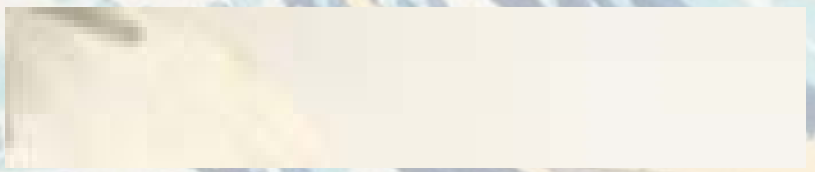
SubOptic 2010 conference & convention
enabling the next generation of networks & services

Lessons Learned in Oil and Gas

Guy Arnos and Stephen Lentz



Presenter Profile

Guy Arnos has over 25 years experience in submarine and terrestrial networks. He joined WFN Strategies in 2001 as Director of Projects, and has been responsible for government, commercial and oil & gas telecoms engineering projects in Angola (ADONES), Australia (NW Shelf, Browse Basin), Antarctica, Trans-Pacific cables (MPC, Unity North), UAE (Multi-use Submarine Cable System), Colorado/Oklahoma/Wyoming (Broadband Wireless), and Gulf of Mexico.

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Presenter Profile

Mr. Lentz has over twenty years experience in the construction and operation of optical communications networks. He joined WFN Strategies in 2005 as Network Design Manager, and has supported government, commercial and oil & gas projects in Antarctica, Oklahoma, Gulf of Mexico, Australia's Browse Basin and West Africa. Concurrently, Mr. Lentz provided network engineering and project management support for the NEPTUNE Canada cabled oceanographic observatory.

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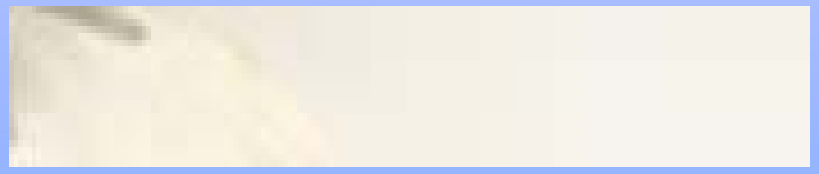
Tutorial Overview

- Opportunities in Oil and Gas
- Business Structures
- Design and Performance Criteria
- System Design Case Studies
- Implementation Issues
- Operational Data and Results



Tutorial Objective

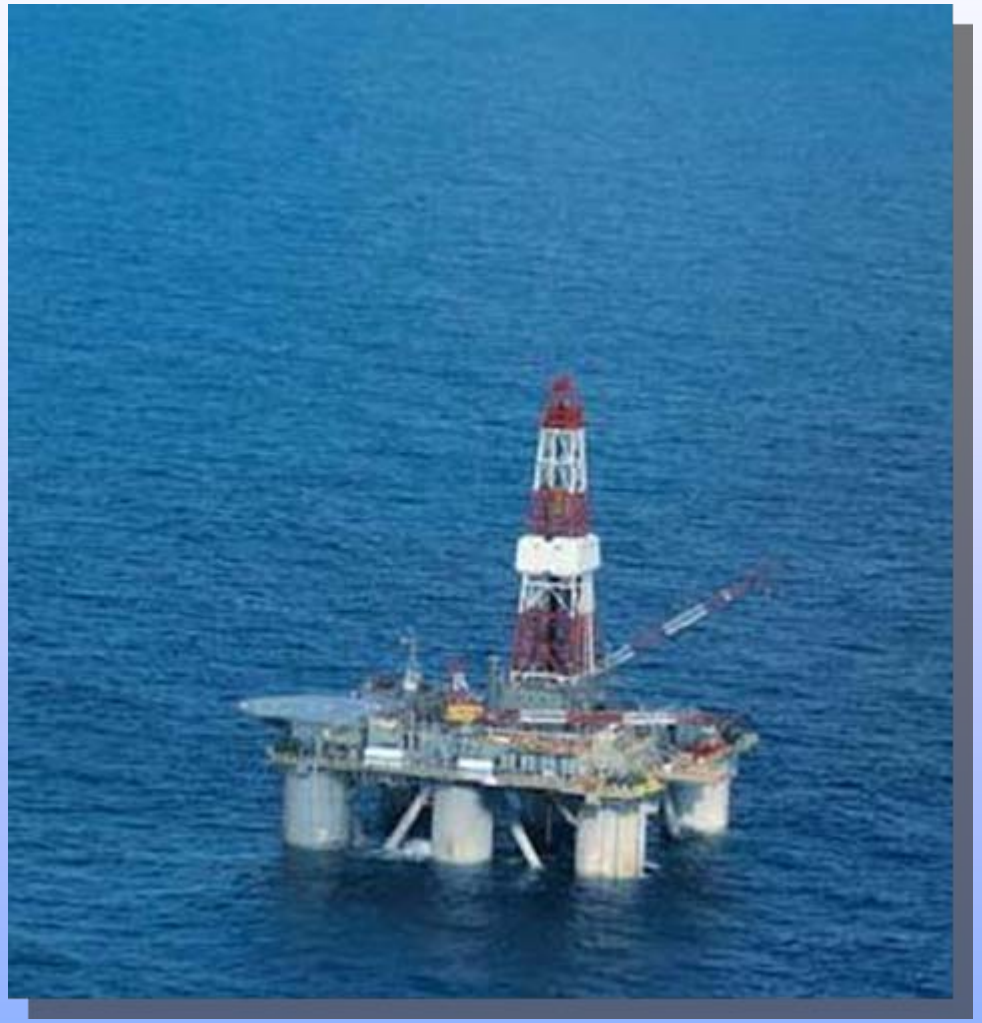
To understand the considerations inherent in the design and construction of subsea telecoms systems for oil and gas production from the perspective of both system owners and system suppliers.

Opportunities

- Energy industry is realizing the value of fiber optic communications
- Subsea telecom industry seeking new markets
- Success demonstrated in Gulf of Mexico
- Other projects under consideration
- Fiber communications to offshore assets becoming the standard approach

Why Fiber Optics Offshore?

- The high capacity, low latency and reliability provided by optical systems has been identified as key to improving production rates
- Multi-decade life cycles and production rates justify investment in these systems



Efficiency Drivers

- **Digital fiber systems offer:**
  - Collaboration
  - Real time data collection
  - Video imaging & surveillance
  - Electronic work management systems
  - Support of information technology systems

- **Existing technologies are struggling to meet these requirements**

Cost Benefits

- Reduced down time
- Shore side experts and suppliers can support multiple platforms
- Operations and maintenance cost savings from reduced manning
- Capital cost savings, if reduced manning considered during Front End Engineering Design
- Improved production
- Ability to re-man faster after abandonment

Business Structures

- Single Owner
- Singe Owner, Multi-User
- Consortium
- Third Party Ownership
- Systems with Mutual Restoration

Single Owner

- Simplest organization structure
- One entity can determine requirements and control the project
- Single owner bears all costs

Single Owner, Multi-User

- Simple organization
- One entity controls the project
- Sharing of total system costs
- Need to consider needs of other users
- Lease of telecoms infrastructure or “IRU” concept not fully developed within energy industry
- Added cost to prepare system for multiple users

Consortium

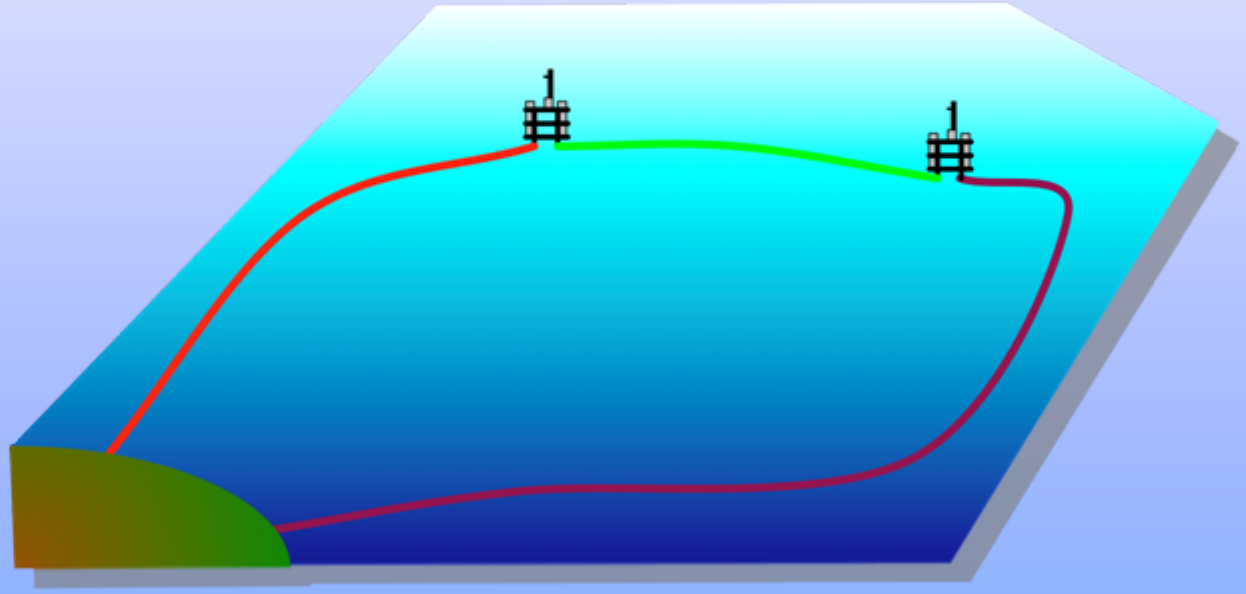
- Shared cost and risk
- More difficult to organize and govern
- Energy companies not organized to collaborate on telecoms infrastructure
- Each partner may have different requirements, leading to compromises in the design criteria

Third Party

- A service provider owns and operates the fiber system
- Oil and gas producers become users of the system
- Traditional approach for provision of microwave and satellite services to offshore platforms
- System owner can set requirements, but must consider service levels which can be offered to end users
- System owner has to work closely with platform operators to land riser cables
- Total cost may potentially be higher

Mutual Restoration

- Two (or more) owners join together to trade capacity, offer mutual restoration or combine/interconnect systems
- Concept is well understood by telecom industry
- Considered in some feasibility studies
- Could potentially develop in energy industry



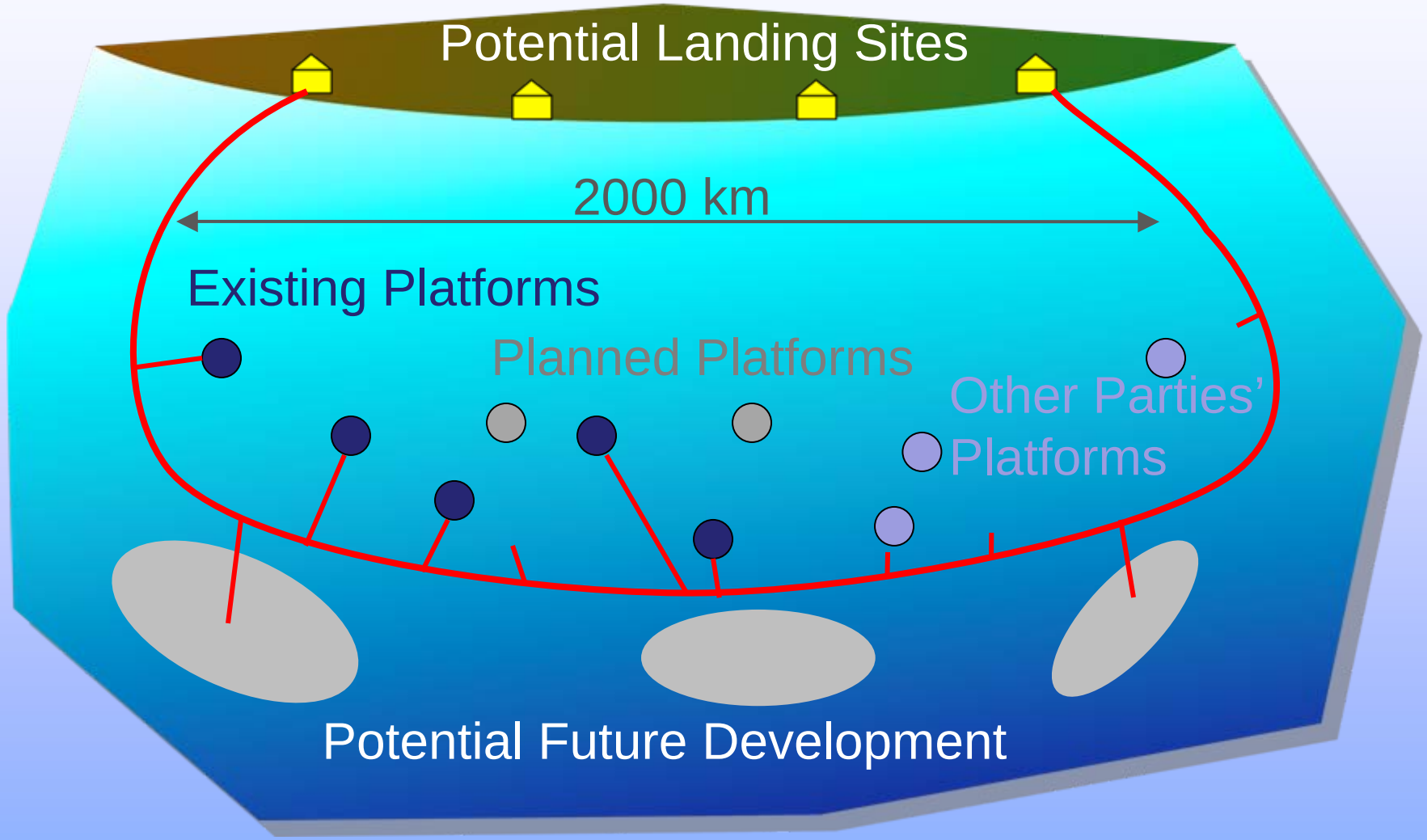
Factors in Selecting a Business Model

- Geographic location and proximity of assets
- Number of interested parties
- Schedules and timelines; when is service needed?
- Willingness of party or parties to take development and financial lead

Design and Performance Criteria

- Locations and areas to be served
- Repeatered or repeaterless network
- Maximum platform capacity
- Maximum number of platforms
- Future expansion requirements
- Ultimate network design capacity
- Level of platform independence
- Survivability Requirements

Finding a Solution



Network Design Factors

- Availability of terrestrial infrastructure
- Platform independence
- Avoiding single points of failure
- Landing point separation

System Design Factors

- Number of fibers and wavelengths
  - Typically two waves needed per location served
  - Wavelengths can be added to increase capacity at existing locations or to support new locations
- Optical line design limits
  - Unrepeatered distance
  - Backbone length
  - Spur cable length
  - Minimum number of channels (line loading)
- Initial vs. Ultimate capacity

Business Factors

- Field lifetime is 25-40 years, leading to requirement for equivalent fiber system design life
- Cost comparison between various scenarios
- Availability of telco infrastructure
- Immediate versus future requirements
- Longevity of field
- Potential to attract additional partners
- Desire to maintain competitive advantage

Project Factors

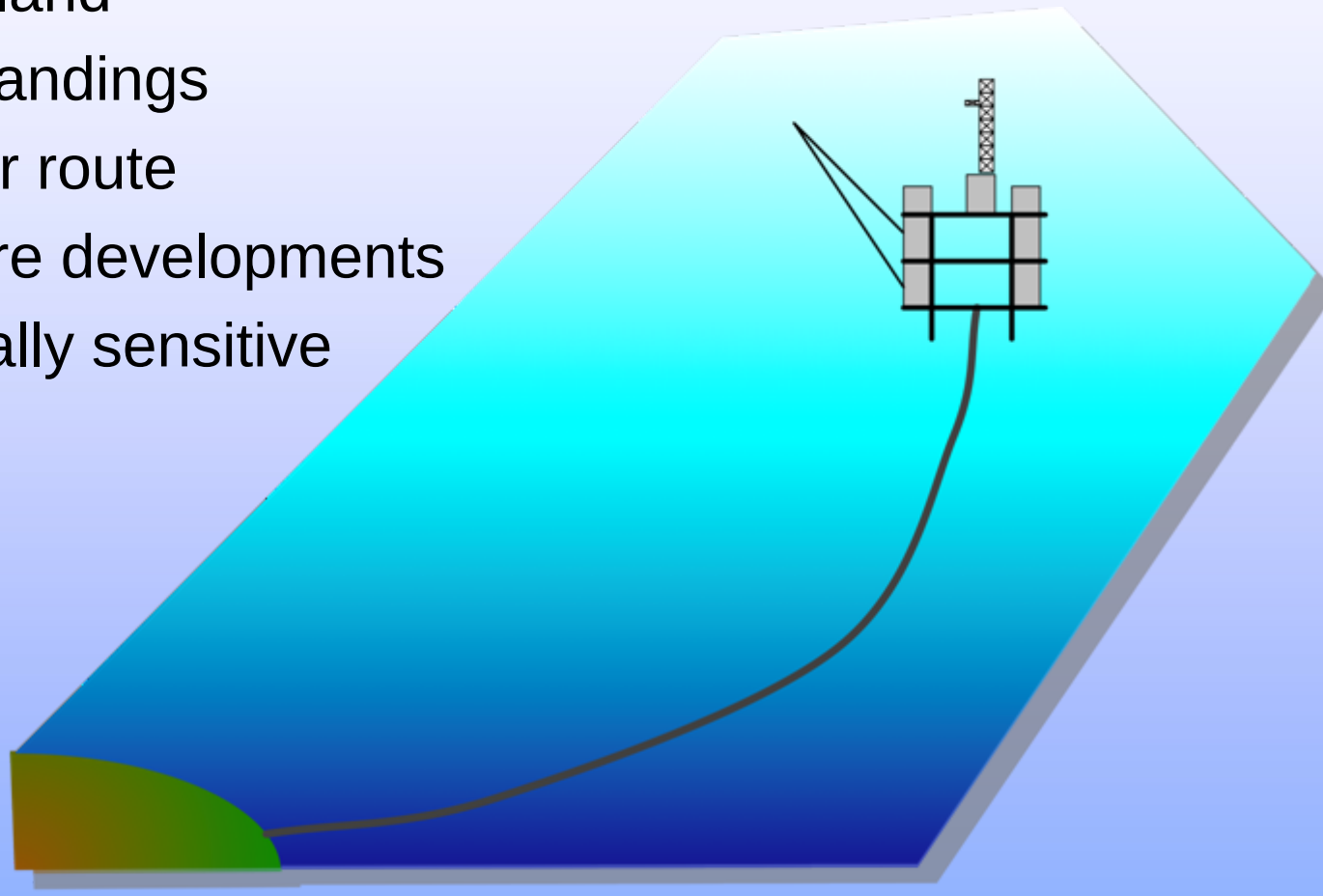
- Implementation feasibility
- Schedule
- Key decision points
- Route security
- Permitting and environmental
- Regulatory environment
- Telecom vs. Energy industry contract language

Case Studies

- Case 1: Point to Point System
- Case 2: Fiber Rings
- Case 3: OADM Branching Units

Case 1

- New production field
- 250 km from land
- Challenging landings
- Shallow water route
- Possible future developments
- Environmentally sensitive

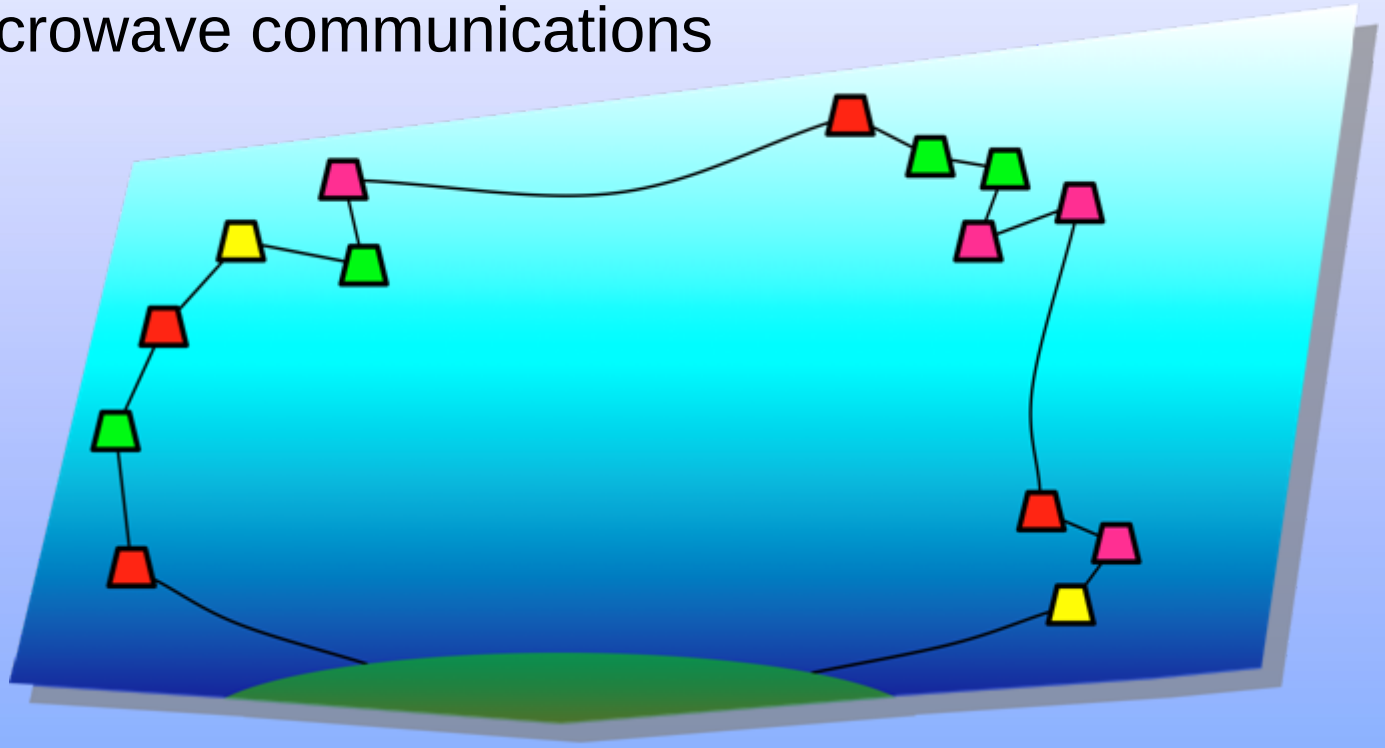


Case 1 Solution

- 300 km unrepeatered link
- Four fiber pairs
- Bandwidth limited by telco backhaul
- Branching unit and stub for future access
- Twenty-four month permitting process
- Three month window for installation
- Turn-key solution cost: $35-40M

Case 2

- Over twenty shallow water (<250m) platforms
- Platforms 10-50 km apart
- Several clusters 100-200 km apart
- At least five different owners
- Existing microwave communications

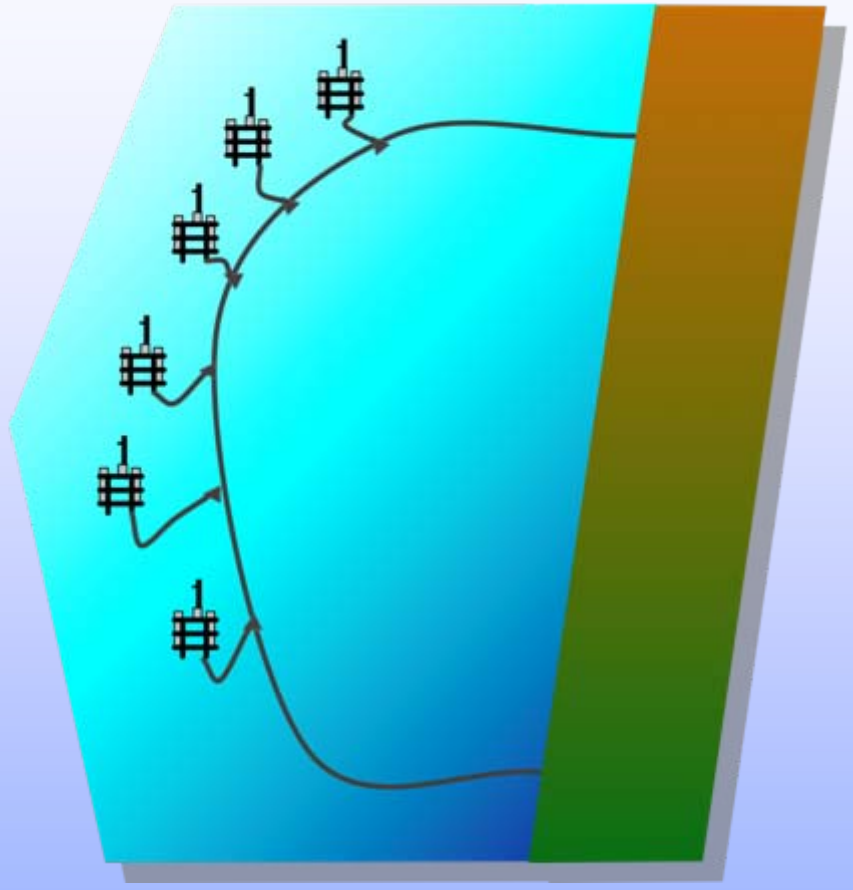


Case 2 Solution

- 500 km total length
- Twenty four fiber cable
- Major users have dedicated fiber pair
- One shared fiber pair for smaller operators
- Fibers patched through other platforms
- Mix of optics: short reach, long haul
- 100 Mb/s per platform
- Allow two ship days for each BU + riser
- No plow burial
- Estimated cost $25M

Case 3

- Eight initial and ten future deep water (up to 2,500m) platforms
- 1,500 km route
- Platforms 100-300 km apart
- Comms reliability and platform independence essential



Case 3 Solution

- Two fiber pair repeatered backbone
- OADM branching units
- BUs and spurs for future platforms
- Total cost: $80-100M

Case Studies Summary

- Cost per platform ranges from $1M to $40M
- Location is single biggest factor driving cost
- Network survivability and resilience is second most important factor
- Greatest benefits achieved if fiber communications available for entire life of field

Implementation Issues

- Project management considerations
- Network design considerations
- System electrical design
- Riser design and installation

Project Management Considerations

- Production is king: the cable ship can wait
- Project complexity: each platform is a unique challenge
- Allow sufficient time for riser design and clashing studies
- Health and safety requirements
- Training for personnel going offshore
- Riser installation is a two ship operation
- DP2 Required to approach platforms
- Other Marine logistics: ROVs, shore ends, matressing
- “Hot” work on platforms

Network Design Considerations

- Ethernet interfaces: 1 Gb/s or 10 Gb/s
- Network protection mechanism: Layer 2, 2.5 or 3
- Limitations of terrestrial backhaul capacity
- Integration with customer provided equipment
- Integration with service provider networks
- Integration with customer NMS: SNMP

Electrical Design

- PSBU allows segment with shunt fault to be isolated
- Repairs can then be performed without taking the entire system out of service
- Spurs to platforms are normally unpowered, but fault location and electroding must be considered
- PSBU allows connection to the backbone electrical conductor from a platform for testing
- For safety, there must be redundant mechanisms to prevent energizing cable head on platform

Riser Design Considerations

- **Existing Risers**
  - Fiber type
  - Fiber Count
  - Electrical Connection
  - End terminations
- **New Risers**
  - Water depth
  - I or J tube availability
  - Hang off point
  - Platform dynamics
  - Clash studies
  - Fiber type/ fiber count/ electrical connection
- **Fiber Only vs. Composite Risers**
- **Riser design and analysis is time consuming**

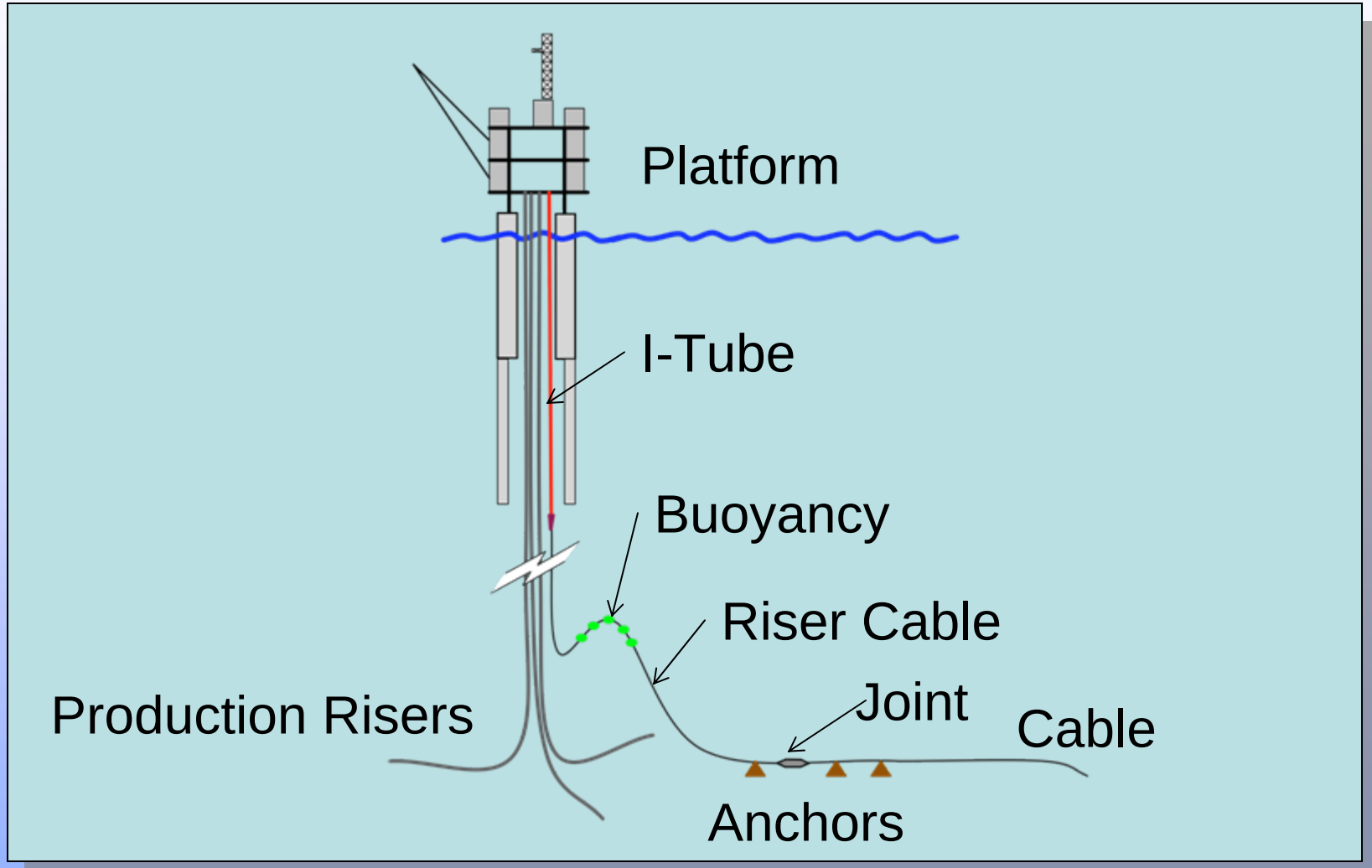
Types of Connections

- Fixed Platforms
- Floating Platforms
- Moored FPSOs
- Turret FPSOs
- Subsea Well Heads

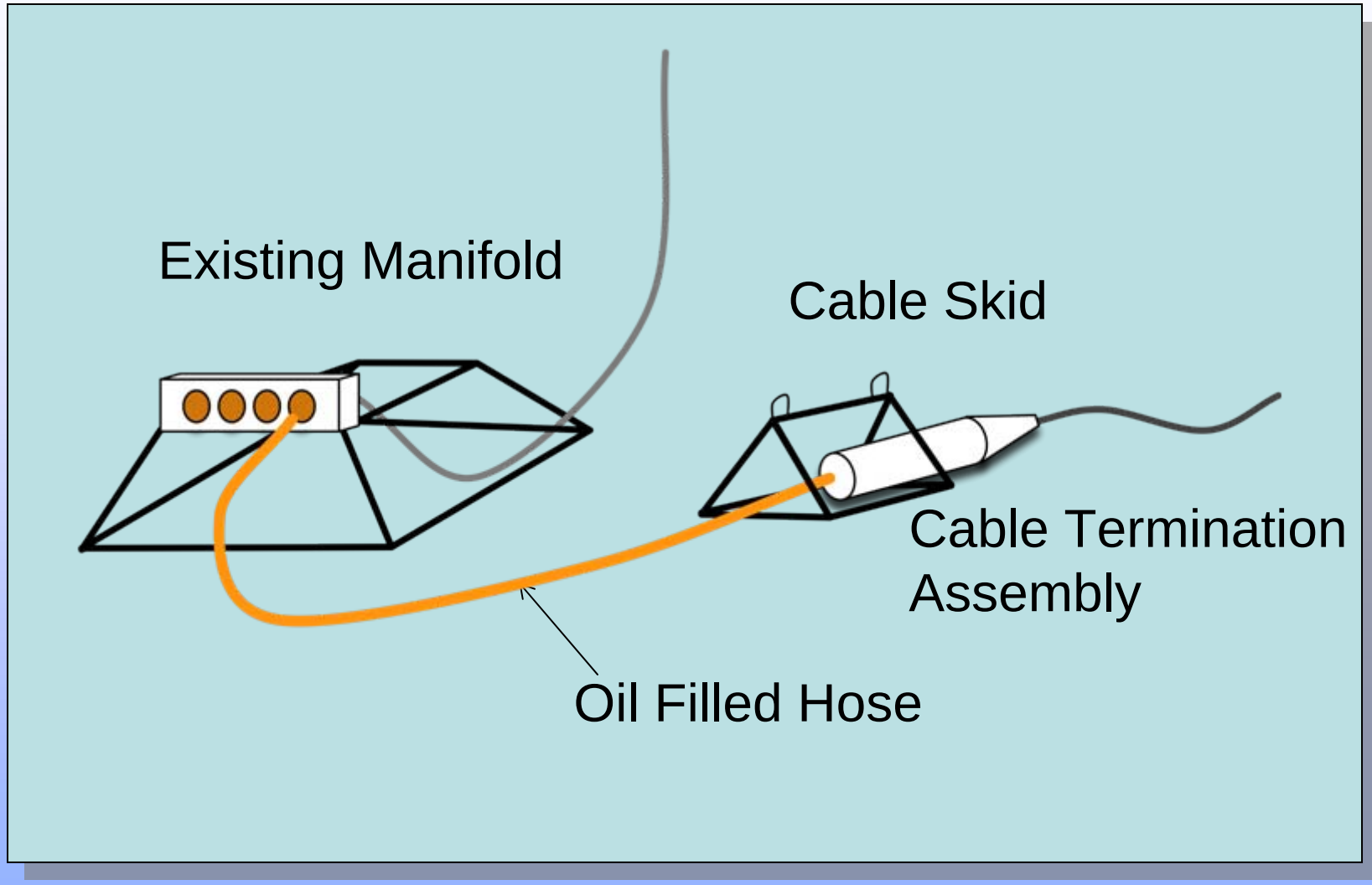
Riser Elements

- Hang-off fixing
- Hang-off termination
- Riser cable
- Bend limiters and buoyancy
- Sea bed anchors
- Fusible links
- Underwater Terminating Assembly (UTA)
- Wet mate connectors

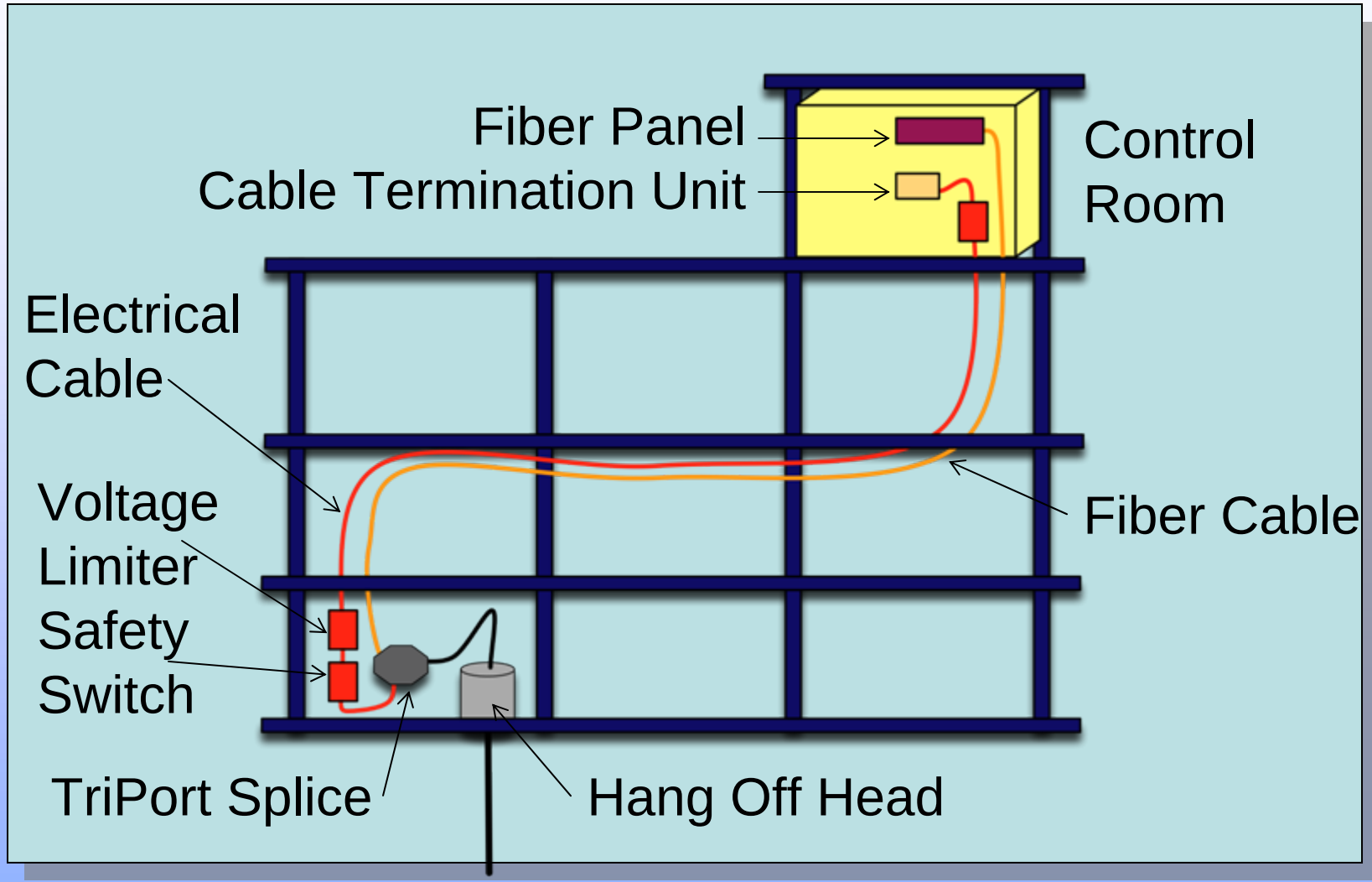
Platform Riser Connection



Connection to an Existing Riser



Topside Cabling



Operational Data and Results

- Early estimations of US$1.0 million per month savings for 7 platforms not yet verified
- Production increases claimed ranging from 0.5% to 4-5% depending on the source
- Survivable telemetry allows better restoration planning and re-manning times are improved by 1 or more days
- Cost and time savings realized through ability to serve multiple platforms from shore
- Work systems are now seen as useful tools rather than burdens

Summary and Conclusions

- The Oil & Gas industry is beginning to fully embrace optical systems as key infrastructure
- Business models for Oil & Gas systems are variable and in early stages of evolution
- Oil & Gas represents a very different business, technical and operational culture than traditional telecom
- The anticipated production, cost saving and operational benefits are meeting and exceeding expectations

Questions and Answers

Thank You!

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