/s up to 30’ (still in development)

Why Talk About Wireless?

- **All Wireless Access Points need a connection**
- **If cabling is run to standards (2 per work area) and additional for wireless antennas there is an *increase* in cable counts**
- **Have a limited range which can vary by sight specifics**
- **Like IP video cameras, should be included in design considerations**
- **SHARED MEDIA = BEST CABLE CHANNEL POSSIBLE**

VoIP and IP Telephony

- **Switch may be in phone, may be separate cable**
- **Standards recommend two outlets per work area**
  - **One for phone, one for PC in this case**
- **If switch is in phone, cable channel becomes shared media**
- **Phones may be powered via data cable**
- **Voice and Telephony traffic are sensitive and require dependable bandwidth**
- **Video conference may be part of system**
- **Category 7 (TERA™) allow PC and phone to operate at 10/100 over one single cable**
- **New wireless IP phones are being introduced**
- **75% of voice traffic expected to be VoIP by 2007 (IDC research)**

Interoperability – Standards Based

- **H.323**
- **SIP**
- **TAPI**
- **IETF**
- **ITU**

Matters for routing and switching

Matters for phone compatibility

Matters for VPN capabilities

Tip 9

- **Understand how to predict the future**
- **Know where is technology going**

Industry Trends

Moore's law = More bandwidth

- Processing power doubles every 18 months
- 1 Gb/s port shipments have surpassed 10 million per year.

Parkinson's Law

- Data will increase to fill available storage
- Storage doubles every 18 months
- By end of Century there will be 1 Terabyte of Data for Each person on earth

Metcalf's Law

- The value of the network grows as the square of the number of users

Gate's Law

10G

- **Fiber – 10x cost of 1G fiber**
- **Copper – 3x cost of 1G fiber**
- **CX4**

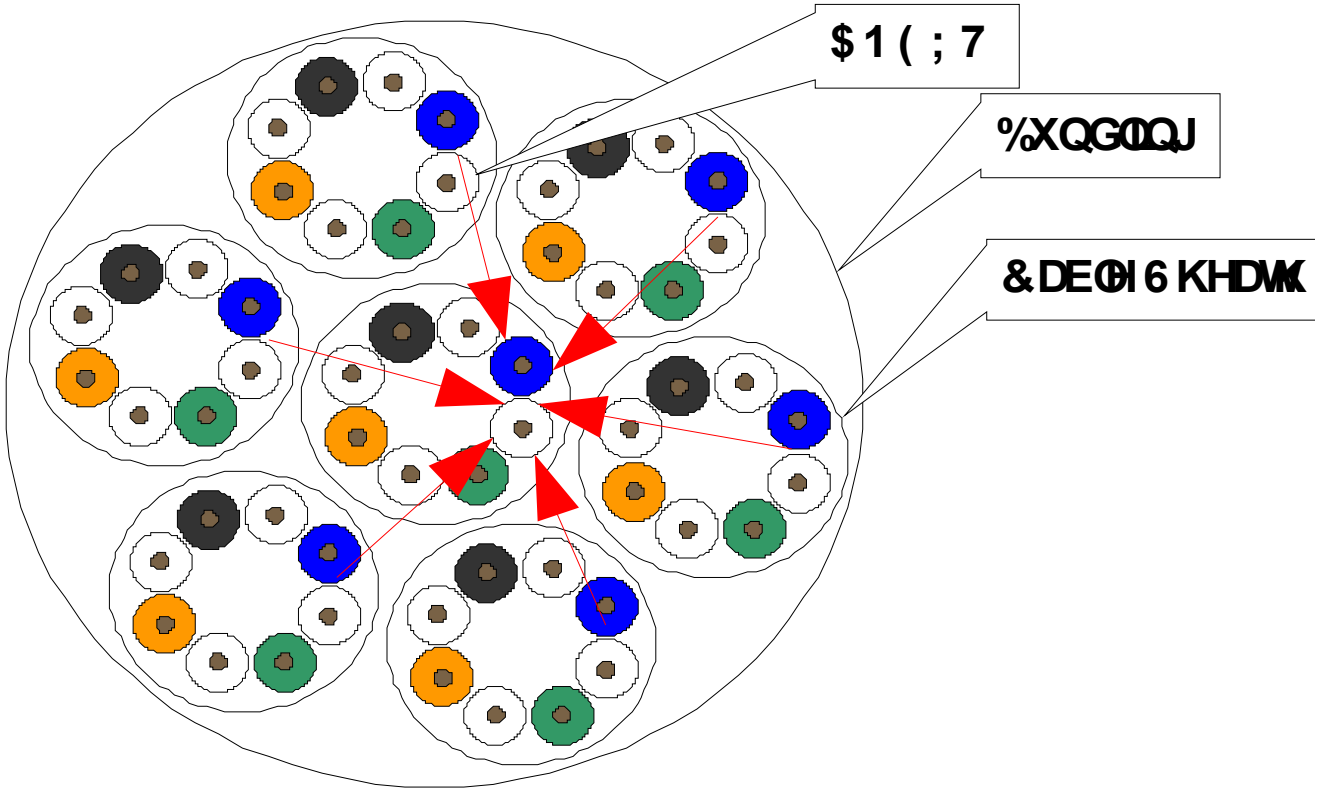
10GBT Objectives

- **Support operation over 4-connector structured 4-pair, twisted-pair copper cabling for all supported distances and Classes**
- **Define a single 10 Gb/s PHY that would support links of:**
  - **At least 100 m on four-pair Class F balanced copper cabling**
  - **At least 55 m to 100 m on four-pair Class E balanced copper cabling**
- **Support a BER of 10^{-12} on all supported distances and Classes**

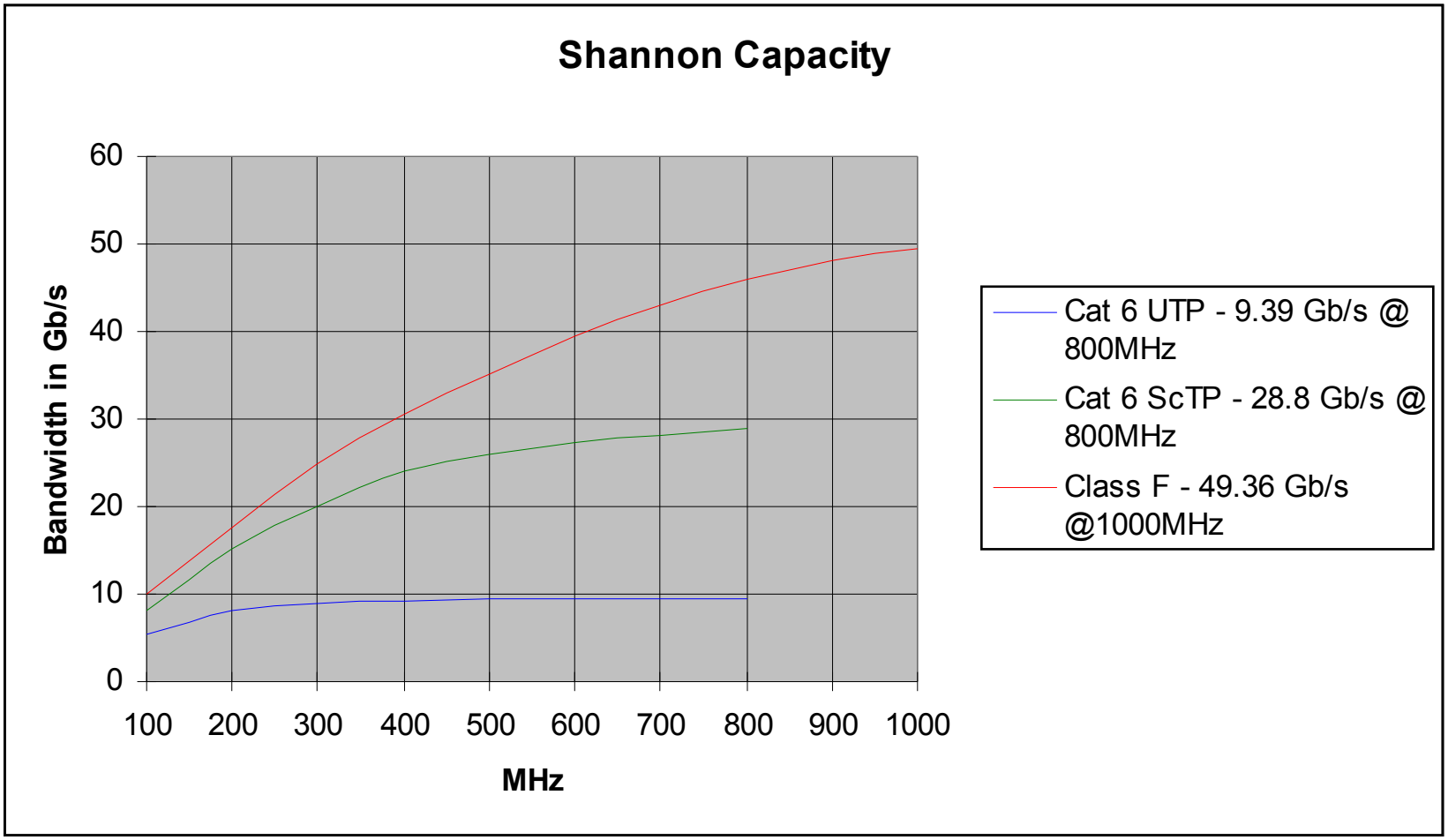
Interference (out of channel effects)

- Alien NEXT (AXTIR)
- Coupling attenuation
- Transfer impedance

ANEXT in Bundled Cable



Shannon Capacity of Channels



Who Uses Shielded Cabling?

- **Germany/France**
- **Manufacturing Facilities (ODVA and Noise driven)**
- **Governments**
- **Noisy environments**
  - **Teleradiology centers**
  - **Factories**
  - **Shipping/Oil**
- **Customers with greater lifespan concerns**
- **Lab environments**
- **New product development**

Project Authorization

- **Approved by 802.3 and forwarded to NESCom in January 2004**
- **Full task force expected by February 2004**
- **Will be 802.3an**
- **Draft 1 Scheduled for June 2004 – in progress**
  - **Revisions**
  - **Refining**
  - **Proof of concept moves to engineering**
- **Final standard approval slated for 2006**
  - **10G Copper products will begin hitting the streets in Q1-Q2 2005**

Tip 10

- **Plan for the future**
- **Business continuity is key**
- **Disaster recovery is not enough**