Intelligent Smoke Alarms

How many lives have been lost because of a 40-year-old design?

Smoke detectors have been responsible for saving countless lives—yet too many people still die in structure fires each year. Smoke alarms haven't changed much in the 40 years since they were first developed. Yet since 1975, the available safe egress time has decreased from 17 minutes to just 3. There have been evolutionary improvements in fire detection design, but no revolutionary improvements have been brought to market. A smoke detector built with the kind of innovation that IOTA enables could make sophisticated life-saving technology available and affordable to everyone.

Even the best of today's smoke detectors are fairly dumb and mute. AC-powered units can trigger all the rest on the same circuit—but only if they are installed in a building built in the past 15 years, when dedicated smoke-alarm circuits with a signaling wire were mandated by code. A few can communicate wirelessly, but they use proprietary protocols, and can't alert the police, the residents' smart phones, or even the neighbors' smoke detectors. Proprietary smoke-alarm communication protocols are not the right answer, because they will remain isolated from the amazing powers of the Internet.

And even the best smoke detectors sold today have a high enough false-alarm rate that many people respond to their noise with a Chicken-Little response. Building a smoke alarm today that can overcome these challenges is difficult and expensive. And the ongoing research in better detection algorithms means that even the best models sold today won't be as effective as they should be a few years down the road.

Scientific research has shown that using multiple sensors—temperature, ionization, photoelectric, and carbon-monoxide (CO)—is the most effective way to detect real fires and eliminate false-alarms due to humidity, dust, and other non-combustion events. Alerting as many people as possible as quickly as possible to a fire is also a critical path in saving lives. Solving this problem is a great example of what IOTA was designed to accomplish from the start—to make putting intelligent networking out at the very edge of the Internet so easy that it will enable revolutionary solutions.

Scenario A—today's smoke alarms

Fess up—you've purposefully removed the battery from a smoke alarm before, right? The one by the kitchen, because it doesn't like your cooking style. The one outside the master bathroom, because it doesn't like the steamy showers you take. But what happens when something just outside the kitchen catches fire? The alarm is delayed until the smoke reaches a detector further away that still has a battery installed—perhaps too late to save the house.

Scenario B—proprietary wireless smoke alarms

The best smoke alarm we found at the big box store is better, but not good enough. It detects both CO and smoke, and uses the CO sensor to increase or decrease the sensitivity of the alarm to smoke, depending on conditions. It also communicates wirelessly with other smoke alarms in the house—but only of the same brand and model, and they must be carefully paired and programmed with their location, without any assistance from a computer or smart phone. How many homes have installed one everyplace required by code and programmed them correctly?

Scenario C—IOTA-powered smoke alarms

Flash-forward one year, and advanced, Internet-enabled smoke detectors are available from nearly all manufacturers at the same price as today's models. The packaging touts the life-saving improvements:

- Four sensors—to spot fires quickly and not sound the alarm over burnt toast or roasts
- 10-year battery life—for reliability, even if you don't change the batteries when you change your clocks
- Data logging—to warn you of elevated CO levels over time that are harmful but not from a fire
- Power-Line Communication and Wi-Fi links—to signal all your other smoke detectors, the fire department, *and* all of your neighbors' smoke alarms that you (and maybe they) are in danger, using whichever network link is available
- Bluetooth link—to ping your cell phone with a status message occasionally, so you know that it's working properly or that the battery needs to be changed

You're impressed, so you buy a 6-pack and screw them into the ceiling of each room in the house. As you snap each one into its bracket, it pings your smart phone, which wakes up and asks you to select its location from a list—master bedroom, kid's room, kitchen, garage, etc. Each time, the display updates with a list of all the units that you have installed, showing that they're talking with each other, and which ones have registered with the fire department's dispatch server.

Silently, each one is also customizing itself, adjusting its sensitivity algorithms. Paranoid for the kids' rooms; decreased weighting of the CO sensor in the garage; and greater weighting from neighboring sensors for the kitchen alarm. It also says that you will get better fire and CO detection if you add network-enabled CO detectors at knee-height in the bedrooms.

A week later, your teenager burns a bagel, and you're impressed that the kitchen smoke alarm never makes a peep. Two weeks later, your phone alerts you as you're walking by one of the alarms—it has just updated the alarm sound based on the latest research, and plays a low-volume sample so you know what to expect. Three weeks later, your teenager leaves a towel on the stove before he takes a nap. You're at work, and your cell phone sounds an alarm, so you rush home to find:

IOTA Benefits

Tight Integration
Spend more time innovating

Reliability
State-machine architecture makes the software predictable

Reprogramability
Automatically upgrade the fire detection algorithms in installed units as the science progresses

- A neighbor rushed over with a fire extinguisher, put out the fire, and got your kid out, simply because all of their smoke alarms were shouting, "Kitchen fire at the Smiths' house!".
- The fire department and paramedics are already there, checking your son and making sure the fire wasn't smoldering inside the walls.
- Your insurance agent is there, checking on the damage and offering to replace all your smoke detectors, at their cost, to make sure any sensors degraded by the smoke are replaced with brand-new units. They're only too happy to help, since your networked smoke detectors saved them some major money.

This sounds like science-fiction, but every bit of this scenario is possible today—just expensive and difficult to build because of the complex systems-integration necessary.

IOTA is the ideal platform on which to build such a sophisticated, mass-market smoke alarm. Its built-in networking and general-purpose input/output capabilities allows the developer to focus on implementing the best detection algorithms developed by scientists, and not on making computer technology from a half-dozen or more vendors work together reliably.