The action is agreed with the **Innovation and Networks Executive Agency (INEA) Department C - Connecting Europe Facility (CEF)**.

The action aim is to contribute to the implementation of the comprehensive network, horizontal priority: Telematic applications systems for road (ITS), and on the core network Corridors: **Orient/East-Med, Rhine-Danube**.
ITS (Intelligent Transport Systems) are being applied to facilitate mobility, make better use of existing infrastructure, improve safety and help mitigating negative environmental impacts. Deployment of ITS is also motivated by the increased difficulty of expanding transportation capacity through conventional infrastructure building.

Romanian TEN-T network is seriously affected by natural risks such as landslides, torrential erosion, rock falls, avalanches, floods and heavy snow. These natural hazards lead to numerous road accidents which cause important casualties and material losses every year.

The overall objective of the action is to improve traffic safety and reduce congestion of the Romanian road Core network by putting in place a compatible, accessible and interoperable intelligent transportation system (ITS) that will provide traffic and travel information services.
Geomorphological and meteorological risk

Legend
TEN-T Network
Corridor
- TEN-T Comprehensive
- TEN-T Core
Geomorphological process
- Landslides and torrential erosion
- Floods and heavy snow
- Rock falls and avalanches
The first specific objective is to contribute to the accessibility of interoperable accurate road and traffic safe-related data across the EU.

This objective will be met by identifying and characterising the list of risks that can affect road transportation, through the identification of the corresponding data sources in line with and by making data available in a standardised format across Europe and in neighbouring countries through a national access point that will consist on an interoperable application module designed, set-up and made available via web and mobile.
The second specific objective is to contribute to reducing the number of accidents, transport time and fuel consumption in the Romanian TEN-T Core network by providing real-time safety-related traffic information services to road users via well-functioning web and mobile applications.

These services will cover information on a wide range of risks and will be easily accessed by the general public using various devices, including smartphones, tablets and laptops.

This objective will be met through the design and the implementation of a cloud-based back-end platform, a cloud-based web application and some mobile applications for the most popular Operating Systems which will provide real-time safety-related traffic information services to road users.
A testing and validation process will be carried out so as to ensure that the web and mobile applications have been designed in compliance with the identified data sources and risks and implemented in line with the applications design.

The web and mobile applications will be fine-tuned on the basis of the user's feedback collected through dedicated forms as well as from the comments posted in the application stores.

A software development firm will be contracted via a public procurement procedure for the design, the development and fine-tune of the back-end platform, the web and the mobile applications.
The third specific objective is to inform the road users, ITS service providers and road users about the results of this Action.

This objective will be met by designing and implementing an Information and Advertising Campaign.
On December 1st 2015, on the DN7 national road (Olt Valley, Core Network) it was a minor accident (without casualties).

The accident led to block traffic in both directions.

The accident was caused by falling rocks which broke away from the slopes (2200 m³). In order to increase the road safety, the National Company of Motorways and National Roads in Romania (CNAIR).

Thus, several hundreds of vehicles including dozens of cargo transport truck were blocked on the Olt Valley.

After several hours of waiting and an assessment of CNAIR specialists, it was decided to redirect the traffic on an alternative route.
Three scenarios

The case study was developed for a charged truck on the Nădlac (Romania - Hungary border) - port of Constanta on the Black Sea route. The analyzed vehicle has 40 tones mass, 5 axes, emission class Euro 5 and has green pollution permits.

Three scenarios were simulated:

- **A scenario** – Transport by truck to a normal situation

- **B scenario** – Truck transport without the benefit of accident alert along its route (Scenario without the project) – present situation

- **C scenario** – Truck transport with the benefit of alert along its route (project scenario) – results from CEF projects.
In a *normal situation* (without route incident), the truck route linking Nadlac to Constanta it is 834 km: Nădlac – Arad – Timișoara – Lugoj – Deva – Sibiu – Rm.Vâlcea – Pitești – București – Constanța.

For *A scenario* were determined the following parameters:

<table>
<thead>
<tr>
<th>Route length (km)</th>
<th>Journey time</th>
<th>Fuel Consumption (litres)</th>
<th>Average consumption (litres)</th>
<th>Total Fuel Cost (Euro)</th>
<th>CO2 (kg)</th>
<th>NOx (g)</th>
<th>N2O (g)</th>
<th>CH4 (g)</th>
</tr>
</thead>
<tbody>
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<td>15h 38’</td>
<td>321</td>
<td>38.5</td>
<td>319.6</td>
<td>849</td>
<td>3352</td>
<td>49</td>
<td>1.92</td>
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</tbody>
</table>
• Accident image 2
Truck transport without the benefit of accident alert along its route (Scenario without the project)
In the event that **an incident occurs on the truck route** (Nadlac to Constanta Port), the route is rerouting after arriving at the incident and analyzing the situation. In this scenario, the route is: Nădlac – Arad – Timișoara – Lugoj – Deva – Sibiu – Brezoii – incident location – Brezoii – Sibiu – Brașov – Predeal – Câmpina – Ploiești – București – Cernavodă – Constanța. The route length has 979 km, 145 km 14 more than the A scenario.

### Emissions

<table>
<thead>
<tr>
<th>Route length (km)</th>
<th>Journey time</th>
<th>Fuel Consumption (litres)</th>
<th>Average consumption (litres)</th>
<th>Total Fuel Cost (Euro)</th>
<th>CO2 (kg)</th>
<th>NOx (g)</th>
<th>N2O (g)</th>
<th>CH4 (g)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>19h 09'</td>
<td>387.7</td>
<td>39.6</td>
<td>386.0</td>
<td>1023</td>
<td>4050.6</td>
<td>57.6</td>
<td>2.27</td>
</tr>
</tbody>
</table>
Truck transport with the benefit of alert along its route (project scenario)
In the chase that the *truck driver is alerted by the application*, the route is redirected before arriving at accident. Thus, the route will be as follows: Nădlac – Arad – Timișoara – Lugoj – Deva – Sibiu - Brașov – Predeal – Câmpina – Ploiești – București – Cernavodă – Constanța. The route has 870 km. In this case, it will be 109 km less then B Scenario and just 36 km more than A Scenario.

<table>
<thead>
<tr>
<th>Route length (km)</th>
<th>Journey time</th>
<th>Fuel Consumption (litres)</th>
<th>Average consumption (litres)</th>
<th>Total Fuel Cost (Euro)</th>
<th>CO2 (kg)</th>
<th>NOx (g)</th>
<th>N2O (g)</th>
<th>CH4 (g)</th>
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<td>335</td>
<td>38.5</td>
<td>333.5</td>
<td>884</td>
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<td>2</td>
</tr>
<tr>
<td>Route length (km)</td>
<td>Journey time</td>
<td>Fuel Consumption (litres)</td>
<td>Average consumption (litres)</td>
<td>Total Fuel Cost (Euro)</td>
<td>CO2 (kg)</td>
<td>NOx (g)</td>
<td>N2O (g)</td>
<td>CH4 (g)</td>
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<td><strong>A scenario</strong></td>
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<td><strong>B scenario</strong></td>
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<tr>
<td>979</td>
<td>19h 09'</td>
<td>387.7</td>
<td>39.6</td>
<td>386.0</td>
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<td>4050.6</td>
<td>57.6</td>
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<td><strong>C scenario</strong></td>
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<tr>
<td>870</td>
<td>16h 28</td>
<td>335</td>
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<td>884</td>
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</table>

### B scenario vs. C scenario

<table>
<thead>
<tr>
<th>Difference between Scenario B and Scenario C</th>
<th>Route length (km)</th>
<th>Journey time</th>
<th>Fuel Consumption (litres)</th>
<th>Average consumption (litres)</th>
<th>Total Fuel Cost (Euro)</th>
<th>CO2 (kg)</th>
<th>NOx (g)</th>
<th>N2O (g)</th>
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<tr>
<td>Procent (%)</td>
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<td>52.5</td>
<td>139</td>
<td>527.9</td>
<td>6.6</td>
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</table>

- Procent (%)
- Difference between Scenario B and Scenario C
EARLY WARNING INTELLIGENT SYSTEM FOR ROAD TRANSPORTATION RISKS

Users (smarphone, web)

Management (IGSU, MT, CNAIR)

Project Team

National Meteorological Administration
- Coduri meteorologice
- Avertizări nowcasting

General Inspectorate for Emergency Situations
- Accidente rutiere

National Company for Road Infrastructure Administration
- Drumuri cu circulație inchisa
- Drumuri cu circulație ingreunata
- Drumuri in lucru
- Identificarea riscurilor geomorfologice (alunecari, inzapeziri, inundatii)
- Puncte de interes (benzinării, parcari)
### Activity 2 - Identification of the data sources

<table>
<thead>
<tr>
<th>Nr. crt.</th>
<th>Data / information source</th>
<th>Total number of event categories or risk generating conditions provided</th>
<th>The share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1-</td>
<td>-2-</td>
<td>-3-</td>
<td>-4-</td>
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<tr>
<td>1.</td>
<td>ANM¹ - National Meteorological Administration</td>
<td>9</td>
<td>18,7</td>
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<tr>
<td>2.</td>
<td>CNAIR² - National Company for Road Infrastructure Administration</td>
<td>7</td>
<td>14,6</td>
</tr>
<tr>
<td>3.</td>
<td>IGPR³ - The General Inspectorate of Romanian Police</td>
<td>4</td>
<td>8,3</td>
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<tr>
<td>4.</td>
<td>IGSU⁴ - General Inspectorate for Emergency Situations</td>
<td>2</td>
<td>4,2</td>
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<tr>
<td>5.</td>
<td>PT⁵ = Project team</td>
<td>26</td>
<td>54,2</td>
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<td>48</td>
<td>100</td>
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</table>
## Agreements concluded

<table>
<thead>
<tr>
<th>No. crt.</th>
<th>Data / information source</th>
<th>providing data / information method</th>
<th>Protocol</th>
</tr>
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<tbody>
<tr>
<td>-1-</td>
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</tr>
<tr>
<td>1.</td>
<td>ANM¹ - National Meteorological Administration</td>
<td>- File Transfer Protocol (FTP)</td>
<td>signed</td>
</tr>
</tbody>
</table>
| 2.       | CNAIR² - National Company for Road Infrastructure Administration | - WEB services,  
- File Transfer Protocol (FTP)  
- Application Programming Interface (API)  
- other available means | signed   |
| 3.       | IGPR³ - The General Inspectorate of Romanian Police |                                     | Under discussion |
| 4.       | IGSU⁴ - General Inspectorate for Emergency Situations | - WEB services,  
- File Transfer Protocol (FTP)  
- Application Programming Interface (API)  
- other available means | signed   |
| 5.       | IP⁵ = Project team         | - GIS data                          | n/a      |

**Notes:**
- ANM¹: National Meteorological Administration
- CNAIR²: National Company for Road Infrastructure Administration
- IGPR³: The General Inspectorate of Romanian Police
- IGSU⁴: General Inspectorate for Emergency Situations
- IP⁵: Project team
3. Collection / acquisition of data / information

<table>
<thead>
<tr>
<th>No. crt.</th>
<th>Event classes or risk generating conditions</th>
<th>Categories of events or conditions generating risk</th>
<th>data / information source</th>
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</thead>
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<td>1.</td>
<td>Meteorological risks</td>
<td>- low temperature (frost)</td>
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<td>- veneer</td>
<td>ANM¹</td>
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<tr>
<td></td>
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<td>- fog</td>
<td>ANM¹</td>
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<tr>
<td></td>
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<td>- heat</td>
<td>ANM¹</td>
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<tr>
<td></td>
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<td>- precipitations</td>
<td>ANM¹</td>
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<td>- hunderstorm phenomena</td>
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<td>- wind</td>
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<td></td>
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<td>- blizzard</td>
<td>ANM¹</td>
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<tr>
<td></td>
<td></td>
<td>- snow</td>
<td>ANM¹</td>
</tr>
<tr>
<td>2.</td>
<td>Hydrological risks</td>
<td>- sectors exposed to floods</td>
<td>EP⁵</td>
</tr>
</tbody>
</table>
3. Collection / acquisition of data / information

| 3. | Geomorphological risks | - landslide  
|    |                        | - rockfall  
|    |                        | - deposition of sediments | CNAIR², PT ⁵  
|    |                        |                            | CNAIR², PT ⁵  
|    |                        |                            | CNAIR², PT ⁵  

| 4. | Morphology / road features related risks | - slippery road  
|    |                                   | - sinuous road (succession of curves)  
|    |                                   | - curve  
|    |                                   | - slope / ramp  
|    |                                   | - narrow road  
|    |                                   | - multiple lanes in each direction  
|    |                                   | - rail crossing | PT ⁵  
|    |                                   |                            | PT ⁵  
|    |                                   |                            | PT ⁵  
|    |                                   |                            | PT ⁵  

| 5. | Road-related risks | - road work  
|    |                    | - bumpy road  
|    |                    | - state marks | CNAIR², EP⁵  
|    |                    |                            | PT ⁵  
|    |                    |                            | PT ⁵  


### 3. Collection / acquisition of data / information

| 6. Traffic characteristics related risks | - traffic lights  
- zebra crossing  
- roundabout  
- continuous line  
- speed limitation  
- crowded road  
- animal warning  
- warning related to pedestrians  
- warning related to bicycles  
- speed limitation  
- accident  
- locality  
- road closed to traffic  
- Alternative circulation on a single band  
- high-frequency road accidents | PT⁵  
PT⁵  
PT⁵  
PT⁵  
PT⁵  
PT⁵  
PT⁵  
PT⁵  
PT⁵  
CNAIR², IGPR³, IGSU⁴  
EP⁵  
CNAIR², IGPR³  
CNAIR², IGPR³  
PT⁵, IGPR³, IGSU⁴ |
Progress on obtaining data
<table>
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<tr>
<th>Ora</th>
<th>observații</th>
<th>limita viteza</th>
<th>parcare</th>
<th>Linie continuă</th>
<th>Sens giratoriu</th>
<th>Trecere de pietoni</th>
<th>Curba</th>
<th>Drum sinuos (succesiune de curbe)</th>
<th>Drum alunejos</th>
<th>Drum cu denivelări</th>
<th>Căderi de pietre</th>
<th>Alunecări de teren</th>
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</tbody>
</table>
Aerial image capturing
Aerial image capturing (into problematic road sectors)
Point cloud obtained (on the road sector with landslides)
3D modelling (on the road sector with landslides)
Mapping

In order to identify the road network characteristics and for obtaining a good positioning of the elements, photographs were taken and GPS measurements were made.
Very detailed Digital Elevation Model (into problematic road sector)
Aerial ortophoto created by project team (into problematic road sector)
Aerial ortophoto created by project team (into problematic road sector)
Means of verification / Milestones

- **M1** Start of the Road transportation sizing – 01.08.2017
- **M2** – Completion of the Road transportation sizing - 31.03.2018
- **M3** – 01.11.2017 – Start of the identification of the data sources
- **M4** – Data sources identified – 30.04.2018
- **M5** – Public tender launched – 15.11.2018
- **M6** – Start of the back-end platform and applications architecture design
- **M7** – Completion of the back-end platform and applications architecture design
- **M8** – Back-end platform deployed on the chosen cloud environment
- **M9** – Web application developed
Our vision – crossborder early warning system
Thank you

17 October 2018