SWAP SHIP-TO-SHIP/SHIP-TO-SHORE WIRELESS ACCESS PROTOCOL

Mesh Networking in the UNOLS Fleet

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ABSTRACT:
In the past two years, a few ships in the NSF University National Laboratory System (UNOLS) oceanographic research fleet have been experimenting informally with commercial 802.11 wireless systems for data transmission between ships. Previously, sending an email between vessels conducting collaborative research in a common area has required transmission of the message to shore and back via low bandwidth, prohibitively expensive satellite services. Indeed, the most economical and expedient way to share large data files has been to put them on portable media (CD or tape), place the media in a plastic bag, and drop it over the side for the other vessel to retrieve. Large gain, omni-directional antennas combined with 802.11b wireless radios have provided line of sight links over several miles, greatly increasing the productivity of scientists and reducing their costs. This has lead to increased interest within the community for wireless networking between ships. When presented with the possibilities that wireless technologies might provide, the UNOLS Research Vehicle Technical Enhancement Committee (RVTEC) responded with a set of requirements in the form of "Story-Scenarios" for wireless networking between UNOLS ships. This poster describes those requirements and the prototype system we have created to meet them. The system consists of ship and shore nodes or "SWAP Devices" each consisting of a single board, Intel compatible PC running Pebble Linux, a high power 802.11b PCMCIA radio card, and a high gain omni-directional antenna. Point-to-point connections are created automatically between nodes within reception range creating complete routable wireless subnets. The nodes share routing information between them with OSPF daemons and this, in turn, creates a fully routable meshed network. A prototype system has been installed at the University of Hawaii, the R/V Kilomoana and recently the R/V Wecoma.

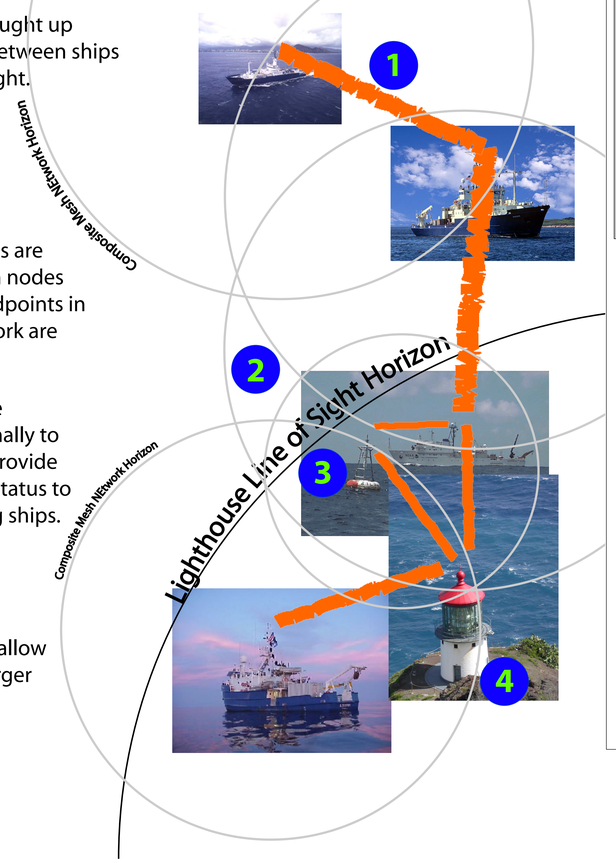
Hypothetical SWAP Mesh Network

1.) Links are brought up automatically between ships within line of sight.

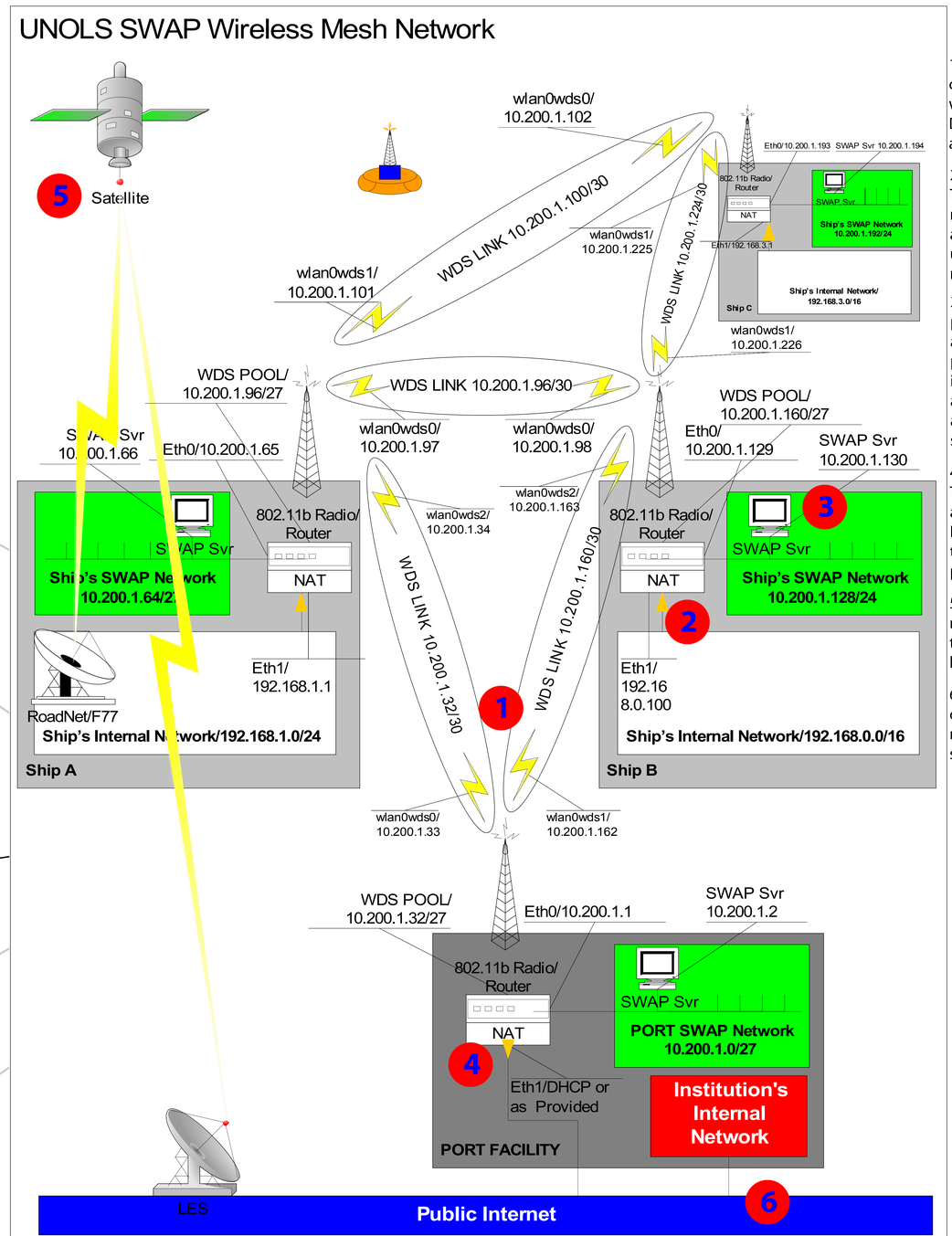
2) Routing tables are shared between nodes such that all endpoints in the larger network are accessible.

3) Buoys may be triggered externally to power up and provide data dumps or status to shore or passing ships.

4) Shore nodes allow access to the larger Internet



UNOLS SWAP Wireless Mesh Network



1) Virtual IP subnets are created automatically when "Wireless Distribution System" links are established.

2) Network Address Translation allows ships to maintain internal addressing and prevents unwanted browsing of ship networks.

3) SWAP Local Servers provide ship web pages and common meeting places to publish information and data. They also might host email, ftp, and automated data pipe services to known peers.

4) Network Address Translation and a Firewall allows access to the public Internet without making the SWAP networks publically accessible.

5) Special provisions can be made for a ship to share their broadband satellite link with SWAP peers.

6) SWAP Networks exist outside institutional networks to prevent security backdoors.

Story Scenarios

1). A ship pulls into its home port, and before the ship hits the pier, a wireless network link is made automatically to the local shore network and larger Internet. No manual configuration required.

2) Same as 1 except the port is not the ship's home port, but any UNOLS facility offering this service.

3) A wireless network link is generated automatically between two ships at sea when they are in reception range. This requires no user interaction, and automated processes that look for the presence of the other ship will execute over the link to dedicated known hosts on the peer ship.

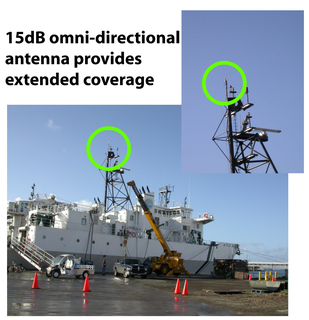
4) A link is generated automatically between three or more ships at sea when in reception range. If ship A is in range of ship B but not ship C, ship B can still forward packets on to ship C from ship A. ("Hidden" nodes are still routable.)

5) In the case of 3 or 4, if one ship is outfitted with a broadband satellite link to shore (e.g. Road Net), shipboard personnel can provide the other ships access to that link via the wireless ship-to-ship service. The satellite linked ship maintains usage statistics for link cost sharing between vessels and PIs.

6) An instrumented buoy outfitted with a wireless radio is externally triggered to attempt a wireless connection with a passing ship. When the connection is made, the buoy's data and operating status are downloaded to a known server on that ship.

7) A ship passing within radio range of a participating shore facility maintains a constant data link to shore. The link might serve ships operating near institutions without deep water ports (e.g. an Ice Breaker passing Barrow), or ships conducting local coastal surveying, testing instrementation, etc.

University of Hawaii Prototype Installation



More Information

Get more information at our collaborative web site
http://data.ldeo.columbia.edu/admin/twiki/bin/view/SWAP/WebHome

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