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ABSTRACT

Gamma Motes for Detection of Radioactive Materials in Shipping Containers

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Shipping containers can be effectively monitored for radiological materials using gamma (and neutron) motes in distributed mesh networks. The mote platform is ideal for collecting data for integration into operational management systems required for efficiently and transparently monitoring international trade. Significant reductions in size and power requirements have been achieved for room-temperature cadmium zinc telluride (CZT) gamma detectors. Miniaturization of radio modules and microcontroller units are paving the way for low-power, deeply-embedded, wireless sensor distributed mesh networks.

To establish the feasibility of using a network of miniature gamma detectors to identify the presence of nuclear materials inside a shipping container, Special Technologies Laboratory's (STL's) CZT motes were integrated first into advanced commercial mote platforms and then into STL's situational operations management software. Field tests in shipping containers were augmented by Monte Carlo N-Particle (MCNP) computer modeling to verify performance, supplement data analysis, and complement testing that could not be easily performed. Data were collected from the wireless mesh network while operating with actual radioactive sources, such as ^{57}Co and ^{238}U (depleted uranium).

Testing has revealed that as few as three miniature CZT detectors can reliably monitor a 40-foot-long shipping container for the presence of radiological materials. In addition, computer analyses indicated that the addition of some typical cargoes to the container will not prevent the detection network from finding smuggled nuclear materials. It is estimated that the total cost to install a gamma mote network in a cargo container will be less than $100 in high-volume production.

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