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Throwing a Lifeline

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A life-threatening event occurs at a large building where many people could be in danger. In this case, it is a smoky fire, but it could also be an earthquake or a mass shooting. The fire alarm system senses the fire, locates the problem, and immediately begins sending signals. It informs the local fire station. Workers receive text messages on their mobile devices with the reason for the alarm and directions for how to get out of the building quickly. It even links to a web page with maps of the escape routes. Along those routes, any secure doors are opened to allow a quick exit.

The alarm system also starts the fire suppression system and instructs the heating, ventilating and air conditioning (HVAC) system to prevent the smoke from spreading to other parts of the building. Using a combination of occupancy sensors and CCTV cameras, it locates areas still occupied and broadcasts specific evacuation instructions to them. Next, other building systems that need to be addressed, such as elevators, are also sent specific information.

Meanwhile, at the fire department, the dispatcher gets the message and directs the firemen. While they are on the way, the fire crew uses the alarm link to view the fire alarm system status and a building diagram showing exactly where the problem is, how to get to it most efficiently using the stairs, and where the usable elevators are in the building. By the time the firefighters arrive at the building, they know exactly which entrance to use, how to get to the area and the locations of services they need to effectively fight the fire.

If there are potential injuries, the appropriate rescue personnel will be given the same information and get to the scene as fast as possible.

That sounds like a good use of technology, available to everyone today, doesn't it? In fact, there ought to be an app for that. Certainly, there are simple ways that electronic systems could coordinate efforts to make this happen. You would need the fire alarm system to work with the building management system, the security system, the local area network (LAN) and probably a few other building systems. Most buildings have comprehensive networks of cabling for LANs that are already being used for security and building management systems.

The future is now

About 25 years ago, Don Horon, president and founder of Cadgraphics Inc., began working on such a system that has evolved to nearly this level of functionality. His RescueLogic system taps into proprietary fire alarm systems using an "antique" RS-232 serial data port to get the necessary information, uses Ethernet to gather data from other systems in a building, then uses a PC to map it onto building drawings to create a visual representation of the systems that looks like the above.

Others, including many major suppliers of fire and life safety systems, have solutions to achieve this goal. However, all are hampered by the lack of standards for systems interoperability.

Wayne Moore, vice president with Hughes Associates, a fire protection and life safety consulting firm, and ELECTRICAL CONTRACTOR columnist for fire/life safety, has been working on NFPA committees for years to determine how to add networking to NFPA 72. Why is it taking so long?

Fire alarm and life safety systems are still based on design criteria developed a century ago. They serve to make them reliable enough to ensure the safety of people inside these buildings. There are comprehensive standards covering the design of these systems (NFPA 72 and 101 in the United States) that are adopted into building codes in most areas.

Today, technology is causing two issues for these systems. First, other systems in buildings are using newer, more powerful computing and networking technology that could make these systems more effective. Second, changes in how we communicate are making it important to consider expanding notification systems to alarms. This would provide faster and more widely distributed notifications using alarms and lights, and also public address systems, phone, text, email, pagers, instant messaging, etc. The need for fast and widespread notification for fire alarms is obvious, but the many instances of shootings on campuses underscores the need for more widespread notification with greater detail about the problem while using every available option for alerts.

Like many fields, new technologies that offer attractive advantages, but require careful consideration, are affecting fire and life safety systems. Commercial aircraft cockpit systems provide a good analogy. As recently as a decade ago, pilots were faced with dozens of instruments, such as dials with pointers going in all sorts of directions, that they had to know how to read and determine immediately if anything was abnormal. Today’s cockpits are full of video monitors and computers that process and simplify the information, making the pilot’s job easier. However, as we have seen recently, pilots can become dependent on these systems and get complacent, sometimes with tragic consequences. This is an important lesson to remember and emphasize when training personnel in the use of these automated systems.

Of course, computers are integrated into everything these days, providing the ability to monitor and control devices with little supervision and fewer mistakes. Even traditional life safety systems with sensors and annunciators connected over traditional copper links, powered from a central monitoring and control unit, benefit from this technology.

Computers have evolved into networks, which promise many benefits to life safety systems once their reliability is acceptable. One major advantage of this computerization is the ability to create smart sensors and alert devices that can monitor and report on their own status, allowing more frequent automated testing that can identify problems before they become critical. Electronics have also made major strides in power conservation, like your cell phone or laptop that run much longer on a battery. Applied to these kinds of life safety devices, they reduce the power requirements, saving energy costs, and make it possible to use smaller copper conductors that save both cable and installation costs.

Technology shifts you can't resist

Some of the technology changes affecting life safety systems are non-negotiable. For example, connection to an analog plain old telephone service (POTS) line to call emergency services can no longer be assumed in many, if not most, buildings. As phone companies and their customers convert to voice over Internet protocol (VoIP), alarm systems must integrate to newer phone systems and/or use cellular services for calling. Using the Internet is another option that can offer additional services including a bidirectional window into the system for outside responders. And redundant paths (e.g., cabling and Wi-Fi connections) are readily available.

The technology shift from POTS phones to VoIP over a LAN is only a small part of the changes affecting most buildings. No company today could survive without a LAN to connect all the employee's computers and other devices. Most users prefer Wi-Fi connections for their laptops and/or tablets; however, some users still must have desktop or laptop computers connected over copper cables (the ubiquitous "Cat 5"), and even the wireless access points require cabling to connect to the LAN and the Internet. All those LAN connections, wireless or wired, require a LAN backbone to the company's computer center (which may have grown into a data center) that will likely be fiber optics in a larger company, copper in small ones.

Larger buildings may also require a system to distribute cellular wireless signals inside the building, another consequence of our dependence on mobile devices. These distributed antenna systems (DAS) typically use single-mode fiber to connect the remote antennas. Cellular providers are now looking at small cellular antennas that can also be distributed throughout a building on single-mode fiber networks. Other DASs offer both cellular and Wi-Fi connections over one system.

The structured cabling system installed for the company LAN now may have many other uses, for example, building management and security systems. The video surveillance system for the building may have moved from coaxial cable to the same cabling system or even connect to the LAN using Internet protocol (IP) cameras connected to PCs for monitoring and storing surveillance videos. Building security systems, including door entry systems and locks, intrusion sensors, occupancy sensors, etc., may also be using structured cabling.

A whole suite of applications is packaged in automated building management systems, which can include sophisticated sensors and controls for heating, air conditioning and lighting, which maintain a comfortable environment for the building's occupants while reducing energy consumption. Some sophisticated systems can even control window shading devices, and—when they get really high-tech—liquid crystal windows can control the lighting and heat entry from the sun. These systems typically also monitor the condition of the devices with the goal of reporting maintenance needs, reducing failures and speeding up problem resolution.

The building management system suppliers have already recognized the need for interfacing to LANs, sharing cabling, data, computing power and responsible personnel. Several systems, such as BACnet (ISO 16484), are designed to interface these systems to LANs. We're headed toward the idea of a real "smart building."

Many of the systems monitored in a smart building are applicable to life safety. There may be monitors for gases (e.g., carbon monoxide or carbon dioxide) and electrical current or faults. Systems that control airflow can close off areas where fires or smoke are detected to prevent it from spreading to other parts of the building.

All these systems use a combination of structured cabling (copper and fiber), proprietary cabling for systems and even several types of wireless connections, including Wi-Fi as either primary or backup connections.

Traditional stand-alone fire and life safety systems with designs that maximize reliability are also beginning to look at networking systems using conventional networks, such as Ethernet, and integration with other networks. Options range from today's hardwired copper networks, which are totally independent from other building or campus systems, to the opposite extreme, using a LAN to communicate among controllers, sensors and annunciators and using other building information on the LAN to enhance the system's life safety aspects with more information and a wider circle of notifications.

Potential of cooperation

On the other hand, information technology (IT) managers may not be enthused by the effects on their networks. Managing a LAN is already hard enough, especially with all the security issues caused by hackers, all the new devices and operating systems that must be accommodated, and all the bandwidth problems from employees wanting to use their own devices on the network. Adding the responsibility of fire and life safety systems operating on the same network is unlikely to be popular with many IT managers.

But the possibilities of communication and interaction between the fire/life safety, security, LAN and building management systems offer life safety enhancements. Imagine a system in which they cooperate. A life-threatening event, such as a fire, could be broadcast to all parties in the building connected to the LAN, even providing a smartphone, tablet or laptop with a diagram of the building showing where the problem is and guiding the user to a safe exit, as in the scenario at the beginning of this article. Working with the building management and security systems could help isolate the problem and prevent smoke or fire from spreading.

Beyond sharing data, there is the issue of sharing cabling infrastructure—both cables and pathways. Here the NFPA documents are vague, and committees are attempting to clarify what the current requirements mean and what a future of networked systems may require. Networks now use a combination of copper, fiber and wireless, while a building is required to have an independent copper network for the building fire system. If it is connected to a campus system, fiber may be used between buildings, but that fiber may be required to be an independent cable. Inside the building, copper is required, but fiber would sometimes be preferred because of its immunity to electrical noise.

Perhaps another vehicular analogy is appropriate here. Most people know that automobiles are full of networked computers that control the engine and drivetrain, brakes, dashboard, entertainment systems and even airbag deployment. However, you may not be aware that industry standards for these independent networks specify how they must work together for traction and stability control, antilock braking, cruise control and more. Of course, they are independent, but they communicate to provide the best data for ensuring the vehicle is safe. They even run over different types of network infrastructures. Two of them—the entertainment and instrument panel network and the passenger safety system (airbags) network—use optical fiber.

Over the last year, much has been reported about autonomous vehicles, led by the U.S. Defense Advanced Research Projects Agency (DARPA) and Google Inc. These vehicles have already proven their reliability enough that many states are modifying laws to allow driverless cars to be tested on public roads. These vehicles depend on all those automatic networks plus a number of other sensors and controls that must work together on a millisecond time scale and have fail-safe systems. If we can build a safe driverless car, you'd think we could build more sophisticated life safety systems.

In talking with people in the industry, creating an integrated standard that allows this kind of blending with related systems will take time. Right now, the issues appear to be how to allow standardized networks into the codes. Only once that is accomplished and accepted widely can further integration be considered.

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