Problems Faced by Industry in Subsea Cable Repair

CIL/ICPC Workshop – 14 April, 2011 Stephen Drew 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
- <u>Speed to repair is essential to restore communications and</u> <u>reduce risk of more disruption</u>



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 cableships (•) 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
- <u>This is important because when the expected fault location changes,</u> <u>the jurisdictional area may change</u>



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 cableship 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



Permitting can be slow & complex

- Overlapping & disputed jurisdictions often require permits from 2 or 3 countries
- Cableships are often approached by Naval ships of neighbouring nations to check permits
- A precautionary approach delays ship mobilization until all permits are obtained, and <u>then</u> the ship starts steaming to the repair area



Sketch of jurisdictional claims

	Permit Name	Same of Permitting Authority	Sesponsible Party	Approximate Tamescale for Application and Granting	Recensary Document for Application	Supported Land or Marine Activity	Permit Filing Date		Permit Approval Date			2
140.							Target	Actual	Terpet	Actual	Status Notes	Sependencies (Predecessors)
1	THE System Approvals	Ministry of Internation Industry, Propiets Republic of China (MI)	PO	40 wulking days	Configuration, MOU, POPV, Investment Exager, Baciground of Investment	N		15-Aup-08		30-319-00		
2	THE System License	National Development & Rotore Constition, Propie's Republic of China (RDRC)	PO	60 working Says	Party, hyestnerd Share of Bach Party, Analysis on UBization of Natural Resources & Consumption	м		08-04-08		15-Dec-06	corried after #1	Permit 1 mont Hansh before Permit 2 can start
3	D15 Coordination Meeting (before equiving the survey presents)	State Oceanic Adhonky Jecoles Republic of Owne (SOA)	PG	10 working save	Project Description, MPL, DTS	Route Survey		(5-feb-0)		06-Feb-57	SCA has agreed o principalito \$15 8 \$2, \$4 and \$11/to be	
4	Celile Route Survey Fernill (skk a., "Application for Investigation and Survey of The Route")	Bake Oceanic Authority Jecolets Republic of China (SOA)	PG with the Type mout needed	20-48 working days Cwitten 30 days" per SCA 30, Artica 5(0))	Purchase provide TPE System License, CTS Corrector provide: Survey Vesse Spec, Gualification Certificate for Survey Suppler, MOP, FOW, SOM	Rode Survey	36-7mb-07	25.Mar-07	09-Apr-07	16-Apr-27	Nutrisiend Ol ders before survey (Per SOA 93, Article S). PIC POC reports to EOS Buil	Permit 2 must finnik before Jermit 4 can utart
	Complete "Report on Investigation and Survey of Route" for \$110.8.53 (Net (Oursee veces) data only)	Not Application	1900	3 working days		Houle Survey	01-JAEG/		NER		nepot must be transplated etc Chinese	
	Complete "Report on Investigation and Survey of Route" for S1N 8 S2 West (Complexentary Data from survey HCP to permitted score)	tiol Application	Type	3 working days		Rode Sirvey	10-يويد.19		NO.		Report must be revealed and Database	
5	Fahery Conpensation	Local Fishery Administration	PO	60 working says	191.	Marce Installation	05-Apr-0*	(CNC pibace provide)	15-Jun-07	(CNC, piease provide)		-
4	Environment impacting Assessment (EA) and protection report (before installation)	Data Oceanic Authority, People's Republic of Owine (SOA)	PO with the Type input rended	780 (60 working days?)	Poject Description, RPI, + others TBA	Marine Installation	10-Apr-0*	(CHC phase provide)	16.Am 07	(ChC, please provide)	polected during PO & SOL surveys. Report porens all of BEZ	furni' 1 min' finish before
7	Cetter Landing Permit	Lice Weer Automy	PO with the Type input needed	30 working days	Purchaser provide THE System Literiox, Farm concentration contract	SMPILOCS	05-Apr-0*	(CNC pieare provide)	15-Ad+0*	rChC, pieces gronde)	Per MVO Pusar, this permit to not required as a pre-	
0	Compensation for NAVY cable crossing (Cut)	Concernet local Administration	PO	depends (45 working dans T)	7PL	Marine Installation	05-Apr-0*	(CNC please (Intrvice)	15.24-01	(CHC, please provide)		
,	Cable Routs Survey Evaluation Meeting (before applying the manne installation permits)	State Ossanis Autority Jeaple's Republic of Clima (SOA)	PO	10 wuting Jaya	Cable Foule Survey Pepurt	Marine Installation	02-JA#07		10-44-67		CHC requests that Type notify 10 dees prior to completion of travely 10 that	Instantings tion and Instant and Fermits 5. 6, and Fermits Danial Terry Farmit 16, 263
10	Ewonit for Laying of Subsarrie Cables or Pipelines	BOA	PC with the Type input received	60 working says officially	Survey of Route, demonstrate that Rohery Companied on has been	Maire Installation	15.4407		13.540.07			Parmit 5 mint finish before Parmit 10 can
ŧ	Non-open Waters Entry Approvals	Melline Sately Adroity Fedders Republic of Chini(M)A)	Type	30 working days	Contractor provide Application Report, PON, MCP, Cable thip Spec., RPI, SDAV	Marine Installation	14-5ep-0*		23-06-07		1955 to ble in 1955 can apply adults Fermin for laying of	Farmit 10 must finish before termit Farmit 11 can winst
42	Meine Installation Permit	State Oceanic Authority Feoplets Republic of Olina (SDA)	Type	30 woning days (in paralet)	MOF, Cable Ship Spec JPL, SOW, Non-coen water entry	Marzie Installation	54.5ep.0*		noedf		See rote above.	finisk before perkit Perkit 12 ma start
13	Shore lite (Ised Literose	Local Port Administration Centre	Type most	40 working says	Description, IPE System	Post Installation	(3.0ec-0*		25.Jan-01			after main lier or PLES.
14	Cable Route Licence	State Oceanii Autority Jecoles	PG	40 working says	Fina Rit, /PE System Loanse	Pottelation	63 Dec-07		05.7eb.00			This permit can be star efter main lay or PLB

Matrix of permit requirements



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

<u>Cableships are specialized vessels with unique capabilities that</u> <u>should be exempt from cabotage requirements</u>



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



- Cableship 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 cableships
- Eliminate or streamline permit requirements
- Consider including repair/maintenance permits with installation permit
- Identify Government agency for Permit application when no incountry 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.

