On Thursday August 14, 2003 at 4:11 PM the lights went out in our Toronto Office (*Black-out 2003*). I thought about how different the life safety world is today compared to just 50 years ago (from flag-drop panels to distributed multiplex transponders). So I wondered, (*when the light went out*) what will future life safety systems 50 years from now be?

At last year’s annual Technical Seminar I presented a paper regarding the specific use of optical fibre for life safety applications. Optical fibre may be considered the “future glue” that will hold the next generation of life safety networks together. However, the future “*where the rubber hits the road*” technology will be driven by advancements in detection or building sensory combined with predictive fire modeling.

As such, I suggest that future life safety systems will make great strides incorporating the collective sensory information with fire modeling, signal processing and interpretation or decision algorithms. This will provide results such as real time predictive fire modeling and threat assessment (I don’t have a crystal ball but I do have a lucid imagination). So lets jump ahead 50 years and look at the following scenario:

**FUTURE SCENARIO**

It is the year 2054. Two executives decide to smoke medicinal tobacco cigars on the 109 floor of the Toronto Science Exchange Building in the corporate wellness lounge. Following a lengthy discussion regarding low impact bio-wear workout socks, the two executives discard their cigars in the ashtray and exit the lounge. The building sensory is aware of the “cigar smoke algorithm” and logs the events in its historical data neural net. (It logs that this is the second time today that Bob and Jim have had biometric access to the lounge and puffed away their troubles.)

A few minutes later the air handling system starts up to fill (and exchange) the room with oxygenated air (so employees will feel better and work longer hours). The forces of the air blow open an antique textbook (“Toronto Real Estate in the Dirty 00’s”). The textbook just happens to be placed next to the ashtray. The embers from the cigar slowly ignite the text.

*Instantly building sensory* is aware of the cigar and paper algorithm and begins the “threat assessment” routine (we’re talking nanoseconds here). Now the incident is reported to the Chief Building Operator and an outcome list or threat assessment is dispatched (e.g. send two guys with an extinguisher in the next 120 seconds or release the expensive suppression agent in the next 480 seconds).
YEAR 2054 CASTING FIRE ALARM NEURAL NETS

Prepared By: David Sylvester

SENSORY DATA COLLECTION PHASE

The building sensory analyzes the following:

- Air velocity, air pressure, air flow, interior and exterior temperature and humidity levels
- Gas monitoring, including oxygen, methane, carbon monoxide, hydrogen sulfide, sulfur dioxide, nitrogen dioxide, hydrogen chloride, hydrogen cyanide, and ammonia levels
- Audibility monitoring via transducers and real time waveform audio analysis including sound pressure level measurements (fire releases specific audible frequencies)
- Illuminometers measure light levels
- Optical sensors provide infrared and ultraviolet analysis
- Biometrics and human image mapping determine personnel quantity and location.

SENSORY PROCESSING PHASE

The entire pool of sensory data travels and weaves through a vast network of optical threads, to a group of organic processors that “learn on the job” through signal cross correlation, poling, pattern dynamics and access of the world historical fire loss data archiving processor. (In other words, the systems have reported what is happening in real time and continue to update the organic processor while comparing the results with the world historical fire loss database.)

THREAT ASSESSMENT

The major part of this approach is the adaptive modeling. In this scenario, adaptive modeling means using the comparison of sensor data with model predictions to determine if the model inputs match the sensor data over the specific time period. Following this analysis, the system will not only tell the Building Operator and the Fire Department where the fire is and alert the occupants (if required), but will determine the optional course or courses of action as follows:

- 30 seconds: a robotic room service attendant dumps water on the ashtray (no loss)
- 120 seconds: Bob and Jim operate a fire extinguisher ($300 extinguisher recharge)
- 480 seconds: full system suppression agent discharge ($30,000 recharge)
- 1440 seconds: if a suppression agent discharge failure ($1,000,000 loss) system evacuates 50,000 people. Court proceedings scheduled for 8 months from today.
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The threat assessment message ends with the following friendly disclaimer:

“The reliability and accuracy of alarm decisions can be improved by increasing the information basis for these decisions. Upgrade your LIFE SAFETY Organic Neural Net today. Remember . . . . . Sensor Rich Environments Save Lives.”

So the likelihood of this type of system structure in the very near future is pretty much not possible. Remember we have Codes, Standards, National Research Council data and the Authority Having Jurisdiction. A fully integrated building sensory combined with decision algorithm based neural net computing is not on the current radar screen. But it is fun to think about the future. In more sensor rich environments it should be possible to use information from a range of building systems to make decisions. The more research that is performed the better the threat assessment.

**Changing our philosophy regarding the benefits of advanced life safety systems will greatly impact future life safety research and development.**

Human beings behave differently during an off-normal situation. The human psychological analysis regarding threat assessment decision algorithms incorporated into life safety systems has really never been explored. A few years back Dr. Guylene Proulx Ph.D. at NRC brought forward this issue: *Is it wise to evacuate a high-rise building?* The “Protect in Place” concept is now gaining some attention. We know that typically there is little response to the sound of a fire alarm. Only when the occupants see smoke is the decision to leave the building made.

The futuristic life safety systems will probably take into account the human psychological responses and as such offer solutions such as *defend in place*, *safe elevators* or *designated rescue areas*. If buildings are to be built over 110 storeys these concerns must be addressed.

I believe that another important issue is related to *psychoacoustics*. The way in which humans perceive sound. The future system will be consciously aware of the audibility and intelligibility of the fire signal. If the human cannot understand the message the psychological analysis is bleak. I believe that the future systems will probably have internal Speech Intelligibility Analyzers (SIA). (Can you imagine someone playing a Bob Dylan tune through a SIA life safety paging system?) The Common Intelligibility Matrix Grid Holographic Readout will look like stringed linguini.

Now that’s something to think about when the lights go out.