Oracle™
Non-Contacting Gas Detector

IDENTIFY: Chemical Warfare Agents and Toxic Gases

Figure 1. The oracle non-contacting gas detector

The Oracle™ is a non-contacting gas identifier with part-per-million sensitivity that requires no consumables, and which is operable over a wide temperature range. Unlike the many point-style gas sensors currently available that detect gases only at a specific location, the Oracle can detect toxic chemicals at distances up to 50 meters away.

FEATURES

- Fast: 1 second
- Line, not point sensor
- Sensitive
- Detection library of over 40 gases
- Requires no consumables

APPLICATION AREAS

- Transit systems and subways
- Critical infrastructure protection
- Sports stadiums and arenas
- Homeland security

It is essentially a long base-line infrared spectrometer that identifies gases by comparing their infrared (IR) signatures with a built-in library of target gas signatures. A beam of infrared light from a remote heat source is intercepted and spectrally analyzed by a base station spectrometer. The unique vibrational and rotational spectra associated with target gases and atmospheric reaction products enable high reliability identification.

Shown above is an example of a subway installation where the Oracle is monitoring the air space over a train platform. Since the Oracle only provides toxic chemical information, it is also designed to support a high-resolution video or thermal camera to fully monitor and document threats. The chemical and visual information collected is relayed to either a remote PC monitoring station, or to an ASAP V multifunctional monitoring system using Ethernet or wireless connectivity. It is possible to monitor or query the device from anywhere in the world if the user knows the unit's IP address. In this way the Oracle can be part of a comprehensive threat detection strategy that includes a full complement of both local and distributed chemical, biological, radiological, and nuclear (CBRN) detectors.

Advantages of this spectral detection method are that it is fast (1 second), sensitive, specific, reliable, and requires no consumables. In contrast to electrochemical detectors, the Oracle has a much lower chance of false readings due to cross-sensitivity, and there are no electrolytes to dry or leak out. In contrast to IMS gas detectors, Oracle's spectral signatures are more unique than IMS signatures and there is a smaller chance of misidentifying the target gas. In addition, there is negligible effect of humidity and there are no scrubber packs to periodically replace.

Perhaps most importantly, as mentioned earlier the Oracle is not a point sensor: it will detect gases that pass anywhere between its remote heat source and the main spectrometer module. This means that the probability of detecting a toxic

gas plume within the local area is significantly improved since the targeted gas does not have to contact either the remote heat source or the instrument. This can also reduce the number of detection devices required for a particular application since area coverage per detector is greatly improved.

At the present time, the built-in library comprises 40 chemical warfare agents (CWAs) and toxic industrial chemicals (TICs).

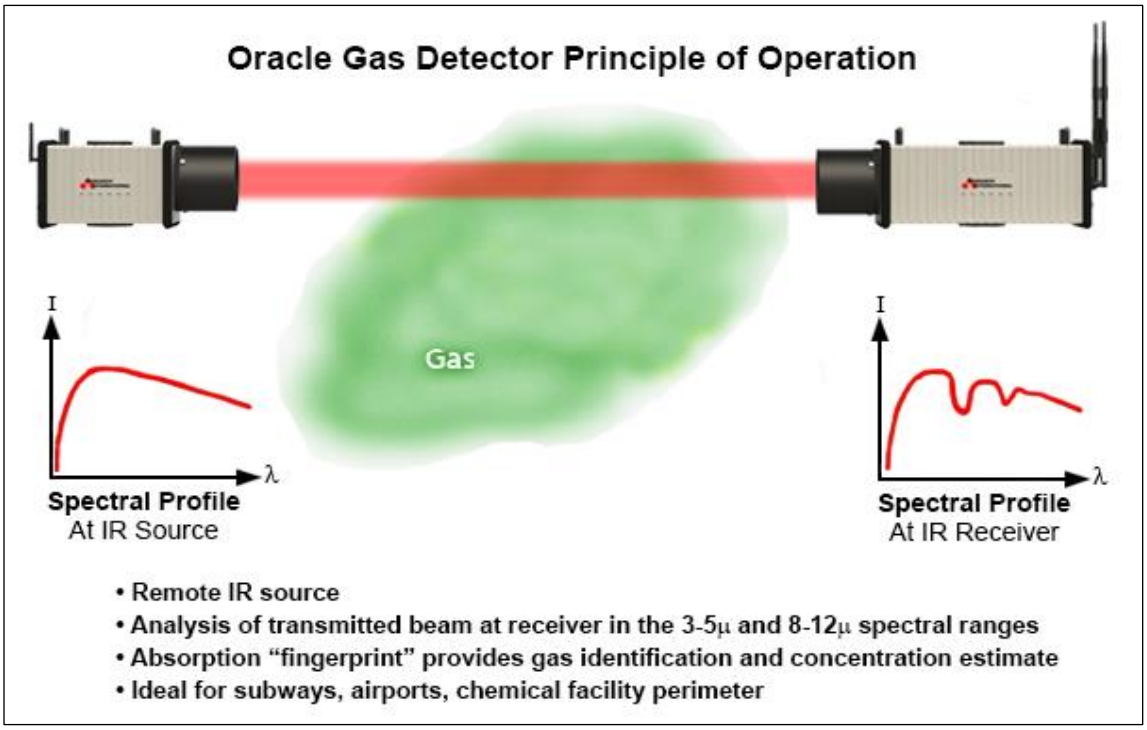

Figure 2. *The Oracle detector identifies gases by their infrared spectral signature.*

Operational Details

The detected infrared signal is divided into 16 separate segments within the 3 to 5 micron and the 8 to 12 micron wavelength ranges. The signal strengths in these wavebands are compared with the library target gas spectral data and background air data using a proprietary mathematical tool that provides a "closeness" of fit to background and target gas signatures. When the fit meets internally preset criteria that the profile is a statistically significant deviation from background and matches a particular gas in the spectral library, a message is sent identifying the gas and its effective concentration.

Recalibration of the instrument is an infrequent requirement and the system can be configured to perform periodic self-tests. During the self-test a polymer film is moved into the beam and the spectral signature of that material is compared to internal library data. If the signature matches, recalibration is not required. Self-test results are also reported via the Ethernet connection. Table 1 below provides general system specifications.

Communications and Software

The Oracle may operate in standalone mode (Figure 3) or may be integrated into an ASAP V multi-threat system or used in conjunction with a Research International Remote Sensor Node. With any of these installation approaches the Oracle's output will typically be connected by a wireless link to an intermediate Monitoring Station (e.g. a vehicle) and optionally to a Headquarters Monitoring and Response Station.

Research International provides a Windows-based software program, ASAP Sentry™, for monitoring its CBRN products such as the Oracle. The ASAP Sentry software monitors all connected sensors and provides a visual situation display. An

Internet connection can be used to access Google Maps, which allows sensor location to be shown on a map and predicted chemical plume paths to be shown based on sensor geophysical location and weather data.

Prediction of toxic cloud movement is based on models developed by the U.S. government for use by emergency responders. These models are used to estimate plume concentrations and to provide advance warning of plume arrival at various downwind locations.

The Internet connection can also be used to relay data to a central headquarters anywhere in the world, or a high power wireless connection may also be used to beam data to a headquarters location.

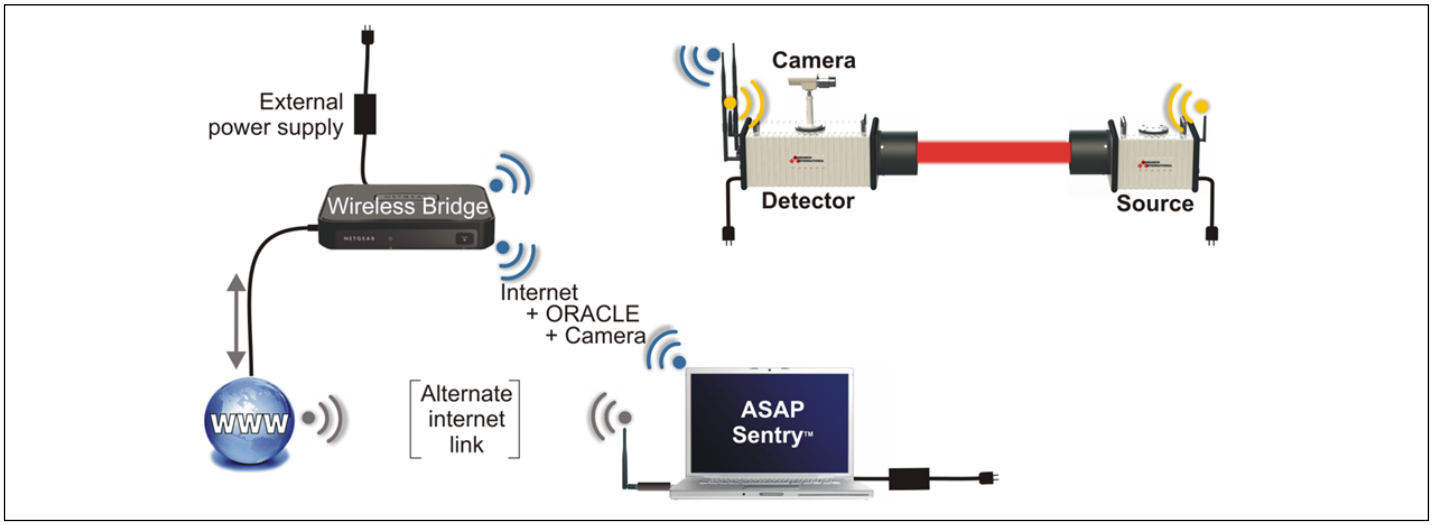

Figure 3. *Example installation showing the Oracle™ and a video camera connected via a wireless bridge to a local monitoring station and to the Internet. Many other configurations are also possible.*

System Specifications	
Feature	**Value**
Sensing method	Infrared absorption, 3-5 micron and 8-12 micron regions
Response time	1 second
Identification time	1-30 seconds
Duty cycle	Continuous
Maintenance	Negligible. Self-monitoring circuits/optics built in; Infrequent cleaning of optical windows may be required
Periodic recalibration	Not required
System Components	Two: IR light source and IR spectrometer modules
Consumables	None
Communication, control	RJ-45 Ethernet, USB type A
Short range IR source (1 to 15m) profile	18cm x 18cm x 27cm / 2.9 kg
Long range IR source (3-50m) profile	35cm x 35cm x 27cm / 4.5 kg
Base Instrument profile	17cm x 19cm x 57cm/ 8.2 kg.
Operating temperature/humidity	0°C to 60°C (Type-I); -30°C to 60°C (Type-E) / 0 to 95% RH.
Power	40-60W @100 - 240 VAC, 50-60 Hz (Detector) 25-50W @ 100 - 240 VAC, 50-60 Hz (Source)
Weight	8.4 kg

Wireless Network Specifications	
Feature	**Value**
Outdoor Line of Sight Range	Up to 2 km for 2.4GHz and 915 MHz models; up to 1.5 km for 868 MHz model using omnidirectional antennas
RF Data Rate	100 Mbps
Frequency	ISM 2.4 GHz standard, 868 MHz and 915 MHz also available
Communication protocol	TCP/IP
Network Topology	Proprietary
Maximum Number of nodes	128
Error Handling	Retries and acknowledgement
Agency Approvals	FCC Part 15.247, Industry Canada

Software Specifications	
Feature	**Value**
Monitoring and display software	ASAP Sentry™
Computer	Pentium class CPU, 1 GHz or better
Display	1024 x 768 pixels, 16-bit color or better
Hard Drive	100 MB for installation; 250 MB or better for data storage
Operating System	Microsoft Windows XP, 7, 8
Memory	1 GB or better
Serial Port	For wireless transceiver connection
Sound Card	For local audible alarms

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