SubOptic 2007

Enabling Global Communications

IS BAS STILL NECESSARY …
… and if so, where and how?

Mark Jonkergouw
ALCATEL-LUCENT

Alcatel·Lucent

Introduction

- Summary of survey and installation techniques since 2001:

  - Little change in Burial Assessment Surveying (BAS)
  - Major change in installation techniques and capability

- Necessity to look at the validity and benefit of BAS operations

- Identify the future applications for BAS operations

Alcatel·Lucent

Agenda

1. Background to Burial Assessment Surveying (BAS)
2. Changes in Marine Installation Techniques
3. Application of Modern BAS operations

Alcatel·Lucent

1 Background to Burial Assessment Surveying (BAS)

Background to Burial Assessment Survey (BAS)

- First generation tools were scaled down versions of the cable installation ploughs, known as Plough Assessment Surveying (PAS)

Alcatel·Lucent

Mini plough BAS tool

- Often requires relatively high tow tensions and therefore often not possible from the route survey vessel
- Timing of data availability is therefore often too late for improvements in cable design
- Scalability issues makes the usefulness of the data questionable

Alcatel·Lucent

Background to Burial Assessment Survey (BAS)

- First generation tools were scaled down versions of the cable installation ploughs, known as Plough Assessment Surveying (PAS)
- Introduction of Cone Penetrometer Tests (CPTs) at discrete sampling locations

Cone Penetrometer Testing

- Performed during the main survey operation, advancing the BAS data delivery time
- Provides very useful (in-situ) geotechnical data for soil strength conditions
- However, the typical frequency of 1 CPT test per 4km or 5km leaves large gaps in the ground-truthing of the low resolution geophysical data

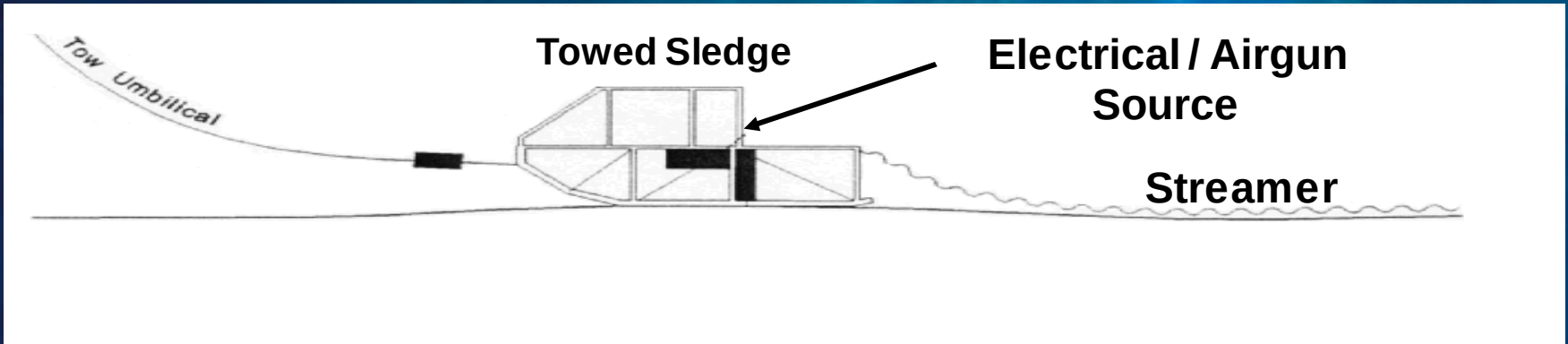
Alcatel·Lucent

Background to Burial Assessment Survey (BAS)

- First generation tools were scaled down versions of the cable installation ploughs, known as Plough Assessment Surveying (PAS)
- Introduction of Cone Penetrometer Tests (CPTs) at discrete sampling locations
- Development of continuous Resistivity and Refraction Seismic survey techniques, coupled with CPT sampling

Alcatel·Lucent

E-BAS: Towed Resistivity or Refraction Seismic (with CPT sampling)



- Typically performed as part of the main survey operation, bringing forward the BAS data
- Provides continuous and high resolution geophysical data for top 1m to 2m of seabed, coupled with ground-truthing by CPT sampling
- However, generally only used in a 2D form without Route Development, resulting in limited ability to improve route at areas of poor burial conditions

Alcatel·Lucent

Effective Cable Protection

Cable Armouring

- **Improves ability of a cable to withstand some impacts …**

…. *however* …..

…. cable remains exposed to threat ….

Cable Burial

- **Aims to place cable below the 'Threat line'**

…. effectively …..

…. putting cable out of harms way….

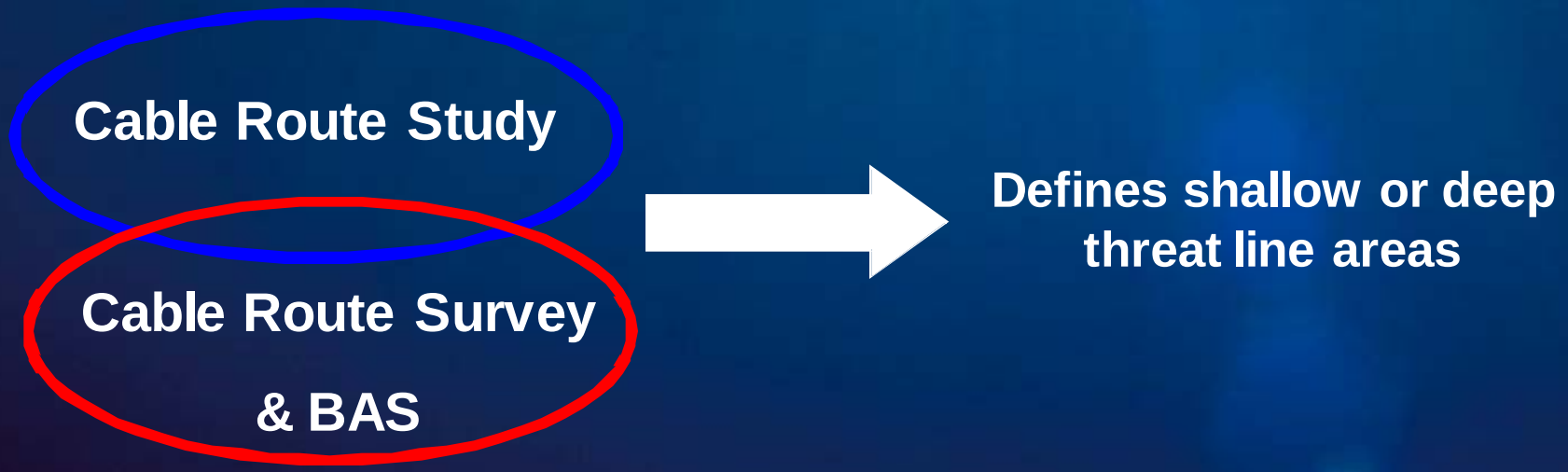
Alcatel·Lucent

Threat Line Philosophy

Threat Line depends on:

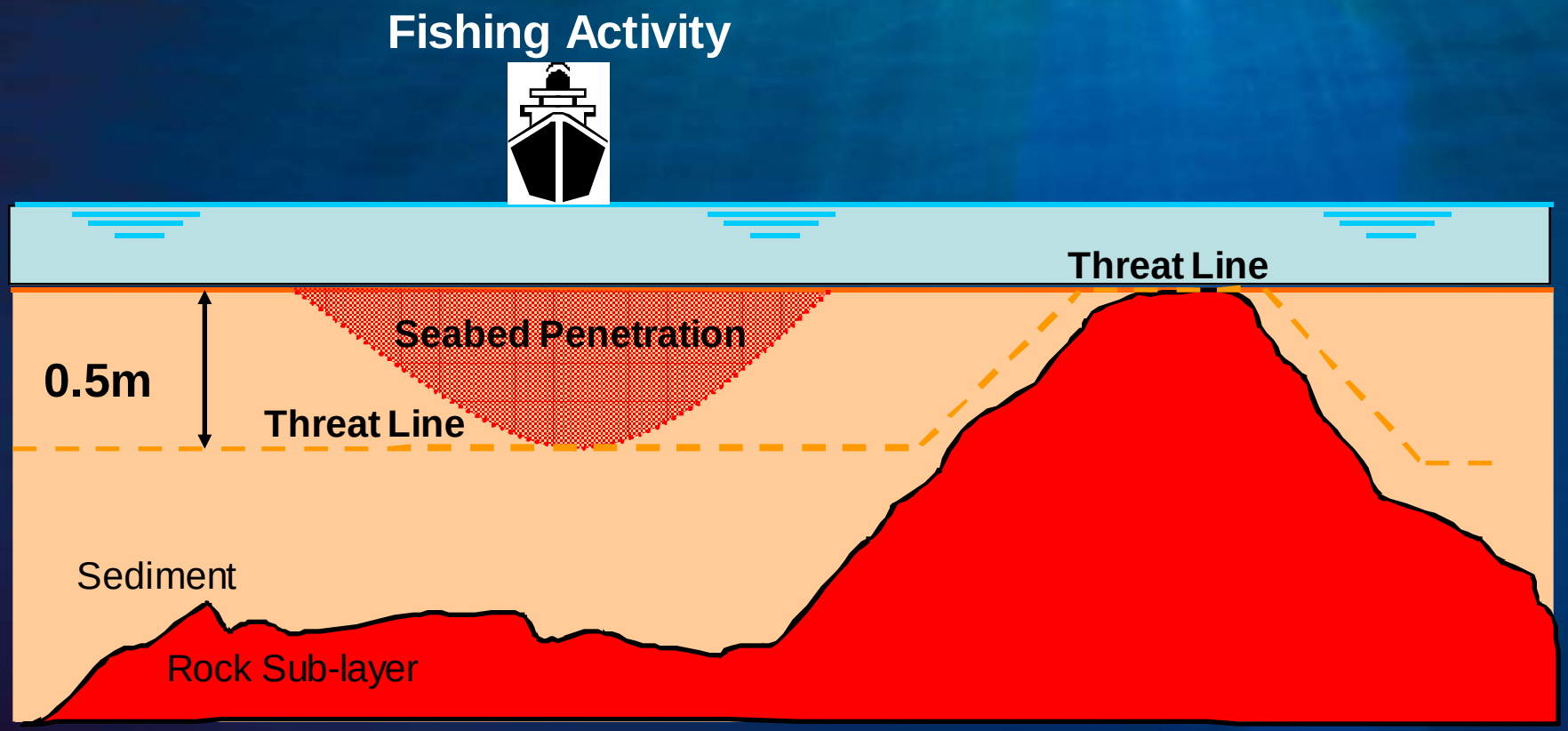
1. **Type and size of aggressive activities**
2. **Nature of the seabed sediments and topography**

Determining Depth of the Threat Line:



Alcatel·Lucent

Threat Line Example



Alcatel·Lucent

Limitations of E-BAS methodology

- E-BAS is proven to be very good at burial prediction
- Poor application of the E-BAS through 2D survey approach does not allow for route development to find an optimised burial route
- Consequently, E-BAS results are generally only useful for optimising protection through *cable armouring*, but not *risk avoidance*

Alcatel·Lucent

Reasons for Poor E-BAS Performance

- Fast-track timescales of modern submarine cable projects
- Danger there is insufficient time for a thorough Cable Route Study to be produced to identify main threats
- Manufacturing SLD often on critical path as soon as survey operations are started
- High potential for manufacturing “at risk”

Alcatel·Lucent

2 Changes in Marine Installation Techniques

Changes to Marine Installation Techniques

- Three main criteria for modern Cableship design:

1. Installation ship with superior ploughing capability
2. Installation ship with superior ploughing capability
3. Installation ship with superior ploughing capability

… did I mention the superior ploughing capability …??

Alcatel·Lucent

History of Cableships

1 Traditional Maintenance Cableships (Pre -1990's)

- Typically bow working vessel designed primarily for maintenance
- Relatively low power (<5MW, 6,500 hp)
- Low bollard pull (40 tonnes)
- Equipped with standard burial plough

Alcatel·Lucent

Traditional Cable Ship

Alcatel·Lucent

History of Cableships

2 During the 1990's – Conversion Ships

- Dynamic Positioning (DP)
- Improved weather capability
- Stern Working and (generally) more powerful
- Equipped with standard burial plough or MD3 ploughs

Alcatel·Lucent

History of Cableships

3 Post 2000 – Custom Designed Installation Ships

- High power, 15MW +, diesel electric for flexibility, Dynamic Positioning (DP2)
- Hull design for maximum stability, increased weather capability
- High bollard pull (150 tonnes) to exploit latest plough capabilities
- Equipped with HD3 plough

Alcatel·Lucent

New Build Cableship

Alcatel·Lucent

Plough Comparisons

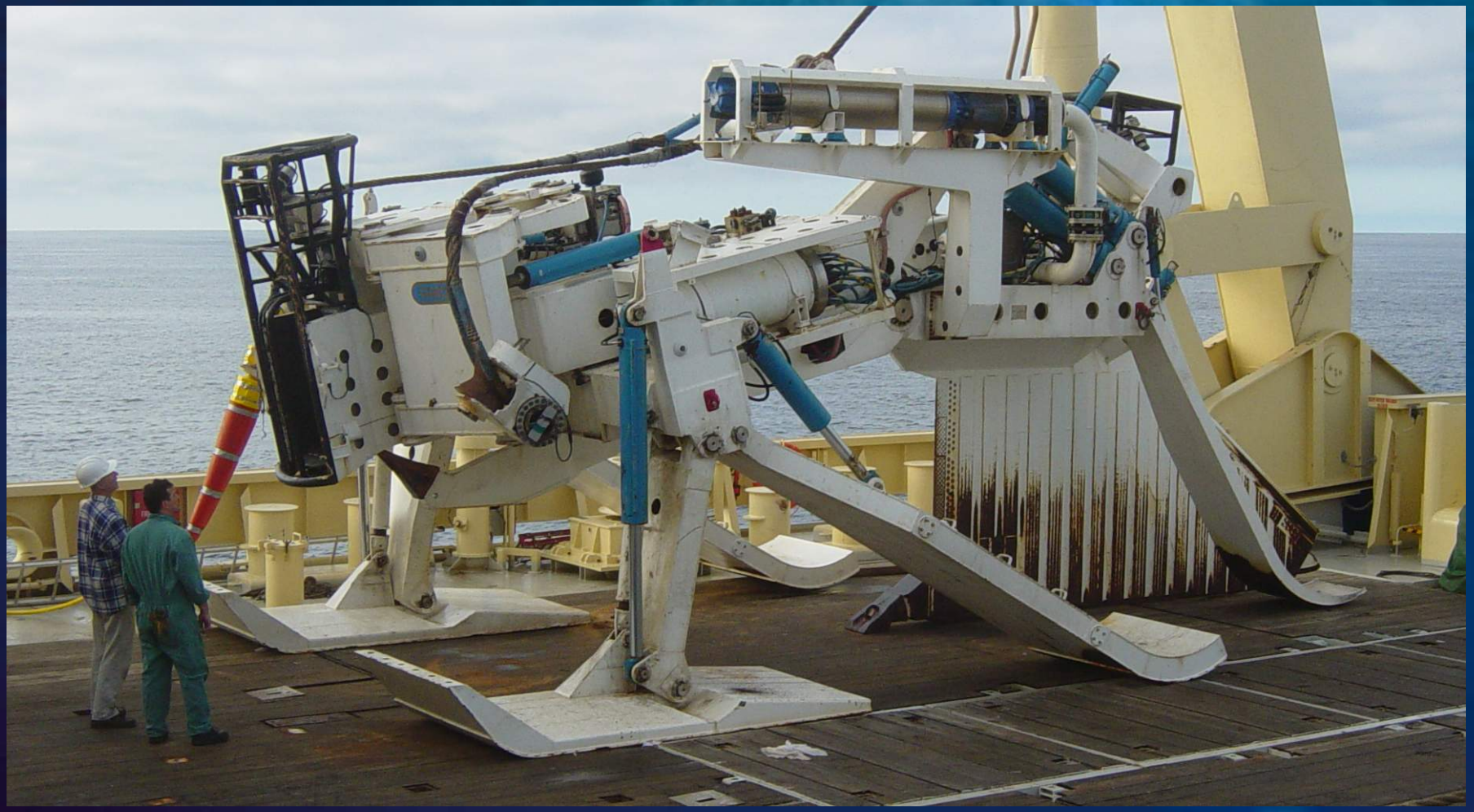
- Standard Ploughs
  - 12 tonnes in weight
  - 40 tonnes max. tow force
  - 1m max burial depth
- Heavy Duty (HD3) Ploughs
  - 30 tonnes in weight
  - 130 tonnes max. tow force
  - 2.3m burial depth
  - 3m burial depth with articulation
  - Under heel jetting option
  - Rock tooth option

… Essentially, we have a larger hammer to crack the same nut …

… and the arm swinging the hammer has been working out!!

Alcatel·Lucent

HD3 Plough Example



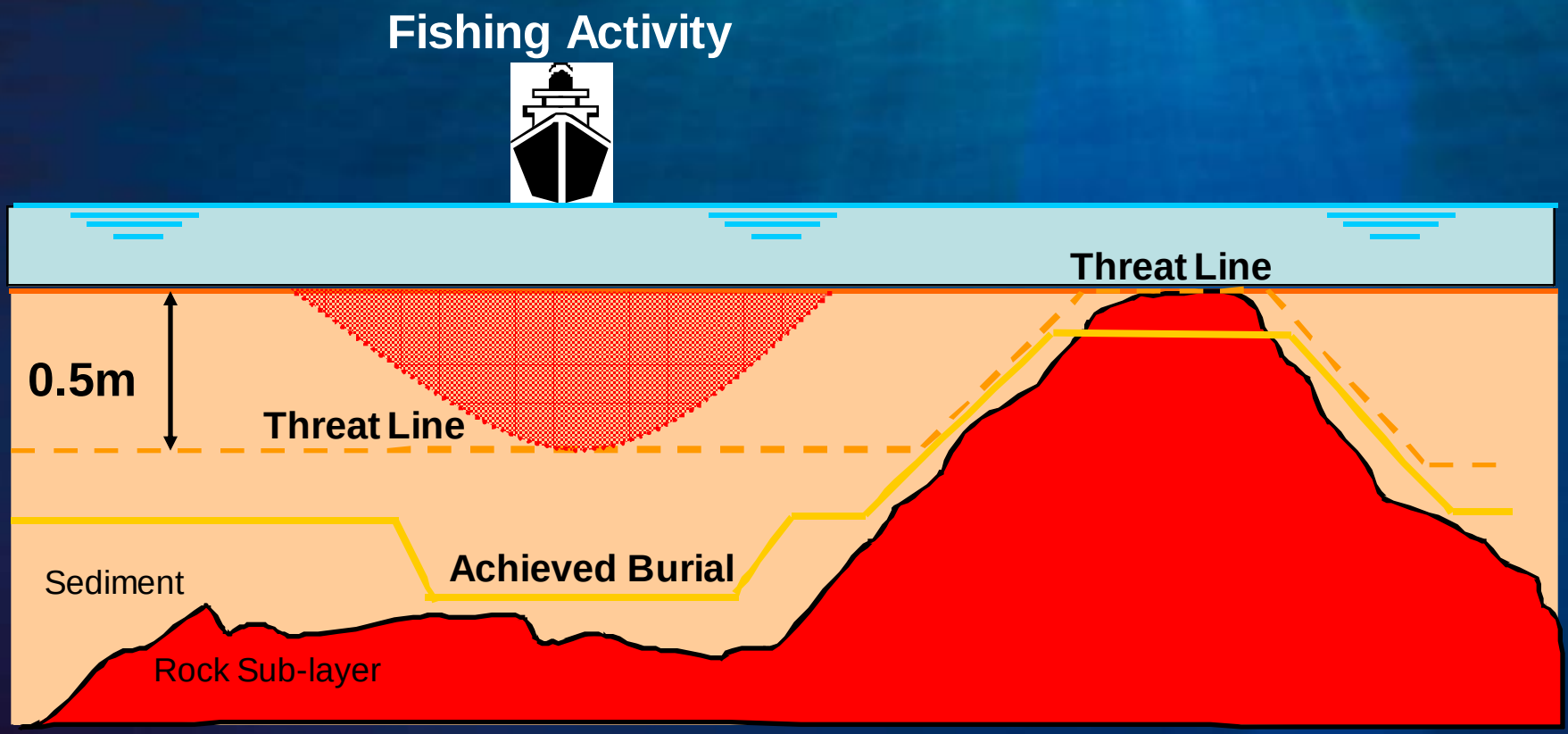
Alcatel·Lucent

Installation Summary

- Cableship and plough design have be specifically focused on achieving improved burial
- The HD3 plough's ability to penetrate the seabed ***far exceeds*** the penetration ability from the most common threat and fault causing activity (e.g. trawling)
- Achievable burial depth is deeper than the Threat Line
- The cable is put safely beyond the "danger zone"
- Deep burial now also allows for protection in areas where threat avoidance was previously the only safe choice (anchoring areas)

Alcatel·Lucent

Threat Line Revisited



Alcatel·Lucent

3 Validity of Modern BAS Operations

Application of Modern BAS Operations

- Wide-scale use of continuous E-BAS through trawling areas now considered a redundant operation
- E-BAS remains useful in niche areas where the results add ***real*** value to the route engineering process
  - Congested anchoring areas (e.g. Singapore, Hong Kong etc)
  - Requires an intensive 3D approach to E-BAS operation
  - This **MINOR** increase in survey time and cost can reap **MAJOR** benefits to installation quality and system security
- CPT BAS remains a useful addition to survey operations in areas where a moderate threat (e.g. trawling) remains

Alcatel·Lucent

… *Is BAS Still Necessary …?*

- Each Cable Route is different, with highly specific threats
- Early and thorough identification of threats is absolutely key
- Strategy for BAS operations needs to take into account the installation ship and burial equipment
- Identification of niche areas where BAS operations can add real value to the route engineering process

… NO!

… and … Yes …!

Alcatel·Lucent

www.alcatel-lucent.com