PROGRAM OF RESEARCH AND EXPERIMENTATION

SLAMR Development

Applicant	Lyntris: Accelint Intelligence Systems
Application	New Conventional Experimental Radio License
Purpose	Scientific and technical radio research and radar product development

1. Complete Program of Research and Experimentation

The applicant proposes a program of scientific and technical radio research to develop, integrate, characterize, and mature an experimental X-band active electronically scanned array (AESA) radar operating at 8.7-9.7 GHz. The effort supports development of the Scalable Low-cost AESA Multifunction Radar (SLAMR), whose primary intended mission is detection, localization, and tracking of Group 1 through Group 3 UAVs (Unmanned Aerial Vehicles). SLAMR is being developed as a low-cost, attritable, high-performance radar architecture suitable for deployment where the cost, size, weight, power consumption, or replacement burden of traditional radar systems may be prohibitive.

Experimental operations will be limited to engineering research, equipment development, integration, characterization, and controlled field testing. The authorization will not be used to furnish communications service to the public or to provide a commercial communications service. Data collected during the experiments will be used solely to evaluate and improve the radar hardware, waveforms, signal processing, beam-control functions, and end-to-end detection and tracking performance.

1.1 Experimental Equipment and Signal Chain

The experimental system is a modular radar brassboard, shown in Figure 1, that combines programmable digital waveform generation and processing with an X-band RF transmit/receive chain paired initially with standard gain horns, or an AESA aperture. The modular configuration permits individual subsystems to be characterized before they are integrated into the intended SLAMR form factor. Major functional elements include:

- A programmable waveform generator implemented with FPGA-based and processor-based control functions, together with high-speed digital-to-analog conversion used to synthesize the selected radar pulse waveform.
- An RF conversion and transmit chain that translates the generated signal to an operating frequency of 8.7-9.7GHz, provides filtering and amplification, and delivers the waveform to either a controlled-development antenna or experimental AESA.
- An experimental X-band AESA capable of electronic beam formation and steering as shown in Figure 2. The maximum requested peak EIRP is 79 dBm. Radiating operation will use the minimum practical power and duty cycle needed for each experiment.
- An X-band receive chain that filters and amplifies radar returns, translates them to a frequency suitable for digitization, and supplies sampled data to the digital processing subsystem.

- FPGA and processor-based radar processing that may include digital downconversion, filtering, pulse compression or correlation, coherent integration, Doppler processing, channel calibration, beamforming, detection processing, and target tracking.
- A computer-based control and data-recording subsystem used to configure experiments, command the radar, monitor equipment status, retain raw or processed data, and perform engineering analysis.

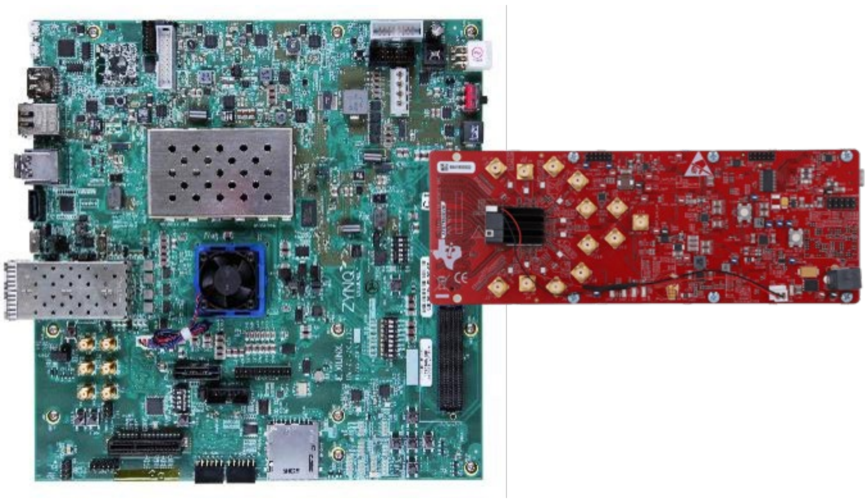

Figure 1. The SLAMR Brassboard Radar Backend consists of an AMD ZCU102 Development Platform and TI AFE7950 Evaluation Board

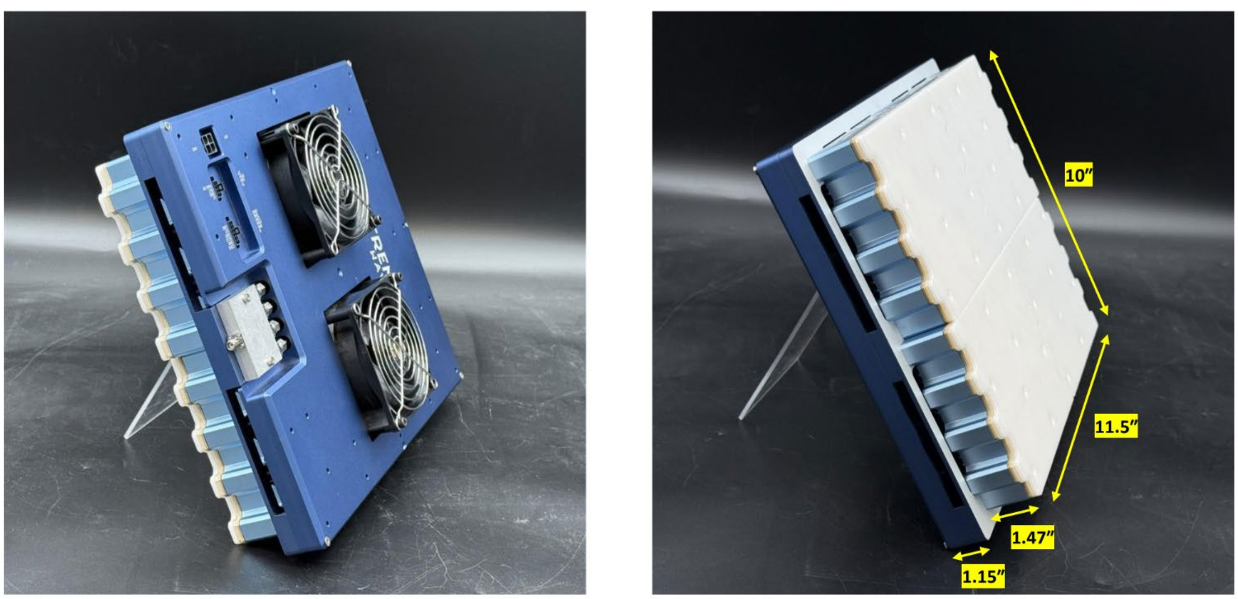

Figure 2. SLAMR Development AESA

1.2 Theory of Operation

The radar operates by generating a controlled sequence of coded or frequency-modulated RF pulses and radiating those pulses through a directional antenna or electronically steered AESA beam. Energy reflected from a test object or target is received by the radar, downconverted, digitized, and processed.

SLAMR is a software-programmable radar that supports multiple waveforms: NMOP (No modulation on pulse), BPSK (binary phase shift keying), LFM (linear frequency modulation), and NLFM (non-linear frequency modulation). Pulse width ranges from 2ns to 10us. To fall within FCC guidelines, duty cycles will be limited to less than 5% with all personnel exceeding a minimum 10m distance from the radiating antenna.

1.3 Experimental Sequence

The work will progress through controlled stages so that RF performance and interference controls can be verified before more integrated testing is attempted:

1. **Conducted and contained testing:** Waveforms and transmit/receive functions will first be evaluated with attenuators, terminations, cabled loopback paths, test equipment, and fully contained facilities where practical.
2. **Low-power horn testing:** Initial radiating tests will verify frequency, occupied bandwidth, unwanted emissions, pointing, timing, and basic target-return acquisition using a simple horn antenna connected to the output of the test system radiating less than 30dBm (estimated 24-27dBm).
3. **Integrated AESA testing:** The radar backend will be integrated with the experimental AESA to evaluate beam steering, channel calibration, coherent operation, waveform fidelity, receive sensitivity, and end-to-end radar processing at increased range.
4. **Controlled detection and tracking trials:** The integrated radar will collect engineering data against representative targets and test geometries to evaluate detection and track continuity against piloted group 1 drones and targets of opportunity.

1.4 Operating Controls

Radiating experiments will be conducted intermittently by qualified engineering personnel at the field test locations specified in Table 1. The radar will be operated only for the time necessary to obtain the required engineering data.

Table 1. Field Test Locations

Site	Latitude	Longitude	Test Radius (miles)	Closest Town
Test Site 1	32.456719	-96.624770	5	Palmer, TX
Test Site 2	33.330970	-96.251033	5	Leonard, TX

The experimental AESA has a maximum requested peak EIRP of 79 dBm. A minimum 10-meter personnel separation will be maintained from the radar during transmission, and the maximum transmit duty cycle will be administratively or technically limited to no more than 4% during operation at the maximum peak EIRP. Lower power or duty cycle will be used whenever sufficient for the experiment. The applicant will maintain the ability to cease transmission immediately, will monitor for unexpected conditions, and will discontinue operation if harmful interference is suspected or reported. These controls supplement, and do not replace, any specific conditions imposed by the FCC authorization.

2. Specific Objectives

The proposed research and experimentation is intended to accomplish the following specific technical objectives:

- Demonstrate stable generation, conversion, amplification, radiation, reception, and digitization of NMOP, BPSK, LFM, and NLFM radar waveforms.
- Characterize and calibrate the AESA transmit and receive channels, including relative gain and phase, beam-pointing accuracy, beam shape, scan performance, and repeatability.
- Quantify range resolution, Doppler resolution, processing gain, pulse-compression sidelobes, ambiguity behavior, coherent integration performance, and sensitivity for each waveform family.
- Develop and validate FPGA, embedded-processor, and computer-based algorithms for waveform control, channelization, pulse compression, Doppler processing, beamforming, detection, localization, and tracking.
- Compare waveform performance in representative noise, clutter, interference, and target conditions to identify operating modes appropriate for detection and tracking of Group 1 through Group 3 UAVs.
- Reduce technical risk and establish measured engineering data needed to transition the modular brassboard into a compact, repeatable SLAMR prototype.

3. Contribution to the Development and Utilization of the Radio Art

The experimental program has a reasonable promise of contributing to the development, extension, expansion, and utilization of the radio art because it combines programmable X-band waveform generation, broadband digital radar processing, and electronically scanned-array operation in an architecture specifically intended to reduce the cost and replacement burden traditionally associated with high-performance AESA radar.

Many AESA radar systems achieve performance through specialized, high-cost hardware and system architectures designed for long service life and correspondingly high unit value. SLAMR investigates a different design point: a sufficiently capable but low-cost and attritable AESA that can be deployed in greater numbers, replaced without disproportionate mission or financial impact, and adapted through programmable waveforms and processing.

4. Conclusion

The applicant therefore requests authority to conduct the described X-band experimental radar program transmitting in the 8.7-9.7GHz band, subject to the power levels, locations, and other parameters specified in the application and ultimately authorized by the Commission. The work is a bona fide program of scientific and technical radio research and product development directed toward maturing a low-cost, attritable, high-performance AESA radar and advancing radar waveform, array, and signal-processing technology.