

# **A Proposal for Functional Data Specifications of On-Demand Fishing Gear**

**Version 2**

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## INTRODUCTION

On-demand fishing technology (also known as ropeless, buoyless, or pop-up gear) is one of the most promising tools for the fixed gear fishing industry to reduce entanglements with marine species. To reduce the level of serious injury and mortality to large whales, including critically endangered North Atlantic right whales (*Eubalaena glacialis*), areas seasonally closed to traditional fixed gear have been introduced within fishing grounds. The use of on-demand fishing gear allows fixed gear fishermen to access these time-area closures. On-demand fishing technology removes the need for persistent surface buoys and vertical lines attached to pots or traps on the seafloor. Instead, an acoustic or timed release device triggers a stowed rope and buoy, a lift bag, or a buoyant spool of rope.

Since on-demand gear removes the surface buoy, there is a potential for increased gear conflicts. The surface buoy has traditionally been used by fishermen to indicate where submerged gear is located on the ocean floor. Without a standardized virtual gear marking system, gear conflicts are more likely between other fixed gear fisheries (e.g., lobster trap, fish trap, gillnet) and mobile gear fisheries (e.g., groundfish trawl, scallop dredge). Therefore, designing a standardized virtual gear location marking system will improve the likelihood of success of on-demand fisheries in the northeast and western U.S., eastern Canada, and beyond.

In 2021, the NOAA Northeast Fisheries Science Center (NEFSC) Gear Research Team received grant funding from the NOAA Fisheries Information System (FIS) to initiate the development of a geolocation cloud database to support on-demand fishing. The overarching goal of that project was to develop an electronic reporting system that will provide near-real-time locations of fixed fishing gear to support on-demand fishing for relevant stakeholders and reduce gear conflict. This document represents Version 2 of the resulting data specification proposal, incorporating stakeholder feedback received following the release of Version 1 (Galvez et al. 2025).

Version 2 deliberately aligns its proposed data fields with existing, operational interoperability platforms – specifically the rmwHUB and the EarthRanger Buoy trawl and gear schemas. The California Department of Fish and Wildlife (CDFW) has also implemented a data reporting schema for its Risk Assessment Mitigation Program (RAMP) for alternative gear authorization, drawing directly from the rmwHUB data model. By aligning with these established systems, this document aims to minimize the need for costly and disruptive modifications to systems that are already operationally proven.

# WHAT CHANGED FROM VERSION 1

The following summarizes substantive changes made from Version 1 (Galvez et al. 2025) to this document, informed by reviewer feedback:

- 1. Scope narrowed to cloud data fields only.** Version 1 described acoustic communication methods alongside data fields, which caused concern that the document was proposing requirements for acoustic communication standards. Version 2 clarifies that acoustic capabilities described in this document are informational, not prescriptive. No acoustic communication standard is being suggested by this proposal.
- 2. Alignment with existing systems.** Version 1 did not explicitly account for the structure of the rmwHUB or the EarthRanger Buoy data schemas. Version 2 aligns proposed data fields with both platforms and with the CDFW RAMP reporting schema.
- 3. "Beneficial" (B) changed to "Optional" (O).** Version 1 used 'B' to denote non-critical fields. Version 2 uses 'O' (Optional) to more accurately reflect that these fields are not critical and that their adoption should be evaluated on a cost-benefit basis by the relevant fishing community.
- 4. Device Status elevated to Functionally Critical.** Version 1 listed Device Status as Beneficial. Feedback clarified that this field is essential: users must be able to determine from the data alone whether gear is actively deployed or has been hauled. A location record in the database is insufficient to establish active deployment status as was suggested in Version 1.
- 5. Fishery added as a new Functionally Critical field.** Version 1 did not include a Fishery field. Without it, there is no mechanism to distinguish which fishery a gear set belongs to, making fishery-specific data governance and enforcement access impossible.
- 6. Share With added as an Optional field.** Share\_with is present in the rmwHUB data schema at the gear set level and enables a submitting party to designate which regulators or partner hubs are authorized to receive a deployment record.
- 7. Device Datetime (Last Position Update) reclassified to Optional.** In Version 1 this field was designated Functionally Critical, implying a universal requirement for acoustic re-localization capability. This was not the intent. Version 2 reclassifies it as Optional and clarifies it applies only to systems that support acoustic or other position refresh methods. It should not be interpreted as a requirement for any acoustic standard.
- 8. Device ID redefined as three separate components.** Version 1 proposed a single concatenated Device ID string with a specific format. Version 2 removes Device ID and replaces it with manufacturer, model, and serial number as separate fields. The year of manufacture has also been removed.
- 9. Release Notification removed.** Version 1 included Release Notification as a data field. This is a local acoustic acknowledgement from the device to the vessel – it is not a cloud data element and is therefore outside the scope of this document.
- 10. Data permission columns removed from the table.** Version 1's table contained columns for user permission groups. Version 2 removes these columns because data governance rules – who sees what and under what conditions – are properly handled at the platform level under official data governance rules, not in a data specification document. A Description/Rationale column has been added in their place to explain what each field is and why it is included.

- 11. Description/Rationale column added to the table.** To improve clarity and justify the inclusion of each field, a Rationale column has been added to the proposed data specifications table.
- 12. Transmission Type column removed from the table and the scope.** Version 1's table and narrative included a Transmission Type column (Priority / Supporting / NA) indicating recommended timing for when each field should be sent to the cloud. This is outside the scope of a data specification document since transmission timing is an implementation decision for regulators and other stakeholders rather than a data content requirement.
- 13. Data fields realigned with CDFW RAMP schema field names and structure.** Version 1 used aggregated field names that were broad and did not align with the current data structure from EarthRanger or the rmwHUB. Version 2 adopts most of the specific field names used in the CDFW RAMP schema, which itself was derived from the rmwHUB. The table is restructured to mirror the rmwHUB, EarthRanger, and CDFW two-part organization: Deployment-Level Fields and Device-Level Fields. Three fields required by CDFW are excluded. Those are: Location Accuracy, Sequence of Trap Within Set, Trap on Set End.
- 14. Data Sensitivity column added to the table.** Version 2 adds a Data Sensitivity column that classifies each field as either Sensitive (contains information that could identify a person, vessel, or business) or Public (describes only gear presence and operational state). This column describes the nature of the data; it does not prescribe how access should be controlled, which remains an implementation decision for platform operators and data governance bodies.
- 15. Set ID and Trap ID added to the table.** These platform-assigned identifiers are present in the EarthRanger Buoy and the rmwHUB data schemas and are the primary keys used to track gear sets and individual devices across the deployment lifecycle

## SCOPE

This document proposes a set of cloud data fields for on-demand fishing gear deployments, including acoustic and timed-releases. The goal is to define the minimum functionally critical data elements needed for virtual gear marking, gear conflict avoidance, and enforcement, as well as a set of optional data elements that individual fisheries or platforms may choose to adopt based on their specific needs.

This document does not prescribe acoustic communication standards or protocols. Where acoustic capabilities are mentioned, they are described as features of some existing systems, not as universal requirements. This document also does not address data governance architecture (e.g., who operates the database, how user onboarding occurs, or subscription models), though it is intended to be compatible with the existing rmwHUB and EarthRanger Buoy architectures.

## EXISTING SYSTEMS

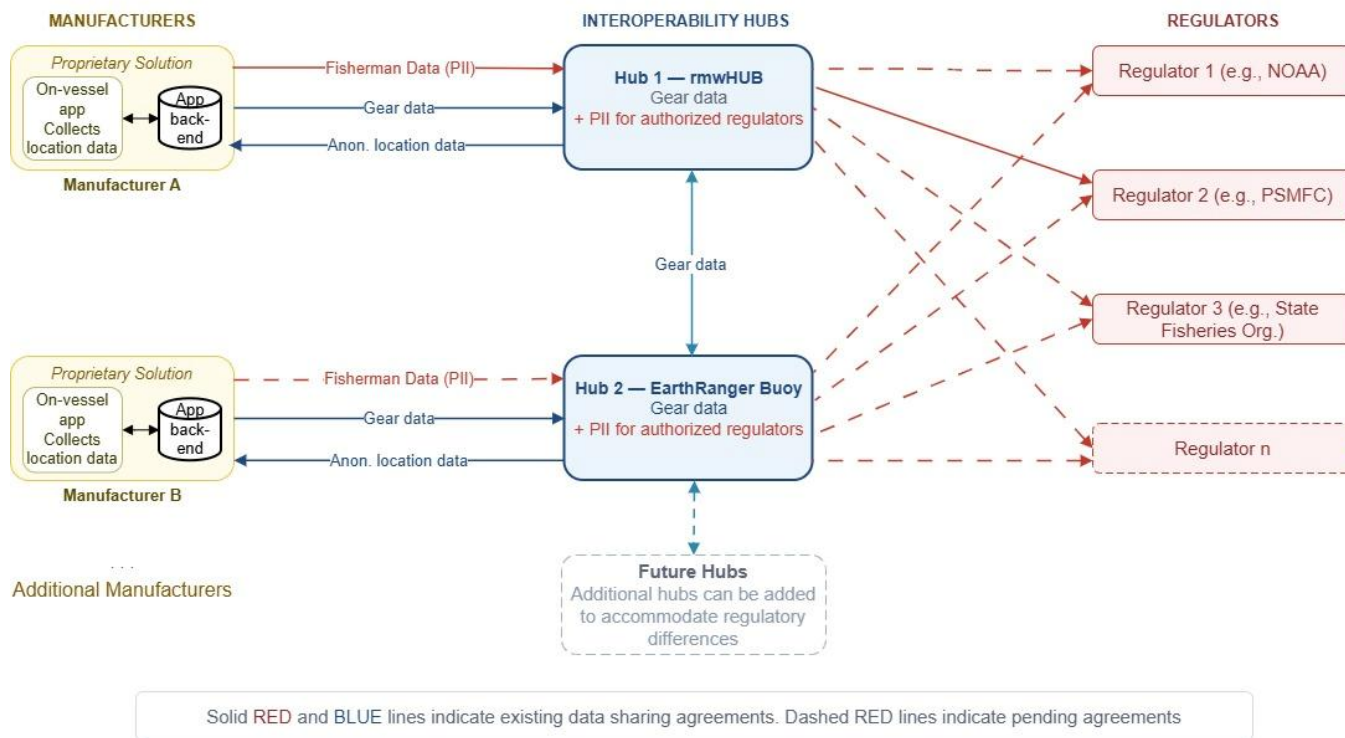
A key principle guiding Version 2 is that this proposal should build on – not replace or disrupt – systems that are already operational and proven. Two platforms currently handle on-demand gear interoperability data in North America:

**rmwHUB** (Ropeless Manufacturers Workgroup HUB): A purpose-built interoperability hub for on-demand gear, currently operated by Britford Software Solutions. The rmwHUB has been running since 2021 and supports manufacturer-to-manufacturer data sharing and enforcement access via dedicated API endpoints.

**EarthRanger Buoy**: A data aggregator operated by the Allen Institute for Artificial Intelligence's EarthRanger program that allows on-demand gear manufacturers to exchange data with each other and with regulators. Similar to rmwHUB, EarthRanger Buoy defines a structured set of required and optional fields for trawl and device-level data.

These two systems are integrated through a hub-to-hub architecture. To enable cloud interoperability of gear location data, manufacturers submit data to their own databases, which synchronize through EarthRanger or rmwHUB. Fishermen access gear location data through manufacturer applications (e.g., Atlas, LiftLabs, Trap Timer, Trap Tracker, etc.); they do not access the hub directly. Enforcement access is provided through dedicated endpoints that expose more granular, confidential data not available through the public or fishermen-facing interfaces. Figure 1 shows the current structure of the data flow between the manufacturers, the aggregate databases, and regulators.

### Ropeless Gear Data Flow



**Figure 1.** The flow structure of on-demand gear data as of March 2026 between the manufacturer's apps/databases, interoperability hubs (i.e., aggregate databases), and regulators. Manufacturer apps send information about the fishermen and their gear to a single interoperability hub. The hubs exchange anonymized gear data with each other and send anonymized gear location data back to the manufacturer databases to allow for viewing interoperability. Pending future data sharing agreements, EarthRanger Buoy would send PII and gear data from the manufacturers that integrate with them to 1 to n regulators. rmwHUB would do the same with the exception that they presently have an agreement to send PII and gear data to the Pacific States Marine Fisheries Commission in compliance with the state of California's gear authorization for a manufacturer integrated with the rmwHUB.

## PROPOSED FUNCTIONAL REQUIREMENTS

The table below details the data elements proposed for a standardized virtual gear location marking system, organized to mirror the structure of the CDFW RAMP reporting schema: Deployment-Level Fields and Device-Level Fields. Fields are classified as Functionally Critical (FC) – meaning they are essential for gear conflict avoidance and/or enforcement – or Optional (O) – meaning they may be valuable to specific stakeholders or fisheries but are not universally required. Fields marked with an asterisk (\*) are confidential and are transmitted only to regulatory and enforcement endpoints. A Rationale column is included to explain why each field is proposed. Three fields present in the CDFW schema are explicitly excluded: Location Accuracy (GPS/Estimated), Sequence of Trap Within Set, and Trap on Set End (Y/N).

Note: All personal identifying information (PII) and business identifying information (BII) will be protected in accordance with all applicable laws. Fields classified as Sensitive in the table below – Fishery, Permit Number, Fisher First and Last Name, Vessel Name and/or Number, Manufacturer, Model, and Serial Number – contain information that could identify a person, vessel, or business. The Data Sensitivity column describes the nature of the data itself. How access to sensitive fields is controlled is an implementation decision left to the platform operator, data governance bodies, and applicable law, and is outside the scope of this document.

FC / O	Data Sensitivity	Data Field	Description/Rationale
<i>Deployment-Level Fields</i>			
FC	Sensitive	Fishery	Identifies the fishery in which the gear is operating and enables relevant parties to distinguish gear by fishery. Without this field, there is no mechanism to distinguish which fishery a gear set belongs to. Fishery names should be standardized. Critical to support data governance.
O	Sensitive	Share With	A list of other regulators or other hubs that should receive specified deployment records. This field does not need to be submitted by manufacturers because the hubs can decide who to share data with based on the Fishery field, meaning once a fishery is identified, a pre-defined set of sharing rules can be applied automatically in the background. Standardized fishery names are required for this to work consistently. Supports data governance in the backend.
FC	Sensitive	Permit Number	Commercial fishing permit or license number associated with the gear set. Ties gear to a permitted operator for enforcement purposes. Critical for enforcement identification.
FC	Sensitive	Fisher First and Last Name	Full name of the fisherman deploying the gear. Critical for enforcement.
FC	Sensitive	Vessel Name and/or Number	Name and/or USCG documentation or state registration number of the fishing vessel. Critical for enforcement.
FC	Public	Set ID	A unique identifier for the gear set (deployment). Enables consistent linkage of all devices in a set across the full deployment lifecycle – from initial deployment through any position updates to haul. Without a set-level identifier, it is not possible to reliably associate individual device records with a single deployment event or to distinguish between separate deployments by the same operator.
FC	Public	Deployment Type	Configuration of the gear set: Single or Trawl. Critical so others on the water know what to expect and for manufacturers to distinguish how to render the gear on a map display.
O	Sensitive	Number of Traps in Set	Total count of traps in the set. Useful for enforcement but not critical for gear conflict avoidance.
O	Public	Data Update Date-time	Timestamp of the most recent update to the deployment record. Enables data consumers to detect stale records.
<i>Device-Level Fields</i>			
FC	Sensitive	Manufacturer	Name or standardized code identifying the device manufacturer. Critical to support multi-manufacturer deck-box functionality and on-water enforcement.
FC	Sensitive	Model	Model designation of the release device. Critical to support multi-manufacturer deck-box functionality and on-water enforcement.
FC	Sensitive	Serial Number	Manufacturer-assigned serial number. Critical to support multi-manufacturer deck-box functionality and on-water enforcement.
FC	Public	Trap ID	A unique identifier for the individual release device. Used as the primary key for each device record and enables reliable tracking of that specific device across deployment events. Without a device-

FC / O	Data Sensitivity	Data Field	Description/Rationale
			level identifier distinct from the manufacturer's serial number, it is not possible to unambiguously link records to a single physical device across multiple deployments or platform systems since multiple manufacturers may have the same device serial numbers.
FC	Public	Latitude	Deployment latitude. Critical for virtual gear marking and gear conflict avoidance.
FC	Public	Longitude	Deployment longitude. Critical for virtual gear marking and gear conflict avoidance.
FC	Public	Deployment Date-time	Date and time when the gear was deployed. Critical for service-interval compliance monitoring and virtual gear marking.
FC	Public	Device Status	Current state of the device: Deployed, Retrieved, or Lost. Functionally critical – data users must be able to determine from the record alone whether gear is actively in the water. A location record alone is insufficient. Deployed and Lost designations would be available to the public on a gear view application, but Retrieved records would only be available to regulators.
FC / NA	Sensitive	Surface Date-time	For timed-release systems only: the datetime the device is programmed to surface. Enables verification of the expected retrieval window. Functionally critical for enforcement to access, not applicable for acoustic device sets.
O	Sensitive	Retrieval Date-time	Date and time when the gear was retrieved. Supports service-interval compliance audits and retrospective effort analysis.
O	Sensitive	Release Type	Mechanism used to release the device: Acoustic, Timed, or Other. Not critical for gear conflict avoidance or enforcement, but useful for on-water enforcement.
O	Sensitive	Device Health	Remaining release capacity (e.g., battery percentage, air pressure reading, etc). Acoustically interrogatable on supported devices. Useful for enforcement and diagnostics but not required for gear conflict avoidance.
O	Public	Device Datetime (Last Position Update)	The most recent datetime when the device location was refreshed acoustically. Only applicable if the system supports acoustic re-localization.

## GLOSSARY

The following are descriptions of the data fields in the table above.

**Data Sensitivity** — A column indicating whether a field contains information that could identify a person, vessel, or business (Sensitive) or whether it describes only the gear's physical presence and operational state (Public). This classification describes the nature of the data itself and does not prescribe any particular access control or data governance rule.

**Data Update Date-time** — Timestamp of the most recent update to the deployment record, as reported by the manufacturer.

**Deployment Date-time** — Date and time when the gear was deployed.

**Deployment Type** — Configuration of the gear set: Single (one trap), or Trawl (a line of multiple traps).

**Trap ID** — A unique identifier for an individual release device. Used as the primary key for each device record and enables reliable tracking across deployment events. Not to be confused with Device Serial Number.

**Device Datetime (Last Position Update)** — The most recent datetime when the device location was refreshed acoustically by systems that support that functionality.

**Device Health** — A metric describing the health of the device if supported by the device itself.

**Fisher First and Last Name** — Full name of the fisherman deploying the gear.

**Fishery** — The commercial fishery in which the gear is being used (e.g., Dungeness crab, American lobster, black sea bass).

**Latitude** — Deployment latitude.

**Longitude** — Deployment longitude.

**Manufacturer** — Name or standardized code identifying the release device manufacturer.

**Model** — Model designation of the release device.

**Number of Traps in Set** — The total count of traps or devices in the set. Formerly 'Gear Count' in Version 1.

**Permit Number** — Commercial fishing permit or license number.

**Release Type** — The mechanism used to release the device: Acoustic, Timed, or Other

**Retrieval Date-time** — Date and time when the gear was retrieved.

**Serial Number** — Manufacturer-assigned serial number of the release device.

**Set ID** — A unique identifier for a gear set (deployment). Enables consistent linkage of all devices in a set across the full deployment lifecycle.

**Share With** — A list of regulators or other hubs that are authorized to receive a given deployment record.

**Status** — Current state of the device: Deployed, Retrieved, or Lost.

**Surface Date-time** — The datetime the device is programmed to surface for timed-release systems only.

**Vessel Name and/or Number** — Name and/or registration number of the fishing vessel.

## **A LIVING FRAMEWORK: DATA FIELDS AND FUTURE ADAPTABILITY**

The data fields proposed in this document are not intended to be a permanent or exhaustive specification. On-demand fishing technology is evolving rapidly, and the operational needs of fisheries managers, enforcement agencies, and industry will continue to develop as on-demand gear technology matures. It is anticipated that additional fields will be identified over time as new use cases emerge.

It is suggested that any future additions or modifications to the data specification should adhere to the following principles:

- **Backward compatibility** – New fields should be additive. Existing required fields should not be removed or redefined in ways that break existing implementations without a formal transition period and adequate notice to manufacturers and platform operators.
- **Architectural consistency** – New fields should be compatible with the existing rmwHUB and EarthRanger Buoy data models. Where a new field requires a structural change to either platform, that change should be evaluated collaboratively with platform operators, and the associated costs should be identified and resourced before the field is designated as required.
- **Stakeholder consultation** – Changes to the specification should involve input from manufacturers, enforcement agencies, fisheries managers, and fishing industry representatives, consistent with the workshop process that informed Version 1.
- **Minimizing burden** – New mandatory fields should be added conservatively. The value of each proposed addition should be weighed against the reporting burden it places on manufacturers and operators, and against the costs of modifying existing systems.

The intent of this framework is to ensure that the virtual gear marking system can grow and improve as the fishery and technology landscape evolves, while protecting the investments already made in existing infrastructure and avoiding unnecessary disruption to manufacturers, fishermen, and platform operators.

## **ACKNOWLEDGEMENTS**

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