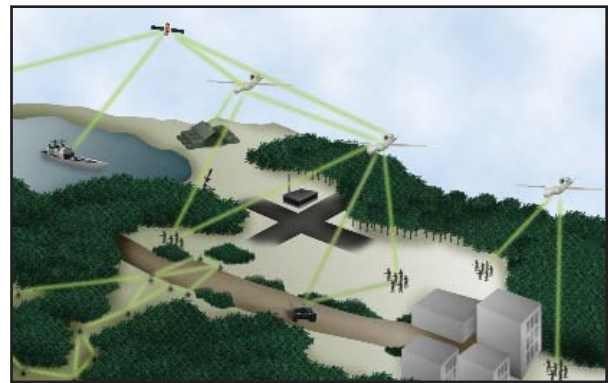


# DAMAN™ (Deployable Adaptive Mobile Ad hoc Network)

## FLEXIBLE MULTIHOP NETWORK SUPPORT FOR HIGHLY DYNAMIC ENVIRONMENTS

Sarnoff's DAMAN protocol is a multihop Mobile Ad hoc Networking (MANET) protocol that enables wireless network connectivity between users in situations where it is impractical or impossible to deploy or use existing network infrastructure. The DAMAN protocol was designed to be an efficient protocol to support anytime/anywhere communications in situations where mobility is the rule rather than the exception. Among its specific design goals were:

- To support continuous operation of groups of highly mobile users
  - UAVs, UGVs, soldiers, vehicles, emergency first responders, etc.
- To enable operation in restrictive and challenging environments
  - Within buildings, in urban environments, or in areas with rugged terrain
- To enable the formation of self-organizing, self-routing, and self-maintaining communication networks



### EXCELS WHERE MOBILITY IS THE RULE RATHER THAN THE EXCEPTION

The DAMAN protocol is optimized for operation in environments in which the routes between data sources and destinations are changing rapidly due to node mobility or RF signal propagation and interference effects. It operates under conditions where the complexity and latency of other commonly used MANET protocols incur too much network control overhead to be useful. Rather than discover the entire topology of the network, it tracks only basic information about the nodes with which it is actively communicating. The DAMAN protocol discovers and disseminates routing and topology information in an efficient manner that permits routes to be established quickly, to be maintained easily, and to be tolerant of dynamic changes. This allows for quick reaction to network topology changes on a packet-by-packet basis to maintain end-to-end network connectivity and enhanced performance.

### Applications

The DAMAN routing protocol has been used to enable flexible, dynamic networking for a wide variety of military and commercial application spaces:

- Situational Awareness System infrastructure for Small Unit Operations
- Reachback to Command and Control infrastructure from Unattended Ground Sensors, UAV helicopters and ground vehicles in Sense and Respond Systems
- Dynamic soldier and radio authentication and encryption key distribution
- Peer-to-peer service discovery, authentication, and hot-spot range extension
- Digital Voice over IP and data communication system for warfighters and civilian first responders operating in urban and subterranean environments

## DAMAN™ Salient Features & Differentiators

- Efficient Layer 2.5 implementation provides optimized performance
  - Permits close integration with radio for efficient routing, lower packet delays and jitter
- Does not require full IP routing functionality
  - Suitable for embedded systems: simpler software, simpler implementations
  - Reduced memory and processing requirements
  - Easier to port between hardware and software platforms
- Independent of MAC/Physical radio layers
- Independent of Network/Transport/Application layers but optimized for use with IP networks
- Pertinent routing information attached to all outgoing packets
  - Encoded for low-overhead and frequent updates
  - Allows for fast route establishment, fast route repair
  - Results in increased network capacity and superior performance characteristics
- Full network topology not tracked or needed, drastically reducing control overhead
  - Forms and maintains the network infrastructure only when it is needed

## Flexibility

- Originally designed for use with military TDMA (Time Division Multiple Access) radios
- Tested and optimized for use with CSMA (Carrier Sense Multiple Access) schemes for COTS 802.11a/b/g WLAN devices
- Well positioned for use with Software Defined Radios, custom radios, or embedded radio controllers

## Security

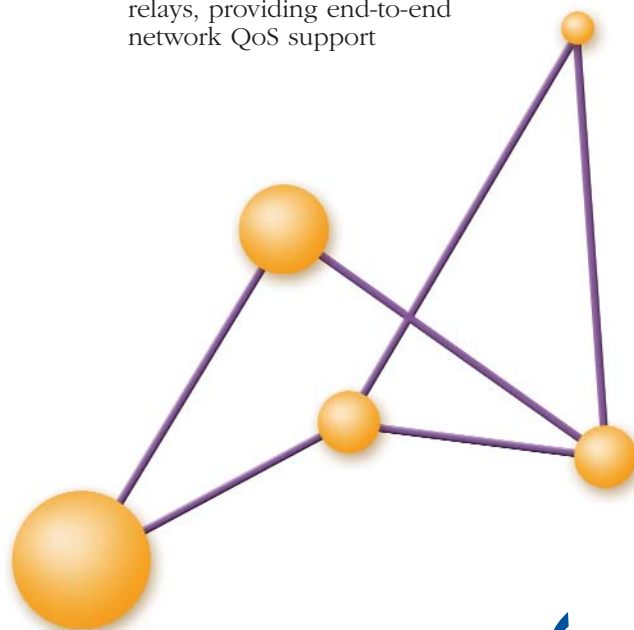
- LPI/LPD: Uses no periodic beacons or housekeeping messages; creates no control packets when there is no application data to be transferred
- Encryption: compatible with end-to-end and per-link encryption provided by other system components
  - Enables flexible use of link-layer encryption by the radio
  - Permits the use of higher-layer network and transport protocols such as IPSec, TLS, or application-level security

## Performance

- Maintains network infrastructure in situations where communication links are made and broken often and network topology is changing frequently
- Provides better network performance in high load environments where other protocols break down
- Maintains high network throughput with low end-to-end delay and very low delay jitter, important characteristics for applications such as streaming audio and video

## Quality of Service

- Supports QoS in the form of Differentiated Service and IP TOS (Type of Service) packet flags
  - Enables priority queuing and other advanced queuing techniques
  - Enforces queuing both at the data source and at intermediate relays, providing end-to-end network QoS support



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