Persistent ISR Without Compromise:
Enabling Continuous Intelligence with Untethered Small UAS

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Executive Summary

The modern security environment demands continuous intelligence, surveillance, and reconnaissance (ISR). Small unmanned aerial systems (sUAS) have become central to ISR missions due to their flexibility, speed of deployment, and cost efficiency. However, their operational value remains fundamentally constrained by battery endurance. Limited flight time creates coverage gaps, increases manpower requirements, and undermines mission effectiveness, particularly in scenarios requiring persistent situational awareness.

GuRu Wireless Inc. has solved this endurance constraint. Using proprietary long-range RF wireless power beaming, GuRu enables sUAS to remain airborne indefinitely, sustaining and recharging batteries while in flight. This persistence is achieved without physical tethers or landings. This capability transforms small drones from intermittent sensors into persistent ISR assets.

GuRu's technology has been demonstrated in real-world outdoor environments while achieving over 96 hours of uninterrupted, untethered flight, including coordinated multi-drone operation from a single ground unit. With TRL-6 maturity, active engagement with U.S. and allied defense stakeholders, and a scalable system roadmap, GuRu Wireless is defining a new operational category: Persistent ISR (p-ISR).

The Operational Problem: ISR Gaps in a Persistent Threat Environment

Defense and security missions increasingly involve distributed, asymmetric, and persistent threats. These encompass situations from perimeter intrusion and border activity to convoy protection and layered counter-UAS operations. At the same time, forces are adopting autonomy, unmanned teaming, and edge intelligence to reduce risk and increase effectiveness. Yet ISR endurance has not kept pace with these operational needs.

Battery-powered sUAS typically operate for 30 minutes to an hour or so, requiring frequent recovery for charging or battery replacement. These cycles introduce unavoidable ISR gaps and impose operational burdens that include:

- Loss of target custody at critical moments
- Reduced force protection and survivability
- Increased operator workload and manpower demand
- Constrained mission planning tied to battery logistics
- Slower detection-to-decision timelines


Base Protection


Border Protection


Convoy Overwatch

Existing approaches such as tethered drones or rotational battery swaps address endurance at the cost of mobility, flexibility, or scalability. As a result, ISR systems today remain persistent in intent, but intermittent in execution. Simply increasing battery capacity does not resolve this limitation. Larger batteries add mass, reducing aerodynamic efficiency and payload capacity while accelerating diminishing returns imposed by gravity and lift requirements. As a result, endurance gains from battery improvements are incremental and slow, constrained by fundamental physics rather than engineering effort alone. Tethered solutions, while extending flight time, impose a different set of trade-offs: the aircraft remains physically bound to a fixed point, limiting altitude, restricting field of view to the horizon, and preventing lateral excursions required to extend perimeter coverage or investigate anomalies. GuRu's approach removes these constraints entirely by delivering persistent power without added mass, physical tethering, or loss of mobility: enabling continuous ISR with full freedom of movement, altitude, and mission flexibility.

GuRu's Solution: Continuous ISR via Mid-Air Wireless Power Beaming

GuRu Wireless has developed a proprietary **24 GHz millimeter-wave RF power beaming platform** that delivers targeted energy from a ground-based transmitter to an airborne receiver integrated into a purpose-built sUAS. Using electronically steered phased arrays (software controlled) and dynamic RF "smart lensing," energy is focused precisely on the aircraft in flight. This allows the drone to:

- Sustain flight indefinitely
- Recharge its onboard batteries while airborne
- Reposition freely and perform mission excursions
- Return seamlessly to persistent overwatch

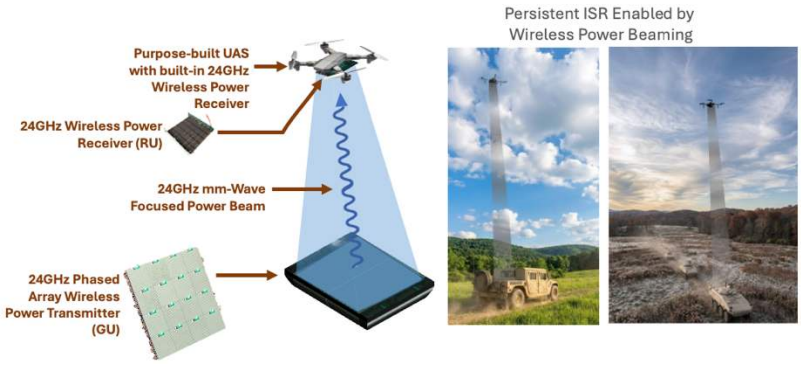
The system is fully electronic, with no mechanical beam steering, enabling rapid tracking, adaptive focus, and can support for multiple autonomous drones from a single ground unit.

Critically, GuRu's solution avoids the trade-offs of existing endurance approaches: No landings. No battery swaps.No physical tethers. No ISR gaps. This represents a fundamental shift from time-limited ISR sorties to continuous aerial presence.

Technology Foundation and Validation

GuRu's platform originates from more than a decade of research at Caltech and has matured through disciplined system development and field testing. Key technical attributes include:

- Electronically controlled phased-array transmission with dynamic beam steering
- RF smart lensing to focus energy efficiently at distance
- Scalable transmitter architectures from hundreds of watts to multi-kilowatt class – Generator Units (GU)
- Compact, embeddable airborne receivers suitable for Group-1 sUAS – Recovery Units (RU)
- Compatibility with ISR payloads including EO/IR, communications relay, and edge AI



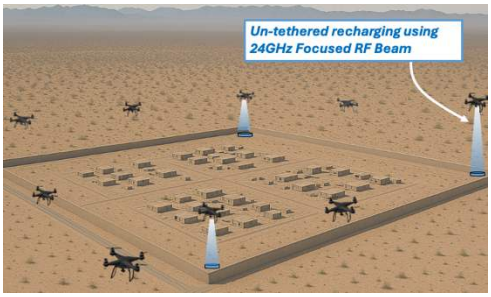
The system has progressed from early proof-of-concept to TRL-6, with demonstrated milestones including:

- Wireless charging of sUAS with ISR payload at an altitude exceeding 200 ft
- Multi-drone autonomous operation from a single transmitter
- Over 96 hours of continuous, untethered flight

GuRu's technology is field-validated, not a laboratory concept, and is advancing toward deployable system configurations.

Operational Impact: From ISR Coverage to ISR Dominance

Persistent ISR fundamentally changes how unmanned systems are employed and integrated into operations. With GuRu-enabled p-ISR, operators maintain continuous custody of areas, routes, or assets while retaining the freedom to investigate anomalies, reposition sensors, and support dynamic missions—all without sacrificing coverage. Representative use cases include:



- **Base and perimeter protection** with continuous aerial overwatch
- **Border security** through virtual, dynamic ISR barriers
- **Convoy and mobile asset overwatch** without restricting maneuverability
- **Layered counter-UAS architectures** with persistent target tracking

Persistent flight also enables higher-level autonomy and analytics, including edge AI for object detection, pattern-of-life analysis, and anomaly flagging. Human operators shift from manual intervention to supervisory control, reducing cognitive load while increasing mission effectiveness and enabling force multiplication by minimizing the need for operator managers.

Conclusion

Persistent ISR has long been a requirement. However, until now, it has not been achievable with small, mobile, untethered systems. GuRu Wireless has developed this capability by removing endurance as a constraint, transforming sUAS into continuous ISR assets and redefining how intelligence is collected, maintained, and acted upon. With proven technology, operational relevance, and a clear roadmap to scale, GuRu is positioned to lead the emergence of persistent ISR as a core defense capability.