Harmonising European ITS Services

Information and Communication Technologies

OPERATING ENVIRONMENTS

Supporting Guideline

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Support

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Preface (2016)

After the EasyWay project ended in 2012, the Deployment Guidelines have been updated by the EIP / EIP+ projects. They focussed on updating Best Practice and did neither have the capacity nor the intention for a full revision of the text, since especially the Member State adoption of the guidelines' requirements form a huge asset of European harmonisation. In the light of recent European Delegated Regulations, the EU EIP platform will now consider a full revision of the format and the content of the whole set of Deployment Guidelines.

Preamble (2012)

EasyWay is a cooperation of road authorities and road operators from 27 European countries that have teamed up to unlock the benefits of cooperation and harmonisation in the deployment of Intelligent Transport Systems (ITS) on Europe's major road network. ITS as a technology is a known contributor to sustainable mobility in terms of improved safety, efficiency and reduced environmental impact. Nevertheless, fragmented deployment on a national level will fail to deliver seamless European services and will not contribute to a coherent European Transport network. The European Member States have consequently launched the EasyWay project together with the European Commission as a platform to harmonise their ITS deployments.

This document has been drafted by EasyWay as part of the set of documents containing the 2012 version of the EasyWay Deployment Guidelines (DG 2012). These guidelines have been developed by EasyWay experts and practitioners. They have undergone a thorough review by international domain experts in an intense peer review exercise and they have been validated by the participating Member State Partners of EasyWay in an extensive formal Member State consultation process, which finally led to their adoption as basis for all deployment activities in future EasyWay phases.

EasyWay as a project is not a standardisation body, nor does it have any power to legally constrain the Member State in their national deployment activities. It is therefore crucial to understand that these documents are neither technical standards, nor are they specifications as they would be required for such cases, e.g. as currently developed by the European Commission as their part of the implementation of the ITS Directive 2010/40/EU. But since a certain level of strictness in compliance is required to achieve the intended goal of the EasyWay Deployment Guidelines – harmonisation and interoperability in Europe – the guideline documents are written in a way that clearly defines criteria that deployments have to fulfil in order to claim overall compliance with the guideline.

Although not legally binding in any sense, compliance may be required for the eligibility of deployments in future ITS road projects co-funded by the European Commission. Deviation from compliance requirements may nevertheless be unavoidable in some cases and well justified. It is therefore expected that compliance statements may contain an explanation that justifies deviation in such cases. This is known as the "comply or explain" principle.

Although not standards themselves, the EasyWay DG2012 Deployment Guidelines in some cases do mention – and sometimes require – the use of such standards. This is the case in particular regarding the use of the CEN/TS 16157 series of technical specifications for data exchange ("DATEX II"). Although standardised data exchange interfaces are a powerful tool towards harmonised services in Europe, it must be understood that real world deployments have to fit into existing – and sometimes extensive – infrastructures and investment in these infrastructures must be protected. It is therefore important to note that the use of DATEX II mentioned below as a MUST is referred to implementation of "new" data exchange systems and not the utilisation of the existing ones, unless these latter affect harmonisation of deployments or interoperability of services.

Operating Environments at a glance

WHAT ARE OPERATING ENVIRONMENTS?

The scope of EasyWay is to provide Core European Services to the European road users. These services are harmonized in content and functionality, but also in their availability: The road users shall be able to expect a certain services offer in a specific road environment. In order to provide a basis for the harmonization process EasyWay needs a tool to define such environments in an agreed manner. This tool is the Operating Environments – a set of pre-defined road environments combining physical layout of the road and network typology with traffic characteristics.

In essence, EasyWay has agreed on a set of 18 pre-defined Operating Environments where each Operating Environment is a combination of three criteria:

- Physical characteristics – Motorways, other 3/4 lane roads or 2-lane roads
- Network typology – Corridor, Network, Link or Critical spot
- Traffic characteristics – Traffic flow and road safety situations (with optional additions)

WHY DO EASYWAY PARTNERS BENEFIT FROM A ROAD NETWORK CLASSIFICATION

Classification means that EasyWay partners describe their actual road network as Operating Environments. By classifying their network into Operating Environments, the partner gets an immediate link between the actual road and the status of EasyWay Core European Services as the EasyWay Deployment Guidelines provide a recommended service composition and design for each Operating Environment. Furthermore, network classification will give EasyWay partners a powerful tool to assess the current situation and discuss national and European deployment needs and strategies ahead.

HOW IS THE NETWORK CLASSIFICATION MADE?

Establish a task force

The first step in the process is to establish a task force (recommended 2-4 people) within the relevant road operator organization to decide on which background information to use, which criteria for flow and safety to use etc. This operating environment classification document gives suggestions on how to accomplish this, including a range of threshold values that are recommended to be applied in order to ensure a harmonized approach.

Road network definition

The next step in the classification process is to decide on the extent of the road network concerned – The EasyWay road network. In general, this is the same as the TEN-T Road Network, with the addition of other key road network elements, interfaces to urban networks etc. The precise extension of the network is decided by the EasyWay partner concerned. All elements will be matched with a common and gapless map database.

Classification

Classification is made through a link-by-link (from one exit/major junction to another exit/major junction) analysis supported by a dedicated Excel-tool and/or EasyWay Map Tool. By defining the value of the three criteria (above), the tool will provide the resulting Operating Environment in the Excel table.

What resources are needed for road network classification?

According to the experiences of several EasyWay partners, a “typical” national partner’s road network will result in 200-500 links, 2-3 experts are able to carry out the classification within a few (2-4) working days when preparations (the first step) have been made.

How are the results used?

Following classification, an EasyWay partner will have a tool to compare the actual situation on its network with the recommended levels from the EasyWay Deployment Guidelines. This information can constitute valuable input to the partner deployment planning process as it reflects agreed European priorities. The partner can also use the network model to compile information on existing service implementations, service levels etc. which will further increase the value of the work. It is the aim of the EasyWay Technical Coordination Team to develop the excel tool further in this direction, and also to link it to a comprehensive map tool. A common map can display the state of development or planning on a Pan-European scale with unambiguous reference to single network elements.

At the EasyWay European level, the results will be compiled and provide important information: which are the Operating Environments in Europe, how are they distributed and how large a part of the network do they constitute? This information will provide input for assessment of the remaining potential of the different Core European Services, and thus contribute to the EasyWay ITS Deployment Road Map. The aim is also to use the network model as the background for results compilation and reporting.

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List of abbreviations

AADT	Annual average daily traffic
GIS	Geographic Information System
ICT	Information and Communication Technologies
ITS	Intelligent Transport Systems
OE	Operating Environment
TERN	Trans-European Road Network

1 Introduction

1.1 Objectives and scope of the document

The aim of this document is to support and advise EasyWay partners in the classification of their EasyWay network into Operating Environments for EasyWay services.

By adopting the procedures specified in this document, the EasyWay partners will maximise the consistency of the Operating Environment classification throughout EasyWay.

1.2 What is an Operating Environment

In EasyWay, an Operating Environment means the category of the road section classified according to types and service levels of ITS services typically expected to be operated and often provided on it by the road authorities and operators. Thereby, the Operating Environment is closely related to the expected service levels of the travellers and hauliers using the road section, the frequently occurring or threatening problems of the section, and the feasibility of possible ITS solutions to deal with these problems. The main properties of the road section affecting the Operating Environment are its physical characteristics, network typology, and the frequency and severity of traffic flow and road safety concerns on the section. Motivation for use of Operating Environments within EasyWay

Operating Environments find their use in different ways within EasyWay: They are used in the Deployment Guidelines to describe the feasibility of different services in relation to the different environments on the EasyWay road network, and they are also used in the Road Map process as the basis for describing network extension and service level development concerning the Core European ITS services. Some examples of their use are illustrated in the Annex B of the document.

Operating Environments and deployment priorities

By describing the critical spots and the sections with most severe problems and concerns, the Operating Environments can be used in selection of the parts of the road network for improvement measures as well as for prioritising between the different road segments and connections when the road operator is implementing different measures. For Europe-level assessments it would be preferable to use as consistent methodology for classifying the EasyWay network into Operating Environments as possible.

Operating Environments and Service Levels –Tools for deployment planning

Operating Environments can also be used to steer and harmonise the implementation of Core ITS Services by the road operators in order to achieve harmonised service composition and harmonised service levels within a certain Operating Environment. To achieve this, there needs to be a description per Core ITS Service on adequate service levels to be applied in different Operating Environments.

Application of Operating Environments in Deployment Guidelines

EasyWay will use the definition of Operating Environments in the Deployment Guidelines in order to guide towards a harmonised service composition. The definition of service levels for European services in relation to Operating Environments will be developed further in the Deployment Guidelines.

Operating Environments in the Road Map process

By using the Operating Environments as the basis for the Road Map, rather than the physical road network, project partners can discuss deployment priorities in relation to an abstract network model, and then bring this information back into their national planning process. By adding the dimension of service level improvements and the dimension of time, the basic information required for an ITS deployment road map can be put in place.

1.3 Organisation of the Operating Environments classification in EasyWay

The Operating Environments classification work is coordinated by the Operating Environments Task Force operating under ICT (Information and Communication Technologies) Expert and Studies Group ESG6 in EasyWay,

Each EasyWay member state will nominate at least one contact person to be responsible for the Operating Environments classification work in their member state and for managing the liaison between partner-specific, national and EasyWay Operating Environments classification activities.

Experiences indicate that the technical classification of the national EasyWay network into Operating Environments will require only a few expert-days, after the national classification criteria have been agreed upon. The agreement on classification criteria may, however, demand much work and many discussions, if there are several EasyWay partners in the country with their own classification practices.

2 Operating Environments

The Operating Environments are defined as a combination of the following key factors:

- physical characteristics of the road section
- road section network typology
- traffic flow impact and/or potential road safety concerns

In addition, a specific road section may be characterized by attributes such as recurring weather problems, a particular sensitivity for environmental impacts or particular importance for freight transport. The classification method allows for such attributes to be added to the Operating Environment identified.

Full information on the Operating Environments can be found in the most recent version of the "Operating Environments for EasyWay Services1" available in the EasyWay Deployment Guidelines package.

The Operating Environments proposed for EasyWay Core European ITS services are defined in a step-by-step approach, in which a road operator can allocate a road or a section of a road (a network element), taking into account the indicators listed above. It has to be noted that the Operating Environments are obtained through a qualitative and sequential approach, in order to make it simple and easy to use for any part of the road network.

The general layout is defined according to a letter code relating to the different physical characteristics (following a slightly modified TELTEN[1] approach):

- C for critical spots (bridges, tunnels, reversible lane sections, etc.)
- T for motorways
- R for roads
- S for motorway corridors or networks
- N for road corridors or networks
- P for peri-urban road networks

[1] Ref TELTEN / TELTEN 2, Ertico 1997

The Operating Environments approved by the EasyWay Steering Committee and by the EasyWay Supervisory Programme Board on 16 November 2010 are the following:

C1 critical spots, local flow-related traffic impact and/or potential safety concerns
T1 motorway (link), no flow-related traffic impact and no major safety concerns
T2 motorway (link), no flow-related traffic impact, potential safety concerns
T3 motorway (link), seasonal or daily flow-related traffic impact, no major safety concerns
T4 motorway (link), seasonal or daily flow-related traffic impact, potential safety concerns
R1 two-lane road (link), no flow-related traffic impact, no major safety concerns
R2 two-lane road (link), no flow-related traffic impact, potential safety concerns
R3 two-lane road (link), seasonal or daily flow-related traffic impact, no major safety concerns
R4 two-lane road (link), seasonal or daily flow-related traffic impact, potential safety concerns
R5 three-/four-lane road (link), no flow related traffic impact, no major safety concerns
R6 three-/four-lane road (link), no flow related traffic impact, potential safety concerns
R7 three-/four-lane road (link), seasonal or daily flow related traffic impact, no major safety concerns
R8 three-/four-lane road (link), seasonal or daily flow related traffic impact, potential safety concerns
S1 motorway corridor or network, at most seasonal flow-related impact, possibly safety concerns
S2 motorway corridor or network, daily flow-related traffic impact, possibly safety concerns
N1 road corridor or network, at most seasonal flow-related traffic impact, possibly safety concerns
N2 road corridor or network, daily flow-related traffic impact, possibly safety concerns
P1 peri-urban motorway or road interfacing urban environment, possibly safety concerns

Table 1: EasyWay Operating Environments for Core European ITS Services.

Existence of weather and/or environmental concerns and/or truck relevance may be used as additional attributes for the Operating Environments.

2.1 Understanding the classification criteria and attributes

This chapter describes the attributes used for classification of Operating Environments.

2.1.1 Physical characteristics

One of the key elements in an Operating Environment is the physical layout of the road section itself. The road user is naturally well aware of the road, which he/she is using, and will base his/her expectancies on the ITS as well as other services on the road type. There are three basic types of roads with regard to the Operating Environments:

- motorways; two or more lanes in both driving directions with separation of the carriageways of each direction, no at-grade intersections with other roads (intersections are handled by over- and under-passes with ramps)
- two-lane roads; one driving lane in each direction, no physical separation between driving directions, typically ground level intersections with other roads
- three/four lane roads; in case of three-lane road, one ordinary driving lane in each direction and one overtaking lane alternating from one direction to another usually with ca. 1–3 km intervals, driving directions separated with a fence and/or barrier or without a barrier; in case of four-lane road, a dual

carriageway road with separation of the two carriageways of two lanes each allowing also at-grade intersections.

Only lanes for motor vehicles (including dedicated bus lanes) are included in the counting of lanes. If there are more than two lanes in at least one of the driving directions, but it is not a case of being a motorway, the road should be classified among the three/four lane roads. Hard shoulders should not be counted as lanes, even if used as temporary driving lanes.

In addition to the road types described above, the TERN (Trans-European Road Network) has some physically distinct sections, which set special requirements to road services including ITS. Such sections are:

- tunnels, bridges, sections with reversible lanes, interchanges, junctions of restricted capacity between different basic types of roads other sections with exceptional characteristics. These types of infrastructure can be inserted in a general category of “critical spots” (see following section) where not only traffic problems may exist but also special services have to be applied.
- ferry connections within EasyWay road network. Even though the ferry connection parts are not likely to have the same ITS services as the surrounding road sections, for network continuity reasons the short ferry connection, which could be replaced by a bridge, should be given the same Operating Environment as the neighbouring road section(s). Longer ferry connections should be excluded.

2.1.2 Network typology

The road section concerned may also have a need for special service levels related to its role in the transport network. The roles important for the ITS service provision include:

- corridor; the road section is part of a long corridor connecting major cities and other key locations such as major ports including in total at least two alternative routes, of which at least one usually is a motorway. An additional requirement of a corridor is that the network or road operator manage the corridor as such at least in some of their network operation plans and schemes; i.e. if the road sections of the corridor are managed and operated (totally) independently of one another (except for using the alternative route for detour during incidents), the road sections are treated as links and spots.
- road/motorway network; grid of roads, motorways or a mix of roads and motorways. As above with corridors, the road sections in a network should be operated by traffic management and/or information tools as a network, and not only as totally independent elements. If the same road element is part of both a corridor and a network, the typology of road/motorway network is the recommended choice.
- peri-urban network; the road section is part of a motorway or road network integrating the TERN with the road/street network of major conurbations. Typically, a ring road round an urban area is a part of this kind of network.
- link; a road/motorway section connecting two locations (spot or a node of a network/road such as city, port, etc.) on the EasyWay network while not constituting a part of a corridor or road/motorway nor peri-urban network. A location separating two links is sometimes an intersection or any other place on the road/motorway, where the characteristics of the road/motorway change in such a way that the Operating Environment or its attributes will also change. This can happen for instance if the traffic volume suddenly increases or decreases drastically at an intersection, the road climate changes abruptly, etc.
- spot (or short stretch); a specific part of the road/motorway differing from the surrounding part of the EasyWay road network (critical bends, uphill sections, tunnels, bridges, interchanges etc.) especially with regard to the need of specific ITS solutions. Note that all bends, uphill sections, tunnels, bridges, interchanges etc. do not need to be classified as spots if they are not considered as a specific problem location.

This typology is a basis for defining Operating Environments and assigning a letter code to each type. Traffic flows and safety (see next points) will provide further details (distinguished with numbers).

Note that any section of the road/motorway can only belong to one typology. This is to ensure the summing up of the network lengths based on the Operating Environments.

2.1.3 Traffic flow impact

Note that both for traffic flow impact and safety concerns, the road section is treated as a whole, consisting of both driving directions, even though in some cases the conditions might vary from one direction to the other. Again, this is done to ensure correct summing up of network lengths. If, however, a partner insists on treating the directions as separate, this is allowed as long as this treatment is carried out consistently in the whole network of the country in question and specifically reported.

The existence of traffic flow impact is related to the actual flow situation on the specific road section in terms of traffic volumes.

It is quite obvious that ITS service levels need to be linked to the volume of traffic and how it varies with time. EasyWay aims at setting quantitative thresholds for annual average daily traffic (AADT) to set up the categories for traffic flow impact. This is described accordingly:

- daily traffic related impact; recurring congestion problems can affect traffic almost each working day, and incidents may also be quite frequent. If AADT is on motorways at least 12,500 vehicles/day per lane (i.e. 50,000 on 2+2, and 75,000 on 3+3 lane motorway) and on other roads at least 9,000 vehicles/day per lane (i.e. 18,000 on a 1+1 and 36,000 on a 2+2 lane road), the road should always be in this category. If the number of lanes changes within the section, the lower number should be used when applying the traffic volume thresholds above.
- seasonal traffic related impact; severe traffic congestion can exist but only seasonally, for instance during weekends during vacation times and holidays. Note that the current Operating Environments do not explicitly address seasonal problems on motorway links. If such, however, exist, these roads should be included in the Operating Environments with daily problems.
- no traffic related impact; congestion and other flow-related problems are infrequent and are usually caused only by major incidents or events. If AADT is on motorways less than 6,000 vehicles/day per lane (i.e. 24,000 on 2+2, and 36,000 on 3+3 lane motorway) and on other roads less than 4,000 vehicles/day per lane (i.e. 8,000 on a 1+1 and 16,000 on a 2+2 lane road), the road should always be in this category.

Note that the thresholds above leave room for EasyWay member states to use their own thresholds set according to national criteria. Naturally, local circumstances can also motivate deviation from the general principles and thresholds for specific road segments.

2.1.4 Potential road safety concerns

The existence of potential road safety concerns is related to the actual situation on the specific road section.

Two safety categories are to be used:

- potential safety concerns; accident rates are considered high or severe outcomes are expected from any crashes according to EasyWay partner; this can be due to e.g. severe weather problems related to snow, ice, fog and/or strong cross-winds affect traffic considerably and frequently – especially in the wintertime. Other reasons for this classification may be high percentage of heavy traffic, existence of vulnerable road users at the road side, risk of severe consequences on isolated mountain roads, old-fashioned or inadequate road design, etc.
- no major safety related concerns; problems considerably affecting road safety are only occasional and infrequent.

There are three methods used to identify a section with potential safety concerns:

1) Road sections, where the long-term (preferable at least five-year average) severe accident rate (accidents/10^9 veh-km) is 30% higher than the national average,
2) Road sections, where the long-term fatality density (fatalities/100 road-km) is 30% higher than the national average, and
3) Road sections, where the EuroRAP rating is less than 3 stars (in scale 1-5).

The first method is recommended as the one most closely related to the safety experienced by the driver. Naturally, local circumstances can motivate deviation from the afore-mentioned methods and thresholds for specific road segments.

2.1.5 Other attributes

The actual Operating Environments are determined on the basis of the attributes listed above. In addition to these, the EasyWay partners may also voluntarily choose to use additional criteria for classifying their road network. Such additional attributes are most likely related to weather, environmental and heavy goods transport concerns. These attributes are elaborated upon below. No agreement on the method for classification of these other attributes has been reached so far.

2.1.5.1 Existence of weather problems

The road/motorway is classified as having critical weather related problems, if severe weather problems related to snow, ice, fog, heavy rainfall and/or strong cross-winds considerably and frequently affect traffic - especially in the wintertime.

2.1.5.2 Existence of environmental concerns

The road/motorway section has critical environment concerns if it is passing through an area sensitive to environmental (pollution, noise) impact or affected by regulations such as groundwater areas, parks, residential areas, schools, playgrounds, etc.

2.1.5.3 Truck transport relevance

The link, corridor or network is of particular importance for freight transport. The proportion of heavy goods vehicles of all traffic or the average daily number of heavy goods vehicles are regarded as high by the EasyWay partner or the road/motorway is leading to a major logistics hub such as a port, airport (cargo), freight village etc.

2.2 Carrying out the classification in practice

2.2.1 Basic principles

This section describes how the EasyWay partners should classify their EasyWay road networks into EasyWay Operating Environments. The definition of what constitutes the EasyWay network is the one used by the EasyWay partner in question. It is an EasyWay obligation to carry out the classification.

Note that if the EasyWay partner cannot classify a specific road section into any of the Operating Environment categories given in the document, the partner should choose the Operating Environment best fitting the specific road section, and to inform the authors of this document of the characteristics of all such sections poorly fitting into the current Operating Environments. Such cases will be considered when future versions of the Operating Environments are being proposed and when this classification guidance document is being updated. It should be noted that the ultimate goal is to achieve a consistent European methodology for classifying the EasyWay network into Operating Environments.

The classification method proposed takes into account the possibility of a later integration of the Operating Environment classification with a map-tool, allowing for network classification to be displayed through an EasyWay map-tool.

In practice, it seems to be easier to classify the EasyWay networks into Operating Environments criteria by criteria, as often each criterion is best dealt with by a specific expert. A congestion expert can easily classify the network by traffic flow impact, whereas another expert on safety will quickly classify the whole network according to the existence of potential safety concerns.

The whole EasyWay network is to be classified. For the classification, the network is to be divided into sections according to the basic factors determining the Operating Environment – physical layout, network typology, traffic flow impact and potential safety concerns as well as the additional attributes (weather, environment, freight), which the EasyWay partner chooses to use. This means that a new section could start each time, when the category of at least one of these factors and attributes changes. This may result in road sections of very varying length (from hundreds of metres to hundreds of kilometres). The EasyWay partners may also cut the sections also at other points, according to their own uses and preferences. The general recommendation is to

use motorway exits and major junctions as the points of division for the road network, because this will simplify some later procedures such as map-matching. Hence, a road section normally runs from one exit/junction to another, but not necessarily the next one.

Naturally road characteristics, traffic flow and road safety conditions evolve over time partly due to ITS deployments. Hence, the need to update the Operating Environment classification should be assessed at regular intervals.

2.2.2 Using the Excel support tool

An efficient way of carrying out the classification is to use an Excel tool for this. The EasyWay network is included into the Excel workbook road by road and motorway by motorway, section by section. All network elements classified should include official names (junction names, road names and/or TMC location codes if available) since this simplifies the matching of elements for various applications and supports error detection and quality management in general. The worksheet has the following columns:

- Identification number of the EasyWay network element (e.g. reference to a map element to be introduced in an optional folder or sheet; to make the numbering unique, nation codes such as DE, FI, SE etc. are recommended to precede the actual numbers)
- Name of road/motorway (e.g. E18, according to the member state naming convention)
- Start of section (distance from start of road/coordinate/location description)
- End of section (distance from start of road/coordinate/location description)
- Length of section (km, 0-3 decimals)
- Physical characteristics,
- Network typology
- Existence of potential safety concerns (0=no, 1=yes)
- Existence of traffic impact (0=no, 1=seasonal, 2=daily)
- Existence of weather problems (0=no, 1=yes); W (optional)
- Existence of environmental concerns (0=no, 1=yes); E (optional)
- Truck relevance (0=no, 1=yes); T (optional)
- Operating Environment; this is automatically determined through a macro utilising the combination of physical layout, typology and existence of traffic flow and safety concerns and to be accompanied with the weather, environment and truck relevance attributes

The other columns of the worksheet can be used for describing the coverage (%) of the road/motorway section with different EasyWay core services of specific service levels, or e.g. the values of the deployment indicators during a year or an EasyWay phase. The excel sheet can also be used as direct input to a map or other ways of reporting the classification.

If this is to be done, the specifications for coverage will be provided at a later stage. An example of the excel sheet is given in Figure 1.

Figure 1: Example of the contents of the excel worksheet for classification of EasyWay network into Operating

Operating Environments Classification

Input cells whose values are to be filled in

					Step 1			Step 2					Step 3		Step 4					Output cell
					Physical Characteristics			Network Typology												
Element id	Name	From	To	Lenght km	Motorways	Two-lane roads	Three/Four lanes roads	Corridor	Road/Motorway network	Peri-ruban network	Link	Spot	Safety concerns	Traffic Flow impact	Weather problems	Environmental concerns	Truck relevance	Other Remarks	Updated	Operating Environment
FI001	E18	Helsinki entrance	Ring I	3,2	◉	☐	☐	☐	☐	☐	☐	◉	0	1				Example		C1
FI002	E18	Ring I	Ring III	8,4	☐	◉	☐	☐	☐	◉	☐	☐	0	2				Example		P1
FI003	E18	Ring III	Lohja	41,3	◉	☐	☐	◉	☐	☐	☐	☐	1	0				Example		S1
FI004	Ring III	VT51	E18	9,8	◉	☐	☐	☐	◉	☐	☐	☐	0	0				Example		S1
FI005	Ring III	Rovaniemi	Norway	368,0	☐	◉	☐	☐	☐	☐	◉	☐	1	2	1			Example		R4-W

Environments. Note that for map use, the start and the end points should be indicated by specific map attributes such as e.g. coordinates.

2.3 Reporting the classification

It is an EasyWay obligation to report the classification. There are two main ways to report the classification in addition to the use of the Excel document as the final outcome. The target should be to connect the report directly to the classification of the Operating Environments either in the Excel tool or the EasyWay Map, so that the reports are more or less automatically generated after the data from the EasyWay network has been properly filled in.

The first way of reporting is to use a map and geographic information system (GIS) provided with the EasyWay Map Tool. Figure 2 indicates an example of classifying the road networks into Operating Environments on a map. Note that the traffic volumes in Finland (figure example) are so low resulting in such rare congestion problems that none of the parallel connections are today operated as corridors. The choice of the mapping software should comply with the mapping requirements of the overall EasyWay deployment monitoring and reporting being provided by the EasyWay Secretariat.

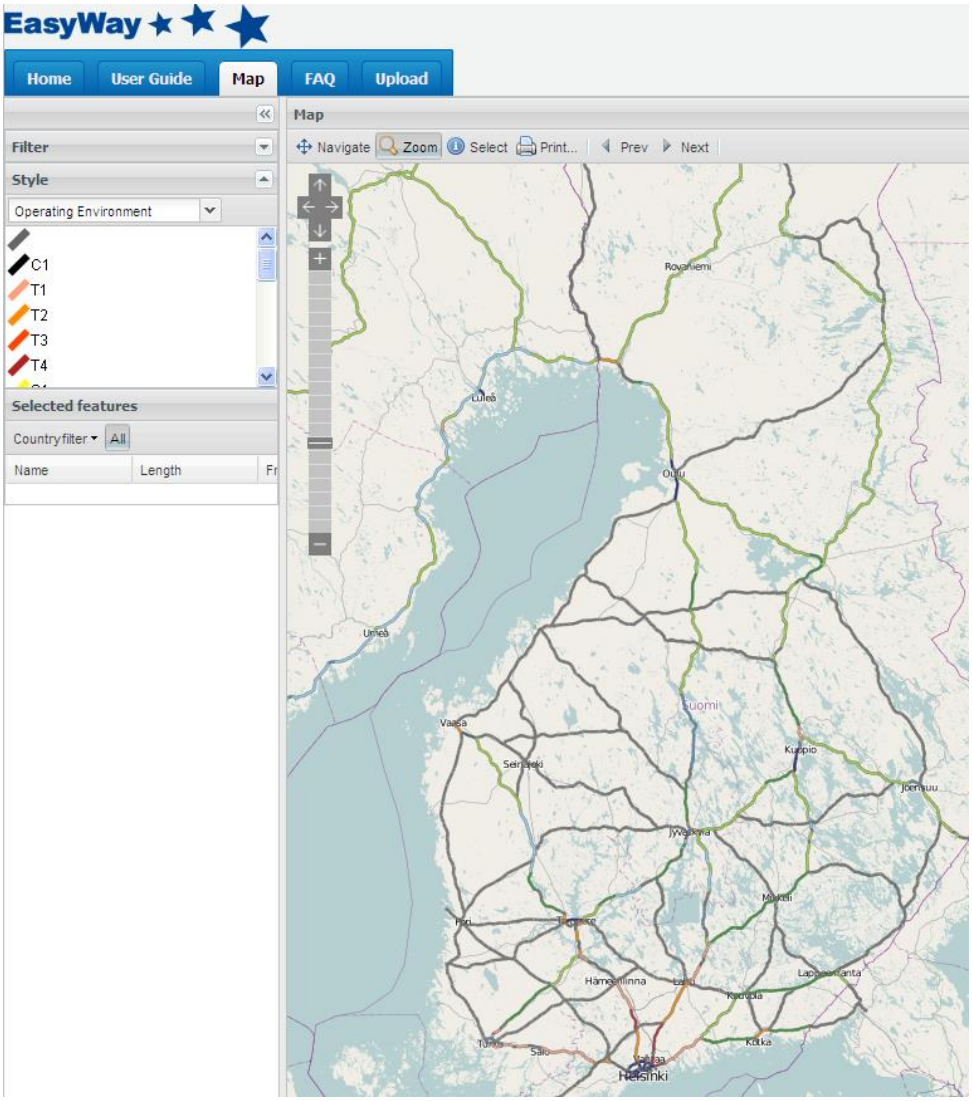

Figure 2: Operating Environments in Finland

If the classification is reported with another map tool, the same colours should be used as in EasyWay Map tool. These colours are the standard HTML colours indicated in Figure 3.

OE	Colour (html)	HEX	RGB
C1	Black	000000	0,0,0
T1	LightSalmon	FFA07A	255,160,122
T2	DarkOrange	FF8C00	255,140,0
T3	OrangeRed	FF4500	255,69,0
T4	FireBrick	B22222	178,34,34
S1	Yellow	FFFF00	255,255,0
S2	Gold	FFD700	255,215,0
P1	MidnightBlue	191970	25,25,112
R1	YellowGreen	9ACD32	154,205,50
R2	ForestGreen	228B22	34,139,34
R3	DarkGreen	006400	0,100,0
R4	DarkSlateGray	2F4F4F	47,79,79
R5	LightSkyBlue	87CEFA	135,206,250
R6	SteelBlue	4682B4	70,130,180
R7	RoyalBlue	4169E1	65,105,225
R8	DodgerBlue	1E90FF	30,144,255
N1	DarkOrchid	9932CC	153,50,204
N2	MediumVioletRed	C71585	199,21,133

Figure 3: The colour scheme to be used for the Operating Environments in the maps.

The second way is to report the lengths of each Operating Environment, and this can be carried out on the basis of the Excel worksheet of Figure 1. This is useful for the deployment target setting and deployment monitoring purposes. An example is given in Table 2 below.

Operating Environment	**Finland** **Km**
C1 critical spots, local flow-related traffic impact and/or potential safety concerns	11
T1 motorway (link), no flow-related traffic impact and no major safety concerns	314
T2 motorway (link), no flow-related traffic impact, potential safety concerns	249
T3 motorway (link), daily flow-related traffic impact, no major safety concerns	11
T4 motorway (link), daily flow-related traffic impact, potential safety concerns	126
R1 two-lane road (link), no flow-related impact, no major safety concerns	2098
R2 two-lane road (link), no flow-related traffic impact, potential safety concerns	1055
R3 two-lane road (link), seasonal or daily flow-related traffic impact, no major safety concerns	0
R4 two-lane road (link), seasonal or daily flow-related traffic impact, potential safety concerns	10
R5 three-/four-lane road (link), no flow related traffic impact, no major safety concerns	96
R6 three-/four-lane road (link), no flow related traffic impact, potential safety concerns	9
R7 three-/four-lane road (link), seasonal or daily flow related traffic impact, no major safety concerns	0
R8 three-/four-lane road (link), seasonal or daily flow related traffic impact, potential safety concerns	0
S1 motorway corridor or network, at most seasonal flow-related impact, possibly safety concerns	0
S2 motorway corridor or network, daily flow-related traffic impact, possibly safety concerns	0
N1 road corridor or network, at most seasonal flow-related traffic impact, possibly safety concerns	0
N2 road corridor or network, daily flow-related traffic impact. possibly safety concerns	0
P1 peri-urban motorway or road interfacing urban environment, possibly safety concerns	61
Total	**4040**

Table 2: Total lengths of road sections in each Operating Environment (example)

It is also essential that each EasyWay partner will describe in detail how they have made the classification into Operating Environments, if their own method of classification differs from the one proposed in these guidelines. This is crucial as the ultimate goal is to arrive at a common and consistent classification throughout EasyWay and its different partners. In order to reach a consensus, it is essential that all involved understand the routines and cultures applied by each partner and their reasons for such ways of applications.

The template for reporting the classifications are given as Report 2 in Annex A of the document.

Annex A: Reporting the Operating Environment classifications

EasyWay partner: Country:

Operating Environment	Length [km]
C1 critical spots, local flow-related traffic impact and/or potential safety concerns	
T1 motorway (link), no flow-related traffic impact and no major safety concerns	
T2 motorway (link), no flow-related traffic impact, potential safety concerns	
T3 motorway (link), daily flow-related traffic impact, no major safety concerns	
T4 motorway (link), daily flow-related traffic impact, potential safety concerns	
R1 two-lane road (link), no flow-related impact, no major safety concerns	
R2 two-lane road (link), no flow-related traffic impact, potential safety concerns	
R3 two-lane road (link), seasonal or daily flow-related traffic impact, no major safety concerns	
R4 two-lane road (link), seasonal or daily flow-related traffic impact, potential safety concerns	
R5 three-/four-lane road (link), no flow related traffic impact, no major safety concerns	
R6 three-/four-lane road (link), no flow related traffic impact, potential safety concerns	
R7 three-/four-lane road (link), seasonal or daily flow related traffic impact, no major safety concerns	
R8 three-/four-lane road (link), seasonal or daily flow related traffic impact, potential safety concerns	
S1 motorway corridor or network, at most seasonal flow-related impact, possibly safety concerns	
S2 motorway corridor or network, daily flow-related traffic impact, possibly safety concerns	
N1 road corridor or network, at most seasonal flow-related traffic impact, possibly safety concerns	
N2 road corridor or network, daily flow-related traffic impact. possibly safety concerns	
P1 peri-urban motorway or road interfacing urban environment, possibly safety concerns	

Report 1: Length of EasyWay Operating Environments

EasyWay partner: Country:

Method used in classification and any problems encountered and ways used to solve them (provide sufficient detail so that any other expert could also use the method)	Reason for choice of method
Road name, start and end point	
Physical characteristics of road	
Network typology	
Traffic flow characteristics and impact	
Potential safety concerns	
Existence of weather problems	
Existence of environmental concerns	
Truck relevance	
Provision of maps	

Report 2: methods of classification of the Operating Environments

Annex B: Use of Operating Environments for Service Level definition

This annex gives some examples on the use of Operating Environments.

The first example shows how the Operating Environments are used in describing the service levels of core EasyWay ITC services.

The second example is about individual services and their service level requirements. The example attempts to illustrate that the same service levels tend to apply to very many Operating Environments.

The third example tries to show how the Operating Environments can be used to set service levels to ICT infrastructures. These kinds of decisions are being regularly made by the EasyWay partners. In such a case, the service level demanded in an Operating Environment depends on the different services provided in the Operating Environment, and the decision maker can with the help of such analysis choose the level of service aimed for.

Example 1: Use in EasyWay Deployment Guidelines

The EasyWay Deployment Guidelines present the Levels of Service in each Operating Environments such as below in Figure A2- 1 for Weather information services.

WEATHER INFORMATION SERVICES			EasyWay OPERATING ENVIRONMENT																
Criteria for the Levels of Service [reference TIS - DG06]			C1	T1	T2	T3	T4	R1	R2	R3	R4	R5	R6	R7	R8	S1	S2	N1	N2	P1
User Interface	2	Information available is capable of being provided independent of language																	
	B	Data available is capable of being provided in a common and shared language	O	O	O	O	O	O	O	O	OM	O	O	O	O	O	O	O	O	O
	A	One fixed language (all official languages)	M	M	M	M	M	M	M	M		M	M	M	M	M	M	M	M	M
Neighbouring Provision	C	Neighbouring and beyond information provider exchange																	
	B	Information exchange to neighbouring only	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
	A	No information exchange	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Local and secondary Network Information	C	Additional information on local routes with impact on the TEN-T (road network).	O																
	B	Exchange and use for strategic non TEN-T road network (key roads)		O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
	A	Only information on TEN-T (road network)	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Level of Information	C	Weather information and weather warning nowcast and forecast	O		O		O		O		O		O		O	O	O	O	O	O
	B	Weather information and weather warning nowcast		O		O		O		O		O		O						
	A	Weather information	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Recommendations for LoS per OE:			M Minimum LoS recommended							O Optimum LoS recommended									
			OM Minimum = Optimum							NA Non applicable									

Figure A2- 1: Operating Environments in a Levels of Service table of the EasyWay Deployment Guidelines.

Note that in these descriptions, M stands for the minimum and O for the optimum (recommended) level of service. As seen from the example, it may be useful to combine all Operating Environments having the same level of service in order to simplify the table.

Example 2: ITS Services A and B

One way to describe the service or quality level requirements for ITS services which depend on the Operating Environment is shown in Table A2- 1. Based on the ITS services (e.g. ITS service A and B) the relevant Operating Environment is assigned to each service and the minimum service level requirements are defined with the help

of 5 parameters. This description is particularly suitable if the minimum service level requirements are similar for different Operating Environments.

ITS service	Operating Environment	Coverage (indicative % of road network length)	Availability (indicative % of time available)	Timeliness (indicative min - time difference between event and information)	Accuracy (indicative % of information being correct enough)	Consistency (indicative % of degree of similarity of services in time and space)
A	All except for R1-R2	>X%	>A%	< B min	>D%	>E%
	R1, R2	>Y%	>A%	< C min	>D%	>F%
B	C1 with surroundings	>W%	>G%	< I min	>K%	>M%
	Other	>Z%	>H%	< j min	>L%	>N%

Table A2- 1: Minimum service levels for two ITS Services in different Operating Environments in EasyWay

Example 3: ICT infrastructure for many services

A further possibility to describe the minimum service level requirements for ITS services, depending on the Operating Environment, is shown in Table A2- 2. Based on the Operating Environment, various ITS services are assigned. For these ITS services, the respective minimum service levels are also defined by using the 5 parameters. The minimum service levels are defined separately for each ITS service.

Operating Environment	ITS services	Coverage (indicative % of road network length)	Availability (indicative % of time available)	Timeliness (indicative min - time difference between event and information)	Accuracy (indicative % of information being correct enough)	Consistency (indicative % of degree of similarity of services in time and space)
C1 critical spots,	A	>X%	>H%	< P min	>J%	>E%
local flow-related traffic impact and/or	B					
critical potential safety concerns	C	>Y%	>I%	<R min	>K%	>E%
	D					
	E					
	F	>Z%	>J%	< S min	>L %	>F%
T1 motorway(link),	A	>W%	>L%	< T min	>M%	>G%
No flow-related traffic impact,	C	>XA%	>L%	< R min	>N%	>G%
no critical safety concerns						
T2 motorway(link),	A	>YC%	>G%	< S min	>K%	>F%
no flow-related traffic impact,	D	>XB%	>I%	< P min	>L%	>F%
critical potential safety concerns	E					
T3 motorway(link),	A	>YC%	>L%	< O min	>M%	>E%
daily flow-related traffic impact,	C	>WD%	>J%	< N min	>N%	>E%
no critical safety concerns	E					
T4 motorway(link),	A	>WE%	>G%	< T min	>K%	>E%
daily flow-related traffic impact,	D	>XF%	>J%	< S min	>L%	>E%
critical potential safety concerns	E					
R1 two-lane roads,	etc.	etc.	etc.	etc.	etc.	etc.
no flow-related traffic impact,						
no critical safety concerns						
Etc. for the other Operating Environments						

Table A2- 2: Recommended service levels for ICT infrastructure for ITS Services in different Operating Environments in EasyWay

3 Part B: Supplementary Information

The EasyWay Deployment Guidelines contain two main elements:

- *Part A elaborates on the content of the ITS service addressed, describing the entire deployment framework including Requirements and Levels of Services.*
- *Part B is an appendix of informative content. Its objective is to illustrate part A with examples and feedback from deployments in the field.*

Part B is a lively chapter – in contrast to Part A, which by nature should be stable for a certain time – and subject to continuous development and update. The focus of Part B lies on national practices and experiences which, as cross-fertilisation material, can benefit any road operator in Europe and which are documented in Chapter "3.1 Best Practice" consisting of two main sections:

Examples of deployment 2010 - 2012

This section consists of contributions delivered by those EasyWay-Partners that have actively participated in the development and editing of the EW Deployment Guidelines 2012. Against this background, the examples - in detail listed in Chapter "3.1.1 Examples of deployments 2010 - 2012" – reflect the state of the art at the end of the year 2012. As such they delivered the basis for the discussion of the EW-deployment guideline development process and the setup of Part A "Harmonization requirements" at this point in time. But this means also that no direct relation or compliance to the harmonization requirements of Part A (as they are listed in the Compliance checklists in Annex A) can be assumed for these examples. Nevertheless, the given examples provide a concrete documentation of the state of the art at that time and in most cases, they can still be considered as current best practice.

EIP/EIP+ user and application survey 2013 - 2015

In trying to keep Part B up-to-date, the EasyWay follow up project EIP (European ITS Platform) – launched in 2013 – started two phases of activities to contribute to Part B by collecting user as well as application experiences (both technical and organisational) of national deployments that applied or at least considered the EW-DG 2012:

- *In the time period from the beginning of 2013 to the end of 2014, the EIP work programme provided essential post-processing steps to improve the usability of the DGs in ITS deployments and further to reflect the initial experiences and feedback gained with the guidelines since their release at the end of the year 2012.*
- *In 2015, the EIP+ work programme contained a follow-up activity with the goal to monitor and collect feedback on the application of the DGs in the five European ITS Deployment Corridor projects and to consolidate reporting of the results, lessons learned and best practices concerning the DG practicability and the compliance with the DG requirements on a European scale.*

The results of those two activities are based on responses on questionnaires which were circulated to national ITS deployment experts and European ITS corridor projects and finally are reflected in Chapter "3.1.2 EIP/EIP+ user and application survey 2013 - 2015".

3.1 Classification in 2010–2012

3.1.1 Outcome of classification and methods used

During EasyWay 2 all Member States (except Cyprus) and Partners classified the EasyWay road network (over 120 000 km) according to the Operating Environments definition into 18 different operating environments. Classification means that the EasyWay partners have described their actual road network as Operating Environments. By classifying their network into Operating Environments, the partner creates a direct link between an actual road link and the relevance of each Core European ITS Services as the EasyWay Deployment Guidelines provide a recommended service composition and design for each Operating Environment.

Furthermore, network classification gives EasyWay partners a powerful tool to assess the current situation and discuss national and European deployment needs and strategies ahead.

The regular 2-lane road (R1–R4) constitutes approximately 26% of the EasyWay road network, while motorways and other 3-4 lane roads constitute 74% of the road network (Figure 4). The 18 Operating Environments can be categorized into six different physical characteristics (Figure 5). All MSs have used the physical layout of the road for this categorisation. Two MSs (FI, NO) have reported to have applied harmonisation to avoid very short elements.

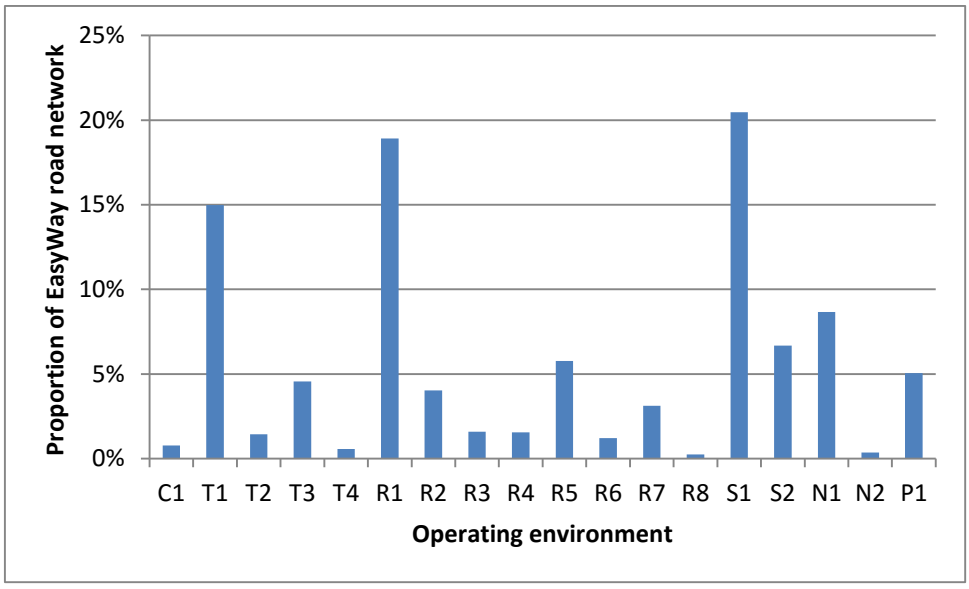

Figure 4. Distribution of EasyWay operating environments on the EasyWay road network (% of EasyWay road network length)

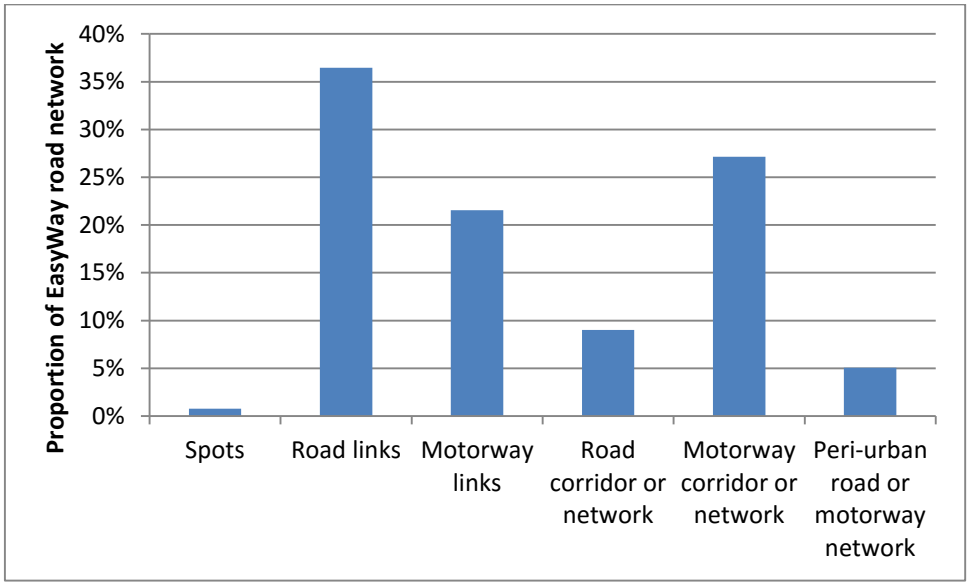

Figure 5: Distribution of physical characteristics (% of EasyWay road network length)

Seasonal or daily flow related impact (OE: C1, T3-4, R3-4, R7-8, N2, P1) was reported on 18% of the EasyWay road network. The method for defining the impact varied from one MS to another. The most typical methods were based on traffic volumes or expert assessment. The thresholds for impact vs. no impact varied between MSs.

Safety concerns were reported on 10% of EasyWay road network. In addition, 41% of road network belong to OE that includes possible safety concerns. The most typical methods for definition of the safety concerns were accident rate, fatality density and EuroRAP classification. Some MSs also used expert opinion.

EasyWay road network without flow related impact or safety concerns totalled 40% (OE: T1, R1, R5). A total of 9% of EasyWay road network suffered both of daily or seasonal flow related impact and safety concerns, excluding critical spots (1%) and peri-urban network (5%) that may also suffer from the same problems.

Approximately 60% of MSs used weather problem attribute in their classification. The approaches taken were several. For example, in a country with annual large-scale weather problems either the whole road network was classified as having weather problems or only the worst road sections were selected. Expert opinion was used in the definition of the sections. Some MSs likely decided not to use the attribute due to rareness of the large-scale weather problems.

Only 35% of MSs used the environmental problems attribute in their classification. Many MSs reported lack of input data as their reason for not using the attribute. Those who used it based the selection of road sections on expert opinion.

The third additional attribute, truck relevance was the most commonly used among the attributes as 75% of the MSs used it in their classification. The method was typically either based on expert opinion or on the amount of heavy traffic (volume or proportion). However, the thresholds varied between MSs.

3.1.2 Conclusions

The main conclusion is that all MSs were able to carry out the classification of its EasyWay road network into operating environments with the 2012 version of the Deployment Guideline. However, the methods in application of the guideline varied. In addition, as expert opinion was used in many cases to define the classes or attributes, it is difficult to assess the approaches chosen. The decision on the preferred methods was in many cases based on tradition of used indicators in that field in the country. Thus, a common method approved by all MSs is challenging to find.

When assessing the distribution of classes used, one conclusion that could be drawn is that a very small part (1%) of the network is classified as critical spots. However, any problems in these spots typically affect large

parts of the surrounding road network. Thereby, these critical spots still require specific attention, sometimes with additional services and very often with higher than average service and quality levels.

It can be also seen that quite a few OEs cover at most around 1% of the network lengths, which would indicate that perhaps some of these very small OEs could perhaps be merged with each other's. For this purpose, all Deployment Guidelines documents 2012 were analysed to check whether some OEs would have identical or close to identical Level of Service (LoS) requirements enabling their merging. This analysis pointed out very clearly that the LoS requirements varied too much in order to carry out such mergings.

The majority of the network consists of road and motorway links. Nevertheless, one third of the EasyWay network is managed as corridors or network. In other words, traffic management plans for corridors and networks are an important service for EasyWay and common procedures are important to connect corridors and networks with each other.

3.1.3 EIP/EIP+ user and application survey 2013 - 2015

3.1.3.1 Results "Concept and Practicability" questionnaire

- Deployment projects were asked to provide feedback on applicability of deployment guidelines in 2015. Questionnaire on operating environments was added as annex to all the questionnaires related to individual TIS or TMS deployment guidelines. In total, 75 filled operating environments questionnaires were returned covering 13 member states (Austria, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, Poland, Portugal, Slovenia, Spain and Sweden), eight corridors (Arc Atlantique, Baltic-Adriatic Corridor, CROCODILE, MedTIS, NEXT-ITS, NordicWay, Scan-Med and URSA MAJOR) and one port (Hamburg). However, some people had filled several questionnaires (typically related to the same corridor) with identical answers. When the duplicates were filtered out, there were 26 different sets of answers in total.
- The feedback from this set of answers and conclusions based on response distributions are made here. As different corridors are represented with various number of responses and responses represent sometimes the views of the respondent rather than the corridor i.e. the views can vary even within one single corridor project, a majority of responses for certain question may not indicate majority of member states or majority of corridors. Nevertheless, the numbers are presented here to be considered as indicative distribution of opinions. The analysis should be considered qualitative, not quantitative.
- There were more respondents (11) who stated that they would be willing to consider using the criterion that the majority of member states favour among those recommended instead the ones that they are currently using than those who would not be willing to do so (5). The willing ones suggested either accident rate or fatality density or a combination of them both to be used as safety concern criterion. For traffic flow impact, AADT and flow characteristics (proportion of heavy vehicles) were suggested to be used. Those who were not willing to harmonise the criterion, stated reasons like national tradition for certain criteria, how European level agreement seems impossible if it cannot be achieved even within one member state, or worry that local special conditions could not be taken into consideration.

3.1.3.2 Results "Compliance checklists" questionnaire

The opinions related to the importance of operating environments reflecting conditions in each member state were almost equally divided: 13 would favour letting operating environments reflect national conditions and 11 would favour harmonised thresholds over EU. Many respondents refer to large differences in traffic safety, roads network or traffic flow in different parts of Europe. They may see the benefits of harmonised classification thresholds but are sceptic in agreement on those. Some propose step-wise approach where thresholds would be aim to be harmonised over time as e.g. traffic safety evolves. The first step in harmonisation could be to agree on same approach within different regions and operators of a single member state or within single cross-border corridor.

The separation of peri-urban road network from the rest of the network was seen necessary by majority of respondents (16 vs. 7). Urban interface was seen as specific environment where traffic and solutions are

different from the rest of the road network. However, some also stated that traffic safety and AADT will separate the peri-urban roads anyway regardless whether it is a class of its own.

In principle, the classification was seen easy to apply. However, some definitions were seen too general. E.g. the notion of corridor and network were seen ambiguous as the same road can be considered as corridor/ network or motorway/road. Most respondents (21) stated that they were able to complete the operating environment classification with current classes and did not consider anything missing. However, some proposals for new classes were given: tunnels (now classified into critical spots), dual carriageway non-motorways (now classified into 3/4-lane roads), and border-crossing sections (with permanent border control) (now classified into critical spots). Operating environment classes were considered all important. Only one respondent suggested 'Corridor' to be merged into 'Motorway' and 'Road'.

There were supporters both for the current class based system i.e. classes based on combination of attribute values (11) and an attribute based classification system i.e. for each road section just a list of values for each attribute, such as road type, safety concern, flow impact, link/network, etc. (7).

With regards to the classification method, there were clearly more respondents who thought that we could give up the separation of 2- and 3/4-lane roads (17 vs. 6) and who would keep the separation of motorways vs. non-motorways for dual-carriage way roads (14 vs. 7). In practice, the current classification of physical characteristics of the road would then be simplified from the three classes (motorway, 2- and 3/4-lane roads) into two classes (motorways vs. non-motorways). There were some responses in favour of single vs. dual carriageway roads. Class-based system was seen simpler, easier to illustrate and supporting better European level comparisons. Attribute-based system was seen to provide possibilities of more information.

Based on feedback from the corridors, it became clear that the role of operating environments should be clearly defined. On the other hand, it has been used on European level, but on the other hand, it has also been used on national level. If the aim is to use the deployment guidelines for cross-border corridors, the requirements resulting from operating environment classification (and thus the operating environments classification) should be the same in different similar parts of the corridor. If European level evaluations and large multi-member state projects such as corridor projects are the seen as the main user group for the deployment guidelines, many see harmonisation of classification criteria and thresholds beneficial and even necessary. Nevertheless, if consensus over all member states is sought, the detailed level harmonisation of the classification method seems challenging as there were always some respondents with strong opposite views than the majority.

The outcome of the questionnaire can also be seen such that the current, methodologically rather loose way of classifying the operating environments works at least on local level. The corridor projects were able to understand the method and to find the operating environments for which they needed to seek the requirements in TIS and TMS specific deployment guidelines.

3.1.3.3 New best practice examples of deployment 2013-2015

None