UNDERWATER CABLES 101

An introduction to underwater cable application, design and installation

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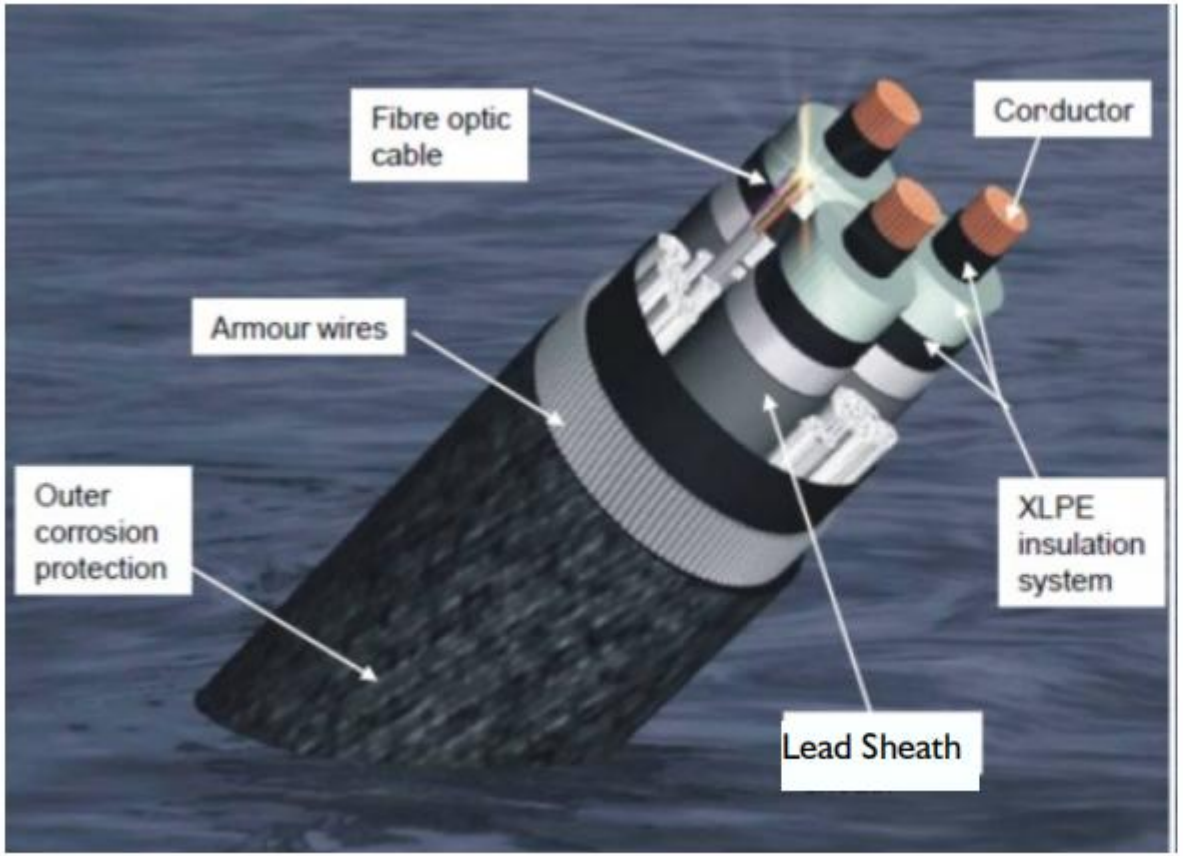
OUTLINE

- Introduction
- Power
- Communications (Fiber Optics)
- Cable Design
- Advantages of Fiber Cables
- Lake, Marsh and River crossings
- Design Considerations
- Cable Laying
- Discussion

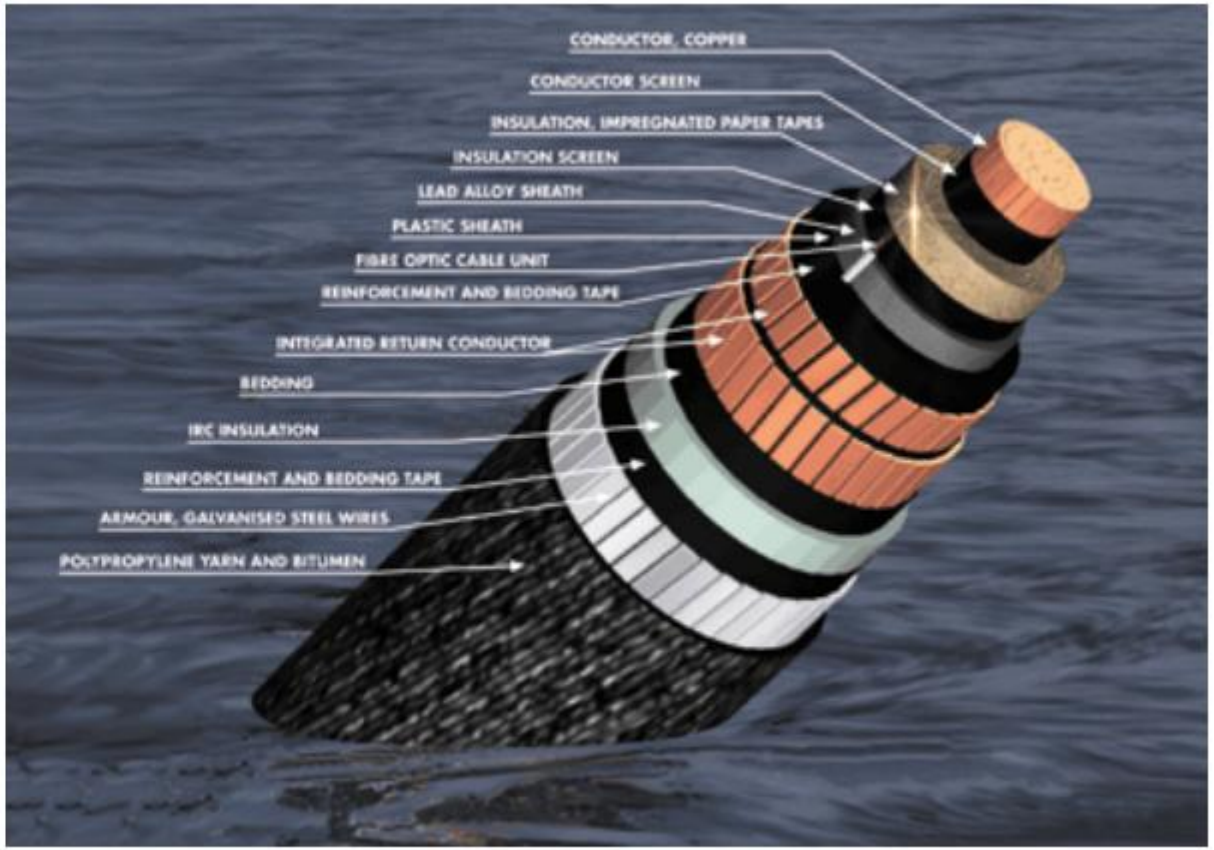
POWER CABLES

- Used for transmission of Electricity
- Specifically designed for AC or DC systems
- The largest operating system is the VikingLink.
  - 756 Km, 525V DC.
  - Initially designed at 800 MW
  - Ultimate capacity of 1,400 MW.
- The design generally includes fiber optic element for thermal monitoring and communications

TYPICAL POWER CABLE DESIGN



3 Phase AC Submarine Power Cable



Co-Axial HVDC Submarine Power Cable

Biggest project on the drawing table

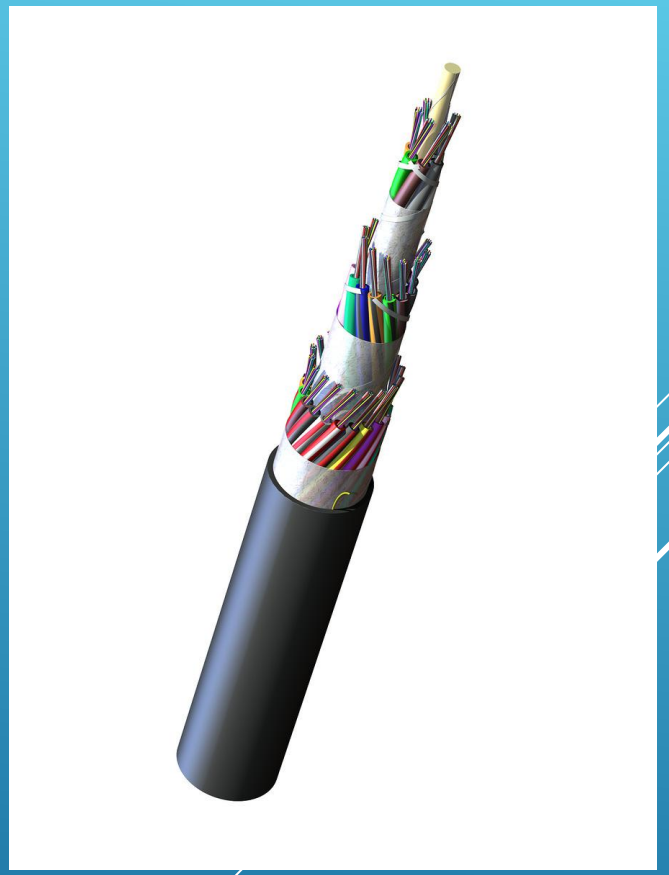
COMMUNICATION CABLES

- Used for the transport of signals
- First design used a co-axial conductor for trans-oceanic applications
- Current designs use fiber optic filaments
- The design is dictated by the application
- The signal can be regenerated (amplified) along the route
- Generally, the fiber optic elements are the least expensive elements

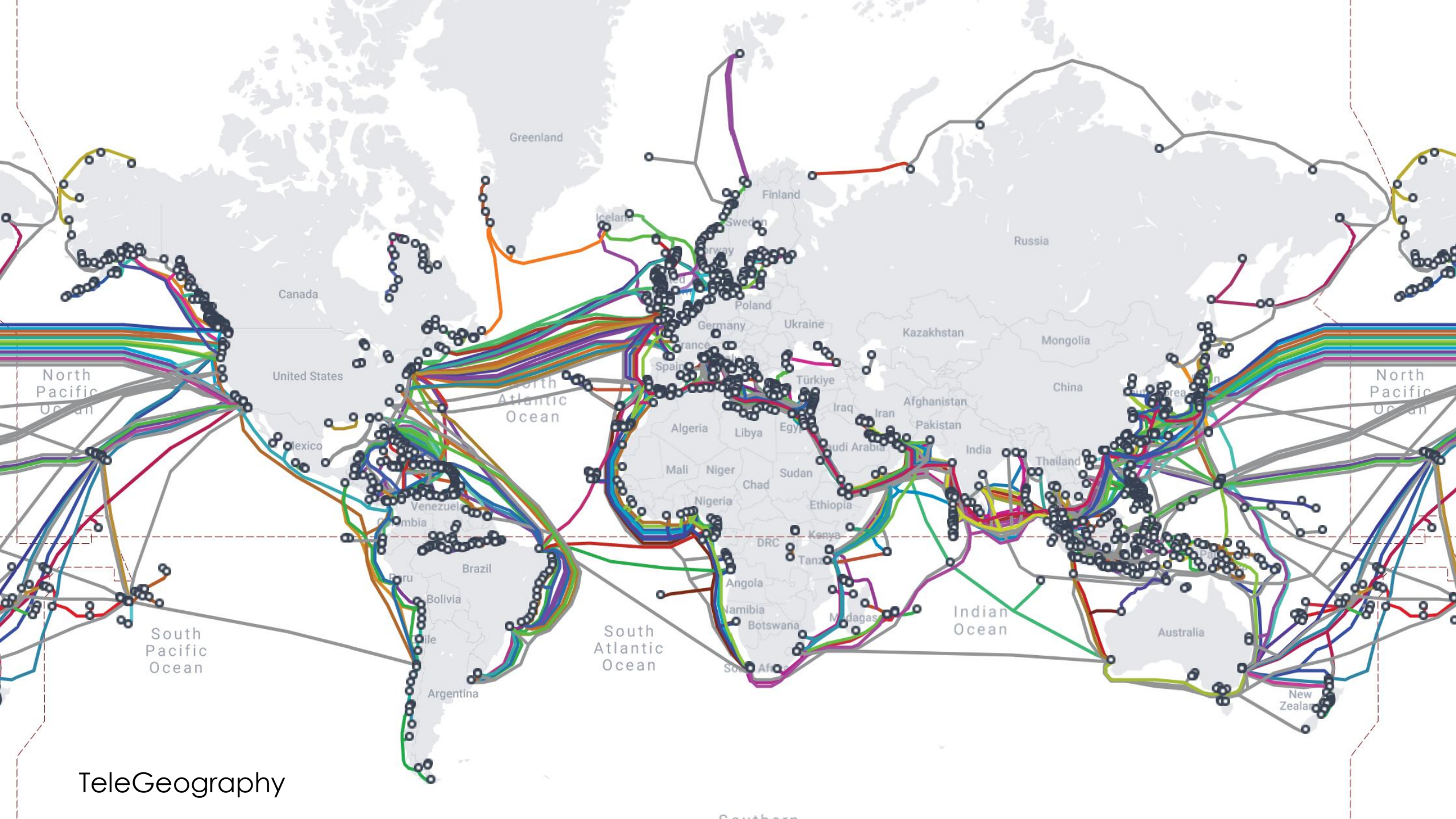
Typical Communication Cable Design

Deep Water

River and Lake Crossings



Metallic Aerial Self Supporting



TeleGeography

THE ANATOMY OF A SUBMARINE CABLE

1. Optical Fibers
2. Plastic Sheathing
3. Steel Wires/Strands
4. Power Conductor
5. Polyethylene Layer
6. Armoring

WHY USE FIBER CABLES

- Vastly Superior Bandwidth
- Capacity and Reliability
- Lower Latency
- Greater Stability and Security
- Upgradeable

COMMUNICATIONS CABLES MANUFACTURERS

- Alcatel Submarine Networks (France.
- SubCom, LLC (US)
- NEC Corporation (Japan).
- Prysmian Group (Italy)
- Nexans (France)
- HENGTONG GROUP CO., LTD. (China)
- ZTT (China).
- NKT A/S (Denmark)
- Furukawa Electric Co., Ltd. (Japan)
- LS Cable & System Ltd (South Korea)

Unique Challenges of Lake, Marsh, and River Crossings

- Environmental Sensitivity
- Terrain Variability
- Water Obstacles
- Accessibility
- Potential Hazards
- Regulatory Requirements

CONSIDERATIONS FOR SYSTEM DESIGN

- Terrain and access to landing points
- Environmental Protection
- Durability and Longevity
- Redundancy
- Cable/Conduit Material
- Monitoring and Maintenance

DEPLOYMENT METHODS AND TECHNOLOGIES

1. **Buried Cables/Conduits:**
   - Direct Burial
   - Horizontal Directional Drilling (HDD)
   - Micro-trenching: For shallower crossings or near shorelines, micro-trenching can create narrow, shallow trenches for cable placement with minimal disturbance.
2. **Submerged Cables:**
   - Weighted Cables
   - Buried Submerged Cables
3. **Aerial Crossings:**
   - Overhead Cables
   - Hybrid Approaches

LAYING THE CABLE

1. Surveying the Route
2. Loading the Cable
3. Laying the Cable
4. Jointing and Testing
5. Shore Ends

SUSTAINABLE INSTALLATION METHODS

1. **Trenchless Technologies**
   - Horizontal Directional Drilling (HDD): Micro-trenching
2. **Eco-Friendly Materials**
   - biodegradable cable sheathing.
   - Fiber optics consume less energy than
3. **Smart grids**
   - optimize energy use, making fiber installations more sustainable.
4. **Wetland and Waterway Protection**
   - Floating cable systems minimize disruption in lakes and rivers.
   - Directional drilling avoids disturbing sensitive ecosystems.
5. **Long-Lasting, Low-Maintenance Design**
   - Fiber optic cables require less frequent replacement than traditional copper wiring.
   - Their durability reduces waste and maintenance costs over time.

POSSIBLE DISCUSSION ITEMS

- Timeline
- Permitting
- Environmental impact
- Maintenance
- Spare equipment
- Advantages of using one type of cable

LOW GROUND PRESSURE VEHICLES

PAY-OFF SYSTEMS

UNDER WATER PLOUGHS

Trenching equipment