

Problems Faced by Industry in Subsea Cable Repair

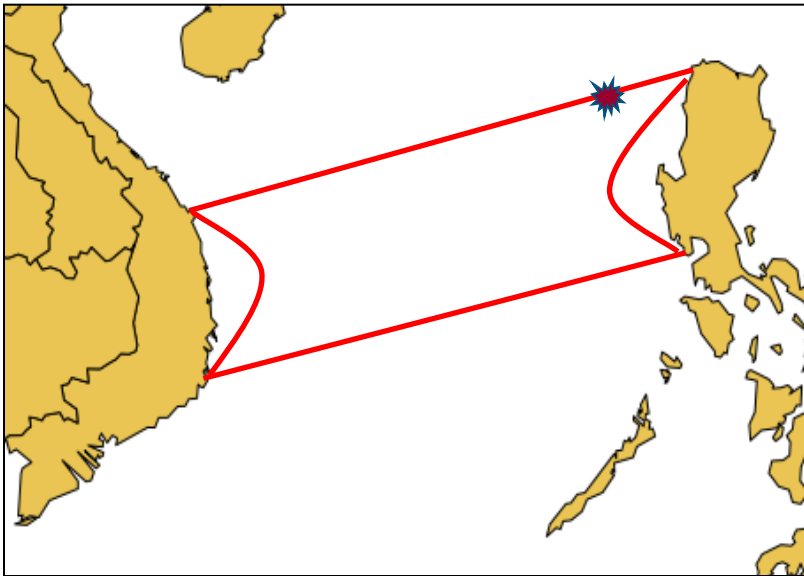
CIL/ICPC Workshop – 14 April, 2011
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TE SubCom

Network Security and Cable Protection

- Network security is of paramount importance to communications companies
- Cable faults can disrupt communications including financial transfers, data, voice, fax and internet
- In some cases, communications can be restored immediately
- In other cases there are not enough restoration pathways
- Satellites generally lack the required capacity and speed
- Any fault can make local and regional communications more vulnerable, in case additional damage occurs
- **Speed to repair is essential to restore communications and reduce risk of more disruption**

Two examples of the need for speed to repair

- A “ring” system can sometimes continue with one break, by transmitting in the other direction

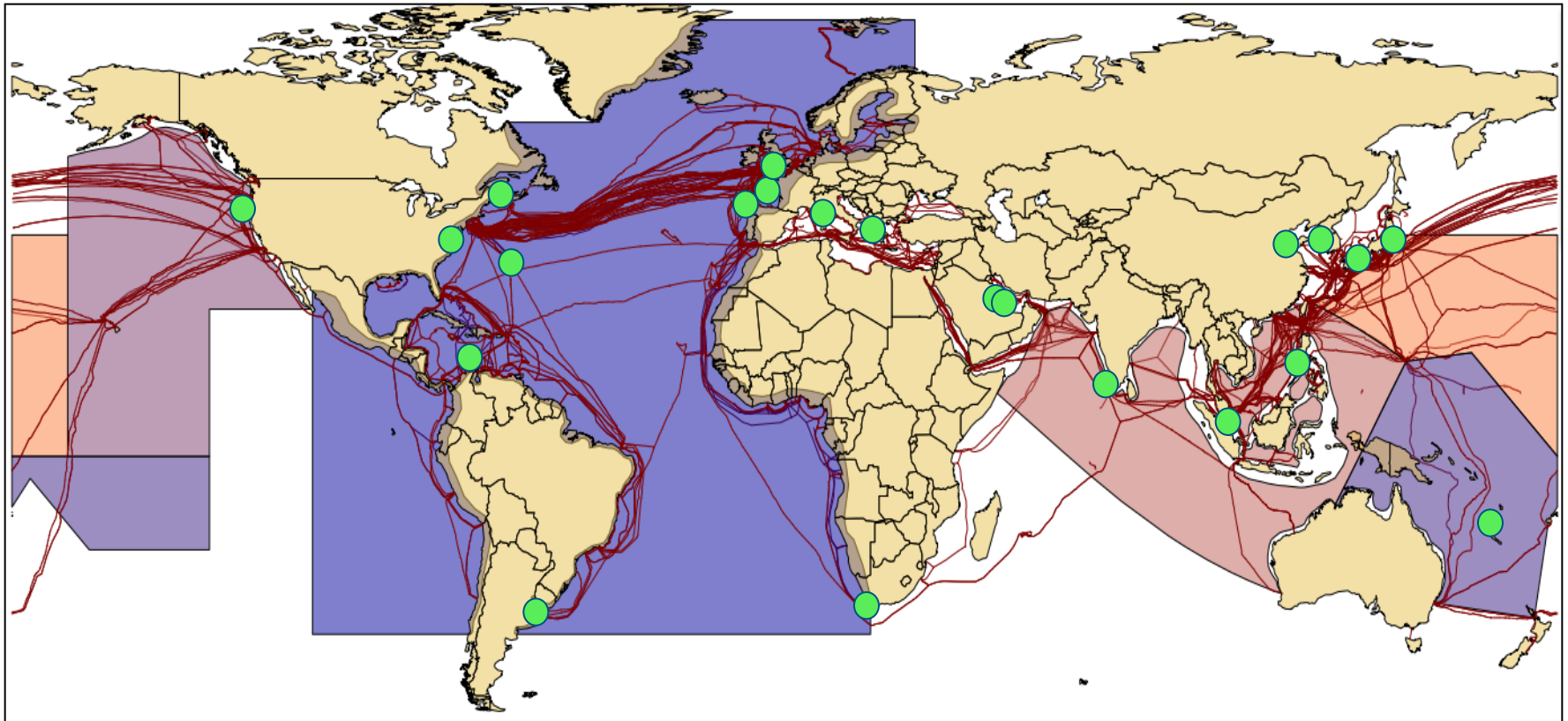


- A cable with a shunt fault can sometimes continue fiber transmission



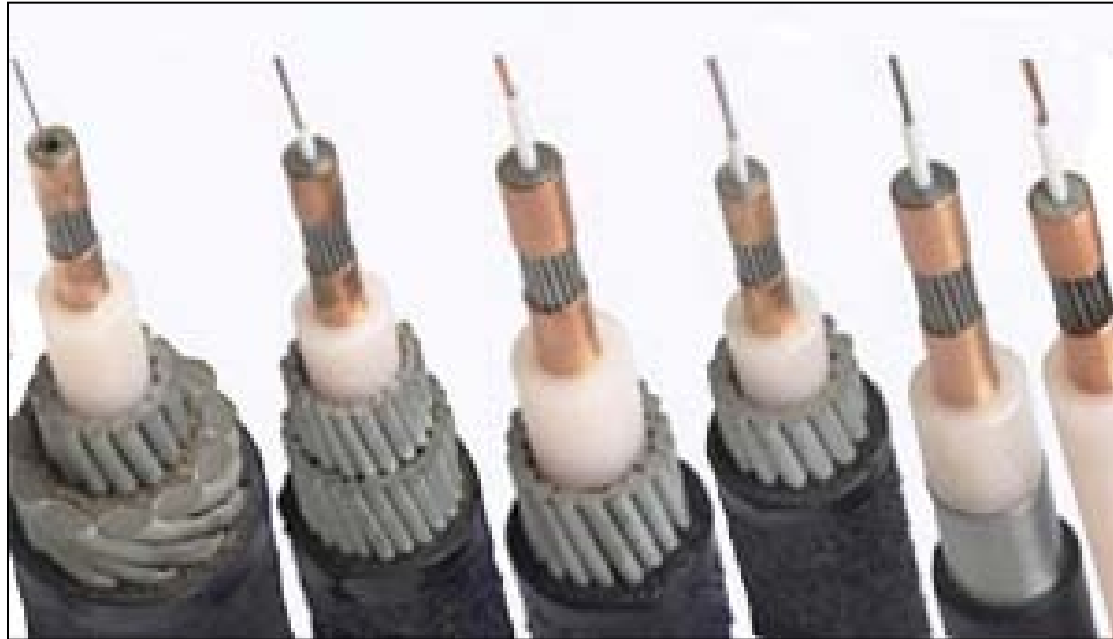
BUT a second fault on either system can shut it down!

Cable owners maintain guaranteed access to strategically located cables (●) to mobilise for repair in 24 hours



- Maintenance zones and ship locations shift as cables & contracts change
- One scenario could look like this

Structure of modern subsea communications cable



- Note fibers (often 8 to 16+) in center, copper tube to carry electrical current to power amplifiers (repeaters), polyethylene insulation
- Armor is optional for areas of risk and burial shallower than 2000 m

Challenges of Fault Localization

When cable damage occurs, alarms sound in coastal terminal stations

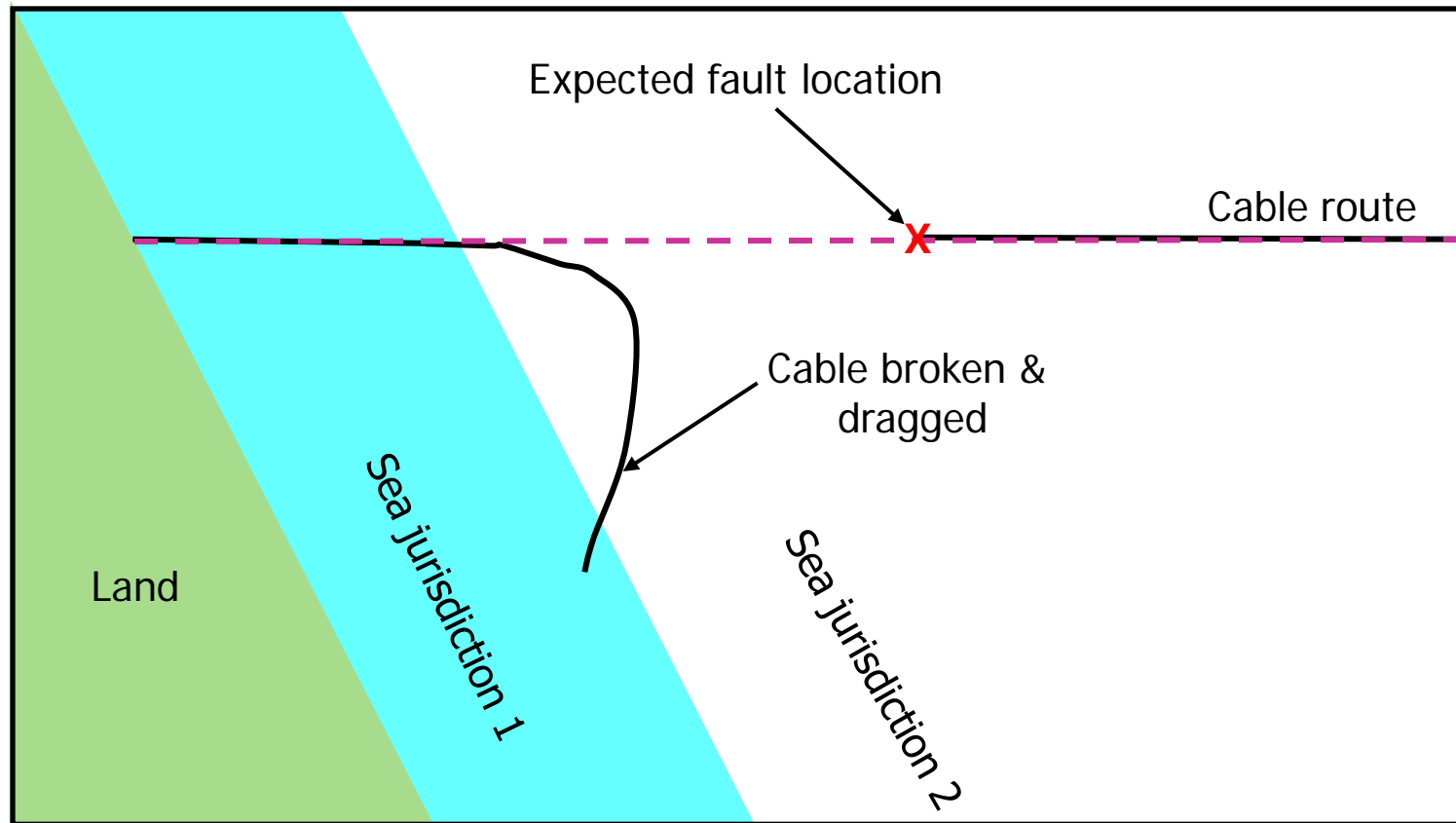
Some fault locations are quickly & precisely determined

But in other cases:

- Instrument readings in terminal stations may change as a fault develops, due to movement of the cable or deteriorating insulation
- A fault location may take hours or days to confirm, and may be imprecise, depending on type and number of faults & network design
- When a ship tests a cable end, it may find additional faults not apparent from instruments on shore
- *This is important because when the expected fault location changes, the jurisdictional area may change*

Challenges in Fault Localization

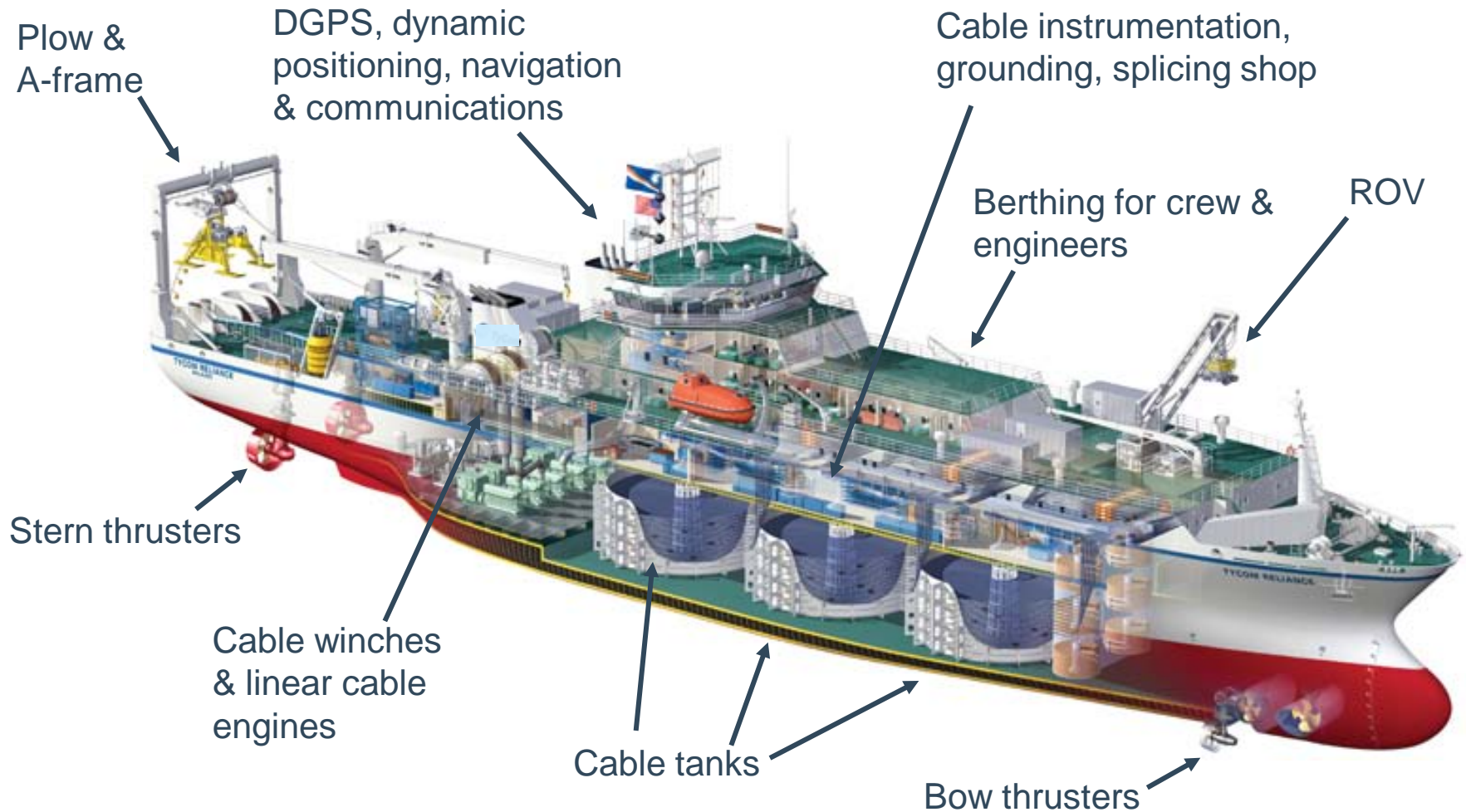
Shore instruments measure length of cable to fault, but if cable has been dragged off its route, position is changed. Actual position may be in different jurisdictional area



Permitting Issues Can Cause Major Delays

- UNCLOS provides international law for operating in different jurisdictional areas
- But .. Coastal State laws may differ so are investigated and complied with (supersede UNCLOS)
- In some areas no repair permits are required
- In other areas a repair permit takes 1-6 weeks or more – requirements unclear
- Some nations require permits beyond areas commonly seen as territorial sea
- In disputed areas we must sometimes obtain permits from 2 or more nations
- Nations' requirements & agencies change – some require permits from 2 agencies
- A typical cables ship crew of 50 has specialist experts of many nationalities – this can also complicate permits
- So, for every operation near any country's territorial sea and extended area, we must have our local representatives confirm whether a permit (or multiple permits) are needed

Cableships have specialized design & equipment for navigation, holding position, handling & splicing cables



Cabotage requirements could prevent the deployment of an effective repair ship

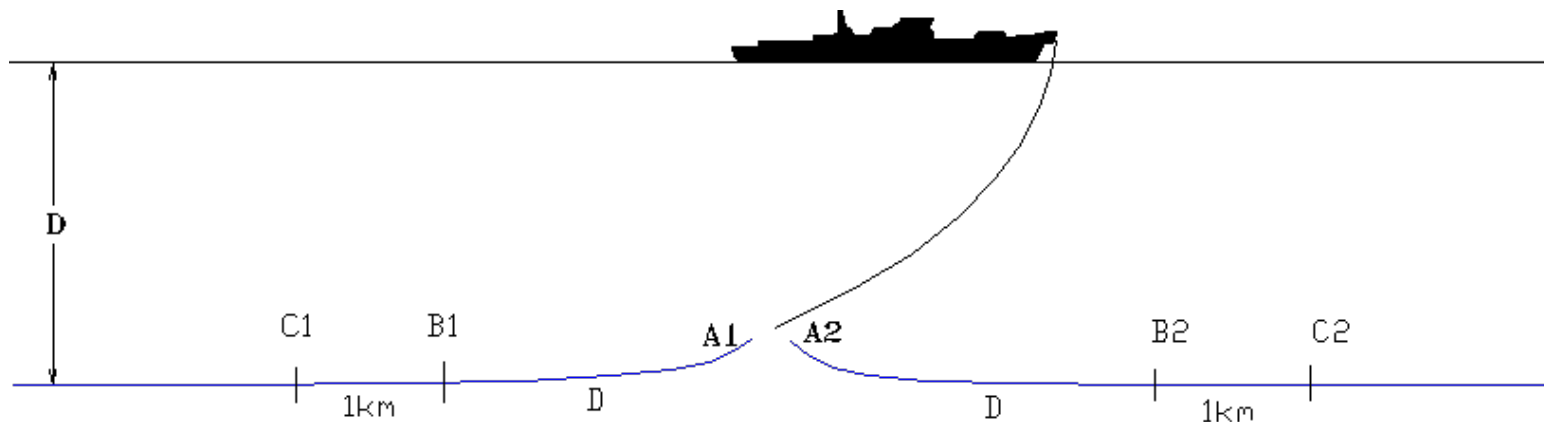
- Cable operations require precise navigation and station-keeping
- Repair water depths range from near zero to over 5000 m
- Precise cable handling requires specialized winches with instruments for measuring cable length, deployment speed and tension
- Cable splicing on board ship requires precise equipment in a sheltered, clean environment
- In some cases (water too shallow for ship, etc.) barges or other platforms are used, but such operations may involve slower mobilization, delays and operational difficulties

Cableships are specialized vessels with unique capabilities that should be exempt from cabotage requirements

Cable Repair Cutting Drive

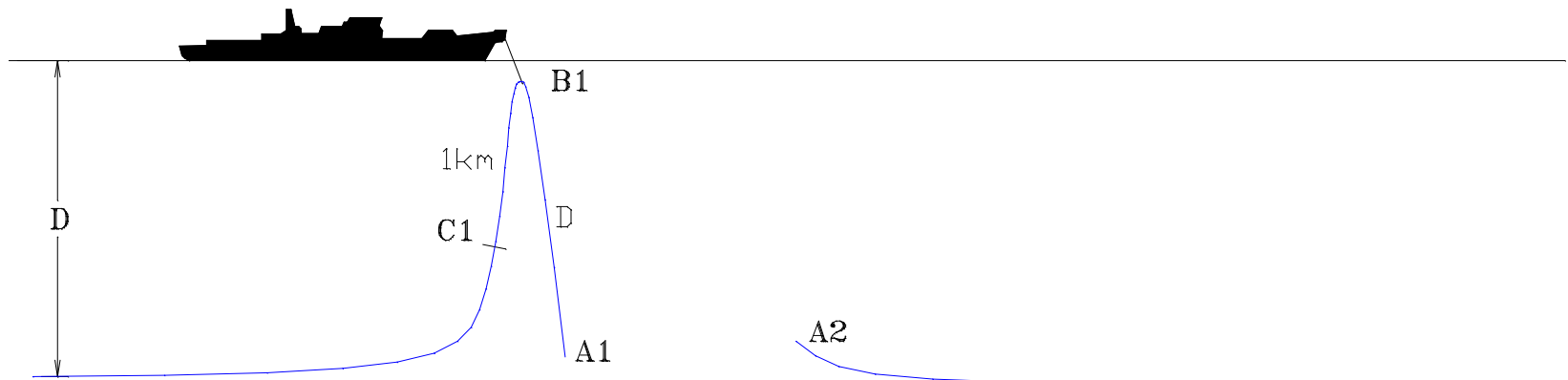
Slides may be replaced by video

- Different repair methods are used in different depths and conditions
- One common method starts with the ship dragging a cutting grapnel to cut the cable
- For cables buried deeper than 1 m into the seabed, multiple cutting runs may be needed to find the cable



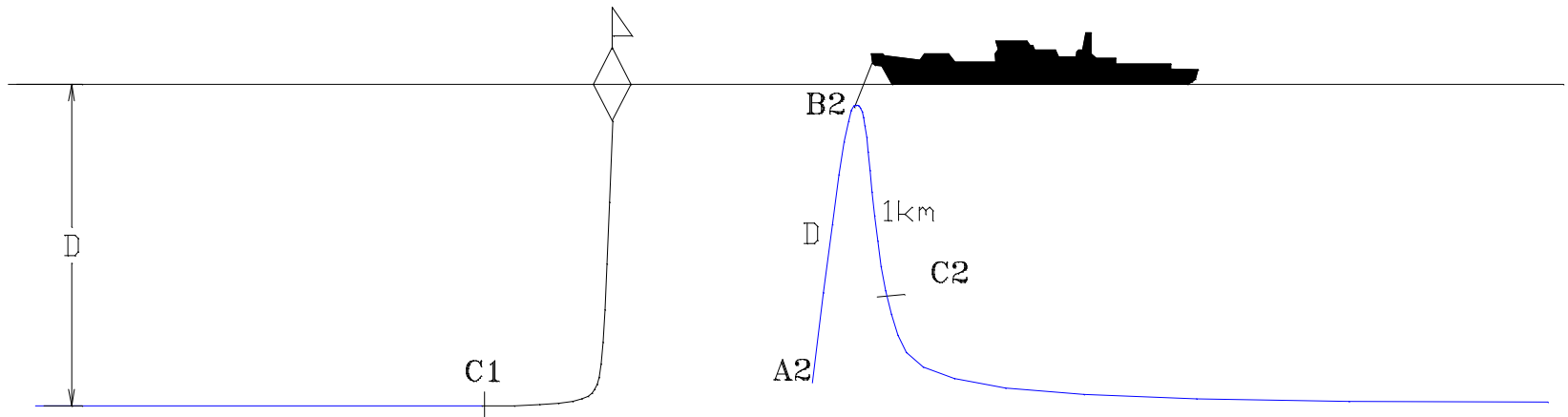
Cable Repair Recovering First End

- After the cutting drive, the holding drive picks up one end of the cable
- The end is tested to see if there are any more faults between it and shore
- Any damaged cable is cut out until the end tests clear to shore



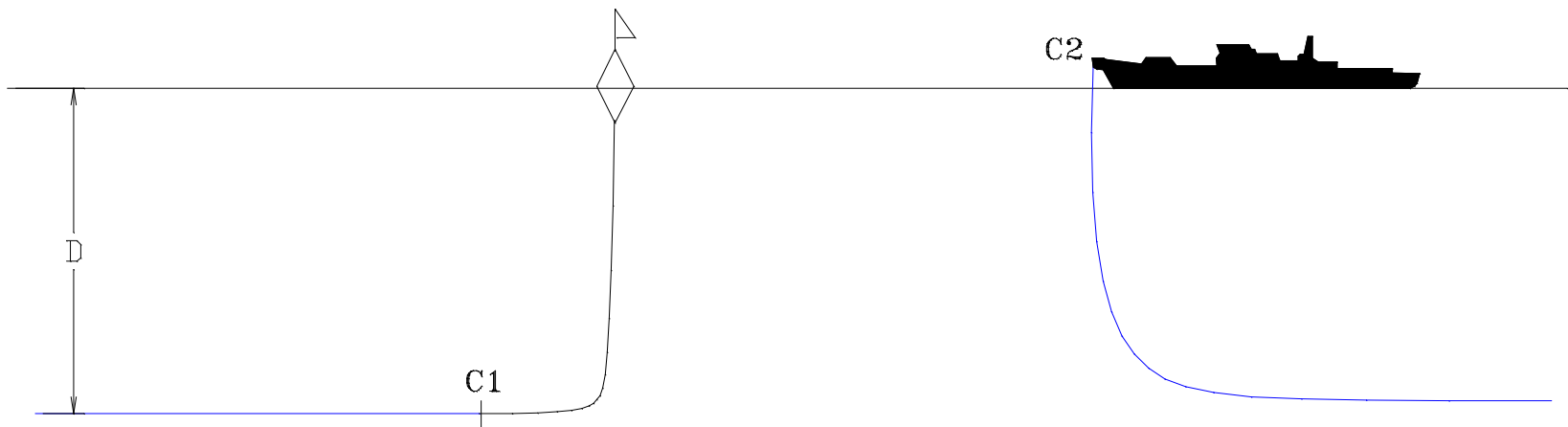
Cable Repair Recovering Second End

- After any damaged cable is removed from the first end and it tests clear to shore, the first end is left on a buoy
- The second end is picked up and tested, and any damaged cable is cut out



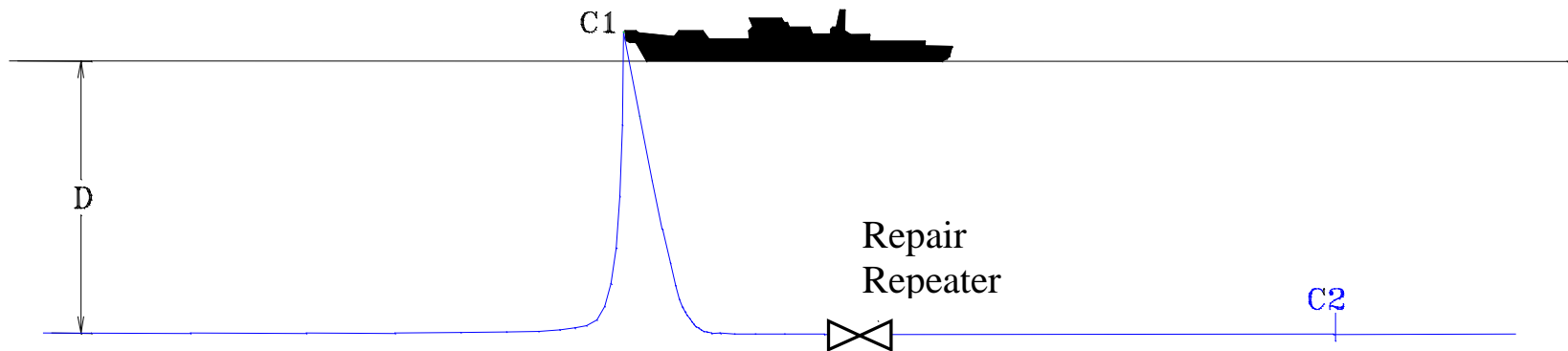
Splicing Spare Cable (Initial Splice)

- After all damaged cable is removed, the ship adds a piece of spare cable long enough to reach between the ends
- Below the ship is performing the Initial Splice (first end of the spare cable)



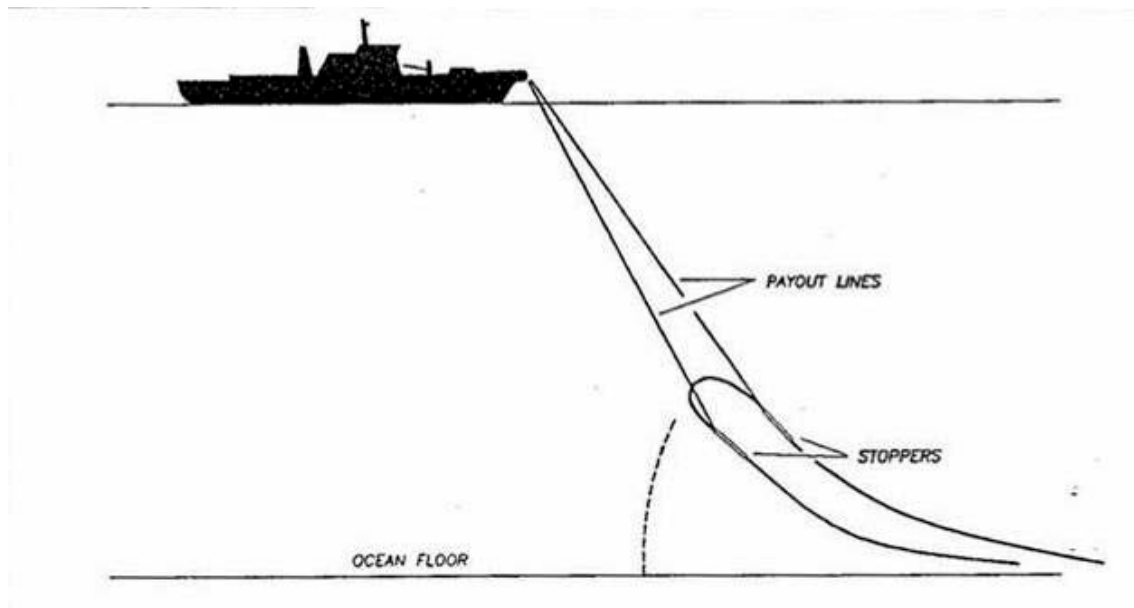
Repair Final Splice

- The length of spare cable needed depends on the amount of cable removed and the water depth
- If much length is added, an extra repeater may be needed
- Below the ship is making the Final Splice



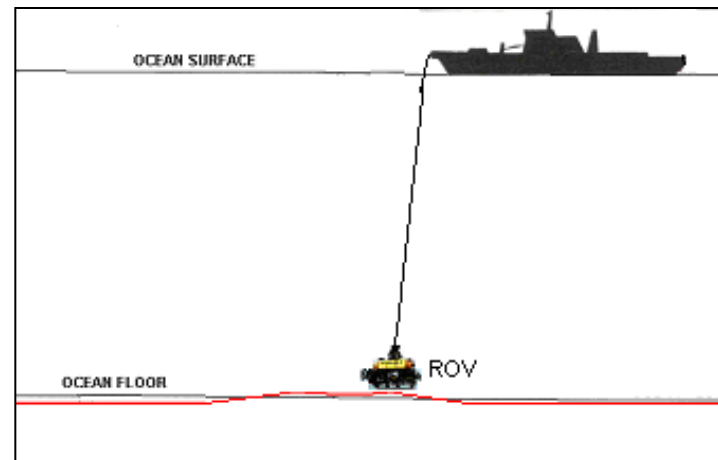
Laying Out & Burying Final Splice

- After the final splice is completed and tested, it is lowered carefully to the seabed
- The Final Splice may be buried with a Remotely Operated Vehicle (ROV) for protection, if seabed conditions allow

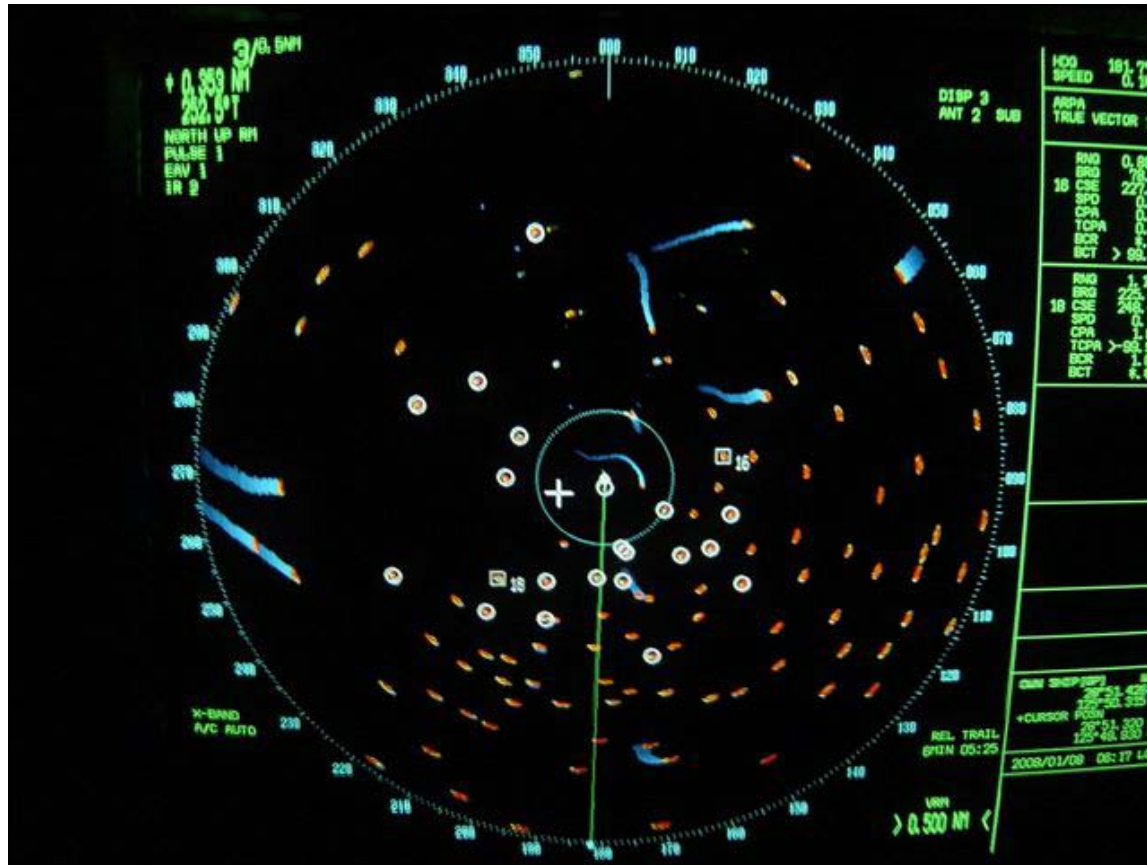


Cable Operations Involve Restricted Mobility

- A typical repair may take several days for the ship to reach fault position, 3-5 days with ship on site, longer for bad weather or other factors
- During cable operations a ship has limited ability to maneuver, with cables or ROV umbilical in the water
- One splice may take 12-24 hours with ship stationary & cable suspended in water column
- During operations the ships, cables and equipment are vulnerable to damage by other vessels and fishing gear



Potential for Interference from Fishermen



- Radar from cableship showing more than 50 fishing vessels within a 5 km radius in the East China Sea
- More than 10 were within a mile of the cableship, causing interference with the cable operation
- Some fishing vessels approach too close, risking collision & entangling nets

International law requires fishermen to keep vessels and gear at least 1 mile away

Interference during operations



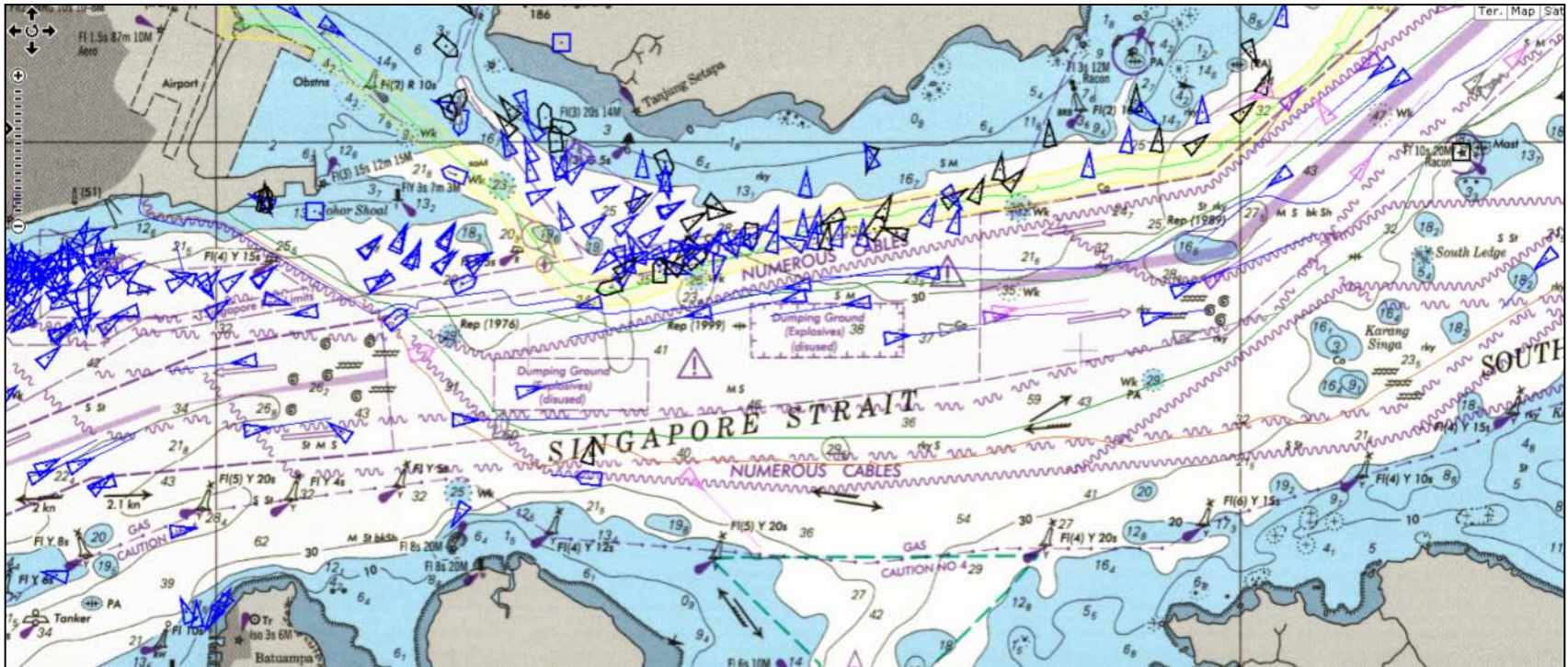
- These fishing vessels approached within a few metres of cableships engaged in operations
- They did not respond to radio & physical warnings

Attempted Theft of Cable & Equipment



- Cables ship left the end of a cable attached to a buoy and returned to port for operational reasons
- Returned a week later to find that this trawler had retrieved the buoy (the yellow object in the photo)
- Several hundred metres of mooring line and 300 metres of undersea cable were found onboard

Enforcement of no-anchor zones is one of several governmental actions that could improve cable security



AIS shows numerous ships anchored in prohibited areas near cables

What can we do to enhance cable security and speed repairs?

- Control and police illegal anchoring and fishing activities, particularly where they impact cables
- Enforce a 1-mile exclusion zone around working cables
- Eliminate or streamline permit requirements
- Consider including repair/maintenance permits with installation permit
- Identify Government agency for Permit application when no in-country landing party is identified
- Consider web based applications and vessel databases
- Consider pre-permitting for specific cables and/or vessels

TE SubCom is most appreciative of this opportunity to discuss and work toward improvements for all parties. Please contact us with any questions.