Remote Metrology

Presentation Agenda

01 What is a remote metrology?

02 A mature solution – remote metrology track record

03 Benefits of a remote solution

04 How do we do it?

05 Lessons learned

06 Sequence of operations

Remote Metrology - No offshore survey personnel

Metrology equipment shipped to vessel/rig/drillship well ahead of the planned metrology date.

The remote communications and metrology equipment are tested prior to metrology date.

Equipment stays on standby until the actual metrology start.

Metrology operations – onshore team logs into the C-PINS COMS / Video / Voice

ROV team mobilizes metrology equipment onto ROV.

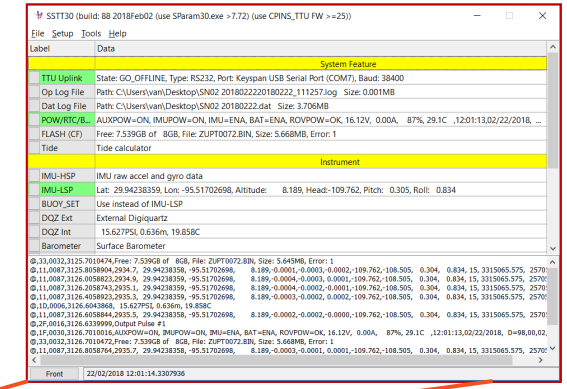
C-PINS is fully controlled from onshore where it is aligned and metrology data is collected.

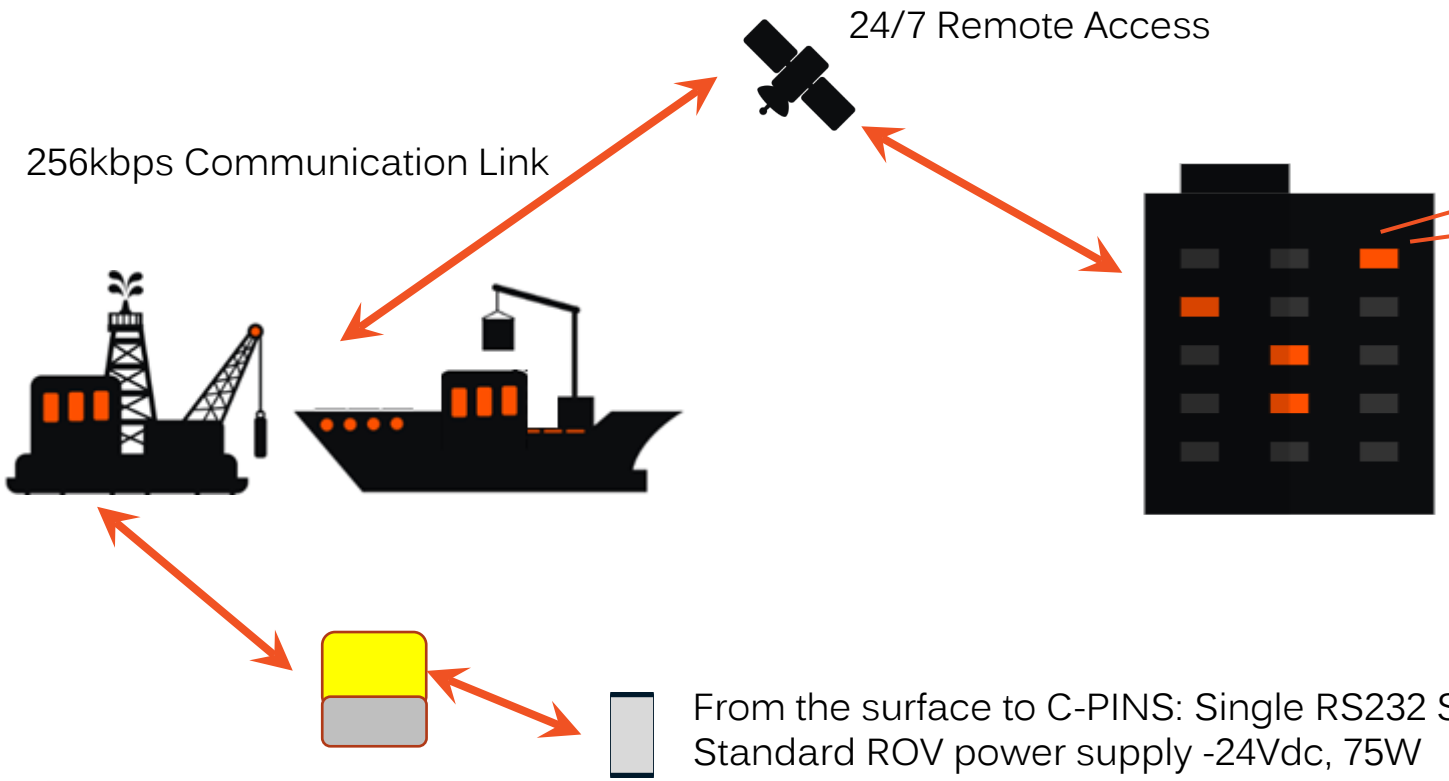
Data review and QC in real time onshore (with client rep if required). Final report delivered.

Demob when convenient

How do we communicate?

Data collection is performed onshore, not sent onshore from ROV.
Metrology task plan followed by the ROV team offshore, under the direction of survey team, onshore.





Onshore Data Collection
- Houston

From the surface to C-PINS: Single RS232 Serial Channel 38,400 baud
Standard ROV power supply -24Vdc, 75W

A Mature Solution – Zupt's Track Record

The first remote metrology was performed by Zupt on June 16, 2017.

To date, Zupt has performed 12 remote metrologies (+3 remote buoy sets)

- PLET PI-2A to KC 875 East Manifold EM12 – June 15, 2017
- PLET PI-1B to KC875 East Manifold E6 – June 16, 2017
- KC 875 East Manifold E5 to Well #4 – July 8, 2017
- EB 646 to Well #12 – October 23, 2017
- Remote Buoy Sets completed Dec 27, 2017
- GC727 Manifold Hub T2 to GC 726 Well #3 – February 21, 2018
- GC 652 West PLEM Hub H3 to Well #7 – April 27 2018
- And more…

Remote Metrology vs. Manned Metrology

Comms configuration troubleshooting during equipment mobilization to the ROV (we regularly deal with this on manned metrology work) have all been remedied by ROV through onshore instruction. The ROV team mobilizes the equipment to the ROV, and the interface test / coms test sorts out any wrong serial channel / baud rate / TxRx crossover issues. The physical presence of a surveyor for troubleshooting coms has not been needed.

A full compliment of spares is shipped – 2 sets of everything.

The risk associated with a remote metrology campaign is no greater (actually less) than a standard offshore manned metrology. Remote metrology benefits from the improved HSE risk profile as no personnel are offshore (no visas, no vessel transfers, flight delays, POB issues)

Risk profile of remote solution is no worse than a manned metrology.

There has been no issues or complications faced during our remote metrology operations to date that would have benefited from a surveyor being offshore.

Benefits of Remote Metrology – Flexibility / Fixed Cost

The benefits of the remote option are more than possible savings from the reduction in personnel day rate.

Metrology "on demand"

- Clients can choose when to do the metrology with no consideration of equipment or personnel logistics.
- No need to mobilize an international team early with premature estimates of tree install or drilling completion.
- The need to plan the exact metrology date weeks in advance is longer a factor with equipment already offshore and no personnel logistics constraints
- No risk associated with early ($) or late ($$) call out of metrology team.

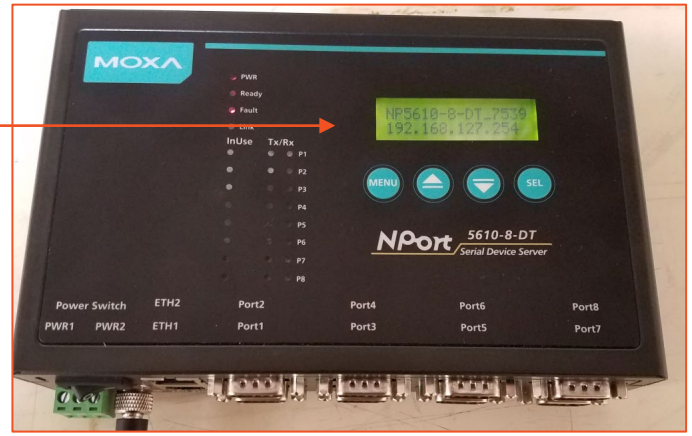
Equipment demobilization – no rush

- Current manned contracts have clients racing to arrange a supply vessel upon completion of the metrology to get the equipment and people off day rate.
- With remote project costing the offshore day rate for the equipment is factored into the lump sum, whether it gets demobilized the day after, or 5 days later when the next supply vessel is scheduled, the cost remains the same.

How does it work? What is required?

- **C-PINS Communications** – single ROV serial channel - 24V / RS-232 38,400 baud
- We use a Moxa Nport installed in the ROV control van to convert C-PINS serial communications from ROV to ethernet:
- The serial data is interfaced to an onshore laptop running SSTT (Zupt's metrology data acquisition software). Data is collected onshore, no metrology data transfer from offshore sensor to onshore team required by ROV.

ROV reads IP address off Nport and provides to onshore



- **Video** - is sent to the beach in a similar manner
- **Voice** – an IP phone with a headset has worked successfully for voice communications between the onshore metrology team and the ROV control van.

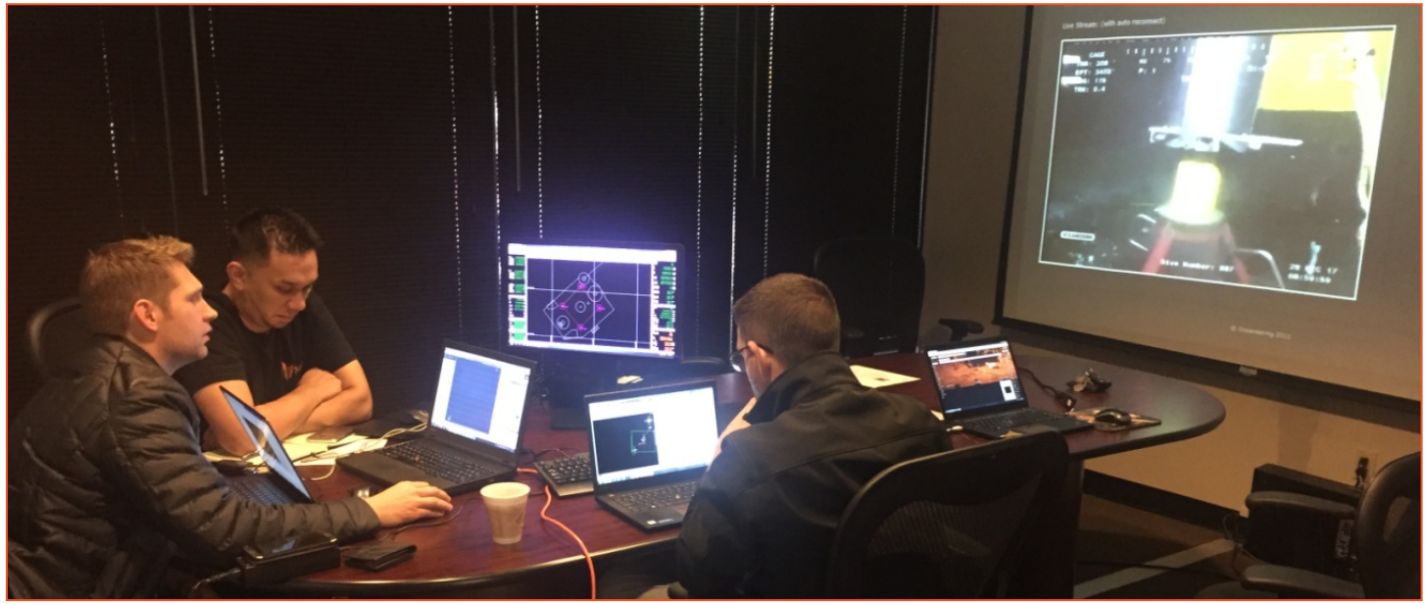
What is Required – Reliable Bandwidth?

ROV Video to Onshore

ROV camera feed to the onshore metrology office is required for remote metrology.

Some latency can exist in video stream (we have successfully dealt with ~6 sec delay).

We don't collect data while C-PINS is transiting so several seconds of video latency does not delay metrology operations.



Lessons Learned

What went well?

- No delivery issues, equipment, procedures, tooling all OK. Export and logistics had no issues.
- Preliminary training with ROV pilots (at least some of the vessel / rig crew) was very helpful once equipment arrived offshore. Essentially an onshore show and tell before shipping equipment (2 hours now – 4 hours for first training session).
- No Survey personnel on board, ROV interfaced/operated the equipment correctly and efficiently.
- Good voice/network/video connectivity to ROV – latency issues with video never impacted timing or metrology efficiency.
- Metrology executed off Rig's/vessel's critical path
- Deliverable turnaround time less than 24 hours

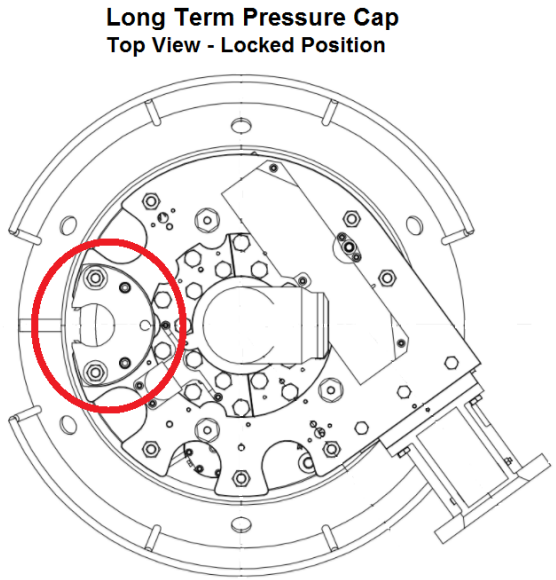
Lessons Learned

What have we improved?

- Clarity needed in tooling, no pull down slot for this work! (same as a manned metrology)
- ROV personnel suggestions have included a request for more detailed C-PINS test box instructions (Done).
- C-PINS tooling preferences (Monkey fist / vs fishtail / vs T-Handle) – ship all options.
- Green tag all primary equipment so ROV can “grab and go” once equipment shows up. No need to decipher what is a spare what is a primary.
- Updated the remote metrology risk assessment with practical experience.
- Note – all improvements had nothing to do with the fact that this was a Remote Metrology!

A Detailed Lesson Learned

- During the remote metrology trials for a current client a Pull Down Slot was requested to be used for the remote trials (jumper in place). While offshore it was found the Pull Down Slots have variable tolerances and the tool originally fabricated for the work needed modification.
- ROV modified the tool and we were back in the water shortly after an adapter was fixed to the tool.
- ROV personnel fixed the issue!



Semi circle of Delrin retrofitted to prevent tool slipping out

Project Preparation – Before the Job

Same as any metrology:

- Client provided data for metrology – Field CAD / Dimensional Control DWGs / Hub IDs
- Task plan preparation and client approval
- Remote metrology risk assessment signed off.
- If needed: ROV personnel training

Remote Metrology Timeline

What does the schedule look like?

10 days out	*5 days out*	*24 Hours Out*	***Metrology***	*Within 24 hours*	*Up to 10 days after*
Equipment shipped and delivered to client many days ahead of first metrology	Equipment arrives offshore – on standby on vessel/rig for another say 5 days.	Client confirms metrology to be conducted the next day. Interface test with ROV prior to job start.	Remote system mobilized by ROV / metrology conducted remotely (8 hours).	Report to client within 24hrs	Equipment demobilized at client's convenience (10 days after job completion).

Contact Info

EMAIL

kv@zupt.com

PHONE

+1 832 295 7280

WEBSITE

www.zupt.com