Breaking Plausible Deniability: A Consensus-Based Definition of "Actionable Dark Fleet" Behaviors for Subsea Cable Protection

Koichiro Hayashi
General Manager, NYK Line, Tokyo, Japan
koichiro.hayashi@nykgroup.com

Abstract

This study develops a research agenda for addressing grey-zone maritime threats under plausible deniability, focusing on suspected subsea cable damage involving commercial vessels. Because attribution is often difficult, coastal states face an enforcement-threshold problem: acting too late weakens deterrence and increases expected infrastructure losses, while acting too early risks arbitrary interference with navigation and trade. Operations under plausible deniability produce a dual strategic opportunity: they can pursue not only direct subsea cable damage but also the erosion of an open, rules-based maritime order by exploiting this very enforcement dilemma. Building on evidence on the expansion and transformation of dark fleets, we propose a consensus-feasible, objective definition of an "actionable dark fleet" based on observable, multi-signal vessel patterns — combining AIS-derived movement anomalies (e.g., loitering/anchoring behavior near cable corridors), compliance/opacity indicators (e.g., governance and insurance transparency proxies), and contextual proximity to critical infrastructure. The planned empirical work constructs an Actionable Dark Fleet Index (ADFI) and evaluates economic implications of alternative response thresholds, including delays, rerouting, risk premia, and market fragmentation. Even without changes to UNCLOS, an industry-diffused objective definition can reduce coordination costs among group of willing countries and stakeholders and counter attempts to "hack" a rules-based maritime order by exploiting ambiguity.

Keywords

AIS, Dark Fleet, Subsea Cable

Extended Abstract

Motivation and objectives:

In recent years, the commercial shipping system has been exposed to a new category of risk: non-regular (grey-zone) maritime activities allegedly conducted using merchant vessels. These activities include suspected intentional damage to subsea infrastructure (telecommunication/power cables and pipelines) through anchor dragging, as well as suspected offshore launch support for drones in proximity to sensitive coastal facilities. Vessels engaged in such activities possess the same external characteristics as the Dark Fleet defined in IMO Assembly Resolution A.1192(33).

A central feature of these incidents is the operational use of plausible deniability—an environment in which the likelihood of hostile intent is strongly suspected by observers, yet criminal- and diplomacy-grade attribution remains difficult. This plausibly deniable operational style imposes a strategic dilemma on coastal states: acting early by boarding/inspecting vessels risks legal controversy and market disruption, while acting late may allow severe externalities on critical infrastructure, public safety, and national security.

From the perspective of maritime economics, the stakes extend beyond security of subsea cables. As such irregular activities accumulate, the damage to the maritime world extends well beyond the acts of sabotage themselves—encompassing the hollowing-out of the principles of freedom of the seas and freedom of navigation (as targeted states invoke countermeasures, aggressors respond in kind under the same pretext), the diplomatization of vessel boarding and inspection procedures that are ostensibly conducted for safety verification, and the fragmentation of shipping markets. Undermining the single, open maritime market and reconfiguring it into something susceptible to their own manipulation — this is the ultimate objective of modern hybrid warfare that exploits commercial cargo vessels for grey-zone operations.

In this context, a key unresolved question is: What kinds of observable vessel movements and operational patterns can reasonably justify possible inspection (i.e., pre-emptive monitoring and targeted Port State Control) in a way that is both economically rational and broadly acceptable among willing countries and stakeholders ("consensus-feasible") under contemporary international maritime governance?

This extended abstract builds on (i) a contributed paper that documents the expansion and qualitative transformation of the "dark fleet" under sanctions and the emergence of suspected non-regular activities, mainly focusing on subsea cable incidents, and (ii) a practitioner-facing article that emphasizes plausible deniability as a deliberate design feature of grey-zone maritime operations using commercial vessels. We argue that the "novelty" for the IAME community is not merely that grey-zone incidents exist, but that plausible deniability creates an enforcement-threshold problem under uncertainty. This changes the economics of inspection: the policy issue becomes the design of a credible, transparent, and minimally distortive (e.g., actionable) "inspection trigger" derived from observable vessel behaviors.

The study aims to:

- Conceptualize plausible deniability as an information-structure problem that shapes enforcement incentives and market outcomes.
- Propose a data-driven framework to identify consensus-feasible inspection triggers based on observable vessel movement patterns and compliance signals.
- Outline an empirical strategy to evaluate the trade-off between (a) deterrence/expected-damage reduction and (b) inspection costs, delays, false positives, and market fragmentation.
- Discuss policy pathways — including the potential need for narrowly tailored legal interpretations or exceptions — while treating these as research questions rather than pre-judged conclusions.

Methodology and data:

Conceptual framework: inspection under plausible deniability

We model the coastal state's decision as a threshold enforcement problem under asymmetric information.

A "malicious" operator can engineer deniability (e.g., flag/ownership opacity, AIS gaps, operational ambiguity, and route choices that complicate jurisdiction) to strike a balance among three objectives:

- successfully executing actual cable cuts,
- securing sufficient legal standing under existing maritime law to resist coastal state inspection, and
- projecting a degree of conspicuousness calculated to provoke an overreaction by the coastal state.

The coastal state chooses whether to inspect based on imperfect signals. Two errors matter economically:

- False negatives (missed inspections): higher expected damage to critical infrastructure and higher deterrence failure, which may increase long-term risk premia and induce costly security-driven market fragmentation.
- False positives (unjustified inspections): direct enforcement costs, port delays, possible diplomatic escalation, and chilling effects on trade flows, which manifest as higher transport costs and route inefficiencies.

The policy-relevant output is a set of observable signals (movement + compliance + context) that yields an inspection trigger balancing these errors. Crucially, plausible deniability is treated as a strategic choice affecting the signal distribution—meaning the "trigger" must be robust to adversarial adaptation.

Empirical design: from descriptive patterns to policy evaluation

The planned empirical work combines three components of signal categories as Table 1.

Table 1: Signal Categories

Signal Category	Examples from the Abstract
Movement Signals	Loitering, anomalous anchoring, AIS dark periods
Institutional Signals	Flag quality (PSC lists), P&I insurance, ownership opacity
Contextual Signals	Proximity to cable corridors, timing of reported outages

(1) Vessel-behavior feature construction (movement signals).

Using AIS trajectories, we extract features commonly associated with suspicious patterns in documented cases:

- Loitering or prolonged presence in an area without commercially plausible reasons (e.g., no port call, no congestion signal, no weather rationale).
- Anchoring patterns (e.g., repeated anchoring in proximity to infrastructure corridors; anomalous zig-zag "anchor track" patterns rather than random drift).
- AIS "dark" periods (sudden gaps, repeated disabling, or suspicious reappearance patterns).
- Route deviations or repeated passes near sensitive subsea corridors or military-adjacent coastal zones.

These features are constructed at daily and voyage levels, enabling clustering/anomaly scoring.

(2) Compliance and opacity features (institutional signals).

We incorporate non-movement indicators that proxy for governance distance and opacity:

- Flag-state quality indicators (e.g., whether the flag is in PSC black/grey lists, and historical deficiency rates).
- Insurance and liability signals (e.g., membership in major P&I clubs or alternative coverage).
- Ownership and management opacity (frequent changes in registered owner/manager, use of shell jurisdictions, complexity of beneficial ownership).
- Vessel age and technical risk indicators (older vessels may correlate with "dark fleet" characteristics, though age alone must not be treated as culpability).

(3) Contextual features (where movement occurs).

Signals are weighted by context:

- Proximity to mapped subsea cable routes (publicly available cable maps) or known critical infrastructure nodes.

- Temporal alignment with subsea faults/outage reports and repair windows (where data are accessible).
- Proximity to restricted zones or sensitive coastal assets (where publicly defensible datasets exist).

Data sources (planned and feasible)

A realistic data plan for a full paper includes:

- Subsea cable/pipeline data (public route maps, outage/repair reports)
- AIS trajectory data
- Vessel particulars and port call lists
- PSC outcomes (Paris MoU / Tokyo MoU inspection public summaries + potential detailed access)
- Insurance signals (P&I club membership)

Analysis plan

- Descriptive case alignment: For documented incidents (subsea cable damage cases and drone-related suspicions), we align AIS-derived features with event timelines to identify recurring patterns.
- Anomaly scoring: Construct a composite "Actionable Dark Fleet Index" using weighted signals. We will test alternative weighting: expert-informed weights, supervised learning using labeled incident windows, and unsupervised anomaly models to avoid overfitting.
- Robustness: Evaluate sensitivity to false positive risk by benchmarking signals against benign explanations such as weather avoidance, congestion, mechanical issues, and legitimate anchoring.

<u>Key findings and implications</u>:

Because the paper is positioned as work-in-progress, the "results" section in the extended abstract is framed as preliminary stylized facts plus expected empirical deliverables.

Preliminary stylized facts from documented cases

(A) The "dark fleet" is not only a sanctions-evasion channel but increasingly a governance and security externality: Recent industry and policy reporting suggests the dark fleet constitutes a non-trivial share of the large tanker fleet, and is characterized by governance distance from Western compliance mechanisms (e.g., insurance and oversight channels), frequent changes in registration/ownership, and older tonnage. This matters economically because reduced oversight can increase accident risk, pollution risk, and uncertainty for counterparties—raising transaction costs and potentially constraining market access.

(B) Subsea cable incidents exhibit patterns that are difficult to reconcile with ordinary commercial navigation when multiple signals overlap: Subsea cable damage is common globally and often accidental. However, several recent high-profile cases are argued (by analysts) to display a combination of signals that, taken together, strongly suggests intentionality: prolonged loitering without commercial rationale, selection of flags with weaker oversight (and therefore higher costs under normal business), and anchor tracks consistent with deliberate dragging rather than random patterns. Yet, plausible deniability remains strong because attributing intent and preserving evidence is difficult, and because international maritime law limits boarding/inspection on the high seas to enumerated grounds.

Core argument: plausible deniability creates an "inspection threshold" problem

The key novelty is that plausible deniability is not simply a rhetorical claim; it is an operational strategy that changes the distribution of observable signals and raises the value of ambiguous tactics. This implies:

1. Traditional enforcement triggers (e.g., direct evidence) may be systematically unavailable.
2. Policy must rely on probabilistic, multi-signal reasoning—but that raises concerns about arbitrariness and discrimination.
3. The economically relevant question becomes: Which signal combinations minimize false positives while preserving deterrence against severe externalities?

Proposed output: a consensus-feasible Inspection Trigger (multi-signal standard)

We propose that inspection should not be justified by any single indicator (e.g., AIS gap alone). Instead, a consensus-feasible trigger is more likely when it is:

- Multi-signal and transparent: requires a minimum number of independent signals (movement + compliance + context).
- Procedurally constrained: includes logging, notification to flag state where feasible, and third-party review mechanisms to reduce abuse.
- Economically proportionate: tailored to high-consequence contexts (e.g., near critical subsea infrastructure corridors) rather than generalized suspicion.

An illustrative trigger logic could be:

- Movement anomaly: prolonged loitering/anchoring in a sensitive corridor plus abnormal anchor-track geometry; or repeated AIS dark patterns in proximity to infrastructure.
- Compliance/opacity signal: flag-state risk indicators + ownership/insurance opacity consistent with dark fleet behaviors.
- Context confirmation: temporal proximity to reported infrastructure fault/outage windows or repeated passages over the same corridor inconsistent with commercial necessity.

Implications for maritime economics and governance

If such a trigger is adopted (formally or informally), we expect:

- Support for cooperation of willing countries and stakeholders: Existing law restricts boarding on the high seas to specific grounds; thus, the economic case for an agreed trigger may motivate either (i) interpretive development focusing on protection of critical infrastructure, (ii) regional agreements, or (iii) industry self-regulation frameworks supported by IMO-level guidance.
- Reduction in cable damage: Should restrictions on vessels meeting specified criteria gain consensus among willing countries and stakeholders, more efficient enforcement becomes attainable, materially increasing the prospect of preventing subsea cable damage.

- Shrinkage of the grey-zone operating space: Even in the absence of explicit authority under UNCLOS, the formation of such a consensus among willing countries and stakeholders would narrow the grey-zone operating space and help deter attempts to undermine the principle of open, rules-based use of the seas.

References

Clare, M. (2021). Submarine Cable Protection and the Environment, ICPC.

International Maritime Organization. (2023). Resolution A.1192(33). IMO.

United Nations. (1982). United Nations Convention on the Law of the Sea (UNCLOS).