

# The Undersea Internet Backbone



The Story of Really Really Long Wires

# Trivia

What is the longest man-made object?

# Trivia

What is the longest man-made object?

Sea-Me-We 3

(39,000 km)



# Honourable Mentions

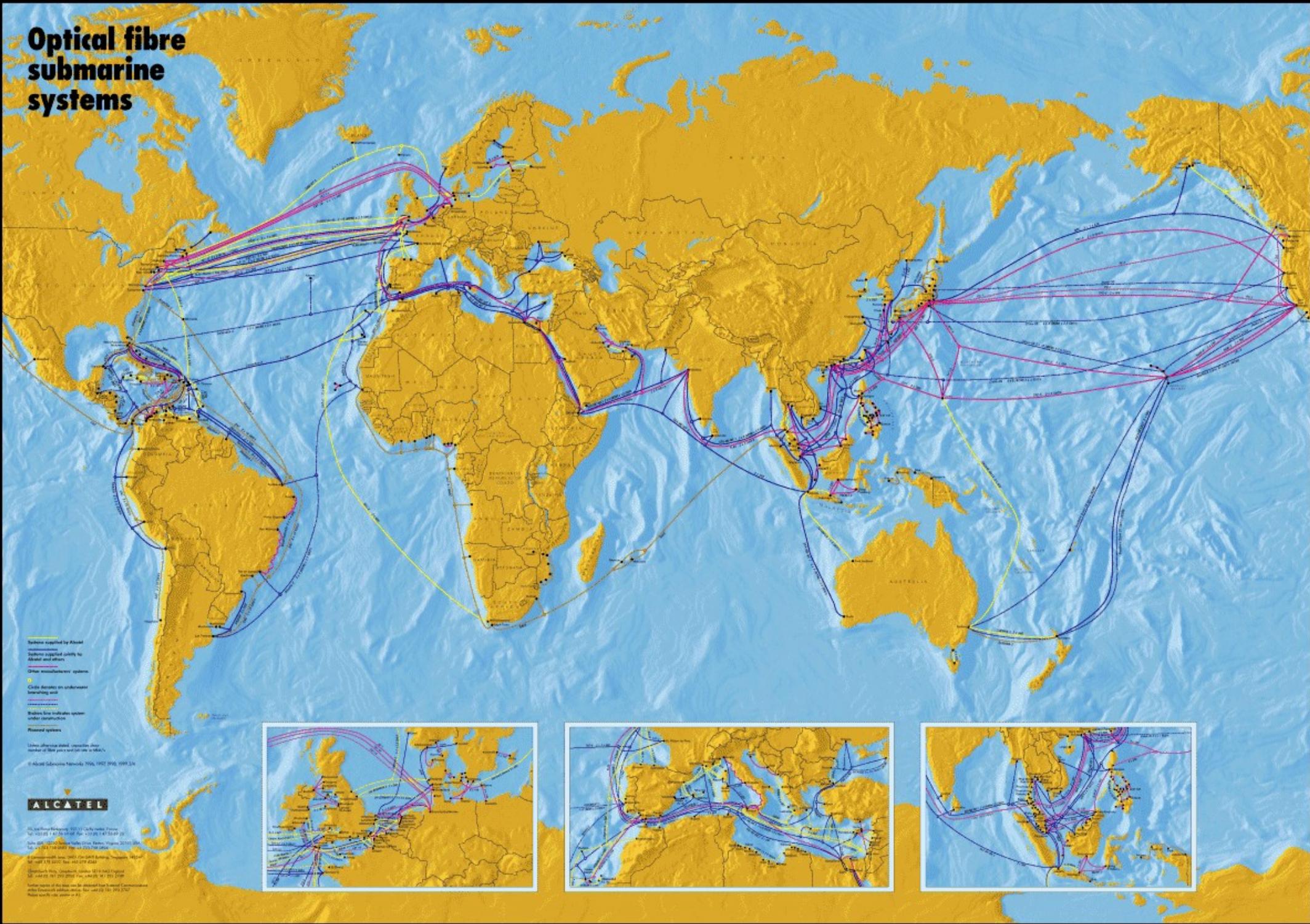


Great Wall of China  
(8,851.8 km)



Australia's Dingo Fence  
(5,614 km)

# Optical fibre submarine systems



Systems supplied by Alcatel  
 Systems supplied jointly to Alcatel and others  
 Other manufacturers' systems  
 Cable routes on underwater knowledge only  
 Systems under construction  
 Planned systems

Unless otherwise stated, capacities show number of fibre pairs and/or use as follows:

© Alcatel Submarine Networks 1996, 1997, 1998, 1999, 2000



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We don't often think about undersea cables

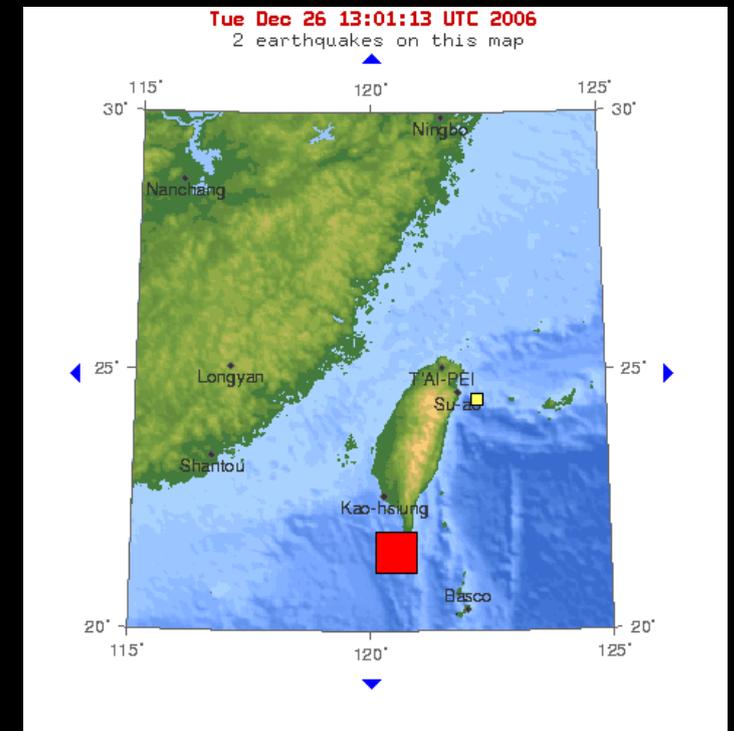
Until they break

# December 26, 2006

A magnitude 7 earthquake off Taiwan damages 9 fiber optic cables

Phone and internet traffic for S.E. Asia disrupted for "up to seven weeks"

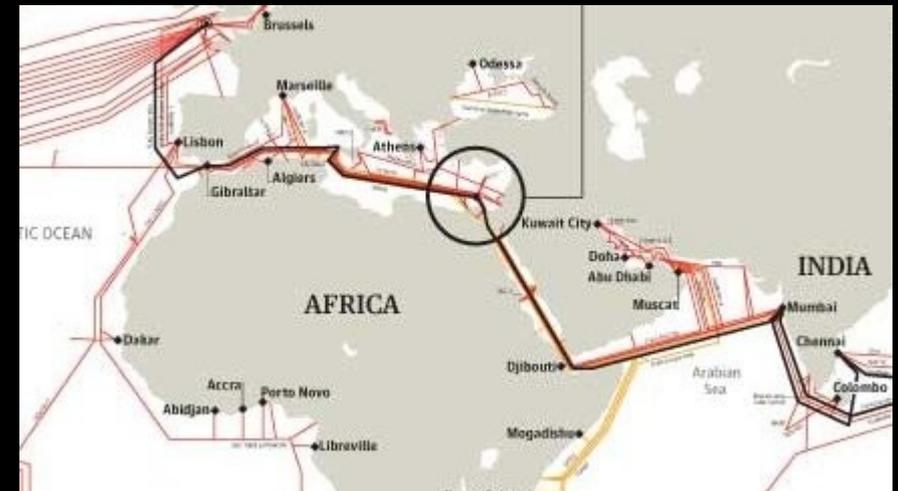
Substantial drop in spam levels worldwide



# January 30, 2008

Two of the main Europe-Asia cables cut near Alexandria

Disruptions throughout south Asia and the Middle East



60 million internet users in India affected

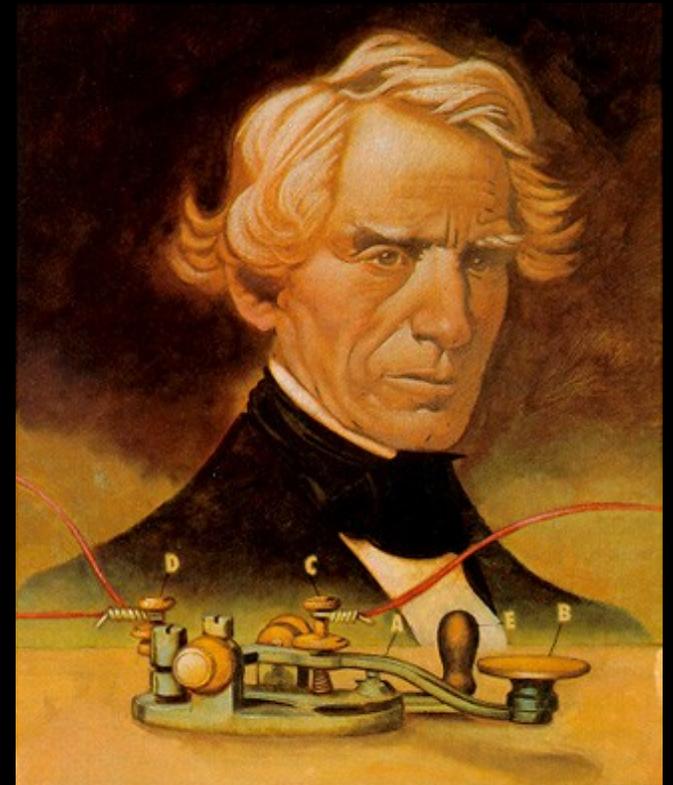
Cause was never determined for certain

1844

Samuel Morse builds  
telegraph cable between  
Washington DC and Baltimore

First message sent:

"What hath God wrought"



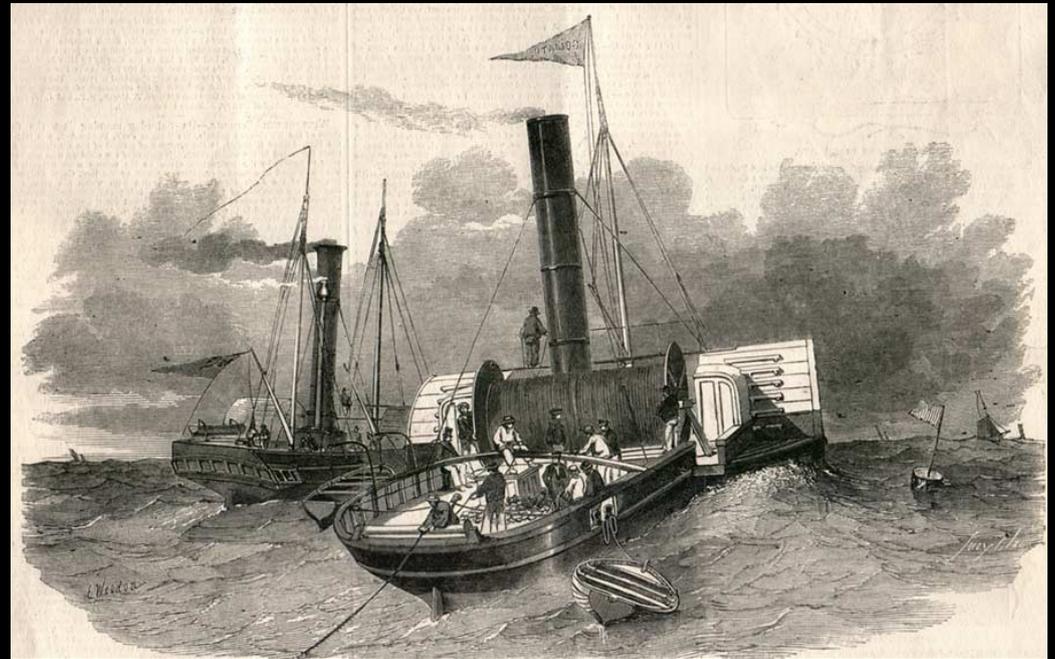
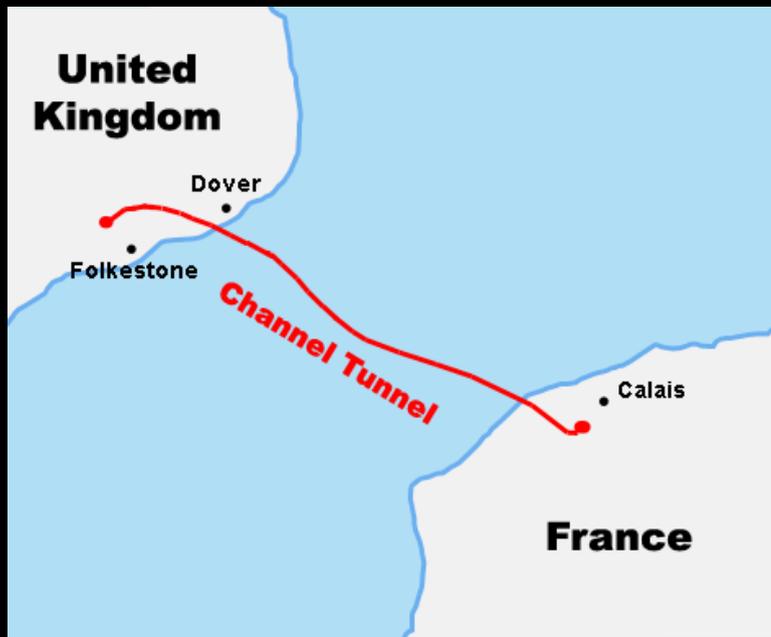
1848

Discovery of gutta-percha  
makes submarine telegraph cables possible



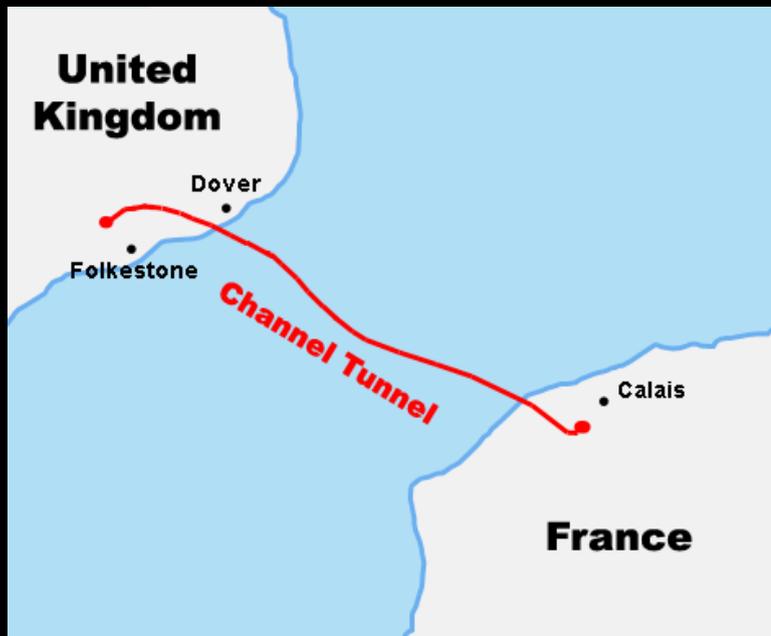
# 1850

## First international submarine wire, connecting Dover to Calais



# 1850

Went bust after just a few messages



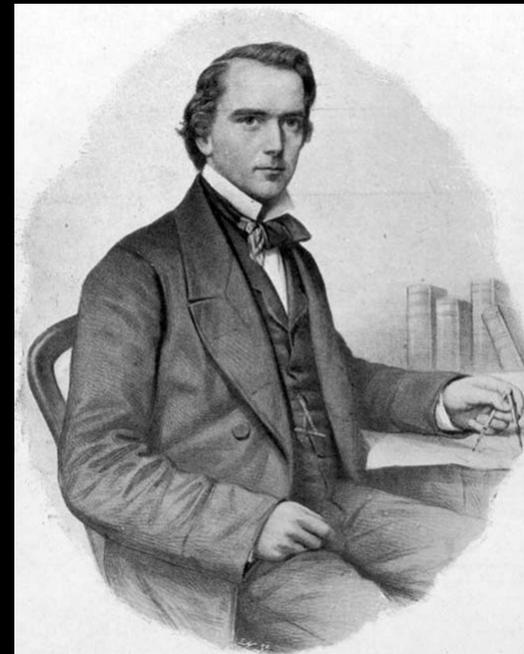
Replaced the following year

# 1858

After several failed attempts, the first transatlantic cable connects Ireland to Newfoundland



Cyrus W. Field



Charles T. Bright



# THE EIGHTH WONDER OF THE WORLD.

THE ATLANTIC CABLE.

PRINTED BY SIMMONS & FOSTER, 254 N. CANAL ST. N.Y.

*Heart's Content, July 27th 1866.*

*I hope that it will prove a blessing to England, and the United States, and increase the intercourse between our Country & the Eastern Hemisphere.*

*Your faithfully  
Cyrus W. Field.*

*Washington, July 29th 1866.*

*To Cyrus W. Field, Heart's Content:  
May the Cable under the sea tend to promote harmony between the Republic of the West and the Governments of the Eastern Hemisphere.*

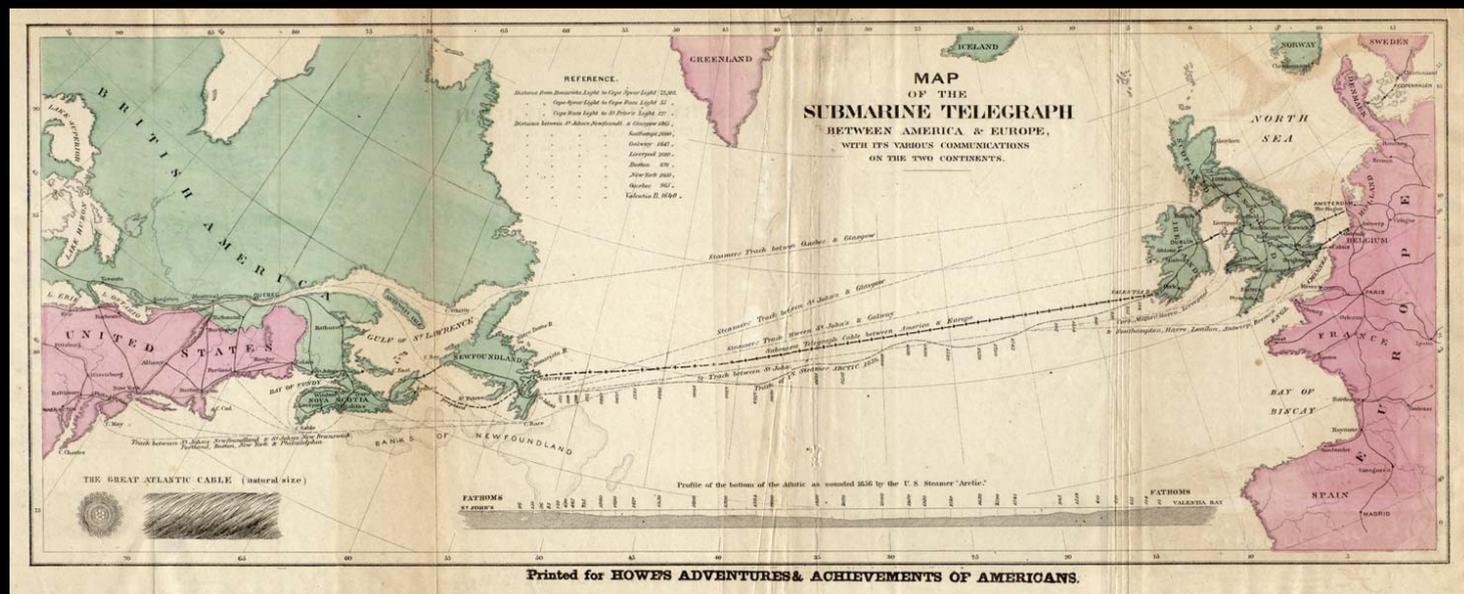
*Andrew Johnson.*

# The Atlantic Cable

The excitement died quickly

Signal drowned in noise, cable virtually unusable

Electromagnetic theory was just being developed



# The Atlantic Cable

Eng. Wildman Whitehouse tried to solve the problem by brute force

Upped the voltage from 600V to 2000V

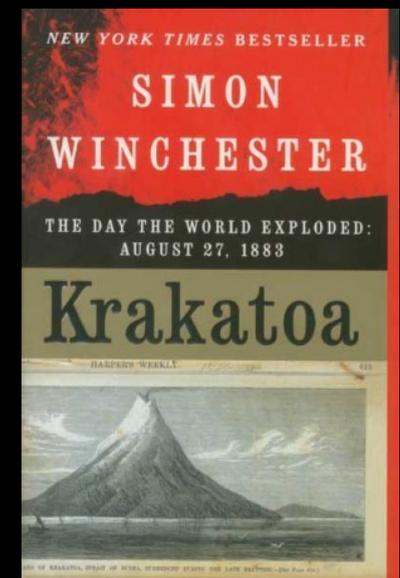
Result: the cable was destroyed after 26 days of operation

# The World is Wired

Second atlantic cable laid in 1866  
(after a few more failed attempts)

Reliable 12 word-per-minute communications  
between Europe and America

By the early 20<sup>th</sup> century,  
much of the world is connected



# The Coaxial Era

1956: first transatlantic telephone cable, called TAT-1, connects Scotland to Newfoundland

Capacity: 36 voice channels

1978: last transatlantic coax, TAT-7

Capacity: 4,000 voice channels

Very bulky and expensive

In service till 1994



# The Fiber Optic Era

1986: first undersea fiber optic cable

1988: TAT-8, first transatlantic FO cable

Capacity 40,000 channels (2.5 Gbps)

1990s onward: privately funded projects

e.g. Hibernia Atlantic – capacity up to 10 Tbps

# The Dotcom Boom and Bust

Late 90s: first cable projects designed with the internet in mind

When the bubble burst, capacity bottleneck quickly became capacity glut

Many of the new private operators went under



# Network Stats

Over 1 million km of submarine cable laid

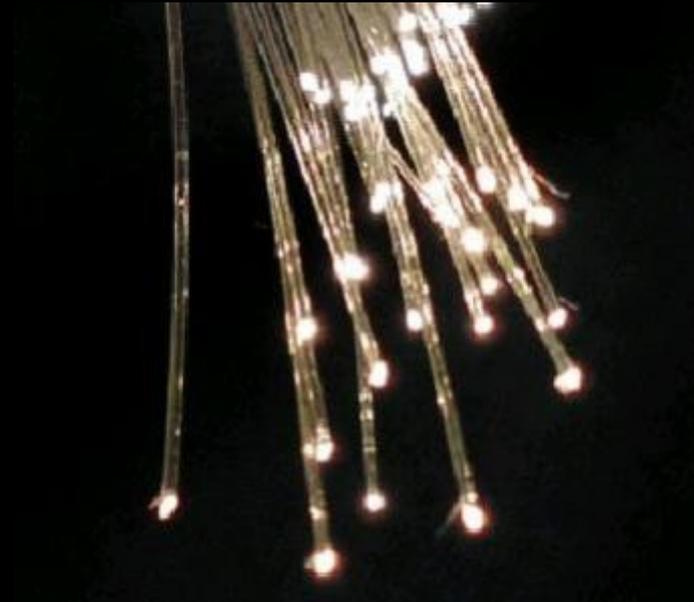
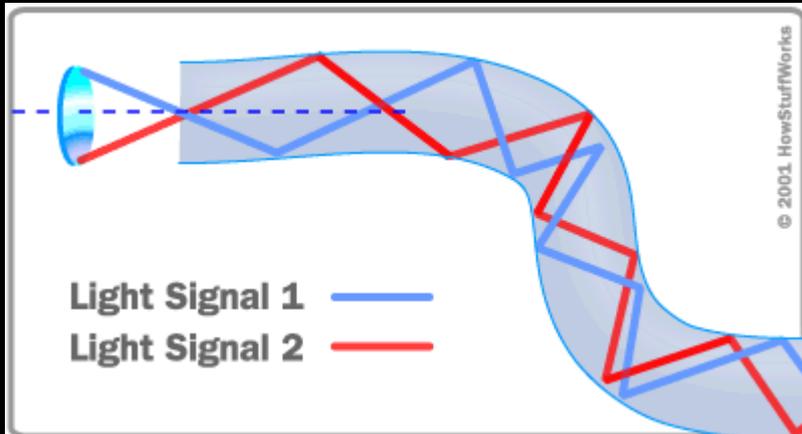
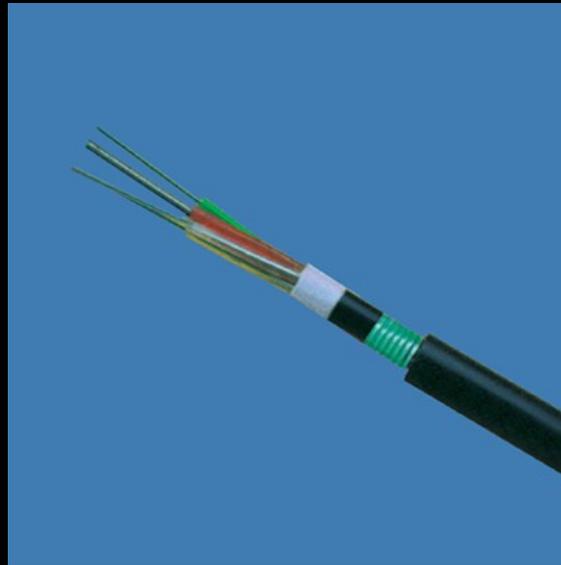
Carry over 95% of international telecom

Current transatlantic capacity: ~40 Tbps

Max system lifetime: ~20 years

# The Making of a Submarine Cable

Fiber pairs



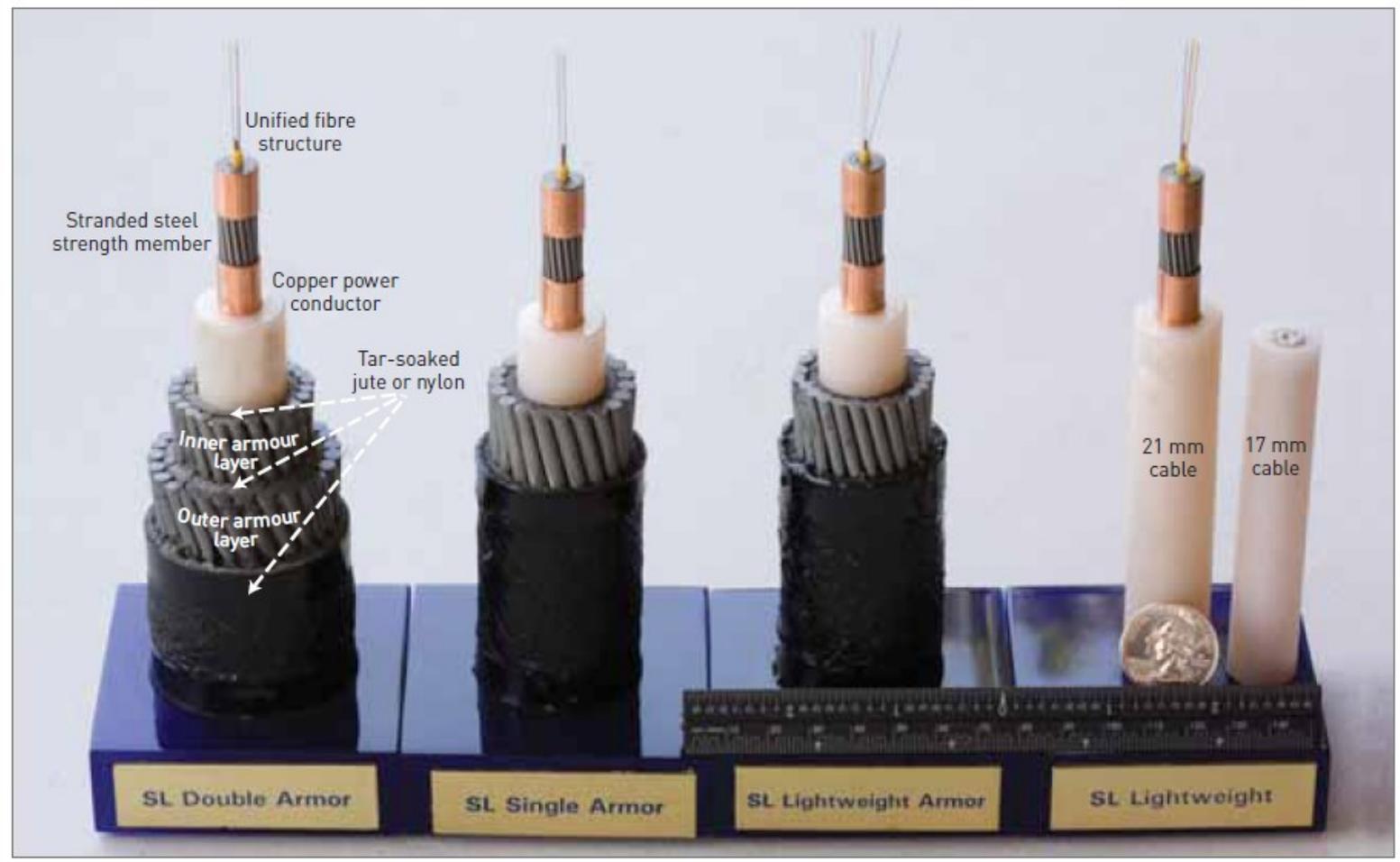
# The Making of a Submarine Cable

## Erbium-Doped Fiber Amplifiers



# The Making of a Submarine Cable

## Insulation, power, and armour



# Landing Stations



# The Enemies of Cable

Quiz: the most common reason for cable failure is:

- a) Shark bites
- b) Commercial fishing
- c) Sabotage by competing operators
- d) Undersea earthquakes

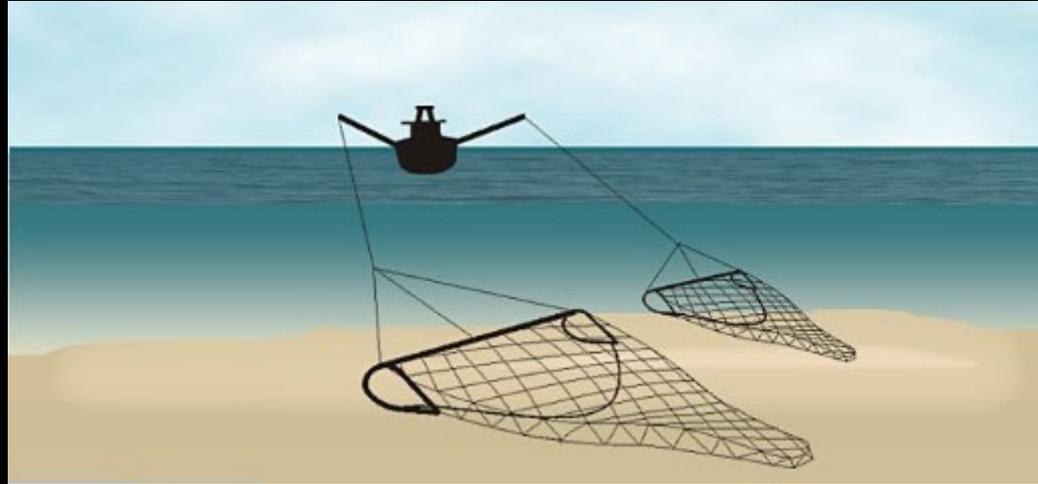
# The Enemies of Cable

Quiz: the most common reason for cable failure is:

- |                                    |       |
|------------------------------------|-------|
| a) Shark bites                     | 0.5%  |
| b) Commercial fishing              | 44.4% |
| c) Sabotage by competing operators | 0%    |
| d) Undersea earthquakes            | 2.6%  |

# The Enemies of Cable

Idiots in trawlers

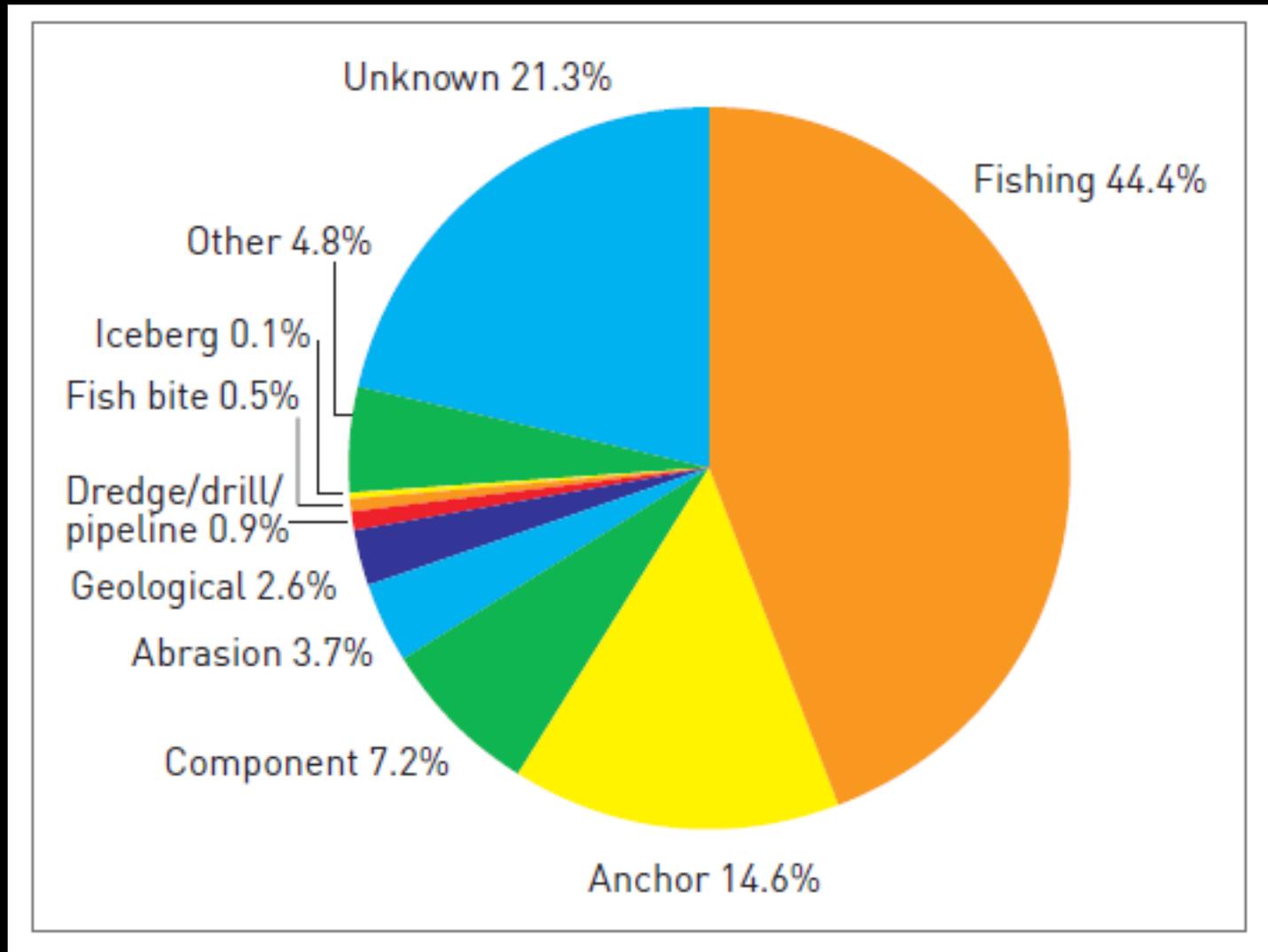


Idiots  
with  
anchors



Idiots in backhoes

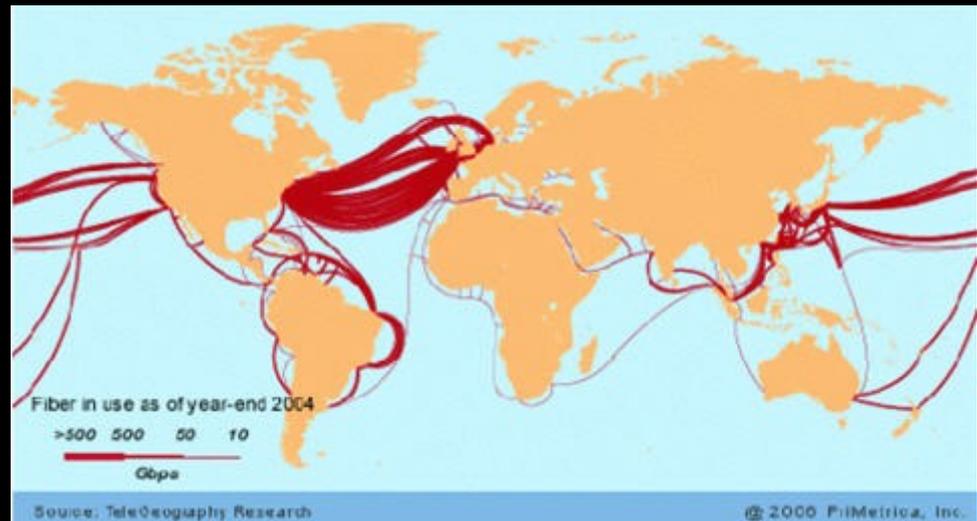
# The Enemies of Cable



# How to Fix Your Cable

## Step 1: reroute the traffic

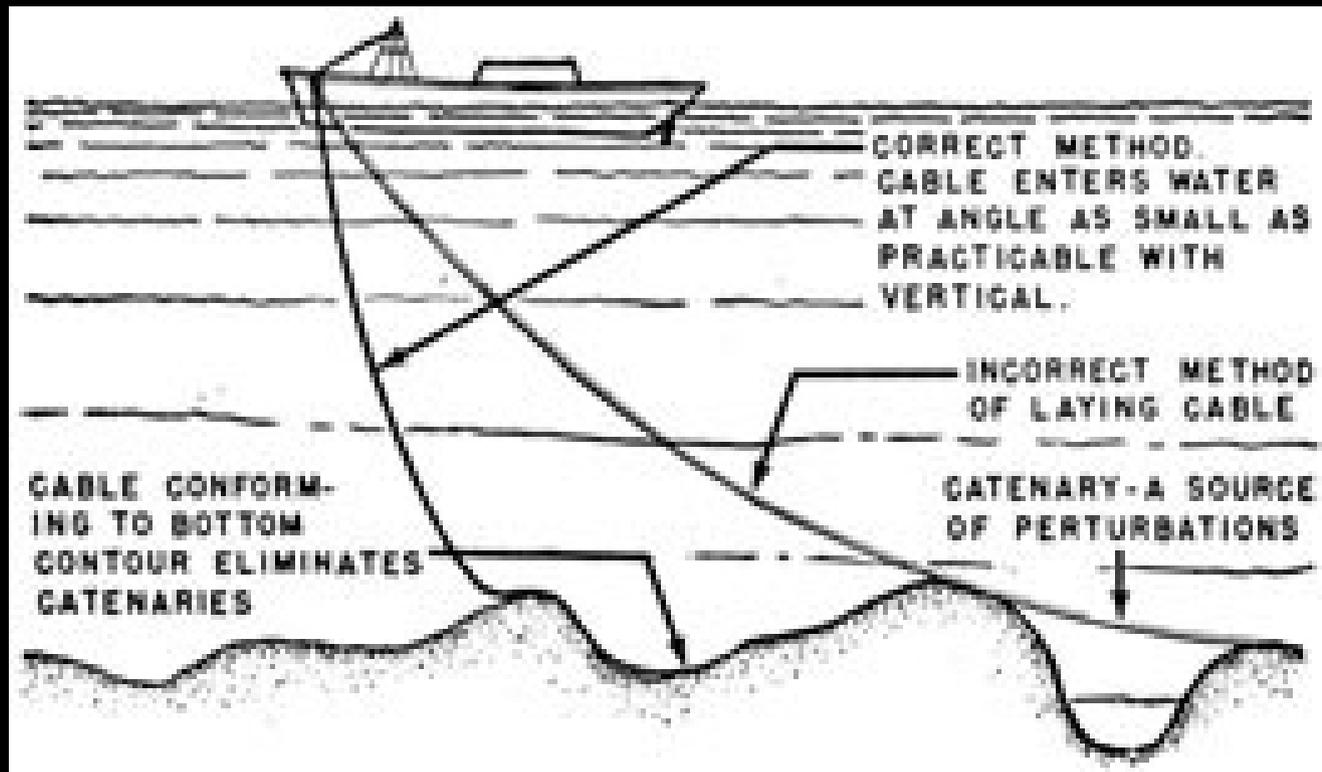
- In-system backup
- Backup agreements
- (Satellite)



# How to Fix Your Cable

Step 2: Dude, where's my cable?

(and where is it broken?)



# How to Fix Your Cable

## Step 3:

Send in the cavalry



# How to Fix Your Cable

Step 4: Find someone to sue

Importance of undersea cables was recognized early on

Protected by international treaties since 1884



# Sources



ICPC-UNEP report

[http://www.iscpc.org/publications/ICPC-UNEP\\_Report.pdf](http://www.iscpc.org/publications/ICPC-UNEP_Report.pdf)

Mother Earth Mother Board

<http://www.wired.com/wired/archive/4.12/ffglass.html>

ICPC history

[http://www.iscpc.org/information/Timeline\\_History.htm](http://www.iscpc.org/information/Timeline_History.htm)