



Deliverable D6.7

Draft specification of Road network exchange format

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Table of contents

1	Scope	5
1.1	The EuroRoadS project	5
1.2	The handling of road data.....	5
1.2.1	Data provider	7
1.2.2	Content provider.....	7
1.2.3	Information provider	7
1.2.4	Service provider	7
1.3	Baseline and results from WP6	7
1.4	Deliverables from WP6.....	8
1.4.1	Report of preliminary findings and directions for the specification work	8
1.4.2	Specification of Road Network Information model	8
1.4.3	Specification of core European road data	8
1.4.4	Specification of road network exchange model and Specification of road network exchange format (this document).....	8
1.4.5	Meta-data catalogue	9
1.4.6	Terminology catalogue.....	9
2	References	9
3	Terms, definitions and abbreviated terms	10
4	EuroRoadS exchange format.....	11
4.1	XML and GML	11
4.2	Overview of the EuroRoadS GML schema.....	12
4.3	EuroRoadS.xsd.....	13
4.4	Dataset.xsd	13
4.5	AttributeBase.....	14
4.6	BasicTypes.xsd.....	15
4.7	ERISO19133Profile.xsd.....	16
4.8	Network.....	19
4.9	Network referencing.....	29
4.10	BorderNodeInfo.xsd.....	32
4.11	GradeSeparatedCrossings.xsd	33
4.12	Updates.xsd	33
5	Appendix	38

5.1	Using XLinks to refer remote or cross document elements	38
5.2	Example XML documents	39
5.2.1	Simple topological road network with directly attached attributes.....	39
5.2.2	Simple geometric road network with directly attached attributes.....	43
5.2.3	Separate dataset with BorderNodeInfoFeature	45
5.2.4	Update dataset	46

1 Scope

This document defines a draft road network exchange format for core European road data as specified by the EuroRoadS project. The exchange format is directly derived from the draft road network exchange model [4] according to the rules specified by GML (ISO 19136) [6].

The exchange format is defined as a number of XML schema files that shall be used for the encoding, decoding and validation of EuroRoadS data.

1.1 The EuroRoadS project

EuroRoadS will lay the ground for a pan-European road data infrastructure built on identified user requirements. It will be a key for opening up public sector road information, for promoting public-private partnership and for establishment of important applications.

The main objective for the project is to build a platform for a European road data solution through a specification framework. The framework will consist of specifications for data content and data exchange. The European road information solution will be built and maintained taking full advantage of national road data solutions as well as existing standards. It will make national data available to the market in a harmonised, interoperable and quality assured way.

Core European road data is characterised by having an infrastructural role by:

- functioning as reference data, which means that other kinds of information can and will be linked to the core data
- being of interest for many different kinds of applications (and being a common denominator and integrator between different data suppliers and product and service providers)
- containing information of specific interest for the public sector in its role to support efficient transportation, traffic safety, to handle environmental and social planning, etc
- being a part of the European Spatial Data Infrastructure and thereby, for example, being easily linked to other kinds of reference information, such as geographical names, administrative units, and addresses
- covering (the entire) Europe
- having a structure that is stable over time (even if parts of the data content frequently changes)
- having specific interest for cross border (pan-European) applications.

1.2 The handling of road data

The handling of road data can be described as a business refinement process with four steps (see figure 2.1). The EuroRoadS project will focus on step two, the "Content provider", but will also cover the other three steps in order to guarantee that the specifications and technical solutions being chosen for EuroRoadS will be efficient for the compilation of raw data as well as for the following steps in the refinement process.

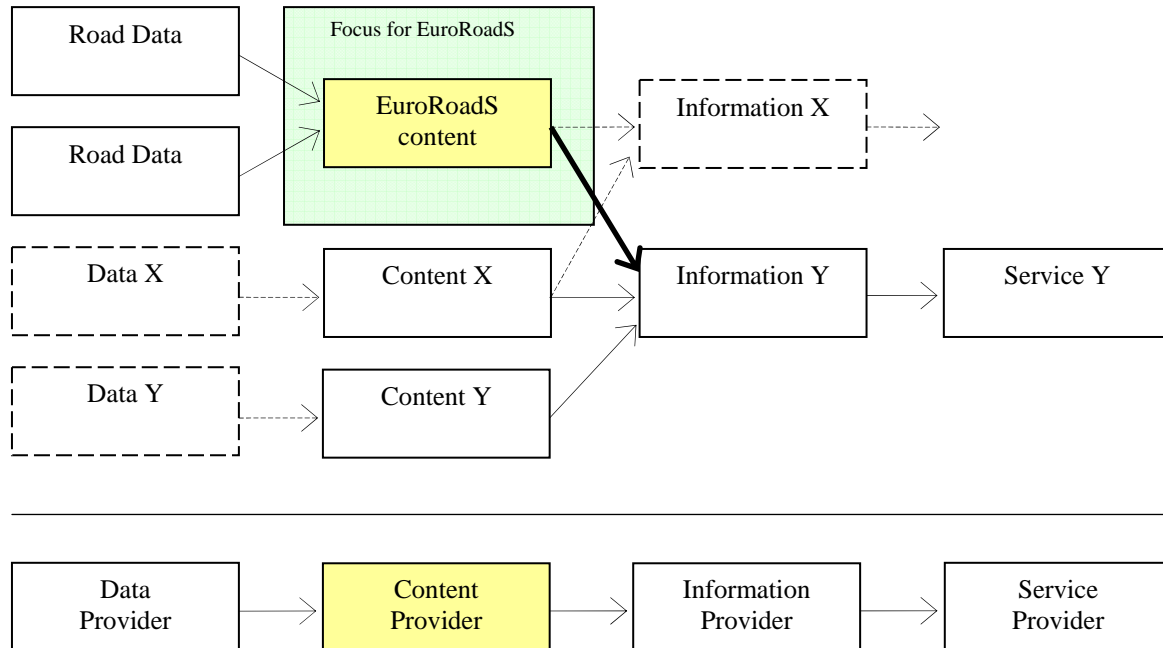


Figure 2.1 Business and data refinement process

Figure 2.1 describes the business and data refinement process, where the end user of data and services is placed to the far right in the figure. Different content providers ideally shall be viewed as keepers of data of a certain domain or possibly also competing providers of data for the same domain. EuroRoadS shall primarily focus on specifications for Content providers for road data.

From a specification development perspective, the business refinement chain can be viewed in the opposite direction (from right to left). In the end, the service users are the ultimate owners of requirements that propagate back all the way to the Data providers.

The business refinement view of EuroRoadS points out that:

- End users will need services that make use of data from different domains.
- Every Content provider can not (or very seldom) be the one and only provider of data for a certain end user service.
- EuroRoadS – will have to be very specific on the question of what is part of the road data domain, and what is not.

Here follows a more in depth description of each step in the information chain.

1.2.1 Data provider

Step one in the information chain includes data capture of different kinds of "raw" data, e.g. existing databases with road networks, geocoded addresses, and information on road technical descriptions, traffic regulations, administrative details, etc. This kind of information is available from national mapping agencies, national road administrations, municipalities and the private mapping industry.

1.2.2 Content provider

Step two is about production – or compilation – of basic data (reference data) needed for many applications, such as intelligent transport systems, mobility management, traffic management, road maintenance, traffic safety, environmental and society planning. This compilation will make use of existing databases with road information, but it is also foreseen that the specification for reference data will have an impact on the future structure of national or regional databases with road data.

1.2.3 Information provider

Step three includes data which are adjusted and "wrapped up" in order to suit a specific application, for example a road map on a CD for a vehicle navigation system.

1.2.4 Service provider

Step four is about more advanced services with different kinds of functions, e.g. to develop a fleet management system due to specific user requirements.

1.3 Baseline and results from WP6

By the end of this project, EuroRoadS will have developed a specification framework built on identified user requirements and developed quality model. The project will also have taken into account existing standards and solutions within the area. EuroRoadS will develop a framework, prepared for a European standard (a profile based on ISO 19 100 components). The framework will consist of:

- **A road network information model** that defines road network objects and a method for how road related objects (attributes) can associate to the network. This common and agreed structure can be the road data "language" of Europe, a harmonised and unified view of how to describe a digital road network.
- **A definition of core European road data** within the proposed structure. This will point out a basic level of data content proposed to be the data set that in the future might be provided to the European market. The European data set should be built on national road database solutions. The future goal is not to establish a European road database. The goal is to be able to, through national contributions of data, transform data and provide it to the market through a uniform data exchange. In many cases existing data, mainly from the public sector (road administrations, mapping agencies, municipalities etc.), will become easily available in this way.

- **A specification of a data exchange model and format** together with a **meta-data catalogue**, showing the characteristics of the accessible information. These specifications can be adopted as the basis of an interface solution, supporting an easy access to European road data defined as above. The data exchange model and format will support exchange of complete data sets and just changes.

1.4 Deliverables from WP6

WP6 will deliver seven official documents, as described below.

1.4.1 Report of preliminary findings and directions for the specification work

The aim of this document was to give recommendations and directions for the work in WP6, especially in the area of road data model, core road data and exchange formats. The recommendations were based on user requirements, existing road data solutions in Europe and standards within the area.

The document will have one version: D6.1

1.4.2 Specification of Road Network Information model

The document includes a definition of the data structure of the road network, and a definition of levels of details and a reference system (e.g. how to reference objects to the road network).

The draft version of this document is D6.2 and the final version is D6.3

1.4.3 Specification of core European road data

The document will include a definition of referred road network and specification of common features (feature types, attribute types and attribute values). It also should contain specified quality levels for the content, generalisation rules for the road network, geodetic reference system to be used and rules for edge-matching at nation borders.

The draft version of this document is D6.4 and the final version is D6.5

1.4.4 Specification of road network exchange model and Specification of road network exchange format (this document)

These two documents will describe the exchange model respective the exchange format.

Data exchange should be specified as a road network exchange model (corresponding to the information model), and a road data exchange format that can communicate road data (both the whole data set and incremental updates) structured as specified in the exchange model.

This interface also should contain a meta-data catalogue showing the characteristics of the accessible information.

The draft version of “exchange model” document will be D6.6 and the final version will be D6.7

The draft version of “exchange format” document will be D6.10 and the final version will be D6.11

1.4.5 Meta-data catalogue

This deliverable is pointed out in the EuroRoadS project specification but not specified in detail. WP6 suggests that the document will be structured as follows: First existing metadata specifications will be investigated. Therefore standards like FGDC, ISO 19110, ISO 19115, GDF as well as catalogues from EuroRoadS partners will be investigated.

Based on this comparison of existing standards and on the road network (document described in chapter 1.4.1) and core road data (document described in chapter 1.4.3) a core metadata specification will be developed. This will include the description as well as the modelling of the metadata elements in UML. The specification will also define the structure for a feature catalogue (which can be viewed as part of the metadata model). The structure of the feature catalogue will be based on ISO 19110 – Feature Cataloguing Methodology or a profile thereof. The actual EuroRoadS feature catalogue (where all EuroRoadS features and attributes are catalogued) will be a part of the Road Network Information model (see 1.4.2) or perhaps the data content specification (see 1.4.3). There will also be a part in the road network exchange format (1.4.4) which will enable the exchange of metadata, including quality data and the feature catalogue.

Furthermore the main results will be concluded and an outlook will be given.

The document will have one version: D6.8

1.4.6 Terminology catalogue

The terminology catalogue will include definitions of road data related terms used in the EuroRoadS project.

The draft version of this document will be D6.9 and the final version will be D6.12

2 References

- [1] EuroRoadS report D6.1 (Report on preliminary findings and directions for the specification work)
- [2] EuroRoadS report D6.3 (Road network information model)
- [3] EuroRoadS report D6.5 (Core European road data)
- [4] EuroRoadS report D6.6 (Road network exchange model)
- [5] EuroRoadS report D6.8 (Metadata catalogue)
- [6] OpenGIS Geography Markup Language (GML) Implementation Specification, version 3.1.0 (will be replaced by GML version 3.2 which is the same as ISO/DIS 19136 – GML)
- [7] ISO/DIS 19118 - Encoding

3 Terms, definitions and abbreviated terms

application schema

conceptual schema for data required by one or more applications [ISO 19101]

attribute

characteristic of a feature

conceptual model

model that defines the concepts of a universe of discourse [ISO 19101]

conceptual schema

formal description of a conceptual model [ISO 19101]

dataset

identifiable collection of data [ISO 19115]

domain

well-defined set

feature

abstraction of real world phenomena

NOTE The term feature is frequently used in GI-systems for classes/relational tables that have an attribute/column which consists of geometry. Sometimes this is confusing as the term in English often actually refers to an attribute or a property (which perhaps would be ok if features are always considered properties of the earth). In EuroRoadS we use the term feature in a wider sense that covers objects or other “abstractions of real world phenomena” that are uniquely identifiable, has a set of characteristics and an independent lifetime.

geographic data

data with implicit or explicit reference to a location relative to the Earth

NOTE Geographic information is also used as a term for information concerning phenomena implicitly or explicitly associated with a location relative to the Earth.

GML

Geography Markup Language. This is the proposed standard for data transfer for EuroRoadS.

metadata

data about data [ISO 19115]

model

abstraction of some aspects of reality

OCL

Object Constraint Language

quality

totality of characteristics of a product that bear on its ability to satisfy stated or implied needs [ISO 19101]

degree to which a set of inherent characteristics fulfils requirements [ISO 9000]

UML

Unified Modeling Language

universe of discourse

view of the real or hypothetical world that includes everything of interest [ISO 19101]

UUID

Universally unique identifier

4 EuroRoadS exchange format

4.1 XML and GML

Extensible Markup Language (XML) is a very flexible text format derived from SGML ([ISO 8879](#)). Originally designed to meet the challenges of large-scale electronic publishing, XML is also playing an increasingly important role in the exchange of a wide variety of data on the Web and elsewhere. XML is a recommendation from w3c (<http://www.w3.org>). There are many associated recommendations adding functionality to XML such as XML schema, XPath, XPointer, XLink etc.

Geography Markup Language (GML) is an XML grammar written in XML schema for the modeling, transport and storage of geographic information. GML has been developed within the Open Geospatial Consortium - OGC (<http://www.opengeospatial.org>). Currently a new version of GML is being developed jointly in OGC and ISO/TC211. The ISO specification will be ISO 19136 – Geography Markup Language. The corresponding OGC specification will be GML 3.2.

The following is quoted from the GML 3.1 specification:

“GML provides a variety of kinds of objects for describing geography including features, coordinate reference systems, geometry, topology, time, units of measure and generalized values.

A geographic feature is "an abstraction of a real world phenomenon; it is a geographic feature if it is associated with a location relative to the Earth". So a digital representation of the real world can be thought of as a set of features. The state of a feature is defined by a set of properties, where each property can be thought of as a {name, type, value} triple. The number of properties a feature may have, together with their names and types, are determined by its type definition. Geographic features with geometry are those with properties that may be geometry-valued. A feature collection is a collection of features that can itself be regarded as a feature; as a consequence a feature collection has a feature type and thus may have distinct properties of its own, in addition to the features it contains."

In order to be conformant with GML, certain rules must be followed. The schema in this document is derived from the EuroRoadS road network information model and adjusted so conformance with GML can be achieved.

Currently, the EuroRoadS schema is based on GML version 3.1 which is the latest official version. The ISO 19136 version of GML will have to be supported as soon as it is available.

4.2 Overview of the EuroRoadS GML schema

The EuroRoadS GML schema is defined with one xsd schema file for every package defined in the road network exchange model [4] (see chapter 6.2 in that document). The correspondence between the package- and xsd file structures is described in the table below.

Package	Xsd file	Remark
	EuroRoadS.xsd	No corresponding package but is the main EuroRoadS xsd file that includes all the other schema files.
Dataset	Dataset.xsd	Described in chapter 4.4
Attribute base	AttributeBase.xsd	Described in chapter 4.5
Basic types	BasicTypes.xsd	Described in chapter 4.6
ISO 19133 Profile	ERISO19133Profile.xsd	Described in chapter 4.7
Network	Network.xsd	Described in chapter 4.8
Network referencing	NetworkReferencing.xsd	Described in chapter 4.9
Border node info	BorderNodeInfo.xsd	Described in chapter 4.10
Grade separated crossings	GradeSeparatedCrossings.xsd	Described in chapter 4.11
Updates	Updates.xsd	Described in chapter 4.12

4.3 EuroRoadS.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:er="www.euroroads.org" xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:gml="http://www.opengis.net/gml" targetNamespace="www.euroroads.org" elementFormDefault="qualified"
attributeFormDefault="unqualified">
  <xs:annotation>
    <xs:documentation>Main schema file for the EuroRoadS exchange schema, version
1.0</xs:documentation>
  </xs:annotation>
  <xs:import namespace="http://www.opengis.net/gml" schemaLocation="./base/gml.xsd"/>
  <xs:import namespace="http://www.w3.org/1999/xlink" schemaLocation="./xlink/xlinks.xsd"/>
  <xs:include schemaLocation="BasicTypes.xsd"/>
  <xs:include schemaLocation="AttributeBase.xsd"/>
  <xs:include schemaLocation="Network.xsd"/>
  <xs:include schemaLocation="Dataset.xsd"/>
  <xs:include schemaLocation="BorderNodeInfo.xsd"/>
  <xs:include schemaLocation="GradeSeparatedCrossings.xsd"/>
  <xs:include schemaLocation="ERISO19133Profile.xsd"/>
  <xs:include schemaLocation="NetworkReferencing.xsd"/>
  <xs:include schemaLocation="Updates.xsd"/>
</xs:schema>
```

4.4 Dataset.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:er="www.euroroads.org" xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:gml="http://www.opengis.net/gml" targetNamespace="www.euroroads.org" elementFormDefault="qualified"
attributeFormDefault="unqualified">
  <xs:import namespace="http://www.opengis.net/gml" schemaLocation="./base/gml.xsd"/>
  <xs:import namespace="http://www.w3.org/1999/xlink" schemaLocation="./xlink/xlinks.xsd"/>
  <xs:annotation>
    <xs:documentation>GML schema definition for root element of the EuroRoadS exchange
model</xs:documentation>
  </xs:annotation>
  <!--=====-->
  <xs:complexType name="EuroRoadSDatasetType">
    <xs:annotation>
      <xs:documentation>Root element of the EuroRoadS exchange schema (complete
datasets)</xs:documentation>
    </xs:annotation>
    <xs:complexContent>
      <xs:extension base="gml:AbstractFeatureCollectionType">
        <xs:sequence>
          <xs:element name="properties" type="er:EuroRoadSDatasetPropertiesType"/>
        </xs:sequence>
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>
  <xs:element name="EuroRoadSDataset" type="er:EuroRoadSDatasetType"
substitutionGroup="gml:_FeatureCollection"/>
  <!--=====-->
  <xs:complexType name="EuroRoadSUpdateDatasetType">
    <xs:annotation>
      <xs:documentation>Root element of the EuroRoadS exchange schema (updates)</xs:documentation>
    </xs:annotation>
    <xs:complexContent>
      <xs:extension base="gml:AbstractFeatureCollectionType">
        <xs:sequence>
          <xs:element name="properties" type="er:EuroRoadSDatasetPropertiesType"/>
        </xs:sequence>
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>
```

```

        </xs:sequence>
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>
  <xs:element name="EuroRoadSUpdateDataset" type="er:EuroRoadSUpdateDatasetType"
substitutionGroup="gml:_FeatureCollection"/>
<!--=====-->
<xs:complexType name="EuroRoadSDatasetPropertiesType">
  <xs:annotation>
    <xs:documentation>Properties of a EuroRoadS dataset</xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element name="id" type="xs:string"/>
    <xs:element name="timestamp" type="gml:TimeInstantType"/>
  </xs:sequence>
</xs:complexType>
</xs:schema>

```

4.5 AttributeBase

```

<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:er="http://www.euroroads.org" xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:gdf="http://www.ukusa.org"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:gml="http://www.opengis.net/gml"
targetNamespace="http://www.euroroads.org" elementFormDefault="qualified" attributeFormDefault="unqualified">
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS AttributeBase package, version
1.0</xs:documentation>
  </xs:annotation>
  <xs:import namespace="http://www.opengis.net/gml" schemaLocation="./base/gml.xsd"/>
  <xs:import namespace="http://www.w3.org/1999/xlink" schemaLocation="./xlink/xlinks.xsd"/>
  <!--=====-->
  <xs:complexType name="RoadAttributeType" abstract="true">
    <xs:annotation>
      <xs:documentation>GML definition of the EuroRoadS class ER_RoadAttribute</xs:documentation>
    </xs:annotation>
    <xs:sequence>
      <xs:element name="validity" type="gml:TimePeriodType" minOccurs="0"/>
    </xs:sequence>
  </xs:complexType>
  <xs:element name="RoadAttribute" type="er:RoadAttributeType" abstract="true"/>
  <!--=====-->
  <xs:complexType name="RoadNodeAttributeType" abstract="true">
    <xs:annotation>
      <xs:documentation>GML definition of the EuroRoadS class
ER_RoadNodeAttribute</xs:documentation>
    </xs:annotation>
    <xs:complexContent>
      <xs:extension base="er:RoadAttributeType"/>
    </xs:complexContent>
  </xs:complexType>
  <xs:element name="RoadNodeAttribute" type="er:RoadNodeAttributeType" abstract="true"
substitutionGroup="er:RoadAttribute"/>
  <!--=====-->
  <xs:complexType name="LinkAttributeType" abstract="true">
    <xs:annotation>
      <xs:documentation>GML definition of the EuroRoadS class ER_LinkAttribute</xs:documentation>
    </xs:annotation>
    <xs:complexContent>
      <xs:extension base="er:RoadAttributeType"/>
    </xs:complexContent>
  </xs:complexType>

```

```

<xs:element name="LinkAttribute" type="er:LinkAttributeType" abstract="true"
substitutionGroup="er:RoadAttribute"/>
<!--=====-->
<xs:complexType name="RoadLinkAttributeType" abstract="true">
  <xs:annotation>
    <xs:documentation>GML definition of the EuroRoadS class
ER_RoadLinkAttribute</xs:documentation>
  </xs:annotation>
  <xs:complexContent>
    <xs:extension base="er:RoadAttributeType"/>
  </xs:complexContent>
</xs:complexType>
<xs:element name="RoadLinkAttribute" type="er:RoadLinkAttributeType" abstract="true"
substitutionGroup="er:RoadAttribute"/>
<!--=====-->
<xs:complexType name="FerryLinkAttributeType" abstract="true">
  <xs:annotation>
    <xs:documentation>GML definition of the EuroRoadS class ER_FerryLinkAttribute</xs:documentation>
  </xs:annotation>
  <xs:complexContent>
    <xs:extension base="er:RoadAttributeType"/>
  </xs:complexContent>
</xs:complexType>
<xs:element name="FerryLinkAttribute" type="er:FerryLinkAttributeType" abstract="true"
substitutionGroup="er:RoadAttribute"/>
<!--=====-->
<xs:complexType name="RoadnetElementAttributeType" abstract="true">
  <xs:annotation>
    <xs:documentation>GML definition of the EuroRoadS class
ER_RoadnetElementAttribute</xs:documentation>
  </xs:annotation>
  <xs:complexContent>
    <xs:extension base="er:RoadAttributeType"/>
  </xs:complexContent>
</xs:complexType>
<xs:element name="RoadnetElementAttribute" type="er:RoadnetElementAttributeType" abstract="true"
substitutionGroup="er:RoadAttribute"/>
<!--=====-->
<xs:complexType name="ComplexRoadnetElementAttributeType" abstract="true">
  <xs:annotation>
    <xs:documentation>GML definition of the EuroRoadS class
ER_ComplexRoadnetElementAttribute</xs:documentation>
  </xs:annotation>
  <xs:complexContent>
    <xs:extension base="er:RoadAttributeType"/>
  </xs:complexContent>
</xs:complexType>
<xs:element name="ComplexRoadnetElementAttribute" type="er:ComplexRoadnetElementAttributeType"
abstract="true" substitutionGroup="er:RoadAttribute"/>
<!--=====-->
</xs:schema>

```

4.6 BasicTypes.xsd

```

<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:er="www.euroroads.org" xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns:gml="http://www.opengis.net/gml" targetNamespace="www.euroroads.org" elementFormDefault="qualified"
attributeFormDefault="unqualified">
  <xs:import namespace="http://www.opengis.net/gml" schemaLocation="base\gml.xsd"/>
  <xs:include schemaLocation="AttributeBase.xsd"/>
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS BasicTypes package, version
1.0</xs:documentation>

```

```

</xs:annotation>
<!--=====-->
<xs:complexType name="ObjectIdType">
  <xs:annotation>
    <xs:documentation>GML definition of the EuroRoadS class ER_ObjectId</xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element name="permanentId" type="xs:string"/>
    <xs:element name="versionId" type="xs:string" minOccurs="0"/>
    <xs:element name="alternatId" type="xs:string" minOccurs="0"/>
  </xs:sequence>
</xs:complexType>
<!--=====-->
<xs:complexType name="RoadFeatureType" abstract="true">
  <xs:annotation>
    <xs:documentation>GML definition of the EuroRoadS class ER_RoadFeature</xs:documentation>
  </xs:annotation>
  <xs:complexContent>
    <xs:extension base="gml:AbstractFeatureType">
      <xs:sequence>
        <xs:element name="id" type="er:ObjectIdType"/>
      </xs:sequence>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
<xs:complexType name="RoadFeaturePropertyType">
  <xs:annotation>
    <xs:documentation>GML property type definition for RoadFeatureType</xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element ref="er:RoadFeature" minOccurs="0"/>
  </xs:sequence>
  <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
</xs:complexType>
<xs:element name="RoadFeature" abstract="true" substitutionGroup="gml:_Feature">
  <xs:annotation>
    <xs:documentation>Root of the ER_RoadFeature substitution group</xs:documentation>
  </xs:annotation>
</xs:element>
<!--=====-->
</xs:schema>

```

4.7 ERISO19133Profile.xsd

```

<?xml version="1.0" encoding="UTF-8"?>
<!-- edited with XMLSpy v2005 rel. 3 U (http://www.altova.com) by Lars Bergström (Triona AB) -->
<xs:schema xmlns:er="http://www.euroroads.org" xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  xmlns:gml="http://www.opengis.net/gml" targetNamespace="http://www.euroroads.org" elementFormDefault="qualified"
  attributeFormDefault="unqualified">
  <xs:import namespace="http://www.opengis.net/gml" schemaLocation="http://www.euroroads.org/base/gml.xsd"/>
  <xs:import namespace="http://www.w3.org/1999/xlink" schemaLocation="http://www.w3.org/1999/xlink/xlinks.xsd"/>
  <xs:include schemaLocation="http://www.euroroads.org/NetworkReferencing.xsd"/>
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS profile of ISO 19133</xs:documentation>
  </xs:annotation>
  <!--=====-->
  <xs:complexType name="LinearReferenceMethodType">
    <xs:annotation>
      <xs:documentation>GML definition for the ISO 19133 class
      LR_LinearReferenceMethod</xs:documentation>
    </xs:annotation>
    <xs:sequence>

```

```

    <xs:element name="name" type="xs:string"/>
    <xs:element name="type" type="xs:string"/>
    <xs:element name="units" type="gml:UnitOfMeasureType"/>
    <xs:element name="offsetUnits" type="gml:UnitOfMeasureType"/>
    <xs:element name="positiveOffsetDirection"/>
  </xs:sequence>
</xs:complexType>
<xs:complexType name="LinearReferenceMethodPropertyType">
  <xs:annotation>
    <xs:documentation>GML property type definition for LinearReferenceMethodType</xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element ref="er:LinearReferenceMethod" minOccurs="0"/>
  </xs:sequence>
  <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
</xs:complexType>
<xs:element name="LinearReferenceMethod" type="er:LinearReferenceMethodType"/>
<!--=====-->
<xs:complexType name="ISO_LRPositionExpressionType">
  <xs:annotation>
    <xs:documentation>GML definition for the ISO 19133 class LR_PositionExpression
  </xs:documentation>
  <xs:annotation>
  </xs:annotation>
  <xs:sequence>
    <xs:element name="referent" type="er:ReferenceMarkerPropertyType" minOccurs="0"/>
    <xs:element name="offset" type="er:OffsetExpressionType" minOccurs="0"/>
    <xs:element name="LRM" type="er:LinearReferenceMethodPropertyType"/>
    <xs:element name="measure" type="gml:MeasureType"/>
    <xs:element name="referenceDomain" type="er:ISO_LRElementType" minOccurs="0"/>
  </xs:sequence>
</xs:complexType>
<xs:element name="ISO_LRPositionExpression" type="er:ISO_LRPositionExpressionType"/>
<!--=====-->
<xs:complexType name="OffsetExpressionType">
  <xs:annotation>
    <xs:documentation>GML definition for the ISO 19133 class LR_OffsetExpression</xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element name="offsetReference" type="er:OffsetReferenceType"/>
    <xs:element name="offset" type="gml:MeasureType" minOccurs="0"/>
  </xs:sequence>
</xs:complexType>
<!--=====-->
<xs:complexType name="ReferenceMarkerType">
  <xs:annotation>
    <xs:documentation>GML definition for the ISO 19133 class LR_ReferenceMarker</xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element name="name" type="xs:string"/>
    <xs:element name="type" type="xs:string"/>
    <xs:element name="position" type="gml:PointType" minOccurs="0"/>
    <xs:element name="location" type="er:ISO_LRPositionExpressionType" minOccurs="0"/>
    <xs:element name="element" type="er:ISO_LRElementType"/>
  </xs:sequence>
</xs:complexType>
<xs:complexType name="ReferenceMarkerPropertyType">
  <xs:annotation>
    <xs:documentation>GML property type for ReferenceMarkerType</xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element ref="er:ReferenceMarker" minOccurs="0"/>
  </xs:sequence>
  <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
</xs:complexType>

```

```

<xs:element name="ReferenceMarker" type="er:ReferenceMarkerType"/>
<!--=====-->
<xs:complexType name="ISO_LRElementType" abstract="true">
  <xs:annotation>
    <xs:documentation>GML definition for the ISO 19133 class LR_Element</xs:documentation>
  </xs:annotation>
</xs:complexType>
<xs:element name="ISO_LRElement" type="er:ISO_LRElementType" abstract="true">
  <xs:annotation>
    <xs:documentation>Root of the LinearElement substitutionGroup</xs:documentation>
  </xs:annotation>
</xs:element>
<!--=====-->
<xs:simpleType name="OffsetDirectionType">
  <xs:restriction base="xs:string">
    <xs:enumeration value="left"/>
    <xs:enumeration value="right"/>
  </xs:restriction>
</xs:simpleType>
<!--=====-->
<xs:simpleType name="OffsetReferenceType">
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS class
LR_OffsetReference</xs:documentation>
  </xs:annotation>
  <xs:union memberTypes="er:OffsetReferenceEnumerationType er:OffsetReferenceOtherType"/>
</xs:simpleType>
<xs:simpleType name="OffsetReferenceEnumerationType">
  <xs:restriction base="xs:string">
    <xs:enumeration value="1">
      <xs:annotation>
        <xs:appinfo source="urn:x-gml:codelistValue">centerLine</xs:appinfo>
      </xs:annotation>
    </xs:enumeration>
    <xs:enumeration value="2">
      <xs:annotation>
        <xs:appinfo source="urn:x-gml:codelistValue">edgeOfTravel</xs:appinfo>
      </xs:annotation>
    </xs:enumeration>
    <xs:enumeration value="3">
      <xs:annotation>
        <xs:appinfo source="urn:x-gml:codelistValue">edgeOfPavement</xs:appinfo>
      </xs:annotation>
    </xs:enumeration>
    <xs:enumeration value="4">
      <xs:annotation>
        <xs:appinfo source="urn:x-gml:codelistValue">rightOfWay</xs:appinfo>
      </xs:annotation>
    </xs:enumeration>
    <xs:enumeration value="5">
      <xs:annotation>
        <xs:appinfo source="urn:x-gml:codelistValue">curbFace</xs:appinfo>
      </xs:annotation>
    </xs:enumeration>
    <xs:enumeration value="6">
      <xs:annotation>
        <xs:appinfo source="urn:x-gml:codelistValue">curbBack</xs:appinfo>
      </xs:annotation>
    </xs:enumeration>
    <xs:enumeration value="7">
      <xs:annotation>
        <xs:appinfo source="urn:x-gml:codelistValue">edgeOfShoulder</xs:appinfo>
      </xs:annotation>
    </xs:enumeration>
  </xs:restriction>

```

```

    <xs:enumeration value="8">
      <xs:annotation>
        <xs:appinfo source="urn:x-gml:codelistValue">edgeOfBerm</xs:appinfo>
      </xs:annotation>
    </xs:enumeration>
    <xs:enumeration value="9">
      <xs:annotation>
        <xs:appinfo source="urn:x-gml:codelistValue">walkwayInside</xs:appinfo>
      </xs:annotation>
    </xs:enumeration>
    <xs:enumeration value="10">
      <xs:annotation>
        <xs:appinfo source="urn:x-gml:codelistValue">walkwayOutside</xs:appinfo>
      </xs:annotation>
    </xs:enumeration>
    <xs:enumeration value="centerLine"/>
    <xs:enumeration value="edgeOfTravel"/>
    <xs:enumeration value="edgeOfPavement"/>
    <xs:enumeration value="rightOfWay"/>
    <xs:enumeration value="curbFace"/>
    <xs:enumeration value="curbBack"/>
    <xs:enumeration value="edgeOfShoulder"/>
    <xs:enumeration value="edgeOfBerm"/>
    <xs:enumeration value="walkwayInside"/>
    <xs:enumeration value="walkwayOutside"/>
  </xs:restriction>
</xs:simpleType>
<xs:simpleType name="OffsetReferenceOtherType">
  <xs:restriction base="xs:string">
    <xs:pattern value="other:\w{2,}"/>
  </xs:restriction>
</xs:simpleType>
<!------->
</xs:schema>

```

4.8 Network

```

<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:er="http://www.euroroads.org" xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:gdf="http://www.ukusa.org"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:gml="http://www.opengis.net/gml"
  targetNamespace="http://www.euroroads.org" elementFormDefault="qualified" attributeFormDefault="unqualified">
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS Network package, version
1.0</xs:documentation>
  </xs:annotation>
  <xs:import namespace="http://www.opengis.net/gml" schemaLocation="http://www.opengis.net/gml/base/gml.xsd"/>
  <xs:import namespace="http://www.w3.org/1999/xlink" schemaLocation="http://www.w3.org/1999/xlink/xlinks.xsd"/>
  <xs:include schemaLocation="http://www.euroroads.org/schemas/BasicTypes.xsd"/>
  <xs:include schemaLocation="http://www.euroroads.org/schemas/AttributeBase.xsd"/>
  <xs:include schemaLocation="http://www.euroroads.org/schemas/BorderNodeInfo.xsd"/>
  <xs:include schemaLocation="http://www.euroroads.org/schemas/GradeSeparatedCrossings.xsd"/>
  <!------->
  <xs:complexType name="NodeType">
    <xs:annotation>
      <xs:documentation>GML schema definition for the EuroRoadS class ER_Node</xs:documentation>
    </xs:annotation>
    <xs:complexContent>
      <xs:extension base="gml:NodeType">
        <xs:sequence>
          <xs:element name="roadNode" type="er:RoadNodePropertyType"/>
        </xs:sequence>
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>

```

```

    </xs:complexContent>
  </xs:complexType>
  <xs:complexType name="NodePropertyType">
    <xs:annotation>
      <xs:documentation>GML property type definition for NodeType</xs:documentation>
    </xs:annotation>
    <xs:sequence>
      <xs:element ref="er:Node" minOccurs="0"/>
    </xs:sequence>
    <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
  </xs:complexType>
  <xs:element name="Node" type="er:NodeType" substitutionGroup="gml:_TopoPrimitive"/>
  <!--=====-->
  <xs:complexType name="EdgeType">
    <xs:annotation>
      <xs:documentation>GML schema definition for the EuroRoadS class ER_Edge</xs:documentation>
    </xs:annotation>
    <xs:complexContent>
      <xs:extension base="gml:EdgeType">
        <xs:sequence>
          <xs:element name="roadnetLink" type="er:RoadnetLinkPropertyType"/>
        </xs:sequence>
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>
  <xs:complexType name="EdgePropertyType">
    <xs:annotation>
      <xs:documentation>GML property type definition for EdgeType</xs:documentation>
    </xs:annotation>
    <xs:sequence>
      <xs:element ref="er:Edge" minOccurs="0"/>
    </xs:sequence>
    <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
  </xs:complexType>
  <xs:element name="Edge" type="er:EdgeType" substitutionGroup="gml:_TopoPrimitive"/>
  <!--=====-->
  <xs:complexType name="RoadnetElementType" abstract="true">
    <xs:annotation>
      <xs:documentation>GML schema definition for the EuroRoadS class
ER_RoadnetElement</xs:documentation>
    </xs:annotation>
    <xs:complexContent>
      <xs:extension base="er:RoadFeatureType">
        <xs:sequence>
          <xs:element name="mapsToAtLowerLevel" type="er:DetailLevelMappingType" minOccurs="0"
maxOccurs="unbounded"/>
          <xs:element name="attributes" minOccurs="0" maxOccurs="unbounded">
            <xs:complexType>
              <xs:sequence>
                <xs:element ref="er:RoadAttribute"/>
              </xs:sequence>
            </xs:complexType>
          </xs:element>
        </xs:sequence>
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>
  <xs:complexType name="RoadnetElementPropertyType">
    <xs:annotation>
      <xs:documentation>GML property type definition for RoadnetElementType</xs:documentation>
    </xs:annotation>
    <xs:sequence>
      <xs:element ref="er:RoadnetElement" minOccurs="0"/>
    </xs:sequence>
  </xs:complexType>

```

```

    <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
  </xs:complexType>
  <xs:element name="RoadnetElement" type="er:RoadnetElementType" abstract="true"
substitutionGroup="er:RoadFeature">
    <xs:annotation>
      <xs:documentation>GML schema definition for the EuroRoadS ER_RoadnetElement class. Root
element of the ER_RoadnetElement substitution group</xs:documentation>
    </xs:annotation>
  </xs:element>
<!--=====-->
  <xs:complexType name="DetailLevelMappingType">
    <xs:annotation>
      <xs:documentation>GML schema definition for the EuroRoadS class
ER_DetailLevelMapping</xs:documentation>
    </xs:annotation>
    <xs:sequence>
      <xs:element name="validity" type="gml:TimePeriodType" minOccurs="0"/>
      <xs:element name="lowerLevelElement" type="er:RoadnetElementPropertyType"/>
    </xs:sequence>
  </xs:complexType>
<!--=====-->
  <xs:complexType name="RoadNodeType">
    <xs:annotation>
      <xs:documentation>GML schema definition for the EuroRoadS class
ER_RoadNode</xs:documentation>
    </xs:annotation>
    <xs:complexContent>
      <xs:extension base="er:RoadnetElementType">
        <xs:sequence>
          <xs:element name="level" type="er:RoadNodeLevelType"/>
          <xs:element name="formOfNode" type="er:FormOfNodeType" minOccurs="0"/>
          <xs:element name="point" minOccurs="0">
            <xs:complexType>
              <xs:sequence>
                <xs:element ref="gml:Point"/>
              </xs:sequence>
            </xs:complexType>
          </xs:element>
          <xs:element name="surface" minOccurs="0">
            <xs:complexType>
              <xs:sequence>
                <xs:element ref="gml:_Surface"/>
              </xs:sequence>
            </xs:complexType>
          </xs:element>
          <xs:element name="node" minOccurs="0">
            <xs:complexType>
              <xs:sequence>
                <xs:element ref="er:Node"/>
              </xs:sequence>
            </xs:complexType>
          </xs:element>
        </xs:sequence>
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>
  <xs:complexType name="RoadNodePropertyType">
    <xs:annotation>
      <xs:documentation>GML property type definition for RoadNodeType</xs:documentation>
    </xs:annotation>
    <xs:sequence>
      <xs:element name="RoadNode" minOccurs="0"/>
    </xs:sequence>
  </xs:complexType>
  <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>

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```

</xs:complexType>
<xs:element name="RoadNode" type="er:RoadNodeType" substitutionGroup="er:RoadnetElement">
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS ER_RoadNode
class</xs:documentation>
  </xs:annotation>
</xs:element>
<!--=====-->
<xs:complexType name="RoadnetLinkType" abstract="true">
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS class
ER_RoadnetLink</xs:documentation>
  </xs:annotation>
  <xs:complexContent>
    <xs:extension base="er:RoadnetElementType">
      <xs:sequence>
        <xs:element name="validity" type="gml:TimePeriodType" minOccurs="0"/>
        <xs:element name="curve" minOccurs="0">
          <xs:complexType>
            <xs:sequence>
              <xs:element ref="gml:_Curve"/>
            </xs:sequence>
          </xs:complexType>
        </xs:element>
        <xs:element name="edge" minOccurs="0">
          <xs:complexType>
            <xs:sequence>
              <xs:element ref="er:Edge"/>
            </xs:sequence>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
<xs:complexType name="RoadnetLinkPropertyType">
  <xs:annotation>
    <xs:documentation>GML property type definition for RoadnetLinkType</xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element ref="er:RoadnetLink" minOccurs="0"/>
  </xs:sequence>
  <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
</xs:complexType>
<xs:element name="RoadnetLink" type="er:RoadnetLinkType" abstract="true"
substitutionGroup="er:RoadnetElement">
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS ER_RoadnetLink class. Root element
of the ER_RoadnetLink substitution group</xs:documentation>
  </xs:annotation>
</xs:element>
<!--=====-->
<xs:complexType name="ComplexRoadnetElementType">
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS class
ER_ComplexRoadnetElement</xs:documentation>
  </xs:annotation>
  <xs:complexContent>
    <xs:extension base="er:RoadnetElementType">
      <xs:sequence>
        <xs:element name="formOfComplexElement" type="er:FormOfComplexElementType"/>
      </xs:sequence>
    </xs:extension>
  </xs:complexContent>

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</xs:complexType>
<xs:element name="ComplexRoadnetElement" type="er:ComplexRoadnetElementType"
substitutionGroup="er:RoadnetElement">
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS ER_ComplexRoadnetElement class.
  </xs:documentation>
  </xs:annotation>
</xs:element>
<!--=====-->
<xs:complexType name="RoadLinkType">
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS class
ER_RoadLink</xs:documentation>
  </xs:annotation>
  <xs:complexContent>
    <xs:extension base="er:RoadnetLinkType">
      <xs:sequence>
        <xs:element name="level" type="er:RoadLinkLevelType"/>
        <xs:element name="formOfWay" type="er:FormOfWayType"/>
        <xs:element name="nationalRoadClass" type="er:NationalRoadClassType"/>
      </xs:sequence>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
<xs:element name="RoadLink" type="er:RoadLinkType" substitutionGroup="er:RoadnetLink">
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS ER_RoadLink
class</xs:documentation>
  </xs:annotation>
</xs:element>
<!--=====-->
<xs:complexType name="FerryLinkType">
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS class
ER_FerryLink</xs:documentation>
  </xs:annotation>
  <xs:complexContent>
    <xs:extension base="er:RoadnetLinkType">
      <xs:sequence>
        <xs:element name="level" type="er:FerryLinkLevelType"/>
        <xs:element name="formOfFerry" type="er:FormOfFerryType"/>
      </xs:sequence>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
<xs:element name="FerryLink" type="er:FerryLinkType" substitutionGroup="er:RoadnetLink">
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS ER_FerryLink
class</xs:documentation>
  </xs:annotation>
</xs:element>
<!--=====-->
<xs:simpleType name="RoadNodeLevelType">
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS class
ER_RoadNodeLevel</xs:documentation>
  </xs:annotation>
  <xs:union memberTypes="er:RoadNodeLevelEnumerationType er:RoadNodeLevelOtherType"/>
</xs:simpleType>
<xs:simpleType name="RoadNodeLevelEnumerationType">
  <xs:restriction base="xs:string">
    <xs:enumeration value="1">
      <xs:annotation>
        <xs:appinfo source="urn:x-gml:codelistValue">Junction</xs:appinfo>

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    </xs:annotation>
  </xs:enumeration>
  <xs:enumeration value="2">
    <xs:annotation>
      <xs:appinfo source="urn:x-gml:codelistValue">Intersection</xs:appinfo>
    </xs:annotation>
  </xs:enumeration>
  <xs:enumeration value="Junction"/>
  <xs:enumeration value="Intersection"/>
</xs:restriction>
</xs:simpleType>
<xs:simpleType name="RoadNodeLevelOtherType">
  <xs:restriction base="xs:string">
    <xs:pattern value="other: \w{2,}"/>
  </xs:restriction>
</xs:simpleType>
<!--=====-->
<xs:simpleType name="RoadLinkLevelType">
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS class
ER_RoadLinkLevel</xs:documentation>
  </xs:annotation>
  <xs:union memberTypes="er:RoadLinkLevelEnumerationType er:RoadLinkLevelOtherType"/>
</xs:simpleType>
<xs:simpleType name="RoadLinkLevelEnumerationType">
  <xs:restriction base="xs:string">
    <xs:enumeration value="1">
      <xs:annotation>
        <xs:appinfo source="urn:x-gml:codelistValue">RoadElement</xs:appinfo>
      </xs:annotation>
    </xs:enumeration>
    <xs:enumeration value="2">
      <xs:annotation>
        <xs:appinfo source="urn:x-gml:codelistValue">Road</xs:appinfo>
      </xs:annotation>
    </xs:enumeration>
    <xs:enumeration value="RoadElement"/>
    <xs:enumeration value="Road"/>
  </xs:restriction>
</xs:simpleType>
<xs:simpleType name="RoadLinkLevelOtherType">
  <xs:restriction base="xs:string">
    <xs:pattern value="other: \w{2,}"/>
  </xs:restriction>
</xs:simpleType>
<!--=====-->
<xs:simpleType name="FerryLinkLevelType">
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS class
ER_FerryLinkLevel</xs:documentation>
  </xs:annotation>
  <xs:union memberTypes="er:FerryLinkLevelEnumerationType er:FerryLinkLevelOtherType"/>
</xs:simpleType>
<xs:simpleType name="FerryLinkLevelEnumerationType">
  <xs:restriction base="xs:string">
    <xs:enumeration value="1">
      <xs:annotation>
        <xs:appinfo source="urn:x-gml:codelistValue">FerryConnection</xs:appinfo>
      </xs:annotation>
    </xs:enumeration>
    <xs:enumeration value="2">
      <xs:annotation>
        <xs:appinfo source="urn:x-gml:codelistValue">Ferry</xs:appinfo>
      </xs:annotation>
    </xs:enumeration>
  </xs:restriction>
</xs:simpleType>

```

```

        </xs:enumeration>
        <xs:enumeration value="FerryConnection"/>
        <xs:enumeration value="Ferry"/>
    </xs:restriction>
</xs:simpleType>
<xs:simpleType name="FerryLinkLevelOtherType">
    <xs:restriction base="xs:string">
        <xs:pattern value="other: \w{2,}"/>
    </xs:restriction>
</xs:simpleType>
<!--=====-->
<xs:simpleType name="FormOfFerryType">
    <xs:annotation>
        <xs:documentation>GML schema definition for the EuroRoadS class
ER_FormOfFerry</xs:documentation>
    </xs:annotation>
    <xs:union memberTypes="er:FormOfFerryEnumerationType er:FormOfFerryOtherType"/>
</xs:simpleType>
<xs:simpleType name="FormOfFerryEnumerationType">
    <xs:restriction base="xs:string">
        <xs:enumeration value="1">
            <xs:annotation>
                <xs:appinfo source="urn:x-gml:codelistValue">ShipOrHovercraft</xs:appinfo>
            </xs:annotation>
        </xs:enumeration>
        <xs:enumeration value="2">
            <xs:annotation>
                <xs:appinfo source="urn:x-gml:codelistValue">Train</xs:appinfo>
            </xs:annotation>
        </xs:enumeration>
        <xs:enumeration value="ShipOrHovercraft"/>
        <xs:enumeration value="Train"/>
    </xs:restriction>
</xs:simpleType>
<xs:simpleType name="FormOfFerryOtherType">
    <xs:restriction base="xs:string">
        <xs:pattern value="other: \w{2,}"/>
    </xs:restriction>
</xs:simpleType>
<!--=====-->
<xs:simpleType name="FormOfWayType">
    <xs:annotation>
        <xs:documentation>GML schema definition for the EuroRoadS class
ER_FormOfWay</xs:documentation>
    </xs:annotation>
    <xs:union memberTypes="er:FormOfWayEnumerationType er:FormOfWayOtherType"/>
</xs:simpleType>
<xs:simpleType name="FormOfWayEnumerationType">
    <xs:restriction base="xs:string">
        <xs:enumeration value="1">
            <xs:annotation>
                <xs:appinfo source="urn:x-gml:codelistValue">Motorway</xs:appinfo>
            </xs:annotation>
        </xs:enumeration>
        <xs:enumeration value="2">
            <xs:annotation>
                <xs:appinfo source="urn:x-gml:codelistValue">MultiCarriageway</xs:appinfo>
            </xs:annotation>
        </xs:enumeration>
        <xs:enumeration value="3">
            <xs:annotation>
                <xs:appinfo source="urn:x-gml:codelistValue">SingleCarriageway</xs:appinfo>
            </xs:annotation>
        </xs:enumeration>
    </xs:restriction>

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<xs:enumeration value="4">
  <xs:annotation>
    <xs:appinfo source="urn:x-gml:codelistValue">RoundaboutCircle</xs:appinfo>
  </xs:annotation>
</xs:enumeration>
<xs:enumeration value="5">
  <xs:annotation>
    <xs:appinfo source="urn:x-gml:codelistValue">TrafficSquare</xs:appinfo>
  </xs:annotation>
</xs:enumeration>
<xs:enumeration value="6">
  <xs:annotation>
    <xs:appinfo source="urn:x-gml:codelistValue">EnclosedTrafficArea</xs:appinfo>
  </xs:annotation>
</xs:enumeration>
<xs:enumeration value="7">
  <xs:annotation>
    <xs:appinfo source="urn:x-gml:codelistValue">SlipRoad</xs:appinfo>
  </xs:annotation>
</xs:enumeration>
<xs:enumeration value="8">
  <xs:annotation>
    <xs:appinfo source="urn:x-gml:codelistValue">ServiceRoad</xs:appinfo>
  </xs:annotation>
</xs:enumeration>
<xs:enumeration value="9">
  <xs:annotation>
    <xs:appinfo source="urn:x-gml:codelistValue">EntranceOrExitCarPark</xs:appinfo>
  </xs:annotation>
</xs:enumeration>
<xs:enumeration value="10">
  <xs:annotation>
    <xs:appinfo source="urn:x-gml:codelistValue">EntranceOrExitService</xs:appinfo>
  </xs:annotation>
</xs:enumeration>
<xs:enumeration value="11">
  <xs:annotation>
    <xs:appinfo source="urn:x-gml:codelistValue">UndefinedFormOfWay</xs:appinfo>
  </xs:annotation>
</xs:enumeration>
<xs:enumeration value="Motorway"/>
<xs:enumeration value="MultiCarriageway"/>
<xs:enumeration value="SingleCarriageway"/>
<xs:enumeration value="RoundaboutCircle"/>
<xs:enumeration value="TrafficSquare"/>
<xs:enumeration value="EnclosedTrafficArea"/>
<xs:enumeration value="SlipRoad"/>
<xs:enumeration value="ServiceRoad"/>
<xs:enumeration value="EntranceOrExitCarPark"/>
<xs:enumeration value="EntranceOrExitService"/>
<xs:enumeration value="UndefinedFormOfWay"/>
</xs:restriction>
</xs:simpleType>
<xs:simpleType name="FormOfWayOtherType">
  <xs:restriction base="xs:string">
    <xs:pattern value="other: \w{2,}"/>
  </xs:restriction>
</xs:simpleType>
<!--=====-->
<xs:simpleType name="FormOfNodeType">
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS class
ER_FormOfNode</xs:documentation>
  </xs:annotation>

```

```

<xs:union memberTypes="er:FormOfNodeEnumerationType er:FormOfNodeOtherType"/>
</xs:simpleType>
<xs:simpleType name="FormOfNodeEnumerationType">
  <xs:restriction base="xs:string">
    <xs:enumeration value="1">
      <xs:annotation>
        <xs:appinfo source="urn:x-gml:codelistValue">Roundabout</xs:appinfo>
      </xs:annotation>
    </xs:enumeration>
    <xs:enumeration value="2">
      <xs:annotation>
        <xs:appinfo source="urn:x-gml:codelistValue">EnclosedTrafficArea</xs:appinfo>
      </xs:annotation>
    </xs:enumeration>
    <xs:enumeration value="3">
      <xs:annotation>
        <xs:appinfo source="urn:x-gml:codelistValue">PseudoNode</xs:appinfo>
      </xs:annotation>
    </xs:enumeration>
    <xs:enumeration value="4">
      <xs:annotation>
        <xs:appinfo source="urn:x-gml:codelistValue">GradeSeparatedCrossing</xs:appinfo>
      </xs:annotation>
    </xs:enumeration>
    <xs:enumeration value="Roundabout"/>
    <xs:enumeration value="EnclosedTrafficArea"/>
    <xs:enumeration value="PseudoNode"/>
    <xs:enumeration value="GradeSeparatedCrossing"/>
  </xs:restriction>
</xs:simpleType>
<xs:simpleType name="FormOfNodeOtherType">
  <xs:restriction base="xs:string">
    <xs:pattern value="other: \w{2,}"/>
  </xs:restriction>
</xs:simpleType>
<!------->
<xs:simpleType name="FormOfComplexElementType">
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS class
ER_FormOfComplexElement</xs:documentation>
  </xs:annotation>
  <xs:union memberTypes="er:FormOfComplexElementEnumerationType
er:FormOfComplexElementOtherType"/>
</xs:simpleType>
<xs:simpleType name="FormOfComplexElementEnumerationType">
  <xs:restriction base="xs:string">
    <xs:enumeration value="1">
      <xs:annotation>
        <xs:appinfo source="urn:x-gml:codelistValue">Interchange</xs:appinfo>
      </xs:annotation>
    </xs:enumeration>
    <xs:enumeration value="2">
      <xs:annotation>
        <xs:appinfo source="urn:x-gml:codelistValue">Roundabout</xs:appinfo>
      </xs:annotation>
    </xs:enumeration>
    <xs:enumeration value="3">
      <xs:annotation>
        <xs:appinfo source="urn:x-gml:codelistValue">AggregatedWay</xs:appinfo>
      </xs:annotation>
    </xs:enumeration>
    <xs:enumeration value="Interchange"/>
    <xs:enumeration value="Roundabout"/>
    <xs:enumeration value="AggregatedWay"/>
  </xs:restriction>

```

```

</xs:restriction>
</xs:simpleType>
<xs:simpleType name="FormOfComplexElementOtherType">
  <xs:restriction base="xs:string">
    <xs:pattern value="other: \w{2,}" />
  </xs:restriction>
</xs:simpleType>
<!--=====-->
<xs:simpleType name="NationalRoadClassType">
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS class
ER_NationalRoadClass</xs:documentation>
  </xs:annotation>
  <xs:restriction base="xs:string">
    <xs:enumeration value="MainRoad" />
    <xs:enumeration value="FirstClass" />
    <xs:enumeration value="SecondClass" />
    <xs:enumeration value="ThirdClass" />
    <xs:enumeration value="FourthClass" />
    <xs:enumeration value="FifthClass" />
    <xs:enumeration value="SixthClass" />
    <xs:enumeration value="SeventhClass" />
    <xs:enumeration value="EighthClass" />
    <xs:enumeration value="NinthClass" />
    <xs:enumeration value="UndefinedNationalRoadClass" />
  </xs:restriction>
</xs:simpleType>
<!--=====-->
<xs:complexType name="RouteLinkType">
  <xs:annotation>
    <xs:documentation>GML definition of the EuroRoadS class ER_RouteLink</xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element name="validity" type="gml:TimePeriodType" minOccurs="0" />
    <xs:element name="direction" type="gml:SignType" />
    <xs:element name="roadnetLink" type="er:RoadnetLinkPropertyType" />
  </xs:sequence>
</xs:complexType>
<!--=====-->
<xs:complexType name="RouteType">
  <xs:annotation>
    <xs:documentation>GML definition of the EuroRoadS class ER_Route</xs:documentation>
  </xs:annotation>
  <xs:complexContent>
    <xs:extension base="er:RoadFeatureType">
      <xs:sequence>
        <xs:element name="routeLinks" type="er:RouteLinkType" minOccurs="0" maxOccurs="unbounded" />
      </xs:sequence>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
<xs:complexType name="RoutePropertyType">
  <xs:annotation>
    <xs:documentation>GML property type definition for RouteType</xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element ref="er:Route" minOccurs="0" />
  </xs:sequence>
  <xs:attributeGroup ref="gml:AssociationAttributeGroup" />
</xs:complexType>
<xs:element name="Route" type="er:RouteType" substitutionGroup="er:RoadFeature" />
</xs:schema>

```

4.9 Network referencing

```

<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:er="http://www.euroroads.org" xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:gml="http://www.opengis.net/gml" targetNamespace="http://www.euroroads.org" elementFormDefault="qualified"
attributeFormDefault="unqualified">
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS NetworkReferencing package, version
1.0</xs:documentation>
  </xs:annotation>
  <xs:import namespace="http://www.opengis.net/gml" schemaLocation="http://base/gml.xsd"/>
  <xs:import namespace="http://www.w3.org/1999/xlink" schemaLocation="http://xlink/xlinks.xsd"/>
  <xs:include schemaLocation="http://ERISO19133Profile.xsd"/>
  <xs:include schemaLocation="http://Network.xsd"/>
  <!--=====-->
  <xs:complexType name="LRElementType">
    <xs:annotation>
      <xs:documentation>GML definition of the EuroRoadS class ER_LRElement</xs:documentation>
    </xs:annotation>
    <xs:complexContent>
      <xs:extension base="http://ERISO19133Profile.xsd/ISO_LRElementType">
        <xs:choice>
          <xs:element name="link" type="http://ERISO19133Profile.xsd/RoadnetLinkPropertyType"/>
          <xs:element name="route" type="http://ERISO19133Profile.xsd/RoutePropertyType"/>
        </xs:choice>
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>
  <xs:element name="LRElement" type="http://ERISO19133Profile.xsd/LRElementType" substitutionGroup="http://ERISO19133Profile.xsd/ISO_LRElement"/>
  <!--=====-->
  <xs:simpleType name="LateralPositionType">
    <xs:annotation>
      <xs:documentation>GML schema definition for the EuroRoadS class
ER_LateralPosition</xs:documentation>
    </xs:annotation>
    <xs:union memberTypes="http://ERISO19133Profile.xsd/LateralPositionEnumerationType http://ERISO19133Profile.xsd/LateralPositionOtherType"/>
  </xs:simpleType>
  <xs:simpleType name="LateralPositionEnumerationType">
    <xs:restriction base="http://www.w3.org/2001/XMLSchema/string">
      <xs:enumeration value="1">
        <xs:annotation>
          <xs:appinfo source="http://urn:x-gml:codelistValue">left</xs:appinfo>
        </xs:annotation>
      </xs:enumeration>
      <xs:enumeration value="2">
        <xs:annotation>
          <xs:appinfo source="http://urn:x-gml:codelistValue">right</xs:appinfo>
        </xs:annotation>
      </xs:enumeration>
      <xs:enumeration value="3">
        <xs:annotation>
          <xs:appinfo source="http://urn:x-gml:codelistValue">middle</xs:appinfo>
        </xs:annotation>
      </xs:enumeration>
      <xs:enumeration value="4">
        <xs:annotation>
          <xs:appinfo source="http://urn:x-gml:codelistValue">crossing</xs:appinfo>
        </xs:annotation>
      </xs:enumeration>
      <xs:enumeration value="left"/>
      <xs:enumeration value="right"/>
      <xs:enumeration value="middle"/>
    </xs:restriction>
  </xs:simpleType>

```

```

    <xs:enumeration value="crossing"/>
  </xs:restriction>
</xs:simpleType>
<xs:simpleType name="LateralPositionOtherType">
  <xs:restriction base="xs:string">
    <xs:pattern value="other: \w{2,}"/>
  </xs:restriction>
</xs:simpleType>
<!--=====-->
<xs:simpleType name="HeightPositionType">
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS class
ER_HeightPosition</xs:documentation>
  </xs:annotation>
  <xs:union memberTypes="er:HeightPositionEnumerationType er:HeightPositionOtherType"/>
</xs:simpleType>
<xs:simpleType name="HeightPositionEnumerationType">
  <xs:restriction base="xs:string">
    <xs:enumeration value="1">
      <xs:annotation>
        <xs:appinfo source="urn:x-gml:codelistValue">above</xs:appinfo>
      </xs:annotation>
    </xs:enumeration>
    <xs:enumeration value="2">
      <xs:annotation>
        <xs:appinfo source="urn:x-gml:codelistValue">below</xs:appinfo>
      </xs:annotation>
    </xs:enumeration>
    <xs:enumeration value="3">
      <xs:annotation>
        <xs:appinfo source="urn:x-gml:codelistValue">on</xs:appinfo>
      </xs:annotation>
    </xs:enumeration>
    <xs:enumeration value="above"/>
    <xs:enumeration value="below"/>
    <xs:enumeration value="on"/>
  </xs:restriction>
</xs:simpleType>
<xs:simpleType name="HeightPositionOtherType">
  <xs:restriction base="xs:string">
    <xs:pattern value="other: \w{2,}"/>
  </xs:restriction>
</xs:simpleType>
<!--=====-->
<xs:complexType name="SegmentExpressionType">
  <xs:annotation>
    <xs:documentation>GML definition of the EuroRoadS class
ER_SegmentExpression</xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element name="direction" type="gml:SignType" minOccurs="0"/>
    <xs:element name="lateralPosition" type="er:LateralPositionType" minOccurs="0"/>
    <xs:element name="heightPosition" type="er:HeightPositionType" minOccurs="0"/>
    <xs:element name="verticalOffset" type="gml:MeasureType" minOccurs="0"/>
    <xs:element name="fromPos" type="er:ISO_LRPositionExpressionType"/>
    <xs:element name="toPos" type="er:ISO_LRPositionExpressionType"/>
  </xs:sequence>
</xs:complexType>
<xs:element name="SegmentExpression" type="er:SegmentExpressionType"/>
<!--=====-->
<xs:complexType name="PositionExpressionType">
  <xs:annotation>
    <xs:documentation>GML definition of the EuroRoadS class
ER_PositionExpression</xs:documentation>

```

```

</xs:annotation>
<xs:complexContent>
  <xs:extension base="er:ISO_LRPositionExpressionType">
    <xs:sequence>
      <xs:element name="direction" type="gml:SignType" minOccurs="0"/>
      <xs:element name="lateralPosition" type="er:LateralPositionType" minOccurs="0"/>
      <xs:element name="heightPosition" type="er:HeightPositionType" minOccurs="0"/>
      <xs:element name="verticalOffset" type="gml:MeasureType" minOccurs="0"/>
    </xs:sequence>
  </xs:extension>
</xs:complexContent>
</xs:complexType>
<xs:element name="PositionExpression" type="er:PositionExpressionType"
substitutionGroup="er:ISO_LRPositionExpression"/>
<!--=====-->
<xs:complexType name="NodeExpressionType">
  <xs:annotation>
    <xs:documentation>GML definition of the EuroRoadS class ER_NodeExpression</xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element name="node" type="er:RoadNodePropertyType"/>
    <xs:element name="heightPosition" type="er:HeightPositionType" minOccurs="0"/>
    <xs:element name="verticalOffset" type="gml:MeasureType" minOccurs="0"/>
  </xs:sequence>
</xs:complexType>
<xs:element name="NodeExpression" type="er:NodeExpressionType"/>
<!--=====-->
<xs:complexType name="PointExpressionType">
  <xs:annotation>
    <xs:documentation>GML definition of the EuroRoadS class ER_PointExpression</xs:documentation>
  </xs:annotation>
  <xs:choice>
    <xs:element name="position">
      <xs:complexType>
        <xs:sequence>
          <xs:element ref="er:ISO_LRPositionExpression"/>
        </xs:sequence>
      </xs:complexType>
    </xs:element>
    <xs:element name="node" type="er:NodeExpressionType"/>
  </xs:choice>
</xs:complexType>
<xs:element name="PointExpression" type="er:PointExpressionType"/>
<!--=====-->
<xs:complexType name="TurnExpressionType">
  <xs:annotation>
    <xs:documentation>GML definition of the EuroRoadS class ER_TurnExpression</xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element name="node" type="er:RoadNodePropertyType"/>
    <xs:element name="fromElement" type="er:LRElementType"/>
    <xs:element name="toElement" type="er:LRElementType"/>
    <xs:element name="fromDirection" type="gml:SignType" minOccurs="0"/>
    <xs:element name="toDirection" type="gml:SignType" minOccurs="0"/>
  </xs:sequence>
</xs:complexType>
<xs:element name="TurnExpression" type="er:TurnExpressionType"/>
<!--=====-->
<xs:complexType name="ManoeuvreExpressionType">
  <xs:annotation>
    <xs:documentation>GML definition of the EuroRoadS class
ER_ManoeuvreExpression</xs:documentation>
  </xs:annotation>
  <xs:sequence>

```

```

    <xs:element name="turns" type="er:TurnExpressionType" maxOccurs="unbounded"/>
  </xs:sequence>
</xs:complexType>
<xs:element name="ManoeuvreExpression" type="er:ManoeuvreExpressionType"/>
</xs:schema>

```

4.10 BorderNodeInfo.xsd

```

<?xml version="1.0" encoding="UTF-8"?>
<!-- edited with XMLSpy v2005 rel. 3 U (http://www.altova.com) by Lars Bergström (Triona AB) -->
<xs:schema xmlns:er="www.euroroads.org" xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:gdf="http://www.ukusa.org"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:gml="http://www.opengis.net/gml"
  targetNamespace="www.euroroads.org" elementFormDefault="qualified" attributeFormDefault="unqualified">
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS BorderNodeInfo package, version
1.0</xs:documentation>
  </xs:annotation>
  <xs:include schemaLocation="AttributeBase.xsd"/>
  <xs:include schemaLocation="BasicTypes.xsd"/>
  <xs:include schemaLocation="NetworkReferencing.xsd"/>
  <!--=====-->
  <xs:complexType name="BorderNodeInfoType">
    <xs:complexContent>
      <xs:extension base="er:RoadNodeAttributeType">
        <xs:sequence>
          <xs:element name="borderNodeType" type="er:BorderNodeType"/>
          <xs:element name="areaCode" type="xs:string"/>
          <xs:element name="neighbourAreaCode" type="xs:string" minOccurs="0"/>
          <xs:element name="neighbourId" type="er:ObjectIdType" minOccurs="0"/>
        </xs:sequence>
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>
  <xs:element name="BorderNodeInfo" type="er:BorderNodeInfoType"
substitutionGroup="er:RoadNodeAttribute"/>
  <!--=====-->
  <xs:simpleType name="BorderNodeType">
    <xs:annotation>
      <xs:documentation>GML definition of the EuroRoadS class ER_BorderNodeType</xs:documentation>
    </xs:annotation>
    <xs:restriction base="xs:string">
      <xs:enumeration value="NationalBorderNodeType"/>
      <xs:enumeration value="AdministrativeAreaBorderNodeType"/>
    </xs:restriction>
  </xs:simpleType>
  <!--=====-->
  <xs:complexType name="BorderNodeInfoFeatureType">
    <xs:annotation>
      <xs:documentation>GML definition of the EuroRoadS class
ER_BorderNodeInfoFeature</xs:documentation>
    </xs:annotation>
    <xs:complexContent>
      <xs:extension base="er:RoadFeatureType">
        <xs:sequence>
          <xs:element name="info" type="er:BorderNodeInfoType"/>
          <xs:element name="location" type="er:NodeExpressionType"/>
        </xs:sequence>
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>
  <xs:element name="BorderNodeInfoFeature" type="er:BorderNodeInfoFeatureType"
substitutionGroup="er:RoadFeature"/>

```

```
<!--=====-->
</xs:schema>
```

4.11 GradeSeparatedCrossings.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:er="http://www.euroroads.org" xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  xmlns:gml="http://www.opengis.net/gml" targetNamespace="http://www.euroroads.org" elementFormDefault="qualified"
  attributeFormDefault="unqualified">
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS Grade separated crossings package,
    version 1.0</xs:documentation>
  </xs:annotation>
  <xs:include schemaLocation="AttributeBase.xsd"/>
  <xs:include schemaLocation="BasicTypes.xsd"/>
  <xs:include schemaLocation="NetworkReferencing.xsd"/>
  <!--=====-->
  <xs:complexType name="LinkLevelType">
    <xs:complexContent>
      <xs:extension base="er:RoadLinkAttributeType">
        <xs:sequence>
          <xs:element name="startLevel" type="xs:integer" minOccurs="0"/>
          <xs:element name="intermediateLevel" type="xs:integer" minOccurs="0"/>
          <xs:element name="endLevel" type="xs:integer" minOccurs="0"/>
        </xs:sequence>
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>
  <xs:element name="LinkLevel" type="er:LinkLevelType" substitutionGroup="er:RoadLinkAttribute"/>
  <!--=====-->
  <xs:complexType name="GradeSeparatedCrossingType">
    <xs:annotation>
      <xs:documentation>GML definition for the EuroRoadS class
      ER_GradeSeparatedCrossing</xs:documentation>
    </xs:annotation>
    <xs:complexContent>
      <xs:extension base="er:RoadFeatureType">
        <xs:sequence>
          <xs:element name="upperLevelElement" type="er:SegmentExpressionType"/>
          <xs:element name="lowerLevelElement" type="er:SegmentExpressionType"/>
        </xs:sequence>
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>
  <xs:element name="GradeSeparatedCrossing" type="er:GradeSeparatedCrossingType"
  substitutionGroup="er:RoadFeature"/>
  <!--=====-->
</xs:schema>
```

4.12 Updates.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:er="http://www.euroroads.org" xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:gdf="http://www.ukusa.org"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:gml="http://www.opengis.net/gml"
  targetNamespace="http://www.euroroads.org" elementFormDefault="qualified" attributeFormDefault="unqualified">
  <xs:import namespace="http://www.opengis.net/gml" schemaLocation="http://www.euroroads.org/gml/base/gml.xsd"/>
  <xs:import namespace="http://www.w3.org/1999/xlink" schemaLocation="http://www.w3.org/1999/xlink/xlinks.xsd"/>
  <!--=====-->
  <xs:include schemaLocation="BasicTypes.xsd"/>
  <xs:include schemaLocation="NetworkReferencing.xsd"/>
  <xs:complexType name="UpdateTransactionType">
```

```

    <xs:annotation>
      <xs:documentation>GML schema definition for the EuroRoadS class
ER_UpdateTransaction</xs:documentation>
    </xs:annotation>
    <xs:complexContent>
      <xs:extension base="gml:AbstractFeatureCollectionType"/>
    </xs:complexContent>
  </xs:complexType>
  <xs:element name="UpdateTransaction" type="er:UpdateTransactionType"
substitutionGroup="gml:_FeatureCollection"/>
<!--=====-->
  <xs:complexType name="UpdateType" abstract="true">
    <xs:annotation>
      <xs:documentation>GML schema definition for the EuroRoadS ER_Update class. </xs:documentation>
    </xs:annotation>
    <xs:complexContent>
      <xs:extension base="gml:AbstractFeatureType"/>
    </xs:complexContent>
  </xs:complexType>
  <xs:element name="Update" type="er:UpdateType" abstract="true" substitutionGroup="gml:_Feature">
    <xs:annotation>
      <xs:documentation>Root element of the ER_Update substitution group</xs:documentation>
    </xs:annotation>
  </xs:element>
<!--=====-->
  <xs:complexType name="SimpleUpdateType" abstract="true">
    <xs:annotation>
      <xs:documentation>GML schema definition for the abstract EuroRoadS class
ER_SimpleUpdate</xs:documentation>
    </xs:annotation>
    <xs:complexContent>
      <xs:extension base="er:UpdateType"/>
    </xs:complexContent>
  </xs:complexType>
  <xs:element name="SimpleUpdate" type="er:SimpleUpdateType" abstract="true"
substitutionGroup="er:Update">
    <xs:annotation>
      <xs:documentation>GML schema definition for the abstract EuroRoadS class
ER_SimpleUpdate</xs:documentation>
    </xs:annotation>
  </xs:element>
<!--=====-->
  <xs:complexType name="CompositeUpdateType" abstract="true">
    <xs:annotation>
      <xs:documentation>GML schema definition for the abstract EuroRoadS class
ER_CompositeUpdate</xs:documentation>
    </xs:annotation>
    <xs:complexContent>
      <xs:extension base="er:UpdateType">
        <xs:sequence>
          <!-- updateInfo ...-->
          <!-- xs:element name="updates" type="er:SimpleUpdateType" maxOccurs="unbounded"/-->
          <xs:element name="subUpdates">
            <xs:complexType>
              <xs:sequence>
                <xs:element ref="er:SimpleUpdate"/>
              </xs:sequence>
            </xs:complexType>
          </xs:element>
          <xs:element name="segmentMappings" type="er:SegmentMappingType" minOccurs="0"
maxOccurs="unbounded"/>
        </xs:sequence>
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>

```

```

</xs:complexType>
<xs:element name="CompositeUpdate" type="er:CompositeUpdateType" abstract="true"
substitutionGroup="er:Update">
  <xs:annotation>
    <xs:documentation>GML schema definition for the abstract EuroRoadS class
ER_CompositeUpdate</xs:documentation>
  </xs:annotation>
</xs:element>
<!--=====-->
<xs:complexType name="SplitType">
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS class ER_Split</xs:documentation>
  </xs:annotation>
  <xs:complexContent>
    <xs:extension base="er:CompositeUpdateType"/>
  </xs:complexContent>
</xs:complexType>
<xs:element name="Split" type="er:SplitType" substitutionGroup="er:CompositeUpdate"/>
<!--=====-->
<xs:complexType name="MergeType">
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS class ER_Merge</xs:documentation>
  </xs:annotation>
  <xs:complexContent>
    <xs:extension base="er:CompositeUpdateType"/>
  </xs:complexContent>
</xs:complexType>
<xs:element name="Merge" type="er:MergeType" substitutionGroup="er:CompositeUpdate"/>
<!--=====-->
<xs:complexType name="ReplaceType">
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS class
ER_Replace</xs:documentation>
  </xs:annotation>
  <xs:complexContent>
    <xs:extension base="er:CompositeUpdateType"/>
  </xs:complexContent>
</xs:complexType>
<xs:element name="Replace" type="er:ReplaceType" substitutionGroup="er:CompositeUpdate"/>
<!--=====-->
<xs:complexType name="InsertType">
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS class ER_Insert</xs:documentation>
  </xs:annotation>
  <xs:complexContent>
    <xs:extension base="er:SimpleUpdateType">
      <xs:sequence>
        <xs:element name="insertedObject">
          <xs:complexType>
            <xs:sequence>
              <xs:element ref="er:RoadFeature"/>
            </xs:sequence>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
<xs:element name="Insert" type="er:InsertType" substitutionGroup="er:SimpleUpdate"/>
<!--=====-->
<xs:complexType name="ModifyType" abstract="true">
  <xs:annotation>
    <xs:documentation>GML schema definition for the EuroRoadS class ER_Modify</xs:documentation>
  </xs:annotation>

```

```

    <xs:complexContent>
      <xs:extension base="er:SimpleUpdateType"/>
    </xs:complexContent>
  </xs:complexType>
  <xs:element name="Modify" type="er:ModifyType" abstract="true" substitutionGroup="er:SimpleUpdate"/>
  <!--=====-->
  <xs:complexType name="ModifyObjectType">
    <xs:annotation>
      <xs:documentation>GML schema definition for the EuroRoadS class
ER_ModifyObject</xs:documentation>
    </xs:annotation>
    <xs:complexContent>
      <xs:extension base="er:ModifyType">
        <xs:sequence>
          <xs:element name="modifiedObject">
            <xs:complexType>
              <xs:sequence>
                <xs:element ref="er:RoadFeature"/>
              </xs:sequence>
            </xs:complexType>
          </xs:element>
        </xs:sequence>
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>
  <xs:element name="ModifyObject" type="er:ModifyObjectType" substitutionGroup="er:Modify"/>
  <!--=====-->
  <xs:complexType name="ModifyAttributeType">
    <xs:annotation>
      <xs:documentation>GML schema definition for the EuroRoadS class
ER_ModifyAttribute</xs:documentation>
    </xs:annotation>
    <xs:complexContent>
      <xs:extension base="er:ModifyType">
        <xs:sequence>
          <xs:element name="newValues" maxOccurs="unbounded">
            <xs:complexType>
              <xs:sequence>
                <xs:element ref="er:RoadAttribute"/>
              </xs:sequence>
            </xs:complexType>
          </xs:element>
          <xs:element name="roadElementId" type="er:ObjectIdType"/>
        </xs:sequence>
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>
  <xs:element name="ModifyAttribute" type="er:ModifyAttributeType" substitutionGroup="er:Modify"/>
  <!--=====-->
  <xs:complexType name="DeleteType">
    <xs:annotation>
      <xs:documentation>GML schema definition for the EuroRoadS class ER_Delete</xs:documentation>
    </xs:annotation>
    <xs:complexContent>
      <xs:extension base="er:SimpleUpdateType">
        <xs:sequence>
          <xs:element name="classId" type="xs:string"/>
          <xs:element name="deletedObjectId" type="er:ObjectIdType"/>
        </xs:sequence>
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>
  <xs:element name="Delete" type="er>DeleteType" substitutionGroup="er:SimpleUpdate"/>
  <!--=====-->

```

```
<xs:complexType name="SegmentMappingType">
  <xs:annotation>
    <xs:documentation>GML definition for the EuroRoadS class
ER_SegmentMapping</xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element name="fromSegment">
      <xs:complexType>
        <xs:sequence>
          <xs:element ref="er:SegmentExpression"/>
        </xs:sequence>
      </xs:complexType>
    </xs:element>
    <xs:element name="toSegment">
      <xs:complexType>
        <xs:sequence>
          <xs:element ref="er:SegmentExpression"/>
        </xs:sequence>
      </xs:complexType>
    </xs:element>
  </xs:sequence>
</xs:complexType>
</xs:schema>
```

5 Appendix

5.1 Using XLinks to refer remote or cross document elements

XLink is a w3c recommendation (<http://www.w3c.org>). In GML it is used to connect objects within documents and between documents. XLink uses other w3c recommendations for the linking syntax (XPointer and XPath). For EuroRoadS, the following needs have been identified for object referencing:

- Referencing objects within a document.
 - o One example is an edge referencing its bounding nodes. The nodes are not duplicated every time they are referenced. Instead the node is instantiated once and referenced.
 - o Another example is a road feature that is located somewhere on the network using an expression (for example a SegmentExpression defining a segment of a Route). The Route shall in this case be referenced.
- Referencing objects between documents.
 - o One aspect of this is that XML documents tend to use quite much space. If the road network of a European country is to be exchanged, the XML document will become enormous. To solve this, the data will probably have to be subdivided into several documents. In order to keep all the necessary relationships between the different data elements, referencing between documents will have to be utilized.
- Referencing “well-known” objects
 - o The EuroRoadS Road Features all have permanent identities which could be kept by the parties exchanging EuroRoadS data. This data could be referenced from an exchanged dataset which implies that the referenced object is already present at the receiver side. One example is road features that uses expressions that specifies a location somewhere on the road network. In this case one would only have to specify the well known permanent identity of the element in the network where the feature is located without having to transmit the element itself.
 - o Another example of this is when network updates are transmitted. One example is a road link whose geometry has been modified. If (in a topological network) all connected (=referenced) elements would have to be transmitted as well, all network elements would have to be transmitted.

EuroRoadS does not interfere with the way XML documents are subdivided or transmitted, but assumes that the mechanisms within XLink are used sensibly to create manageable and interpretable datasets. In the EuroRoadS deliverable D6.6 [4], the model has been designed in such a way that it allows for object referencing in certain cases. The following table gives an overview on where instances in a EuroRoadS dataset may use references.

Relationship		
From	To	Remark
Edge	Node	The bounding nodes of an edge can be referenced. This means that parts of a road network can be exchanged.
RouteLink	RoadnetLink	The links which make up a route can be referenced. This means that new routes can be added to an existing road network without having to exchange the underlying network as well.
DetailLevelMapping	RoadnetElement	The lower level elements in a detail level mapping can be referenced. This means that complex elements in the road network can be added to an existing road network without having to exchange the underlying network as well.
LRElement	Route/RoadnetLink	The linear element referenced from an expression can be referenced. This means that data which relates to the road network using expressions can be exchanged without having to exchange the road network itself.

The specifics for the linking syntax remain to be investigated and examples will be created in the final version of this specification. All three referencing scenarios described above will have to be resolved.

5.2 Example XML documents

5.2.1 Simple topological road network with directly attached attributes

The xml sample below represents a simple road network according to the following figure where the network has a topological representation:

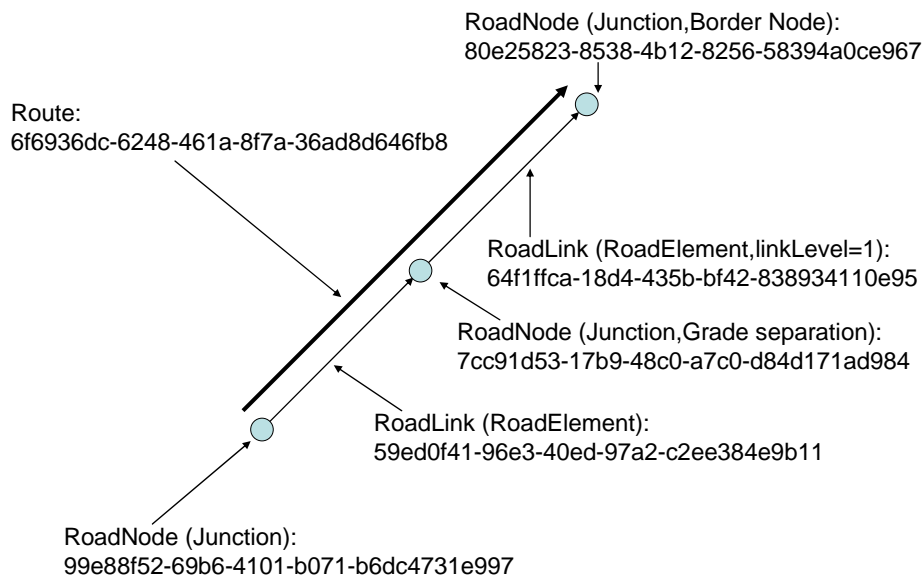


Figure 5-1- Network example 1

```

<?xml version="1.0" encoding="utf-8"?>
<er:EuroRoadSDataset xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="www.euroroads.org C:\Projekt\Vägverket\Euroroads\Leveransobjekt\GML\EuroRoadS.xsd"
xmlns:gml="http://www.opengis.net/gml" xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:er="www.euroroads.org">
  <gml:featureMember>
    <er:RoadNode>
      <er:id>
        <er:permanentId>7cc91d53-17b9-48c0-a7c0-d84d171ad984</er:permanentId>
      </er:id>
      <er:level>Junction</er:level>
      <er:formOfNode>GradeSeparatedCrossing</er:formOfNode>
      <er:node>
        <er:Node gml:id="i1">
          <gml:pointProperty>
            <gml:Point>
              <gml:coord>
                <gml:X>123.456</gml:X>
                <gml:Y>123.456</gml:Y>
                <gml:Z>123.456</gml:Z>
              </gml:coord>
            </gml:Point>
          </gml:pointProperty>
          <er:roadNode xlink:href="//er:RoadNode/permanentId[.='&quot;7cc91d53-17b9-48c0-a7c0-
d84d171ad984&quot;]"/>
        </er:Node>
      </er:node>
    </er:RoadNode>
  </gml:featureMember>
  <gml:featureMember>
    <er:RoadNode>
      <er:id>
        <er:permanentId>80e25823-8538-4b12-8256-58394a0ce967</er:permanentId>
      </er:id>
      <er:attributes>

```

```

    <er:BorderNodeInfo>
      <er:borderNodeType>NationalBorderNodeType</er:borderNodeType>
      <er:areaCode>SWE</er:areaCode>
      <er:neighbourAreaCode>NOR</er:neighbourAreaCode>
      <er:neighbourId>
        <er:permanentId>d8865118-0c95-4b88-8d0e-fe5c8ded2a77</er:permanentId>
      </er:neighbourId>
    </er:BorderNodeInfo>
  </er:attributes>
  <er:level>Junction</er:level>
  <er:node>
    <er:Node gml:id="i2">
      <gml:pointProperty>
        <gml:Point>
          <gml:coord>
            <gml:X>234.567</gml:X>
            <gml:Y>234.567</gml:Y>
            <gml:Z>234.567</gml:Z>
          </gml:coord>
        </gml:Point>
      </gml:pointProperty>
      <er:roadNode xlink:href="//er:RoadNode/permanentId[.=&quot;80e25823-8538-4b12-8256-58394a0ce967&quot;]"/>
    </er:Node>
  </er:node>
</er:RoadNode>
</gml:featureMember>
<gml:featureMember>
  <er:RoadLink gml:id="i3">
    <er:id>
      <er:permanentId>64f1ffca-18d4-435b-bf42-838934110e95</er:permanentId>
    </er:id>
    <er:attributes>
      <er:LinkLevel>
        <er:startLevel>1</er:startLevel>
      </er:LinkLevel>
    </er:attributes>
    <er:edge>
      <er:Edge gml:id="i4">
        <gml:directedNode orientation="-" xlink:href="//er:RoadNode/permanentId[.=&quot;7cc91d53-17b9-48c0-a7c0-d84d171ad984&quot;]er:Node"/>
        <gml:directedNode orientation="+" xlink:href="//er:RoadNode/permanentId[.=&quot;80e25823-8538-4b12-8256-58394a0ce967&quot;]er:Node"/>
        <gml:curveProperty>
          <gml:LineString>
            <gml:coord>
              <gml:X>123.456</gml:X>
              <gml:Y>123.456</gml:Y>
              <gml:Z>100</gml:Z>
            </gml:coord>
            <gml:coord>
              <gml:X>234.567</gml:X>
              <gml:Y>234.567</gml:Y>
              <gml:Z>100</gml:Z>
            </gml:coord>
          </gml:LineString>
        </gml:curveProperty>
        <er:roadnetLink xlink:href="//er:RoadLink/permanentId[.=&quot;64f1ffca-18d4-435b-bf42-838934110e95&quot;]"/>
      </er:Edge>
    </er:edge>
  <er:level>RoadElement</er:level>
  <er:formOfWay>SingleCarriageway</er:formOfWay>
  <er:nationalRoadClass>FirstClass</er:nationalRoadClass>

```

```

</er:RoadLink>
</gml:featureMember>
<gml:featureMember>
  <er:RoadNode>
    <er:id>
      <er:permanentId>99e88f52-69b6-4101-b071-b6dc4731e997</er:permanentId>
    </er:id>
    <er:level>Junction</er:level>
    <er:node>
      <er:Node gml:id="i5">
        <gml:pointProperty>
          <gml:Point>
            <gml:coord>
              <gml:X>34.567</gml:X>
              <gml:Y>34.567</gml:Y>
              <gml:Z>34.567</gml:Z>
            </gml:coord>
          </gml:Point>
        </gml:pointProperty>
        <er:roadNode xlink:href="//er:RoadNode/permanentId[.='&quot;99e88f52-69b6-4101-b071-
b6dc4731e997&quot;]"/>
      </er:Node>
    </er:node>
  </er:RoadNode>
</gml:featureMember>
<gml:featureMember>
  <er:RoadLink gml:id="i6">
    <er:id>
      <er:permanentId>59ed0f41-96e3-40ed-97a2-c2ee384e9b11</er:permanentId>
    </er:id>
    <er:attributes>
      <er:LinkLevel>
        <er:endLevel>1</er:endLevel>
      </er:LinkLevel>
    </er:attributes>
    <er:edge>
      <er:Edge gml:id="i7">
        <gml:directedNode orientation="-" xlink:href="//er:RoadNode/permanentId[.='&quot;99e88f52-
69b6-4101-b071-b6dc4731e997&quot;]er:Node"/>
        <gml:directedNode orientation="+" xlink:href="//er:RoadNode/permanentId[.='&quot;7cc91d53-
17b9-48c0-a7c0-d84d171ad984&quot;]er:Node"/>
        <gml:curveProperty>
          <gml:LineString>
            <gml:coord>
              <gml:X>34.567</gml:X>
              <gml:Y>34.567</gml:Y>
              <gml:Z>100</gml:Z>
            </gml:coord>
            <gml:coord>
              <gml:X>123.456</gml:X>
              <gml:Y>123.456</gml:Y>
              <gml:Z>100</gml:Z>
            </gml:coord>
          </gml:LineString>
        </gml:curveProperty>
        <er:roadnetLink xlink:href="//er:RoadLink/permanentId[.='&quot;59ed0f41-96e3-40ed-97a2-
c2ee384e9b11&quot;]"/>
      </er:Edge>
    </er:edge>
    <er:level>RoadElement</er:level>
    <er:formOfWay>SingleCarriageway</er:formOfWay>
    <er:nationalRoadClass>FirstClass</er:nationalRoadClass>
  </er:RoadLink>
</gml:featureMember>

```

```

<gml:featureMember>
  <er:Route>
    <er:id>
      <er:permanentId>6f6936dc-6248-461a-8f7a-36ad8d646fb8</er:permanentId>
    </er:id>
    <er:routeLinks>
      <er:direction>+</er:direction>
      <er:roadnetLink xlink:href="//er:RoadLink/permanentId[.='&quot;64f1ffca-18d4-435b-bf42-838934110e95&quot;]"/>
    </er:routeLinks>
    <er:routeLinks>
      <er:direction>+</er:direction>
      <er:roadnetLink xlink:href="//er:RoadLink/permanentId[.='&quot;59ed0f41-96e3-40ed-97a2-c2ee384e9b11&quot;]"/>
    </er:routeLinks>
  </er:Route>
</gml:featureMember>
<er:properties>
  <er:id>96379990-f928-4f39-b065-6bd9c5746475</er:id>
  <er:timestamp>
    <gml:timePosition>2005-06-29 10:24:00</gml:timePosition>
  </er:timestamp>
</er:properties>
</er:EuroRoadSDataset>

```

5.2.2 Simple geometric road network with directly attached attributes

The xml sample below represents the same network as the example above but with a geometric representation. Observe that the road nodes not carrying extra attributes is not required.

```

<?xml version="1.0" encoding="utf-8"?>
<er:EuroRoadSDataset xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="www.euroroads.org C:\Projekt\Vägverket\Euroroads\Leveransobjekt\GML\EuroRoadS.xsd"
xmlns:gml="http://www.opengis.net/gml" xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:er="www.euroroads.org">
  <gml:featureMember>
    <er:RoadNode>
      <er:id>
        <er:permanentId>7cc91d53-17b9-48c0-a7c0-d84d171ad984</er:permanentId>
      </er:id>
      <er:level>Junction</er:level>
      <er:formOfNode>GradeSeparatedCrossing</er:formOfNode>
      <er:point>
        <gml:Point>
          <gml:coord>
            <gml:X>123.456</gml:X>
            <gml:Y>123.456</gml:Y>
            <gml:Z>100</gml:Z>
          </gml:coord>
        </gml:Point>
      </er:point>
    </er:RoadNode>
  </gml:featureMember>
  <gml:featureMember>
    <er:RoadNode>
      <er:id>
        <er:permanentId>80e25823-8538-4b12-8256-58394a0ce967</er:permanentId>
      </er:id>
      <er:attributes>
        <er:BorderNodeInfo>
          <er:borderNodeType>NationalBorderNodeType</er:borderNodeType>
          <er:areaCode>SWE</er:areaCode>
        </er:BorderNodeInfo>
      </er:attributes>
    </er:RoadNode>
  </gml:featureMember>
</er:EuroRoadSDataset>

```

```

        <er:neighbourAreaCode>NOR</er:neighbourAreaCode>
        <er:neighbourId>
          <er:permanentId> d8865118-0c95-4b88-8d0e-fe5c8ded2a77</er:permanentId>
        </er:neighbourId>
      </er:BorderNodeInfo>
    </er:attributes>
    <er:level>Junction</er:level>
    <er:point>
      <gml:Point>
        <gml:coord>
          <gml:X>234.567</gml:X>
          <gml:Y>234.567</gml:Y>
          <gml:Z>100</gml:Z>
        </gml:coord>
      </gml:Point>
    </er:point>
  </er:RoadNode>
</gml:featureMember>
<gml:featureMember>
  <er:RoadLink gml:id="i8">
    <er:id>
      <er:permanentId>64f1ffca-18d4-435b-bf42-838934110e95</er:permanentId>
    </er:id>
    <er:attributes>
      <er:LinkLevel>
        <er:startLevel>1</er:startLevel>
      </er:LinkLevel>
    </er:attributes>
    <er:curve>
      <gml:LineString>
        <gml:coord>
          <gml:X>123.456</gml:X>
          <gml:Y>123.456</gml:Y>
          <gml:Z>100</gml:Z>
        </gml:coord>
        <gml:coord>
          <gml:X>234.567</gml:X>
          <gml:Y>234.567</gml:Y>
          <gml:Z>100</gml:Z>
        </gml:coord>
      </gml:LineString>
    </er:curve>
    <er:level>RoadElement</er:level>
    <er:formOfWay>SingleCarriageway</er:formOfWay>
    <er:nationalRoadClass>FirstClass</er:nationalRoadClass>
  </er:RoadLink>
</gml:featureMember>
<gml:featureMember>
  <er:RoadNode>
    <er:id>
      <er:permanentId>99e88f52-69b6-4101-b071-b6dc4731e997</er:permanentId>
    </er:id>
    <er:level>Junction</er:level>
    <er:point>
      <gml:Point>
        <gml:coord>
          <gml:X>34.567</gml:X>
          <gml:Y>34.567</gml:Y>
          <gml:Z>100</gml:Z>
        </gml:coord>
      </gml:Point>
    </er:point>
  </er:RoadNode>
</gml:featureMember>

```

```

<gml:featureMember>
  <er:RoadLink gml:id="i9">
    <er:id>
      <er:permanentId>59ed0f41-96e3-40ed-97a2-c2ee384e9b11</er:permanentId>
    </er:id>
    <er:attributes>
      <er:LinkLevel>
        <er:endLevel>1</er:endLevel>
      </er:LinkLevel>
    </er:attributes>
    <er:curve>
      <gml:LineString>
        <gml:coord>
          <gml:X>34.567</gml:X>
          <gml:Y>34.567</gml:Y>
          <gml:Z>100</gml:Z>
        </gml:coord>
        <gml:coord>
          <gml:X>123.456</gml:X>
          <gml:Y>123.456</gml:Y>
          <gml:Z>100</gml:Z>
        </gml:coord>
      </gml:LineString>
    </er:curve>
    <er:level>RoadElement</er:level>
    <er:formOfWay>SingleCarriageway</er:formOfWay>
    <er:nationalRoadClass>FirstClass</er:nationalRoadClass>
  </er:RoadLink>
</gml:featureMember>
<gml:featureMember>
  <er:Route>
    <er:id>
      <er:permanentId>6f6936dc-6248-461a-8f7a-36ad8d646fb8</er:permanentId>
    </er:id>
    <er:routeLinks>
      <er:direction>+</er:direction>
      <er:roadnetLink xlink:href="//er:RoadLink/permanentId[.='&quot; 64f1ffca-18d4-435b-bf42-838934110e95&quot;]"/>
    </er:routeLinks>
    <er:routeLinks>
      <er:direction>+</er:direction>
      <er:roadnetLink xlink:href="//er:RoadLink/permanentId[.='&quot; 59ed0f41-96e3-40ed-97a2-c2ee384e9b11&quot;]"/>
    </er:routeLinks>
  </er:Route>
</gml:featureMember>
<er:properties>
  <er:id>0667eba2-1f10-45c1-a4f5-e12bc329cdfb</er:id>
  <er:timestamp>
    <gml:timePosition>2005-06-29 13:08:40</gml:timePosition>
  </er:timestamp>
</er:properties>
</er:EuroRoadSDataset>

```

5.2.3 Separate dataset with BorderNodeInfoFeature

This example attaches a BorderNodeInfoFeature as a separate feature to the border node from the previous examples. This is an alternate way (compared to the previous example) that represents the same border node information. The road node itself is not present in the dataset, it is just referenced by the <er:location> element.

```
<?xml version="1.0" encoding="utf-8"?>
```

```
<er:EuroRoadSDataset xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="www.euroroads.org C:\Projekt\Vägverket\Euroroads\Leveransobjekt\GML\EuroRoadS.xsd"
xmlns:gml="http://www.opengis.net/gml" xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:er="www.euroroads.org">
  <gml:featureMember>
    <er:BorderNodeInfoFeature>
      <er:id>
        <er:permanentId>fe6a659e-1dd9-48aa-8e80-30f506c194dd</er:permanentId>
      </er:id>
      <er:info>
        <er:borderNodeType>NationalBorderNodeType</er:borderNodeType>
        <er:areaCode>SWE</er:areaCode>
        <er:neighbourAreaCode>NOR</er:neighbourAreaCode>
        <er:neighbourId>
          <er:permanentId> d8865118-0c95-4b88-8d0e-fe5c8ded2a77</er:permanentId>
        </er:neighbourId>
      </er:info>
      <er:location>
        <er:node xlink:href="http://www.EuroRoadS.org/er:RoadNode/permanentId[.&quot;80e25823-
8538-4b12-8256-58394a0ce967&quot;]"/>
      </er:location>
    </er:BorderNodeInfoFeature>
  </gml:featureMember>
  <er:properties>
    <er:id>27e928f9-f842-45b3-920c-42dc82cdb417</er:id>
    <er:timestamp>
      <gml:timePosition>2005-06-29 13:01:21</gml:timePosition>
    </er:timestamp>
  </er:properties>
</er:EuroRoadSDataset>
```

5.2.4 Update dataset

In the following example, the top right node (the border node) has been moved which affects both the road node itself and the attached road link. Observe that the modified objects need to be transmitted as complete objects and that the other node (the one not affected by the change) is only referenced and not part of the dataset.

```
<?xml version="1.0" encoding="utf-8"?>
<er:EuroRoadSUpdateDataset xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="www.euroroads.org C:\Projekt\Vägverket\Euroroads\Leveransobjekt\GML\EuroRoadS.xsd"
xmlns:gml="http://www.opengis.net/gml" xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:er="www.euroroads.org">
  <gml:featureMember>
    <er:UpdateTransaction>
      <gml:featureMember>
        <er:ModifyObject>
          <er:modifiedObject>
            <er:RoadNode>
              <er:id>
                <er:permanentId>80e25823-8538-4b12-8256-58394a0ce967</er:permanentId>
              </er:id>
              <er:attributes>
                <er:BorderNodeInfo>
                  <er:borderNodeType>NationalBorderNodeType</er:borderNodeType>
                  <er:areaCode>SWE</er:areaCode>
                  <er:neighbourAreaCode>NOR</er:neighbourAreaCode>
                  <er:neighbourId>
                    <er:permanentId> d8865118-0c95-4b88-8d0e-
fe5c8ded2a77</er:permanentId>
                  </er:neighbourId>
                </er:BorderNodeInfo>
              </er:attributes>
```

```

    <er:level>Junction</er:level>
    <er:node>
      <er:Node gml:id="i11">
        <gml:pointProperty>
          <gml:Point>
            <gml:coord>
              <gml:X>334.111</gml:X>
              <gml:Y>334.111</gml:Y>
              <gml:Z>100</gml:Z>
            </gml:coord>
          </gml:Point>
        </gml:pointProperty>
        <er:roadNode xlink:href="//er:RoadNode/permanentId[.&quot; 80e25823-8538-4b12-8256-58394a0ce967&quot;]"/>
      </er:Node>
    </er:node>
  </er:RoadNode>
</er:modifiedObject>
</er:ModifyObject>
</gml:featureMember>
<gml:featureMember>
  <er:ModifyObject>
    <er:modifiedObject>
      <er:RoadLink gml:id="i12">
        <er:id>
          <er:permanentId>64f1fca-18d4-435b-bf42-838934110e95</er:permanentId>
        </er:id>
        <er:attributes>
          <er:LinkLevel>
            <er:startLevel>1</er:startLevel>
          </er:LinkLevel>
        </er:attributes>
        <er:edge>
          <er:Edge gml:id="i13">
            <gml:directedNode orientation="-" xlink:href="
http://www.EuroRoadS.org/er:RoadNode/permanentId\[.&quot;7cc91d53-17b9-48c0-a7c0-d84d171ad984&quot;\];er:Node"/>
            <gml:directedNode orientation="+"
http://www.EuroRoadS.org/er:RoadNode/permanentId\[.&quot;80e25823-8538-4b12-8256-58394a0ce967&quot;\];er:Node"/>
            <gml:curveProperty>
              <gml:LineString>
                <gml:coord>
                  <gml:X>0</gml:X>
                  <gml:Y>123.456</gml:Y>
                  <gml:Z>100</gml:Z>
                </gml:coord>
                <gml:coord>
                  <gml:X>334.111</gml:X>
                  <gml:Y>334.111</gml:Y>
                  <gml:Z>100</gml:Z>
                </gml:coord>
              </gml:LineString>
            </gml:curveProperty>
            <er:roadnetLink xlink:href="//er:RoadLink/permanentId[.&quot; 64f1fca-18d4-435b-bf42-838934110e95&quot;]"/>
          </er:Edge>
        </er:edge>
      </er:RoadLink>
    </er:modifiedObject>
  </er:ModifyObject>
</gml:featureMember>

```

```
</er:UpdateTransaction>
</gml:featureMember>
<er:properties>
  <er:id>14dff5a9-4149-430a-9cc0-3ff5bb730743</er:id>
  <er:timestamp>
    <gml:timePosition>2005-06-29 14:42:38</gml:timePosition>
  </er:timestamp>
</er:properties>
</er:EuroRoadSUpdateDataset>
```