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

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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 release device releases/triggers a stowed rope and buoy, a lift bag, or a buoyant spool of rope. All on-demand fishing systems are currently composed of four basic components: a transducer on the vessel, a transceiver on the release unit, a release mechanism, and a graphical user interface on a computer, tablet, or mobile application. The transducer sends a coded signal unique to the transceiver on the unit; the transceiver receives the signal, triggering the release mechanism. In addition, some systems send a message back to the topside transducer that confirms the release was triggered. The user interface allows the user to trigger the acoustic release device and mark its position on a map. In some cases, the gear can be marked automatically using acoustic localization.

On-demand fishing allows for continued fishing in areas and times of heightened entanglement risk that might otherwise be closed to vertical line fishing, thereby mitigating the burden of vertical line closures on the industry. However, 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 that broadcasts and displays the necessary information, 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 U.S., eastern Canada, and beyond.

Recognizing that multiple stakeholder groups will be affected by on-demand fishing practices (e.g., because of the removal of the surface buoy), involving all relevant parties in discussions regarding data collection, data sharing, and user permissions is important to build a framework around the common goal of replacing a traditional surface buoy with a virtual one. Stakeholders for this effort include owners/operators, law enforcement, other mobile and fixed gear fishermen, research vessels, other ocean users, on-demand gear manufacturers, fisheries managers, and researchers or other land-based parties.

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. This program is a state/regional/federal partnership that fosters collaboration and funds innovative projects to improve and streamline the collection of fisheries-dependent data, mainly via electronic means. The overarching goal of the 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/partners and reduce gear conflict. The first objective of the project was to host several workshops with regional and federal management, enforcement agencies, and industry

representatives. The purpose of the workshops were to educate stakeholders on the current state of on-demand technologies and collect stakeholder input on functionally critical and optional data fields for a geolocation database for on-demand fishing.

Initial workshops with U.S. and Canadian fishing industry representatives and regional, federal, and enforcement agencies indicate that a useful standardized marking system would display and disseminate the information traditionally accompanied by a surface buoy as well as information associated with the release devices (Galvez et al. 2023, Baumgartner et al. 2021). Ideally, all release devices and associated user apps (e.g., Atlas, OpenCPN, Trap Timer, Trap Tracker, etc.) from all manufacturers would send standardized pieces of information to the proper stakeholders at the appropriate times. The goal is to disseminate the necessary information to the relevant parties for gear conflict avoidance, enforcement, and on the water communications between fishermen.

## Scope

The following sections detail the data elements that have been preliminarily identified from multiple workshops as useful to prevent gear conflict and enforce the use of the gear. Proposed methods of communications between the submerged devices (acoustic communications) and the topside software (cloud communications) are also detailed.

## Proposed Functional Requirements

The table features the data elements that have been identified by relevant stakeholders as useful for a standardized virtual gear location marking system. Column 1 divides the data elements into two categories: data that would be critical for functionality of a standardized gear location marking system (FC) and data that could be beneficial (B) to other stakeholders for fisheries management and device diagnostic purposes. In addition, the table includes information regarding permissions, data transmission priorities, and information that should be able to be acquired acoustically from the device itself. Columns 3 - 10 are the identified users who may need real-time access to the data, retrospective access, or both. Notably, in all cases, personal identifying information (PII) and business identifying information (BII) will be protected in accordance with all applicable laws.

**Table. Draft functionally critical and beneficial (but not critical) data elements for an on-demand gear deployment as preliminarily identified by various stakeholders within the Northeast U.S. region. See Galvez et. al. 2023 and Baumgartner et. al. 2021. The table breaks down data access by user permission, access type, and data transmission priority. Live access refers to information that should be sent to the cloud as soon as possible and in some cases, acoustically. Retrospective access refers to access to historical set and haul data.**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| | Functionally Critical (FC)/ Beneficial (B) | Acoustic/ Priority/ Supporting Data | Owner/ Operator | Law Enforcement | Mobile & Fixed Gear Fishermen | Research Vessels | Other Ocean User | Manufacturer | Fisheries Manager | Researcher/Other Land-Based Party |
| **Real-Time Access** | | | | | | | | | | |
| Owner ID | FC | Priority | X | X | | | | X | | |
| Device ID | FC | Acoustic/ Priority | X | X | | | | X | | |
| Device Location | FC | Priority | X | X | X | X | X | X | | |
| Device Datetime | FC | Priority | X | X | X | X | X | X | | |
| Device Datetime (Last Position Update) | FC | Priority | X | X | X | X | X | X | | |
| Device Health | B | Acoustic/ Supportive | X | X | | | | X | | |
| Device Status | B | Acoustic/ Supportive | X | X | | | | X | | |
| Release Notification | B | Acoustic | X | X | | | | X | | |
| Gear Type | B | Supportive | X | X | | | | X | | |
| Gear Count | B | Supportive | X | X | | | | | | |
| **Retrospective Access** | | | | | | | | | | |
| Owner ID | B | NA | X | X | | | | X | | |
| Device ID | B | NA | X | X | | | | X | | |
| Device Location | B | NA | X | X | | | | X | X | X |
| Device Datetime | B | NA | X | X | | | | X | X | X |
| Device Datetime (Last Position Update) | B | NA | X | X | | | | X | X | X |
| Device Health | B | NA | X | X | | | | X | | |
| Device Status | B | NA | X | X | | | | X | | |
| Gear Type | B | NA | X | X | | | | X | X | X |

# Glossary

The following are short descriptions of the terms in the table.

**Device Datetime** - Time and date of the initial setting of gear (UTC).

**Device Datetime (Last Position Update)** - The latest datetime when updated acoustically by a passing vessel using certain acoustic systems.

**Device Health** - Some metric that describes remaining capacity for release, such as battery % or % air left, depending on the type of release system being used. This can be interrogated acoustically or can be a physical display on the device itself, such as a pressure gauge, indicator light, etc.

**Device ID** - Device identification (ID) should contain a standardized code for the device manufacturer, year built, model, and serial number. NOAA and other stakeholders recommend using a specific structure for the ID. For example, the ID could be structured as follows: first four letters of the manufacturer, last two numbers of the device year of manufacture, and last four numbers of the device serial number. Using the example provided, an Acoulink device ID could be: ACOU24ABC1.

**Device Location** - Decimal degrees (DD) to five decimal places (e.g. 42.35482, -71.54821). Presence of a location in the standardized marking system would indicate that the device status is "deployed" or "set" (i.e., gear is currently present at that location).

**Device Status** - Device status describes the current status of the device via labels, such as "armed" / "ready", "fault" / "error", "deployed", *et cetera*. "Deployed" devices and associated gear would be viewable on a map display or chart plotter connected to the cloud, as permissions allow. Other statuses would only be viewable to the gear owner, manufacturer, and potentially other users who the device owner chooses to share the data with.

**Release Notification** - An acoustic message from the device that notifies the device owner that the release command has been received and initiated. This message indicates that the release was successful but does not guarantee that the retrieving device will surface.

**Gear Type** - The type of gear the device is attached to (e.g., lobster/fish trap, gillnet, etc.).

**Gear Count** - The quantity of traps on a trawl or number of panels on a gillnet string.

**Owner ID** - Unique identification number of an individual user that can be tied to the vessel ID, hull ID, operator ID, permit #, and/or license # (as appropriate by law).

**Acoustic** - Information that the device sends to the user if interrogated acoustically.

**Priority Data** - Data elements that should be immediately sent to the cloud with either a cellular or satellite connection immediately after a gear deployment.

**Supporting Data** - Data elements that are not necessarily critical to gear conflict avoidance, thus may not need to be immediately sent to the cloud after a gear deployment, but should be sent as soon as possible when the user is in cellular range.

# DESCRIPTION and JUSTIFICATION

## Communications

To ensure continued and safe operation and enforcement of the fishery, and reduce gear conflict, the sharing of information about a gear deployment falls into two main categories: acoustic communications and cloud communications. Cloud communication specifications are divided into two categories: priority data and supporting data. Because of the current high cost of broadband satellite internet connectivity services, only data elements identified as priority would be sent using narrowband satellite services, whereas supporting data would be sent when the vessel enters cellular communication range. If broadband satellite internet services are available offshore (e.g., Starlink), all data could be sent concurrently using those. For all bolded terms below, see **Glossary**.

## Acoustic Communications

The data fields that may be interrogated from the device include: **Device ID**, **Device Health**, **Device Status**, and **Release Notification**. The release notification is only obtainable via acoustic interrogation, whereas the other data may also be accessed in the cloud (see the table). These pieces of information serve several objectives, including providing useful information for the device owner/operator, efficient recovery operations by enforcement for gear compliance checks, and facilitating manufacturer troubleshooting and potential warranty claims. Notably, that the cloud would only display Device Health and Device Status from the last time the device was interrogated acoustically. Therefore, discrepancies between the health and status of the device in the water versus what is displayed in the cloud may occur.

## Cloud Communications

### Priority Data

Priority data refers to data elements that have been preliminarily identified as needed in real-time and sent to the cloud immediately with an available cellular or satellite connection, such as Iridium or Starlink. The data fields identified as priority may be necessary to minimize gear conflict and comply with enforcement needs. Those data fields include **Owner ID**, **Device ID**, **Device Location**, **Device Datetime** and **Device Datetime (Last Update)**.

### Supporting Data

Supporting data refers to data that is not critical for gear conflict avoidance and can therefore be delayed in sending to reduce costs associated with satellite services and instead sent when the user is within cellular range. These fields include **Device Health**, **Device Status**, **Gear Type**, and **Gear Count**. These data may be desirable for 1) the owner/operator for operational awareness and planning, 2) enforcement to know what to expect when hauling gear, 3) for

fisheries managers to calculate on-demand fishing effort (gear count), and 4) for manufacturers to fulfill potential warranty claims (device health and status).

# User Permissions

Specific user groups were identified by various stakeholders as needing access to specific data elements during the Fisheries Information System (FIS) workshops (Galvez et. al. 2023) and in the Baumgartner et al. 2021 report. Below, we summarize information arising from the workshops and report. User permissions have been broken down into eight categories with varying levels of access to real-time information on current deployments and/or retrospective access to historic deployments. Refer to the table for the identified column-level permissions.

### Real-time Access

Referring to the table, the *owner or operator* of the gear and *law enforcement* should be given access to all the proposed data fields. *Mobile & fixed gear fishermen*, *research vessels*, and *other ocean users* are anyone who is within a specified range of the device. They should be given access to the **Owner ID, Device Location**, **Device Datetime,** and/or **Device Datetime (Last Update**). These user groups may only need to visualize the gear in cases where action is needed to avoid gear conflict. The *manufacturer* may require access to all the proposed data fields (except gear count) to allow them to help troubleshoot with a user on the water or fill/void any potential warranty claims. *Fisheries managers* and *researchers/other land-based parties* may not need live access to these data.

### Retrospective Access

Various stakeholders have identified certain users as potentially needing retrospective access to the data. Referring to the table, from left to right, the *owner/operator*, *law enforcement,* and the *manufacturer* may be given retrospective access to all the data fields for maintaining their fishing history (owner/operator), law enforcement purposes (law enforcement), and for potential warranty claims or troubleshooting (manufacturer). *Fisheries managers* should have retrospective access to **Device Location**, **Device Datetime**, **Gear Type**, and **Gear Count**. These data can be used to calculate on-demand fishing effort over time and space. Lastly, *researchers/other land-based party* may desire access to **Device Location**, **Device Datetime**, **Gear Type**, and **Trawl Length** to calculate other useful metrics that may aid in managing the fisheries. No PII or BII should be made available to these outside research organizations to protect user privacy and to comply with state and federal regulations related to data sharing. *Mobile & fixed gear fishermen*, *research vessels*, and *other ocean users* are not expected to need retrospective access since they would only need access to the live locations of any gear near their position when at sea to prevent gear conflict.

# Acknowledgements

# References

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