a.) The Wave Glider communication “Hot Spot" program is responding to a need for rapid transfer of large data sets from at-sea assets to shore. Experiments using AUV’s that do push limits on data return quickly run into difficulties with too much AUV time spent on the surface and a large dollar cost for data return. A major reason for this is our historical reliance on the Iridium Satellite constellation for over-the-horizon communications. While the AUV Iridium satellite systems are required for command and status updates, are reliable and provide worldwide coverage, they have a very limited data transfer rate and a large cost per byte. We propose to upgrade and operate the Wave Glider mobile communications Hot Spot to directly support MBARI field objectives. One an experiment that would benefit from high bandwidth communications relay from the Long Range AUV to shore, the second an experiment that would benefit from an acoustic communications relay that can pass data to shore from underwater assets. We plan to integrate a Globalstar satellite modem, 802.11 Wi-Fi, and 900 MHz RF link.
The Aerostat “Hot Spot" program is an attempt to efficiently network multiple semi-autonomous vehicles and experiments deployed within a few miles from a research vessel at sea. Experience has shown that typical low-profile autonomous vehicles and experimental platforms cannot maintain a direct radio link to a small research ship just 1km away due, primarily, to ducting and other atmospheric interference at the air/sea boundary. Range is much improved by raising the antenna height, but masts > 100ft are unworkable for small ships. While existing satellite based systems can provide basic network connectivity, low-power omnidirectional satellite links have a very limited data transfer rate, large cost per byte and high latency, making them impractical for any bulk data transfer or interactive "telepresence".
We intend to mount a radio relay on a helikite (combination balloon/kite) tethered to the stern of the research vessel. The lift capacity of the helikite is 1.5kgs. Power will be supplied by an Li-ion battery attached to the kite. The helikite remains tethered to the ship and can be retrieved within 5 minutes. It will be routinely retrieved every 1 to 2 days to swap batteries and replenish helium.

Most of the experimentation will involve determining which lightweight radio and antenna combinations can provide the largest coverage area within these system constraints. Various commercially available radios operating in ISM bands are being considered:

b.) Hot Spot is a store-and-forward system on the sea surface that relays data files between "end points" such as ships, shore, and AUVs, using RF line-of-sight, satellite, and acoustic communication links. Each end point can both send and receive data to and from any other end point. Command files as well as telemetry files can thus be exchanged between end points through the Hot Spot. Shore will be a common end point, but Hot Spot also facilitates exchange between autonomous platforms. An AUV can quickly exchange data with the Hot Spot via high-speed line-of-sight radio then dive to continue its mission, avoiding lengthy surface dwell time and dollar cost associated with satellite communications. If shore is the destination end point, Hot Spot then transfers the data via cell modem or satellite link, using optimal antenna designs to increase throughput and reliability. Multiple end points can use Hot Spot simultaneously. Hot Spot will emphasize functionality with existing MBARI assets.
The Aerostat "Hot Spot" seeks to provide reliable, low-latency TCP/IP network connectivity within a 5 to 10 mile radius around the ship from which it is flown. The project will experiment with tradeoffs of bandwidth and range using combinations of various radios and various commercial and custom antennas.

c.) MBARI's contribution is this area is that our work is directed specifically at developing an operational system that supports unique mobile assets, for example different classes of AUV's. While we are leveraging extensively from commercial products for the hardware we use, for example the use of the Wave Glider as a platform, using the Liquid Robotics processor as our current host, and with each of the individual radio modems, the system created by the aggregation of these products, the unique mix of radio telemetry, the network configuration and the software scripts that effect the file transfers are very unique to the ocean engineering problem space are and not available on any commercial product.
No commercially available system provides low latency, near 1Mb/s bandwidth networking for low profile, power limited experimental platforms at sea to facilitate intense study of many mile wide patches of ocean.