TN-ITS GO; IRELAND'S STEPS TOWARDS A HARMONISED EUROPEAN SERVICE FOR FRESH AND ACCURATE ROAD-NETWORK MAP DATA.

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ABSTRACT

In January 2018, TN-ITS GO was launched in Ireland, and in 15 other EU states, in the second stage of research and development into a European wide service to link road agencies, organisations and operators with the mapmakers. The core objective is to enable a service that will make fresh, accurate and important map data available to intelligent transport services at all times. Various elements of this project are building on previous work that, for example, introduced a European wide Road-Data Standard, Rosetta, where it is being used, developed and matured by iterative involvement by various mapmaker stakeholders and more and more EU states that are working towards its implementation. Principally, TN-ITS wishes to facilitate and foster the exchange of ITS-related spatial road data between road authorities, as trusted data providers, and data users, such as map makers and other parties. TN-ITS is concerned with the exchange of information on changes in static road attributes. Static meaning that the attributes are of a more or less permanent nature, even though they may sometimes change, such as speed limits.

It is important that digital maps for ITS are highly up to date for attributes that are critical in terms of safety and efficiency. The map providers cannot easily keep their maps up to date for such attributes, while up-to-date maps are and will be a key asset for existing and future ITS applications, especially Autonomous Vehicle technology. One solution is to retrieve the information on changes from the road authorities as they are typically empowered to enact and make such changes. As they create the changes, they are the most efficient and immediate source for such information. This requires digital storage and maintenance on the side of road authorities, and some kind of flagging of changes.

Towards this, in 2017, Ireland became one of 7 EU states to get involved in the initial prototype implementation of a TN-ITS service for Europe. At this projects conclusion a prototype road-network data update platform had been developed that could serve out attribute changes to the TN-ITS standard for mapmaker consumption. This project and its prototype outputs was only possible because of the significant help and provision of data by Transport Infrastructure Ireland (TII), with TEN-T data; the Local Government Management Agency (LGMA), with Galway and Monaghan data; and with important input on legislation, licensing and state-of-the-art status from

Ordnance Survey Ireland, National Transport Authority and the Department of Transport, Tourism and Sport.

1. Introduction

1.1   Background

TN-ITS is the Transport Network ITS Spatial Data Deployment Platform. Its mission is to provide support to Member States and ITS map providers for the implementation of the Commission Delegated Regulation (EU) 2015/962, supplementing the ITS Directive (2010/40/EU), for the elements related to static road data. The purpose of this sub-activity is to advance this implementation in each involved Member State by setting up pilot or live services for any or all of the roads networks, particularly the main corridors and preferably those that are the focus of the corridor projects.

A main goal is to make the data of the TN-ITS pilot service in each EU Member State available through the national access point, if it exists, or to contribute to setting up such a national access point. For this, the sub-activity will liaise and closely cooperate with the sub-activity 4.6, "Monitoring and Harmonisation of Single Point of Access" (which will support the implementation of national access points of member states to make spatial road data searchable for users). To this purpose, where relevant, partners in sub-activity 4.7 will participate in the workshops organised within the scope of sub-activity 4.6. The implementations will also serve to demonstrate to other Member States involved in the EU EIP, but not directly in this sub-activity, the feasibility and value of setting up a TN-ITS service.

The sub-activity will also closely liaise with the INSPIRE community (JRC, ELF project) and will build on and further extend the experience gained in the Transportation Pilot, a successful joint collaborative endeavour between the TN-ITS and INSPIRE communities, which was running for one year from September 2015, and included both TN-ITS implementation efforts in Norway and Sweden, and exploration of the use of INSPIRE data through the ELF platform, especially for solving difficult cases of TN-ITS updates in terms of failing interpretation of the location code in the update message.

1.2   Roadmap towards TN-ITS GO

The TN-ITS Roadmap, to the point where this TN-ITS GO project was launched, involved Ireland and 4 other EU Member States piloting a basic TN-ITS implementation. In each of the five Member States they addressed a limited set of attributes and route corridors, to gain experience for future further roll-out of the service to the comprehensive network, and to get a thorough understanding of;

(1) how the service can be modelled in relation to the existing infrastructure for storing spatial road data; and

(2) which enhancements may be needed for the existing infrastructure to better accommodate the intended service.

It was also used to investigation existing procedures for the instantaneous updating of the stored spatial road data for changes in the real world on a Member State basis. This was then used to fully understand the state-of-the-art and inform the EU on a country by country basis on what the real-time TN-ITS roll-out requirements and challenges will be going forward.

2. Ireland State-of-the-Art for TN-ITS GO

2.1   Road Network Management in Ireland

The operation and management of the public road network in Ireland is the responsibility of a number of state organisations that comprises the Department of Transport, Tourism and Sport (DTTAS), Transport Infrastructure Ireland (TII) and the various Local Authorities (LA). DTTAS provide, within the framework of a balanced and integrated transport policy, for the safe, efficient and cost effective movement of persons and goods by road. As such they have the ultimate responsibility and oversight in legislative and policy terms towards the roles of those agencies charged with specific Roads roles. TII operate and manage the National Primary and Secondary road network which accounts for 7,959 km's on the network, about 8% of the network, which also carries about 40% of the network traffic. The rest is operated and managed by the LA's for their respective regional and local road networks, these account for about 90,572 km's or 92% of the network.
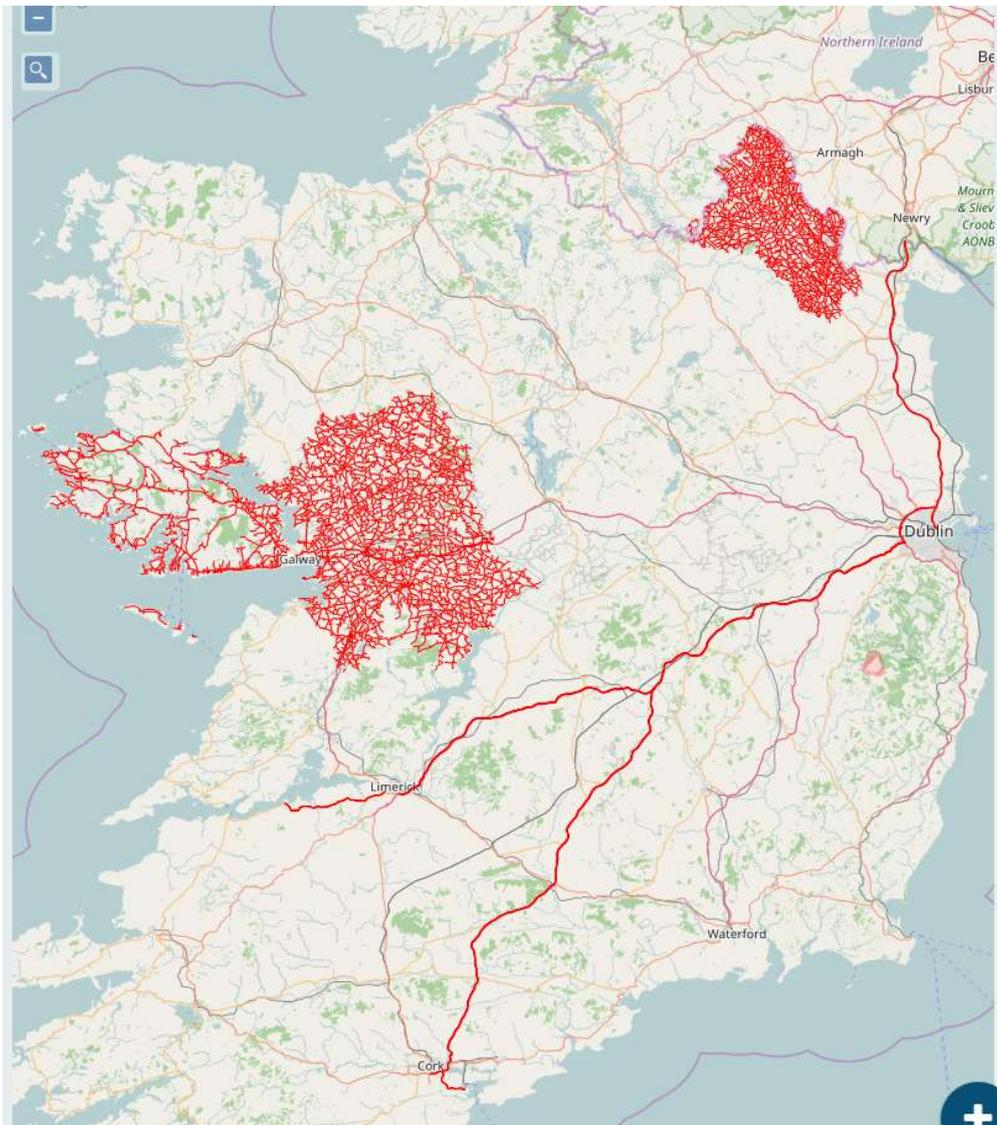
In terms of road management processes and systems that could feed into this TN-ITS GO project, many of the agencies charged with the management and maintenance of roads data have different approaches. Currently, TII maintain their own road network information system through ESRI software. When change happens on the network this is reported back to TII's GIS section who then update their road network information system.

Whereas, all the LAs use a centrally managed Pavement Management System (PMS) called MapRoadPMS[2]. Management and coordination of the MapRoadPMS platform is handled through the Local Government Management Agency (LGMA) on behalf of all Local Authorities (LA), in a technical/operational capacity, and by the Roads Management Office (RMO) in a policy and funding capacity. Originally, MapRoadPMS was installed as independent systems in each LA, but through 2017/18 has undergone a fully managed conversion process to a cloud based centralised solution. Importantly this process has been built as a cloud based MapRoadPMS solution where the core or base network information source has been set as Ordnance Survey Ireland's Prime2[3] spatial data storage model. Prime2 is designed as the authoritative spatial reference framework for Ireland.

2.2   Road Network Coverage from the TN-ITS Irish Pilot 2017

The Irish Pilot study, completed in 2017, has been implemented using 10,551 km 's of road network data sourced from 3 different road network data platforms/providers:

(1) - Ten-T National Core Network - provided by Transport Infrastructure Ireland

(2) - Galway County Network - available from Galway County Council Open Data Portal[1]

(3) - Monaghan County Network - provided by Monaghan County Council through the Local Government Management Agency
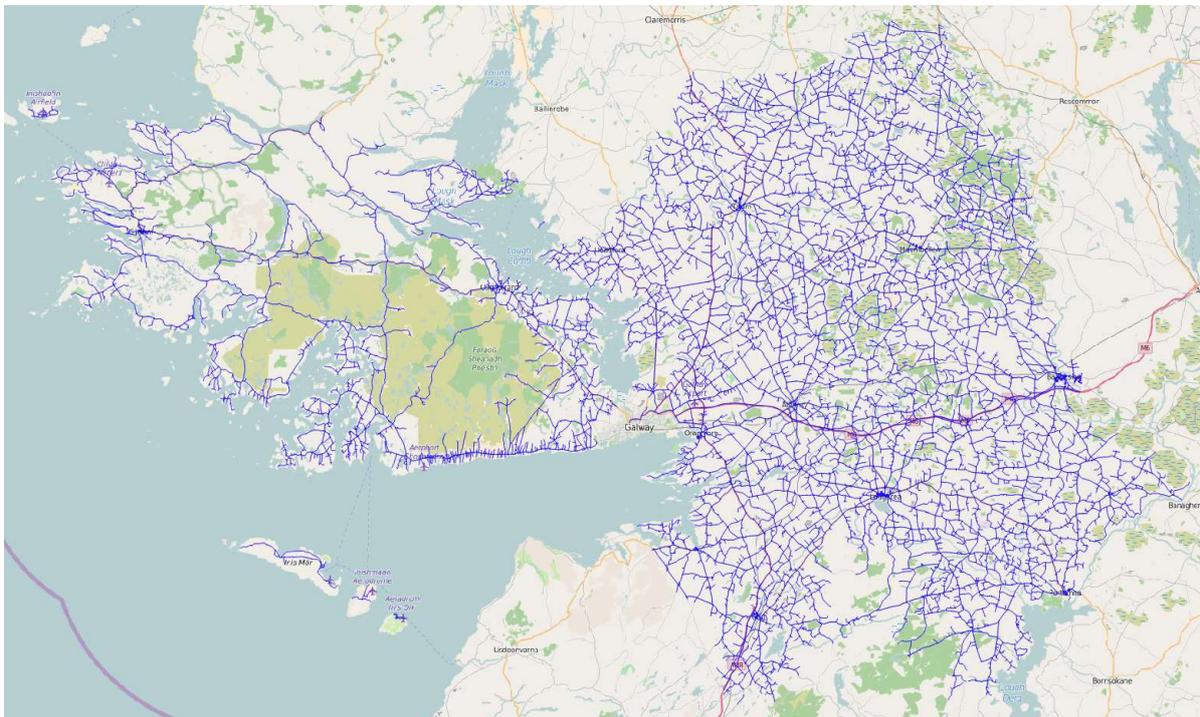

The Irish Pilot Study Road Network (10,551 km's) - highlighted in Red

The Ten-T National Core Network was provided by Transport Infrastructure Ireland (TII) and comprises 1498.44km's of network data and is highlighted in Yellow below. This data set is spatially comprehensive as it provides both lane and road centre line geometry.
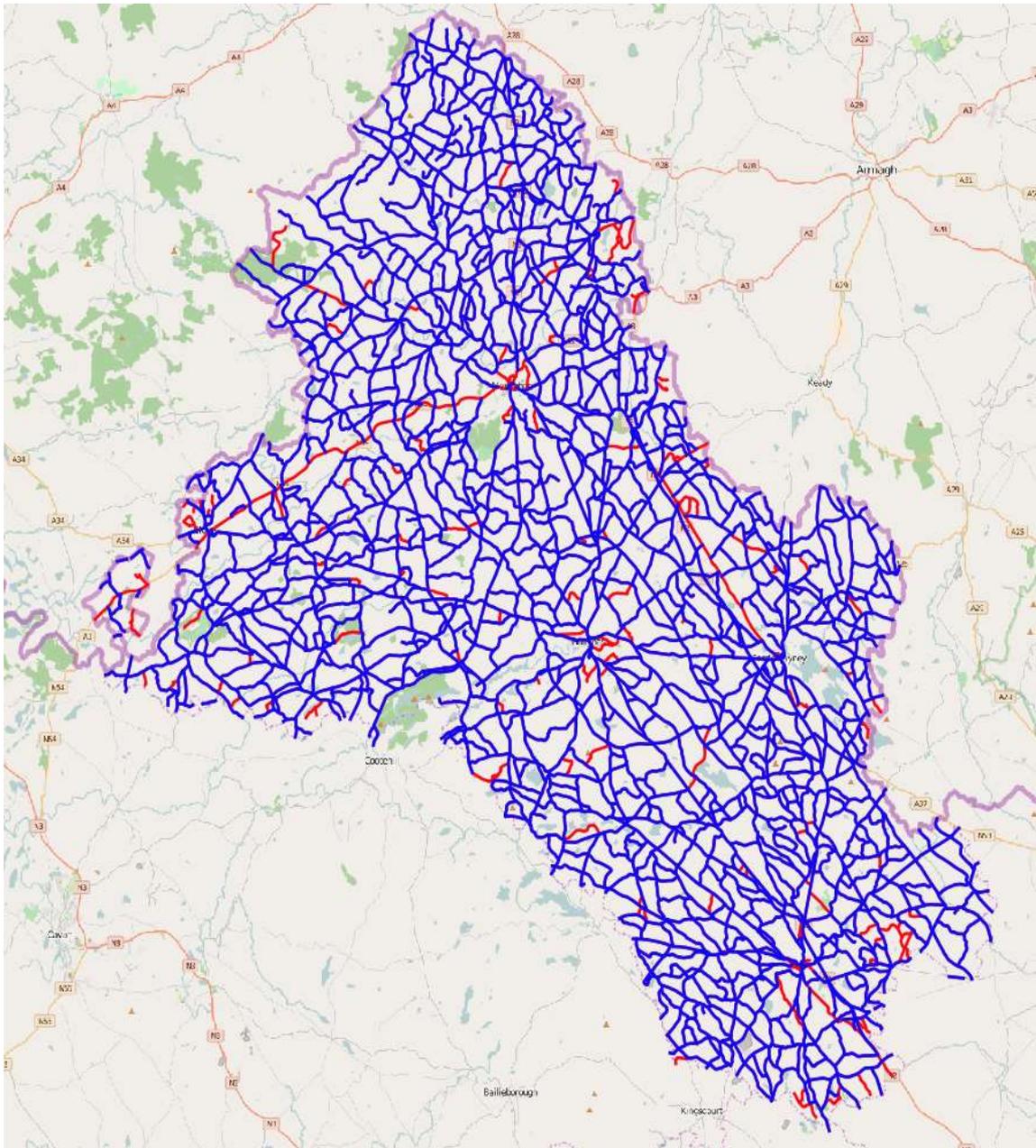

TII Ten-T National Core Network overview.

The Galway road network data set was downloaded from the Galway County Council Open Data Portal[1] and comprises 6645km's of road network data. This data is complete for coverage of all National and Regional roads in Galway County, however Galway City network data was not available at the data ingestion stage of the pilot study. An overview of the Galway County road network coverage is highlighted in blue below.

Galway County Council Road Network overview.

The Monaghan road network data was provided from Monaghan County Council by the Local Government Management Agency (LGMA) and comprises 2408km's of road network data. This data was sourced from the original 'MapRoad'[2] platform which is procured and managed by the LGMA on behalf of all local authorities in Ireland. MapRoad has since been developed as a centralised cloud based web-application service that used the OSI Prime2 spatial data model. An overview of the Monaghan road network data is highlighted in blue below.

County Monaghan's 2,408 km's of road network

2.3 Road Network Meta-Data

As part of this TN-ITS projects stated aims, the spatial data and its associated meta-attributes where either defined or generated such that the following parameters for every geometric or spatial-data record provided, was set:

TN-ITS Pilot Implementation Spatial & Meta-Data Types	
System ID	DB Identifier
Line Geometry	Open Geospatial Consortium (OGC) standard geometry representation
Road Identifier	ID taken from data provider/source
Road Name	Name taken from data provider/source
Form Of Way (FOW)	OpenLR standard identifying physical properties
Functional Road Class (FRC)	OpenLR standard indicating importance in the network
Speed Limit	Data taken from data provider/source
Number of Lanes	Data taken from data provider/source
Max Width	Data taken from data provider/source
Min Width	Data taken from data provider/source
Max Height	Data taken from data provider/source
Max Weight	Data taken from data provider/source
Valid To Date	Data taken from data provider/source

Because of the pilot nature of the TN-ITS Pilot, not all these meta-data parameters were available across all data sets provided. It was also the case the OpenLR FOW and FRC parameters do not have equivalent universal representation in the data sets used in the pilot. As such the following table overviews the availability of these Meta-Data types across the 3 data sources used. Attribute Data types in green were available while those in red were not available in their respective data sets.

Data Sources	Attribute Data								
	Road Identifier	Road Name	Road Type	No. Lanes	Max Width	Min Width	Speed Limit	Max Height	Max Weight
Galway County Council	green	green	green	red	red	red	red	red	red
Monaghan County Council	green	green	green	red	green	green	green	green	green
TII Ten-T Core Network	green	green	green	green	red	red	green	red	red

To generalise the pilot data across all these data sources, the following rules table was used to generate values, during the data import stage, for data types that were missing.

Description	Type	FRC	FOW	SPEED	LANES	MIN_WIDTH	MAX_WIDTH
Motorway	ML	0	1	120	2	3.5	3.5
Motorway	ML	0	6	120	1	3.5	3.5
Carriageway	CM	1	2	100	2	3.5	3.5
Local Tertiary	LT	7	3	50	1	3	3
Local Secondary	LS	6	3	50	1	3	3
Local Primary	LP	5	3	80	1	3	3
National Secondary	NS	3	3	80	1	3	3
National Primary	NP	2	3	80	1	3	3
Regional	R	4	3	100	1	3	3
No Assignment	NA	7	0	50	1	3	3

This cross reference table is based on the 'Road Type' data type that is available across all data sources. Thus, for each spatial record provided in the source data, if any of the Meta-Data type parameters were not present or invalid, then the above rules were applied to assume the FRC, FOW, Speed, ...etc. for the given 'Road Type' such that they had at least some value.

2.4   TN-ITS Pilot Implementation and Access

The TN-ITS Pilot implemented both a Restful service and a user accessible Web-Application. The Restful service fulfilled the requirements of the TN-ITS objectives for an access point to connect to and test data types, changes and updates. To help encapsulate this Restful approach, as set out in the TN-ITS Standards, a Web-application front-end was also built to interact with the stored spatial data in such a way that local area engineer might connect when changes to the static road network occurred.

2.4.1 Irelands TN-ITS Specification Restful Service implementation:

The TN-ITS Specification has been implemented as a Restful service that is available at the following Internet Protocal (IP) address - 52.49.197.111

This service implements 3 core quest types:
List all updates available from the service:
- http://52.49.197.111/download/queryDataSets

For any particular update listed from the 'All Updates' request, details can be returned using any of the listed IDs:

- http://52.49.197.111/download/readDataSet?dataSetID=YmcaiLJW8X1p3ML8lyi1

For any particular ID previously queried all subsequent updates can be listed as follows:

- http://52.49.197.111/download/queryDataSets/?lastValidDatasetId=JR6yUTQwRy4EqT1Vz6iW

Also, as a beta-testing improvement, a number of other more flexible query types, that are not directly defined in the TN-ITS Specifications, have been built into this service implementation to facilitate update generation and queries by date, change-type and area. For example, to generate a new update and define its update key the following query could be called:
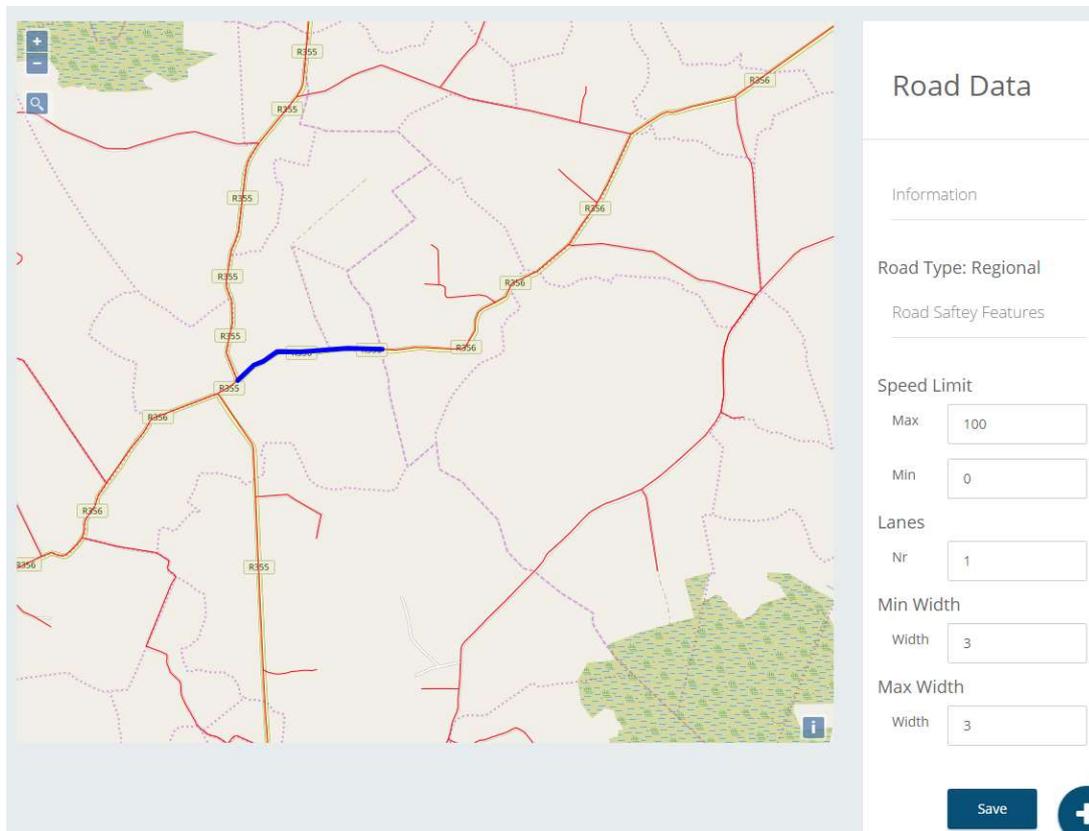
- http://52.49.197.111/download/?query=generateUpdate&key=7ZUSEMbuZYSgABmrHsAk

2.4.2 Road Network Update Demonstrator Web-Application:

This Web-Application was built as a demonstrator platform which is being used to both test the Restful Service but is also useful in our engagements with the various organisations and agencies that are responsible for or use Pavement Management Systems to maintain and update road network information in Ireland. Access to the Web-Application is open and can be reached at the following URL:

http://marobs.eu/tn-its/

This system allows a user to load, select and edit road network information which is then saved back to the database. It is also possible to generate new Restful Service updates based on any changes that have been made in any period. An example of the Web-Application user interface is below and shows a road section selected, in blue, and an update form to the right of the user interface for editing the selected geometries attributes.

3. TN-ITS GO for Ireland

While the precursor TN-ITS implementation has been detailed in the previous sections, it was carried out over 2016/2017 in each of the five Member States and addressed a limited set of attributes in order to gain experience for future further roll-outs of the service. Some challenges were identified by member states relating to legislative, organisational and technical issues that impede the smoother roll-out of this updated digital road data service. This TN-ITS GO Programme Support Action (PSA) stage will build on the aforementioned precursor action and explore further implementation and facilitation efforts for a seamless spatial data exchange mechanism. DTTAS and Maynooth University, together with input from TII, LGMA, RMO, OSI and other such agencies that have a interest here have all agreed to continue to participate in this next stage project. Work to-date through 2018 has worked through various iterations of scoping and understanding documents with the various stakeholders such that further and more integrated involvement from the stakeholders will help TN-ITS develop and positively impact on safe, regulated, efficient traffic management across Europe by providing comprehensive data regarding 'traffic flow directionality, traffic-rules, turn-restrictions, detailed lane information and bridge-clearance, for example. Some of the existing outstanding challenges that the TN-ITS GO project is addressing include;

- Pan-EU deployment of TN-ITS data-exchange Services
- Varying levels of maturity within Ireland with respect to spatial data infrastructure
- Fragmented, non-consolidated road map databases held by various data owners
- Usage of various formats, database schema, data-models and data dictionaries
- Variety of Linear & Location Referencing frameworks
- Sometimes complexity of entire data exchange chain (legal, commercial, technical, organisational)
- Building a successful, operational stakeholder group including data originators, owners, end-users etc
- Multiple licenses as well as Terms & Conditions
- SLA's between data originators, owners and end-users

Currently the project is finalising the detailed parameters of stakeholder needs and involvement in the development of a more highly integrated set of TN-ITS services. This will probably take the form of more pre-operational demonstrators that will address the specific challenges in Ireland, particularly the concerns of the stakeholders that relate to organisational and technical issues. These will help facilitate a more robust and seamless delivery of TN-ITS compatibility for high-quality road network data in a timely fashion. Thus, the current period of work will see progress in a number of key objectives;

- Examine and finalise the minimum static road attributes that are consistent and reliable across Irish data sets that can be published through this new prototype pan-EU TN-ITS static road network update service
- Further mature and develop the current geospatial solution for database schemas, data cross-walk, attribute mapping and related transformation e.g. multiple Linear Referencing Systems (LRS)
- Continue working with current road data owners and aggregators to discuss and trial improved work-flows that will facilitate the delivery of more timely road data updates

4. REFERENCES

1 - Galway County Council Roads Network Open data Portal access URL -
https://sourceforge.net/projects/twmodmanager/files/latest/download

2 - MapRoadPMS is a cloud based Pavement Management System, developed by Compass Informatics Ltd. Information and can be accessed here - http://maproadpms.ie

3 - Ordnance Survey Ireland Prime 2 spatial data storage model details URL -
https://www.osi.ie/about/future-developments/prime2/

4 - OpenLR Linear Reference System Standard - http://www.openlr.info/