

Photo: Digital Shield 2.0, Estonia, March 2026 · U.S. Army, Maj. Alexander Watkins · Public domain · Wikimedia Commons

OSINT · TECHNICAL ASSESSMENT

THE LAYERED PICTURE

Parts 1 and 2 of Sound and Sight showed that sensors work better together. In the field, the hard part is less the algorithm than the plumbing: getting a radar from one maker, a microphone array from another and an interceptor from a third to share one picture. This final part looks at the open standard built for that job, how it has been tested and used, and what it means for the acoustic layer.

REPORT DETAILS

PUBLISHED	SUBJECT	SOURCE BASE
November 2026	Open standards and networks that link counter-drone sensors, fusion and effectors	UK Dstl SAPIENT guidance and case study, NATO interoperability test reporting, Estonian Defence Forces, U.S. Army, airport detection review (2025)
METHOD	**VERDICT**	**CONFIDENCE**
Trace how sensors are connected in tests, exercises and one operation; place the acoustic layer in that chain	Ask whether a sensor speaks an open standard and what it reports, not only how well it detects	Moderate
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BOTTOM LINE

The weakest link in counter-drone defence is often the connection between sensors rather than any one sensor. A layered defence mixes radar, radio detectors, cameras and acoustic sensors with jammers, interceptor drones and guns, usually from different makers. A 2025 review of airport drone detection found that in field tests sensor data was often simply overlaid on a screen without true fusion, so one sensor ended up dominating. The answer gaining ground is an open message standard that every component speaks. The leading one is SAPIENT, developed by the UK's Defence Science and Technology Laboratory and published free as BSI Flex 335. The UK Ministry of Defence has adopted it for counter-drone technology, and NATO is adopting it as the basis of a standard recommendation. At a 2021 NATO test it linked 17 sensor modules from different vendors to seven decision modules, and in June 2025 it coordinated the systems that intercepted drones at the NATO summit in The Hague. An acoustic layer is worth most when its detections arrive, in a common format, at the node that fuses them.

70+

SENSOR-TO-COMMAND LINKS IN ONE NATO TEST

◆ NOVEMBER 2021, OVER SAPIENT

17⟶7

SENSOR MODULES FROM DIFFERENT VENDORS TO DECISION MODULES

◆ SOME PLUG-AND-PLAY

June 2025

DRONES INTERCEPTED AT THE NATO SUMMIT

◆ SYSTEMS COORDINATED THROUGH SAPIENT

1 of 25

AIRPORT DETECTION STUDIES THAT USED SOUND ALONE

◆ 2025 SYSTEMATIC REVIEW

SERIES · SOUND AND SIGHT · PART 3 OF 3

PART 1	The Ear Points the Eye	✓ READ
PART 2	Three Senses Are Better Than One	
PART 3	The Layered Picture	YOU ARE HERE

KEY QUESTIONS

What is SAPIENT in counter-drone defence?

SAPIENT is an open standard and architecture, developed by the UK Ministry of Defence's Defence Science and Technology Laboratory (Dstl), for networking sensors and effectors from different makers. It is published free as BSI Flex 335 (first version July 2023, version 2.0 March 2024), is the UK MOD's standard for counter-drone technology, and is being adopted by NATO as the basis of a standard recommendation for counter-drone systems.

Why do counter-drone systems need a common standard?

Because no single sensor is enough, and a defence typically mixes radar, radio detectors, cameras, acoustic sensors and several kinds of effector from different suppliers. Without a common message format each pairing needs custom integration, and in practice data is often just overlaid on a screen rather than fused. At a 2021 NATO test, SAPIENT linked 17 sensor modules from different vendors to seven decision modules, some with zero integration time.

Where do acoustic sensors fit in a layered counter-drone defence?

As a passive, wide-area early layer: they hear in every direction, emit nothing, need no line of sight to a radio link and are cheap enough to deploy densely. Their detections cue cameras and other sensors and reach operators through the same network. A 2025 review of airport drone detection recommends cameras with infrared plus acoustic sensors as a cost-effective initial layer for perimeters and lower budgets.

THE RULER — THE WHOLE ARGUMENT

Who does what in a layered defence

A layered defence divides the work. Sound has a part in several layers, not just one.

LAYER — JOB	TYPICAL COMPONENTS	WHERE SOUND HELPS
DETECT SOMETHING IS THERE	Radar, radio detectors, acoustic arrays	Wide-area, passive; hears radio-silent drones
CUE AND CONFIRM WHAT IS IT, EXACTLY WHERE	Cameras, EO/IR, lidar	Points the cameras (Part 1)
FUSE AND TRACK ONE PICTURE	Fusion and decision nodes	Adds an independent signature (Part 2)
DECIDE MAY WE ACT	Operator, command and control	Corroboration before engaging

LAYER — JOB	TYPICAL COMPONENTS	WHERE SOUND HELPS
DEFEAT ACT NEW	Jammers, interceptor drones, guns, missiles	Keeps tracking when jamming fails
CONNECT THE COMMON LANGUAGE	Open standards such as SAPIENT	Lets any maker's sensor join the network
DETECT AND CUE DROSONIC'S PLACE	Passive acoustic nodes classifying on board	Hears radio-silent drones and hands a cue to the network

OUR REPORTS ON JAMMING AND ON FIBRE-OPTIC DRONES EXPLAIN WHY SOUND MATTERS MOST WHEN RADIO-BASED DEFEAT FAILS

COMPONENTS FROM THE SOURCES CITED BELOW

FIELD 01 — THE INTEGRATION PROBLEM

Overlay is not fusion

A 2025 systematic review of drone detection at airports, published in the journal *Array*, is blunt about what goes wrong outside the laboratory. Multi-sensor systems face practical problems of calibration, synchronisation and fusion; "the simple graphical overlay of data from different sensors, without true fusion, was a limitation observed in field tests, where often a single sensor ended up dominating the detection process." Effective fusion needs data aligned in time and in a common frame of reference, or machine learning will learn false correlations. Array↗

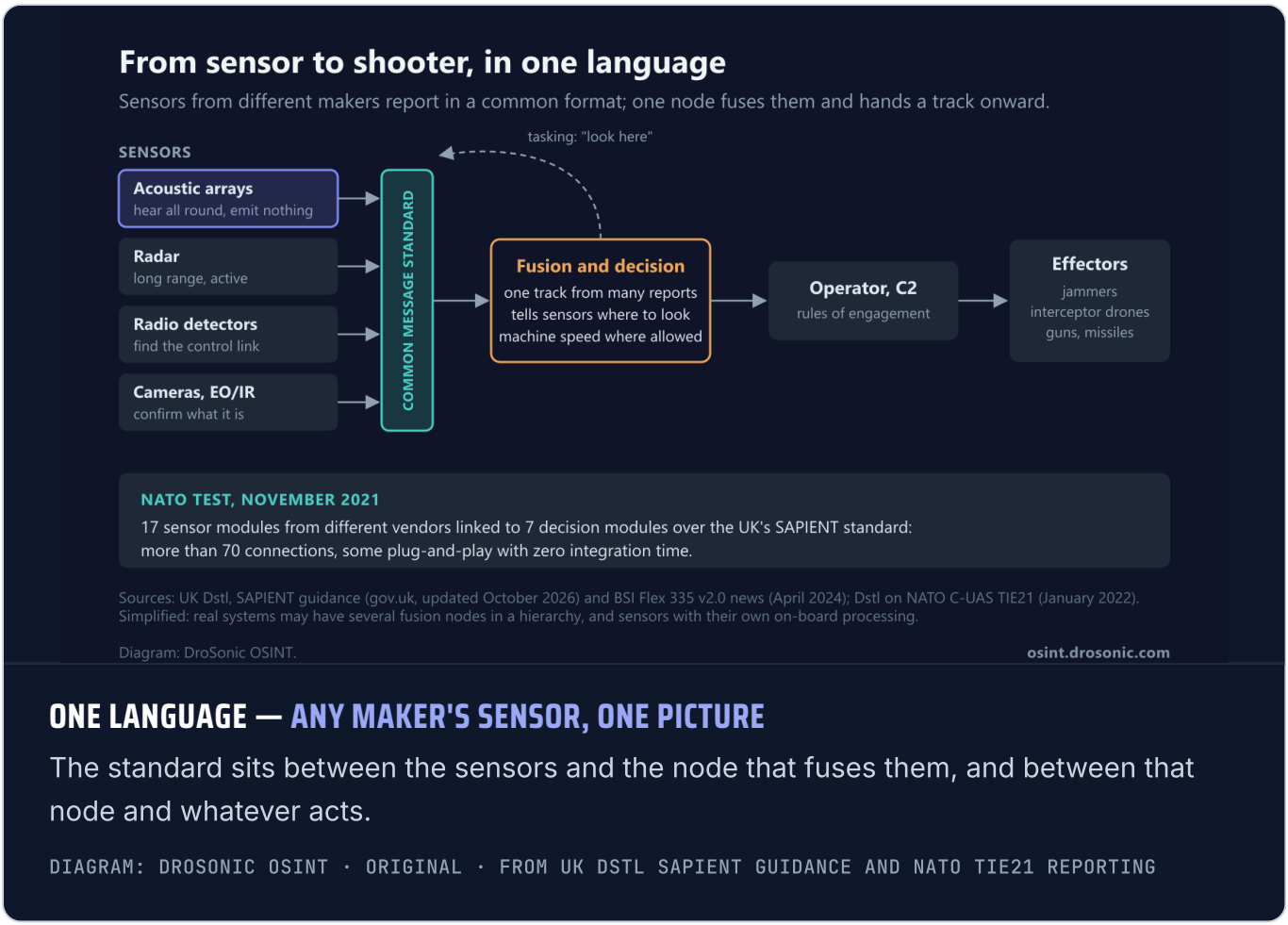
The review's advice to airport operators is layered too. For the most critical zones it favours radar and radio detection for range and reliability; for perimeters or smaller budgets, cameras with infrared for round-the-clock use plus acoustic sensors as "a cost-effective initial layer of defense", with fusion the remaining practical challenge. It also found how thin the research base is: of 25 airport studies reviewed, one used sound alone and two combined sensors. Array↗ Our report Closed on a Sighting shows what the gap costs airports.

FIELD 02 — A COMMON LANGUAGE

SAPIENT and BSI Flex 335

SAPIENT, short for Sensing for Asset Protection with Integrated Electronic Networked Technology, is in the UK government's words "an open standard and open architecture for networking multiple advanced sensors", using artificial intelligence at the edge and intelligent fusion to manage sensors and effectors where "rapid sensing, autonomous decision making and machine-speed effect are required". The UK Ministry of Defence has adopted it as its standard for counter-drone technology, and its open-source test harness and middleware were released on GitHub in September 2024. GOV.UK↗

The interface is published free by the British Standards Institution as BSI Flex 335. The first version appeared in July 2023; version 2.0, published on 31 March 2024, added a hierarchy of networked nodes to match military command structures, extended the standard to sensors and effectors on moving platforms, and let sensors from any domain, from chemical detectors to underwater and space sensors, define their own categories and have their data fused. GOV.UK↗



ONE LANGUAGE — ANY MAKER'S SENSOR, ONE PICTURE

The standard sits between the sensors and the node that fuses them, and between that node and whatever acts.

DIAGRAM: DROSONIC OSINT · ORIGINAL · FROM UK DSTL SAPIENT GUIDANCE AND NATO TIE21 REPORTING

FIELD 03 — TESTED, THEN USED

From a NATO trial to a NATO summit

NATO runs a series of counter-drone Technical Interoperability Exercises. At the November 2021 edition in the Netherlands, SAPIENT's interface was tested as a candidate standard: according to Dstl, 17 autonomous sensor modules from different vendors connected to seven decision-making modules, more than 70 connections between counter-drone and command systems were made, and "in some cases this connection was completely plug-and-play, achieving zero-second integration time." ADS Group↗

One of the first publicised operational uses followed. At the NATO summit in The Hague on 24–25 June 2025, according to Dstl, "numerous unauthorised drones were neutralised" by SAPIENT-compliant technology that coordinated different defence systems and enabled Dutch military forces to intercept them. GOV.UK↗ The UK

government now says NATO will adopt SAPIENT as the basis of a standard recommendation (STANREC) for counter-drone systems, following evaluations in that exercise series. GOV.UK↗

> **The question for any sensor is no longer only how well it detects. It is whether its detections arrive where they can be used.**

FIELD 04 — ALLIES WIRING IT UP

Estonia's shared picture

NATO's eastern members are building the same plumbing at speed, partly in response to the base and airport incursions described in Watching the Bases. At Digital Shield 2.0 in Rutja, Estonia, on 5 March 2026, Estonian and allied sensors and command centres were linked into one real-time data network; sensor data passed through command centres to units with CV90 armoured vehicles and Piorun missiles, and new interceptor drones were tested. The Estonian Defence Forces compared the data exchange to the Delta system used in Ukraine. "The goal is to integrate all counter-drone defence systems arriving in the near future," said Maj. Tõnis Pärn of the Estonian Air Force's Air Surveillance Wing. Estonian Defence Forces↗



DIGITAL SHIELD 1.0 — A RADAR FEEDS THE NETWORK

An Estonian Giraffe radar during the first exercise, November 2025, which tested sharing data from active and passive sensors with the Estonian Command and Reporting Center.

PHOTO: U.S. ARMY, CAPT. ALEXANDER WATKINS · PUBLIC DOMAIN · WIKIMEDIA COMMONS



DIGITAL SHIELD 2.0 — EFFECTORS ON THE SAME NETWORK

Two interceptors and a command-and-control system in use on the Estonian coast, March 2026.

PHOTO: U.S. ARMY, MAJ. ALEXANDER WATKINS · PUBLIC DOMAIN · WIKIMEDIA COMMONS

The U.S. Army's Project Flytrap trials in Germany have the same aim at the level of a platoon. In November 2025 the 10th Army Air and Missile Defense Command tested new, lower-cost, portable sensors and shooters for the Eastern Flank Deterrence Line. U.S. Army↗



VIDEO: PLAY IT IN THE ONLINE REPORT

PROJECT FLYTRAP 4.5 — CHEAPER SENSORS AND SHOOTERS, TESTED TOGETHER

Soldiers of the 10th Army Air and Missile Defense Command on the trials at Putlos, Germany, November 2025. About a minute.

VIDEO: U.S. ARMY, PFC. LUIS JIMENEZ · PUBLIC DOMAIN · WIKIMEDIA COMMONS

FIELD 05 — WHERE SOUND PLUGS IN

The acoustic layer on the network

Acoustic sensors are already being wired into these networks. At Project Flytrap in June 2025, soldiers of the 2nd Cavalry Regiment followed the acoustic detections of Squarehead panels on a handheld Nett Warrior device connected to a radio, watching the real-time location of a test drone flying within the panels' range.[U.S. Army↗] As early as 2020, DroneShield integrated its radio, radar and camera detectors with Squarehead's Discovair direction-finding acoustic system inside one command-and-control software package, then under evaluation by the U.S. Department of Defense.[Unmanned Airspace↗]



ACOUSTIC DETECTIONS IN HAND — THE EAR REPORTS TO THE SOLDIER

Soldiers track a test drone located by acoustic panels on a handheld device, Project Flytrap, June 2025.

PHOTO: U.S. ARMY, SPC. ELIJAH MAGAÑA · PUBLIC DOMAIN · WIKIMEDIA COMMONS

At national scale, Ukraine's Sky Fortress network of thousands of cheap acoustic sensors feeds mobile fire teams, as our report Listening to the Sky describes. In each case the acoustic layer does the same job: hear early, in every direction, without emitting, and pass a cue to whatever can look or act. It matters most when the drone sends no radio signal to find, or when jamming has failed; see When the Detector Stays Silent and When Jamming Stops Working. Who may act on that cue is a separate question. In the United States, for example, the law treats detecting a drone very differently from defeating it, as Allowed to Listen, Not to Shoot explains.

FIELD 06 — THE LIMITS

A standard is not a guarantee

A shared language makes integration possible; it does not make any sensor good. The best-documented results here are self-reported: the 2021 connection counts come from Dstl, and the account of The Hague names neither the number of drones nor the sensors used. GOV.UK↗ Fusing many sensors also concentrates a great deal of data in one place, and the airport review warns that cameras and radio sensors can capture data on the public and staff as well as on drone pilots, so the network needs clear rules on access and retention to avoid "function creep". Array↗

For anyone specifying a layered system, the questions follow:

1. **Does each sensor speak an open standard, and which version?** BSI Flex 335 v2.0 is not the same as earlier interface versions.
2. **What does the sensor report?** Direction, position, confidence and classification each help the fusion node differently.
3. **Is the data fused or only overlaid?** Ask to see one track built from several sensors, not several tracks on one map.
4. **Can the fusion node task sensors?** Cueing cameras from acoustic or radar detections needs a return path.
5. **What still works when radio and GPS are jammed?** A layered defence should degrade, not collapse.

CONFIDENCE

How sure we are, and what would change it

High confidence in the existence, status and adoption of SAPIENT: the UK government publishes the standard, its history and NATO's intention to adopt it, and Estonian and U.S. Army sources describe allied efforts to link sensors and effectors on shared networks.

Moderate confidence in how well such networks perform. The 2021 trial figures and the account of the 2025 summit come from the standard's developer, with few operational details, and acoustic sensors' place in these networks is shown in trials and vendor integrations rather than published performance data.

What would change it: independent, published results from NATO interoperability exercises, including acoustic sensors, and post-operation reports that say which sensors contributed to an interception.

The acoustic node on the network

DroSonic's sensors are designed to be one layer among several: networked passive acoustic nodes that detect, classify and locate drones on low-cost edge hardware and pass a cue onward. DroSonic↗ Its U.S. provisional patent application covers that hand-off as tiered defeat cueing. DroSonic↗

An open standard such as SAPIENT is how a cue like that reaches a fusion node and an effector from another maker. DroSonic has not announced SAPIENT certification; it tested a prototype against live drones at DIRT Days 26.04 in September 2026 DroSonic↗ and joined the SOF RACER consortium in October 2026. DroSonic↗



DIRT DAYS 26.04 — ONE SENSOR, ONE LAYER

DroSonic's test position at the field exercise. On a real network, its output would be one more feed into a shared picture.

PHOTO: DROSONIC · FIELD-TEST WRITE-UP

CLOSE — WHAT IT MEANS

Sound and sight, on one network

The three parts of Sound and Sight make one argument. A microphone array is the natural wide-area cue for narrow, precise optics (Part 1). Fused with cameras and radio, sound turns three unreliable sensors into one dependable one (Part 2). And neither matters unless the detections reach a shared picture that the people and systems who act can trust, which is what open standards such as SAPIENT are for (Part 3).

DroSonic builds passive acoustic detection to be that early, quiet layer: hearing drones that cameras cannot yet see and radio detectors cannot hear, and handing the cue to the rest of the defence. For us and for anyone else, the test that matters is whether the cue arrives in time and in a form the network can use, which a laboratory score cannot show.

ABOUT DROSONIC

DroSonic builds passive acoustic drone detection: networked sensors that listen for drones instead of their radio signals, using acoustic AI and edge computing. DroSonic OSINT is our open-source research into the threat that technology is built to meet.

THE RECORD SO FAR

OCT 2026	Joined the SOF RACER consortium, which connects USSOCOM with commercial technology companies
SEPT 2026	Prototype tested against live drones at DIRT Days 26.04, a field exercise supported by CMI2 with U.S. Central Command and U.S. Army DEVCOM
SEPT 2026	Technical presentation at NDIA's Emerging Technologies for Defense conference on detecting fibre-optic and radio-silent drones

SEPT 2026	Filed U.S. provisional patent 64/148,522 on passive acoustic detection, classification, localisation and defeat cueing
JUL 2026	Pitched to the U.S. Space Force at Space Systems Command's Reverse Industry Engagement Day, Colorado Springs

How DroSonic detection works → · Where it is used → · Talk to the team →

THIS REPORT ONLINE

https://osint.drosonic.com/assessments/layered-counter-drone-sapient.html

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DroSonic OSINT: open-source assessments on drones and counter-UAS from DroSonic, passive acoustic drone detection. drosonic.com · sudo@drosonic.com



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Ghulam Mujtaba, Ph.D., is the founder and CEO of DroSonic and leads its work on passive acoustic drone detection. A computer engineer with 13 years of experience building machine-learning systems for edge hardware, he holds a Ph.D. in computer engineering from Gachon University in South Korea, was an NSF postdoctoral fellow at West Virginia University in the United States, and is an Assistant Professor of AI and Data Science at Regis University in Denver, Colorado. An IEEE Senior Member, he has published more than 20 papers on deep learning, computer vision and multimedia for edge devices.

PROFILE ↗ LINKEDIN ↗ ORCID ↗

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