Communications Cables in Commercial Buildings

New thinking about a new problem

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Behind the walls, ceiling and floors of every commercial building is an unseen and unacknowledged hazard that grows larger every year: voice and data communications cables. The amount of communications system cabling in buildings has increased exponentially since the emergence of desktop PC's and the client/server computing model a generation ago. In 1991 there were approximately five billion feet of plenum cable in place. By Y2K the estimate had grown to 45 billion feet in 739,000 office buildings, or 1,323 feet of cable per office worker.

Driven by the role that communications technology plays as the essential work tool in every kind of workplace and inefficient design practices, the amount of cable in buildings continues to grow rapidly. The fat bundles of cables found in every modern building represent serious fire safety and environmental risks. Facility managers must acknowledge those risks and take steps to manage them. New products and design alternatives are available that reduce the fire and environmental risks associated with communications cables, and cut the costs of installation and management of cable systems.

Fire and smoke hazards

Communications cables in commercial buildings, much of it installed in plenum spaces, present a substantial fire hazard. In 1975, a significant fire occurred in One World Trade Center in New York City. An investigation after the fire revealed the hazard associated with cables running in air conditioning spaces. Throughout the years, there have been a number of serious plenum fires that have caused extensive property damage and, tragically, loss of life. "Because of the high volume of air flow in these horizontal open spaces, fires can spread with alarming speed and introduce copious amounts of smoke and gases or fumes into the ventilation system." (Peri, 2000)

Even at a time before the boom in network installations that led to today's dangerous accumulation of cables, this and other fire investigations revealed the aggravating role of cabling in spreading smoke and flame. Every 1,000 feet of four-pair unshielded twisted pair (UTP) contains approximately 11 pounds of plastic material for insulation and jacketing, a substantial fuel load that can act as a "highway" for fire and produce toxic gases from burning, or even overheated, cable.

In 1999 an electrical short ignited the cable in the plenum of United Airlines Operations Control Center. Virtually all electrical equipment was destroyed, but fortunately, United had just completed a back-up center a few weeks before. Otherwise, their operations would have virtually shut down.

Environmental hazard

In addition to the fire hazard, the materials used to create the products and the cable systems within the building represent a significant and growing environmental problem. Every year 1.5 billion pounds of copper are freshly mined for use in cables. The extraction, refining and processing of these raw materials is energy intensive and leads to emissions and environmental degradation (Wilson, 2004). In copper mining, as much as 80 percent of the original rock moved becomes waste that contains high concentrations of toxic materials. Mining has serious local and regional impacts on water quantity and quality, air and soils, and on the social and cultural environments where it takes place. In addition, copper production is energy intensive, requiring approximately 130 gigajoules of energy/ton for mining, smelting and processing.

Most communications cables are jacketed in polyvinyl chloride (PVC), a petroleum-derived plastic. PVC production, use and disposal result in the creation and release of toxic chemicals, hazardous gases, endocrine disrupting chemicals and organochlorines. Because of the persistent nature of the chemicals used to make PVC, any attempt to treat the waste products of production only creates other toxic by-products (Greiner 2002). According to the US Environmental Protection Agency, PVC production, use and incineration is the largest single source of dioxins, a group of powerful carcinogenic endocrine disrupters. PVC manufacturing also produces chlorine and vinyl chloride monomer gases—highly toxic and explosive greenhouse gases that pose hazards to workers and fire crews while driving global warming and climate change.

While the toxicity of pure PVC production, use and disposal alone is ample cause for concern, cable manufacturing requires further additives. The most significant of these additives is lead, a persistent, bioaccumulative, toxic element. In a typical cable, lead makes up 2 to 8 percent of the jacket (Lobash, 2003). At a weight of 29 pounds/1000 feet for a cable (4 Pair UTP, Cat5e), communications cables put 35 to 139 pounds of lead in a typical U.S. office building. Recent studies indicate that as the PVC covering on cables deteriorates with heat and time, particles of lead and other additives may migrate to the surface and accumulate as hazardous dust behind walls, beneath floors and above ceilings, where they can readily circulate through building ventilation systems. Also, workers who handle the cables on a regular basis may be exposed as chaffing cable jackets against hands, cable trays or other structural elements can cause lead to be released (Greiner, 2002, Wilson, 2004).

U.S. codes and regulations

The fire hazard from cables was recognized in the early 1980's when the NFPA Committee 90A issued requirements for all materials "exposed to the air flow" to be non-combustible or limited combustible. In order to ensure an abundant supply of affordable cable, and because it was anticipated that the amount of cable involved would be minimal, an exception to the primary requirement for combustibility was made for wire and cables. That exception applies to virtually all of the plenum-rated cable installed today.

Newer fire and electrical code standards specify the use of "limited combustible" cables, including NFPA 90A (2002), NFPA

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5000 Building Code (2003), NFPA 13 Sprinkler Systems (1999 and 2002) and National Electrical Code (NEC) 2005 Article 800. The same standards also require the removal of "abandoned" cables. However, local authorities are responsible for the implementation of national standards in their area and the application of new standards is not uniform across the U.S. Enforcement of the higher standards has been noted in jurisdictions of Massachusetts, California, Michigan and Georgia.

Removal and disposal of abandoned cable

The National Electrical Code NEC 2002 and NEC 2005 include several articles that require removal of abandoned cables—those unused and not marked for future use—in ceiling and floor plenum spaces. Enforcement of removal generally occurs during building renovations or remodels. Enforcement of the abandoned cable codes is becoming more common and contractors report that many local jurisdictions require cable removal before they will issue permits. After removal, used cables become an environmental problem and should be handled responsibly. Today, most retired wire and cable is shipped to India or Pacific Rim countries where the cladding is stripped away and the copper recovered. Disposal of the PVC plastic jacket at that point is a significant environmental problem. As with electronics, new programs exist for the disposal of used cables that guarantee proper handling and provide a "Certificate of Waste Diversion" for the client.

International standards

While U.S. cabling code remains decidedly focused on fire resistance and smoke density of the cables, international standards are beginning to address the questions of toxicity. Tests have been convincing enough for many countries, including Australia, France, Italy, Japan, Korea, New Zealand and the U.K. to limit, or even ban many of the components currently used in communications cables. For example, the European Union (EU) Directive on the Restriction of Hazardous Substances Directive (RoHS) bans use of some toxic materials such as lead, cadmium and some brominated flame-retardants. The EU Waste Electrical Electronic Equipment Directive (WEEE), controlling the disposal of waste electrical and electronic equipment and promoting the reuse of electrical and electronic equipment, takes effect in 2006.

Alternative products

In 2000, major manufacturers of network cable began listing limited combustible (LC) network cables through Underwriters Laboratory (UL 2424) that meet the standard for the Installation of Air Conditioning and Ventilating Systems in NFPA 90A. These cables also comply with the requirements for cables in ducts, plenums and other spaces used for environmental air, in accordance with Articles 725, 760, 770, 800, 820 and 830 of the National Electrical Code. Limited combustible cables use FEP (fluorinated ethylene propylene) as the jacket material as well as the insulation, due to the inherent low smoke and flame spread of these compounds. In some cases, new LC products are also 100 percent recyclable and the manufacturer will accept the return of used product at the end of useful life for re-use in new products. Manufacturers also offer cable products that do not contain lead.

Alternative designs

Because of the growth in networked devices, constant movement of people within workplaces and the difficulties of installing additional cables after a space is occupied, the common "real world" practice today is to install cable outlets anywhere there might be current or future demand for a connection. The result is a very low asset utilization rate for IT cabling systems. The majority of cable installed in a workplace is typically not in use at any one time and frequently a substantial portion of the cable infrastructure is never used at all. In addition, very few organizations keep accurate, up-to-date records on communications cable systems.

The key concepts for new approaches to the design and management of IT cable systems are flexibility and integration. Many of the problems cited in this article, including environmental issues, fire safety, under-utilization of assets and lack of proper record keeping, can be eliminated or minimized by incorporating the information transport infrastructure as a fundamental design element for a facility from the earliest stages of a project.

As described above, the problem of over-provisioning of cabling is a direct result of systems that are inflexible. Designing a facility to have raised access floors (or some other type of easily accessible system) creates an environment where cable systems are relatively easy to expand or re-configure to meet any kind of need. Flexibility by design makes it easier to adapt a facility to changing uses over time, which lowers life-cycle costs. It also allows for the installation of only the exact amount of cable that is actually needed for use today, which reduces costs, environmental impact and fire hazards. In a space designed for easy accessibility, labor costs can be reduced by using modular, standardized snap-together components. All of these design options also reduce the need for and difficulty of record keeping, which increases system longevity and further reduces life-cycle costs.

New technologies that allow for the integration of voice and data systems sub-systems and the use of wireless systems as a substitute for hard-wired cables also create opportunities for more efficient cable system designs, as well as the more efficient use of space within a facility. For example, an "active zone" cabling design that brings electronics components out of closets and into the floor or ceiling of workspaces can reduce the amount of space dedicated to IT equipment. Integrating voice and data communication streams onto a single wire can reduce to one the number of cables to each faceplate, particularly when combined with a robust wireless local area network (WLAN) that can handle both voice and data traffic. The voice and data communications infrastructure can also be integrated with building management cabling systems, saving cost on another sub-system and reducing materials use.

Conclusion

Communications cable in buildings is an issue that facility managers cannot ignore, or simply leave up to the "IT people" to deal with. There are significant safety, environmental, financial and public relations risks associated with the installation, management and disposal of communications cables in commercial buildings. Ultimately, facility managers will bear some responsibility for managing those risks. Getting ahead of the curve by addressing the issues in advance makes it more likely the risks won't turn into ugly and expensive problems in the future. FMJ

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