



RAMM

for Monitoring

Power Plants

Dry Casks

Radiological Facilities

Isotope Devices

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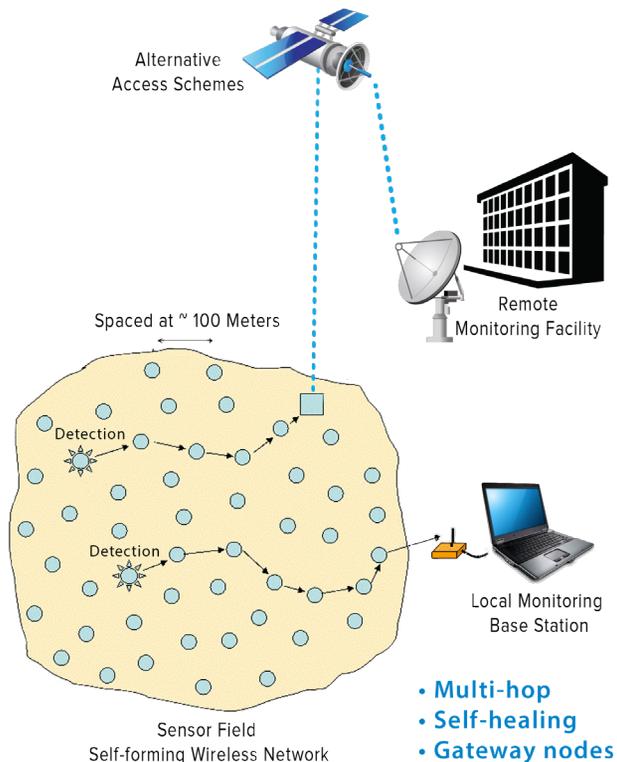
RAMM

Remote Area Modular Monitoring
for Nuclear Facilities



Overview and Benefits

- ▶ Knowing the status of critical environmental parameters of nuclear plants at all times is vital — particularly during and after a disruptive accident.
- ▶ Conventional hard-wired assets may be decimated by such events, as witnessed in the Japanese Fukushima nuclear power plants in March 2011.
- ▶ To eliminate this vulnerability, Argonne is developing a Remote Area Modular Monitoring (RAMM) system that would remain functional after a Fukushima-type calamity.
- ▶ RAMM can also be valuable in normal operations, including dry cask monitoring and tracking sensitive materials in transport, as well as in monitoring radiological facilities and isotope devices.



Schematic of Wireless Sensor Network



Prototype RAMM Unit

Operating Principle

- ▶ Individual RAMM units are pre-positioned at strategic locations of nuclear installations and linked with wired Ethernet. Power-over-Ethernet (PoE) keeps the on-board batteries charged.
- ▶ RAMM units are equipped with appropriate sensors — including those for neutron and β - γ radiation, water level, temperature, humidity, imaging, criticality alarm, and hydrogen gas — for the specific surveillance needs.
- ▶ Wireless transceiver in the units form a Wireless Sensor Network (WSN) overlay, which automatically takes over the surveillance when conditions are disrupted. The WSN architecture is self-healing, meaning that the network can remain intact — even if some nodes are damaged.
- ▶ “Gateway” units relay the collected plant information via cellular and satellite communication links to the outside world. The same gateway features permit RAMM to be installed on transport conveyance to monitor sensitive shipments, such as fuels and isotopes.

RAMM Units – Highlights

- ▶ Modular design and construction enables use of a wide range of sensors and communication combinations.
- ▶ New technology leverages Argonne’s mature ARG-US RFID knowledge base.
- ▶ RAMM units can operate indefinitely on Ethernet or vehicle power and can operate for weeks on built-in batteries after an incident.
- ▶ Robust weather-tight enclosures can withstand degraded plant environments.

Ongoing Development

First Prototype Units in Production – Available Fall 2014

- ▶ Verify function of basic module — PoE, power management, internal and external sensor interfaces, data acquisition and storage, firmware, software, and user interfaces.
- ▶ Verify wired and wireless network functionality — auto-switching, “self-healing” and “self-forming” features, transmission range and characteristics, performance of gateway cellular and satellite communication.
- ▶ Adapt the first RAMM units for small-scale field-testing at the nuclear power plant, such as for used fuel dry-cask monitoring.

