FISSURE for UAS Payloads & Aerial Operations

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1. EXECUTIVE SUMMARY

Unmanned aerial systems (UAS) are reshaping spectrum operations by carrying small, adaptable payloads into contested environments. They allow rapid deployment, extended reach, and flexible mission profiles, but most available payloads are proprietary, costly, or too rigid to adapt. What is missing is an open-source solution that delivers advanced capability in a compact, cost-effective package tailored to the mission.

The FISSURE Framework, developed by Assured Information Security, Inc. (AIS), provides that solution. FISSURE is a modular, community-driven framework for RF, electronic warfare, and cyber experimentation that can be deployed as compact payloads on drones or integrated into ground and vehicle platforms. Payloads are easy to assemble, customizable for endurance, data collection, or electronic effects, and ruggedized when needed for vibration and weather. The same design scales up with more powerful processors for advanced analysis and AI-driven workflows, or down for small expendable nodes.

While most often mounted on multirotor drones, FISSURE payloads can also be integrated into balloons, fixed-wing UAS, or tethered aerial platforms. These options extend endurance and coverage, giving operators persistent sensing or higher-altitude vantage points when missions demand it.

Networking is central to making these payloads effective. Operators must be able to control nodes, receive alerts, and share data across teams. FISSURE supports both low-throughput links, such as Meshtastic for mesh coordination, and higher-bandwidth options like Wi-Fi HaLow, reused drone control links, or cellular backhaul. These connections allow simple commands and alerts in austere conditions or rich, real-time data exchange when bandwidth is available.

FISSURE supports a wide set of radios and sensors, including general-purpose SDRs, protocol-based radios, and acoustic or visual inputs. This adaptability makes it suitable for both broad RF monitoring and specialized missions targeted at specific applications or emitters.

The open-source foundation lowers barriers to entry and accelerates adoption. Civilian organizations, partner nations, and operational teams can all deploy FISSURE quickly without vendor lock-in or high cost. The same framework supports education, research, and operational missions, making it a mission-ready foundation for modern spectrum operations.

2. PROBLEM STATEMENT

Unmanned aerial systems (UAS) are changing how spectrum operations are conducted. Small drones extend reach, carry adaptable payloads, and operate in environments where fixed infrastructure cannot. Yet most available payload options are locked, high-priced, and inflexible, designed for narrow tasks rather than flexible missions. This creates a clear shortfall between current tools and operational needs.

Organizations face several challenges when trying to leverage UAS for spectrum operations:

- Cost and availability: Proprietary payloads are priced beyond the reach of small teams, partner nations, and civilian responders.
- Rigidity: Many systems are built for a single purpose, making it difficult to adapt to new signals, protocols, or threats.
- Centralization: Heavy infrastructure or centralized backends make many tools unsuitable for contested or austere environments.
- Fragmentation: Open-source projects exist, but they are often single-use or require expert integration, creating high barriers for new users.

The result is a landscape where adversaries employ low-cost, modular payloads on drones to achieve real effects, while allied and civilian users struggle to field affordable, adaptable alternatives. This imbalance highlights the need for a payload framework that is inexpensive, customizable, and expendable, yet still capable of supporting a wide range of missions.

What is missing today is a system that can scale across use cases, from targeted applications to broader spectrum monitoring, from lightweight expendable payloads to more powerful ruggedized nodes. It must be intuitive enough for new operators to use quickly, while flexible enough for advanced users to expand and adapt.

This is the gap that the FISSURE Framework addresses. By combining affordability, openness, and modularity, it provides a foundation for payloads that can be tailored to different missions, deployed in multiple configurations, and adopted across research, training, and operational contexts.

3. CURRENT STATE OF PRACTICE

The use of unmanned aerial systems (UAS) for intelligence, surveillance, and reconnaissance (ISR) has expanded rapidly. Militaries and non-state groups alike now deploy drones carrying cameras, radios, and electronic payloads to monitor adversaries, collect data, and disrupt communications. UAS have become a low-cost extension of capabilities once limited to large aircraft and fixed infrastructure.

Today's drone payloads generally fall into three categories. The most common are ISR sensors, such as visual or infrared cameras, sometimes paired with acoustic sensors or basic RF detectors.

These provide situational awareness but are limited in spectrum adaptability. Cyber and electronic warfare payloads exist that can jam radios, spoof GPS, or inject traffic into wireless protocols, but these are usually single-purpose systems tied to proprietary hardware. A growing class of network relay payloads turns drones into airborne repeaters, extending tactical communications or bridging ground units. While useful, these systems are often narrow solutions optimized for voice or IP traffic, with little integration of spectrum sensing or analysis.

Across the world, this fragmentation is evident. In Ukraine and the Middle East, commercial drones have been adapted for reconnaissance or strikes, but spectrum sensing is often limited to improvised detectors or handheld gear. Larger militaries field ISR pods, signals intelligence (SIGINT) packages, or jamming systems on high-end drones, but these are costly, export-restricted, and not easily replicated by partners or civilian users.

Open-source tools are available, yet they remain poorly integrated into airborne operations. Projects such as GNU Radio or Wireshark can analyze signals but require deep expertise and rarely transition from labs to drones. Vendor ecosystems tie their software tightly to specific radios or airframes, preventing reuse across platforms. At the other end of the spectrum, large defense systems provide advanced multi-sensor fusion but are prohibitively expensive and slow to field.

The result is a persistent gap. Drone payloads today are either improvised and disposable or powerful and prohibitively costly. Few options exist that balance affordability with adaptability. What is missing is a modular, open framework that allows spectrum sensing, cyber experimentation, alerts, and data integration to coexist within the same small, customizable payload.

4. SOLUTION: FISSURE FRAMEWORK

The challenges facing modern spectrum operations require more than a collection of single-purpose tools. What is needed is a software framework that can bring together diverse hardware, operate flexibly in the field, and scale from lightweight expendable payloads to larger mission-ready systems. The FISSURE Framework was designed to provide exactly that capability.

At its core, FISSURE is a software environment that runs on general-purpose computers. This makes it uniquely adaptable. Radios, sensors, cameras, and other systems can be integrated through USB, PCIe, or network interfaces and used as part of the operational workflow. The same flexibility applies to networking. Whether a payload connects through Meshtastic, Wi-Fi HaLow, existing drone control links, or cellular backhaul, FISSURE can move data, forward alerts, or receive commands over the channels available.

This openness allows FISSURE to scale across different hardware and mission profiles. On a small drone, it can run on a compact single-board computer with a single SDR, providing lightweight spectrum sensing or alerting. On larger platforms, it can support more powerful processors and multiple radios, enabling wideband monitoring, AI-driven classification, and real-time analysis. The framework is not limited to one form factor or one role. It adapts to the resources available and the mission at hand.

Another defining aspect of FISSURE is its modularity. The plugin architecture allows new radios, sensors, algorithms, or countermeasures to be added without rewriting the entire system. This makes it possible for operators, researchers, or developers to extend capabilities quickly as new needs arise. Whether the mission requires reconnaissance, protocol analysis, data logging, or electronic effects, the framework can be configured to support the task.

FISSURE also emphasizes operational readiness. It provides operators with clear visualizations, structured data management, and direct integration with TAK, ensuring that payloads feed into a broader operational picture rather than operating in isolation. At the same time, its open-source foundation keeps the system accessible and affordable, making it practical for small teams, allied forces, and civilian organizations.

By bridging the flexibility of research tools with the reliability of operational systems, FISSURE offers a foundation no other payload framework provides today. It combines affordability, adaptability, and scalability in a single system, making it possible to field spectrum payloads that are as expendable as they are powerful.

5. DEPLOYMENT SCENARIOS

FISSURE can be deployed in many ways depending on mission needs and available resources. The framework scales from lightweight nodes with minimal connectivity to distributed systems that coordinate across multiple roles.

In low-bandwidth environments, FISSURE operates in reduced mode where only simple commands and alerts are exchanged. Using mesh networking such as Meshtastic, operators can direct nodes to change modes or trigger behaviors while still receiving timely alerts. This allows networks to function with minimal infrastructure while providing actionable awareness.

When higher bandwidth is available, payloads can transfer larger datasets, provide live feedback, and even stream IQ samples in near real time. Richer connectivity supports more complex workflows where operators interact dynamically with nodes instead of relying only on alerts.

FISSURE can also run as a stand-alone “brick” payload with its own battery and housing. In this configuration the system operates independently of the host drone, reducing integration requirements and enabling rapid deployment. Bricks can be mounted externally, carried as cargo, or placed on the ground as persistent nodes, making them especially useful as expendable or temporary sensors.

Beyond multirotor drones, FISSURE payloads can also be mounted on balloons, fixed-wing UAS, or tethered platforms. These options extend endurance and coverage, enabling persistent sensing or higher-altitude vantage points where longer dwell time or wider-area observation is required.

Coordinated deployments allow nodes to operate in different modes simultaneously. One might capture wideband activity while another conducts classification or replay. Together, they can provide geospatial analysis, direction finding, or emitter localization, turning multiple small payloads into a capable sensing network.

FISSURE also supports signal simulation, a valuable tool for training and exercises where live transmissions are not practical. Simulated traffic can be replayed into the system to test workflows, practice analysis, or build realistic exercise conditions.

Finally, nodes can be configured with specialized triggers for unconventional missions. They may switch modes, activate external systems, or release payloads in response to a specific signal or operator command. Examples include authenticating a signal before dropping a package or shifting from passive sensing to active disruption when a threshold is reached.

From minimal mesh-connected nodes to independent brick payloads, high-bandwidth ISR workflows, and persistent aerial platforms, FISSURE provides deployment flexibility that allows payloads to be tailored to the mission instead of locking operators into narrow, one-off payloads.

6. KEY BENEFITS

FISSURE delivers advantages that set it apart from existing payload solutions. Its affordability, adaptability, and open design ensure it can meet the needs of researchers, trainers, and operational users alike.

Affordable and Broadly Applicable: Built on COTS hardware, FISSURE payloads are low-cost, risk-tolerant, and usable by both military and civilian organizations.

Configurable and Extensible: The plugin-based framework allows operators to add new radios, sensors, algorithms, or effects without vendor lock-in. Payloads can be tailored to specific missions or scaled for broader spectrum monitoring, with options to adjust endurance, processing, and modes of operation.

Distributed Coordination: Multiple nodes can work together to cover large areas or perform complementary roles. Mesh networking supports lightweight alerting and tasking, while high-bandwidth links enable real-time analysis, geospatial mapping, and direction finding across coordinated deployments.

Seamless Integration: FISSURE connects with existing ecosystems rather than operating in isolation. GPS provides accurate time and location, PostgreSQL supports structured storage and analysis, and TAK integration delivers outputs into a familiar operational picture for faster decision-making.

Advanced Analytics and AI: The framework supports machine learning for classification, anomaly detection, and adaptive workflows. AI-driven analysis enables payloads to recognize new signals more quickly and apply smarter responses.

Together, these benefits make FISSURE not just a toolkit but a mission-ready framework that bridges research, training, and operational use.

7. RELEVANT EXPERIENCE

Assured Information Security (AIS) brings decades of experience in cybersecurity, electronic warfare, and spectrum analysis, supporting the Department of Defense, the U.S. Air Force, U.S. Special Operations Command, and partner organizations. This foundation of modular, open experimentation led directly to the development of the FISSURE Framework.

AIS has applied its expertise to RF systems, drone exploitation, and counter-UAS research, including GPS spoofing, video feed manipulation, protocol fuzzing, denial-of-service, and system-level disruption. These efforts have provided insight into how unmanned platforms behave under stress and how countermeasures must adapt.

This expertise has translated into real deployments. AIS has flown FISSURE on low-cost, 3D-printed drones as part of combined solutions that demonstrated how affordable platforms and modular software can deliver advanced capabilities. The framework has been showcased at joint operations events, where it provided spectrum sensing, alerting, and data relay as part of coordinated missions.

AIS regularly participates in demonstrations, field events, and technology evaluations with government, academic, and industry partners. Facilities such as the ORION technology accelerator in Rome, New York, support safe prototyping, testing, and collaborative evaluation of emerging systems.

Beyond UAS-focused research, AIS maintains expertise in RF signal processing, digital analysis, and integration across C5ISR systems. This breadth ensures that FISSURE is designed not as a stand-alone experiment, but as a framework that works with existing workflows and operational ecosystems.

Together, this background shows AIS's ability to bridge research, experimentation, and operational deployment. It is the same philosophy driving FISSURE as an adaptable, open-source solution for spectrum operations across research, training, and real-world missions.

8. CONCLUSION

The rapid growth of unmanned aerial systems has shown the potential of small, adaptable payloads, yet most current solutions remain too rigid, costly, or closed to keep pace with operational needs. Modern spectrum operations require capabilities that are affordable, flexible, and accessible across research, training, and real missions.

FISSURE provides that foundation. Built on COTS hardware, it transforms low-cost drones into powerful spectrum tools. The same framework used in classrooms and labs can be flown as lightweight payloads, integrated into larger UAS, or coordinated across distributed networks. This adaptability makes spectrum payloads not rare and expensive assets, but accessible tools that can be tailored to specific missions.

By lowering barriers to entry, FISSURE enables partner nations, civilian users, and operational teams to adopt advanced spectrum capabilities quickly. It allows payloads to contribute directly to broader operational pictures, giving commanders and operators clearer insight into the spectrum environment.

AIS continues to refine FISSURE through research, demonstrations, and partnerships. Its core strength is already evident: an open, scalable framework that ensures aerial payloads evolve with mission demands. FISSURE is not just a research tool, but a practical framework that ensures aerial payloads remain adaptable, scalable and ready for tomorrow's missions.