Annex II to the Invitation to Tender

Frontex/OP/1262/2018/RS

Terms of Reference

Purchase of the Transportation Network Spatial Vector Data along the EU external borders

1. Background Information

1.1. Risk analysis and supporting IT systems

Frontex, the European Border and Coast Guard Agency (hereinafter referred to as Frontex) was established by the Council Regulation (EC) Regulation (EU) 2016/1624 with a view to improve the integrated management of the external borders of the Member States of the European Union. Further information about Frontex can be found on the Agency's website www.frontex.europa.eu.

Among Frontex' key tasks are to conduct risk analysis, vulnerability assessment and situation monitoring. The situation at the EU external borders is continuosly monitored and analysed at the external Schengen air, land and sea borders. For this purpose, multiple types of information are integrated, analysed and visualized into Frontex systems and applications.

The IT systems used to compile, maintain and analyse the diferent sources of information are GIS centric and the information is displayed on top of background, static and dynamic, maps for analysis and situational awareness. These systems used in Frontex are mainly built on the Microsoft and ESRI technology stack but there are also open source solutions in Frontex.

This tender is a response to requirements collected from end users in Frontex and in the Member States to support:

- Defining EU Member States external land border sections that are more vulnerable to specific threats;
- According to the Common Integrated Risk Analysis Model (CIRAM) requirements:
  - Providing a description of each border section in the form of a permeability assessment, including its natural and border-crossing characteristics;
  - Highlighting those areas where surveillance is of the highest priority (hotspots) and areas where illegal or irregular activities might take place and additional surveillance might be needed;
- Defining geospatial indicators:
  - Communication Network Density;
  - Borderline Intersections;
  - Distance to borders;
  - Travel times (shortest, most probable, quickest, optimum) between defined start and destination points;
  - Least cost path for selecting various source/destination points;
- Connectivity network analysis:
  - Avenues of Approach (AoA): indicating possible "avenues" to approach the borderline.
  - Distance Analysis: a quantitative evaluation of the potential routes, employing least-cost path methodology. Examination of the source/destination points and the optimum route for crossing;
  - Route Analysis: detailed routing analysis for car, truck or pedestrian for a given set of source/destination points and the optimum route calculating;

1.2. Scope and deliverables

The required geograpihcal data is a set of High Resolution Transportation Network Vector Data which can be used for analyses and visualizations.

The Transportation Network Vector Data is understood as vector database which includes all types of transportation network information for vehicles and pedestrians regarding roads, railways, ferry connections and connectivity between them.

The Transportation Network Vector Data must have the following specification:

1.2.1. Description

1.2.1.1. Content

Data has to include the following feature types:

- Roads – Routes with a specially prepared surface that is maintained for use by motor vehicles and or pedestrians. Roads tend to have a smooth alignment with sharp, straight and well defined edges e.g. highways, motorways, streets, roads, trunks, primary and secondary roads, unpaved etc.
- Historical traffic data – historical data must store traffic flow information by day of the week and time of day in 15 minutes time bins. Historical traffic data should allow to be utilized by specifying start times when creating routes and result in different travel times for different day and week time. For example, routing through the city at 7:30 am on a weekday should take longer than routing through the city at midnight.
- Railways - all active railways for referencing information to road data.
- Ferry connections, active ferry connections with spatial defitinion of common standard routes.
- Database schema, editing templates and workflow documentation for adding new custom road features to original delivered Transportation Network Vector Data.

Data should model the multilevel crossings like overpasses, viaducts, tunnels etc.

Feature geometry and attributes values must represent and reflect the reality.

For delivered data the high-quality cartographic map display should be predefined.

1.2.1.2. Coverage

The spatial data of the total area of interest shall cover Europe continent, including a 25 km buffer outside the EU external land border in the neighbouring third countries. Exclusions may apply to African or Asia continent.

Annex 1 shows the EU Member States and Schengen Associated Countries and countries adjacent to the external borders of EU.

1.2.1.3. Precision and accuracy

- The reference mapping scale: 1:5 000 or more detailed.
- Absolute Horizontal Accuracy: 5 m or better.

1.2.1.4. Detailed geometry and attributes

Road data should include:

- Geometry elements: segments, junctions. Segments should represent the centreline of the road. In case of a divided road each route should be represented by its centreline.
- Minimum attributes assigned to geometrical segments as:
    - length in metres;
    - name;
    - road/route number;
    - functional road class (motorway, major road, secondary road, local road, small road, etc.);
    - one way (yes/no);
    - direction of traffic flow;
    - manoeuvres (bifurcations, permitted, priority, prohibited, restricted);
    - trucking restrictions (height, weight, length, width, hazmat and other loads, truck speed limits, truck specific manoeuvres, truck restricted);
    - speed class based on posted or legal speed (km/h);

- average driving travel time from the start to the end of the segment (min.);
- average driving travel time from the start to the end of the segment (min) for trucks;
- historical travel time speeds by day of the week and time of day in 15 minutes time bins;
- surface type (paved, unpaved, etc);
- construction status (open, closed to public use);
- ferry connections (yes, no);
- public road (yes, no);
- special restrictions (preferred pedestrian, stairs restriction, carpool road, express lane, controlled access, private or restricted);
- vehicle type-specific restrictions (taxi, public buses, automobiles, emergency vehicles, trucks, motorcycles);

Railways data should include:

- Geometry elements: segments
- Required attributes assigned to geometrical segments as:
  - length in metres;
  - official railway name/number;
  - railway type (railroad, subway, light rail);
  - construction information (bridge, tunnel).

Ferry connections data should include:

- Geometry elements: segments, junctions
- Required attributes assigned to geometrical segments:
  - length in metres;
  - connection name or number;
  - allowed vehicles (and type of vehicles) or passangers only;

Database schema templates for adding custom roads features must include:

- All necessary database schema elements required for keeping routing data consistency during adding new road features – feature classes, attribute schema, relations.
- Editing templates for adding custom road features by feature digitizing and feature edits.
- Workflow description and manual guide for compliant edits of custom roads features with original network data.

All attribute tables must be filled with English transliteration for non-latin charaters except for local name attribute if applied, and the first letter must be capitalized. All characters must be encoded in UTF-8 codepage.

It is not required but advisable for feature defition purposes to consult and follow the standards set: Multinational Geospatial Co-production Program (MGCP) standards and its Extraction Guidance TRD4 v4.0 – Thematic Category for Lines of Communication & Associated Features.

1.2.1.5. Delivery format
- Delivery format must be:
  - ESRI File Geodatabase with Network Dataset created and built,
  - mobile map package (MMPK) format.
- Delivery format should be ready to be published as ArcGIS Server geoprocessing routing service with no data preparation.

- Delivery format should include high-quality and multiscale cartographic map display of delivered data with presymbolized scale-dependent features, labels, and themes automatically turn on or off according to the zoom level selected.
- Data has to be out-of-box ready for displaying and routing in Desktop ArcGIS 10.5.1, ArcGIS Pro 2.2, and ArcGIS Enterprise 10.5.1 (with Network Analyst extension enabled).
- Data should be modelled in one global database schema for all countries.
- Roads, railways, and ferry connections segments data should be modelled as polylines.
- Data should be free of topological errors (e.g. null geometries, self-intersecting polylines).
- Endpoints of adjacent polylines have to be coincident if the elements are connected on the ground.
- Provider should allow for adding new features (geometry and attributes) to the source data and include them in network analysis. Once integrated, this data should allow to be used for seamlessly routing on both custom roads and commercial streets.
- For digitizing new road features, street network connectivity and attribute requirements should be automatically enforced through the use of editing templates delivered with the database schema templates.
- Delivered Network Dataset for Transportation Network Vector Data should allow to:
    - Find the quickest, shortest, the optimal route depending on the value chosen to solve for. Routes can accumulate any number of cost values such as distance, time or other flow attributes. Solve for just two stop locations, or sequence many stops in the best order.
    - Generate service areas - a region that can be reached from a location within a given travel time or travel distance.
    - Find closest facilities - measure the cost of traveling between incidents and facilities to determine which are nearest one to another. Specify how many to find, whether the direction of travel is toward or away, and other constraints like search cut-off thresholds.
    - Solve multi-vehicle routing problems - given a set of work locations and a fleet of vehicles, determine what stops should be serviced by each route and in what sequence the stops should be visited. The solution minimizes the overall operating cost for the entire fleet while considering defined business rules.
    - Perform location allocation - find the best location for defined action. A right location keeps costs low and accessibility high, for maximizing profit and high-quality service. The analysis takes into account facilities that provide goods and services, and where those good and services are consumed.
    - Create origin destination matrices - a distance table, with least-cost paths along the network from many origins to many destinations. The cost values reflect the network distance, not the straight-line distance.

1.2.1.6. Coordinate system

Coordinate system: ETRS89 or WGS84.

1.2.1.7. Metadata

Provide metadata in XML format, compliant with ISO 19115.

1.2.1.8. Maximum age

At least 60% of source data must be more recent than 1 January 2016.

1.2.1.9. Redistribution rights

Minimum redistribution rights required by Frontex are:

- Static and dynamic electronic maps;
- GIS feature services inside secured application for authorized users;
- GIS map services inside secured application for authorized users;
- Geoprocessing Network Analysis services inside secured application for authorized users;
- Data can be edited by indefinite number of Frontex' staff members;
- Hardcopy renditions that are plotted, printed, or publicly displayed (e.g. on the Internet network) as results of analysis of the road network dataset;
- Interactive products made of the road network dataset (not the original source data) are redistributable on the Internet inside secured application for authorized users;

1.2.1.10. Data maintenance

Tenderer shall provide the information if updates of the geometry and/or attributes of the data can be included in the offer.

1.2.2. Deliverable quality criteria

The tenderer must perform data quality control procedures before delivering the geodabase, based on ISO 19115. A quality data report must be provided jointly with the product delivery.

	Quality requirements
1	Vector data covers spatially all of the indicated area.
2	The precision and accuracy of the dataset meet the requirements
3	Data maximum source age meets the requirements (1.2.1.8)
4	Data feature classes meets the requirements (1.2.1.1)
5	Data format meets the requirements (1.2.1.5)
6	Data geometry and attributes meets the requirements (1.2.1.4)
7	Data coordinate system meets the requirements (1.2.1.6)
8	The data does not contain topology errors.
9	Metadata meets the requirements (1.2.1.7)
10	Detailed explanation on expected data source is given
11	Minimum redistribution rights required by Frontex meets the requeirments (1.2.1.9)
12	Proposal is compliant with the original data source licensing policy and does not violate any copyright or Intellectual Property Rights

1.3. Delivery timeframe

The Transportation Network Vector data sets shall be delivered within 20 weeks after the contract is in force. Where it is justified that due to a national law some permit(s) are to be obtained to cover specific areas, the delivery time of that specific data can be extended after a mutual written agreement between Frontex and the Contractor.
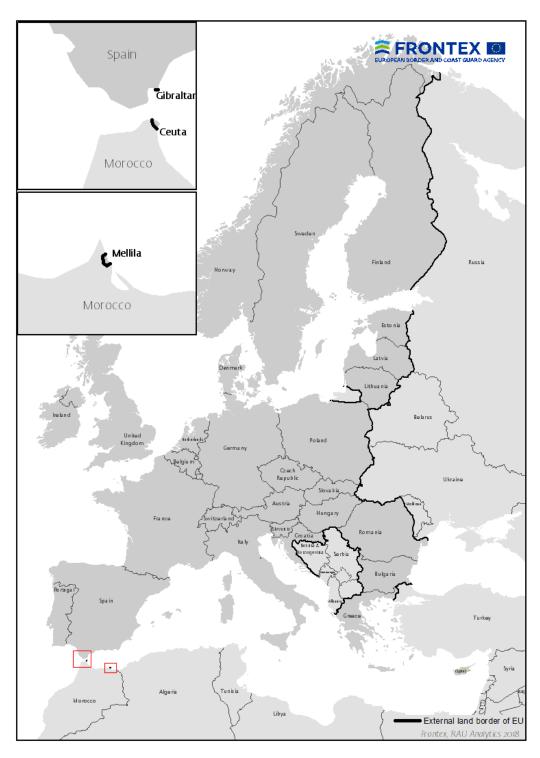
1.4. Acceptance Criteria

The deliverables shall meet the following acceptance criteria:

- All deliverables must meet the deliverable quality criteria set in 1.2.2.

The acceptance for the deliverable shall be confirmed by Model of Task/Deliverable Acceptance Form signed by Frontex Project Manager in Annex 2 .

Appendix 1 to the Terms of Reference

Map with the external land border of EU

Appendix 2 to the Terms of Reference

Model of Task/Deliverable Acceptance Form

Model of Task / Deliverable Acceptance Form

FOR SPECIFIC CONTRACT No ……

Original document - duly signed - to be attached to the invoice

TASK / DELIVERABLE DESCRIPTION:

PROVISIONAL ACCEPTANCE:

TASK / DELIVERABLE is ACCEPTED / REJECTED:

To be filled in by Frontex:

Official responsible for acceptance (in block capitals):	
Date and signature	
Official responsible for final validation (in block capitals):	
Date and signature	

Appendix 3 to the Terms of Reference

Minimum technical parameters:

Completeness					
1)	Vector data covers spatially all the indicated area?	Yes	☐	No	☐
2)	Absolute Horizontal Accuracy is up to 5 m?	Yes	☐	No	☐
3)	The reference mapping scale: 1:5 000 or more detailed?	Yes	☐	No	☐
4)	Coordinate system: ETRS89 or WGS84?	Yes	☐	No	☐
5)	The data delivered has at least 60 % of age younger or equal to 1 January 2016?	Yes	☐	No	☐
6)	Data includes the following feature types: Roads ; Railways; and Ferry connections.	Yes	☐	No	☐
7)	Data includes historical traffic flow information by day of the week and time of day in 15 minutes time bins?	Yes	☐	No	☐
8)	Data models the multilevel crossings like overpasses, viaducts, tunnels etc.	Yes	☐	No	☐
9)	Delivery format is ESRI File Geodatabase with Network Dataset created and built and Mobile Map Package MMPK?	Yes	☐	No	☐
10)	Data is out-of-box ready for displaying and routing in Desktop ArcGIS 10.5.1, ArcGIS Pro 2.2 and ArcGIS Enterprise 10.5.1 (with Network Analyst extension enabled)?	Yes	☐	No	☐
11)	Data is modelled in one global database schema for all countries?	Yes	☐	No	☐
12)	Data is delivered with high-quality and multiscale cartographic map display with presymbolized scale-dependent features, labels, and themes automatically turn on or off according to the zoom level selected?	Yes	☐	No	☐
13)	Roads, railways and ferry connections segments data are modelled as polylines?	Yes	☐	No	☐
14)	Data is free of topological errors (e.g. null geometries, self-intersecting polylines)?	Yes	☐	No	☐

15)	Endpoints of adjacent polylines are coincident if the elements are connected on the ground?	Yes	☐	No	☐
16)	Data allows addding new features (geometry and attributes) to the source data and rebuilding the network?	Yes	☐	No	☐
17)	Data is delivered with database schema and editing templates for digitizing new road features that enforce street network connectivity and attribute requirements?	Yes	☐	No	☐
18)	Delivered Network Dataset for Transportation Network Vector Data allow to find the quickest, shortest, the optimal route ?	Yes	☐	No	☐
19)	Delivered Network Dataset for Transportation Network Vector Data allow solve multi-vehicle routing problems ?	Yes	☐	No	☐
20)	Delivered Network Dataset for Transportation Network Vector Data allow perform location allocation ?	Yes	☐	No	☐
21)	Delivered Network Dataset for Transportation Network Vector Data allow to create origin destination matrices ?	Yes	☐	No	☐
22)	Road data should include minimum of 60% of the following attributes assigned to geometrical segments as: - length in metres; - name; - road/route number; - functional road class (motorway, major road, secondary road, local road, small road, etc.); - one way (yes/no); - direction of traffic flow; - manoeuvres (bifurcations, permitted, priority, prohibited, restricted); - trucking restrictions (height, weight, length, width, hazmat and other loads, truck speed limits, truck specific manoeuvres, truck restricted); - speed class based on posted or legal speed (km/h); - average driving travel time from the start to the end of the segment (min.); - average driving travel time from the start to the end of the segment (min) for trucks;	Yes	☐	No	☐

	- historical travel time speeds by day of the week and time of day in 15 minutes time bins; - surface type (paved, unpaved); - construction status (open, closed to public use); - ferry connections (yes, no), - public road (yes, no) - special restrictions (preferred pedestrian, stairs restriction, carpool road, express lane, controlled access); vehicle type-specific restrictions (taxi, public buses, automobiles, emergency vehicles, trucks, motorcycles);				

23)	Railway data should include minimum of 60% of the following attributes assigned to geometrical segments as:
	
	• Required attributes assigned to geometrical segments as:
	  - length in metres;
	  - official railway name/number;
	  - railway type (railroad, subway, light rail);
	  - construction information (bridge, tunnel).
		Yes	☐	No	☐

24)	Ferry connections data should include minimum of 60% of the following attributes assigned to geometrical segments as:
	
	• Required attributes assigned to geometrical segments as:
	  - length in metres;
	  - connection name or number;
	  - allowed vehicles (and type of vehicles) or passangers only;
		Yes	☐	No	☐

25)	Metadata in XML format, compliant with ISO 19115?	Yes	☐	No	☐
26)	Explanation on data source?	Yes	☐	No	☐
27)	Minimum redistribution rights required by Frontex ?	Yes	☐	No	☐
28)	Data is compliant with the original data source licensing policy and does not violate any copyright or Intellectual Property Rights?	Yes	☐	No	☐