INTERNATIONAL TELECOMMUNICATION UNION

ITU-T G.971

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TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

SERIES G: TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

Digital sections and digital line system – Optical fibre submarine cable systems

General features of optical fibre submarine cable systems

ITU-T Recommendation G.971

(Formerly CCITT Recommendation)

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ITU-T Recommendation G.971

General features of optical fibre submarine cable systems

Summary

This Recommendation applies to optical fibre submarine cable systems. The purpose of this Recommendation is to identify the main features of optical fibre submarine cable systems, and to provide generic information on relevant Recommendations in the field of optical fibre submarine cable systems.

This Recommendation was firstly issued in 1993 and revised in 1996. Amendments have been made taking into account the establishment of new Recommendation (G.977 [6]). An updated version of a list of cable ships and submerged equipments, which was available in the *Blue Book*, Volume III, Supplement 11, is also included.

Source

ITU-T Recommendation G.971 was revised by ITU-T Study Group 15 (1997-2000) and approved under the WTSC Resolution 1 procedure on 4 April 2000.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSC Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

INTELLECTUAL PROPERTY RIGHTS

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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

CONTENTS

ITU-T Recommendation G.971

General features of optical fibre submarine cable systems

1 Scope

This Recommendation applies to optical fibre submarine cable systems.

The purpose of this Recommendation is to identify the main features of optical fibre submarine cable systems.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

[1] ITU-T G.972 (1997), *Definition of terms relevant to optical fibre submarine cable system*s.

[2] ITU-T G.974 (1993), *Characteristics of regenerative optical fibre submarine cable systems.*

[3] ITU-T G.973 (1996), *Characteristics of repeaterless optical fibre submarine cable systems*.

[4] ITU-T G.975 (1996), *Forward error correction for submarine systems*.

[5] ITU-T G.976 (1997), *Test methods applicable to optical fibre submarine cable systems.*

[6] ITU-T G.977 (2000), *Characteristics of optically amplified optical fibre submarine cable systems.*

3 Terms and definitions

Terms used in this Recommendation are defined in ITU-T G.972 [1].

4 Abbreviations

This Recommendation uses the following abbreviations.

BU Branching Unit

CTE Cable Terminating Equipment

PFE Power Feeding Equipment

TTE Terminal Transmission Equipment

5 Features of optical fibre submarine cable systems

An optical fibre submarine cable system has specific technical features:

a) A submarine cable system should achieve a long lifetime and a high reliability; the main reason is that, due to the difficulty in accessing the submerged plant, the construction and maintenance of a link are long and expensive; moreover most of submarine links are of strategic importance in the transmission network and the interruption of a link usually results in significant loss of traffic and revenue.

b) A submarine cable system should possess mechanical characteristics which enable it:

   1) to be installed accurately with correct slack and with due safety consideration on the sea bed; deep water installations may reach 8000 metres. (In general, submarine cable systems shall be installed, buried or inspected by specially designed cable ships and submerged equipments. Detailed information of such cable ships and submerged equipments (i.e. ploughs, ROVs, etc.) is contained in Appendix I.);

   2) to resist the sea bottom environment condition at the installation depth, and particularly hydrostatic pressure, temperature, abrasion, corrosion, and marine life;

   3) to be adequately protected (i.e. by armoring or burying) against aggression, due for example to trawlers or anchors;

   4) to survive recovery from such a depth, and subsequent repair and relay, with due safety consideration.

c) The material characteristics of a submarine cable system should enable the optical fibre:

   1) to achieve its desired reliability over its design lifetime;

   2) to tolerate stated loss and aging mechanisms, especially bending, strain, hydrogen, stress, corrosion and radiation.

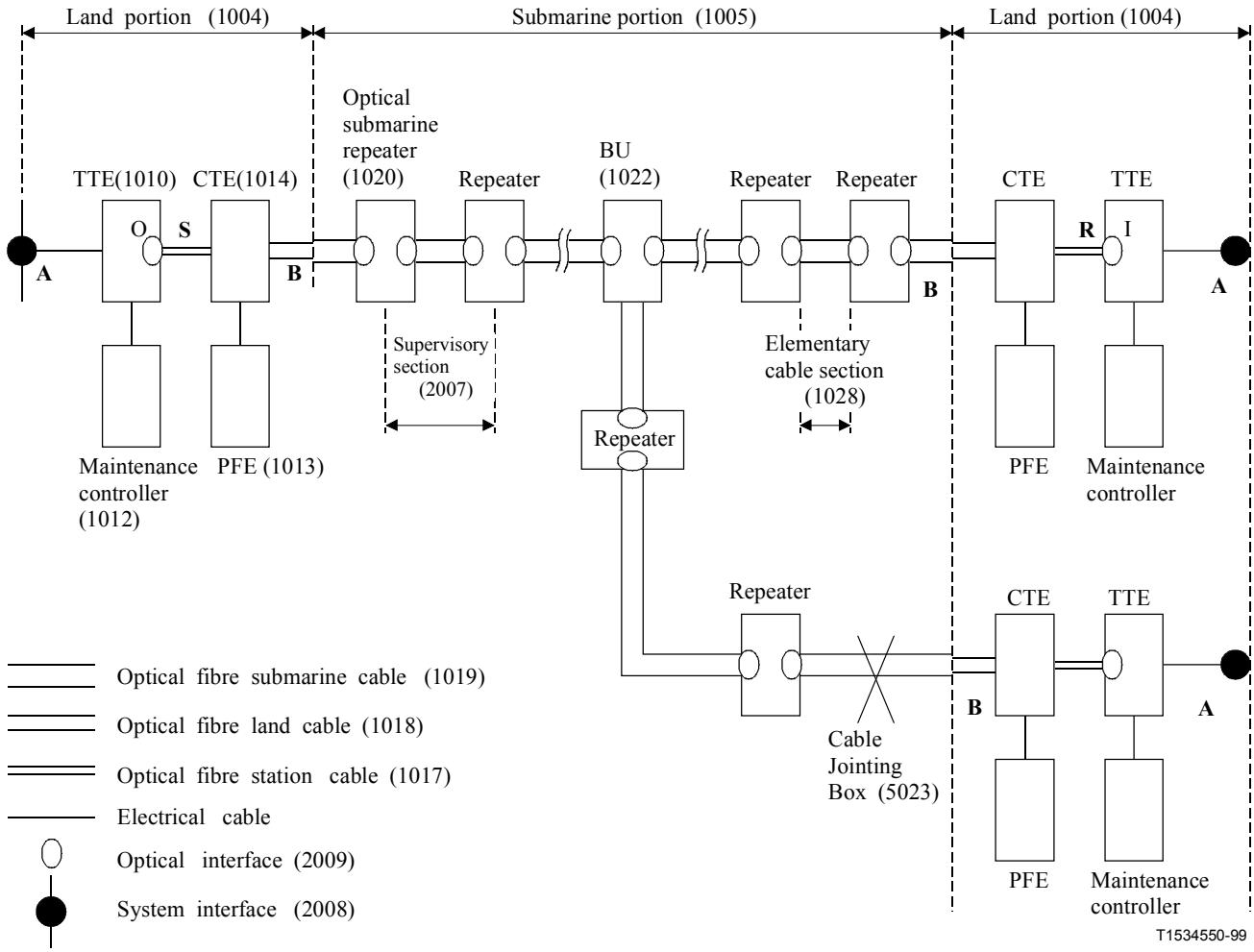
d) The transmission quality of a submarine cable system should follow as a minimum ITU-T G.821.

Figure 1 shows the basic concept of optical fibre submarine cable systems and boundaries. Optical submarine repeaters or optical submarine branching units could be included, depending on each system requirement.

In Figure 1, A denotes the system interfaces at the terminal station (where the system can be interfaced to terrestrial digital links or to other submarine cable systems), and B denotes beach joints or landing points. Numbers in brackets in the Figure refer to ITU-T G.972 [1].

6 Relationship among Recommendations relevant to optical submarine cable systems

Relationship among the various Recommendations pertaining to optical fibre submarine cable systems are shown in the flow chart presented in Figure 2.



Note 1 – **A** denotes system interface
Note 2 – **B** denotes landing points or beach joints (1006)
Note 3 – X denotes cable jointing box (5023)
Note 4 – Numbers in brackets relate to ITU-T G.972

Figure 1/G.971 – Example of optical fibre submarine cable systems

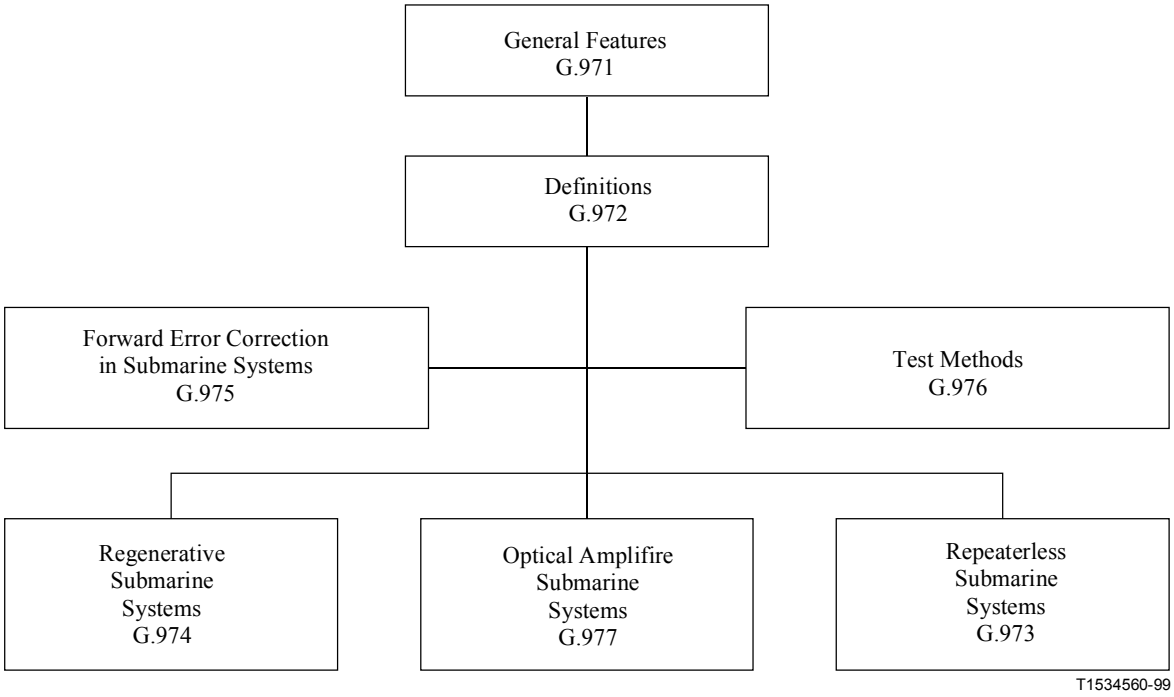


Figure 2/G.971 – Relationship between Recommendations relevant to optical submarine cable systems

APPENDIX I

Data on cable ships and submersible equipments of various countries

(Mar del Plata, 1968, amended at Geneva, 1972, 1976, 1980, 1984, 1988, 1995 and 2000)

Section 1 – Cable ships

Name of ship	Year of construction	Displacement (tons)	Overall length (m)	Draft (m)	Normal speed (knots)	Range (autonomy) (nautical miles)	Number of tanks	Cable capacity			Cable gear				Maximum operating depth (m)	Capability
								Cable		Repeaters	Cable engine		Unwinding pulley			
								Cubic metres (m^3)	Weight (tons)		Drum (diameter) (m)	Linear (pairs of wheels)	Bow sheave (diameter) (m)	Stern sheave (diameter) (m)		
DENMARK *Ships belonging to Tele Denmark*																
Peter Faber	1982	Open 750 Closed 1830	78.4	Open 3.8 Closed 5.0	14.0	7000	1 tank 1 hold	310 230	600 400	App. 10	3.0		3.0	–	4000	Reinforced for operation in icefilled waters. On the aft deck: one A-frame with hydraulic topping. Max. load 35 tons. One hydraulic towing and general purpose winch. Two hydraulic double-drum warping winches.
Maersk Fighter	1992/94	2961	82.5	6.24	15.7 Max	7700	2	1263	2400	24	4.0 (25t)	65 (4t)	4000	–	–	Laying/burying and repair of all types of cables (coaxial, optical fibre and power cables). Ploughs and ROV capability.
Maersk Defender	1996	8746	96.0	8.70	16 Max	7700	4	3162	6000	>54	4.0 (25t)	20 (20t)	8000	–	–	Laying/burying and repair of all types of cables (coaxial, optical fibre and power cables). Ploughs and ROV capability.
FINLAND *Ship belonging to Sonera LTD*																
M/S Telepaatti	1978 (modification)	450	42.6	3.0	12	–	1	–	350	–	2 linear engines with 3 caterpillar tracks on each	3.0		300		Laying of all types of telecom cables. Specially equipped for cable route survey and cable repair. Fully automatic autopilot and DP-system.

Name of ship	Year of construction	Displacement (tons)	Overall length (m)	Draft (m)	Normal speed (knots)	Range (autonomy) (nautical miles)	Number of tanks	Cable capacity			Cable gear				Maximum operating depth (m)	Capability
								Cable		Repeaters	Cable engine		Unwinding pulley			
								Cubic metres (m^3)	Weight (tons)		Drum (diameter) (m)	Linear (pairs of wheels)	Bow sheave (diameter) (m)	Stern sheave (diameter) (m)		
FRANCE ***Ships belonging to France Telecom***																
Vercors	1974	11 000	136	7.2	16.6	12 000	3	2425	4900	144	3.0	24	3.0	Chute	All	Laying and repair of all types of telecom cables. Burying of cables with plough.
Leon Thevenin	1983	6800	107	6.24	15.0	10 000	2 + 1	1420	2000	11	3.4	12	3.0	Chute	All	Laying and repair of all types of telecom cables. Burying of cables using Scarab.
Raymond Croze	1983	6800	107	6.24	15.0	10 000	2 + 1	1420	2000	11	3.4	12	3.0	Chute	All	Laying and repair of all types of telecom cables. Burying of cables using Scorpio 2000.
ITALY ***1) Ship belonging to Elettra TLC S.p.A***																
Teliri	1996	6500	111.5	6.5	15.0	10 000	3	2000	2600	70	N.2 × 3.5	N.1 × 18wp	1-splitted	1	All	Laying and repair of armoured coaxial and optical fibre cables; survey.
Gertament (ex John Cabot)	1995 rebuilt 1999	5900	102	7.3	13.5	12 000	3	600	1900	24	1 × 3	1 × 18+ 1 × 6	3	3	All	
2) Ships belonging to Pirelli Cavi																
Arabella	1975	2620	76.66	5.18	11	2000	2	1100	2000	–		–	–	3	All	Lay/repair.
G.Verne	1984	16 900	128.5	8.5	10	8000	2	2600	8000	20	6.0 (50t)	1 (Pads type 10t)	–	6.0	All	Stern only.
SPAIN ***Ships belonging to Tyco Submarine Systems Ltd.***																
Teneo	1992	4000	81	5.7	14.5	4200	2	500	1000	20	2 × 3.5	1 × 9	2 × 3	1 × 3	All	Lays and repairs of all types of telephone cables.
Atlantida	1987	7853	114	6.5	15.7	6800	3	1500	2500	33	2 × 3.5	1 × 12	2 × 3	1 × 3	All	Lays and repairs of all types of telephone cables.
Iberus	1978	10 000	136.03	6.6	12.5	13 500	3	2580	4000	108	1 × 3	1 × 20	–	2 × 3	All	Lays and repairs of all types of telephone cables.

Name of ship	Year of construction	Displacement (tons)	Overall length (m)	Draft (m)	Normal speed (knots)	Range (autonomy) (nautical miles)	Number of tanks	Cable capacity			Cable gear				Maximum operating depth (m)	Capability
								Cable		Repeaters	Cable engine		Unwinding pulley			
								Cubic metres (m^3)	Weight (tons)		Drum (diameter) (m)	Linear (pairs of wheels)	Bow sheave (diameter) (m)	Stern sheave (diameter) (m)		
JAPAN																
1) Ships belonging to Kokusai Cable Ship (KCS)																
KDD Ocean Link	1992	11 700	133.2	7.0	15	10 000	Main 3 Spare 4	2320	4500	100	3.6	21	3.2	4.0	All	Laying by linear engine. Lays and repairs all types of submarine cables.
KDD Pacific Link	1997	–	109.0	7.5	12	–	Main 2 Spare 2	2720	4500	–	3.6	20	–	3.0	All	Laying by linear engine. Lays and repairs all types of submarine cables.
2) Ships belonging to NTT World Engineering Marine Corporation (NTT-WE Marine)																
NTT Kuroshio Maru	1974	5656	119.3	5.60	16.5	6883	3	1429	1900	95	3.8	8 (24 inch)	3.0	3.0	All	Lays and repairs all types of telephone cables.
Subaru	1999	9557	123.3	7.0	13.2	8800	Main 2 Spare 2	2770	4000	50	4.0	21	–	3.2	All	Lays and repairs all types of telephone cables.
UNITED KINGDOM																
1) Ship belonging to British Telecommunications plc																
Sovereign	1991	13 018	131	7.0	13.5	14 000	4	2800	6200	90	3.50		3.00	3.50	All	Lays, repairs all types of coaxial and optical fibre cable. (Operated by C&W marine.)
2) Ships belonging to Cable & Wireless (Marine) Limited																
Alert	1961	9477	130	7.1	14	10 000	3	1509	3100	48	2.98		2.98	2.98	All	Laying by linear engine and sea-bed burial by plow. Lays/repairs all types of coaxial and optical fibre cables.
Cable Venture	1962	16 983	153	8.97	12.5	10 000	4 + 1 (spare)	5086	9000	400	2.80		3.00	3.39	All	Laying by linear cable engine. Ploughs, lays and repairs armoured and lightweight cables.
Mercury	1962	11 683	144	7.5	14.5	8000	3	2970	3500	144	3.05		3.50	Chute 3.05	All	Ditto (no plough).
Cable Enterprise	1964	5759	113	5.84	13	8000	3	887	2150	30	2.8		3.00	Chute 3.05	All	Lays/repairs armoured cables. Repairs lightweight cables. (Note)
Monarch	1975	4639	97	5.5	14	7000	4	417	850	12	3.00		3.00	None	All	Lays/repairs armoured coaxial and optical fibre cables. Repairs lightweight coaxial and optical fibre cables. Detrenching/reburial by submersible jetting.

Name of ship	Year of construction	Displacement (tons)	Overall length (m)	Draft (m)	Normal speed (knots)	Range (autonomy) (nautical miles)	Number of tanks	Cable capacity			Cable gear				Maximum operating depth (m)	Capability
								Cable		Repeaters	Cable engine		Unwinding pulley			
								Cubic metres (m^3)	Weight (tons)		Drum (diameter) (m)	Linear (pairs of wheels)	Bow sheave (diameter) (m)	Stern sheave (diameter) (m)		
Iris	1976	4639	97	5.5	14	7000	4	417	850	12	3.00		3.00	None	All	Lays/repairs armoured coaxial and optical fibre cables. Repairs lightweight coaxial and optical fibre cables.
MV Cable Installer	1980	6065	89.42	5	12	42 days	4	840	1600	None	3.0	4-track pair	–	3.0	–	Repeaterless installation vessel fully DP Cegelec 901 system.
Seaspread	1980	10 887	116	6.8	13	65 days	2	1010	1701	–	2 × 3	–	–	3	All	Lays/repairs by aft drums. Burial by plough. Lays/repairs armoured and lightweight cables.
Pacific Guardian	1984	7526	116	6.32	14.0	8000	3	1416	3470	96	3.5		3.00	3.00	All	Laying by linear cable engine. Lays and repairs armoured and lightweight cables.
Sir Elic Sharp	1988	7526	115	6.3	13.5	9600	3	1416	1700	96	2 × 3.5	–	3	3	All	Laying by linear cable engine. Repairs and lays armoured and lightweight cables. Post lay/repair burial by integral ROV.
MV Cable Innovator	1995	–	142	8.3	14.5	42 days	4	4900	7500	180	4.0	21 pair (min)	–	4.0	–	Simplex *D/P* system. Lays/repairs cables.
MARSHALL ISLANDS *Ship belonging to Tyco Submarine Systems Ltd.*																
CS Coastal Connector	1997 Converted in 1996	6761	92.47	7.1	12.5	25 000	3 main 1 spare	675 (main, total) 70 (spare)	1600	30	2 × 3	N/A	N/A	2 × 3	–	The CS Coastal Connector is stern laying design. She is capable of deploying the SCARAB II, SCARAB IV, and Pacific SCARAB I ROV's, as well as the Seabed Tractor
CS Tyco Provider	1978, Converted in 1999	14 500	139.4	7.6	14.5	20 000	5	3349	6000	100+	2 × 4	–	–	2 × 3	–	The CS Tyco Provider is a stern laying design. She is capable of deploying Sea Plow VIII.
NETHERLANDS ANTILLES *Ship belonging to Tyco Submarine Systems Ltd. (charterer)*																
Dock Express 20	1983	21 731	169.52	8.79	12.5	20 500	3 main 2 spare	4050 (main, total) 640 (spare, total)	10 000	100+	1 × 3.0	1 × 3 module belt type	N/A	2 × 3		The Dock Express 20 is a stern laying design. She is capable of deploying the SCARAB II ROV, as well as the Seabed Tractor and Sea Plow VI.

Name of ship	Year of construction	Displacement (tons)	Overall length (m)	Draft (m)	Normal speed (knots)	Range (autonomy) (nautical miles)	Number of tanks	Cable capacity			Cable gear				Maximum operating depth (m)	Capability
								Cable		Repeaters	Cable engine		Unwinding pulley			
								Cubic metres (m^3)	Weight (tons)		Drum (diameter) (m)	Linear (pairs of wheels)	Bow sheave (diameter) (m)	Stern sheave (diameter) (m)		
UNITED STATES OF AMERICA *Ships belonging to AT&T*																
CS Charles L. Brown	1954, Reflagged in 1985	4298	99.94	5.6	13	7550	3	660	1186	30+	2 × 3	N/A	2 × 3	N/A	–	The Charles L. Brown is primarily a repair ship. She is not fitted with any stern laying equipment. She is capable of deploying the SCARAB II ROV.
CS Global Link	1990	16 375	145.7	8.08	15	10 000	3 main, 4 spare	3258 (main, total) 164 (spare, total)	6098	100+	2 × 3.7	1× Western Gear Tractor Type	2 × 3	1× trough/ Chute type	–	The Global Link is capable of deploying the SCARAB II ROV's.
CS Global Mariner	1993	15 638	151.5	7.8	13.8	10 000	2 main, 3 spare	2172 (main, total) 447 (spare, total)	4999	80+	2 × 3.7	1× Dowty 21 pair	2 × 3	1× trough/ Chute type	–	The Global Mariner is capable of deploying the SCARAB II and SCARAB IV ROV's, as well as Sea Plow VII, Sea Plow VIII, and the Seabed Tractor.
CS Global Sentinel	1991	16 375	145.7	8.08	15	10 000	3 main, 4 spare	3258 (main, total) 164 (spare, total)	6098	100+	2 × 3.7	1× Dowty 21 pair	2 × 3	1× trough/ Chute type	–	The Global Sentinel is capable of deploying the SCARAB II and SCARAB IV, and Pacific SCARAB I ROV's, as well as Sea Plow VII and Sea Plow VIII.
NOTE – Only relatively short cables are laid and only shore-end.																

Section 2 – Submersible equipments

Type of submersible	Weight (tons)	Overall length (m)	Width (m)	Height (m)	Trenching system	Trenching	Propulsion	Max.operating depth (m)	Capability
FRANCE *Submersibles belonging to France Telecom (FTRSI)*									
ELISE2 Submersible Plough system	17	7.60	2.90	2.95	Ploughshare	Immediate burial up to 1.1 m	Towed by support ship	1500	Lay and bury all types of cables.
ELISE3 Submersible Plough system	17	7.60	2.90	2.95	Ploughshare	Immediate burial up to 1.1 m	Towed by support ship	1500	Lay and bury all types of cables.
Self-advancing buried system CASTOR2	12	7.0	2.40	3.00	Trenching wheel or chain	Burial of existing cables down to 2 m	Tracked vehicle	1000	Burial of cables and pipes. Visual inspection.
Scarab 3	9	4.0	3.50	2.10	High pressure water jets	Up to 60 cm depth	Thrusters (inspection) Back drive (burial)	1000 (burial) 2000 (inspect)	Visual inspection, post lay burial, cable location, cable manipulation, cable cutting.
Remote control submersible Scorpio 2000	3.4	2.9	1.5	2.11	High pressure water jets	Up to 60 cm depth	Thrusters	1000	Visual inspection, post lay burial, cable location/ manipulation/cutting.
ITALY *Submersibles belonging to Pirelli Cavi*									
Plough 1	10	7	2.7	3	Plough share	Up to 1 m	Towed by support ship	50	Lay and bury cables.
Plough 2	9	8.5	3.8	3.5	Plough share	Up to 1.2 m	Towed by support ship	50	Lay and bury fibre optic cables.
UNITED KINGDOM *Submersibles belonging to Cable & Wireless (Marine) Ltd.*									
Submersible trencher	17.0	6.6	4	3.4	Fluidization and cutting jets and dredge pump	Up to 1 m depth with cutting and fluidization jets	Three vertical and four horizontal thrusters, track drive differential steering	274	Trench in existing cable and pipe.
Submersible Plough system	9.75	6.1	2.6	2.6	Ploughshare proceeded by disc	Immediate burial of cable on ploughing	Towed by support ship	900	Lay and bury cable, umbilical and pipe in one action giving full cable protection.

Type of submersible	Weight (tons)	Overall length (m)	Width (m)	Height (m)	Trenching system	Trenching	Propulsion	Max.operating depth (m)	Capability
Remote control submersible 2 off Cirus A&B	3.2	3.5	2.1	2.3	Water jets	Trenching capability 0.3 m	Thrusters (7)	1000	Visual inspection, cable location/inspection/deburial, manipulation. Tools include cable cutter, cable gripper and 2 manipulators with line cutters.
Plough 2 off A&B	14.5	9	4.1	4	Passive blade	Trenching capability 1.0 m	Towed	1000	Steerable, repeater burial.
Remote control submersible ROV 128	7.5	2.9	1.8	2.0	Jetting tool	Trenching capability 0.6 m	Tracked burial Thrusters survey	1000 (burial) 2000 (survey)	Tools include cable cutter, cable gripper and 2 manipulators with line cutters.
Underwater vehicle-MARLIN	7.8	4.191	2.438	3.175	Burial skid	To 1.0 m (Optimized for 0-30 kPa soil)	Hydraulic driven thrusters	2500	Burial, deburial, inspection. Maintenance and repair. Tools include cable cutter, cable gripper.
Scarab I – Umbilically tethered ROV	3.2	2.74	1.82	1.52	Jetting tool	Up to 0.6 m	Thrusters: 2 vertical 4 vectored	2000	Cable detection and inspection. Visual survey. Cable manipulation and cutting Debris elimination. Cable and repeater burial/ deburial.
Subtrack - ROV	10.0	8.0 (Max)	3.7	3.8	Jetting tool	Burial to 1.0 m	Electro hydraulic track drives	1000	Cable burial and deburial. Inspection. Maintenance and repair.
EUREKA: Deepwater burial + trenching system	17 (Max)	5.5	4.2	3.85	Jetting tool Rock wheel cutter Mechanical chain excavator	1 m 1.2 m 2.2 m	Electro hydraulic track drives	1500	Capable of burying cable, small flexible flowlines and also rigid pipes. Can also debury cable and restore. Visual and electronic inspections.
Plough 5	14.0	9.0	4.6	3.7	Passive blade	Variable from 0-1100 mm (600-900 mm in all conditions)	Towed	1000	Simultaneously lay and bury cables and umbilicals at varying depths.
Plough 6 and 7	14.0	9.0	4.6	3.7	Passive blade	Max burial depth: 1100 mm	Towed	1000	Simultaneously lay and bury cables and umbilicals at varying depths.

Type of submersible	Weight (tons)	Overall length (m)	Width (m)	Height (m)	Trenching system	Trenching	Propulsion	Max.operating depth (m)	Capability
Cable Plough 1000 mm	14.4	9.75	4.1	3.9	Passive blade	1000 mm (Good conditions: 1100 mm; Repeaters/Joints: 500 mm)	Towed	1000	Simultaneously lay and bury cables and umbilicals at varying depths.
				DENMARK *Submersibles belonging to Telecom Denmark*					
Plough D	13.5	9.0	4.6	3.7	Plough share	Variable from 0-1100 mm (600-900 mm in all conditions)	Towed by host vessel	1500	Lay and bury telecom cables, power cables and umbilicals. Cables: Up to 120 mmϕ (bary). Joints and repeaters: Up to 400 mmϕ (pass).
Plough 7	13.5	9.0	4.6	3.7	Plough share	Variable from 0-1100 mm (600-900 mm in all conditions)	Towed by surface vessel	1000	Lay and bury fibre optic cables, power cables and umbilicals.
Subtrack-Subsea tractor	10.0	8.0 (Max)	3.7	3.8	Jetting tool	Burial to 1.0 m	Electro hydraulic track drives	1000	Cable burial and deburial. Inspection. Maintenance and repair.
Super Phantom S4-ROV	0.09	1.5	0.75	0.6	–	–	Thrusters 4 prop fwd/aft 2 prop vertical 2 prop transvers	300	Inspect cables and other underwater objects. Can also be used to inspect seabed conditions.
				JAPAN *1) Submersibles belonging to KCS*					
MARCAS-II-ROV	Jet tool mode: 8.0 Track base mode: 7.5	Jet tool mode: 2.9 Track base mode: 5.3	Jet tool mode: 2.3 Track base mode: 4.0	Jet tool mode: 3.2 Track base mode: 3.8	Water jet tool	–	4 horizontal, 2 vertical and 2 balance thrusters	Jet tool mode: 2500 Track base mode: 2000	Post-lay burial, maintenance of cable. Can survey seabed.
MARCAS-SBT-ROV	15 (minimum) 23 (maximum)	Jet tool mode: 9.5 Chain cutter mode: 13.0 Wheel cutter mode: 12.0	Jet tool mode: 5.5 Chain cutter mode: 5.5 Wheel cutter mode: 5.5	Jet tool mode: 4.4 Chain cutter mode: 4.4 Wheel cutter mode: 4.4	2.1 m Rear jet tool and 1 m Forward jet tool 1.2 m Wheel cutter 3 m Chain cutter		One single hydraulic thruster	1500	Lay and burial, post-lay burial, maintenance of cable, and survey of seabed.

Type of submersible	Weight (tons)	Overall length (m)	Width (m)	Height (m)	Trenching system	Trenching	Propulsion	Max.operating depth (m)	Capability
				2) Submersibles belonging to NTT-WE Marine					
Plough-type MARK-5 submarine cable burying system	19.0	9.1	4.0	4.0	–	Up to 1.5 m depth immediate burial of cable on ploughing	Towed by support ship	600	Simultaneous or post-lay burial of cable.
Submarine cable repair burial and inspection system	6.2	3.8	2.1	2.3	Fluidization jets	Fluidization jets	Vertical and horizontal thrusters	1000	Post-lay burial maintenance of cable and survey of seabed.
Plough-type MARK-6 submarine cable burying system	18	9.3	5.1	4.4	–	Up to 2.0 m depth immediate burial of cable on ploughing	Towed by support ship	1500	Simultaneous or post-lay burial of cable.
Submarine cable repair burial and inspection system	8.0	3.2	2.1	2.8	Fluidization jets	Trenching capability 1.0 m	Vertical and horizontal thrusters	2500	Cable detection & inspection visual survey. Cable manipulation & cutting. Debris stockage. Cable & repeater burial/deburial.
SEA MOLE Tractor type Submarine cable Burial system	23	8	6	3.5	3 types attachment (jetting tool, wheel cutter & chain cutter)	Trenching capability 2.0 m (max.)	–	1000	
				SPAIN ***1) Submersible belonging to Tyco Submarine Systems Ltd.***					
ARADO I	12	9	4.6	4	Plow-share	1100 mm	Towed	1500	Bury cable from 19 to 40 mm. Bury repeaters until 380 mm. Velocity 1 m/s.
ARADO II	12	9	4.6	4	Plow-share	1500 mm	Towed	1500	Bury cable from 17 to 150 mm. Bury repeaters until 380 mm. Velocity 1 m/s.
ARDI	3.6	6.1	3	2.6	Plow-share	900 mm	Towed	1500	System to evaluate if land is arable.
NEREUS	8.5	3.2	3.4	2.9		1 m	150 KW	2000	Repair, inspect and bury all types of telephone cable 2 × manipulating 7 functions. Velocity 3 knots.
SCARAB III	8.5	4	3.9	2.1		0.6	180 KW	2000	Repair, inspect and bury all types of telephone cable 2 x manipulating 7 functions. Velocity 3.1 knots.

Type of submersible	Weight (tons)	Overall length (m)	Width (m)	Height (m)	Trenching system	Trenching	Propulsion	Max.operating depth (m)	Capability
					2) Submersible belonging to Consorcio ESCARAB				
ROV	8.5	4.0	3.9	2.1		Up to 1 m		2000 1000	
					UNITED STATES OF AMERICA ***Submersibles belonging to Tyco Submarine Systems Ltd.***				
PACIFIC SCARAB I	5.48	4.27	1.83	3.05	Jetting Modules	560 meters/hour. Soil hardness to 100 kPa.	150HP Electro Hydraulically Powered using 8 thrusters	2500	PACIFIC SCARAB I Submersible Craft Assisting Repair and Burial is a tethered, swimming ROV capable of operating at depths of 2500 meters. It can locate, inspect, retrieve, and bury submarine cables.
SCARAB II	3.45	3.7	2.1	2.3	35 HP Cable Jetter	255m/hr depending on soil conditions. Soil hardness to 60 kPa.	Horizontal: 4×5 HP Electric Thrusters Vertical: 2×5 HP Electric Thrusters Aft Lateral: 1×10 HP Hydraulic Thruster Bow: 2×2.5 HP Hydraulic Thrusters	1850	SCARAB II Submersible Craft Assisting Repair and Burial is a tethered, swimming ROV capable of operating at depths of 1850 meters. It can locate, inspect, retrieve, and bury submarine cables.
SCARAB IV	4.6	3.4	2.02	1.96	Jetting Modules	530 meters/hour Soil hardness to 100 kPa	150 HP Electro-Hydraulically Powered using 8 thrusters	1850	SCARAB IV Submersible Craft Assisting Repair and Burial is a tethered, swimming ROV capable of operating at depths of 1850 meters. It can locate, inspect, retrieve, and bury submarine cables. SCARAB IV is part of the ACMA SCARAB Agreement.

Type of submersible	Weight (tons)	Overall length (m)	Width (m)	Height (m)	Trenching system	Trenching	Propulsion	Max.operating depth (m)	Capability
Sea Plow VI	25.5	10.5	6.0	4.3	Towed Plow System	1.2 meter burial	Towed by ship	1000	Sea Plow VI is a towed burial tool employing state-of-the-art burial features. It can achieve 1.2 meter burial depth in up to 1000 meter water depth.
Sea Plow VII	14.0	10.5	6.0	4.3	Towed Plow System	1.0 meter burial	Towed by ship. 1 Thruster for Launches and Recoveries	1400	Sea Plow VII is a towed burial tool employing state-of-the-art burial features. It can achieve 1.0 meter burial depth in up to 1400 meter water depth.
Sea Plow VIII	19.3	9.2	5.5	3.6	Towed Plow System with water jet assist	1.5 meter burial	Towed by ship	1500	Sea Plow VIII is a towed burial tool employing state of the art burial features. It can achieve 1.5 meter burial depth in up to 1500 meter water depth.

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