The C-Kore Subsea TDR

Automated Cost-Effective and Reliable Subsea Testing

C-Kore

C-Kore
Introduction

Greg Smith

- General Manager
- Working with C-Kore for 8 years
- Frequently supported products in the field

C-Kore
Contents

C-Kore

Simplify Subsea Testing

Introduction

C-Kore
Applications

Subsea Tools for:

- Installation/Commissioning
- Fault-finding Operations
- Down-hole Testing

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Simplify Subsea Testing

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Subsea Testing Tools

Cable Monitor (IR & Continuity)

Subsea TDR

Pressure Monitor

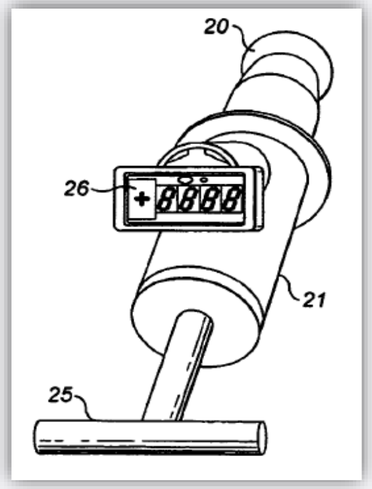
Subsea Modem

C-Kore

Simplify Subsea Testing

C-Kore
Development

Development



Started in 2010

Cable Monitor Prototype Trials

2011

Cable Monitor Released

2015

Cable TDR Prototype Trials

2017

C-Kore
TDR Specification

Specification

Range of over 20km

Precision of 10cm

Gain up to +52dB

Automated pulse and step modes

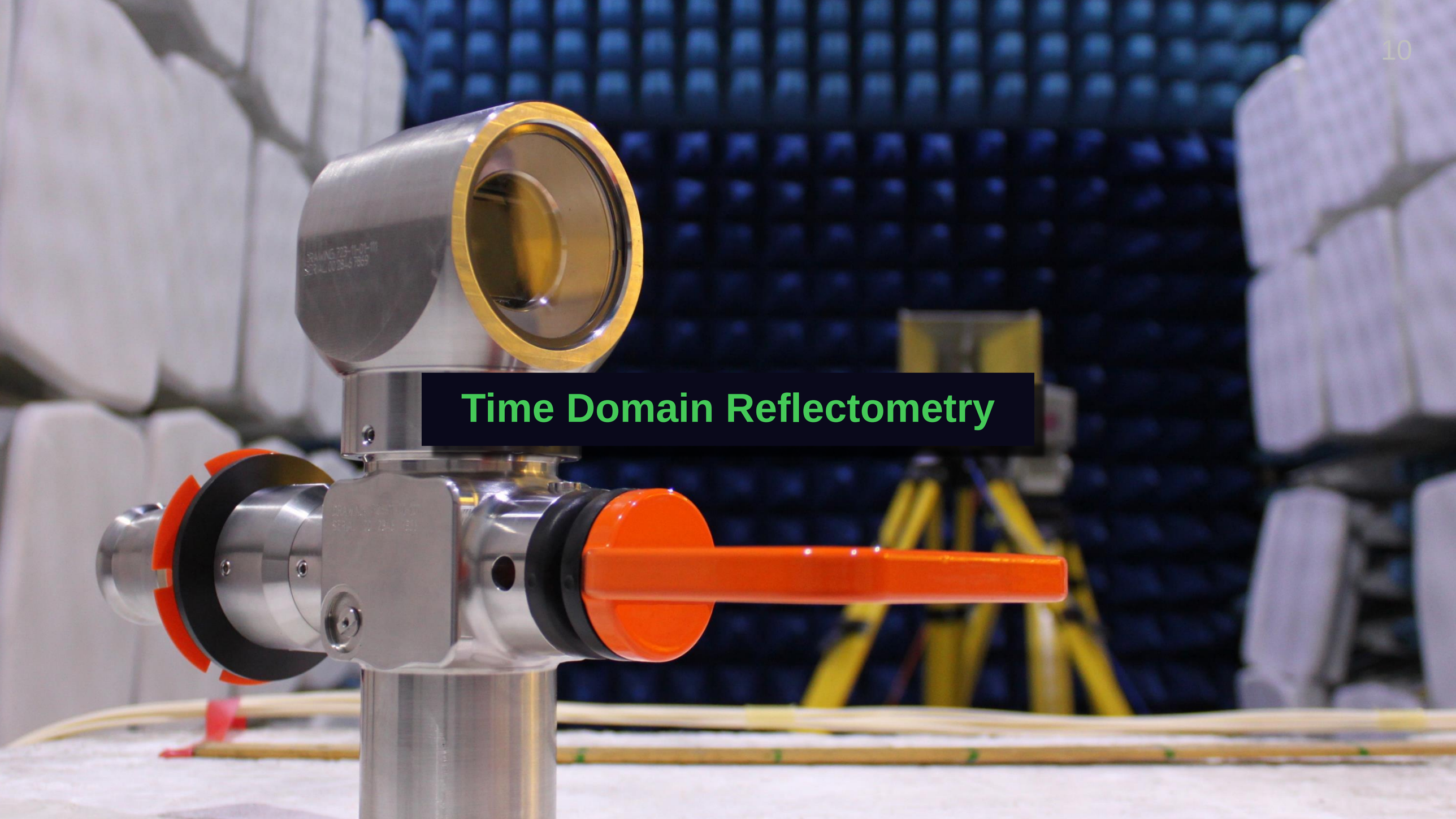
C-Kore
TDR Specification

Results

All results datalogged

Built-in analysis tools with C-Kore result viewer

Easy report generation

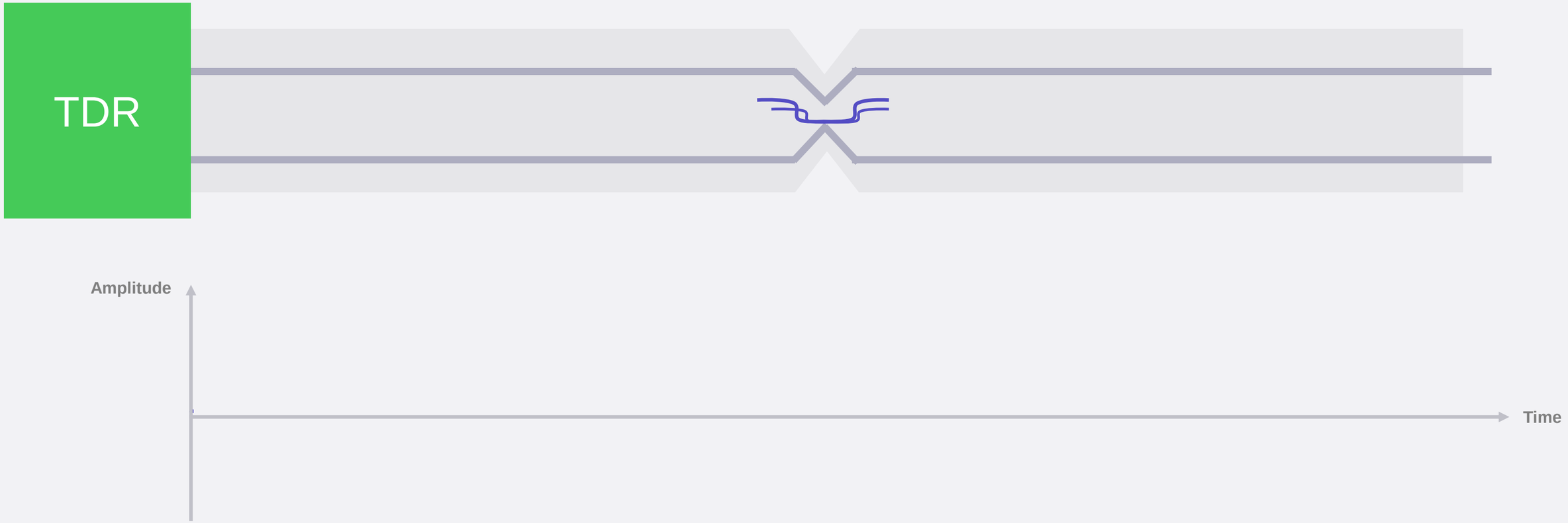


Time Domain Reflectometry

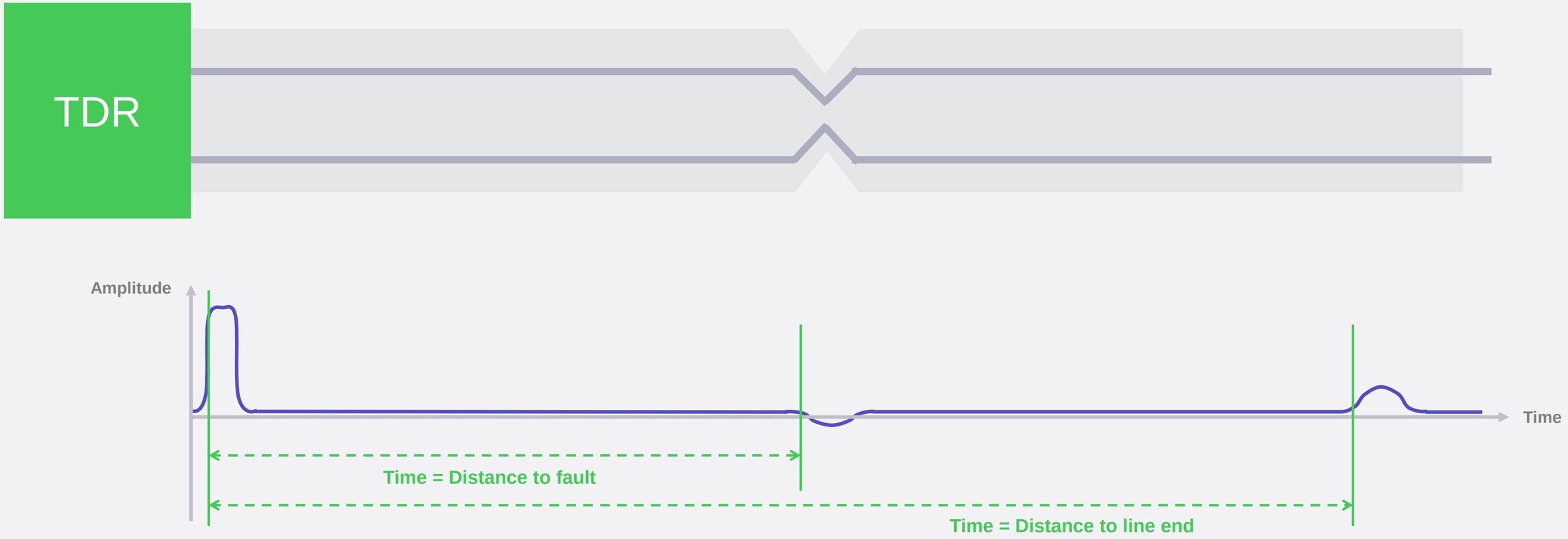
TDR
Theory of Operation

- **Operation:**
  - Transmits an electrical pulse and measures reflections (similar to sonar)
- **Identifies:**
  - Distance to end of line / discontinuity
  - Type of discontinuity / termination

TDR Reflection
Impedance Change

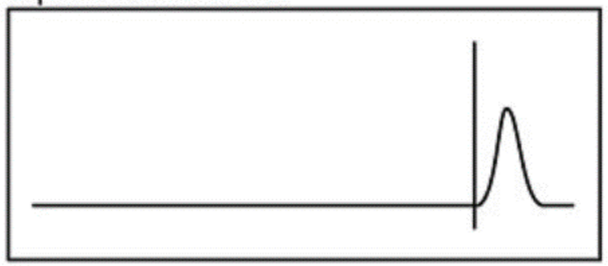


TDR Reflection
Impedance Change

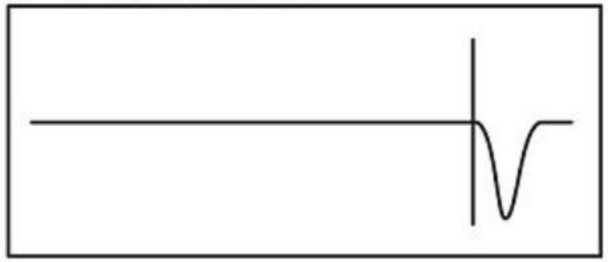


TDR Reflection
Further Examples

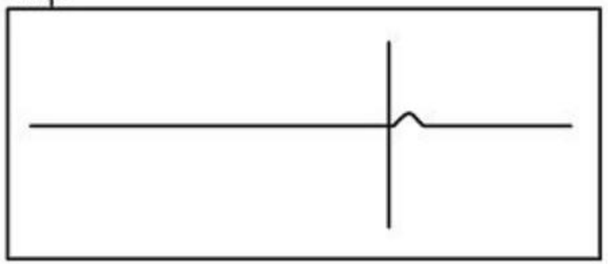
Open conductor



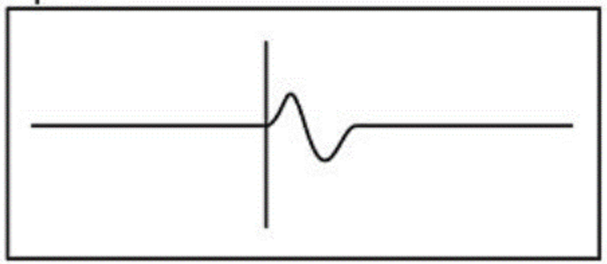
Shorted conductor



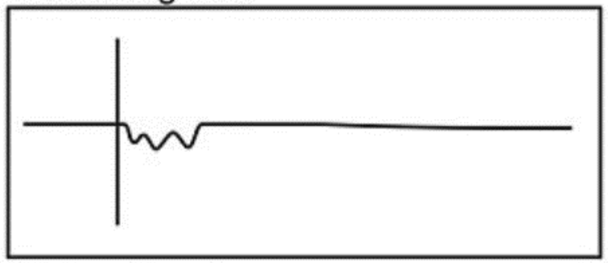
Tap



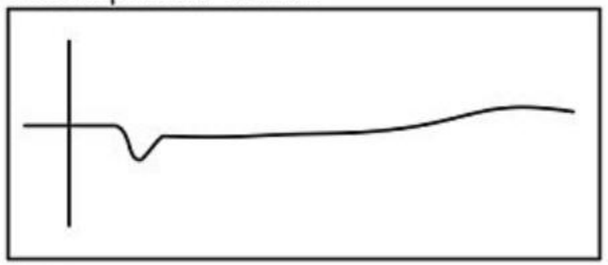
Splice



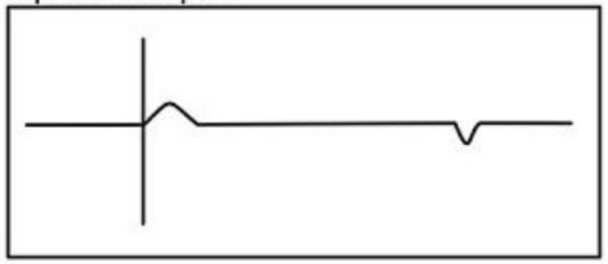
Water ingress



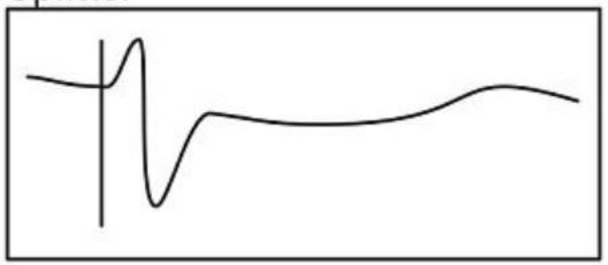
Wet splice / water



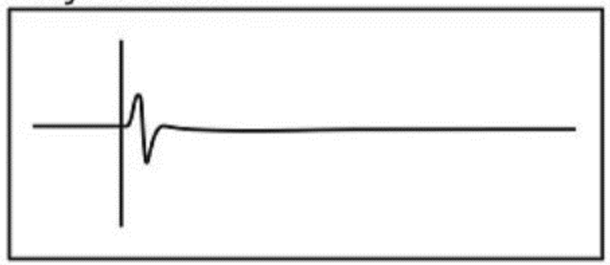
Split / resplit



Splitter

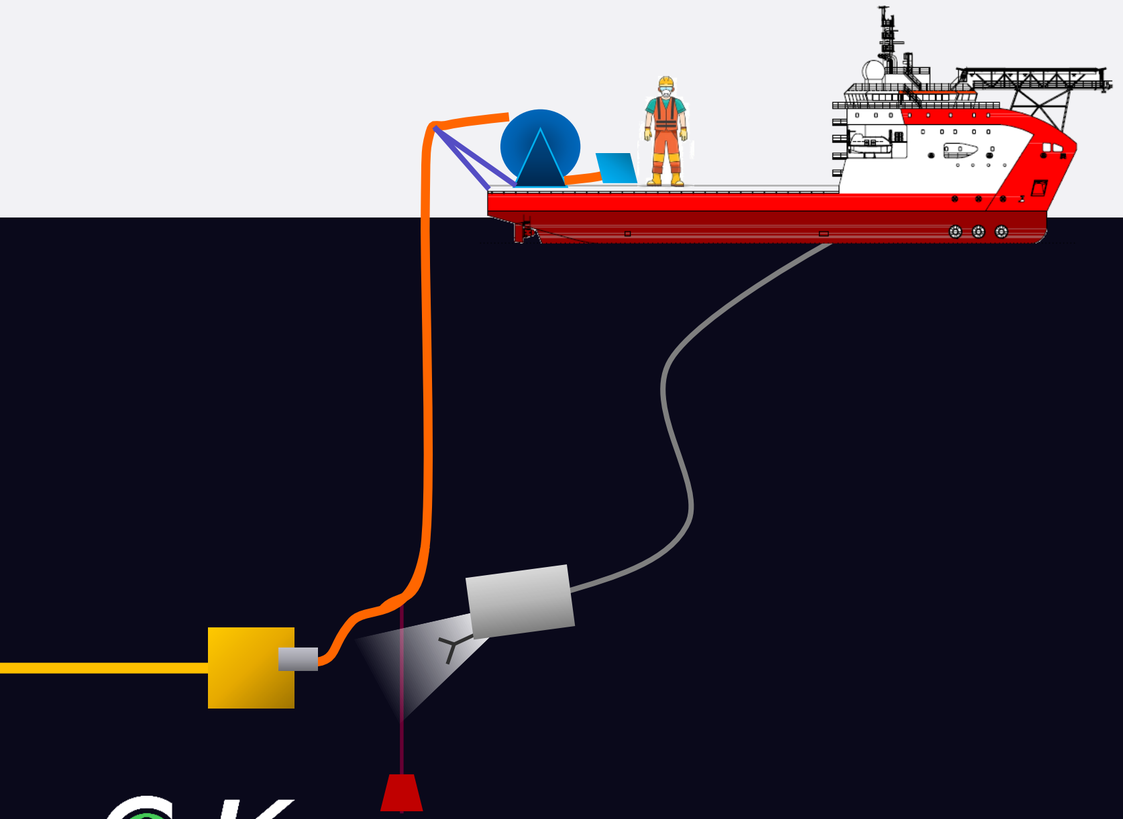


Frayed cable




C-Kore vs. Traditional

TDR Deployment
Traditional Method



1. Vessel arrives in field
2. ROV launched
3. Downline deployed (move to safe distance)
4. ROV derigs and connects downline
5. TDR testing from back-deck

Downline Issues:

Impedance mismatch at interfaces

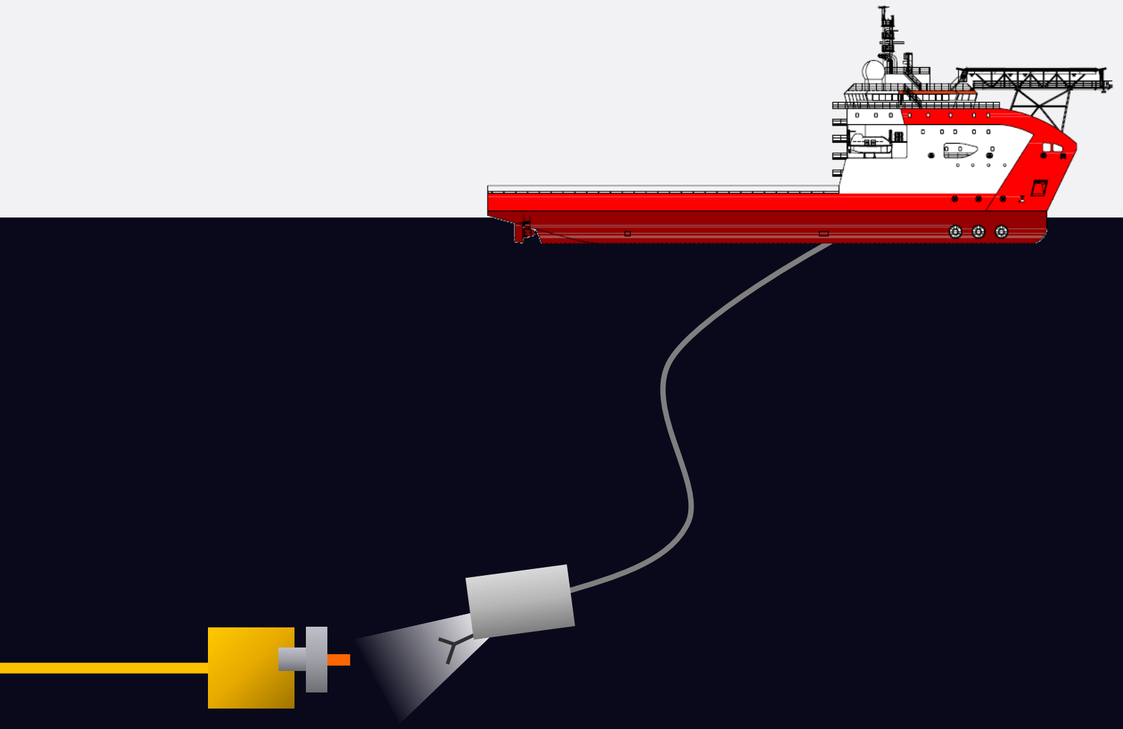
Extra attenuation (reduced range)

Operator skill under time pressure

Quality of saved data

TDR Deployment
C-Kore Subsea TDR

1. Vessel arrives in field
2. ROV launched
3. ROV connects and triggers C-Kore TDR



C-Kore Benefits:

Matched impedance (no extra reflections)

Direct measurement (see extra detail)

Automated and repeatable

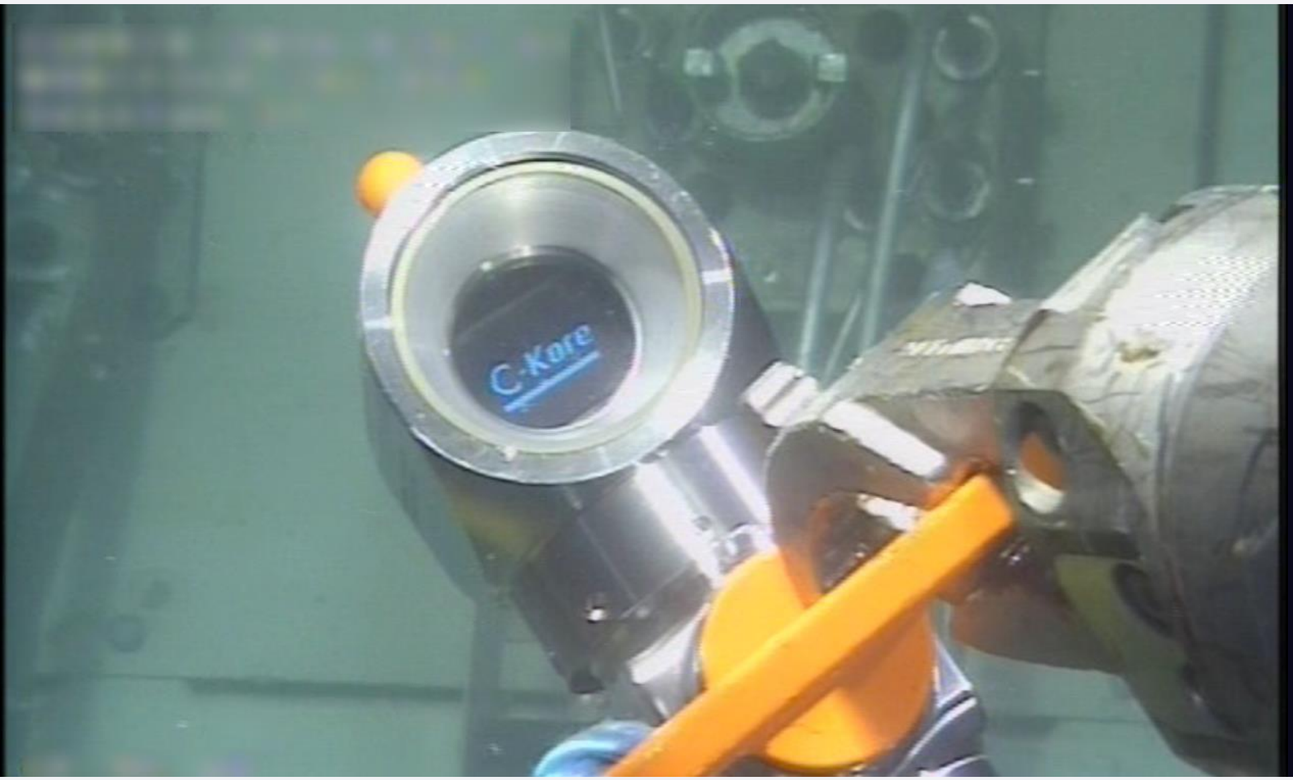
Interactive result analysis

C-Kore

Simplify Subsea Testing

Case Study: Fault-Finding

Case Study
Fault Finding



Background

LIM shows IR failure on one channel

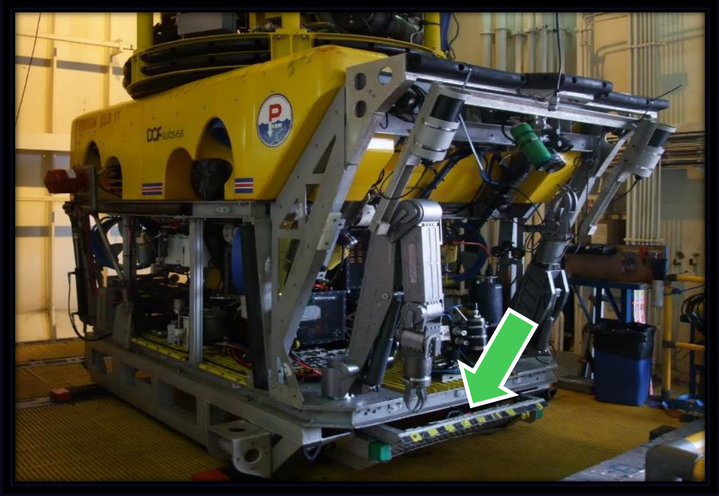
Some spare cables available

If umbilical failed (suspected) will need to decide repair vs replace

Case Study
Fault Finding

Supplied in small
peli-case

Deploy in
work basket
or tooling tray



C-Kore

Simplify Subsea Testing

Case Study
Fault Finding

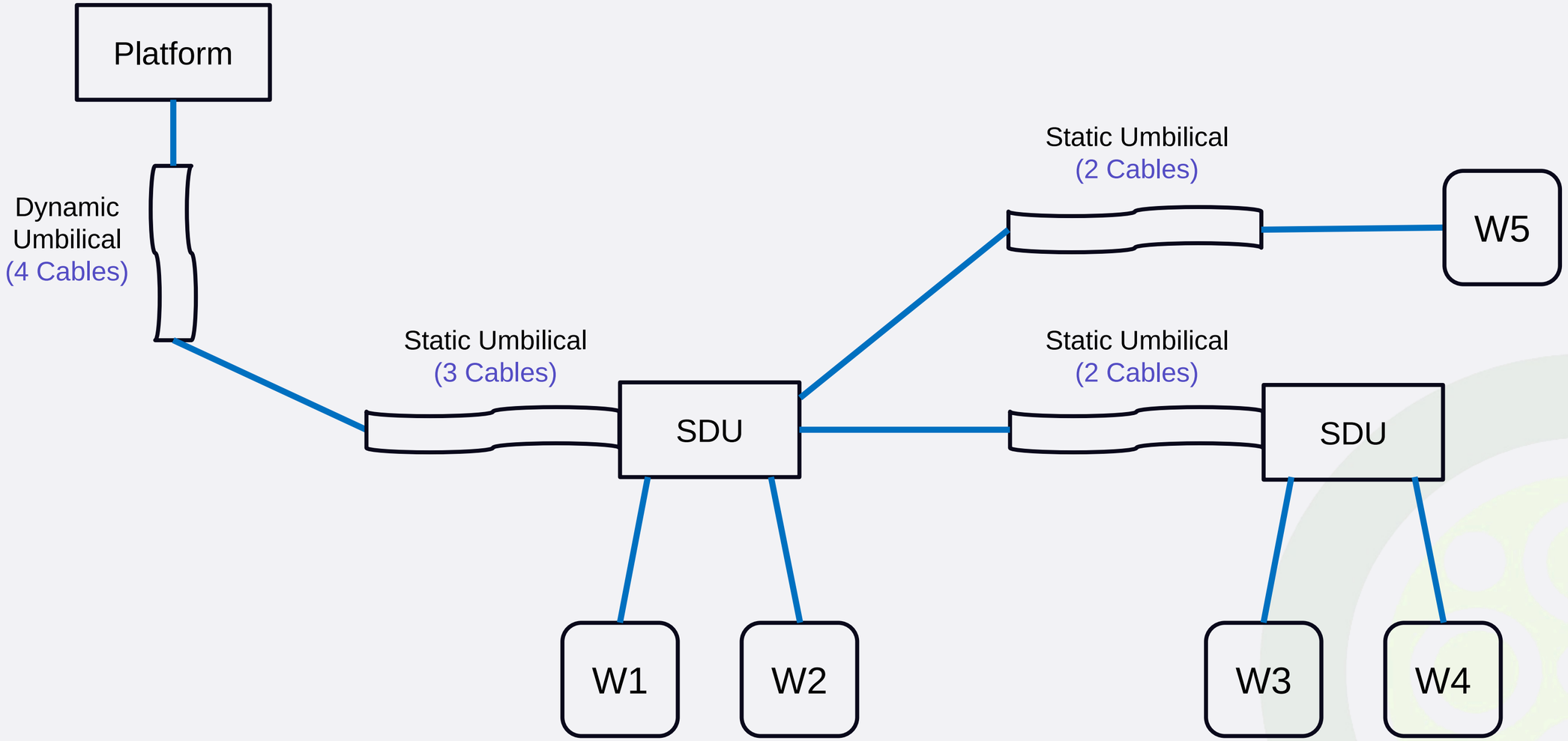
Usage

Test routine pre-programmed for simple subsea deployment

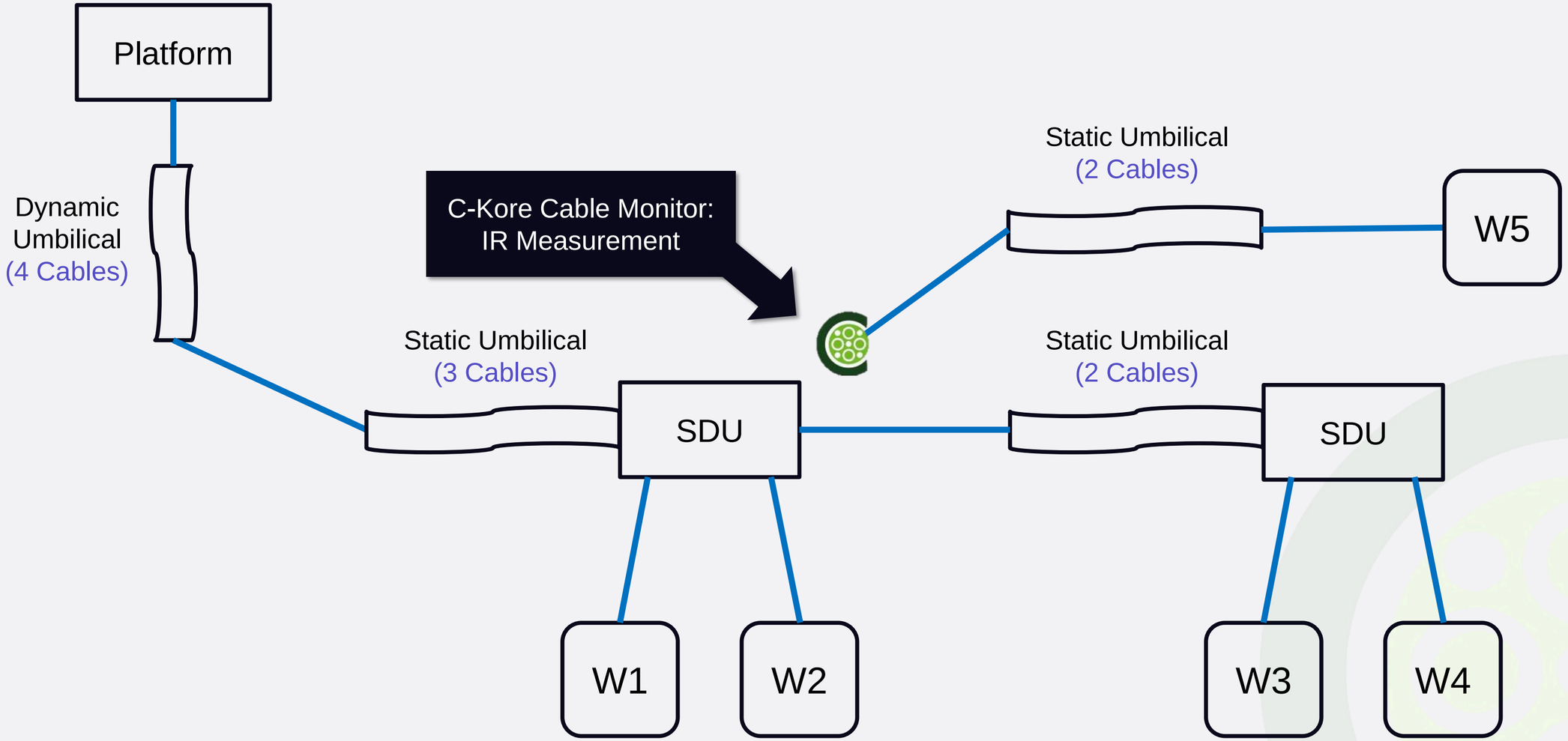
Connect directly to subsea equipment, no downlines required

Trigger measurement with light sensor, proximity sensor or schedule

Case Study
Fault Finding



Case Study
Fault Finding



C-Kore

Simplify Subsea Testing

Case Study
Fault Finding

Platform

Dynamic Umbilical (4 Cables)

Static Umbilical (2 Good Cables)

W5

Static Umbilical (3 Cables)

Static Umbilical (2 Cables)

SDU

SDU

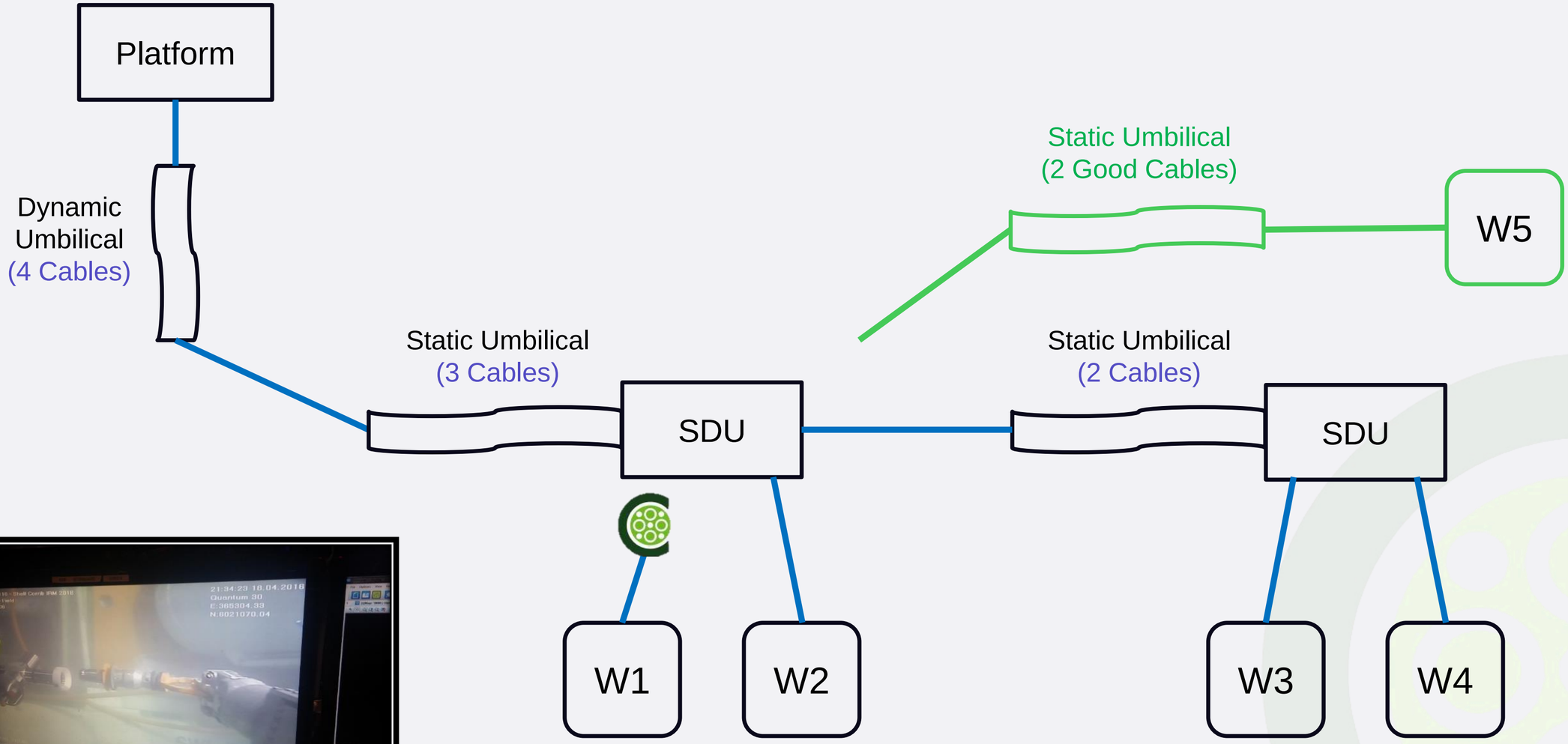
W1

W2

W3

W4

Case Study
Fault Finding



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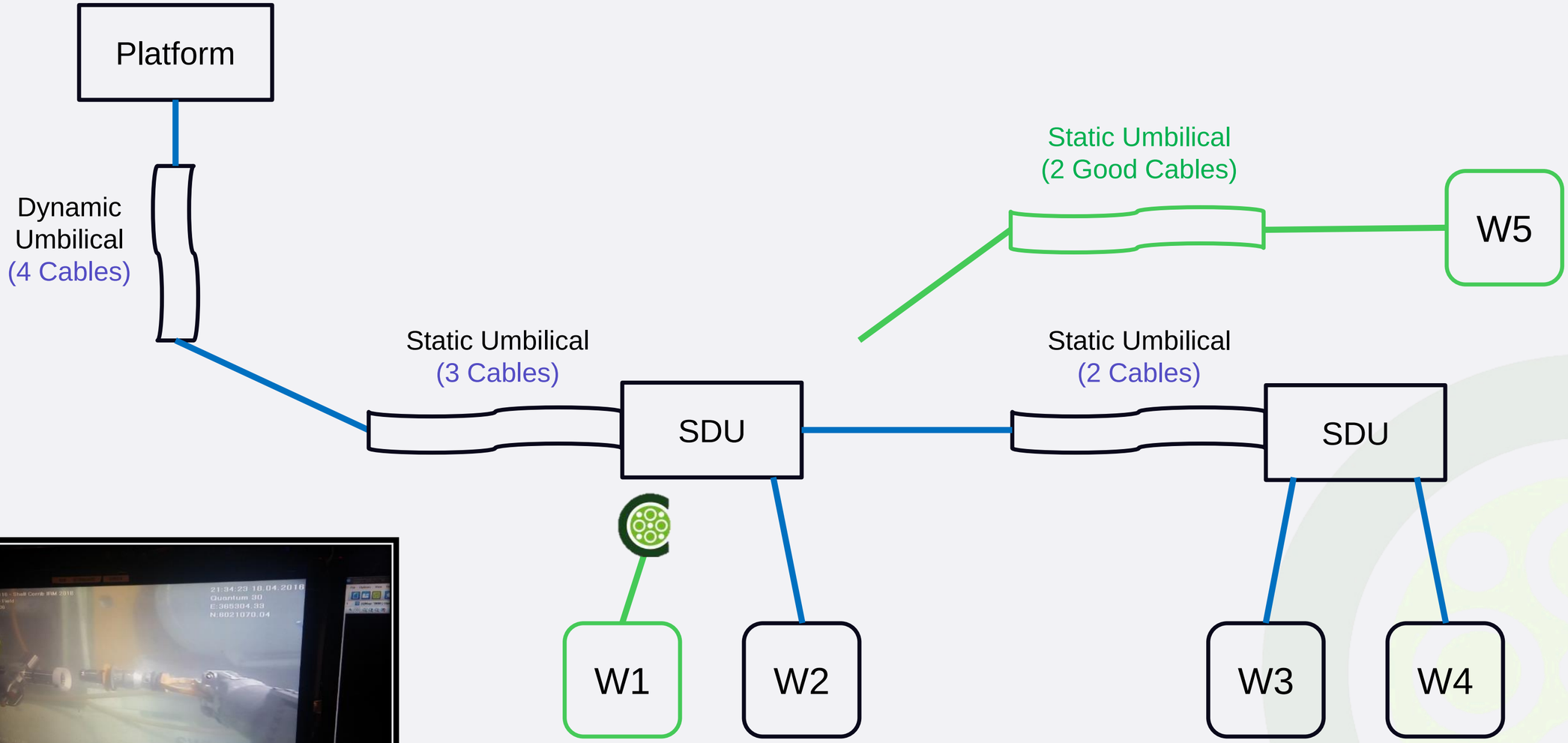
Fault Finding



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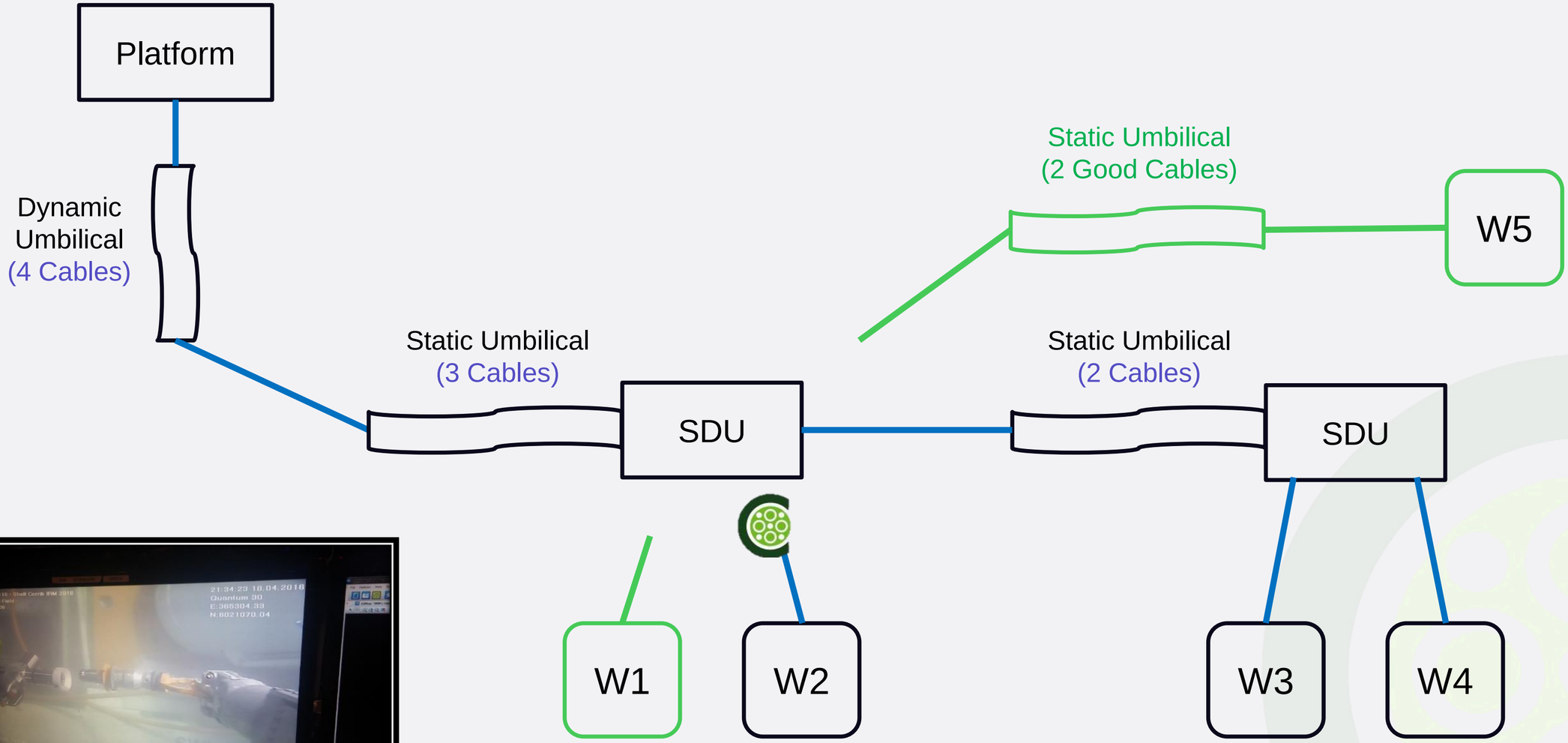

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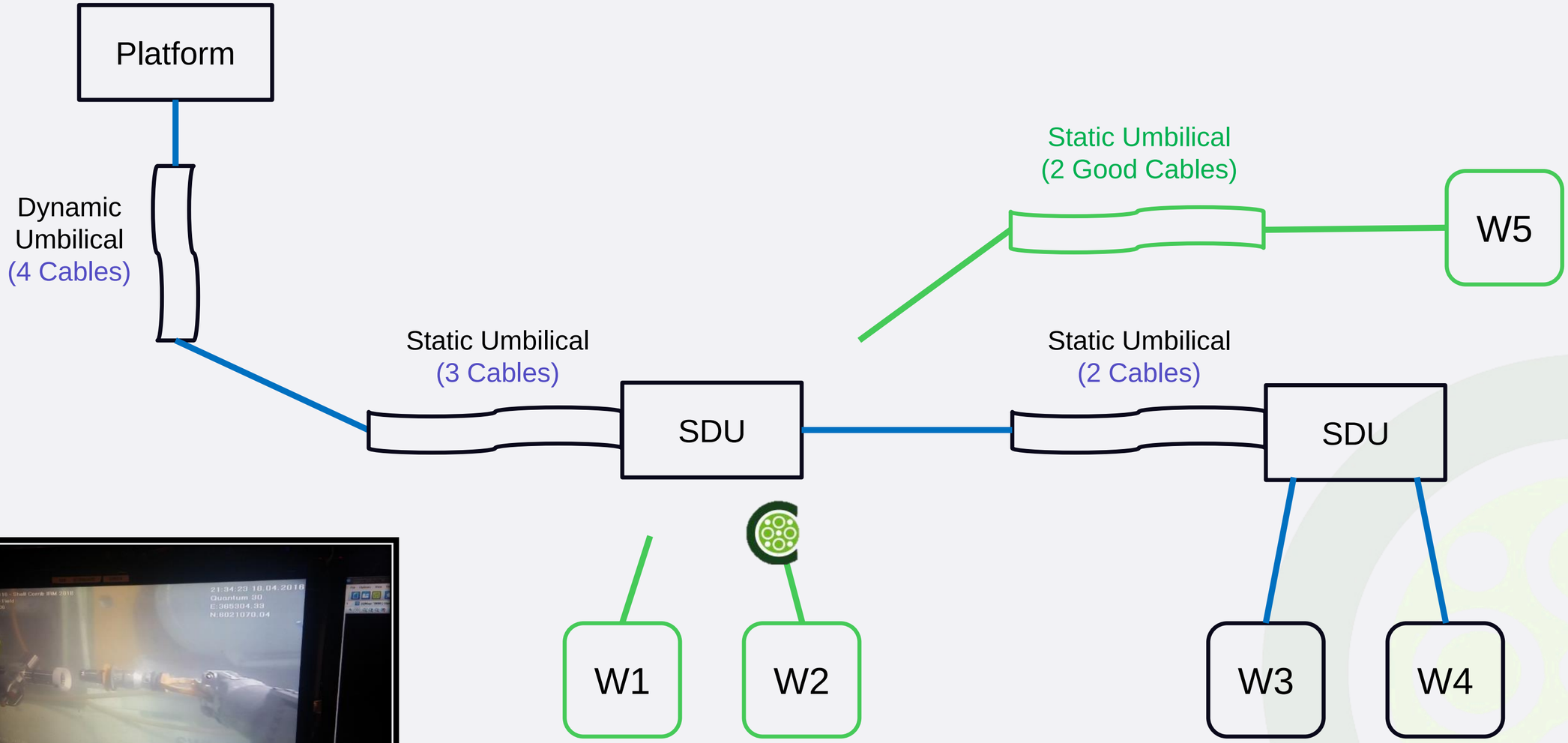

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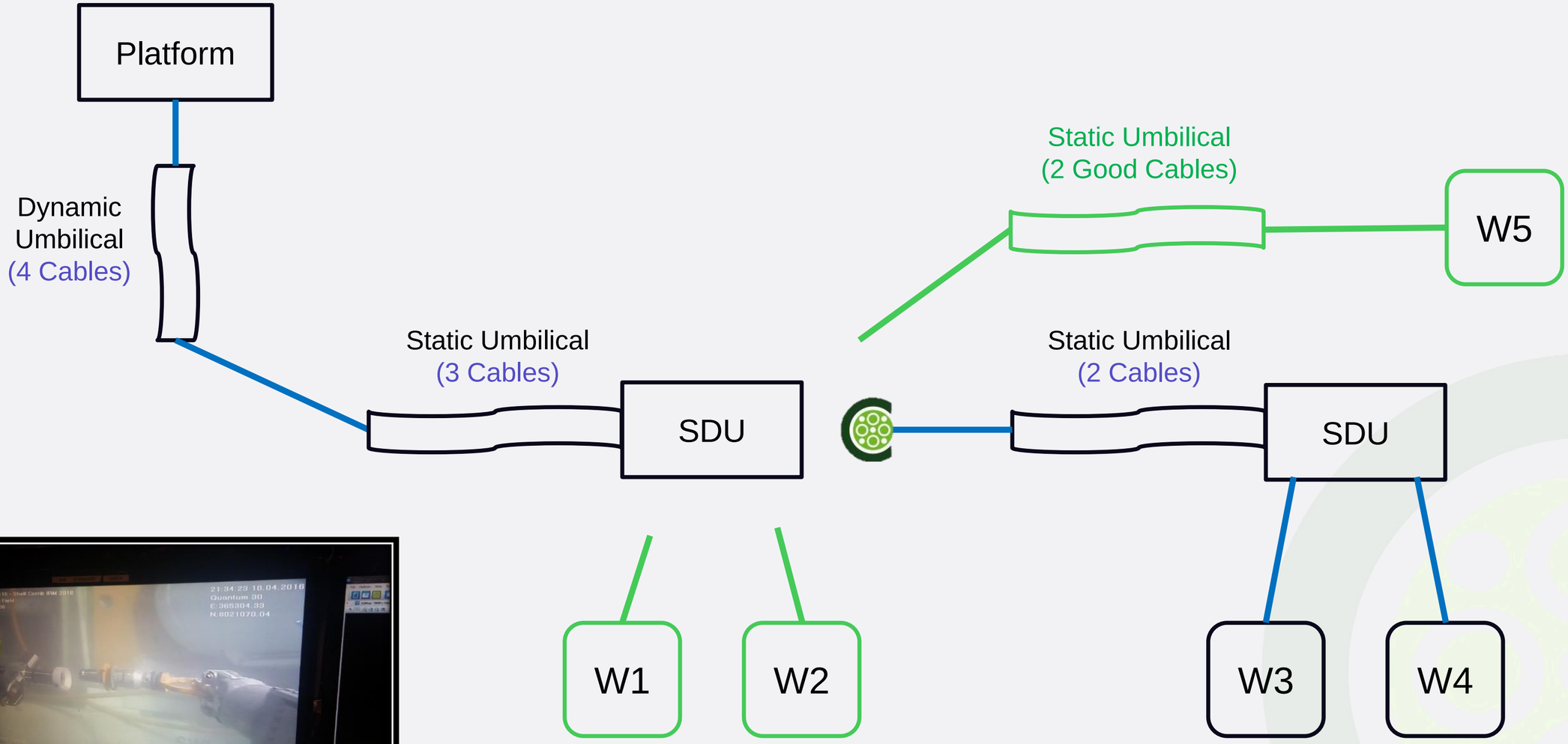

Case Study
Fault Finding

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W1

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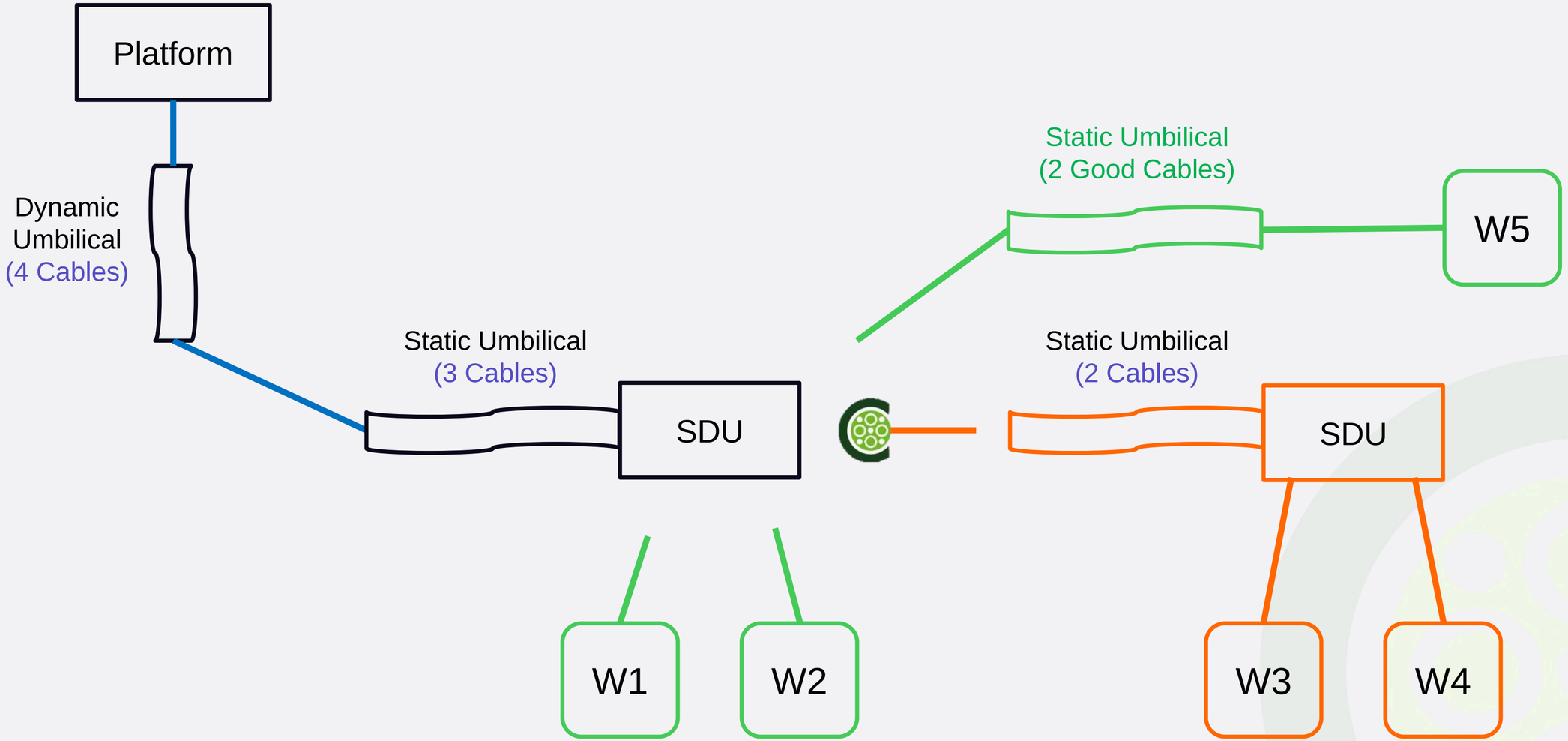
Fault Finding



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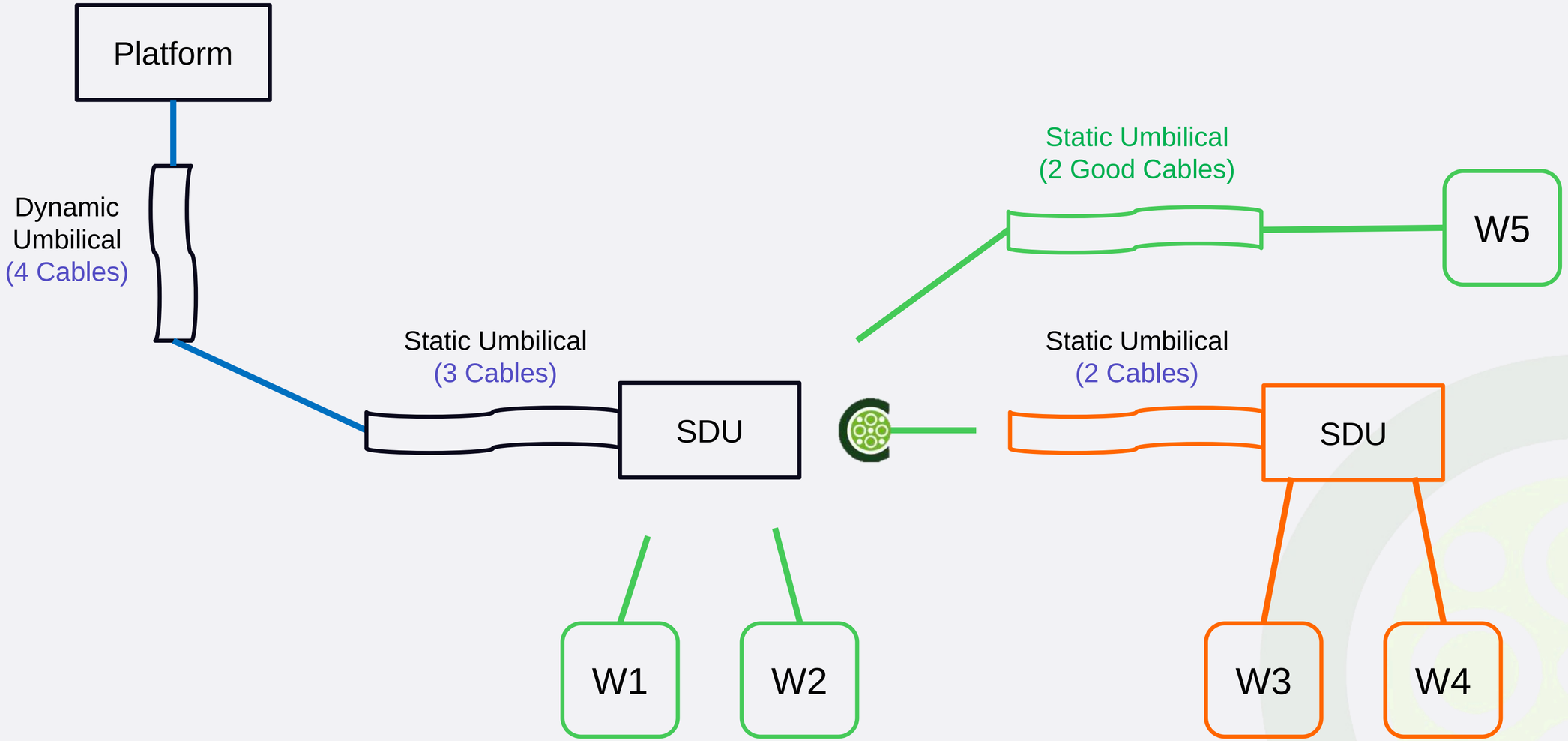

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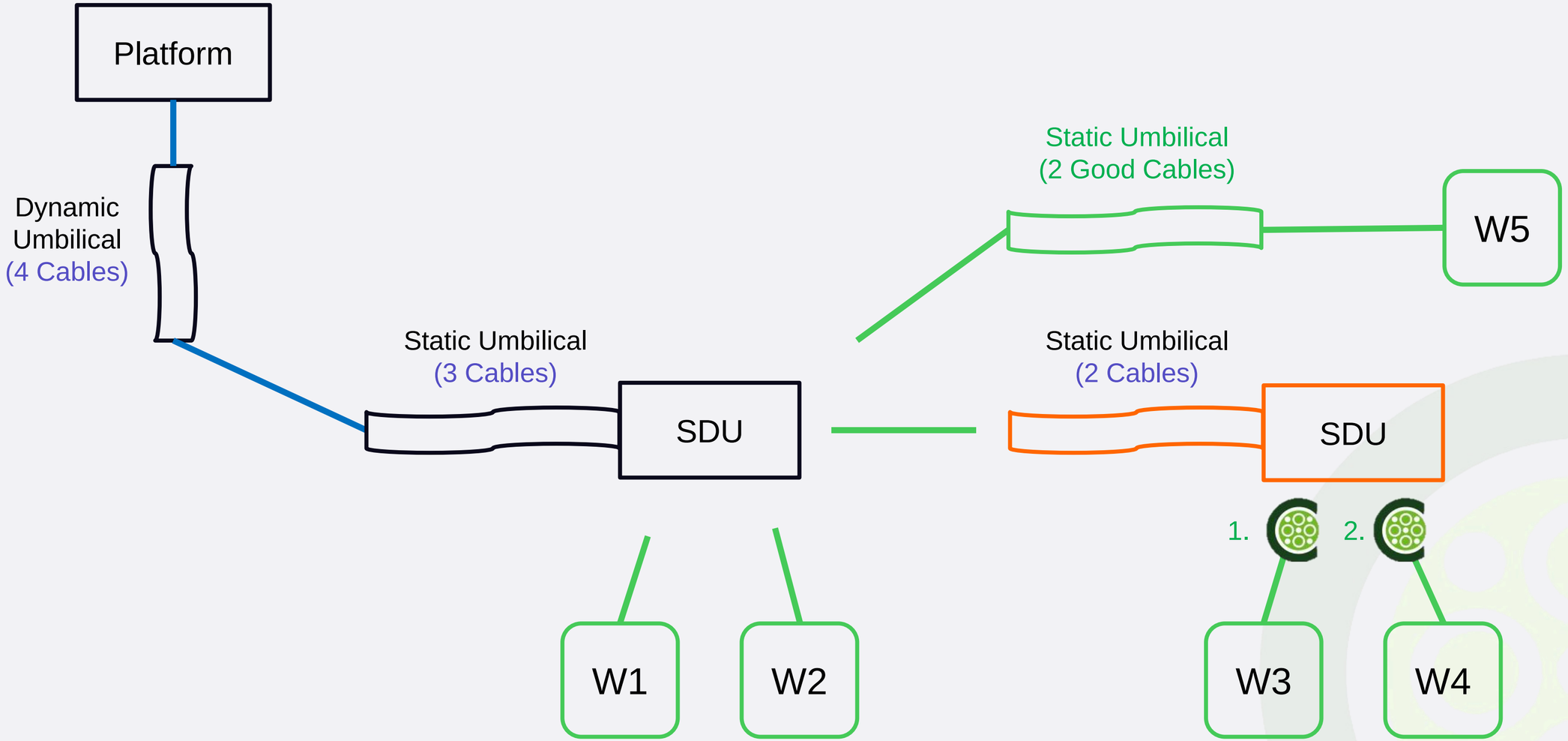

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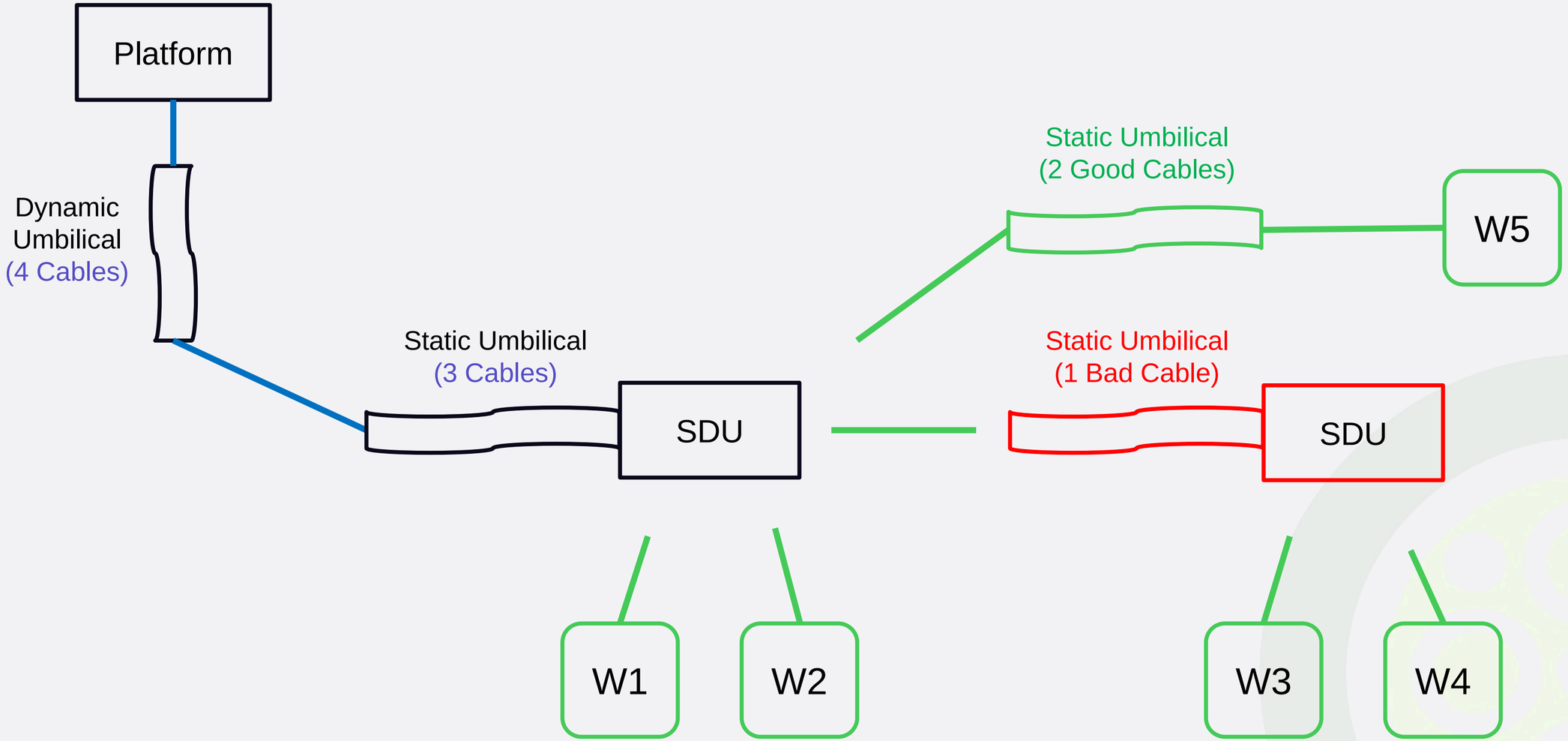

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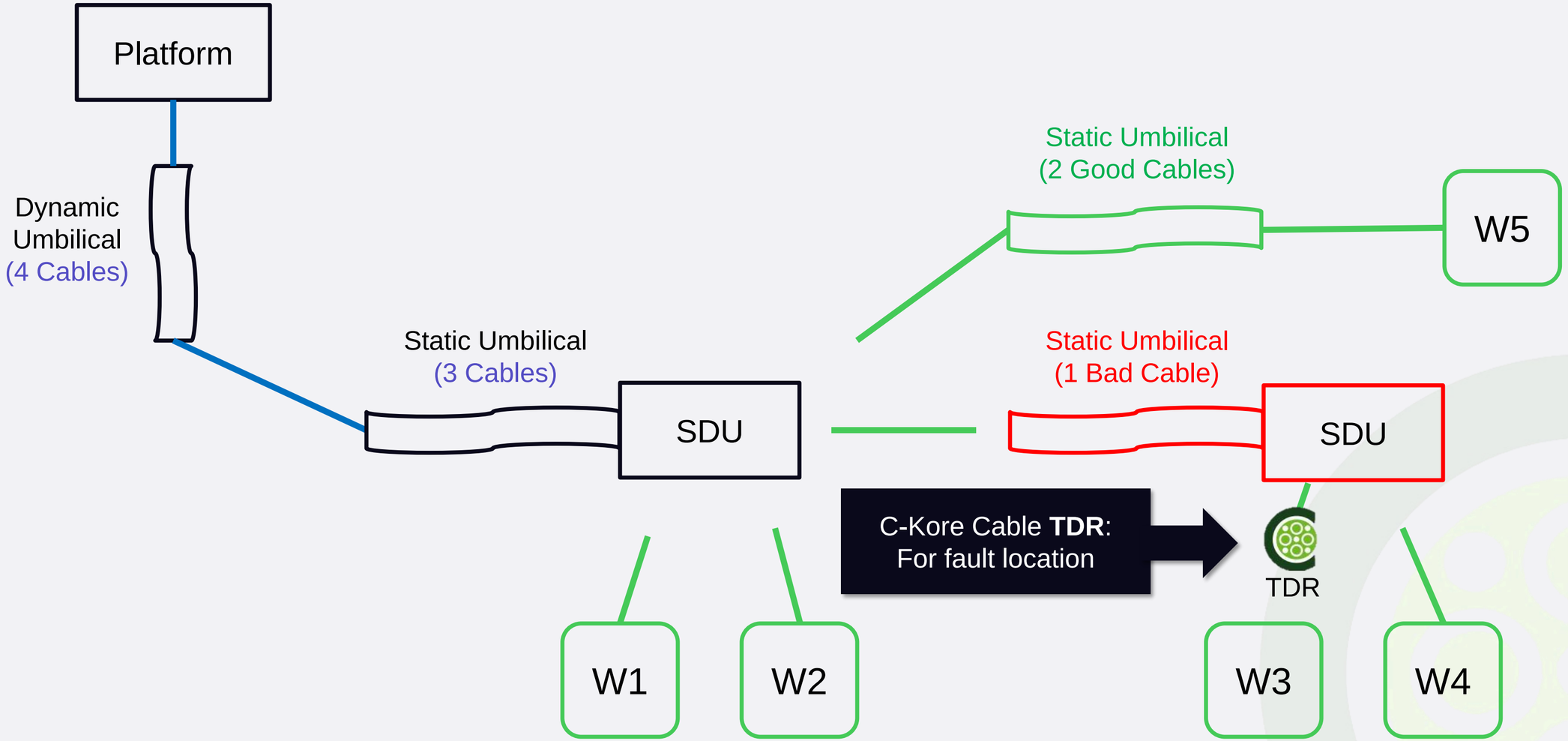


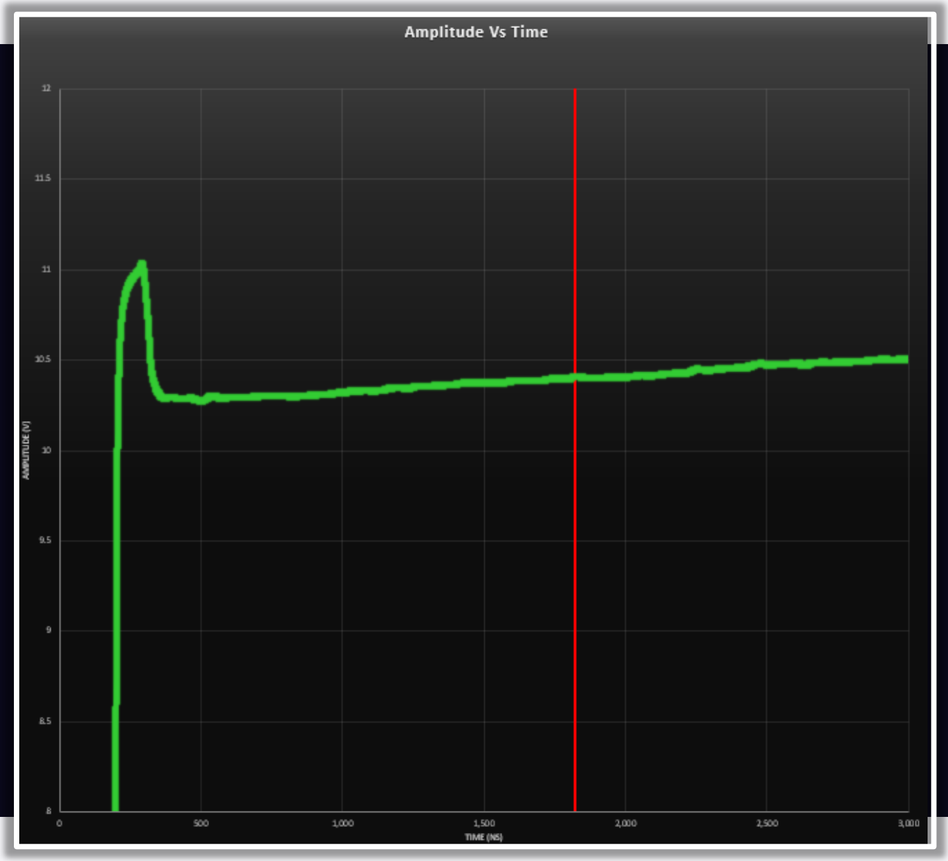
Case Study
Fault finding with Subsea TDR

IR fault identified using C-Kore Cable Monitor on infield umbilical

Location will decide repair or replacement

C-Kore Cable TDR used to determine location

Case Study
Fault finding with Subsea TDR



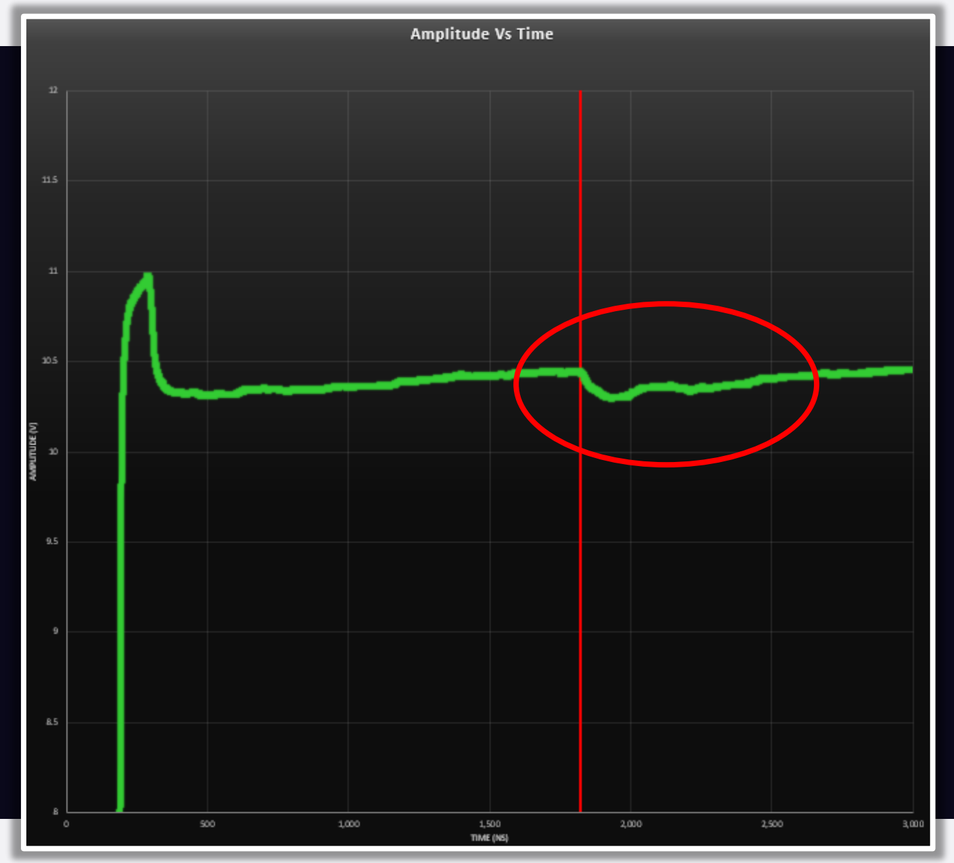
Baseline measurement

Measurement on cores with good IR

EFL to umbilical connection seen in impedance at beginning of graph

Umbilical trace then flat showing no further discontinuities

Case Study
Fault finding with Subsea TDR



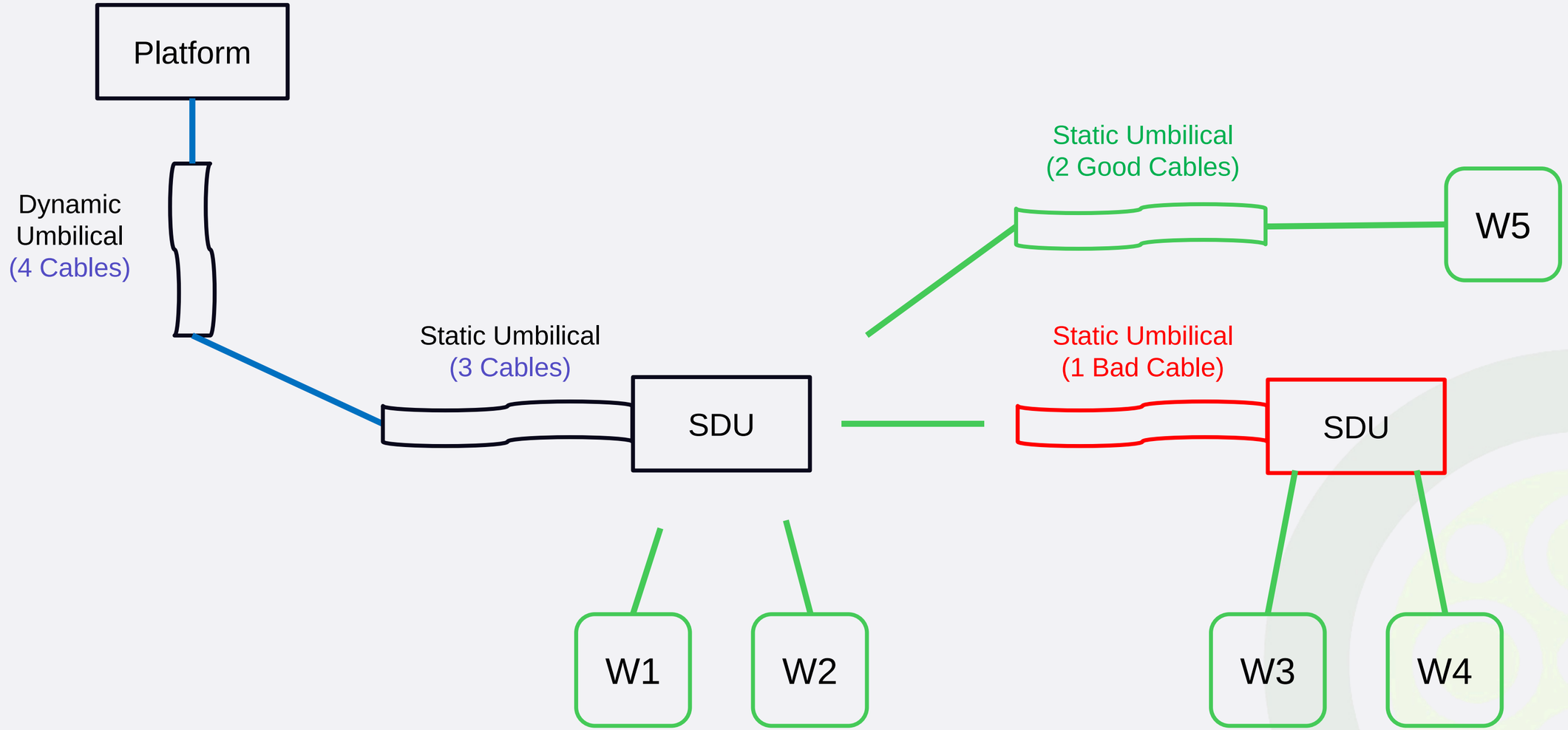
Fault measurement

Measurement on cores with low IR

EFL to umbilical connection seen in impedance at beginning of graph

Discontinuity seen at 270m indicating fault location

Case Study
Fault Finding



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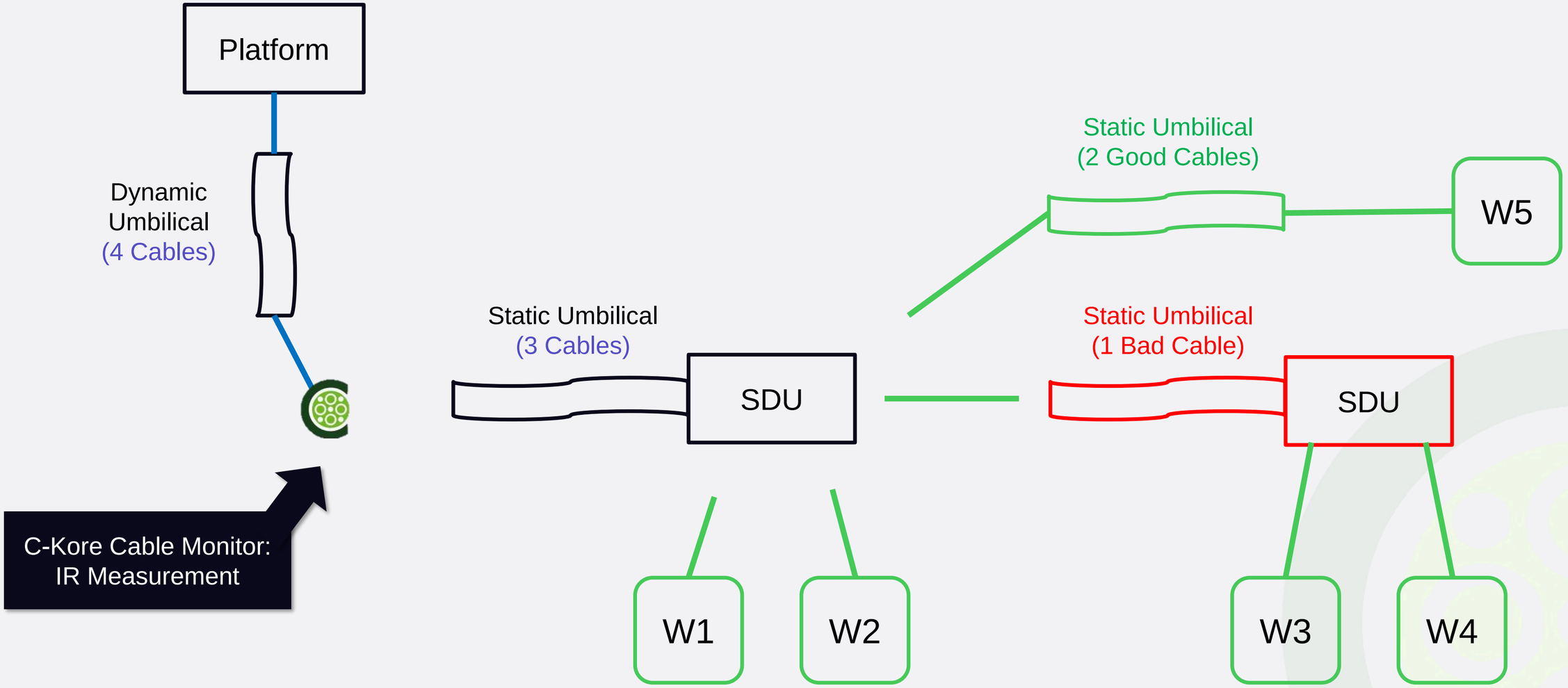
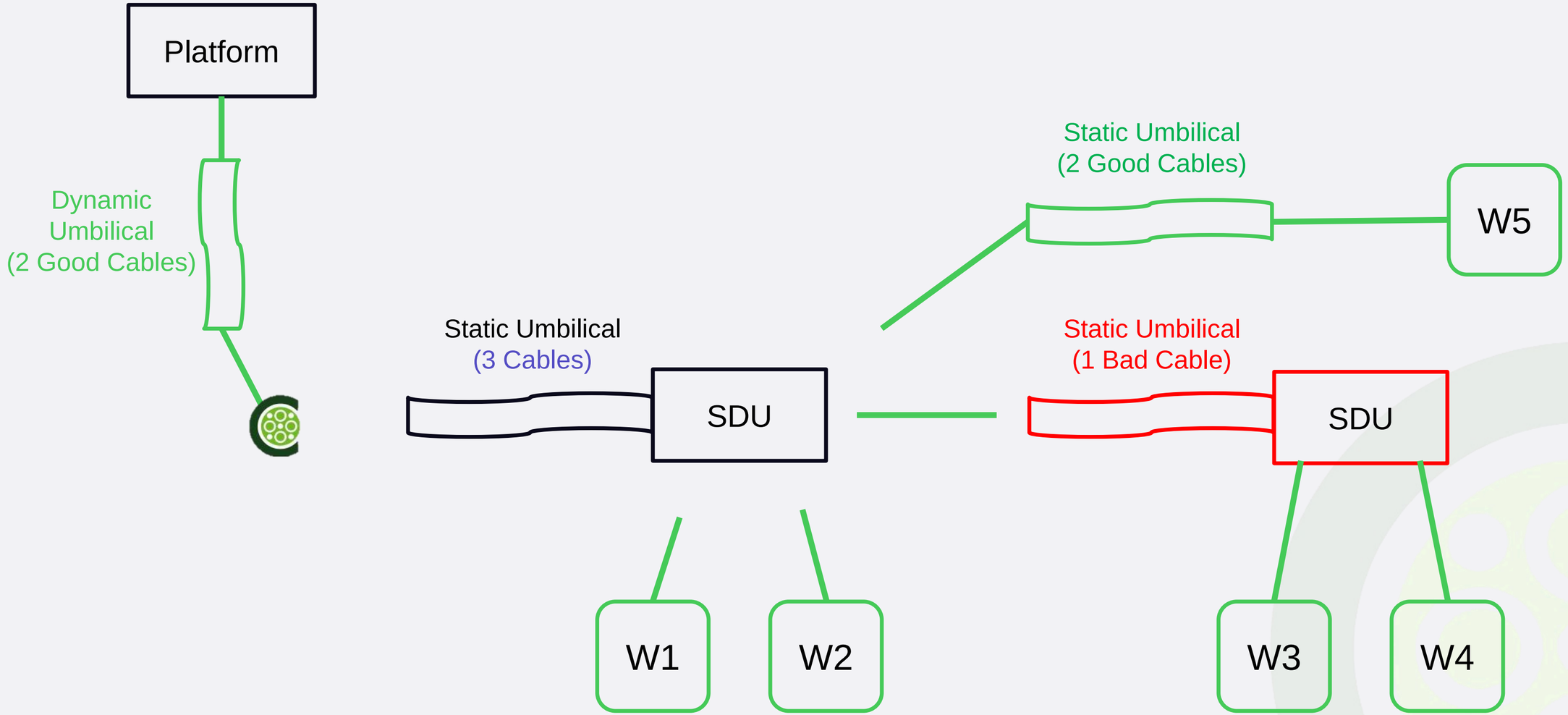


C-Kore

Simplify Subsea Testing

Case Study
Fault Finding



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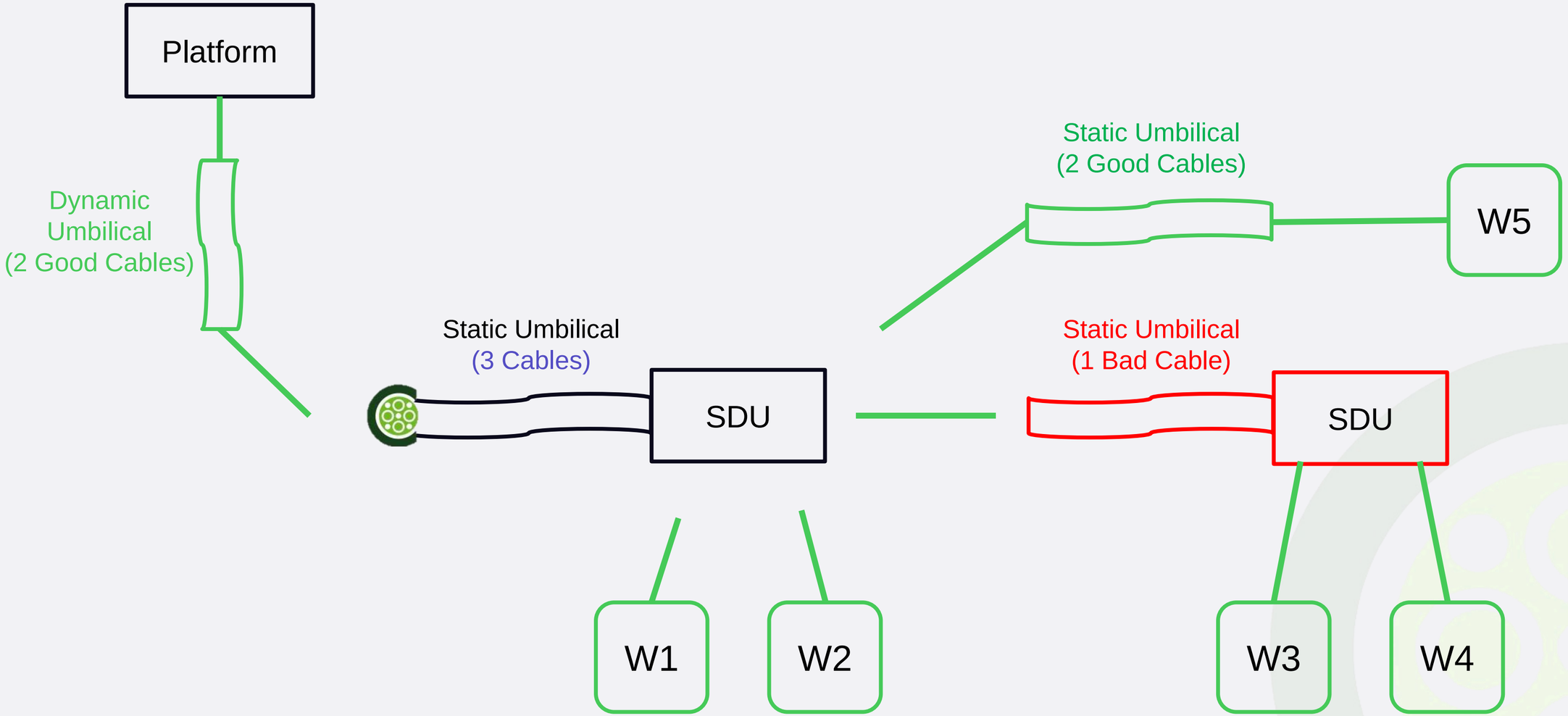

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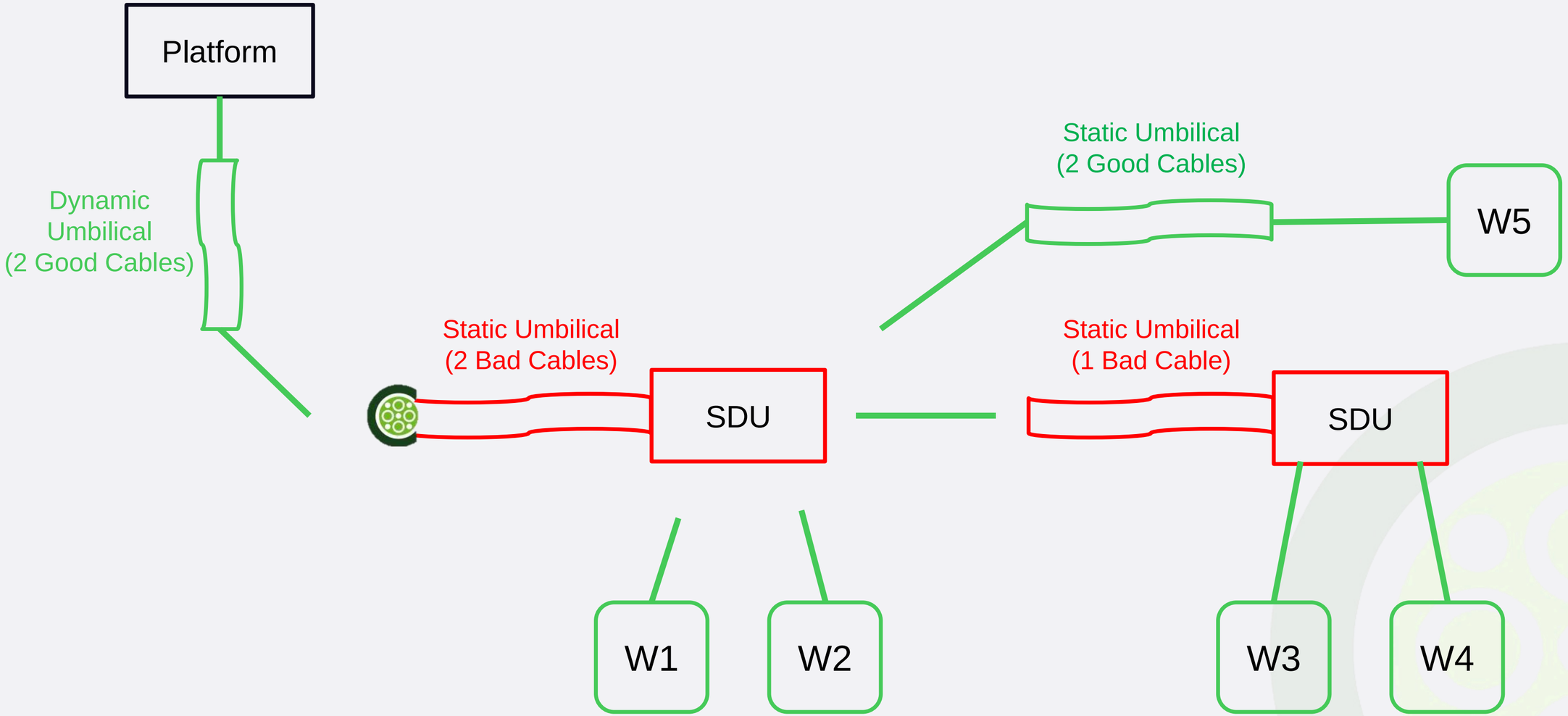

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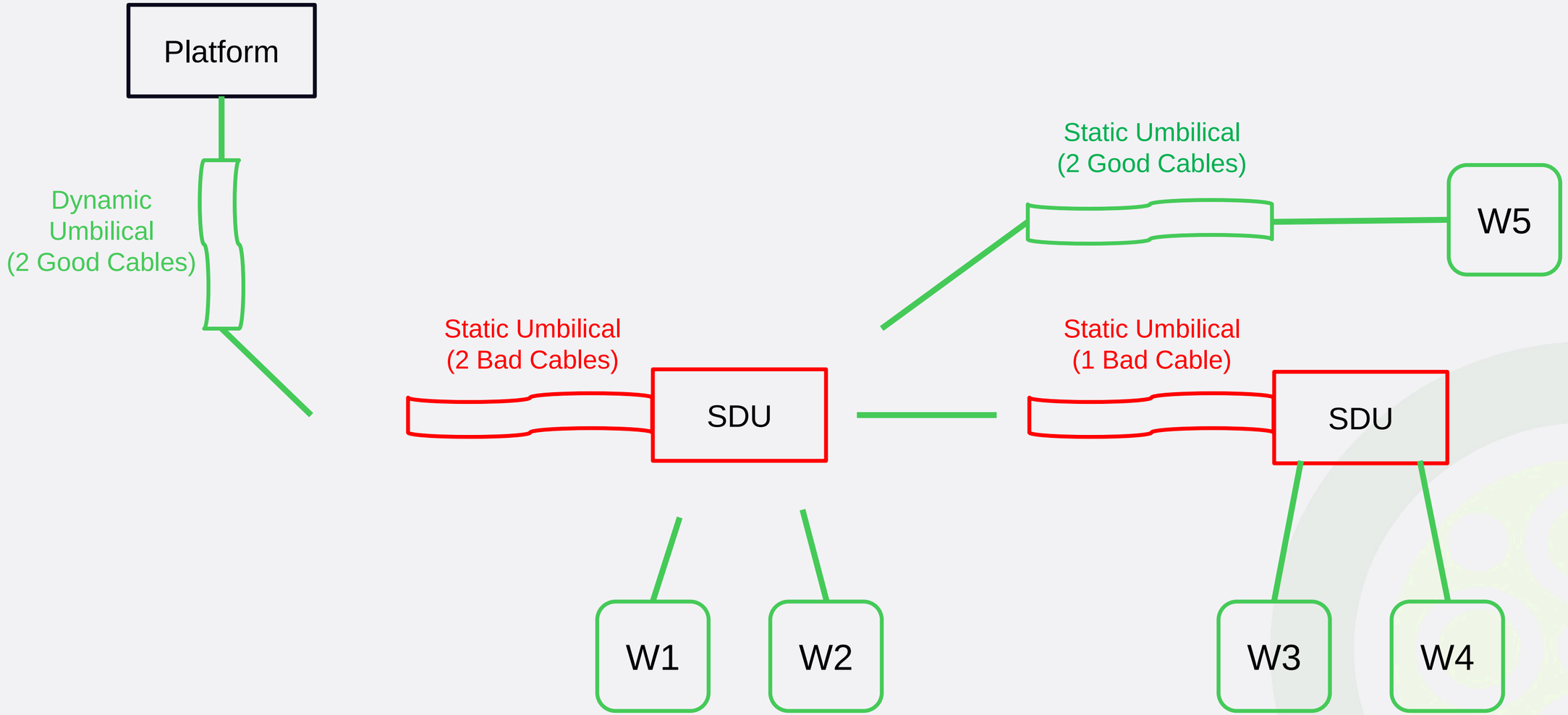

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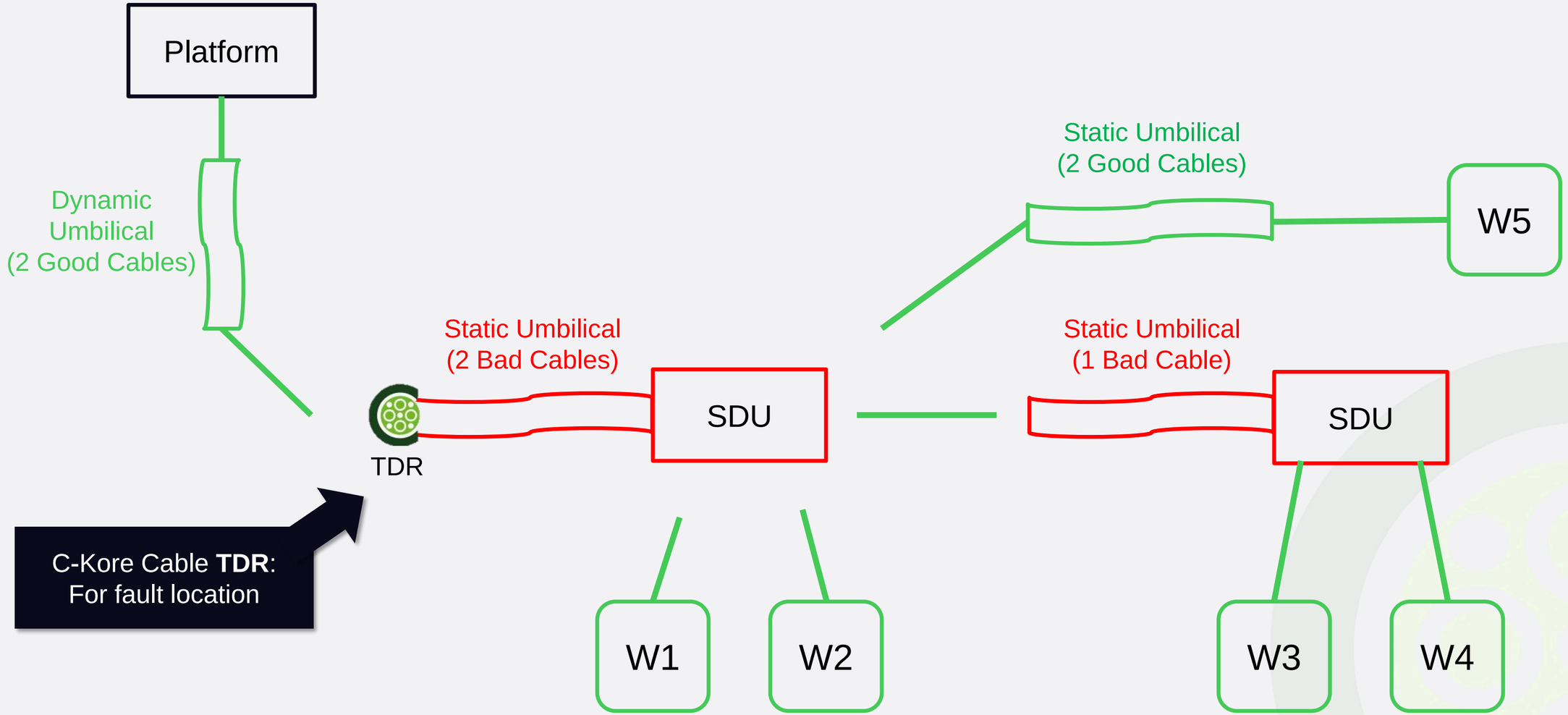

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Simplify Subsea Testing

Case Study
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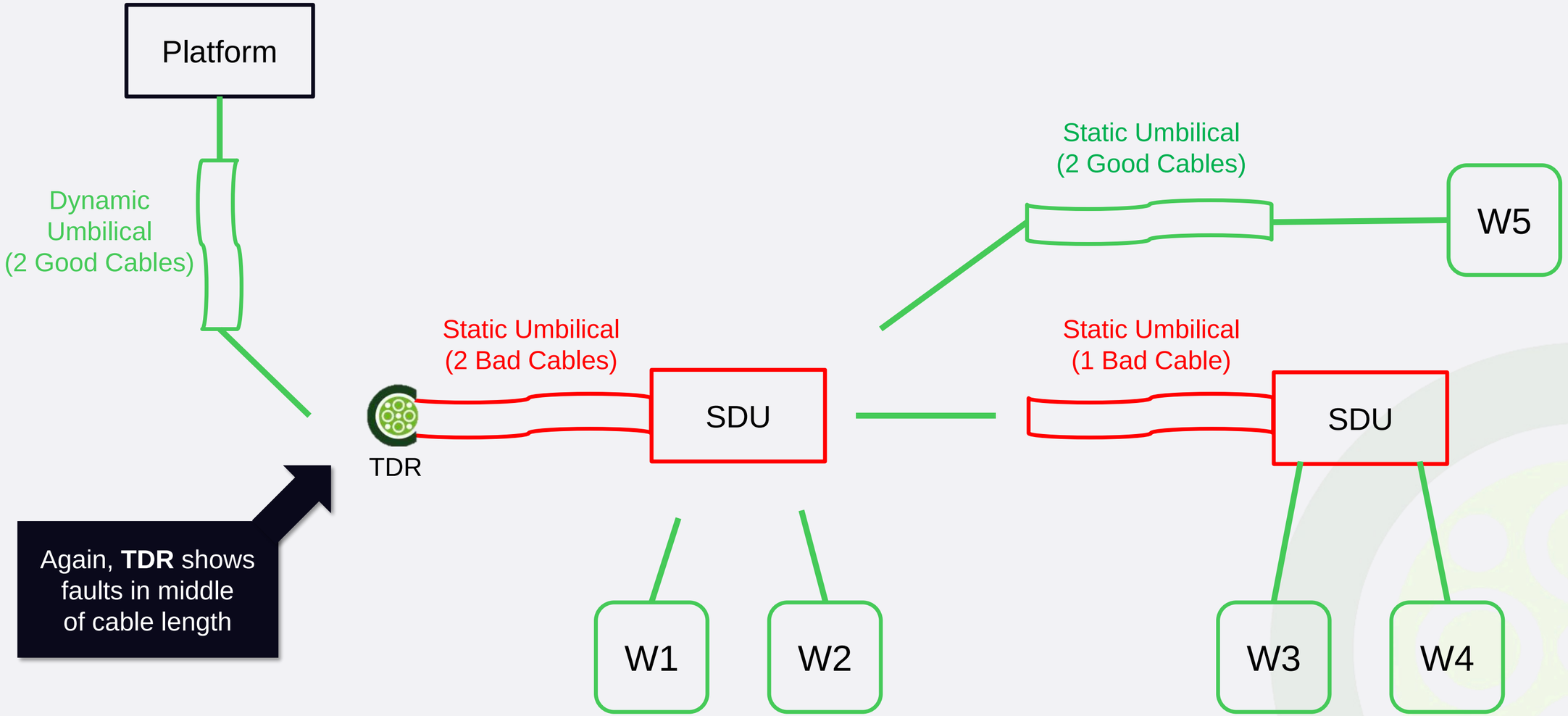
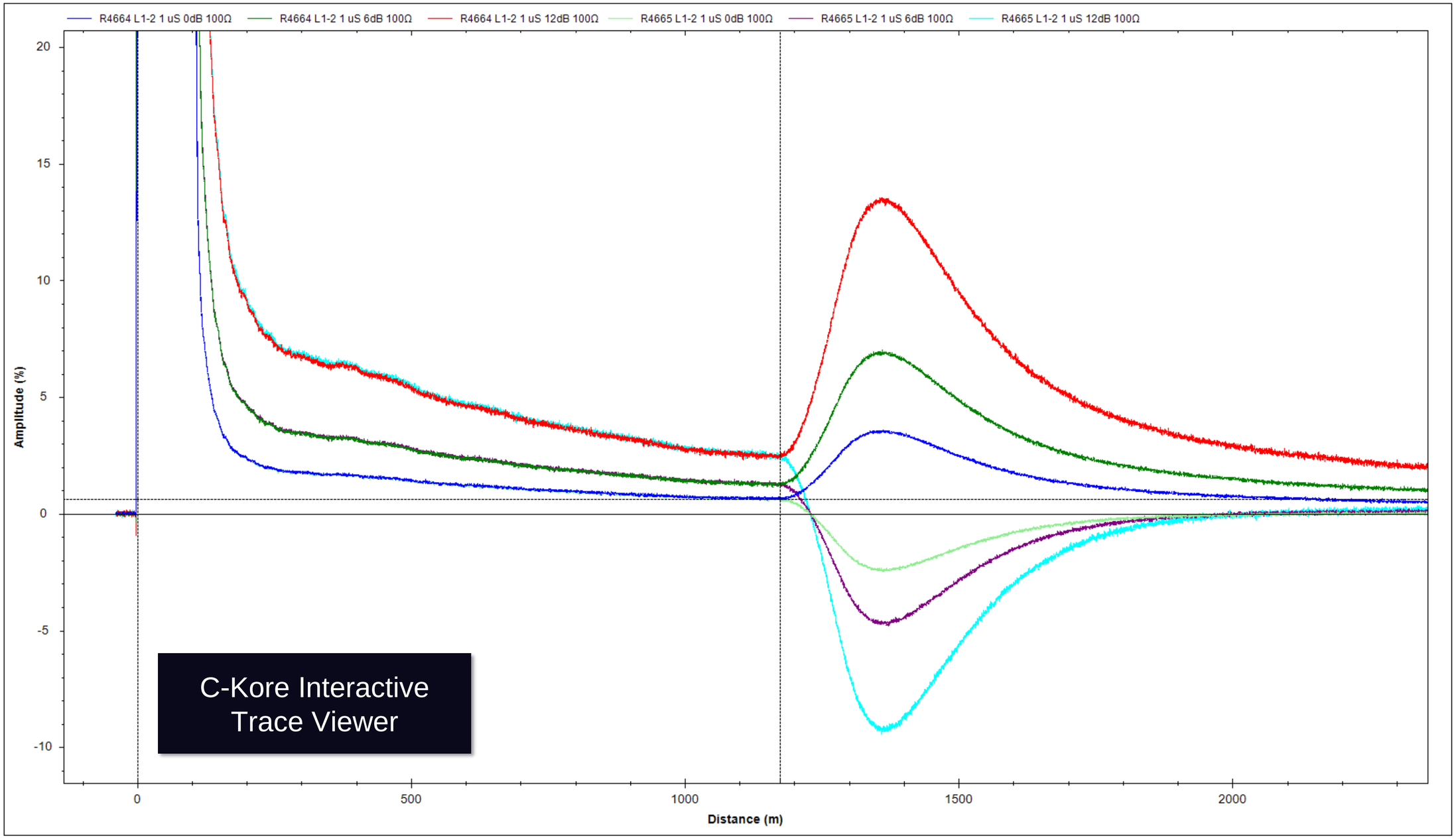




Report Graph

Multiple Results

Filter:
All Pulse Widths | All Gains

Navigation: Multi Trace

- Result: 4661
- Result: 4662
- Result: 4663
- Result: 4664
  - Lines: 1-2
    - 1 uS 0 dB
    - 3 uS 0 dB
    - 6 uS 0 dB
    - 1 uS 6 dB
    - 3 uS 6 dB
    - 6 uS 6 dB
    - 1 uS 12 dB
    - 3 uS 12 dB
    - 6 uS 12 dB
- Result: 4665
  - Lines: 1-2
    - 1 uS 0 dB
    - 3 uS 0 dB
    - 6 uS 0 dB
    - 1 uS 6 dB
    - 3 uS 6 dB
    - 6 uS 6 dB
    - 1 uS 12 dB
    - 3 uS 12 dB
    - 6 uS 12 dB

Select a maximum of 6 traces at a time
<< < > >>

Mode: Distance Change to Time

VoP (%): 73

Cursors:
X1: 0.0 m X2: 1.1730 km
Shortcut: Ctrl+Shift+Left/Right Click
Difference: 1.1730 km

Smoothing: None

Zoom Options: Undo All
Drag: Zoom to Window
Ctrl + Drag: Pan

Export Screenshot Close

Case Study
Fault Finding with Subsea TDR

automated

Pre-programmed test routine removes the need for skilled TDR operator.

fast, liberated

No downline deployment / recovery time. No waiting for platform testing.

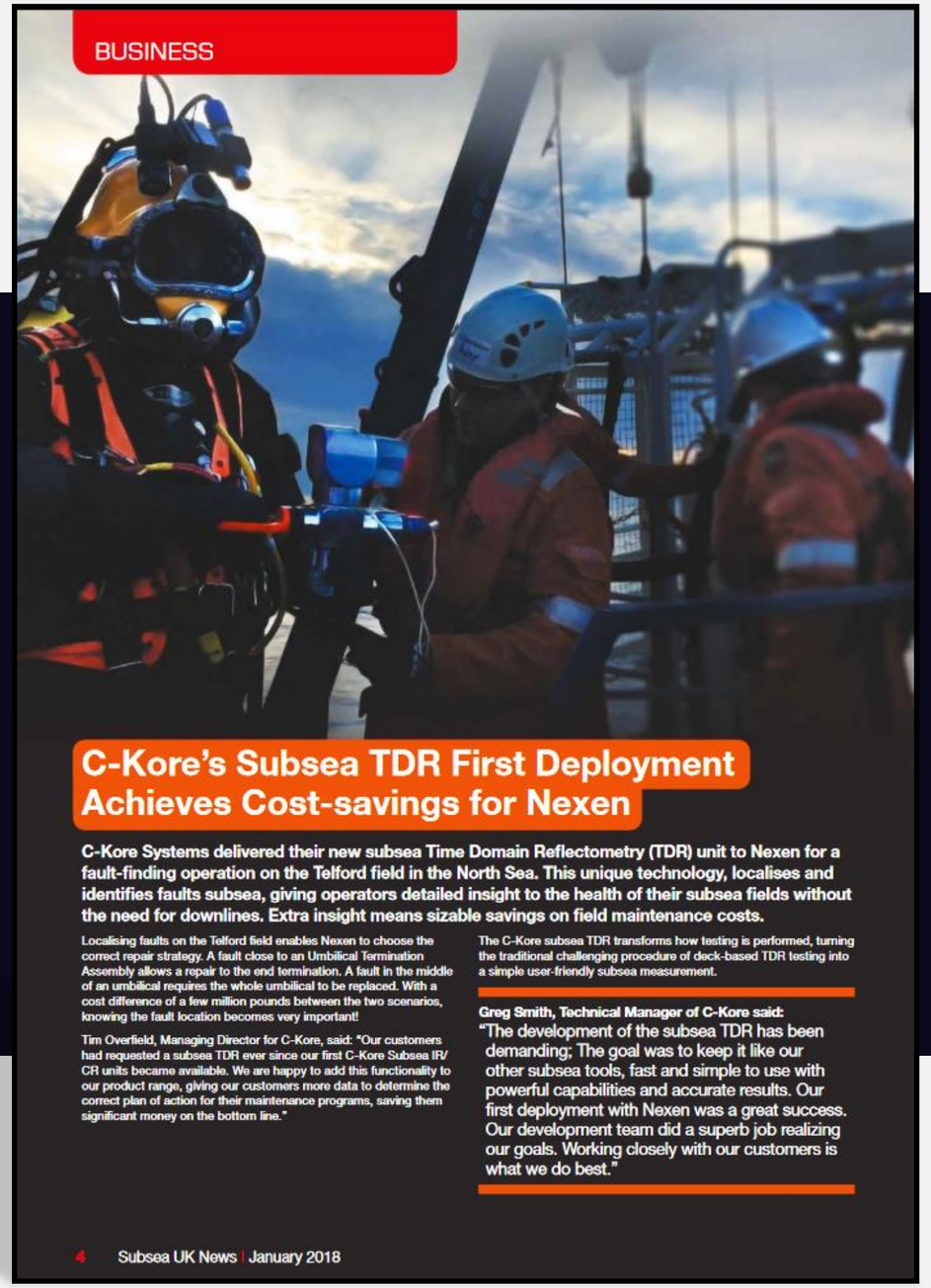
direct, reliable

Measurements made directly subsea. No errors from impedance mismatches.

Case Study
Fault Finding

Cost savings

- Vessel Time
- Personnel and Equipment



BUSINESS

C-Kore's Subsea TDR First Deployment Achieves Cost-savings for Nexen

C-Kore Systems delivered their new subsea Time Domain Reflectometry (TDR) unit to Nexen for a fault-finding operation on the Telford field in the North Sea. This unique technology, localises and identifies faults subsea, giving operators detailed insight to the health of their subsea fields without the need for downlines. Extra insight means sizable savings on field maintenance costs.

Localising faults on the Telford field enables Nexen to choose the correct repair strategy. A fault close to an Umbilical Termination Assembly allows a repair to the end termination. A fault in the middle of an umbilical requires the whole umbilical to be replaced. With a cost difference of a few million pounds between the two scenarios, knowing the fault location becomes very important!

Tim Overfield, Managing Director for C-Kore, said: "Our customers had requested a subsea TDR ever since our first C-Kore Subsea IR/CR units became available. We are happy to add this functionality to our product range, giving our customers more data to determine the correct plan of action for their maintenance programs, saving them significant money on the bottom line."

The C-Kore subsea TDR transforms how testing is performed, turning the traditional challenging procedure of deck-based TDR testing into a simple user-friendly subsea measurement.

Greg Smith, Technical Manager of C-Kore said:
"The development of the subsea TDR has been demanding; The goal was to keep it like our other subsea tools, fast and simple to use with powerful capabilities and accurate results. Our first deployment with Nexen was a great success. Our development team did a superb job realizing our goals. Working closely with our customers is what we do best."

4 Subsea UK News | January 2018

Simplifying Subsea Testing

Thank You, Any Questions?

C-Kore