INSPIRE
Infrastructure for Spatial Information in Europe

Drafting Team "Data Specifications"
Guidelines for the encoding of spatial data

Title	D2.7: Guidelines for the encoding of spatial data, Version 2.0
Creator	INSPIRE Drafting Team "Data Specifications"
Date	2008-06-27
Subject	Guidelines for the encoding of spatial data
Publisher	INSPIRE Drafting Team "Data Specifications"
Type	Text
Description	Draft of the guidelines for the encoding of spatial data
Contributor	Members of the INSPIRE Drafting Team "Data Specifications"
Format	Adobe (pdf)
Source	
Rights	Open access; comments limited to registered SDICs and LMOs
Identifier	Inspire_dataspec_D2.7_v2.0.pdf
Language	En
Relation	n/a
Coverage	Project duration

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Foreword

INSPIRE is a Directive proposed by the European Commission in July 2004 setting the legal framework for the establishment of the Infrastructure for Spatial Information in the European Community, for the purposes of Community environmental policies and policies or activities which may have an impact on the environment.

INSPIRE will be based on the infrastructures for spatial information that are created and maintained by the Member States. The components of those infrastructures include: metadata, spatial data themes (as described in Annexes I, II, III of the Directive), spatial data services; network services and technologies; agreements on data and service sharing, access and use; coordination and monitoring mechanisms, processes and procedures.

The guiding principles of INSPIRE are that the infrastructures for spatial information in the Member States will be designed to ensure that spatial data are stored, made available and maintained at the most appropriate level; that it is possible to combine spatial data and services from different sources across the Community in a consistent way and share them between several users and applications; that it is possible for spatial data collected at one level of public authority to be shared between all the different levels of public authorities; that spatial data and services are made available under conditions that do not restrict their extensive use; that it is easy to discover available spatial data, to evaluate their fitness for purpose and to know the conditions applicable to their use.

The text of the INSPIRE Directive is available from the INSPIRE web site (http://www.ec-gis.org/inspire). The Directive identifies what needs to be achieved, and Member States have two years from the date of adoption to bring into force national legislation, regulations, and administrative procedures that define how the agreed objectives will be met taking into account the specific situation of each Member State. To ensure that the spatial data infrastructures of the Member States are compatible and usable in a Community and transboundary context, the Directive requires that common Implementing Rules (IR) are adopted in a number of specific areas. Implementing Rules are adopted as Commission Decisions, and are binding in their entirety. The Commission is assisted in the process of adopting such rules by a regulatory committee composed by representatives of the Member States and European Parliament[1]. The committee is chaired by a representative of the Commission (this is known as the Comitology procedure). The committee will be established within three months from the entry in force of the Directive.

The IR will be shaped in their legal structure and form by the Commission legal services on the basis of technical documents prepared by especially convened Drafting Teams, for each of the main components of INSPIRE: metadata, data specifications, network services, data and service sharing, and monitoring procedures. For data specifications, the technical documents for each spatial data theme will be prepared by especially convened Thematic Working Groups.

This document represents a contribution of the Data Specification Drafting Team.

This document version (version 2.0) is published on the INSPIRE web site for public view and commenting by registered SDICs and LMOs until August 27, 2008. The comment resolution process is expected to include a workshop with representatives of SDICs and LMOs. Based on the discussions, the Drafting Team “Data Specifications” will propose comment resolutions to the Consolidation Team. After resolving the comments a revised version of the document will be produced. The baseline version (version 3.0) will be published on the INSPIRE web site and will be used by the Thematic Working Groups to prepare guidance documents for encoding.

It is important to note that this document is not a draft Implementing Rule, but a document that assists in the development of the thematic data specifications that will be the input to the Implementing Rules and additional guidance documents. Currently, it is expected that encoding will not be part of the Implementing Rule and addressed in guidance documents.

[1] The implementing rules are formally adopted through the comitology procedure that has been amended by Council Decision of 17 July 2006 (2006/512/EC). Under the new regulation, the Parliament and the Council are on equal footing for all comitology procedures related to co-decision acts. As a consequence, all measures must be ratified by all three institutions to come into force.

This is an auxiliary document to help the INSPIRE process and the Thematic Working Groups and the Consolidation Team. The document itself does not create any obligations to Member States.

Introduction

This document contains a draft version of the guidelines for the encoding of spatial data (document identifier: D2.7).

One of the main tasks of the INSPIRE programme is to enable the interoperability and, where practicable, harmonisation of spatial data sets and services within Europe. Here, it is important to note that interoperability has to go beyond any particular community, but take the various cross-community information needs into account. If one takes a look at the huge difference in the scope of the different themes (from reference systems to hydrography and from cadastral parcel to atmospheric conditions), the question does arise about the specific requirements of and for interoperability and harmonisation of the geographic information. These were also the questions faced by the Drafting Team "Data Specification" and one of the contributions of the Drafting Team is the identification of a set of *interoperability components*, which make the concepts of interoperability and harmonisation more tangible. Examples of interoperability components addressed in this document are: rules for application schemas, coordinate referencing and units model, identifier management, multi-lingual text and cultural adaptability, object referencing modelling, multiple representations (levels of detail) and consistency, and more. All these components do apply to (nearly) all themes identified within INSPIRE and this document together with the Generic Conceptual Model describes approaches to these shared components. Using this framework across the different themes will therefore result in a first level of interoperability.

It is important to note that “interoperability” is understood as providing access to spatial data sets as specified in Article 4 of the Directive through network services in a representation that allows for combining them with other such spatial data sets in a coherent way. This includes agreements about the different interoperability components. In other words, by enabling interoperability data can be used coherently, independent of whether the existing data set is actually changed (harmonised) or “just” transformed by a download service for publication in INSPIRE depending on the approach taken by the Member State. It is expected that these agreements will be based on existing data interoperability or harmonisation activities, whenever feasible and in-line with the environmental requirements.

The starting point for the development of INSPIRE data specifications is the input delivered by the LMOs and SDICs with their reference material and domain knowledge. Further and more specifically the foundation is formed by the internationally accepted standards reflecting the collective state-of-the-art knowledge (such as the reference model described in ISO 19101).

The individual themes (as defined in the Annexes I, II and III of the Directive and refined in document D2.3 'Definition of Annex Themes and Scope') will be modelled based on document D2.5 ‘Generic Conceptual Model’. This document specifies the process. The result are data product specifications for the individual themes, i.e. conceptual information models that describe the relevant classes, their attributes, relationships, constraints, and possibly also operations as well as other appropriate information like data capturing information or data quality requirements. Care has to be taken that common or shared spatial object types relevant in multiple themes are identified and modelled in a consistent manner. This could then be considered a second level of interoperability: agreement on the shared (formal) semantics between the different themes. Note that the spatial characteristics of a spatial object will be represented by vector geometries, coverage functions and/or references to gazetteer entries.

The methodology (document D2.6) specifies how individual INSPIRE spatial data themes will be modelled based on the user requirements, the INSPIRE Generic Conceptual Model (document D2.5) and the relevant international standards. It provides a process model and tools to assist in the process. The document is applicable for INSPIRE data specifications. It is not required that it will be applied for the modelling of data specifications at the national level. What is important is that each Member State is able to transform existing data sets to the INSPIRE data specifications and publish the transformed data via network services. On the other hand, this methodology is expected to influence modelling activities at the national level, because it adds value to the national spatial data infrastructure and simplifies synchronisation with the INSPIRE data specifications.

How the geographic information will actually be encoded for the transfer process will be described in this document, the 'guidelines for the encoding of spatial data' - the third level of geographic information interoperability.

Besides the partner documents D2.3, D2.5, D2.6 and D2.8.m.n[2], this document is also related to other INSPIRE documents and registers:

- The terms used in this document are drawn from the "INSPIRE Glossary".
- INSPIRE application schemas will be based on the Generic Conceptual Model and maintained in the "Consolidated INSPIRE UML model" that also includes the external schemas, for example, the harmonised model of the ISO 19100 series published by ISO/TC 211. INSPIRE application schemas will be developed for every theme listed in the annexes of the INSPIRE Directive.
- The "INSPIRE Feature Concept Dictionary Register" is used to manage the names, definitions and descriptions of all spatial object types used in INSPIRE application schemas. In the future, the register may be extended to manage properties, too.
- Other registers include a coordinate reference system register, a feature catalogue register and a code list register.
- The implementing rule on metadata and associated guidance documents.
- The implementing rules on network services and associated guidance documents.

Figure 1 below illustrates relationships from the point of view of the data specifications. The boxes denote INSPIRE Implementing Rule documents or supporting documents, the cylinders registries. The arrows denote dependencies, the areas with dashed boundaries denote areas of responsibility.

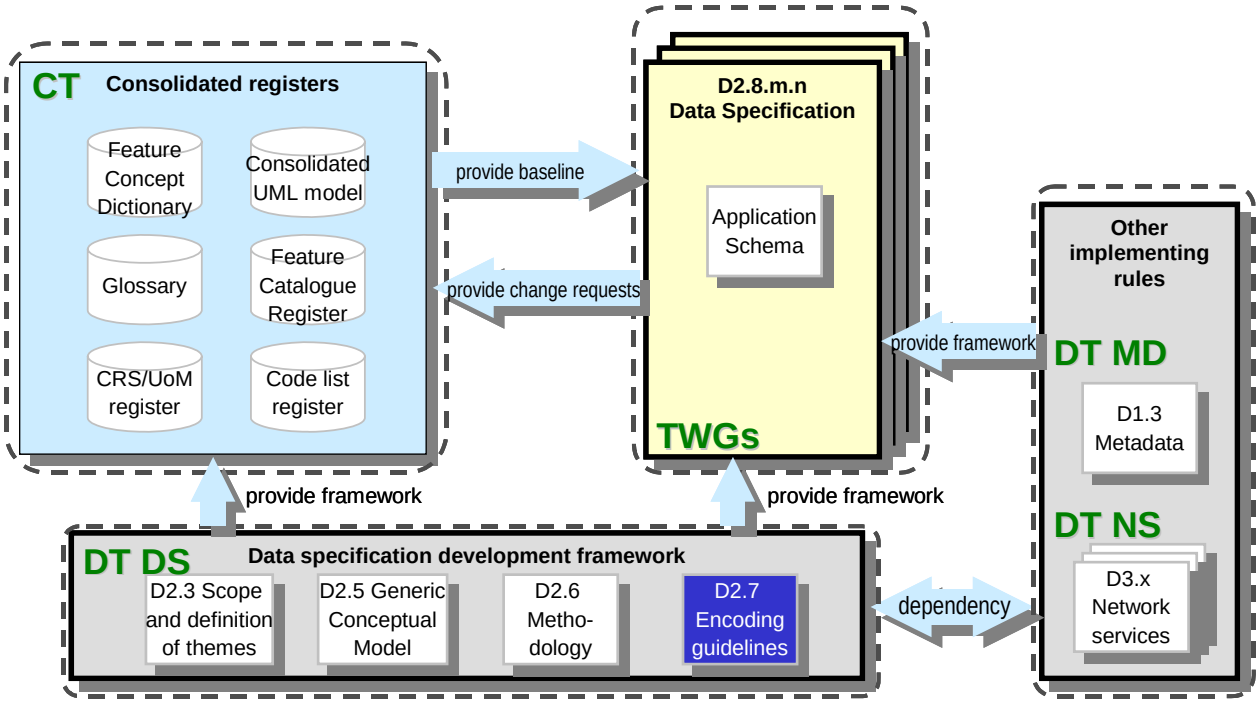

Figure 1 – The encoding guidelines as part of the data specification development framework

Since the conceptual modelling framework of INSPIRE is based in the ISO 19100 series of International Standards, in-depth knowledge about this series is required in every team developing an INSPIRE data specification.

The approach to encoding specified in this document can be summarised as follows:

- Conformant spatial data in INSPIRE will conform to the INSPIRE data specifications.
- The encoding of the spatial data in INSPIRE depends on the particular encoding rule chosen for the data.
- All valid encoding rules will conform to ISO 19118.

[2] "m" is the number of the annex and "m" the sequential number of the theme within the annex.

- A default GML/19139-based encoding rule will be specified. Additional or alternative encoding rules may be specified for each application schema.
- The encoding rules and application-schema-specific data structure schemas used within INSPIRE will be published in guidance documents.

1 Scope

This document specifies requirements and recommendations for the encoding of spatial data for the purpose of transfer between systems in INSPIRE. The requirements and recommendations specified by this document are requirements and recommendations for encoding rules as specified by ISO 19118.

This document does not specify a mandatory encoding rule. The appropriate encoding rule(s) for each INSPIRE application schema will be determined based on the specific characteristics of the data.

For spatial data that belongs to a theme listed in Annex I or Annex II of the Directive, this document also specifies requirements and recommendations on the way in which updates of the data are to be encoded.

NOTE 1 No requirements and recommendations regarding the encoding of updates are currently known.

The focus of “data transfer” is understood by this document primarily as “access to data via services” which includes but is not limited to a download of a complete spatial data set.

NOTE 2 Dependencies may exist to the Implementing Rule with regard to download services, which is not yet available.

2 Conformance

This document specifies the minimum requirements for any encoding rule for spatial data in INSPIRE. Every encoding rule claiming conformance to this document shall pass the conformance test in Annex A.

3 Normative references

D2.5 v3.0, Generic Conceptual Model, June 2008

ISO 19118:-[3], Geographic Information – Encoding

ISO 19136:2007, Geographic Information – Geography Markup Language (GML)

ISO/TS 19139:2007, Geographic Information – Metadata – XML Schema implementation

4 Terms and abbreviations

4.1 Terms

(1) application schema
conceptual schema for data required by one or more applications [ISO 19101]

(2) conversion rule
rule for converting instances in the input data structure to instances in the output data structure [ISO 19118]

(3) data interchange
delivery, receipt and interpretation of data [ISO 19118]

(4) data transfer

[3] to be published (revision of ISO 19118 is expected to enter DIS stage later this year)

movement of data from one point to another over a medium [ISO 19118]

NOTE Transfer of information implies transfer of data.

(5) encoding
conversion of data into a series of codes [ISO 19118]

(6) encoding rule
identifiable collection of conversion rules that define the **encoding** for a particular data structure [ISO 19118]

NOTE An encoding rule specifies the types of data to be converted as well as the syntax, structure and codes used in the resulting data structure.

(7) transfer format
structured representation of data in a file for transfer between systems

NOTE Typically, a machine readable schema will document the structure of the data in the transfer file.

EXAMPLE GML encodes the application schema in XML Schema.

(8) transfer protocol
common set of rules for defining interactions between distributed systems [ISO 19118]

4.2 Abbreviations

CEN	European Committee for Standardization
D2.3	INSPIRE document "Definition and scoping of the Annex themes"
D2.5	INSPIRE document "Generic Conceptual Model"
D2.6	INSPIRE document "Methodology for the development of data specifications"
D2.7	INSPIRE document "Guidelines for the encoding of spatial data"
GI	Geographic Information
GML	Geography Markup Language
INSPIRE	INfrastructure for SPatial InfoRmation in Europe
IR	Implementing Rule
ISO	International Standardisation Organisation
LMO	Legally Mandated Organisation
NID	URN Namespace Identifier
OGC	Open Geospatial Consortium
SDI	Spatial Data Infrastructure
SDIC	Spatial Data Interest Community
TR	Technical Report
TS	Technical Specification
UML	Unified Modelling Language
URN	Uniform Resource Name
UTF	Unicode Transformation Format
XML	eXtensible Markup Language

4.3 Verbal forms for the expression of provisions

In accordance with the ISO rules for drafting, the following verbal forms shall be interpreted in the given way:

- “shall” / “shall not”: a requirement, mandatory for every data specification
- “should” / “should not”: a recommendation, but an alternative approach may be chosen for a specific case if there are reasons to do so
- “may” / “need not”: a permission

To make it easier to identify the mandatory requirements and the recommendations for INSPIRE data specifications in the text, they are highlighted and numbered.

Requirements are shown using this style.

Recommendations are shown using this style.

4.4 References within the document

In accordance with the ISO rules for drafting, references to highest level of the document structure include the word “Clause” (or “Annex” in case of an annex).

EXAMPLE “Clause 2”, “Annex A”

References to lower levels within the document structure are given without this qualifier.

EXAMPLE 7.1, 7.1.8.4, A.1

References to ISO standards are given without the full title.

EXAMPLE “ISO 19101” instead of “ISO 19101 – Geographic Information – Reference Model” or “ISO 19101 (Reference Model)”

5 Background and principles

5.1 Requirements as stated in the INSPIRE Directive

5.1.1 Articles of the Directive

5.1.1.1 General remarks

This sub-clause provides an overview of the articles in the Directive which are addressed by this proposal and describes how they are addressed. To make this sub-clause easier to read, the relevant paragraphs from Chapter III “Interoperability of spatial data sets and services” are repeated in the text in italics.

5.1.1.2 Article 7(1)

Implementing rules laying down technical arrangements for the interoperability and, where practicable, harmonisation of spatial data sets and services, designed to amend nonessential elements of this Directive by supplementing it, shall be adopted in accordance with the regulatory procedure with scrutiny referred to in Article 22(3). Relevant user requirements, existing initiatives and international standards for the harmonisation of spatial data sets, as well as feasibility and cost-benefit considerations shall be taken into account in the development of the implementing rules. Where organisations established under international law have adopted relevant standards to ensure interoperability or harmonisation of spatial data sets and services, these standards shall be integrated, and the existing technical means shall be referred to, if appropriate, in the implementing rules mentioned in this paragraph.

This document, together with documents D2.3, D2.5 and D2.6, is intended to facilitate the drafting process of the implementing rules referenced above. In particular, the documents D2.5 and D2.6 provide a common framework for developing the various INSPIRE data specifications in a harmonised way. Access to data in a harmonised way is understood to occur by invoking network services that return data in a representation that allows for combining it with other INSPIRE data in a coherent way. The guidelines specified in this document are intended to support a harmonised approach to encoding data to enable interoperability between systems.

This topic is discussed in more detail in D2.5 4.3.

However, the encoding of data is currently not expected to be mandated as part of an implementing rule, but in guidance documents.

5.1.1.3 Article 8(2)

The implementing rules shall address the following aspects of spatial data:
…
(e) updates of the data.

Article 8(2)(e) is addressed by this document (see clause 8).

5.1.2 Recitals in the Directive

Of the 35 recitals of the Directive, recital (6) is partially relevant for the technical specification of implementing rules on data specifications:

"The infrastructures for spatial information in the Member States should be designed to ensure
- *that spatial data are stored, made available and maintained at the most appropriate level;*
- *that it is possible to combine spatial data from different sources across the Community in a consistent way and share them between several users and applications;*
- *that it is possible for spatial data collected at one level of public authority to be shared between other public authorities […]."*

This points out that the encoding guidelines in particular needs to address the topic of references to spatial data maintained, stored and made available by other parties. See 7.3 for requirements on the encoding of references.

Also, recital (16) and (28) state that *"implementing rules should be based, where possible, on international standards […]"* and that *"in order to benefit from the state of the art and actual experience of information infrastructures, it is appropriate that the measures necessary for the implementation of this Directive should be supported by international standards and standards adopted by European standardisation bodies.*"

5.2 A standards-based approach

The statements in D2.5, sub-clause 4.2 apply to the encoding guidelines, too. This documents extends this to the implementation level, i.e. in the context of data the supported encoding rules that will be specified will conform to international or European standards whenever possible.

5.3 Data interoperability components

The work on INSPIRE data specifications is based on a framework that identifies the components relevant to the interoperability and harmonisation of data. These components are introduced and described in the Generic Conceptual Model, sub-clause 4.3. The different components cover different aspects that need to be addressed in the process. For each of the components, a separate clause in document D2.5 specifies how this component is addressed in the Generic Conceptual Model.

This document in particular addresses the harmonisation component "Data Transfer" which is described as follows:

"This component will describe methods for encoding spatial data as well as information products.

"The encoding of spatial objects will in general be model-driven, i.e. fully determined by the application schema in UML. Where appropriate, existing encodings will continue to be used.

"To support network services that are implemented as web services, spatial objects are expected to be primarily encoded in XML/GML for the transfer of spatial data. Coverage data is expected to use existing encodings for the range part."

6 General approach to encoding

6.1 Data interchange between information systems

ISO 19109 distinguishes two ways of data interchange between information systems:

- The "traditional data transfer model", where a dataset is encoded according to a transfer format in one or more files and then transferred to the user.

  In this model, the dataset to be transferred is fully defined by the supplier and a data product specification (including spatial extent, etc). The user receives a copy of the complete dataset.

  The reference material analysis indicates that delivery via mass storage media is still and will continue to be used in practice.

- The service- or message-based "interoperability model", where the user application communicates with the supplier application through a common communication protocol, usually service interfaces which are also specified as part of the application schema.

  In this model, a requester first specifies selection criteria, such as spatial extent and predicates on property values of spatial object types, for the data from the supplier's data store. Data meeting the selection criteria are then retrieved from the data store and provided to the user.

  EXAMPLE In the OGC Web Feature Service standard (ISO 19142), the GetFeature operation allows to query spatial objects based on selection criteria encoded using the Filter Expression standard (ISO 19143).

Both models will be supported by INSPIRE and by the implementing rule with regard to download services.

6.2 The encoding process

The encoding process is discussed in detail in ISO 19118. This sub-clause provides a brief introduction of the most important concepts. The figure below illustrates the relationships between an encoding service and schemas as well as instances.

The encoding rule provides the necessary specifications so that an encoding service is able to read the input data structure and convert the instances to an output data structure and vice versa.

The encoding rule also provides the necessary specifications to determine a data structure schema, e.g. a GML application schema, for an application schema.

I.e., the encoding rule specifies conversion rules at both levels, the schema level and the instance level.

At the schema level, the conversion rules define a mapping for each of the concepts defined in the application schema to corresponding concepts in the data structure schema.

At the instance level the conversion rules define a mapping for each of the instances in the input data structure to corresponding instances in the output data structure. The instance conversion rules may be deduced from the schema conversion rules.

The application schema is defined using concepts of the conceptual schema language, as specified by the Generic Conceptual Model.

The output data structure is also described with a schema, called the data structure schema, which defines the possible content, structure and coding schemes of the output data structure. The data structure schema is described with a schema language, e.g. XML Schema.

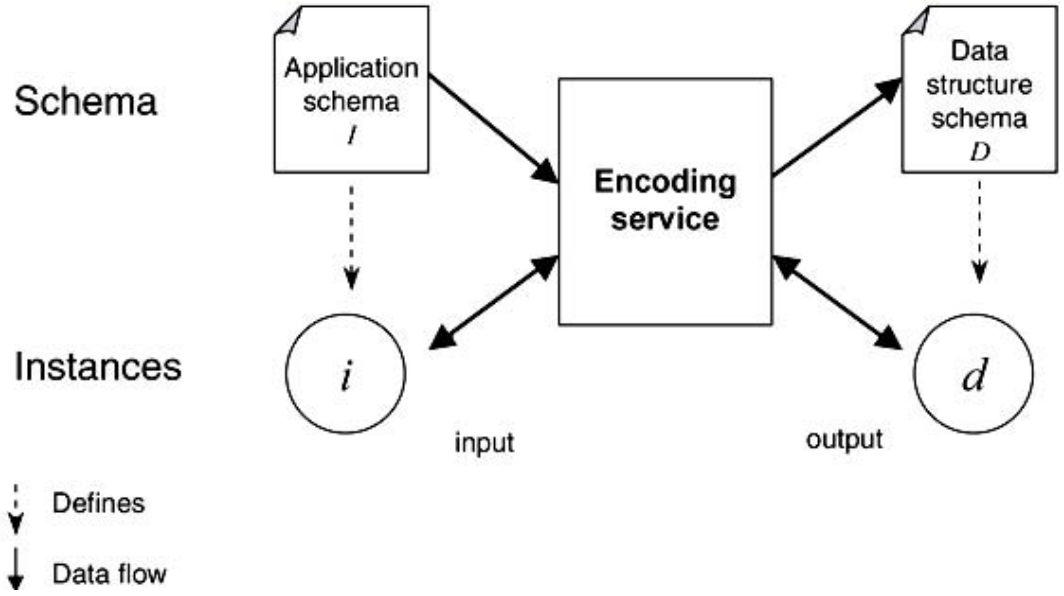

Figure 2 – Overview of the encoding process [ISO 19118]

6.3 Encoding rules in INSPIRE

Currently, encoding rules and output data structure schemas are not expected to become part of the implementing rules, but be part of guidance documents. Therefore, this document in general does not state requirements, but recommendations. However, there is one requirement for all encoding rules:

Requirement 1	Every encoding rule in INSPIRE shall conform to ISO 19118. In particular, it shall specify schema conversion rules for all elements of the application schemas to which the rule is applied.

NOTE This requirement should be binding and be part of implementing rule for the interoperability of spatial data sets and services. Clear and unambiguous mappings from the concepts to the implementation level are considered a minimum requirement, otherwise the encoded data would no longer reflect the agreed application schema.

While it is not expected that specific encoding rules and output data structure schemas will be mandated as part of the implementing rules, interoperability between systems will require support for common encoding in all systems interchanging data. Thus, one or more guidance documents will be specified for each INSPIRE application schema specifying recommended encodings.

Recommendation 1	To support interoperability and enhance coherence across communities, the encoding rules and output data structure schemas in INSPIRE should be as consistent across the various themes as possible.

GML (ISO 19136) and ISO/TS 19139 are promoted as the default encoding in INSPIRE. The main reasons for this are:

- GML and ISO/TS 19139 cover encoding rules for large parts of the INSPIRE application schemas. This is not the case for any other commonly used encoding.
- GML specifies a XML based encoding rule for ISO 19109 conformant application schemas specifying spatial object types that can be represented using a restricted profile of UML that allows

for a conversion to XML Schema. In addition, GML provides a standardised encoding for many commonly used types from core standards of the ISO 19100 series (in particular ISO 19107, ISO 19108, ISO 19111, and ISO 19123) that form the foundation of the Generic Conceptual Model (D2.5).

- ISO/TS 19139 specifies a XML based encoding rule for conceptual schemas specifying types that describe geographic resources, e.g. metadata according to ISO 19115 and feature catalogues according to ISO 19110.
- The reference material provided by SDICs and LMOs shows that GML is increasingly used in Member States and international communities to represent and transfer geographic information.
- GML and ISO/TS 19139 are well integrated with the current candidate standards of the network services.
- The use of these standards is inline with the recommendations of CEN TR 15449 on encoding which promotes GML as the encoding method when transferring spatial objects and ISO/TS 19139 as the encoding method when transferring information related to spatial data such as metadata, feature catalogues and data dictionaries.
- A default encoding rule allows for a coherent encoding approach inline with the overall interoperability requirements of the Directive.

Therefore, guidance documents specifying an XML based encoding on the basis of GML and ISO/TS 19139 will be developed for all INSPIRE data specifications. Clause 7 specifies recommendations for the encoding of specific aspects, for example, references. That clause with the recommendations is expected to eventually form part of the GML guidance document.

The default encoding is applicable to both data interchange models, the “traditional data transfer model” and the "interoperability model". In addition, if the GetFeatureInfo operation is offered by a view service, it may use the same encoding.

While a default encoding rule is provided, the diversity of themes and practice in the communities is recognised by allowing the use additional or alternative encoding rules. Examples are:

- a specific encoding for certain data has to be used to meet performance requirements
- existing file-based data (binary or text) has to be integrated as-is

Recommendation 2 Encoding rules should be based on open standards.

While flexibility to support additional encoding rules is important, harmonisation and reduction of the spread of encoding rules is important, too. The list of recognised encoding rules and output data structure schemas will be maintained in a register as part of the data specification process.

Recommendation 3 Additional encoding rules should only be added, if the new encoding rule has unique characteristics required by the encoded data that are not fulfilled by an encoding rule that has already been endorsed.

EXAMPLE An encoding rule to support geographic visualisation in a number of commonly-used clients could be KML-based. Unlike GML, KML is an XML language focused on geographic visualisation, including annotation of maps and images. Geographic visualization includes not only the presentation of graphical data on the globe, but also the control of the user's navigation in the sense of where to go and where to look.

7 Default encoding rule

7.1 Recommendations for GML application schemas

Recommendation 4 For every INSPIRE application schema, a GML application schema should be specified.

Recommendation 5 The encoding rule specified in ISO 19136 Annex E should be applied. For types within the scope of the ISO/TS 19139 encoding rule, the encoding rule of ISO/TS 19139 should be applied.

To identify the applicable encoding rule, a tagged value “xsdEncodingRule” should be provided for packages and classifiers. A value “iso19136_2007” (the default, if no value is provided) indicates the GML encoding rule, “iso19139_2007” indicates the ISO/TS 19139 encoding rule.

Since the UML profile supported by the Generic Conceptual Model is more general than the UML profile specified by ISO 19136 Annex E, it may be required to derive first a GML-specific implementation schema in UML from the relevant INSPIRE application schema. This process is illustrated in Figure 3.

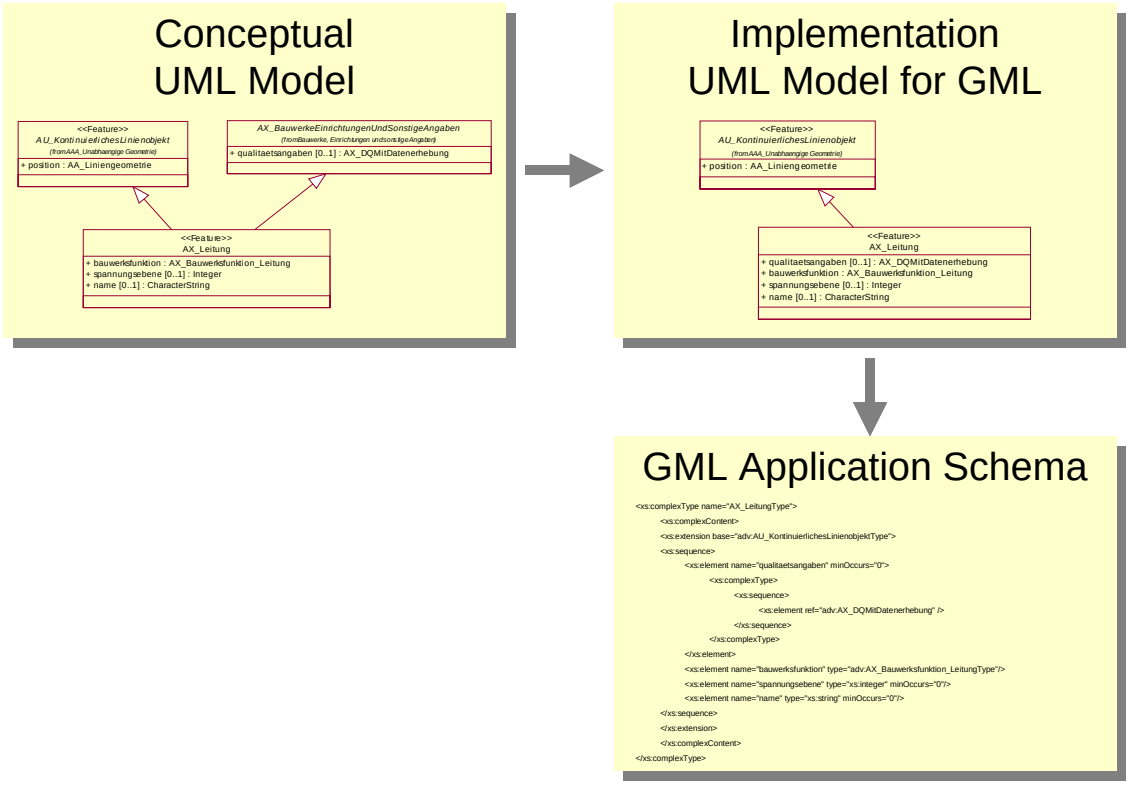

Figure 3 – Process of creating the GML application schema

NOTE 1 See Annex B for examples of conversions between the application schema and the implementation schema.

Recommendation 6 The transformation from the application schema on the conceptual level to the UML implementation profile from which the GML application schema is automatically derived should follow a common set of rules across all themes.

Since it is unknown at this time which parts of the UML profile of the Generic Conceptual Model that are outside of the UML profile specified by ISO 19136 Annex E and ISO/TS 19139, new rules will be developed once a new extension is used in a model by a Thematic Working Group. The common rules for these transformations will be developed and maintained under the responsibility of the Consolidation Team.

The intention of the following recommendations is to harmonise the encoding style across the different data specifications where the GML encoding rule leaves encoding options.

Recommendation 7 All navigable feature association roles should be assigned a tagged value "inlineOrByReference" with the value "byReference".

NOTE 2 The result of this particular recommendation is that features are not embedded in other features in XML documents but that they are all first level objects in a feature collection. An example where this recommendation would in general be ignored are complex spatial objects that own their parts.

Recommendation 8 All code lists should be assigned a tagged value "asDictionary" with the value "true". Instance should reference the INSPIRE register that is used to manage this code list.

NOTE 3 As a result, the code list values are managed only in the register (i.e. outside of the application schema) and all instances have to reference the register to allow applications to evaluate the code list value and its validity or definition.

7.2 Recommendations for XML documents

Recommendation 9 XML documents should be encoded using UTF-8 or UTF-16 as character encodings.

NOTE Following this recommendation ensures that all linguistic texts can be encoded in any language – which in turn simplifies processing of data. The use of UTF also aligns with common practice and the default character encodings for XML documents.

7.3 Recommendations for the use of URNs

7.3.1 Precondition

The Consolidation Team will execute the necessary steps for the registration of the URN NID "inspire" with IETF/IANA. The definition of the URN NID "inspire" is expected to support all URN patterns described in this document.

NOTE 1 In the following "x-inspire" is used to denote that the NID has not yet been registered. Once registration is complete, the "x-" can be omitted.

All software components comparing or resolving URNs in INSPIRE datasets are expected to consider URNs with or without the "x-" as identical.

NOTE 2 This is general rule for URNs, but is highlighted for the avoidance of doubt.

EXAMPLE The URNs "urn:x-inspire:object:id:DEAB:1241" and "urn:inspire:object:id:DEAB:1241" are identical.

7.3.2 XML namespaces

Recommendation 10 The target namespace of the GML application schema should be a URN of the form

urn:x-inspire:specification:<name>:<version>

where <name> is a name of the GML application schema and <version> identifies the particular version.

NOTE This is required to provide a common approach to the use of XML namespaces across the different data specifications. URNs are used instead of the often used URLs, since the INSPIRE-related URLs do not appear to be stable.

7.3.3 Encoding of an external object identifier

Recommendation 11 URNs should be used to encode unique identifiers including the namespace and the local identifier part.

The URNs should use the following structure:

urn:x-inspire:object:id:<namespace>:<local identifier>[:<version>]

where
- <namespace> is the namespace of the object identifier;
- <local identifier> is the local identifier part of the object identifier;
- <version> is an optional version qualifier to be added only if a specific version of the object shall be identified.

NOTE The intention of this recommendation is to harmonise the encoding style across the different data specifications where the GML encoding rule leaves encoding choices.

7.3.4 Encoding of a reference to a spatial object

Recommendation 12 To reference a spatial object or a specific version of a spatial object the URNs specified in Recommendation 11 should be used.

NOTE 1 The intention of this recommendation is to harmonise the encoding style across the different data specifications where the GML encoding rule leaves encoding choices.

NOTE 2 If no version is encoded and several versions of a spatial object exist, the relevant versions of the spatial object have to be determined based on the context, e.g. the lifespan of the version of a spatial object that includes the reference.

7.3.5 Encoding of a reference to a registered item

Recommendation 13 URNs should be used to encode item identifiers of items in registers and to reference such items.

The URNs should use the following structure:

urn:x-inspire:def:<item class>:<register>:<item identifier>

where
- <item class> is the name of the item class (ISO 19135: RE_ItemClass) of the registered item;
- <register> is the name of the register (ISO 19135: RE_Register);
- <item identifier> is the item identifier of the registered item (ISO 19135: RE_RegisterItem).

Other URIs may be used, too. It is recommended to register them as an alias of the item in the INSPIRE register.

EXAMPLE 1 urn:x-inspire:def:FeatureConcept:IFCD:125 would be a reference to a feature concept in the INSPIRE Feature Concept Dictionary. The item identifier 125 is unique and identifies the item within the register. It should be noted that the name of the feature concept cannot be used as the item identifier as over time the same name may be associated with different concepts; e.g., when the definition of a feature concept is amended.

This applies to all items that will be managed in registers: terms, feature types, coordinate reference systems, coordinate operations, units of measurements, identifier namespaces, application schemas, etc. The list of item classes will be compiled during the data specification process.

NOTE 1 The intention of this recommendation is to harmonise the encoding style across the different data specifications where the GML encoding rule leaves freedom.

NOTE 2 The use of other URNs is intended to support the usage of URNs that are already commonly used and supported by software components or specified in other standards.

EXAMPLE 2 OGC provides a URN namespace to reference coordinate reference systems.

8 Guidelines for the encoding of updates

Currently, no user requirements for data updates for spatial data from the themes of Annex I or Annex II are known. Therefore, this version of the encoding guidelines do not specify any requirements or recommendations. It is kept as a placeholder for future requirements.

9 Rules for exchange metadata

Exchange metadata is metadata about the encoded data that provides the necessary metadata about the transferred data to the receiver of the data.

Recommendation 14 For data transfer using the transfer model (download of a complete spatial data set), the data set should include the data set metadata for evaluation (MD_Metadata as specified in the INSPIRE data specification) and use (the INSPIRE data specification itself).

EXAMPLE 1 In an XML instance the metadata elements will be encoded as part of the data set.

```
<i:DataSet
   xmlns:i="urn:x-inspire:specification:BaseTypes:1.0"
   xmlns:ad="urn:x-inspire:specification:Addresses:1.0"
   xmlns:gmd="http://www.isotc211.org/2005/gmd"
   xmlns:gml="http://www.opengis.net/gml/3.2"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:schemaLocation="urn:x-inspire:specification:BaseTypes:1.0
        http://schemas.inspire.jrc.it/baseTypes/1.0/all.xsd
        urn:x-inspire:specification:Addresses:1.0
        http://schemas.inspire.jrc.it/addresses/1.0/all.xsd">
   <i:metadata>
      <gmd:MD_Metadata>
         <!-- metadata elements encoded according to ISO/TS 19139 -->
      </gml:MD_Metadata>
   </i:metadata>
   <!-- address features in the data set -->
</i:DataSet>
```

Recommendation 15 For data transfer using the interoperability model (download of a spatial objects based on a query), the response of the download service should not include any data set metadata, but should provide a reference to the data set or data set series metadata in a discovery or registry service.

EXAMPLE 2 In an XML instance the reference will be encoded using an Xlink:

```
<wfs:FeatureCollection
   xmlns:ad="urn:x-inspire:specification:Addresses:1.0"
   xmlns:wfs="http://www.opengis.net/wfs/2.0"
   xmlns:gml="http://www.opengis.net/gml/3.2"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:schemaLocation="http://www.opengis.net/wfs/2.0
        http://schemas.opengis.net/wfs/2.0/wfs.xsd
        urn:x-inspire:specification:Addresses:1.0
        http://schemas.inspire.jrc.it/addresses/1.0/all.xsd">
   <wfs:metadata
    xlink:href="http://service.xyz.org/discovery?REQUEST=GetRepositoryItem&ID=5325423"/>
   <!-- requested address features -->
```

```
</wfs:FeatureCollection>
```

Annex A
(normative)

Abstract Test Suite

A.1 Test case for an encoding of spatial data

a) Test Purpose: Verify that the encoding fulfils the mandatory requirements.

b) Test Method: Inspect the encoding rule of the encoding to verify that it specifies a mapping for all items of the application schema to the output data structure schema of the encoding.

c) Reference: Clause 6, ISO 19118

d) Test Type: Basic Test

Annex B
(informative)

Examples of conversions between the application schema and a GML implementation schema in UML

B.1 Overview

This annex provides some example of changes to the UML model so that the UML profile used conforms with Annex E of GML (ISO 19136).

It is expected that most application schemas will already conform to the target UML profile and that no conversion of the UML model has to take place.

B.2 Multiple inheritance

This example illustrates removing multiple inheritance by propagating duplicates of properties down to instantiable types. Figure 4 shows the schema on the conceptual level, figure 5 the schema on the implementation level.

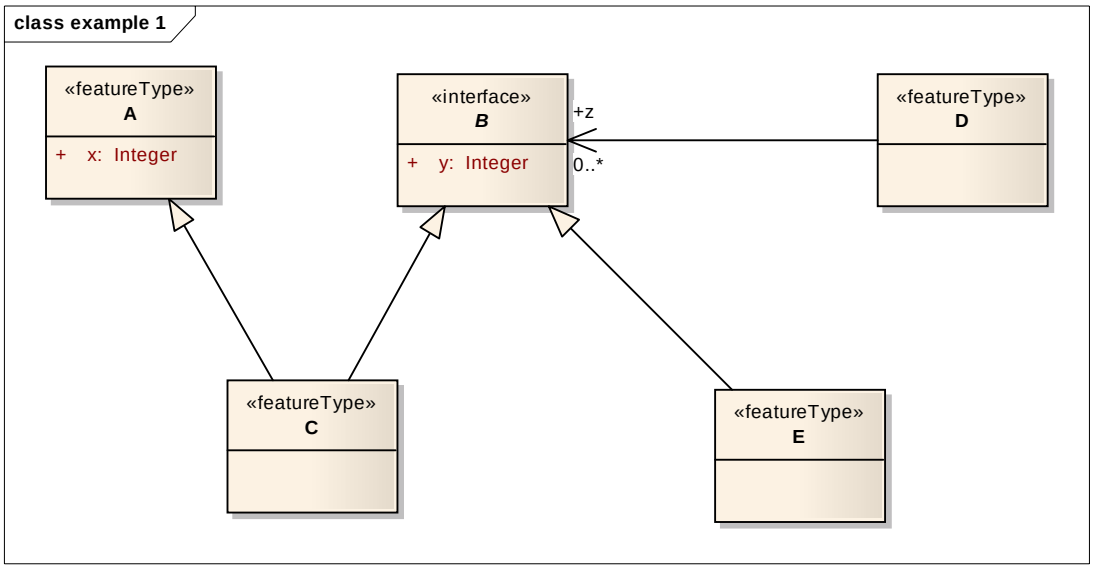

Figure 4 – Example 1: Types in the application schema

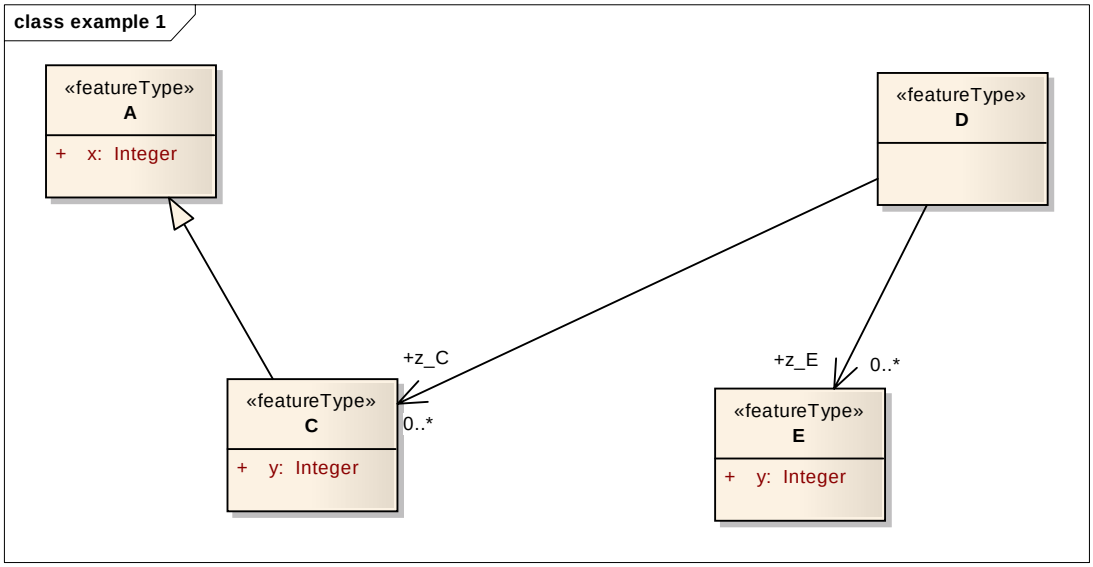

Figure 5 – Example 1: Types in the GML implementation schema

B.3 Association classes

This example illustrates the conversion of association classes to spatial object types with associations to both ends of the original association. Figure 6 shows the schema on the conceptual level, figure 7 the schema on the implementation level.

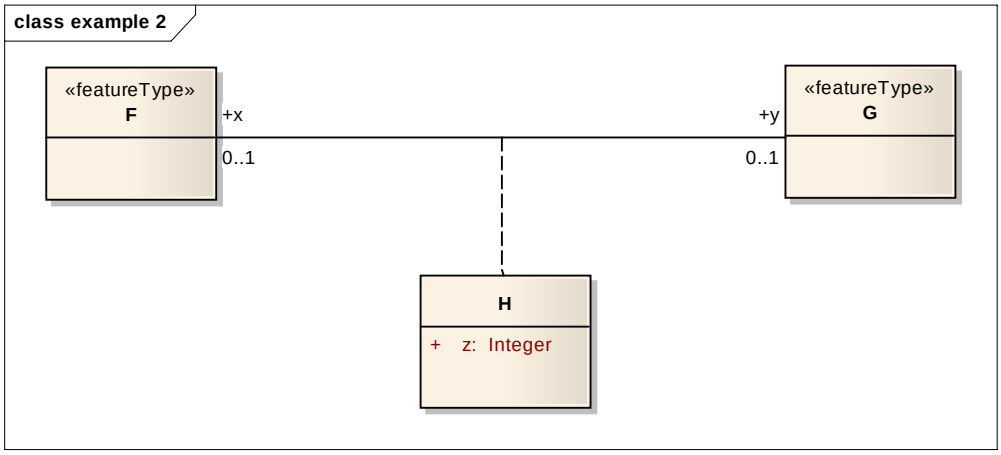

Figure 6 – Example 2: Types in the application schema

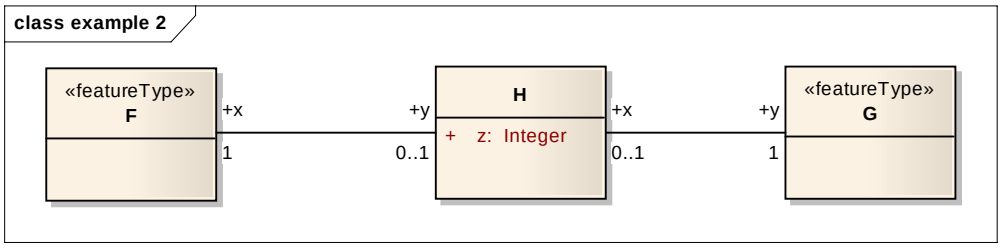

Figure 7 – Example 2: Types in the GML implementation schema

B.4 Names

This example illustrates the conversion of names (type or property names) to comply with the NCName production rule specified in XML Namespaces (i.e., a letter or an underscore followed by a sequence of characters that may appear in an XML element name with the exception of a colon) so that the names can be used in XML Schema. Figure 8 shows the schema on the conceptual level, figure 9 the schema on the implementation level.

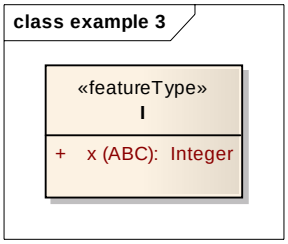

Figure 8 – Example 3: Type in the application schema

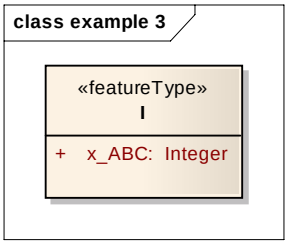

Figure 9 – Example 3: Type in the GML implementation schema

B.5 Topology vs. geometry

This example illustrates the conversion of spatial attributes from topology to geometry. A reason for such a conversion may be that on the conceptual level topology is used to express constraints on the spatial relationships between the spatial objects while the encoded data should just contain the geometry (as software could rebuild the topology where needed). Figure 10 shows the schema on the conceptual level, figure 11 the schema on the implementation level.

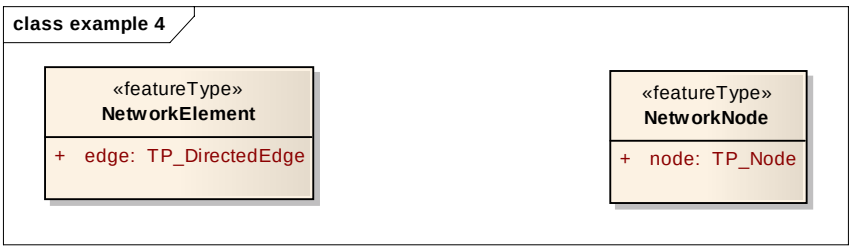

Figure 10 – Example 2: Types in the application schema

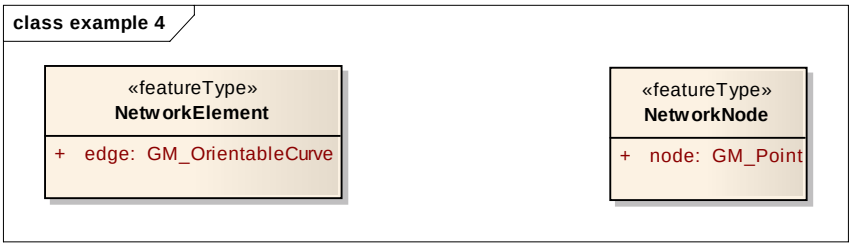

Figure 11 – Example 2: Types in the GML implementation schema

B.6 Adding tagged values requested by the encoding rule

Another example are tagged values that are processed by the GML encoding rule. Examples are ”inlineOrByReference” on attributes and association ends (see Recommendation 7), “targetNamespace” on application schema packages, etc.