



AVIATION



MARITIME



RAIL



ROAD

# DRUG DETECTION CAPABILITIES EVOLVE TO COUNTER SMUGGLERS' SHIFTING TACTICS

By James T. McKenna

New drugs, routes and tricks spur operators and vendors toward smarter, faster, safer devices.

**A**ir, ground, maritime and rail operators as well as enforcement officials face rapid changes in drug smugglers' tactics, while detection vendors that support them are refining technology — including artificial intelligence (AI) — for products to help foil the crooks.

Tougher enforcement efforts around the world, greater supplies and higher prices have spurred smugglers to decentralize their organizations, outsource methods and diversify routes for moving narcotics, such as "designing" more potent drugs that can be shipped in smaller, less detectable parcels.

"The traditional smuggling routes and methods have not changed significantly," said Jeff Sweetin, a retired U.S. Drug

Enforcement Administration (DEA) special agent and counter-narcotics consultant for Thermo Fisher Scientific. However, he and his colleagues have seen "several methods of countering added border enforcement. While these trends have

not yet amounted to a complete shift in cartel tactics, enforcement personnel are reporting them more frequently."

Thermo Fisher in May unveiled the TruNarc Delta and Tau upgrades of its handheld narcotics analyzer, which uses Raman spectroscopy for rapid, non-contact identification of more than 1,200 substances. The Delta is aimed at U.S. customers, the Tau for others worldwide.

Vendors look to build on their portfolios of proven spectroscopic- and radiation-based detectors by increasing the speed, range and adaptability of results for field investigators, in part with AI-based tools. For instance, they are linking detector results with cloud-computing libraries of spectroscopic signatures that can detect specific drug ingredients from tens of



*In May, Thermo Fisher introduced TruNarc Delta and Tau upgrades of its handheld narcotics analyzer, shown here. Thermo Fisher image.*

thousands of possibilities within seconds and can learn new signatures without the need to add them manually.

### SMUGGLERS' NEW TACTICS VARY

Many have foregone top-to-bottom supply chain control and outsourced shipping phases, processing stages and money-laundering. Police have seized single bulk shipments that contained drugs labelled for competing gangs and destined for a multitude of customers — an Amazon-like model for saving money and speeding delivery. Cryptocurrency is replacing cash to evade scrutiny as payments change hands.

More roundabout routes are adopted — say by ship from Latin America to West Africa on to Scandinavia and Russia, then by truck to inland points — to break patterns that make police suspicious. Some smugglers have moved upstream products like coca paste from Latin American cocaine labs to final processing closer to consumers in Europe and fentanyl powder to pill pressers in the U.S. Others are experimenting with liquifying drugs to hide them in fuel tanks, seat cushions and insulation, Sweetin said. Smugglers are hiding drugs in auto batteries and masking them with chemicals to throw off detectors.



Andreas Kaufmann, Smiths Detection

Some are developing submersibles to sail tons of drugs between continents, even as far as Europe and Australia. There are reportedly smugglers hiring professional divers to attach drug shipments outside cargo ship hulls then fly to the destination to remove them.

"Illicit trafficking networks have evolved

into increasingly industrialized criminal economies that exploit weaknesses in border security, customs controls and screening technologies," Andreas Kaufmann, aviation marketing manager for Smiths Detection, said. "This shift is creating distinct smuggling patterns across all major modes of transportation."

He added, "While the methods differ across transport modes, they share a common thread: growing sophistication that poses significant new challenges for global border security."



The Smiths SDX 10080 SCT is a modular hold-baggage and air cargo screening system. Smiths image.

Smiths in October released the SDX 10080 SCT, the latest product in the global EDS line. It is a modular hold-baggage and air cargo screening system that combines advanced dual-energy computed tomography (CT) with an optional high-resolution dual-view line scanner that Smiths said "offers exceptional modularity, reliability and efficiency."

Among its other products is the HCVM XL mobile scanner, which provides high-energy X-ray imaging for non-intrusive inspection of cargo to enable customs officers to rapidly and accurately identify illicit goods without disrupting the flow of trade. At the turn of the year, Smiths installed four with Trinidad & Tobago's customs agency at Port of Spain and the Port of Point Lisas.

Efforts to counter new drugs and tactics are bolstered by greater counter-drug funding, particularly in the U.S. and Europe.

That increased funding "will institutionalize demand" in the narcotics-detection and related markets and support growth in them, said the CEO and co-founder of 908Devices, Kevin J. Knopp.



Kevin J. Knopp, 908Devices



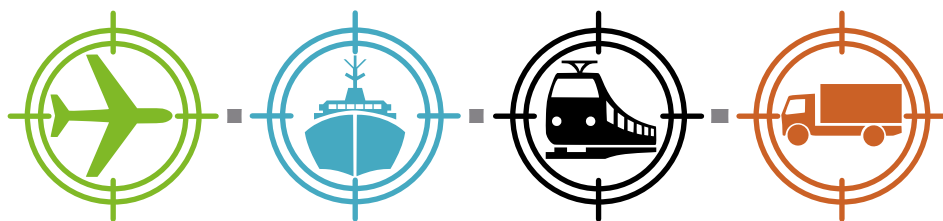
Recently, the U.S. Coast Guard bought 23 of 908Devices' MX908 handheld mass spectrometers for narcotics interdiction efforts. 908Devices image.

"This is setting up not only in the United States, but globally." One recent report forecasts the global market for narcotics detection equipment to grow from \$3.76 billion last year to \$5.05 billion by 2029, maintaining a compound annual growth rate of more than six percent.

Additional funding in the U.S. includes this year's budget reconciliation law and last year's DETECT Fentanyl and Xylazine Act, which should boost research and development of means to detect those drugs.

In October, 908Devices said the U.S. Coast Guard bought 23 of its MX908 handheld mass spectrometers for narcotics interdiction efforts and hazardous threat detection. The service now fields more than 35 of the MX908, which combines thermal desorption, chemical ionization and high-pressure mass spectrometry to detect hundreds of chemical substances at trace levels, including fentanyl, explosives and other threats. The MX908 can identify over 2,000 fentanyl analogs, the company said.

In Europe, funding boosts stem from increased defense funding by NATO



members and others. Customers are showing greater interest in detection capabilities elsewhere in the world, too. For instance, Bruker Corp. saw a 30 percent year-over-year increase in orders for its airport-deployed detectors, related consumables and services through October.

"There are significant improvements outside of the U.S.," Bruker president and CEO Frank Laukien said, including in Europe, Japan, China, South Korea and the Middle East. He added that the company's Applied Markets segment is "growing very nicely" with "a pretty broad international distribution."



*The Road Runner is a 7.5-pound, handheld device to detect narcotics and explosives vapors and particles made by Bruker. Bruker image.*

Bruker's products include the Road Runner, a 7.5-pound, handheld device to detect narcotics and explosives vapors and particles. It uses ion mobility spectrometry (IMS) with a compressed high-intensity radiated pulse (CHIRP) algorithm and guides its user step by step via a touchscreen display. Another product is the Mobile-IR II, a portable, battery-powered Fourier Transform Infrared (FT-IR) spectrometer that the company said delivers laboratory-level spectral performance with an intuitive workflow set-up for IDing illegal substances.

The greater funding also stems from Europe's efforts to combat a spike in cocaine use there (which now may exceed that in the U.S.). "Belgium, the Netherlands and Spain have reported the highest volumes of seizures, reflecting their importance as entry points for cocaine trafficked to Europe," said a March report by the U.S. State Department's

Bureau for International Narcotics and Law Enforcement. That has increased cross-border criminal activity, "with European organized crime groups expanding their footprint in Mexico and South America and vice versa."

Facing such crime, geopolitical conflicts and terrorism, "governments worldwide are investing heavily in advanced systems to enhance detection, deterrence, and response capabilities," said Ajay Mehra, president, CEO and director of OSI Systems. He added customers are addressing the growing threats by increasing their focus on technology innovation and shifting policy priorities, supported by targeted funding.

OSI Systems designs and manufactures specialized electronic systems and components for critical applications, serving customers in 170 countries. Its Rapiscan Systems unit offers a wide range of scanners and inspection systems for aviation security, cargo, and vehicles. These include the MobileTrace simultaneous dual-mode narcotics/explosives detector, which uses the company's patented Ion Trap Mobility Spectrometry. It has been deployed at airports, border crossings, military bases and other critical global checkpoints.

In September, Rapiscan launched its Orion Road 930DX-V mobile X-ray system. With a van-size footprint, the system is designed to detect narcotics, concealed weapons, explosives and other contraband for customs and border protection, critical infrastructure fortification, law enforcement and other missions.

### THE THREAT OF DRUGS IS BROAD AND CHANGING

Fentanyl — the synthetic drug and most potent narcotic used by doctors (50-100 times more potent than morphine) — is highly addictive. Fentanyl analogs are synthetic opioids generally engineered to be more potent; carfentanil is 100 times more so. More potent ones can be small enough for hundreds of lethal doses in envelopes to be mailed — still a major smuggling method — or hidden on the body.



*Heather Colby, Apstec Systems*

"Detecting narcotics concealed on the body under clothing is incredibly challenging," said Heather Colby, who manages sales channels and alliances for Apstec Systems. "Technology has struggled to deliver effective solutions, and large-scale manual operations are intrusive, costly and generally impractical."



*Detecting narcotics hidden on the body has long been a complex challenge for customs authorities, with traditional methods proving costly, intrusive and inefficient. Apstec says its HSS Falcon Select changes this by offering fast, non-intrusive, real-time screening for large numbers of passengers and their belongings. The solution identifies drugs concealed on the body while respecting privacy and ensuring a smooth border crossing experience. Apstec image.*

Apstec develops high-throughput screening technology to detect narcotics, explosives and weapons. It said its products can screen large numbers of people and identify diverse threats while ensuring seamless, non-intrusive processing. It described its flagship product, HSS Falcon, as a powerful, AI-driven solution that provides comprehensive detection on people and in body-worn/hand-carried bags.





Dr. JihFen Lei, Teledyne FLIR Defense

The first fentanyl analogs emerged in 2019. Last year, there were 688 reported variants, according to the United Nations. Today there are nearly 1,400.

"Drugs like fentanyl remain a deadly threat and drain on our country, consuming lives and resources across America," said Dr. JihFen Lei, president of Teledyne

FLIR Defense. In October, that company got an order from U.S. Customs and Border Protection (CBP) for 15 of its Griffin G510x portable chemical detectors, which are specifically designed to analyze and identify explosives and narcotics (such as fentanyl and its analogs) within five minutes. The instruments are to be fielded across the U.S. to help CBP identify the most challenging drug



Teledyne FLIR Defense says its Griffin G510x portable chemical detector is specifically designed to analyze and identify explosives and narcotics (such as fentanyl and its analogs) within five minutes. Teledyne FLIR Defense image.

samples, such as those containing fentanyl in extremely low concentrations mixed with other compounds.

Those analogs are among a diverse group of lab-made compounds called novel psychoactive substances (NPSs). Most are created to mimic prescription or illicit drugs' effects and to evade controlled-substances laws by slightly modifying an existing drug. With unfamiliar chemical signatures, these drugs can evade detectors until those signatures are added to devices' libraries. Thermo Fisher's Sweetin recalled that when traffickers began mixing fentanyl with xylazine, a pet sedative, detectors didn't recognize it because its signature wasn't in their libraries. Once it was added, investigators looked back and found it had been used widely.

"No matter how good the devices are," he said, "if we don't know to add an



## The Future of Security Screening

AI-driven, high-throughput screening technology to detect explosives, weapons and narcotics.

Advanced  
Technology

Powerful  
Capabilities

Premium  
Experience

### HSS Falcon Select

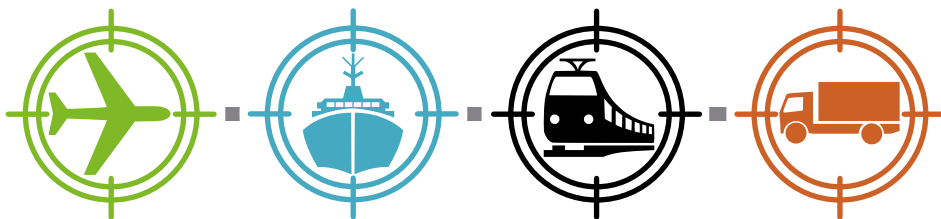
- Innovative Technology to Detect and Deter Body-Worn Drugs
- Awarded EU Horizon 2020 PEN-CP Innovation Project

### HSS Falcon and Falcon Plus

- High-throughput screening to detect non-metallic and metallic threats
- Detektor International 2025 Award Winner for Best Detection Solution



[apstecsystems.com](https://apstecsystems.com)



The N2300 Fentanyl Trace Detector can be added to any Autoclear X-ray baggage scanner, the company says. Autoclear image.

emerging drug to a device library, our customers can't identify them."

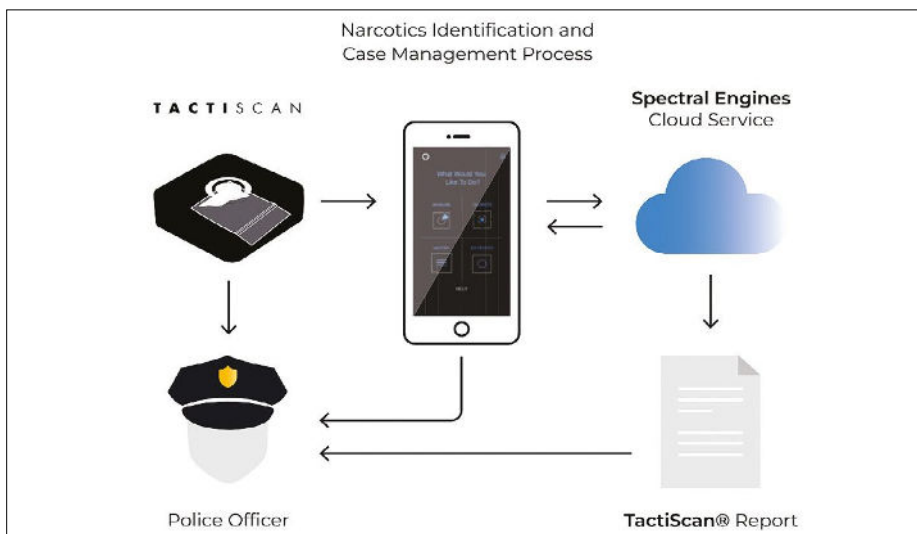
That need is one reason vendors are adding AI. In February Leidos said it was partnering the AI software company SeeTrue to improve the efficiency of airport security and customs screenings through AI-enabled algorithms for detecting prohibited items. Smiths has partnered with BigBear.ai, Deepnoid and other AI experts to hone its systems threat-detection capabilities.

The threat-detection company Autoclear offers proprietary AI Threat Assist software with its X-ray security screening systems. Its N2300 Fentanyl Trace Detector can be added to any Autoclear X-ray baggage scanner.

TactiScan's pocket-sized narcotics scanners use cloud AI that taps advanced deep learning algorithms together with commonly used reference standards to analyze readings, identify substances and update its signature library. This reduces the risk that TactiScan will be confused by cutting agents and adulteration.

"AI and advanced analytics are transforming the detection landscape," Smiths' Kaufmann said. "These tools will be critical in busy logistics hubs, where authorities must assess large volumes with limited resources.

Old drugs still prevail. Around the world, the stimulants methamphetamine and amphetamine dominate the use of and trafficking in synthetic drugs, according to the U.N., and cocaine production and use is setting records year after year. The U.N. estimated worldwide illegal cocaine production in 2023 at 3,708 tons, 34.5 percent more than 2022 and 327 percent more than 2014. (Heroin production is dropping.)




Tactiscan enables officers to identify unknown substances through plastic bags without contamination and ensures the occupational safety of officers when identifying drugs. The entire identification process is digitally documented.

Smugglers have long used aircraft, trucks and ships. They also are expanding their use of trains, which have been used mostly to traffic people. In one example, officials in India's Kerala state said trains are now a prime narcotics smuggling method. In 2024, they said 1,232 pounds were seized on trains in the state. By this March, police had seized 928 pounds. Those totals were for only one of India's 68 rail divisions.

That development is just one indication that drug smugglers are always seeking

new markets and new ways of getting their products to them.

"Looking ahead, traffickers will remain exceptionally agile, exploiting distinct vulnerabilities across various sectors of international trade and travel," Smiths' Kaufmann said. "Global drug trafficking today is not constrained by geography, mode of transport, or concealment method. Countering this evolution will require next-generation detection capabilities." 

# X-RAY DIFFRACTION COMES INTO PLAY

**R**ecently, TSI conducted a webinar on X-ray diffraction technology. This scientific technique has been around for years and has been used in laboratories and industrial applications. It can be used to analyze materials at a molecular level. It represents a powerful, relatively untapped innovation. Unlike conventional X-ray imaging, which shows shapes and densities of items, X-ray diffraction can identify substances by their molecular fingerprints.

This makes it especially valuable for reducing false alarms, improving detection accuracy and providing operators with clear, more reliable information. In regulatory environments, like aviation security, X-ray diffraction is only beginning to gain traction.

It's complementing established technologies such as computed tomography and traditional X-ray.

Our webinar panelists included Anne-Marie Pellerin, founder and managing partner of LAM LHA, a paraspace consultancy specializing in aviation security, regulatory compliance and innovation; and Joachim Petry business development and product manager for air cargo at Smith's Detection. He leads their efforts to shape the future of air cargo security.

**TSI: X-ray diffraction has been used in labs, scientific labs, for years. Please give us an overview of this technology, and what has changed to make it so interesting and viable for environments like high-throughput real-time security screening.**

**Joachim Petry:** Yes, indeed, X-ray diffraction is a very established technology when it comes to knowing more about the composition of any material. Diffraction is known for being very material-specific and this is why it's been widely used in a laboratory environment, for example. It lacked the speed required in screening technology solutions. Only with the latest generation we recently introduced, is it possible to do this analysis in real time to make it more beneficial for applications in security screening, but also in ports and border screening applications, or wherever contraband shall be detected. The major game changer is that we can do this analysis at a constant speed, and that was a capability which was not known before using X-ray diffraction.

**TSI: Can you also explain how X-ray diffraction differs from computed tomography and conventional X-ray?**

**Petry:** The major difference is that X-ray diffraction does not create an X-ray image, per se. In the case of computed tomography, it is based on a 3D image and related density. With conventional X-ray devices, we are looking at 2D images. What's different with X-ray diffraction is that it's not related to the image, or the density of material, but rather to the molecular structure of substances. So, it gives much more precise information on the material. It creates a spectrum, as you may know it, from trace detection devices. But the differentiator of X-ray diffraction is that it can create this spectrum on the fly while the object passes the diffraction X-ray beam. So that's the key difference to other X-ray-based technologies.

**TSI: X-ray diffraction technology has the ability to detect materials down to its molecular fingerprint. Can you explain a little bit about that, why it matters, and how it can assist?**

**Petry:** Having the detailed information about the molecular structure gives us much more specific information on the material scanned. So, with conventional technologies like transmission X-ray or computed tomography, even, we only have information about the density of materials or the form and shape of objects. Maybe we will get a rough idea about the materials, but what's really different with X-ray diffraction is this molecular information about the molecular structure. What it really does is, it uses the scattered information from the object scans, and it creates a spectrum, which is unique to every material. This spectrum is related to the molecular structure of the material, so it's very precise when it comes to the definition of the material scan. That's the key differentiator, and that helps us by being more material-specific than other X-ray-based technologies.

**TSI: Can you explain how national authorities are currently integrating X-ray diffraction into port and security frameworks?**

**Anne Marie Pellerin:** Ports and border authorities, as well as aviation authorities, are faced with the challenge that they have to screen more and more stuff every year, more and more people, more and more things. As you look to scan or screen

more and more things, you have to be faster. And as you get faster in running your technology, with traditional types of technologies, what's going to happen is you're going to have more alarms. Those more alarms require more people to open and to resolve those alarms. So, in the kind of border customs domain, for example, you might have a package that has bulk baby powder, and you might think it's cocaine, so that's going to go into the alarm bucket. Well, once you have an alarm, X-ray diffraction is incredibly good, just making this very practical, at resolving that alarm in an automated fashion. It will tell you, this is not cocaine. This is baby power, it's fine, and it'll keep the package moving.

**TSI: Can you touch on how it's being used in the aviation community as well?**

**Pellerin:** Customs authorities, as well as aviation authorities for explosives and other types of materials, are very interested in that, because as we move to an environment where things are more and more automated, and as we increase our detection performance, the only way we're going to get to fully automated system is with better sensors and the ability to resolve alarms in an automated way from an orthogonal and better technology. And so, X-ray diffraction holds a lot of promise in that space, which is why border customs authorities and aviation professionals, are very, very interested in it. Now, with regulatory frameworks and putting this in place, aviation is much more highly regulated than ports and borders in terms of the standards the equipment has to meet. Both are very interested in detection performance, but the systems are different in terms of how they certify equipment. Both parties are really doing a lot of operational testing of the technology right now. So, it's not widely deployed, but it's very much seen by national authorities as a complement to existing CT and traditional X-ray systems and other methods of screening.

To listen to the entire webinar on demand, go to <https://tsi-mag.com/webinars/>. 