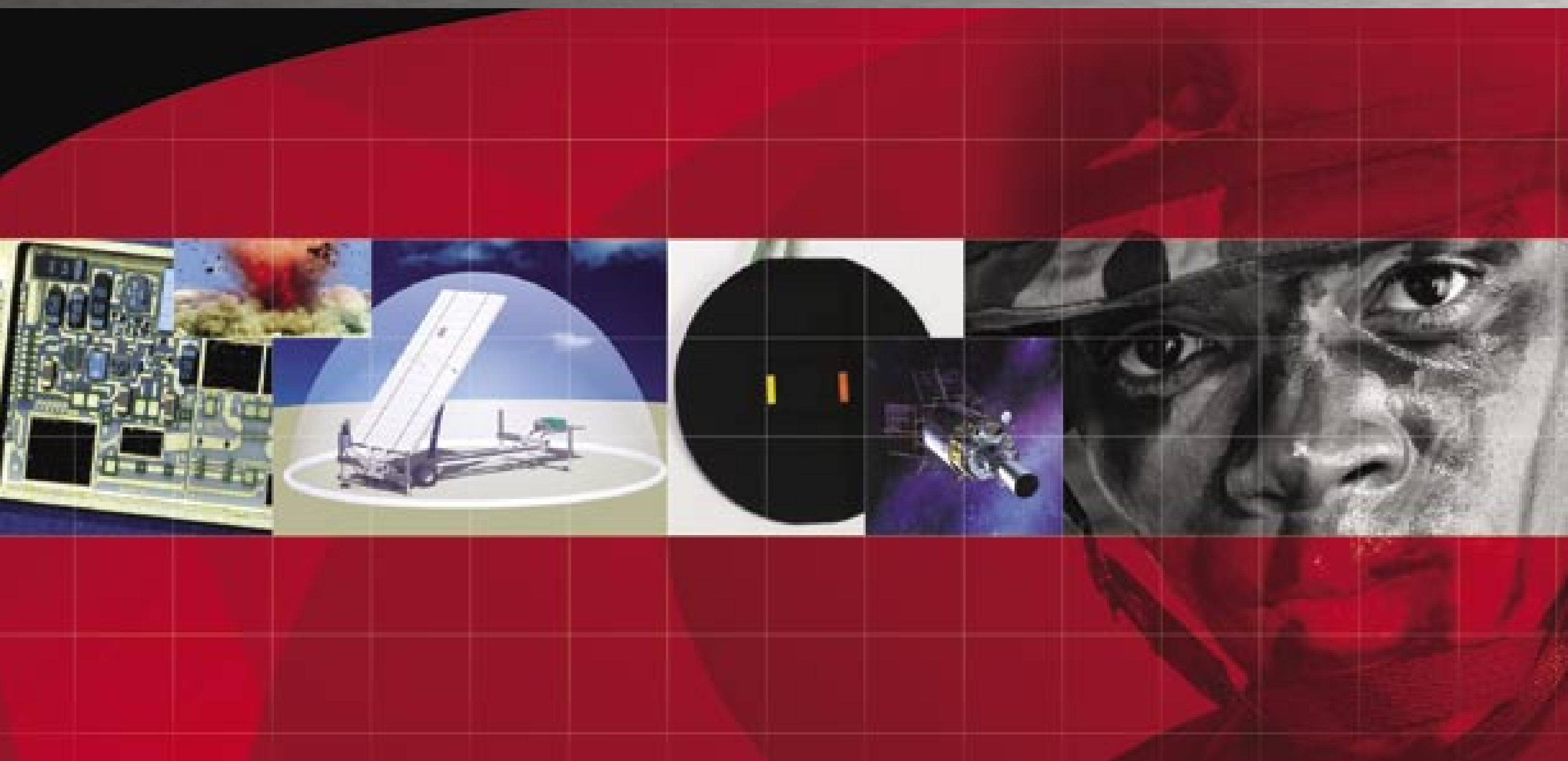
UNITED STATES ARMY
SPACE AND MISSILE
DEFENSE COMMAND

SMD–TC
Space & Missile Defense
Technical Center

RST

Radar Systems Technology



Summary

- Based on proven technologies that demonstrate greatly enhanced, even revolutionary capabilities
- Enhance current radar technologies
- Develop Next Generation Radar testbed capability
- Develop a self-contained optical unit with a single RF input and output
- Explore Gallium Nitride (GaN) microwave power amplifier technology

The RST Program develops advanced radar technologies that will greatly enhance existing radar systems.

Future missile defense systems must demonstrate improved performance over current state-of-the-art radar systems. The Radar Systems Technology (RST) program focuses on four primary areas of radar performance improvement: sensitivity, signal/data processing, enhanced transportability, and increased performance of receivers/exciters. The program is based on proven technologies that demonstrate greatly enhanced, even revolutionary capabilities at the system level. A test bed capability for the Next Generation Radar (NGR) is being developed to meet future Ballistic Missile Defense (BMD) system acquisition, track, and discrimination requirements for advanced threat sets. Gallium Nitride (GaN) microwave power amplifier technology is also being explored to meet future BMD radar performance requirements.

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Overview

To enhance future Ballistic Missile Defense (BMD) system capabilities, the Radar Systems Technology (RST) program focuses on four primary areas of radar performance improvement: improved sensitivity, signal/data processing, enhanced transportability, and increased performance of receivers/exciters. The RST program is sponsored by the Missile Defense Agency Advanced Systems (MDA/AS) Directorate, but involves the Army, Air Force, and Navy. The RST program is based on a proven, successful philosophy of targeted, incremental investment in key enabling component technologies that will demonstrate greatly enhanced, even revolutionary capabilities at the system level.

Benefits for Tomorrow's Defense

To realize advancements in target acquisition and discrimination timelines, future endoatmospheric and exoatmospheric missile defense systems require performance advances over current state-of-the-art radar systems. To this goal, the U.S. Army Space and Missile Defense Technical Center is developing advanced radar technologies that will increase existing radar system performance capabilities. A test bed capability for the Next Generation Radar (NGR) is being developed. This sensor is designed to meet future BMD system acquisition, track, and discrimination requirements for advanced threat sets.

Technical Concept

For improved sensitivity, high power Gallium Arsenide (GaAs) power amplifier technology and advanced thermal management techniques and materials are being used to enable higher power radiating elements or lower prime power losses. Signal and data processing techniques such as distributed aperture and extended bandwidth applications enhance discrimination capabilities. To improve transportability to meet future BMD mission requirements, the focus is on developing scalable, low power density, air cooled, low-cost antenna arrays. Advanced receiver/exciter technologies will improve dynamic range and enable enhanced capabilities in severe clutter and countermeasures.

As part of RST, the Photonic Time Delay Unit (PTDU) program is a four-year effort to develop a photonic-based true time delay unit on a silicon optical platform. This true time delay unit will be based on digital path length switching of an optical carrier modulated by an RF signal. The PTDU is a self-contained optical unit with a single RF input and a single RF output. It is composed of a laser source, a modulator, a set of electronically selectable waveguide paths combined in a digital mode to achieve time delays with less than one wavelength increments, and a photodetector. This PTDU is capable of a wide range of electronically selectable time delays in a digital progression. Phase scanning, for electronically scanned arrays (ESA) is currently performed by switching different lengths of transmission line. This type of phase scanning is band limited—the antenna beam scans as a function of frequency and at a designated scan angle. True time delay scanning is frequency independent. Realization of variable (switched) time delay in an optical medium affords the opportunity to significantly improve ESA performance and to realize a high level of integration (hybrid integrated circuit). Attendant reductions in volume, weight, and cost of the PTDU functions have the potential to drastically change the architecture of ESAs for advanced radars.

In addition to the GaAs power amplifier technology, Gallium Nitride (GaN) microwave power amplifier technology is also being explored to meet future BMD radar performance requirements. This effort will demonstrate a microwave power amplifier using GaN substrate grown by vapor phase epitaxy as the wide-band gap material. High performance X-band power amplifiers will provide as much as three to four times the current capability to future ground based radar and missile seekers. The transistor design chosen offers the advantages of high mobility and high carrier concentration, high versatility, high breakdown voltage and high gain, proper engineering of channel composition using alloy layers, and low susceptibility to micro-pipe defects.

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