802.11s Wireless Mesh Network Visualization Application

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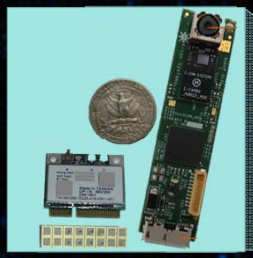
Abstract

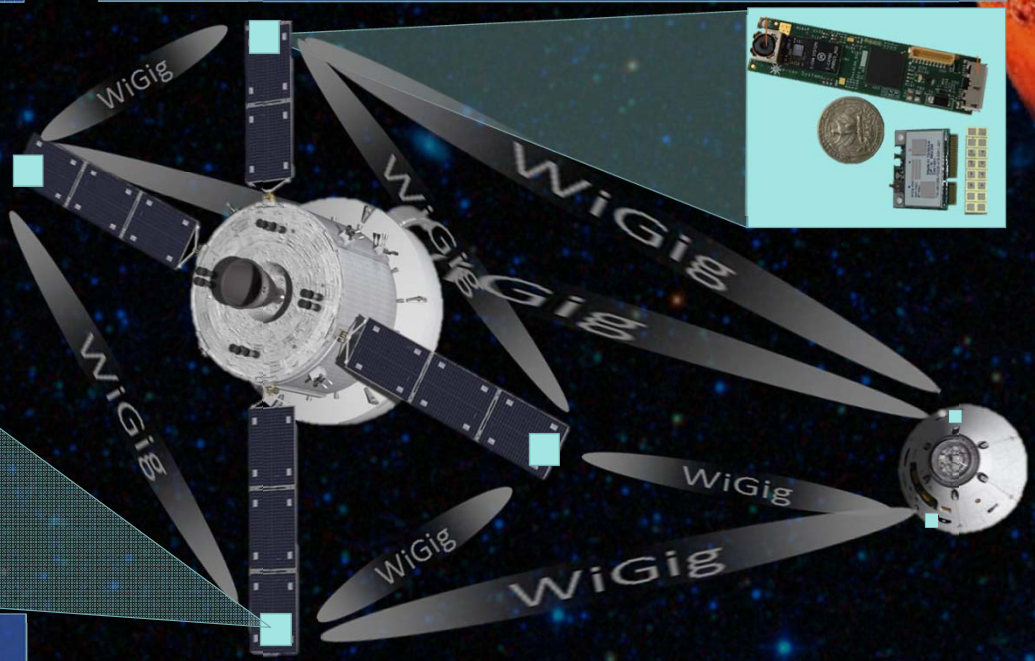
Results of past experimentation at NASA Johnson Space Center showed that the IEEE 802.11s standard has better performance than the widely implemented alternative protocol B.A.T.M.A.N (Better Approach to Mobile Ad hoc Networking). 802.11s is now formally incorporated into the Wi-Fi 802.11-2012 standard, which specifies a hybrid wireless mesh networking protocol (HWMP). In order to quickly analyze changes to the routing algorithm and to support optimizing the mesh network behavior for our intended application a visualization tool was developed by modifying and integrating open source tools.



Mesh Network

A wireless mesh network is a self-organizing network in which each node is responsible for routing traffic to other nodes in the network, thus providing a decentralized wireless network. This topology allows the network to be self-healing, if any node goes down or is out of range the network will adapt to find another route through the mesh. This decentralized nature of the mesh provides redundancy and reliability that make it a good solution for use in mission critical systems. In addition a wireless mesh network can provide extended range with very little additional resources. With traditional custom point-to-point solutions, infrastructure must be added in order to extend the range of the network or support a new application. In a wireless mesh topology the network can be extended simply by adding or moving nodes. Other potential applications for Orion could include audio, video and telemetry communication during EVA or from other payloads. Mesh technology could be extended to support communication between the International Space Station and visiting vehicles, or communication between astronauts and rovers for surface operations scenarios.

Targeted Application : Orion Camera System



Mesh Visualization

Methodology

Several open source projects were integrated together to develop a visualization solution. Two components from an existing visualization tool built for the B.A.T.M.A.N (Better Approach to Mobile Ad hoc Networking). protocol were used, a daemon that passed information between nodes named A.L.F.R.E.D (Almighty Lightweight Fact Remote Exchange Daemon) and a server that collected next hop information on each node called Vis. The Vis server was significantly modified to be compatible with the 802.11s routing protocol . Modifications were also made to collect and display a data rate associated with each connection, to display possible connections as dotted lines and to display the routing protocol's chosen routes as solid lines.

The Vis server's role is to insert the connection information into A.L.F.R.E.D via Unix sockets . Vis updates this information at a time interval specified in a configuration file. A.L.F.R.E.D distributes the information to all listening nodes via multicast when a request is sent out from a listening node. This information is compiled by the Vis server on the listening node and a network topology is written to a file in GraphVis ".dot" format. This file is displayed by an open source graph viewer named Kgraph. A simple bash script was written to request a new picture of the network when the data in A.L.F.R.E.D is updated by Vis, this happens at the configuration file's specified intervals. The display in Kgraph automatically updates when the ".dot" file is modified by Vis.

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