Annex II to the Invitation to Tender

Frontex/OP/735/2018/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 was established in 2005 to assist both EU member states and other countries within the Schengen passport-free area in the management of their external borders and to bring greater consistency and harmonisation to the EU border control. The agency facilitates cooperation between border authorities by providing the necessary technical support and expertise available where and when it is needed. Frontex also promotes solidarity among the member states by coordinating assistance to those facing disproportionate pressures at their external borders.

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, trails, cart tracks, ferry connections and connectivity between them.

The Transportation Network Vector Data shall 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. 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.
- Railways - all active and inactive railways, standard and narrow gauge railroads.
- Trails (paths worn by the passage of people or animals, unmaintained, not sufficiently wide enough to accommodate four-wheeled vehicles or carts) bicycle roads, pedestrian paths etc.
- Cart-tracks -(Unimproved roads used by wheeled vehicles. With usually rough surface (for example: rutted) and minimally prepared (for example: packed earth or thinly covered with gravel). For example: forest roads, forest clearing ways for transmission towers , mountain routes.
- Ferry connections.

Data should model the multilevel crossings like overpasses, viaducts, tunnels etc.
Feature geometry and attributes values must represent and reflect the reality.

1.2.1.2. Coverage

The exact coverage will be disclosed to the awarded bidder only, however the following basic information is provided to allow for estimation of the services:

- The spatial data of the total area of interest width equal 50 km and shall include a 25 km buffer inside the EU countries with the external EU land border and a 25 km buffer in the neighbouring third countries. Annex 1 shows the countries adjacent to the external borders of EU.
- The estimated total area to be covered is approximately 345 000 sq km calculated in ETRS89 / LAEA Europe (EPSG:3035).

1.2.1.3. Precision and accuracy

- Within the indicated area the Transportation Network Vector Data should cover:
  - all the roads,
  - all the railways,
  - all the cart tracks,
  - all the trails equal or wider than 1 m.
  - for definitions see 1.2.1.1
- 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 must 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.

- Required attributes assigned to geometrical segments:
    - length in metres;
    - name (official name with English transliteration for non-latin charaters)
    - alternate name;
    - local name;
    - road/route number;
    - speed limits (km/h);
    - 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);
    - average speed of vehicles (km/h);
    - average driving travel time from the start to the end of the segment (min.);
    - surface type (paved, unpaved, etc);
    - road condition (good, poor, nearly impassable);
    - construction status (open, closed, under construction);
    - toll (yes/no);
    - road weather restriction (seasonal roads – closed during winter, etc);
    - special restrictions (residents, employees, authorized personnel, members only);
    - vehicle type-specific restrictions (taxi, public buses, residential, passengers only);
    - source description (indication of the source used to extract the features);
    - source date (feature acquisition date e.g. DD/MM/YYYY 10/02/2018) ;

Railways data must include:
- Geometry elements: segments, junctions
- Required attributes assigned to geometrical segments:
    - length in metres;
    - status (active/inactive);
    - official railway name/number;
    - railway type;
    - source description (indication of the source used to extract the features);
    - source date (feature acquisition date e.g. DD/MM/YYYY 10/02/2018) ;

Trails must include:
- Geometry elements: segments, junctions
- Required attributes assigned to geometrical segments:
    - length in metres;
    - source description (indication of the source used to extract the features);
    - source date (feature acquisition date e.g. DD/MM/YYYY 10/02/2018) ;

Cart tracks must include:
- Geometry elements: segments, junctions
- Required attributes assigned to geometrical segments:
    - length in metres;
    - width in meters;

- surface type (paved, unpaved, etc);
- source description (indication of the source used to extract the features);
- source date (feature acquisition date e.g. DD/MM/YYYY 10/02/2018) ;

Ferry connections data must include:

- Geometry elements: segments, junctions
- Required attributes assigned to geometrical segments:
  - length in metres;
  - opening period;
  - connection name or number;
  - allowed vehicles (and type of vehicles) or passangers only;
  - source description (indication of the source used to extract the features);
  - source date (feature acquisition date e.g. DD/MM/YYYY 10/02/2018) ;

All attribute tables must be filled with English transliteration for non-latin charaters exempt 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 should be an ESRI File Geodatabase with Network Dataset created and built.
- Data has to be out-of-box ready for displaying and routing in Desktop ArcGIS 10.5.1 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, trails, car tracks 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 rebuilding the network.
- The geodatabase must contain the following Feature Classes:
  - Road,
  - Railway
  - Trail,
  - Cart Track,
  - Ferry Conections
- 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 / LAEA Europe (EPSG:3035).

1.2.1.7. Metadata

Provide metadata in XML format, compliant with ISO 19115.

1.2.1.8. Maximum age

The maximum age of the source data shall be not more than 2 years (shall be more recent than the 1st of June 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 (1.2.1.3)
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)
13	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.

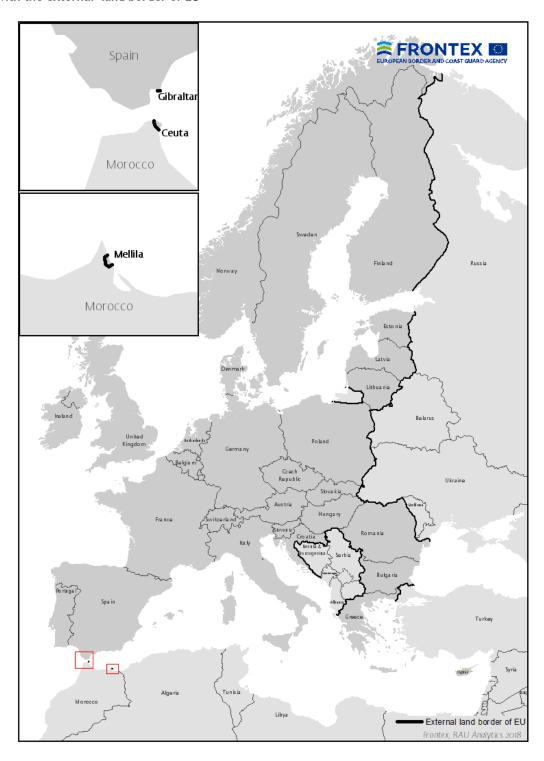## 1.4.   Acceptance Criteria

The deliverables shall meet the following acceptance criteria:

- All deliverables must meet the deliverable quality criteria set in 1.2.2.
- All deliverables must meet the following criteria based on completeness of data and age:
    - The data delivered shall have 60 % of age younger or equal to 1 of January of 2018
    - The data delivered shall have 60 % of attributes described in 1.2.1.4 filled in with values that reflect the reality. Attrbitues as "Null", "Not applicable", "Unknown" and "Other" or any other with similar sense shall not be considered as filled.

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 of the Terms of Reference

Map with the external land border of EU

Appendix 2 of 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	

Checklist					
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 / LAEA Europe (EPSG:3035)?	Yes	☐	No	☐
5)	Is data more recent than the 1st of June 2016?	Yes	☐	No	☐
6)	Data includes the following feature types: Roads ; Railways ;Trails ;Cart-tracks and Ferry connections.	Yes	☐	No	☐
7)	Data models the multilevel crossings like overpasses, viaducts, tunnels etc.	Yes	☐	No	☐
8)	Delivery format is ESRI File Geodatabase with Network Dataset created and built?	Yes	☐	No	☐
9)	Data is out-of-box ready for displaying and routing in Desktop ArcGIS 10.5.1 and ArcGIS Enterprise 10.5.1 (with Network Analyst extension enabled)?	Yes	☐	No	☐
10)	Data is modelled in one global database schema for all countries?	Yes	☐	No	☐
11)	Roads, railways, trails, car tracks and ferry connections segments data are modelled as polylines?	Yes	☐	No	☐
12)	Data is free of topological errors (e.g. null geometries, self-intersecting polylines)?	Yes	☐	No	☐
13)	Endpoints of adjacent polylines are coincident if the elements are connected on the ground?	Yes	☐	No	☐
14)	Data allows addding new features (geometry and attributes) to the source data and rebuilding the network?	Yes	☐	No	☐
15)	Delivered Network Dataset for Transportation Network Vector Data allow to find the quickest, shortest, the optimal route ?	Yes	☐	No	☐

16)	Delivered Network Dataset for Transportation Network Vector Data allow solve multi-vehicle routing problems ?	Yes	☐	No	☐
17)	Delivered Network Dataset for Transportation Network Vector Data allow perform location allocation ?	Yes	☐	No	☐
18)	Delivered Network Dataset for Transportation Network Vector Data allow to create origin destination matrices ?	Yes	☐	No	☐
19)	Road data includes geometry elements: segments, junctions?	Yes	☐	No	☐
20)	Roads attributes assigned to geometrical segments are: - length in metres; - name (official name with English transliteration for non-latin charaters) - alternate name; - local name; - road/route number; - speed limits (km/h); - 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); - average speed of vehicles (km/h); - average driving travel time from the start to the end of the segment (min.); - surface type (paved, unpaved, etc); - road condition (good, poor, nearly impassable); - construction status (open, closed, under construction); - toll (yes/no); - road weather restriction (seasonal roads – closed during winter, etc); - special restrictions (residents, employees, authorized personnel, members only); - vehicle type-specific restrictions (taxi, public buses, residential, passengers only);	Yes	☐	No	☐

	- source description (indication of the source used to extract the features); - source date (feature acquisition date e.g. DD/MM/YYYY 10/02/2018) ?						
21)	Railways data includes geometry elements: segments, junctions?	Yes	☐		No	☐	

22)	Railways attributes assigned to geometrical segments are:
	    - length in metres;
	    - status (active/inactive);
	    - official railway name/number/;
	    - railway type;
	    - source description (indication of the source used to extract the features);
	    - source date (feature acquisition date e.g. DD/MM/YYYY 10/02/2018) ?
		Yes	☐		No	☐	

23)	Trails data includes geometry elements: segments, junctions?	Yes	☐		No	☐	

24)	Trails attributes assigned to geometrical segments are:
	    - length in metres;
	    - source description (indication of the source used to extract the features);
	    - source date (feature acquisition date e.g. DD/MM/YYYY 10/02/2018) ?
		Yes	☐		No	☐	

25)	Cart tracks data includes geometry elements: segments, junctions?	Yes	☐		No	☐	

26)	Cart tracks attributes assigned to geometrical segments are:
	    - length in metres;
	    - width in meters;
	    - surface type (paved, unpaved, etc);
	    - source description (indication of the source used to extract the features);
	    - source date (feature acquisition date e.g. DD/MM/YYYY 10/02/2018) ;
		Yes	☐		No	☐	

27)	Ferry connections data includes geometry elements: segments, junctions?	Yes	☐		No	☐	
28)	Ferry connections attributes assigned to geometrical segments are:	Yes	☐		No	☐	

	- length in metres; - opening period; - connection name or number; - allowed vehicles (and type of vehicles) or passangers only; - source description (indication of the source used to extract the features); - source date (feature acquisition date e.g. DD/MM/YYYY 10/02/2018)?				
29)	Metadata in XML format, compliant with ISO 19115?	Yes	☐	No	☐
30)	Detailed explanation on expected data source?	Yes	☐	No	☐
31)	Minimum redistribution rights required by Frontex ?	Yes	☐	No	☐
32)	Data is compliant with the original data source licensing policy and does not violate any copyright or Intellectual Property Rights?	Yes	☐	No	☐
33)	The data delivered has at least 60 % of age younger or equal to 1 of January of 2018 ?	Yes	☐	No	☐
34)	The data delivered has at least 60 % of attributes filled in with values that reflect the reality?	Yes	☐	No	☐