Kwajalein: The Next Fifty Years

Looking back is the role of other articles. This one looks forward.

MIT Lincoln Laboratory has had staff resident on Kwajalein continuously since 1962. The primary mission support areas, the types of tests, and the sensor suite have all changed significantly over that time frame. The continuing evolution and importance of the ongoing missions suggest that the Ronald Reagan Ballistic Missile Defense Test Site (RTS) will remain vital to the U.S. Department of Defense for many years into the future.

The primary mission areas that RTS currently supports are global strike offensive capabilities, missile defense, and space surveillance. It is important to perform operational tests of the Air Force Minuteman III intercontinental ballistic missile system (ICBM) to gain assurance that the system continues to operate properly and reliably. At the other end of the global strike spectrum are hypersonic boost-glide systems whose development, test, and evaluation are in their infancy. Given the immaturity of boost-glide systems, there is a need for exquisite test data in order to understand and assess the systems' performance. RTS, with its unparalleled sensor suite and unique geographic location, is likely to remain a primary impact site for testing these global strike systems. However, the low-altitude trajectory of the hypersonic boost-glide systems could motivate a reconsideration of the Laboratory-developed fly-along sensor packages into multiple sensors carried on autonomous air-breathing platforms deployed along the vehicle's trajectory, platforms that hopefully are small, low cost, and maybe even disposable.

Lincoln Laboratory's earliest involvement with Kwajalein dealt with defending our homeland against ICBM attack. Tests of components and systems at Kwajalein have finally resulted in the deployment of an operational Ballistic Missile Defense System (BMDS) to defend our homeland and to protect our allies and deployed forces. As the BMDS evolves, more complex developmental and operational testing will be needed and RTS will play a central role.

Space is evolving from a sanctuary to a contested, congested area. Sensors that in the past updated the orbit of a satellite so the satellite could be found the next day are now being tasked for more time-critical data. The number of objects in Earth orbit is high and growing. Consequently, the probability of near-collisions and actual conjunctions will continue to rise. Kwajalein sensors are increasingly tasked to urgently provide accurate, precise data to refine the orbits of the involved satellites in order to improve the estimated probability of a conjunction, thereby eliminating unnecessary collision-avoidance maneuvers. Demands on the Kwajalein sensors will evolve as the space control mission increases in national importance.

While global strike, missile defense, and space control will remain critical mission areas requiring Kwajalein sensor support, there is also a shift under way in the national focus to meet the challenge of near-peers and

advanced threats around the globe, including in the Pacific. A shift to the Pacific will likely affect Kwajalein's role in test bed development, another indication that RTS capabilities are likely to grow in importance to national decision makers.

Sensor technology advancements have kept Kwajalein sensors relevant to the different mission areas as they have evolved. Maxwell's equations and the radar range equations will not change, but the underlying technology should continue to evolve with the replacement of high-power vacuum devices by solid-state devices on one end and greater signal processing power on the other end. Advances in open architectures and networks, together with the implementation of an optical fiber connection from Kwajalein to the continental United States, have led to remote, distributed operations of both the sensors and the mission control centers. This new operational flexibility will permit tighter coupling between the sensors. Simultaneous radar and optical data collection combined with real-time processing will fuse the precise radar range data with the precise optical angle data.

Kwajalein has a long history with multistatic systems. New short-baseline multistatic radar systems could provide three-dimensional images, while long-baseline systems, combining on-atoll and off-atoll sensors, could enhance the accuracy of satellite ephemeris data. GPS-based systems that are on board test articles provide, via telemetry downlink, precise position information. The wealth of data flowing into RTS begs for improved automation and decision support tools for the individual sensors and, more importantly, for integrated situational awareness and control of the suite of sensors. Developments in this area will be of growing importance in an increasingly networked world, especially in light of potential additions of new sensors to be integrated into the sensor suite.

Twenty-five years ago, I was the TRADEX leader and asked the antenna engineer to paint "25 years of service" on the antenna. They have updated the sign ever since. Little did I know 25 years ago that I would be back for the 50th!

While we cannot predict the future, we can be certain that significant change and technical challenges will be dealt with at RTS. As the Department of Defense budget pressures continue, RTS will continue to optimize its operation and maintenance costs, and take full advantage of the efficiencies that programs such as the Kwajalein Modernization and Remoting and RTS Distributed Operations have brought to the range.

A tour of duty on Kwajalein will always be a unique experience for Lincoln Laboratory staff because they must learn to deal with real operational systems participating in global-scale events. Ballistic missile warheads streak across the sky. Interceptors blast off to collide with their intended targets. Satellite launches are acquired and characterized in minutes. Maneuverable hypersonic vehicles dive to impact. The Kwajalein instrumentation must be prepared to gather the crucial data required by these events. Thorough, exacting technical competence is demanded. The ability to work with a diverse team of Laboratory, government, and contractor personnel is essential. In the years ahead, Laboratory staff will return from Kwajalein with newfound professional maturity and lifelong memories.

Lincoln Laboratory is eager to address new challenges at RTS. As the Laboratory's Kwajalein program moves into its sixth decade, the Laboratory has strong confidence that the challenges will be met and will result in a new round of significant technical achievement.

—Kurt Schwan

Kurt Schwan has spent most of his Lincoln Laboratory career working with the sensors at the Lincoln Space Surveillance Complex in Massachusetts and the Reagan Test Site at Kwajalein. He has worked to improve the capabilities of those sensors to advance the space control and missile defense mission areas. He is currently on his third tour of duty at Kwajalein.