An Introduction To Remote Metrology

In 2017 Zupt started providing remote metrology services in a response to a request from Anadarko. Zupt, working with Oceaneering has delivered a total of 12 remote metrologies to date.

In simple terms, all that we are doing to provide remote metrology services is to connect ROV video, data communications and voice (phone line) from offshore to onshore. The survey equipment is exactly the same, the data acquisition software we use is exactly the same, the survey team just sit at a conference table in Houston (in the case of Anadarko) instead of sitting in the ROV control van offshore.

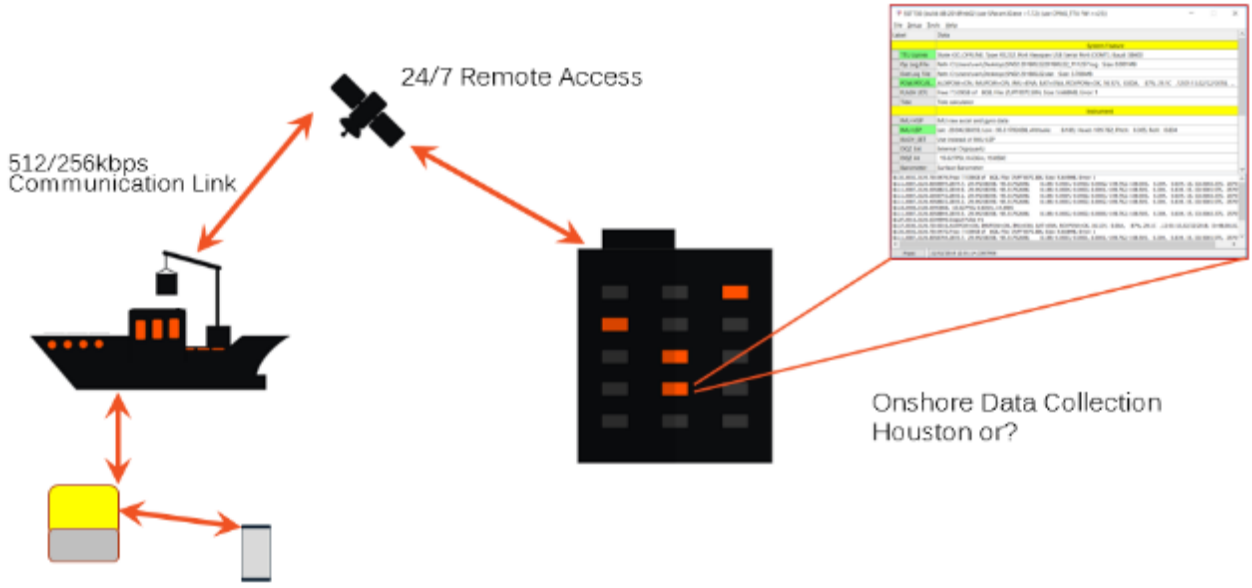

Figure 1. Remote Metrology System Diag

The equipment required is a small rack of equipment (the Oceaneering ROS system) to provide the connection between offshore/onshore. This rack mount system contains all of the connectivity to allow the serial, video and voice to be connected to a single IP connection port (switch) in the ROV room or wherever the appropriate Ethernet connection port is made available on the vessel. The rack mount system contains:

Tunneling level 3 router to connect to the Satellite modem
Moxa NPort Serial to ethernet server (M5410 or M5210A) – C-PINS connection
H.264 or H.265 Video encoding device - video connection
IP Phone with headset
Uninterruptable Power Supply (UPS) with managed power distribution outlets (IP enabled)

The rack mount system is connected to vessel's power and the ethernet is connected to the appropriate switched port on the vessel. The serial connection from the C-PINS system on the ROV is connected to the Moxa N Port device (serial to Ethernet server), the video feed from the ROV will be connected to the video encoding device and the IP phone/headset will be placed next to the ROV pilot's work location. The remote rack is connected to a vessel based IP system through the bandwidth providers managed switch.

What bandwidth do we need?

Note we specifically keep the conversation below to bits per second (bps) to try to not confuse megabytes per second MB/s (~10 times Mbps) with megabits per second Mbps.

As a minimum we think 512,000 bits per second (bps) is the short answer. This includes very decimated compressed video, the serial channel to our instrument and maybe a voice channel (VOIP).

Some background – satellite communications is not really any different than ROV mux communications – we just need a certain amount of bandwidth up and down. Because of the cost of satellite bandwidth, the provision of satellite bandwidth services is very configurable (or confusing). If you need to just send information (perhaps video) from the vessel to onshore you need perhaps 512,000 bits per second (bps) "traffic coming from the vessel". If we are just sending simple commands like we send to C-PINS on the ROV from onshore to offshore we only perhaps need 128,000 bps "traffic going to the vessel". In the satellite business this connection is defined as a 512/128Kbps connection.

If we want to be sure that we have this bandwidth available to us (like quality of service in a network connection – QoS) we then define to the satellite bandwidth provider that this is a "Committed Information Rate" (CIR) 512/128Kbps connection.

Voice - IP Phone with headset (if needed)

In most cases we believe that we may be able to easily get a voice phone line into the ROV operational area and we may not need to deliver the voice channel. It is our understanding that a single voice channel will need ~60,000 bps up and down using standard Codec's for encoding (G.726 56 Kbps Used in international trunk calls, G.728 32Kbps delivers toll voice quality for lower bandwidth). This is a bi-directional requirement.

C-PINS

38,400 bps serial comms via Moxa N Port Serial to ethernet server. This, with some overhead will need an additional 60,000 bps, but this is from offshore to onshore and from onshore to offshore we will need perhaps 20,000 bps capability for this serial comms capability.

Video - Compressed HD video – 1 or 2 seconds latency not an issue

This is another area where we are learning – both H.264 and H.265 video encoding devices are readily available and deliver the best compression available for video. The type of video we need is to

see what is happening subsea indicating that the C-PINS system is located at the right heading and in the correct slot. We can live with lower frame rates of even 10fps. If we were watching a F1 race at 10fps we would be frustrated with the quality, but watching C-PINS sitting in a receptacle does not need a high frame rate. We believe that 1280×720 (HD) with 30fps encoded with H264 will require 3,000,000 bps. If encoded with H265 this should be cut by apx. 50% or 1,500,000 bps. When we drop the frame rate to 10fps this should be apx. 1,000,000 bps for H264 and 500,000 bps for H265. If we drop the frame rate by another third to a point where we start to see jitter between frames at 5fps this drops to 335,000 for H264 and 167,000 for H265.

This video bandwidth requirement is all from the vessel to the beach. We need nothing from the beach to the vessel – maybe just a very low IP config data rate (20,000bps).

So the total bandwidth requirements are:

From the offshore vessel to the beach:

Optimal – good video with overhead	1,250,000 bps (H264, 10fps, 10% overhead)
Low resolution	512,000 bps (H264, 5fps, 10% overhead)

From the beach to the vessel:

No difference in resolution	100,000bps (60voice/20serial coms, 10% overhead)

Or:

CIR 512/128Kbps for significantly compressed video
CIR 1,024/128kbps for much clearer video

Simple procedure for Remote Metrology:

Equipment ships offshore. As soon as it arrives offshore ROV personnel check packing case count against manifest listing.

3 days prior to metrology:

ROV take all equipment to ROV deck and complete full system integration. When all is OK C-PINS is plugged in and tested. Then we have proven comms from the ROV to onshore. Equipment re-stowed

Day before metrology:

ROV personnel collect CTD profile, assemble C-PINS into lifting hardware and attach stab.

Metrology:

Bring system up – comms check to Houston – start collecting data