The Benefits of **ADDRESSABLE** Fire Alarm Technology

**NOTICE:** If you were born after 1990 or if you lived through the 60’s and can’t remember what happened since, you may be surprised to learn that fire alarm systems did not always utilize addressable technology. Nope. Honest. Cross my heart.

Just a few decades ago, fire alarm systems used what we now call "conventional" technology. Pronounced “CON-VEN-SHUN-ALL” if you’re wondering.

Of course, those systems accomplished the bulk of tasks that modern fire alarm systems do; they Detected Fire; Notified Occupants; Lit up annunciators; etc. Except those systems used conventional zone supervision instead of addressable technology. So what’s the big difference?

In conventional fire alarm systems, imagine that every detection circuit running from the panel is being “watched” by a built-in “virtual eyeball”. The eyeball constantly looks for a certain amount of power coming back from the END-OF-LINE (EOL) device. If the amount of power is appropriate, the Fire Alarm Control Panel (FACP) will tell you that everything is **NORMAL**. If the wire between the FACP and the EOL device breaks, the power will disappear and the FACP will tell you that one of the circuits is in **TROUBLE**.

And if any pair of detection circuit wires between the FACP and the EOL devices becomes shorted together, the FACP will tell you that there is an **ALARM** condition in the system.

To ensure that the FACP will annunciate a **TROUBLE** condition if a detection device is missing (removed from its base), the electrical contacts in a device base are sometimes designed to open the circuitry whenever a device is removed (snapped out of) a device base. The real take-away is that a
conventional FACP only supervises the wires running between the FACP and the EOL devices, rather than supervising the presence of each fire detection device.

So what does a conventional fire alarm system do when a fire alarm condition occurs? Well, for one, it sounds the notification devices to ensure everyone is alerted to leave the building. In addition, among other things, the fire alarm control panel will light up some indicators to show the fire department which zone activated the alarm condition.

For the installation contractor, a conventional fire alarm system required a separate pair of wires run to each and every fire alarm zone. Same thing for the notification circuits. Everything was hunky-dory until some smart-alec engineer decided that fire alarm systems could benefit from addressable technology. The idea was that placing an address in each device would somehow bring benefits to everyone. Before discussing the benefits, we should examine how an addressable fire alarm system works.

Firstly, every addressable fire alarm control panel requires some type of programming to establish a database consisting of all the devices the fire alarm panel needs to support. Second, there are no End-of-Line resistors in addressable fire alarm systems. Third, there is no “breaking” of the wire when an addressable device is removed from its base.

And instead of the virtual “eyeball” used by a conventional system, imagine that addressable fire alarm systems use a virtual “voice” and “ear”. The voice is used to send messages and the ear is used to listen to the replies from the field devices. When an addressable fire panel is working properly, it constantly sends messages down its addressable circuits to “ask” each device if it is working properly. Each device responds to the
request with a short status report. If a device fails to report, the fire alarm panel annunciates a trouble condition to say that one of the devices is “missing” or “failed”. OK, so if that’s how it works, what are the benefits associated with addressable technology?

For the installing contractor, the introduction of addressable technology provided a significant cost savings. Addressable device wiring could span multiple fire alarm zones and thus, there was no need to install a “home run” from each fire alarm zone. In result, the conduit size could be reduced as it accommodated fewer wires. Overall, cost savings were realized. In the early days of addressable systems, there was no code requirement for field isolation between fire zones. More recent codes and standards require addressable circuit isolation to ensure that a faulty circuit in one fire zone does not hinder the devices in another fire zone from reporting an alarm condition. However, even today, where some situations require 2 isolators placed in series when an addressable circuit crosses into a different fire zone, cost savings and benefits far outweigh the added cost of isolators. The benefits are multiple.

For the building operator, reacting to the fire condition is much more efficient. Now the fire department can tell EXACTLY which DEVICE initiated the Alarm, and can respond with much more precision. At the same time, addressable systems now offer “drift compensation” which helps to eliminate false alarms due to dirty smoke detectors. In fact, when the CAN/ULC-S536 Fire Alarm Inspection Standard introduced the requirement to test the effective sensitivity of each smoke detector, many addressable panels could provide proof of inherent sensitivity adjustment and therefore avoided the cost of manual sensitivity testing.

Overall, the benefits of addressable technology on the fire alarm system have been extremely valuable to end-users, first responders and installers. Addressable technology has proven itself over the past ~30 years.
But when people refer to “addressable” fire alarm systems, most are really only referring to the DETECTION side of the fire alarm system. Seldom is the Notification side of the fire alarm system mentioned in the same sentence as addressable technology.

How can Addressable Communication technology improve Fire Alarm Notification?

- Can it reduce circuit wiring requirements?
- Can it reduce the cost of installation and verification?
- Can it reduce the ongoing cost of inspections?

Let’s take a closer look so we have something to haggle about.

One major difference between conventional notification circuits and addressable notification circuits is the operating mode. Most conventional systems utilize a 24 VDC reverse-polarity circuit. A polarity-reversal circuit has two operating modes. Normally, while it operates in “supervisory” mode, (when that watchful virtual eyeball is present), the circuit polarity is “+ and –“. In this mode, none of the notification devices sound (or flash). When the fire alarm panel switches to “alarm” mode, the polarity-reversal circuit flips its polarity over to “- and+”, which causes all the devices to start sounding and/or flashing. It is simple technology that has been used for decades.

With Addressable notification circuits, the operating mode is different and the operating voltage is set a little higher at 29 VDC. The same type of wiring that is used with
conventional notification can be used with addressable notification, but the conductors carry data communications signals as well as operating power. To activate the notification devices to sound and/or flash, the fire alarm control panel issues a command to instruct the devices to operate. Note that the commands do not have to be directed to every device on the circuit. The commands can select one, two, more or all of the devices on the circuit, depending on alarm requirements.

So how can this technology reduce circuit wiring?

For one, most conventional notification circuits are wired to provide notification within one fire zone or floor area. This is especially true when a “floor-above, floor-of-alarm, floor-below” signaling sequence is required. This conventional notification wiring method, just like conventional detection systems, requires a “home-run” from each floor. With addressable notification, like addressable detection, circuits can span more than one fire zone and thus, reduce the number of “home-runs” required. In fact, addressable notification can also leverage “tee-tapped” wiring schemes because supervision travels directly to each device just like in addressable detection circuits, not just to the wiring as in conventional circuits.

To do a little comparison, let’s design a conventional circuit that needs to supply power to equip this building area with combination horn/strobes:

According to table 5 in CAN/ULC-S524, this 200 foot long corridor would require 3 x 15 CD strobes, while Table 7 indicates that the large rooms would require 75
CD, the medium size room would require 60 CD (or 2 x 30 CD) and the small rooms would require 15 CD.

Thus, the final circuit layout should look something like this:

![Circuit Layout Diagram]

To create a viable circuit, every notification circuit must be designed to ensure that the last device on each circuit receives enough power to properly operate. To calculate the capacity of each circuit, a 20% voltage drop is permitted. As shown in the tables below, if we try to use AWG #16 or AWG #14, either the voltage drop would be too high or the maximum permitted wire length would not meet the circuit layout. Thus, for a conventional notification system running at 24 VDC to serve this floor area, a wire size of AWG #12 would be required. And with a maximum length of 529 feet, the wire may have to be pulled in pretty tight...(think: guitar strings)
Now let’s design the same circuit using addressable notification technology, including the ability to Tee-tap and the extra power available with 29 VDC operating power.

To save some cost let’s not overlook the fact that we can utilize less wire to accommodate the area as T-tapping allows us to eliminate all of the “return legs” from each room. (See the diagram below).

The second cost savings stems from the fact that higher operating voltage translates to lower current and lower current translates to smaller gauge wire. Notice in the calculation table below, the entire circuit can be run with AWG #16, which is much less costly than the AWG #12 that had to be used in the 24 VDC conventional scenario:

Also note that these results are based on the “lump-sum” end-of-circuit calculation method. The calculator assumes that the entire cumulative load of all notification appliances is
situated at the very **end of the wire run**. Obviously, this is not the case, so consider that the circuit could easily support more devices than the calculator indicates.

In addition to saving wire, both in size and length, as well as the labour savings of working with smaller gauge wire, addressable communication also offers other “smart” device features which translate into installation cost savings.

Just about every conventional notification device is built with an “adjuster” to allow the installer to select different Candela outputs on the device. Select 15 CD and the device flashes at 15 CD. Move the selector to a different position and the candela output increases to match the device output with the appropriate illumination to meet CAN/ULC-S524 requirements.

In contrast to the “movable selector”, let’s jump back to the discussion on addressable detection features. Remember that the smoke detection and heat detection devices could be programmed to operate according to a different smoke sensitivity and/or a different alarm temperature?

That same type of programmable functionality can be used in addressable notification systems to set the candela output of each device. This feature not only eliminates the labour required for the contractor to set each device. It also allows the fire alarm technician to change the candela output (with a keystroke) in case architectural modifications during the system installation phase alters candela output requirements.
What about addressable circuit isolation? Do addressable notification appliance circuits require isolators? To answer this question, let’s take a look at CAN/ULC-S524-06 Installation of Fire Alarm Systems:

Just like with addressable detection circuits that span more than one fire zone, addressable notification circuits require isolation if they span more than one fire zone. However, if the circuits are run like conventional notification circuits (one circuit per zone), no isolation would be needed.

The most labour saving feature of addressable notification circuits becomes evident when it comes to testing the system. Notice in CAN/ULC-S537, Standard for Verification of Fire Alarm systems, the requirement for testing a conventional device differs greatly from the requirement for testing an addressable device.

To test a conventional notification device, you probably know the routine:

- A fire alarm technician accompanies an electrician to visit each and every fire alarm notification device in the building.
- The fire alarm technician watches the electrician remove the device from the wall or ceiling and then proceed to remove 1 wire from the device.
- Once the wire is removed, the technician listens intently to the walkie-talkie strapped to his belt.
- Meanwhile, back at the fire alarm control panel, another fire alarm technician witnesses the fire alarm panel annunciate a trouble condition on the signal circuit connected to the partially disconnected notification device.
- In turn, he radios the trouble receipt to the field fire alarm technician to confirm that the wire can be reconnected to the notification device and the device can be remounted to the wall or ceiling.
- Considering that this process must be conducted for each and every conventional notification device (because conventional fire alarm circuits ONLY supervise WIRE and NOT actual devices), much labour time is consumed.

With an addressable notification device, the process is much easier:
A fire alarm technician watches an electrician disconnect the conductors that run to an addressable notification appliance circuit from the fire alarm control panel.

The Fire Alarm Control Panel individually identifies each and every addressable device on that circuit as “missing/failed”.

The fire alarm technician watches the electrician re-connect the conductors to the Fire Alarm Control Panel.

The Fire Alarm Control Panel individually identifies each and every addressable device on that circuit as “normal”.

Considering that this process can be conducted at the panel for each and every addressable notification circuit, the labour time required to execute is much reduced.

The testing process for new installations is much more efficient with addressable notification devices, but what about the testing that must be completed on a regular basis; can addressable notification technology reduce the cost to complete ongoing testing? The answer is “yes”.

Why do building managers “hate” fire alarm annual inspections? One main reason is that they know the testing process involves “sounding” the horns and “flashing” the strobes and then waiting for a good number of their tenants to call up complaining about the ongoing disruptions. So much so that many building owners ask for “after-hours” testing to avoid the conflict. They’d opt to pay additional $$ to cover the overtime cost just to avoid having their tenants disrupted. But with addressable technology, this can be easily solved.

Remember that in addressable notification systems, the fire alarm control panel communicates to each individual device. This one-to-one communication channel allows the testing process to be much less disruptive. Instead of having to “ring” or “flash” all the devices on an entire circuit at the same time, addressable technology allows a single device to be tested by itself, by just activating it with a “magic” wand.

Once subjected to the “magic wand”, each device flashes a short code on a built-in LED to tell the testing technician which addressable channel and device number it occupies. Then the device will sound the horn for 1 second and flash the strobe for 1 second. Considering that each device is tested individually and is under the control of the testing technician, the extra cost for after-hours testing is not necessary.
However, addressable notification technology is now more self-sufficient than ever before. Now addressable notification devices are equipped with built-in sound and light sensors. To compliment these sensors, the fire alarm control panel provides the ability to conduct a “self-test”.

During the testing process, each and every device sounds its audible output and flashes its strobe for a duration of 1 second. Once the outputs are exercised, each sensor reports back to the fire alarm control panel to signify a “pass” or “fail” for each separate output function and places the results in a testing log file. The test file is accessible in report form or by selecting the test result for an individual device. Not only does this self-test process virtually eliminate disruptions to building occupants but it also significantly reduces labour time required to perform the tests.

In summary, we reviewed Conventional fire alarm systems and how they supervise circuits based on wiring continuity only. We showed how a Conventional system identified fire conditions by zone and we showed the drawbacks of multiple home runs in wiring installation.

We contrasted Conventional systems vs. Addressable fire alarm systems to show the benefits of less wiring, less nuisance alarms due to smoke detector dirt compensation, device-level alarm location annunciation, and the added functionality inherent to specific device to fire alarm panel communications and supervision.

Then we considered how addressable technology improves the entire notification side of fire alarm systems. We reviewed wiring schemes and reduced wiring size and quantity available via higher voltage addressable circuits. We showed how the requirement for isolation could be avoided and also how verification cost was significantly reduced with addressable notification. Lastly, we learned how device specific supervision and communication to the fire alarm control panel could bring about significant advantages for routine testing as well as annual testing.

As the implementation of new technology into fire alarm systems continues to evolve, consider that new enhancements must provide benefits to a wide audience. Usually, that audience includes Installers as well as End Users. Considering the features explained in this short discussion, it appears that addressable technology, whether used in detection systems, notification systems or both, delivers benefits to all.

The future is now.