CLOUD CONNECTED SENSOR NETWORKS AND BUILDING REOPENING IN 2021

Tim Quinn | Sr. Product Manager – Cloud Sensor Networks

SGS Galson Laboratories | timothy.quinn@sgs.com | 619.368.1533

FORWARD

01 Covid-19 has disrupted indoor work environments and occupancy levels worldwide.

02 We will examine the science behind airborne transmissions of virus' new mitigating strategies.

03 We shall examine 4 things common in indoor office spaces. By monitoring their levels with new cloud-based sensor technology we can help predict the likelihood of their presence in these spaces and possible transmission to workers.

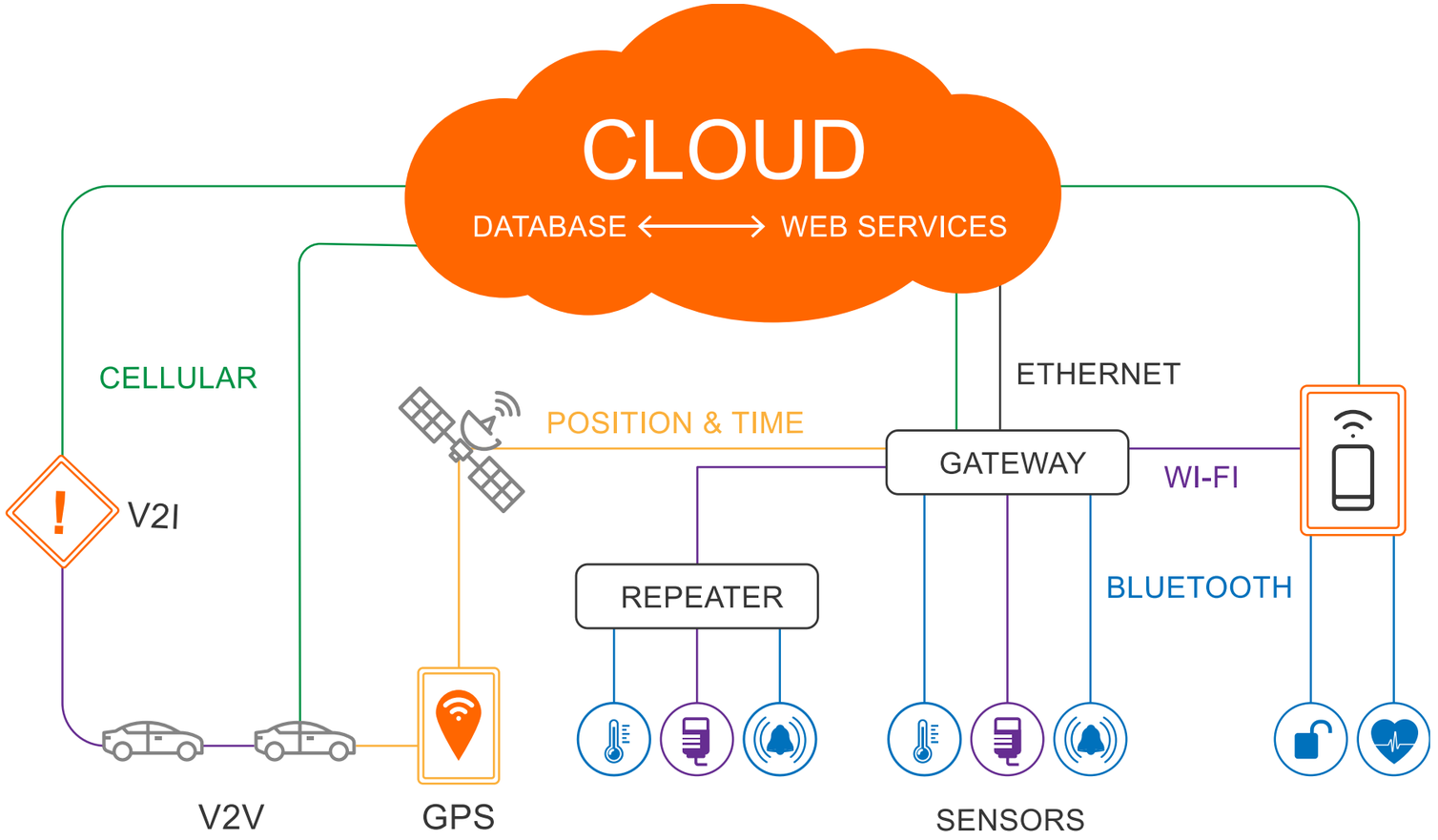
SUMMARY

01 How do we prepare today for the unknown tomorrow in the new world of Covid-19?

02 The public has taken some responsibility by social distancing and the wearing of masks.

03 What responsibility does industry have to provide safe work environments, clean and disinfect buildings and use real time monitoring equipment?

WHAT IS THE CLOUD?



THE SCIENCE

01 Monitoring the air supply flow rate can ensure that adequate ventilation is supplied to the building. The proper distribution and circulation of air will reduce exposure.

02 Continuous measurement of CO2 as a ventilation proxy is important. If properly measured it ensures that supplied air (outdoor and recirculated) is appropriately distributed throughout the building & work-spaces.

03 What responsibility does industry have to provide safe effectiveness in filtering. It is recommended to update to MERV 13 or MERV 16 filters, this in combination with portable filters and continuous cloud-based monitoring of Particles (PM 0.3 and higher) can serve as an indicator that the filtration systems are working efficiently and removing the particles from the air, clean and disinfect buildings and use real time monitoring equipment?

THE SCIENCE

01 Relative Humidity (RH) can impact transmission of infectious diseases through air.

02 The suggested RH range for minimizing airborne transmission is 40% to 60%.

03 Air Ionization is effective in removing particles and viruses from the air (or inactivation of viruses), such techniques have been associated with Ozone (O3) emissions.

04 The use of Ion generators can benefit from continuous monitoring of O3 on your platform and potentially reduce negative health impacts associated with elevated O3 levels (above 0.07 ppm).

AIRBORNE TRANSMISSION

01 Studies have shown that the SARS-CoV-2 virus can be viable in air for up to 3 hours and can stay viable on plastic and stainless-steel surfaces for up to 3 days.

02 Detectable particles of SARS-CoV-2 have been found on ceiling tile, patient toilets, furniture and most things that are commonly found inside workspaces with people.

03 Recent studies has the scientific community suggesting that airborne transmission of COVID-19 must be mitigated.

04 Important; through expiratory activities (breathing, talking, and coughing), infective asymptomatic people release infectious aerosols into the indoor environment.

05 To reduce transmission risk, mitigating strategies and continuous monitoring must be implemented.

MITIGATION EFFORTS AND HOW TO MEASURE THEM

01 DNA Tracer Technology

02 Based on DNA science, technology, and analytics to provide critical information on aerosol mobility and the infectious aerosol exposure risk in buildings.

- 3 ways to effectively measure aerosol mobility in buildings.
    - Tracer Particles
    - Assessment and Methodology/Data Technology
    - Cloud based portal platform to access results

TRACER PARTICLES

Proprietary airborne tracers safely mimic the chemical composition, particle size distribution, and mobility of viral emissions from coughing and sneezing. The solution uses edible, invisible ingredients that are FDA Generally Recognized as Safe (GRAS) and are well below the OSHA- and NIOSH- safe exposure limits.

ASSESSMENT AND METHODOLOGY

Professionals release tracers in designated test areas for dispersion throughout a building and air ducting. Air and surface samples are collected and tested at selected points and time periods.

This process occurs simultaneously as real time monitoring of CO2, O3, PM and RH are being done. This will allow the user to compare the DNA tracer (control aerosol) with the other common trace indicators for evaluation.

Based on assessment results, data analytics visualize exposure risk based on the DNA signal strength in the tracers. Final client reports include heat maps, clearly communicating results and informing real-world safety decisions.

ASSESSMENT AND METHODOLOGY / LIMITATION CONCERNS

1. Communication path to the cloud is essential to the technology, the standard ways are cellular, ethernet, Wifi or satellite.
2. Cloud remote monitoring is a diagnostic/screening device with the ability to alert users when there is an issue present at their site. This is not an expensive handheld piece of equipment with very low sensitivity and specificity capabilities.
3. Powering the technology is essential, for remote and far out of the way projects portable batteries and/or solar technology will have to be employed.
4. Theft, like most things in life this must be considered while monitoring at any site.

MEASUREMENT AND EFFECTIVENESS OF TOOLS

01 Measure how much air in the ventilation system is recirculated, outside or a combination?

02 Is proper air flow getting to all office's, meeting rooms, break rooms and places where people meet?

- Note: continuous measurement of CO2 as a ventilation proxy with a distributed network of remote sensors is extremely important.
- Note: continuous monitoring of PM levels is also very important.
- Note: monitoring O3 & RH levels in the same system is highly encouraged.

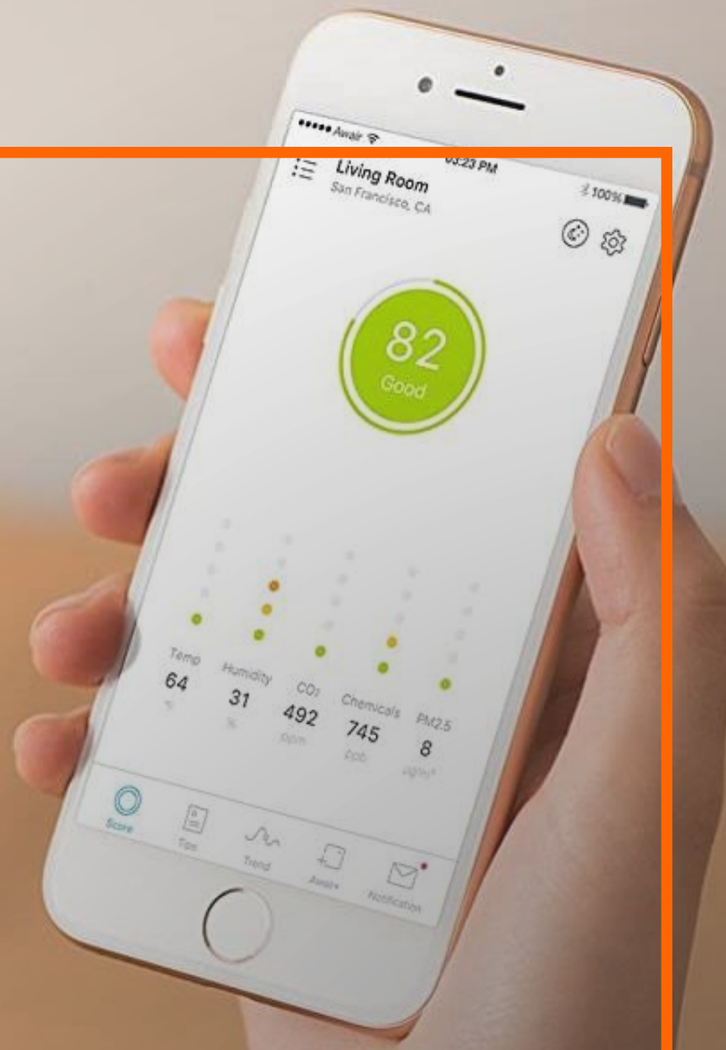
WHAT TECHNOLOGY DEVICES ARE AVAILABLE IN THE MARKET THAT WILL ALLOW YOU REMOTELY MONITOR YOUR SITE…

SGSSMARTSENSE

SGS

Devices that can deliver this type of sensor data

AWAIR



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Devices that can deliver this type of sensor data

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Devices that can deliver this type of sensor data

Devices that can deliver this type of sensor data

DATA PLATFORMS

01 Online portal platform that displays sensor data on any connected phone, tablet or PC via the cloud.

02 Ability to download data instantly on mentioned said devices.

03 Receive monitor alerts via text message and email.

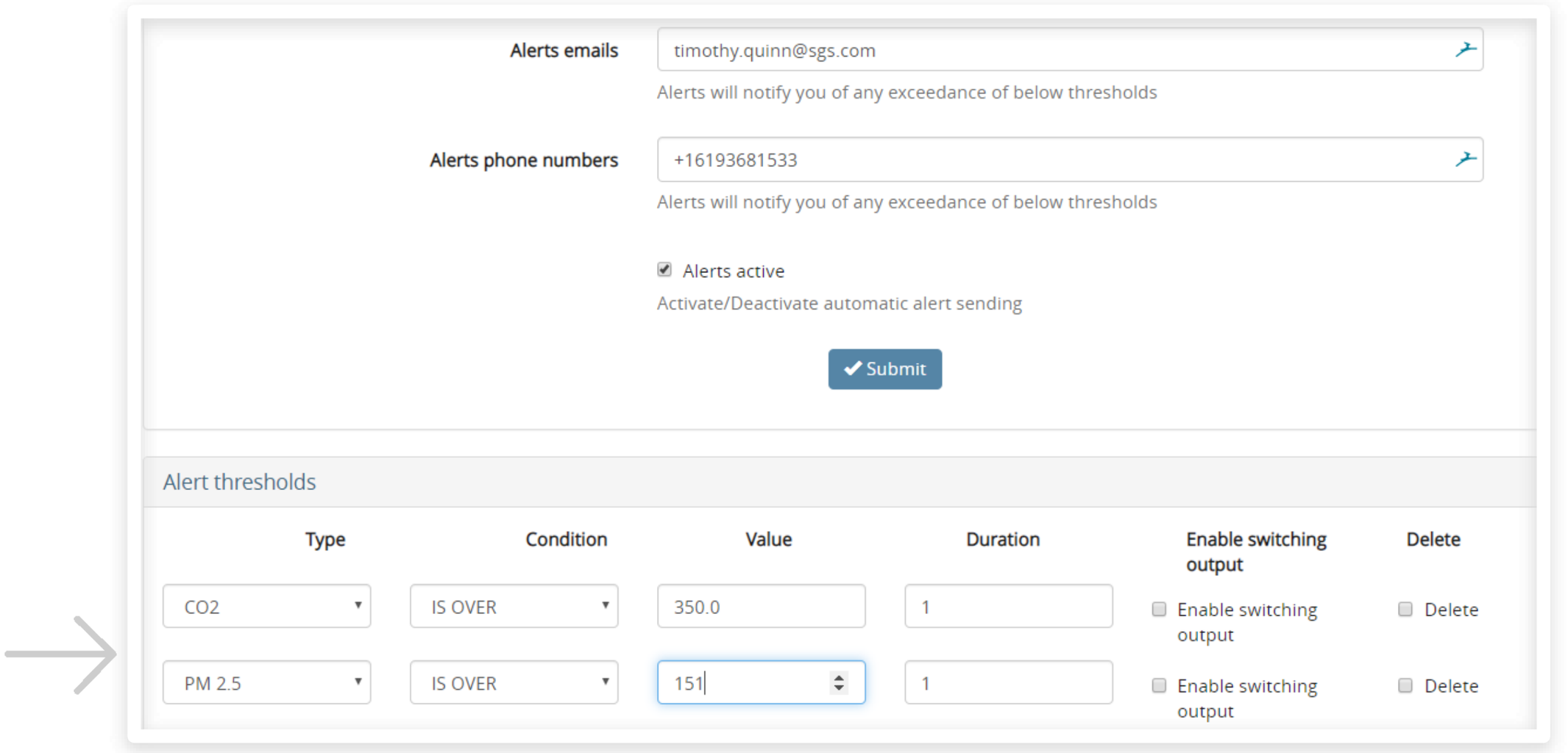
04 Remote calibration adjustments can be achieved remotely via the cloud interactive platform.

ECM - **SGS0001-CL-1.56b**

Home | Time series | Download | Warnings | Reports

Time series

Date	9 minutes ago	an hour ago	an hour ago	an hour ago	an hour ago
Temp (deg F)	81.710	81.728	81.765	81.821	81.931
RH (%)	30.222	30.034	30.006	29.971	29.997
Pressure (mbar)	1003.536	1003.675	1003.655	1003.730	1003.824
CO (ppb)	207.390	176.652	172.880	166.446	173.252
NO2 (ppb)	13.860	6.628	6.557	7.010	7.888
SO2 (ppb)	0.000	0.000	0.000	0.000	0.000
VOC (ppb)	1836.344	1836.344	1836.344	1836.344	1836.344
CO instant (PPB)	207.390362324	191.443383868	191.739052209	192.182967865	152.835915013
NO2 instant (PPB)	13.8600220917	8.63776861528	6.9126136741	5.19691519054	5.2536391084
VOC instant (PPB - Isobutylene)	1836.34440104	1836.34440104	1836.34440104	1836.34440104	1836.34440104


Alerts emails
timothy.quinn@sgs.com
Alerts will notify you of any exceedance of below thresholds
Alerts phone numbers
+16193681533
Alerts will notify you of any exceedance of below thresholds
Alerts active
Activate/Deactivate automatic alert sending
Submit
Alert thresholds
Type
Condition
Value
Duration
Enable switching output
Delete
CO2
IS OVER
350.0
1
Enable switching output
Delete
PM 2.5
IS OVER
151
1
Enable switching output
Delete

01 **Distribution sensing networks** represent a reasonable proxy for the effectiveness of performed interventions.

02 **Previously recommended** air quality levels need to be reevaluated based on the current COVID-19 concerns.

CO_2	PM	RH	O_3
~700	0.3	40-60	0.07
ppm	µm	%	ppm max

CONCLUSION

01 When a mesh sensor network is deployed building managers and system operators can gain real-time values and alerts that can keep them informed about the operation of interventions implemented to mitigate the transmission of COVID-19 throughout the workspace and keep the most vulnerable spaces in the building operating safely.

02 Specifically, they will be able to quickly estimate if more clean air needs to be distributed to the site, is the air equally distributed or if there are potential hot spots of stagnant air.

03 Real-time monitoring creates a framework to provide the assurance of a healthy indoor environment and the confidence people need to resume their daily lives.

Sources

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Dr. Pantelic's research has focused on healthy and energy efficient buildings, including the investigation of airborne modes of influenza transmission by quantifying source strength and investigating capabilities of ventilation systems to mitigate airborne transmission. He is a member of ASHRAE's Environmental Health Committee responsible for putting together ASHRAE's Position Document on Infectious Aerosols.

By Jovan Pantelic, Ph.D., Assistant Professional Researcher at University of California Berkeley Oratories

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WHEN YOU NEED TO BE SURE