# Superboat International
Digital Island Media and Silvus Technologies
September 28th 2014 – Clearwater Beach, FL

Introduction:
The goal of the demonstration was to deploy a Silvus mesh network to cover a 4 mile off-shore race course in Clearwater Beach FL, enabling reliable RF connectivity for a live "in-boat" video feed from the Team STIHL Superboat traveling at 150+MPH:
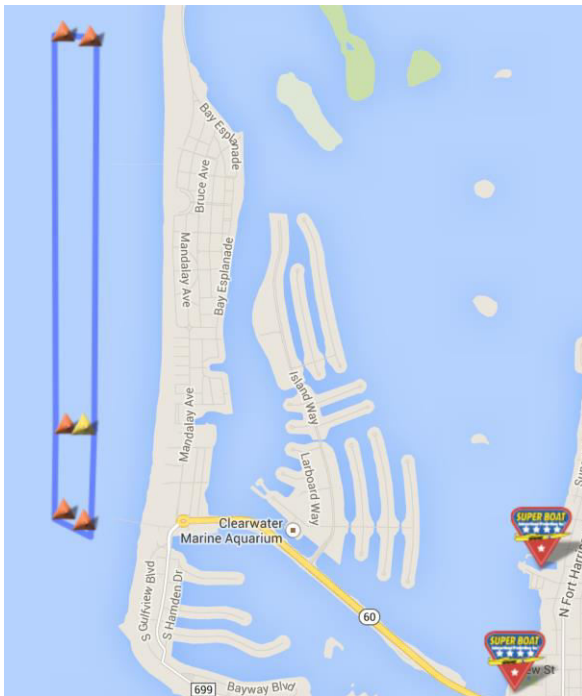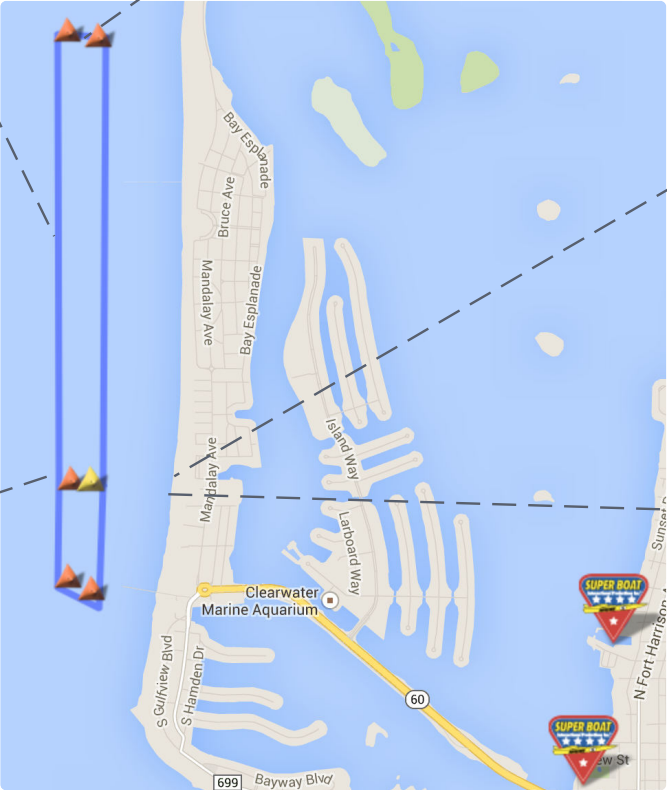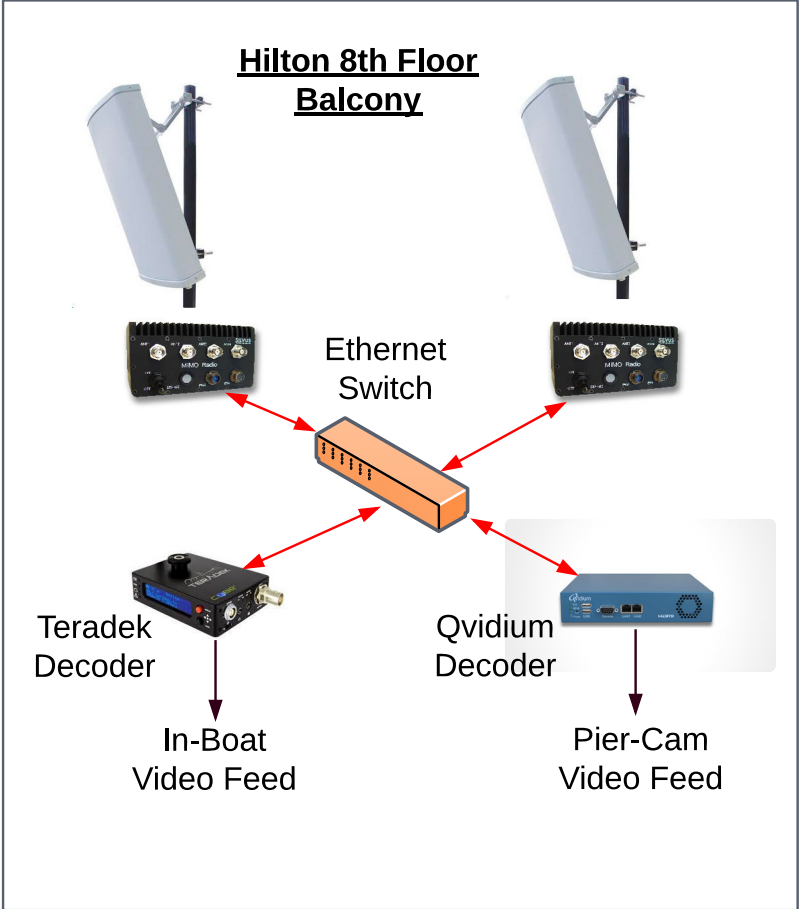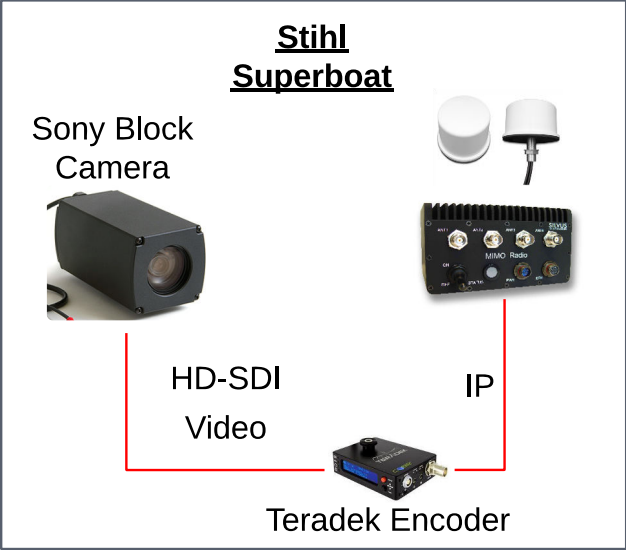

System Configuration:
An overview of the Silvus mesh system that was deployed is shown on the following page.

The system was deployed in a matter of hours, with only one opportunity for testing prior to the race. As a result, the configuration was purposefully over-engineered, with mesh nodes deployed at several points around the course to maximize the possibility of seamless video coverage during the race.

Superboat International Test
Clearwater, FL - Sept 28th, 2014

Stihl Superboat

Sony Block Camera

HD-SDI Video

IP

Teradek Encoder

Far Turn Boat Repeater

Hilton 8th Floor Balcony

Ethernet Switch

Teradek Decoder

Qvidium Decoder

In-Boat Video Feed

Pier-Cam Video Feed

Finish Line Boat Repeater

Pier 60-Cam

KT&C Square-Cam

IP

STIHL Superboat:

A 4x4 MIMO SC3500 radio, operating at 2.49GHz / 20MHz bandwidth, with 2x 4dBi horizontal and vertical multi-polarized omni-directional antennas, was installed in the STIHL boat.

The in-boat video feed was provided by a standard Sony "Block" camera, connected via HD-SDI to a Teradek Cube H.264 Encoder. The data rate of the video transmission from the boat was 4MBps.
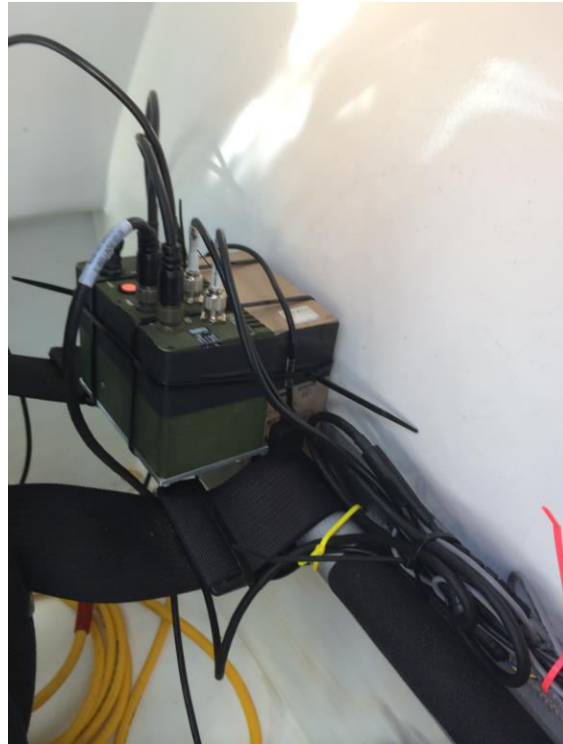

It is notable that the antennas had to be installed _inside_ of the cockpit. The ability to deploy multiple antennas (MIMO) allowed sufficient flexibility in choosing antenna locations within the cockpit, that in the aggregate, good RF coverage could still be achieved without any antennas mounted on the outside of the boat.
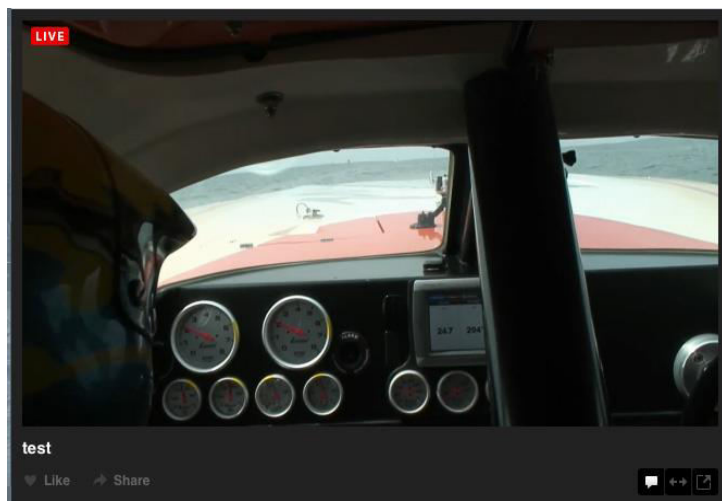
Turn and Finish-Line Boat Repeaters:
60ft recreational boats were anchored at both the finish-line and at the far north turn of the course. Radios were installed on each of these boats to act as wireless repeaters for the STIHL in-boat video feed.

Two 4x4 MIMO SC3500 radios, operating at 2.49GHz / 20MHz bandwidth, each with 2x 5dBi horizontally polarized omni-directional antennas and 2x 5dBi vertically polarized omni-directional antennas were installed on the far-turn boat as shown in the photos below:
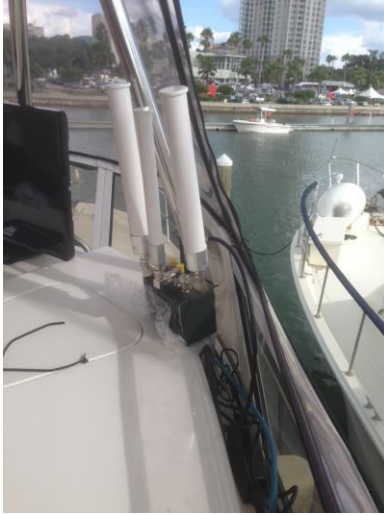
It is worth noting that for ease of install, the radios were mounted inside the cabin of the boat, not above the cabin where the permanently installed comms antennas and radar were positioned. However, full 360 degree coverage was still assured by deploying two radios (one of each side of the cabin).

Additionally, a single 4x4 MIMO SC3500 radio, operating at 2.49GHz / 20MHz bandwidth, with 2x 5dBi horizontally polarized omni-directional antennas and 2x 5dBi vertically polarized omni-directional antennas was installed on the finish-line boat as shown in the photo to the right:

Pier 60 Wireless Camera System – Pier-Cam:
A small camera with a wide-angle view was deployed on Pier 60 to provide video showing the crowd on the pier watching the race, the view of the beach and Hilton Hotel from the pier and closer in shots of the boats crossing the finish-line – all to add some additional perspective to the race broadcast.

The camera had a built-in H.264 encoder, and fed video via an IP connection to a single 4x4 MIMO SC3500 radio, operating at 2.49GHz / 20MHz bandwidth, with 4x 3dBi vertically polarized "rubber-duck" omni-directional antennas. The data rate of the video transmission from the Pier-Cam was set to 4MBps.

Hilton Hotel Balcony:

The video from the STIHL boat was routed to H.264 decoders located at the main control / video production room, on the 8th floor of the Hilton Hotel in Clearwater Beach. At this location, two 4x4 MIMO SC3500 radios were deployed, operating at 2.49GHz / 20MHz bandwidth, each with a 16dBi, dual slant +45/-45 degree polarized antennas, with spatial diversity (two independent sets of antenna elements side-by-side within the same radome) and 90 degree azimuth beamwidth – as shown below:
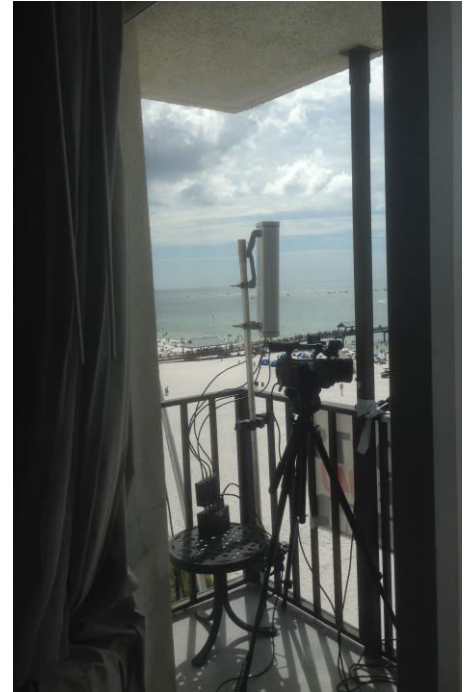
The antennas were positioned on the balcony with one pointed up towards the north end of the course and the far turn boat, and the other antenna pointed towards the south side of the course and the finish-line boat. Both antennas had a slight mechanical down-tilt.

A simple IP switch was used to connect the two radios together, and also to connect the two H.264 decoders (Teradek Cube and Qvidium QVDEC), which were used to decode the video feeds from the STIHL boat and Pier-Cam respectively, Video was routed to the video production switcher via HDMI:
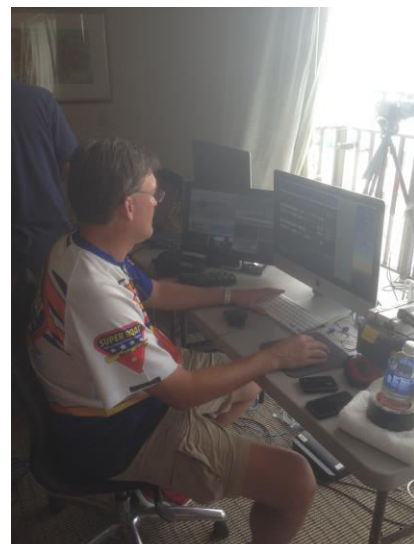
Test Results:

The Silvus mesh network was able to support flawless video transmission from the STIHL boat to the production location throughout the entire race 30+ minute race.

For almost the entire race the available network capacity from boat to production location was between 30 and 60MBps, only occasionally dropping below that.

As the STIHL boat moved around the course, the network automatically routed the video through one of four paths – direct to the north-facing sector antenna on the balcony, direct to the south-facing sector antenna on the balcony and via either the left or the right side relay radio on the far-turn boat to the north-facing sector antenna. As the network adjusted its routing, no video glitching or packet drop was observed.

In the picture below the Streamscape GUI shows the optimum route that the network selected by indicating the path with bold lines:
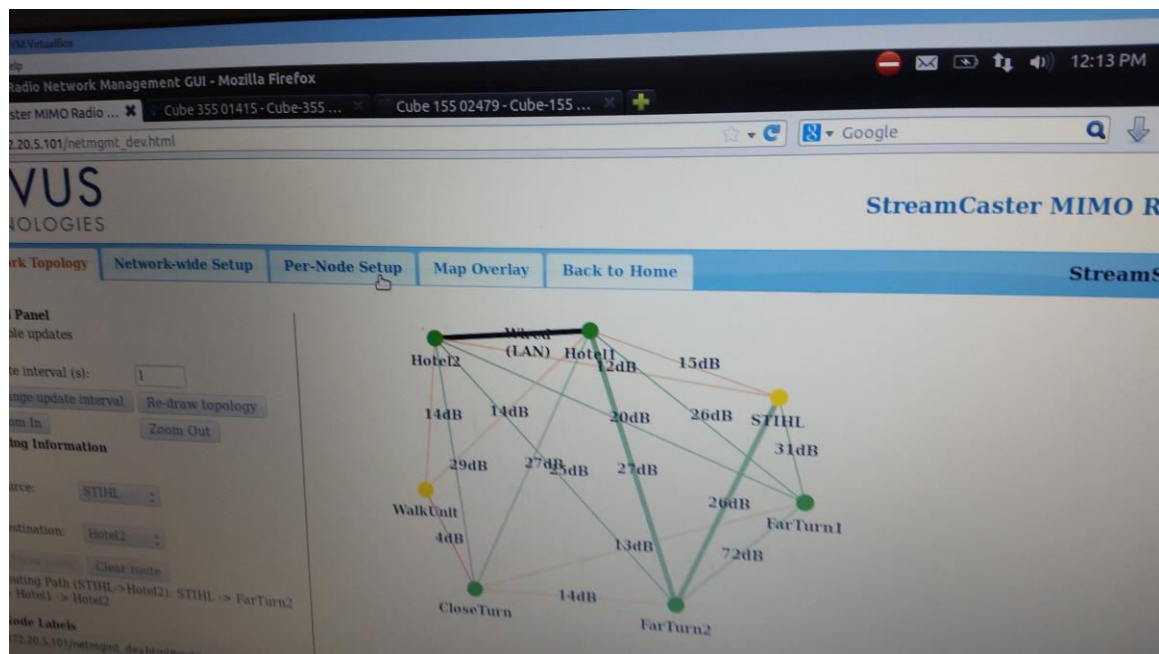
The Pier-Cam also delivered solid video during the race, over the same network and channel frequency as the race boat. Occasional drop-outs were seen on this feed as the radio and camera were re-located to different positions on the pier and the radio was in a non-optimal location (in a back-pack on the floor and shaded by the pier infrastructure) – however once a shot was set-up the video feed was observed to be solid, and was used numerous times on the race broadcast.

Links to Video:
Livestream of race
http://new.livestream.com/sbi/clearwater2014
The in-boat and pier-cam feeds are cut to continually throughout the livestream of Race 3, and the commentators discuss the Silvus mesh network from approximately the 52.45 minute mark onward.

Streamscape GUI showing hand-offs as the STIHL boat moves around the track
https://www.dropbox.com/s/atquw6a3003oi8w/20140928_151342%5B2%5D.mp4?dl=0

Streamscape GUI, video feed and video switcher
https://www.dropbox.com/s/8r5vmb45qwwwpdw/20140928_144851%5B1%5D.mp4?dl=0