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White Paper

Geofencing Facilities in Transport and Logistics

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Acknowledgement

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Introduction

Industry is increasing the use of smart container technology and smart devices (IoT) within their supply chains to improve security, visibility, predictability, and plan more efficiently. They transmit to the smart device's management system, among other things, the location of the assets (such as shipping containers) to which they are attached or embedded, however the context of where the assets are at that point in time is often not known unless it is part of the transport plan and being within an existing virtual geographic boundary, a geofence.

The UN/CEFACT whitepaper on 'Smart Containers - realtime smart container data for supply chain excellence' outlined a number of practical use cases for a wide variety of actors to implement smart containers (or devices) within their supply chain, however as many parties can be involved in a transport movement, and container owners may make use of several vendors of smart devices, along with shippers own smart devices being deployed there is currently no single definition of a facility, or methodology to define those facilities with a geofence.

This leads to duplicated effort and more importantly differences between definitions of the same facility (terminal, berth, container facility or other) and there is no guidance or methodology on how to draw these geofences or to improve quality when reviewing them.

Scope

The scope of this paper will focus on facilities that are common to all in the supply chain namely the BIC[1] Facility Code and SMDG[2] Terminal Code which are child codes of the UN/LOCODE[3].

The purpose of this paper is to define the rules for their respective facilities and outlining the methodology, providing consistency and a drive towards quality geofences that can be used and trusted in industry.

Other types of facilities such as shipper locations and logistic platforms (intermodal area) are not in scope for this paper, however the intention is that the paper will serve as a reference for evaluating and drawing of geofences for other types of facility.

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[1] Bureau International des Containers - https://www.bic-code.org

[2] Ship Message Design Group - https://smdg.org/

[3] United Nations Code for Trade and Transport Locations

Geofence

A geofence is a representation of a virtual boundary around a real-world geographic area such as a port or container facility using a collection of latitude and longitude pairs.

Here is an example of HHLA Container Terminal in Hamburg Germany

They serve various purposes, such as enabling the smart devices' management system to trigger specific actions based on data received from smart devices, such as notifying when a transportation unit (container) enters or exits the defined boundary, enabling efficient geo-queries to filter data based on location, providing visual understanding of areas on a map, and facilitating spatial analysis for decision-making. In diverse fields such as logistics, security, environmental monitoring, and location-based services, geofences offer a versatile and powerful tool for spatial management and insights. Geofences for facilities should be drawn using **polygons** as the physical boundaries of a facility are complex shapes as in the example above, and use of simple shapes such as a circle or rectangle would not offer the accuracy needed to define a geofence for a facility.

A geofence can be defined at various levels and shapes, depending on the specific use case. For example, at the United Nations Code for Trade and Transport Locations (UN/LOCODE) level, geofences can be used to monitor the movement of goods between different countries or administrative areas. Geofences can also be applied to specific ocean terminals to manage and monitor shipping activities or within a container facility to track the movement of individual containers, enhancing efficiency and security.

Defining Geofences

When creating and using geofences that are shared and used across multiple parties it is important to have a clear definition that everyone agrees to and that for common facilities there is a single source of truth, to achieve this we need to define the geofence and rules for easy review and understanding.

Classification and Rules

During the creation process of geofences, it is key to define specific guidelines based on the type of facility. Organisations such as BIC, SMDG, and IMO each have distinct rules for the facilities for which they provide codes. Recognizing this differentiation, we will categorise each entity as a distinct 'family' in our framework.

Under this family classification system, a set of geofences would typically be defined.

Examples of such families are the child codes of the UN/LOCODE:

1. **BIC Facility Codes** – depots and other container handling facilities
2. **SMDG Terminal Codes** - Ocean container and Roll-On/Roll-Off terminals
3. **IMO GISIS**[4] – Port facilities

Each of the above families could have different definitions and uses for geofencing and would define their own rules for those locations.

To facilitate the process of creation and review of geofences, the base criteria for rules associated to a family of geofences should consider:

• Boundaries: how boundaries of geofences are defined. For instance, whether berthing areas are included or not.
• Overlapping: whether overlapping geofences are allowed.
• Nesting and if any related geofences are to be published.

Boundary rules should be clearly outlined for the creation and importantly the review of geofences such that geofences can be unambiguously created, reviewed, accepted, and evolved.

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[4] International Maritime Organization – Global Integrated Shipping Information System

Overlapping of geofences needs careful consideration. It is generally discouraged to allow the overlapping within the same family as it makes intersecting geolocation data with geofences ambiguous. A concrete example can be interpreting whether a smart device entered or departed from a geofence for facility A or B. Additionally, in case of transfer of ownership, duty of care or financial implication being determined, overlapping geofences can also result in unexpected or confusing results. Overlaps can however exist across *different* families of geofences, for example a container depot or repair yard (identified by a BIC Facility Code) may exist within an Ocean Terminal (identified by an SMDG code). Instead of overlapping the recommendation is to apply nested geofences where they relate to areas within a facility.

An example of overlapping facilities within Hamburg can be seen as below, the same SMDG terminal (DEHAMEGH) has two BIC Container facilities within its boundary with respective BIC codes.
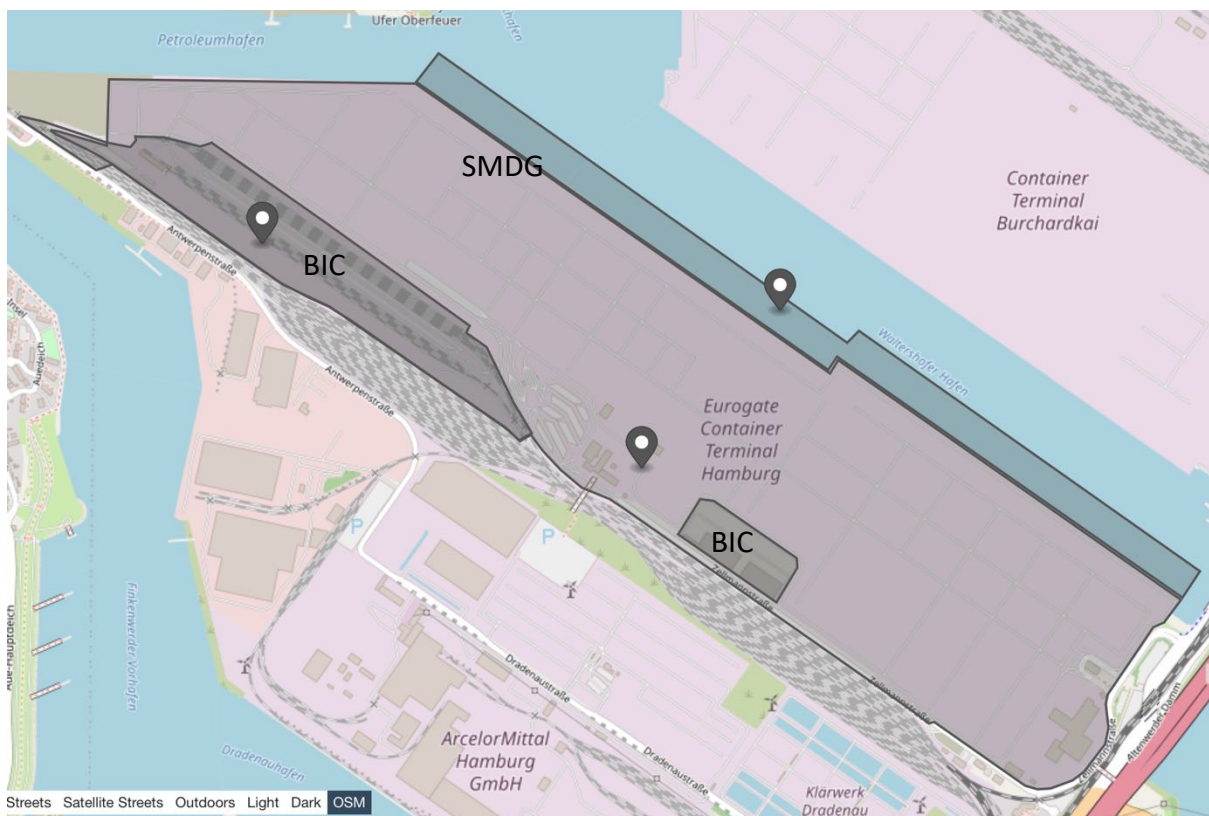
Nesting geofences allows for enhanced precision and control when triggering events from smart device location data. An ocean terminal is represented by a primary geofence linked to its SMDG code. Inside this main geofence, subsidiary geofences define specific areas or berths. Consequently, a container may be situated within a terminal geofence, yet also reside within a berth geofence inside that terminal.

To allow for extension of the base geofence for a facility a user may wish to create zones of interest in or around the base facility geofence within their platform, and link them back to

the facility code to allow for the above scenario, this can be achieved by using meta data as described in the 'Nesting of Geofences' section

Ruleset for Geofencing

Each of the 'families' noted will maintain evolutions of their geofence definitions over time and their respective websites should be checked for the most up to date position.

BIC Facility Codes

BIC provides a nine character code which is based on the UN/LOCODE for identifying container handling facilities globally. This data is accessible via API and provides structured data for the facility covering the name, address, and geographic coordinates. Ocean carriers use these codes in their internal systems for maintenance and repair, lease hire and providing detail in track and trace messages and communicating the pick-up and return depot with their customers.

DCSA[5] standards use BIC Facility Codes in their Information Model to define a container facility.

BIC defines the following rules for geofencing container facilities.

1.   BIC Facility Codes (BFC) will provide geographic coordinates which will always be contained within a geofence that would be sufficient for driving directions to a facility. The **geofence** for a BFC will always follow the perimeter fenced area that the facility is operating within. The geofence precisely demarcates the perimeter of the facility and thus excludes any area not belonging to the facility. For this reason, simpler shapes such as a circle, a square or a rectangle will usually not lead to the desired precision.

2.   **Overlapping geofences** are not accepted, each facility MUST be unique and have its own non-overlapping geofence.

3.   **Nesting of geofences** against a facility is out of scope for BIC to maintain, however it is encouraged for others to maintain geofences linked to a BFC where it is advantageous to do so, in which case BIC recommend using the BFC as a key in the nested geofence's metadata and where possible describe using linked data to join to the BFC.

For more information about BIC Facility Codes and geofencing or to access the API visit
https://www.bic-code.org/bic-facility-codes/

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[5] Digital Container Shipping Association - https://www.dcsa.org

SMDG Terminals

SMDG provides ocean terminal codes using a three to six character reference extension to the UN/LOCODE; this data is accessible from the SMDG website and available from a shared API hosted by BIC.

Ocean carriers and terminals use these codes to identify and communicate loading and discharge locations in stowage plans of container vessels, as well as ocean vessel schedules. DCSA standards use SMDG Terminal Codes in their Information Model to define an ocean terminal.

SMDG has the following ground rules established.

1.   SMDG provides geographic coordinates at the centre of a quayside within the defined ocean terminal, this would always be within the geofences area. The geofence would also usually be directly located next to water including an area covering the berthing areas for ocean vessels. However, for some locations there are 'virtual ports' where lighters are used to transfer containers to/from vessels whilst at sea.

2.   **Overlapping facilities** may be accepted in specific cases, there are for practical reasons in some locations areas that have their own SMDG code for the terminal but partially share the berthing area for vessels.

3.   **Berthing areas** should be defined in addition to the geofence relating to the land, to enable the identification if a container is on the vessel or in the terminal, this should cover the width of a ship or the crane(s) at the terminal.

4.   **Nesting of geofences** against a facility is out of scope for SMDG to maintain, however it is encouraged for others to maintain geofences linked to an SMDG terminal where it is advantageous to do so, if doing so SMDG recommend that you use the SMDG as a key in your metadata and where possible describe using linked data to join to the SMDG Terminal.

For more information about SMDG Terminal Codes and geofencing or to access the API visit https://smdg.org/documents/smdg-code-lists/smdg-terminal-code-list/

IMO GSIS – Port Facility Number

The IMO GSIS Port Facility Number defines port facilities of all kinds, with a focus on maritime security in compliance with the International Ship & Port Facility Security (ISPS) regulation. The code is made up using a 4-number extension to the UN/LOCODE, this data is accessible from the IMO Website.

A location, as determined by the contracting government or by the designated authority, where the ship/port interface takes place. This includes areas such as anchorages, waiting berths and approaches from sea as appropriate.

IMO have the following ground rules established.

1. IMO GSIS provides geographic coordinates within the port area.
2. **Overlapping facilities** are not accepted, each facility MUST be unique and have its own non-overlapping geofence.
3. **Nesting of geofences** against a facility is out of scope for IMO to maintain, however it is encouraged for others to maintain geofences linked to an IMO GSIS location where it is advantageous to do so, if doing so IMO recommend that you use the IMO Port Facility Number as a key in your metadata and where possible describe using linked data to join to the IMO facility.

For more information about IMO GSIS Port Facility Numbers visit
https://gisis.imo.org/Public/ISPS/Default.aspx

UN/LOCODE

Following the guidelines in the UNECE Recommendation 16 for UN/LOCODES the following is recommended for those who wish to geofence a UN/LOCODE

1. UN/LOCODE would contain geographic coordinates within the geofence, this should ideally be the centre point, town hall or municipality or other administrative location within the UN/LOCODE area as defined under recommendation 16. The geofence should cover the boundary of the area referenced, for example a city or council administrative boundary, these should follow the outline and would never be simple shapes.

2. UN/LOCODE do not overlap as you cannot have two UN/LOCODE for the same place, however changing boundaries will require maintenance to reflect new codes or deprecated codes.

For more information about UNECE Recommendation 16 visit
https://unece.org/trade/publications/recommendation-ndeg16-united-nations-code-trade-and-transport-locations

Nesting of Geofences

The concept of nesting a geofence is to allow for the base facility geofence to be extended by linking another geofence or library of geofences to it, as an example SMDG wish to identify the berthing area of a terminal in addition to the land based boundary of the terminal, these geofences should contain meta data indicating they are the berthing area of a terminal making the geofence more useful when combined with IoT data.

Another entity may wish to make geofences available to its members or generally available, and the concept of nesting would allow them to become a publisher of a geofence library with a link back to the base facility, a good example could be IANA (Intermodal Association of North America) publishing the truck queue geofences for a given facility in North America.

To achieve this the geofences that could be nested should be coded to enable interoperability and clarity to those using them.

The table below highlights some common examples, a maintained list will be published at https://github.com/bic-org/Facility-Code/blob/master/geofencing/nesting-codes.csv

Category	Name	Description
GATE	Gate	The gate or entry point to a container depot or terminal
QUEUE	Queue	The defined area for the queue to enter a terminal gate by road
BERTH	Berth	The defined area for a SMDG Terminal to identify the berthing area
ON_DOCK_RAIL	On Dock Rail	
MAINTENANCE_REPAIR	M&R Area	The maintenance and repair area, or roadability area.
DANGEROUS_GOODS	Dangerous Goods Zone	
REEFER_ZONE	Reefer Zone	Area for Reefer storage or power
CLEANING_AREA	Cleaning Area	'Wash Area'
CROSS_DOCKING	Cross Docking Facility	
CUSTOMS_INSPECTION	Customs Inspection	
EMPTY_STORAGE	Empty Storage	
CONTAINER_PREPARATION	Container Preparation	(food, textiles etc)
QUARANTINE	Quarantine Area	For pests and other

To use the coded values in a geofence they should be added to the meta data for that geofence, using the 'category' label in 'properties'. There should always be a geofence where the category will be 'FACILITY'; this denotes the geofence of the facility itself.

An example below highlights how this could work for a nested geofence within the same collection covering the 'gate'

```
"properties": {
      "code": "GBLIVJMDA",
      "codeProvider": "BIC",
      "category": "GATE"
}
```

By including this meta data with the geofence, we are identifying that the geofence we are looking at is the 'Gate', and that it relates to the BIC Facility Code 'GBLIVJMDA' so if the geofence is triggered it can provide more context.

We have seen that geofences can include multiple disconnected areas, like https://geofence-review.bic-code.org/view-pending-request/SMDG/DEHAMSWT.
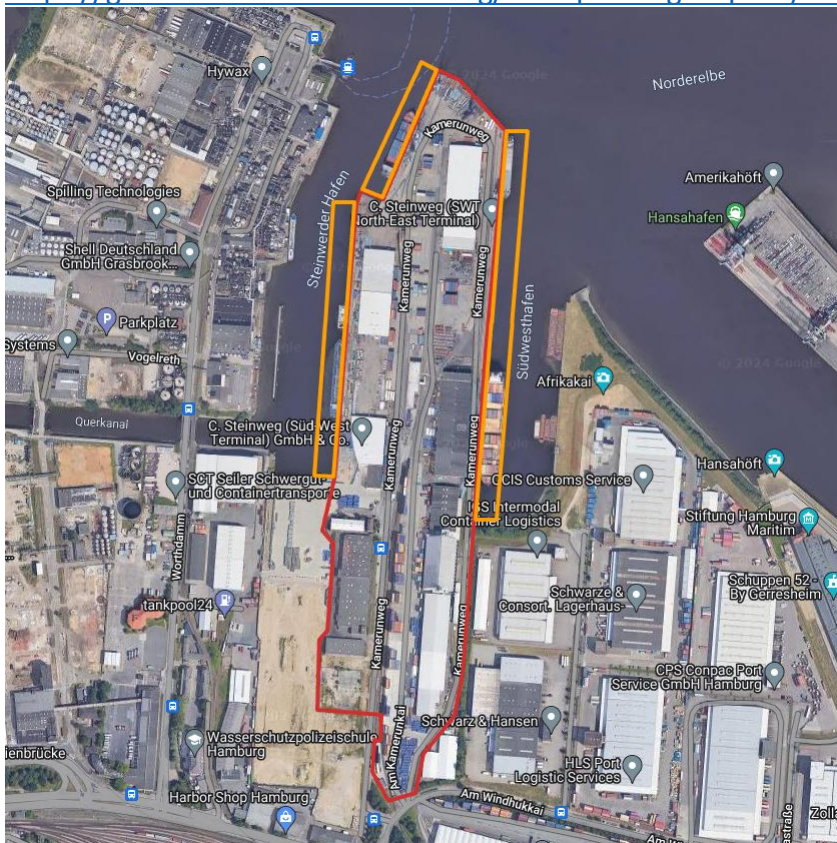
This leads to two scenarios:

1) Multiple geofences relating to the same facility code (i.e., 1 BFC or SMDG code). In this case we would want to identify each geofence in the collection with a unique identifier, this should be done in 'properties' using the `id` tag. It would be possible to automate this identification, see appendix 1.

2) Nested geofences that relate to a facility, for example you may have a 'gate' and a 'berth' geofence relating to an SMDG terminal. In some cases, this could also be a one to many i.e., one gate for many terminals or depots within a port area. To link to the facility, you should use the 'parent' tag in properties as an array to allow this.

```
"properties": {
    "parent": ["NLRTMDDN", "NLRTMDDE"]
},
```

Drawing and Reviewing Geofences

When reviewing it is important to be able to easily decide on the quality of a provided geofence and if it meets the rules of the code list provider, this should be easy to understand and repeatable with a similar outcome regardless of the participants reviewing a geofence.

Before considering the quality of the geofence we need to understand a few topics which may influence the decisions taken.

- Smart devices will periodically send geographic coordinates to their management system, the frequency of which can be configured, so smaller geofences such as a small entry gate may not always be triggered.
- Positioning and coverage of the smart device may skew the reported position of the equipment, showing a smart device as in then out of a geofence when it has not moved when near to the boundary of a geofence.

These should not influence the quality of the geofence, by for example adding a buffer zone to the physical fence of a facility to negate the impact of the above, the geofence should be reflective of the physical boundaries where possible. It is the responsibility of the data processor receiving the positioning data to post process and consider variation, dwell times and other factors which are specific to their smart devices.

With the above in mind and to facilitate the process of reviewing a geofence and forming a consensus on its quality, here are some examples that can be referenced to overcome common challenges.

Railway Examples

Example 1 – Rail lines running through a facility

Container Facilities and terminals are often close to or part of a rail network. The rail line is not considered part of the facility if trains do not stop there for loading and unloading.

CMR, Hamburg, Germany

The facility is split either side of the railway except for a small bridge crossing the railway which forms part of the facility.
The rail line is not part of the facility, in that trains do not stop there for loading and unloading, and it is on a different vertical axis to the container facility, in this case below the level of the facility land, hence the decision to include the bridge and exclude the rail.

https://www.bic-code.org/facility-codes/DEHAMCMRA

Ventura Transfer Company, Los Angeles, USA

The rail is at the same level as the facility land, but not part of the facility, so a second geofence as part of the feature collection is the recommended approach.
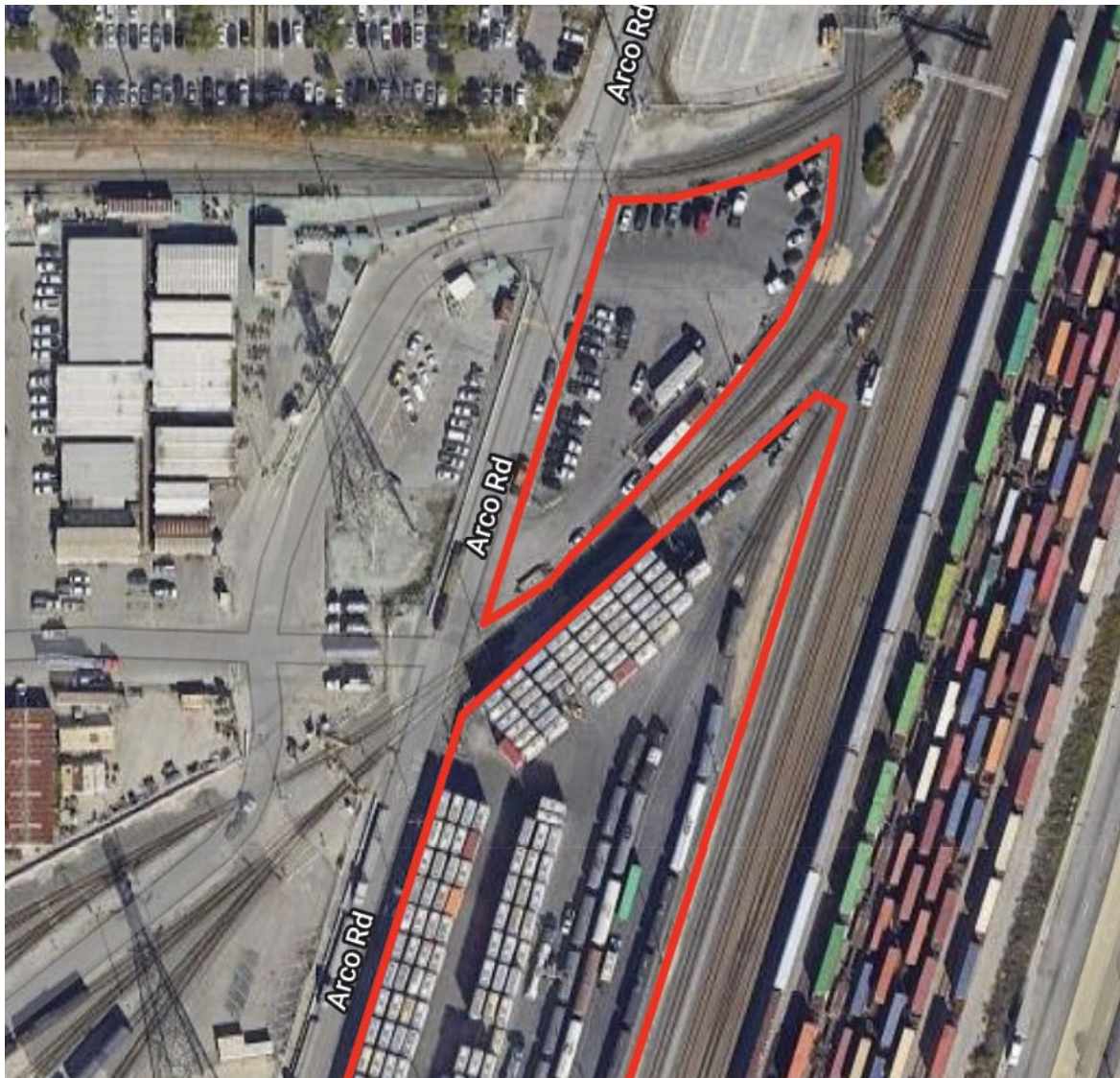
Example 2 – Railhead within a facility

A railhead within the facility where trains will load and unload is part of the facility and should be included within the geofence.

Freightliner Garston, Liverpool, UK

The train line terminates within the facility and there is a railhead where trains will load and unload. This is part of the facility and would be included within the geofence as below.

https://www.bic-code.org/facility-codes/GBLIVRUIK

CN Intermodal, Memphis, USA

The rail siding runs through the facility but is used to load and unload containers so this should be considered part of the facility.

https://geofence-review.bic-code.org/view-pending-request/BIC/US8MIMKNB

Example 1 – Geofence overlapping a public road

Spinelli - Erzelli 2, Genoa, Italy

In the case of Spinelli - Erzelli 2, the geofence provided overlaps a public road which is not part of the facility. This is not acceptable as it will trigger events unnecessarily, the top left area of the facility needs to be redrawn to follow the fence line.

The facility is also located adjacent to a public road, so care should be taken to follow the fenced line of the facility carefully.

https://www.bic-code.org/facility-codes/ITGOAGRCA

Example 2 – Road Overpass

Everport Container Terminal, Los Angeles, USA

In the case of Everport Container Terminal (SMDG), there is an overpass that goes above the container storage area of the facility. This road is not part of the facility and is a main freeway; the depot stores containers underneath the overpass.

The road is on a different vertical axis to the facility so the boundary of the facility should be used rather than separating the road.

https://geofence-review.bic-code.org/view-pending-request/SMDG/USLAXETS

Boundary Rule Examples

Example 1 – Incomplete area of a facility

DIL Container Depot, Yangon, Myanmar

In the case of a geofence contributed for DIL Co (BIC) the geofence was incomplete and not reflective of the full facility. This is common where a contributed geofence is provided that maybe only covers a specific area within the facility for a customer or other reason.

For this level of granularity, it is recommended for their software or provider to make use of a nested geofence on top of the base facility from the geofence library, which then provides the link between the facility and the third party geofence.

Allowing the combination of the container position and the geofence(s) to provide the fact that the container is in the facility MMRGNVXCG and in (or out) of the reserved area for that customer.

https://geofence-review.bic-code.org/view-pending-request/BIC/MMRGNVXCG

The decision here is to re-draw the geofence to include the complete facility. The revised geofence is shown below.

Example 2 – SMDG Multiple Areas

Some facilities using a single code have multiple areas that will need to be geofenced even when they do not intersect with each other.

Leixoes Container Terminal, Leixoes, Portugal

The example below shows Leixoes Container Terminal, PT (SMDG). As there is 1 SMDG terminal code in use for both areas (a decision by the terminal to operate this way) there should be two geofences covering the areas including the berth as defined in SMDG boundary rules.

https://geofence-review.bic-code.org/view-pending-request/SMDG/PTLEITCLA

West Basin Container Terminal, Los Angeles, USA

Another Example for West Basin Container Terminal, Los Angeles, US (SMDG)

https://geofence-review.bic-code.org/view-pending-request/SMDG/USLAXWBCT
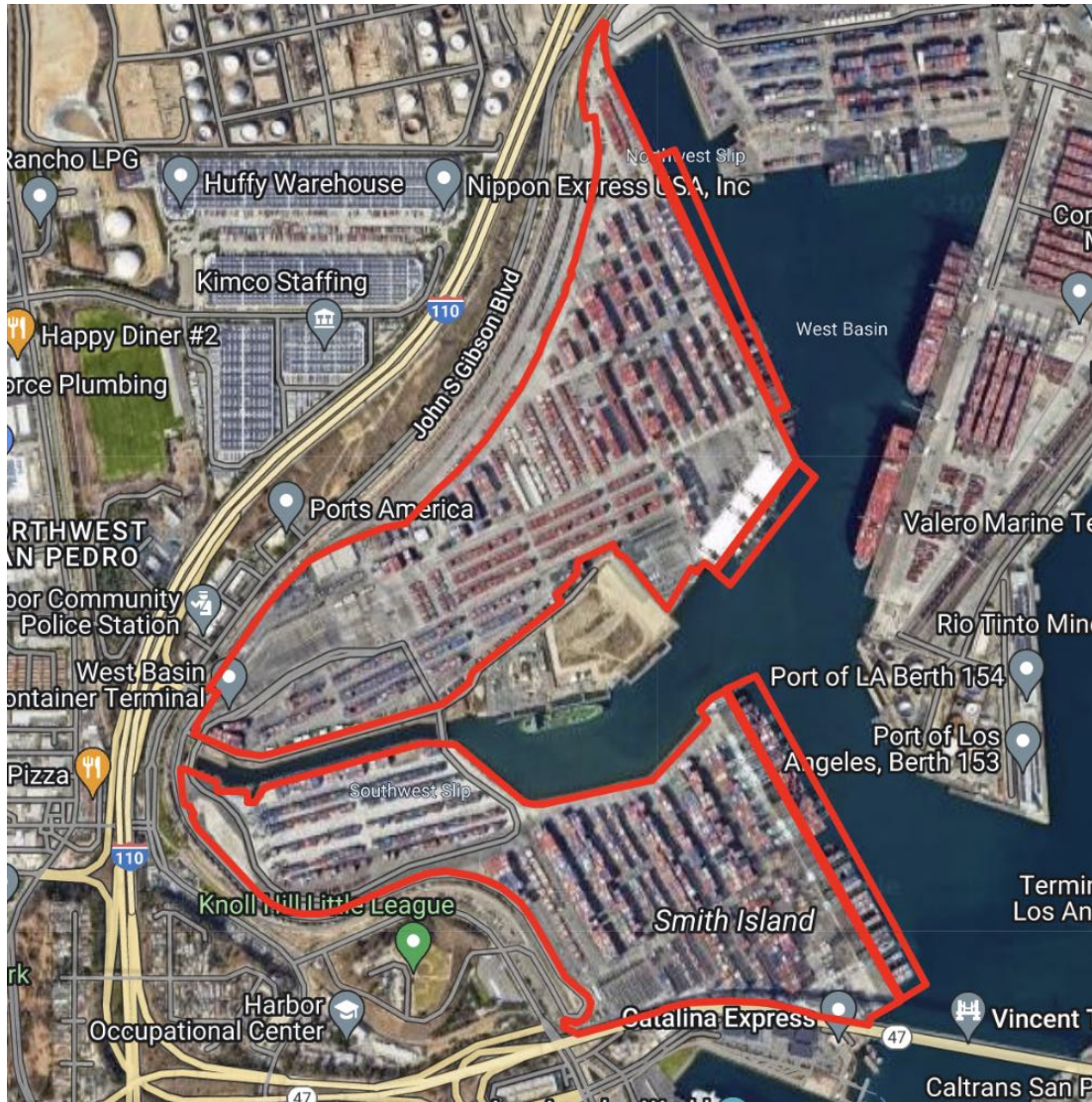
Gate Examples

Gates are important to identify the entry point into a facility, in most locations this will be the point at which the UN/EDIFACT CODECO message is triggered from to create a 'gate in' or 'gate out' event commonly found in track and trace, but also used to determine the turn time of vehicles within the facility, and trigger Equipment Interchange Receipt and on/off hire.

There are some points to consider when it comes to the gate,
1. The gate may be detached from the facility.
2. The gate may be well-defined and a clear point of entry.
3. The gate may be as simple as a line or cone.

The gate may also be contained within land operated by or on lease to the facility which may include a waiting area for trucks (the queue) so identification and attention should be considered around the gate.

For the base facility how to draw the geofence around the gate are suggested below, there is also the possibility to create a nested geofence specifically for the 'GATE' area to meet specific business requirements.

Fenix Marine Container Terminal, Los Angeles, USA

In the case of USLAXEAGLE (SMDG), the gate in and the truck queue are clearly identifiable from the satellite images, you can also see the trucks queuing to enter the facility, it is recommended where possible to draw the line crossing the gate area.

https://geofence-review.bic-code.org/view-pending-request/SMDG/USLAXEAGLE

Blue Container, Marseille, France

An example of where the 'GATE' is not clearly identifiable can be seen below at depot FRMRSKURI (BIC). In this case following the fenced area is recommended.

https://geofence-review.bic-code.org/view-pending-request/BIC/FRMRSKURI

Leixoes Container Terminal, Leixoes, Portugal

This facility in Portugal shows an example where the gate is part of a larger port area serving multiple terminals and container facilities. Roads leading off also service other facilities within the port area. In these cases, it is recommended to draw an outline of the gate area as a nested geofence and draw the facility by its physical boundary as that will determine the gate in event.

https://geofence-review.bic-code.org/view-pending-request/SMDG/PTLEITCLA

Drawing the 'GATE' as a nested geofence is a complex topic and whilst out of scope for this paper it is important to recognise some of the complexities that should be considered. Ultimately those drawing the nested geofence will need to decide on their business rules and use cases for the gate geofence.

For the terminal in Portugal, the gate area is a simple choice and there could be two views on this.

The first is to draw only the gate entry or exit as below. The centroid of the geofence would be good enough for driving directions, and the geofence is reflective of the physical gate area where a truck would present themselves and credentials to enter.

However, there could be consideration that the truck parking area should also form part of the 'GATE' as any vehicle that requires to show more paperwork or needs checks will need to wait there, so the other view is to include this area as it is part of the gate process.

Rotterdam Short Sea Terminal, Rotterdam, Netherlands

For a more complex case we look at the SMDG terminal Rotterdam Short Sea Terminal (RST) Southside, which has an OCR scanner in the internal area of the facility, followed by a larger parking area for holding trucks requiring checks and then a gate which is shared by multiple facilities. So, in this example it may suit to have an enlarged gate area to cover the complete gate entry process to suit business rules of the party using the geofence for a gate.

https://geofence-review.bic-code.org/view-pending-request/SMDG/NLRTMRSZ
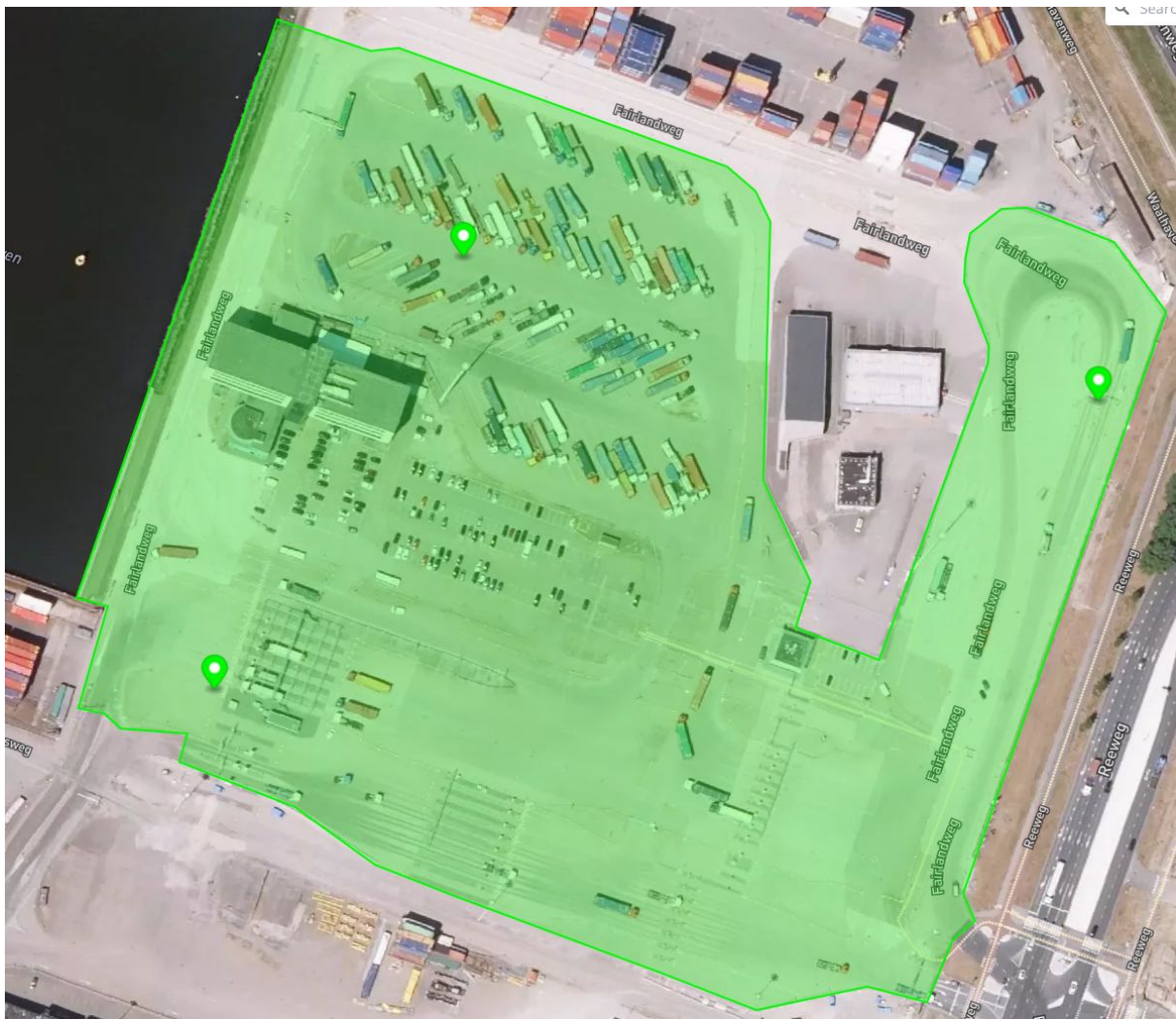
Truck Queue

The truck queue is defined as the area that trucks queue to enter a facility. Parts of the queue may be land owned by the facility, or they could be public roads. When drawing a geofence for a 'truck queue' related to a facility it is important that the end of the truck queue meets with the entry point or gate of the facility. It is only at this point that the truck is no longer queuing to enter a facility, and they have entered a facility, an important definition.

CSX Transportation, Fairburn, USA

https://geofence-review.bic-code.org/view-pending-request/BIC/USATLTDFV
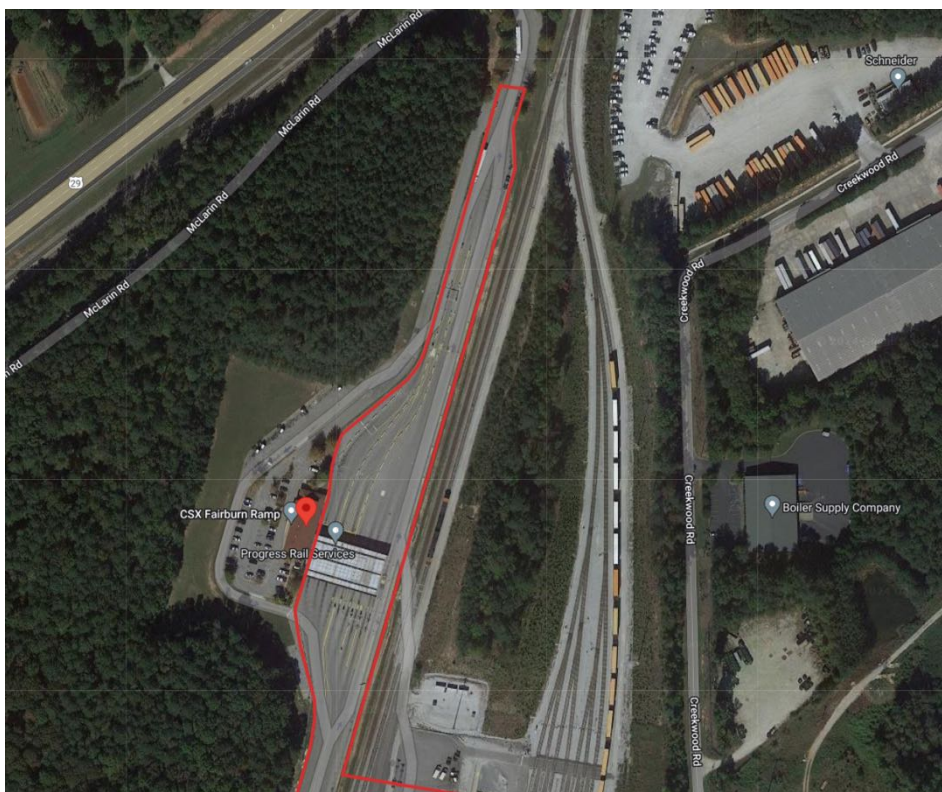
The area of land past the 'gate' toward the highway is owned by CSX, so it has been provided as part of the geofence for the facility.

It is recommended to exclude this area if providing a matching 'truck queue' as shown in the below example, clearly providing distinct geofences for the 'facility' (in red) and the 'truck queue' (in blue).

Structure of the Geofence Data

Geofences can be provided in many formats, for example:

- GeoJson
- KML
- GPX

For interoperability and comprehensive inclusion of facility metadata, we recommended to using GeoJson, this format is consumable by many tools and software platforms natively, the standard published under IETF RFC 7946, in addition the UN/CEFACT Smart Container BRS[6] also recommends using GeoJson for polygons, and accommodates in its data structures under Buy Ship Pay Reference Data Model. So sharing in this way should facilitate the interoperability of geofences. Use of formats to share such as CSV that require further processing prior to use should be avoided.

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[6] Annex 2 – Inputs for Smart Container Data Modeling

Publication of Geofences

When publishing the geofences they should be published with some meta data covering the following:
- Facility Code they relate to
- Facility Code Provider for identification
- Version of the geofence
- Geofence and type of shape

This could look like:

```
"properties": {
    "trustGrade": "LOCAL_KNOWLEDGE",
    "code": "GBLIVJMDA",
    "category": "FACILITY",
    "codeProvider": "BIC",
    "version": "2024-01-22",
    "url": "https://www.bic-code.org/facility-codes/gblivjmda/"
}
```

This allows preservation of the source of the geofence, and the same structure can be used to show nested data by changing the 'category' to identify what that specific geofence relates to i.e., queue, gate or other.

Facility Code and Code Provider
Identification of the facility using the coded identifier paired with the code list provider is important to provide the context of where a smart device is, and in which type of facility.

Category
The category identifies the type of facility, for the baseline facility 'FACILITY' is used, other category types can be found in the nesting section.

Version
The geofences should be versioned to provide an anchor in time, improving trust and confidence for the user. Use of the date adds value as its clear when the geofence was published, enabling the version to be used as a filter to sort and find earlier or later revisions.

URL
Optionally a URL to more detail could be included, this may be an anchor to the code list provider website, or to point at a URI to make use of linked data resources. Sometimes referred to as 'self'.

Id

Used to give an identifier for the geofence when multiple geofences form part of the collection i.e., berth areas or separated areas for the same facility. Could be a custom or automated identification system as outlined.

Geofence and Type of Shape

Each Facility should ideally provide 2 types of Geofence shapes,

- Point
- Polygon

The point should be a single latitude, longitude pair that provides an accurate point on a map to enable point to point routing and directions.

The Polygon is the most appropriate shape for facilities due to the geographic nature of a container facility or terminal. Use of other shapes such as circle or rectangle would generally not meet requirements and would likely lead to a rejection when passing the quality checks during a review process. All geofences should abide by the rules defined by the code list provider for what would be an acceptable geofence.

Downloading the Library

The library needs to be interoperable between tools, IoT providers and any actor in the supply chain with an interest in using the geofences. This can only be achieved by standardising the format in which the library can be accessed and imported, allowing those wishing to use the library to build a standardised import that can be updated with future releases and new versions.

Due to the large number of facilities globally for BIC, SMDG and IMO it is preferred to create a GeoJson file for each facility to facilitate easy processing and allow incremental version updates to be downloaded.

An example of this structure can be found at https://github.com/bic-org/Facility-Code/tree/master/geofencing/publish-example

Each file should be named by the facility code (i.e., DEHAMSWT or USLAXVNTU) and then the code list provider (BIC, SMDG or IMO), the contents will be a valid GeoJson Feature Collection with all geofence features contained within for that facility only, file format is '.json'

Example naming structure for files:

- DEHAMSWT-SMDG.json
- USLAXVNTU-BIC.json

Glossary

Term	Meaning
Circle (geometric shape)	A round-shaped figure that has no corners or edges. See https://vocabulary.uncefact.org/Circle
Geographic Coordinates	Also known as a latitude/longitude pair. Identifies a point on a map using the latitude and longitude. The coordinate reference system would be WGS84
GeoJson	https://geojson.org – Covers the standard for the Internet Engineering Task Force (IETF) under RFC 7946
IoT	Internet Of Things
Line	A single line between two latitude/longitude coordinates. See https://vocabulary.uncefact.org/GeographicalLine
Logistics Platform	A specialised area with the infrastructure and services required for co-modal transportation and added value services, where different agents coordinate their activities to benefit the competitiveness of the products making use of the infrastructure.
Point	A single latitude/longitude coordinate pair. See https://vocabulary.uncefact.org/GeographicalPoint
Polygon	A collection of latitude/longitude pairs used to create a shape. See https://vocabulary.uncefact.org/Polygon
Smart Device	A device that captures and transmits latitude/longitude position and other information, for example a smart container, IoT device or telematics in a truck.

References

The UN/CEFACT Smart Container paper contributed to the enrichment of the Buy-Ship-Pay reference data model providing the necessary data elements and structures required for geofences. This project builds upon that work https://unece.org/DAM/cefact/GuidanceMaterials/WhitePapers/WP-SmartContainers_Eng.pdf and also the Business Requirements Specification (BRS) https://unece.org/fileadmin/DAM/cefact/brs/BRS-SmartContainer_v1.0.pdf

Data Attributes and definitions used are taken from the Buy Ship Pay Reference Data Model, and are also available at https://vocabulary.uncefact.org/ The UN/CEFACT Web Vocabularies are linked data representations of the UN/CEFACT Buy-Ship-Pay Reference Data Model, UN/LOCODE and Sustainability.

The official specification for GeoJson can be found at https://geojson.org/

Appendix 1 – Unique Identification of Multiple Geofence Areas

One way to ensure easy and deterministic identification of each area – assuming the map is oriented such that the north points to exactly 0°, east 90°, south 180° and west 270° – would be to traverse the area fully encapsulating the geofence from left to right and top to bottom and number them according to the order in which they are met or intersected.

This approach works for any type of facility, for SMDG we would typically see a minimum of two geofences, to meet their criteria, for BIC it will be the case when a depot is separated by a road or rail line.

For illustration of how this can be achieved, viewing the facility Sud-West Terminal in Hamburg (DEHAMSWT) with a grid overview will demonstrate.

https://geofence-review.bic-code.org/view-pending-request/SMDG/DEHAMSWT

We now follow the approach to determine the most northwest point where a square intersects with the geofence, as in the below diagrams.
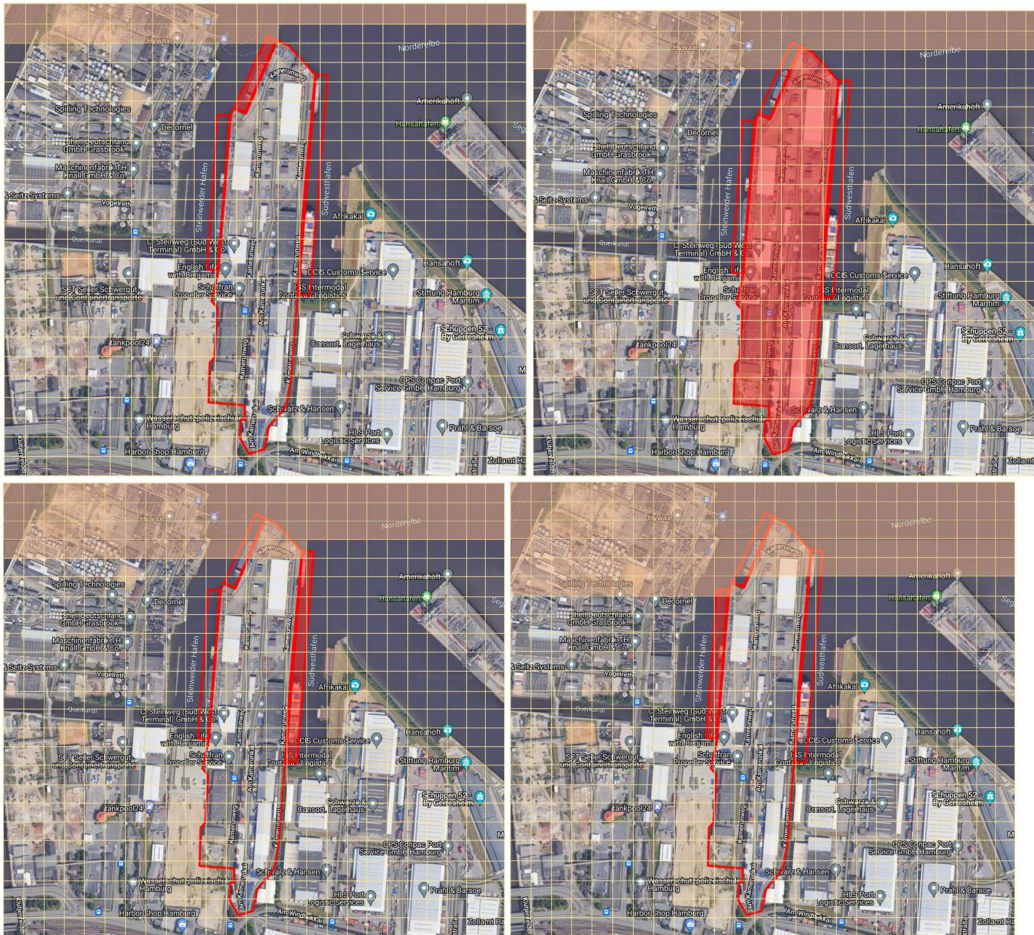
For each geofence we assign an 'id' in the properties section, for this facility there are four separate geofences and each would be assigned a numeric identifier, allowing automation of this identifier.

In the event of known labels being applied (i.e., berth numbers) they would ideally take precedence over an automated identifier.

The outcome of the above would look like this.