INSPIRE
Infrastructure for Spatial Information in Europe

D2.10.1 INSPIRE Data Specifications – Base Models – Generic Network Model

Title	D2.10.1: INSPIRE Data Specifications – Base Models – Generic Network Model, Version 1.0rc3
Status	Version for Annex II/III data specifications v3.0rc3
Creator	Drafting Team "Data Specifications"
Date	2013-04-05
Subject	Generic application schema for networks
Publisher	Drafting Team "Data Specifications"
Type	Text
Description	Generic application schema for networks
Contributor	Members of the INSPIRE Drafting Team "Data Specifications", INSPIRE Spatial Data Interest Communities & Legally Mandated Organisations, INSPIRE Consolidation Teams and other Drafting Teams
Format	Portable document format (pdf)
Source	Drafting Team "Data Specifications"
Rights	Internal
Identifier	D2.10.1_v1.0rc3
Language	En
Relation	n/a
Coverage	Project duration

Table of contents

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 should 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://inspire.ec.europa.eu/). The Directive identifies what needs to be achieved, and Member States had 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 Regulations 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 was established on 15 August 2007.

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.

It is important to note that this document is not a draft Implementing Rule, but a document that is a basis for the development and maintenance of the thematic data specifications that will serve as technical basis for the legal text of the INSPIRE Implementing Rules. It is foreseen that relevant requirements will continue to be included in the Implementing Rules.

The document will be publicly available as a 'non-paper', as it does not represent an official position of the Commission, and as such can not be invoked in the context of legal procedures.

---

[1] The implementing rules for interoperability of spatial data are formally adopted through regulatory procedure with scrutiny according to Council Decision of 17 July 2006 (2006/512/EC). Under this regulation, the Parliament and the Council are on equal footing for all regulatory procedures related to co-decision acts. As a consequence, all measures must be ratified by all three institutions to come into force.

1 Scope

This document specifies an application schema for a Generic Network Model for use by thematic application schemas in INSPIRE.

The document identifier is: D2.10.1.

2 Normative references

D2.5 v3.4, Generic Conceptual Model

3 Terms and abbreviations

The terms and definitions, abbreviations and other conventions specified in clause 3 of the Generic Conceptual Model apply.

4 The generic network model

4.1 Overview

The package "Network" contains a generic application schema for networks. The types defined in this application schema provide basic capabilities that are supposed to be extended in application schemas of the spatial data themes, e.g. transport networks and hydrography.

The main type is the network element which may be any element that is relevant for a network. In particular the following network elements are included in this network model:

- Nodes are 0-dimensional network elements that may connect links.

    EXAMPLE 1   A junction in a road network.

- Links are 1-dimensional network elements.

    EXAMPLE 2   A continuous segment in a road network from one junction to another.

    NOTE   Nodes are not required – not all network data sets maintain the nodes in the network explicitly.

- Areas are 2-dimensional network elements

    EXAMPLE 3   A large square in a road network.

- Network connections are network elements where it is possible to move from one network to another

    EXAMPLE 4   At a train station it is usually possible for a traveller to change from the road network to the railway network.

- Grade separated crossing are locations where two network elements intersect in a 2D projection, but where there is no physical connection of the network elements

    EXAMPLE 5   Two roads separated by a bridge.

- Aggregated links are sequences of links

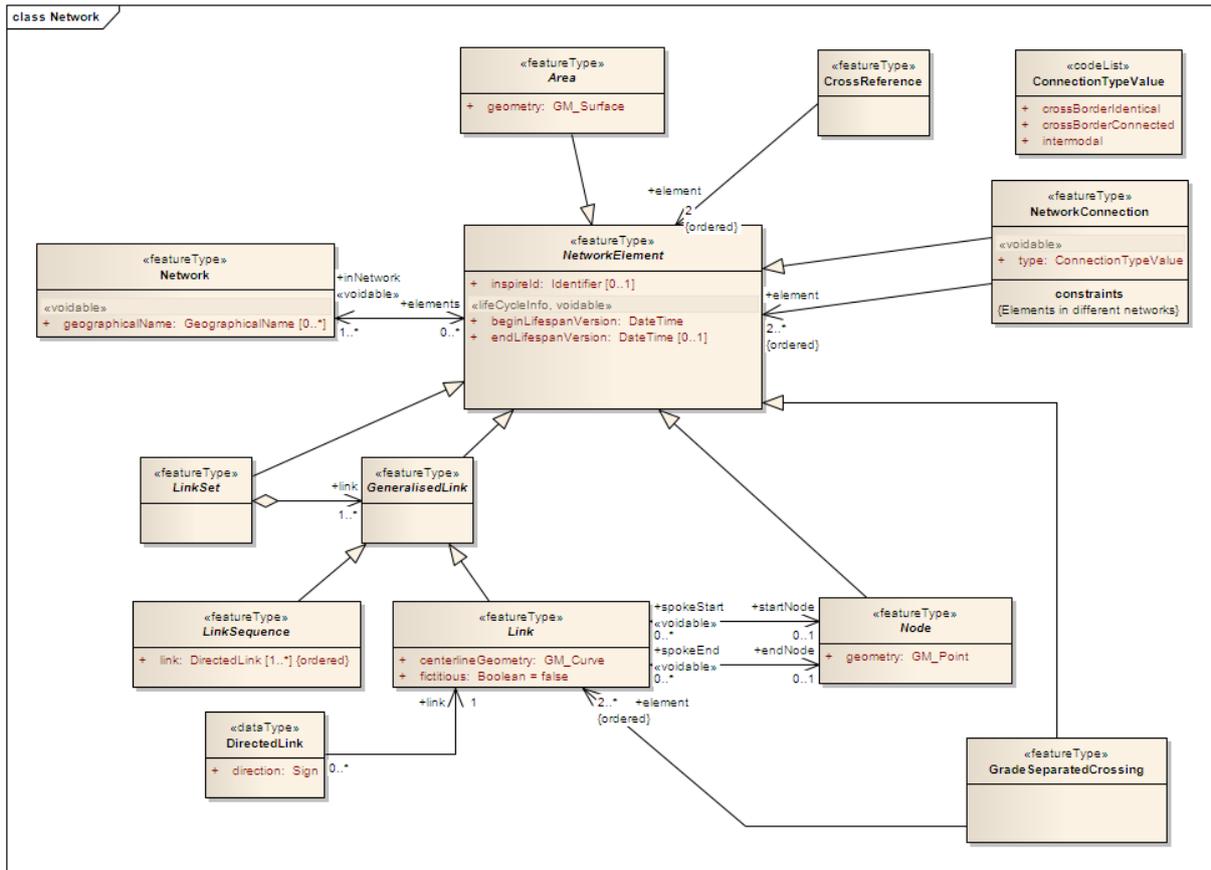   EXAMPLE 6   A route along a road network.

Figure 1 – Network application schema

In application schemas that are related to networks, phenomena are often spatial referenced indirectly by a reference to a network element instead of a geometry (see also Clause 13 of the Generic Conceptual Model).

For phenomena that are located along a link, their spatial reference usually applies to a part of the link only. Linear referencing may be used to describe such references. ISO/TC 211 has been developing a standard (ISO 19148). A mechanism to express linear references is provided in this version of the network model in the sense of a "candidate type" that may require an update once ISO 19148 is stable and supported by implementations. The current model requires for all linear references one or two expressions representing a distance from the start of the Link along its curve geometry. The network property applies to the location at the expression (in case of one expression) or to the part of the Link between two expressions. Where applicable, an offset can be provided.

EXAMPLE 7   Figure 2 shows an example of a network property, a speed limit, along a road. It is spatially referenced by referencing the link along which the speed limit occurs plus the start and end of the speed limit along the link (110m and 240m from the start of the link respectively).
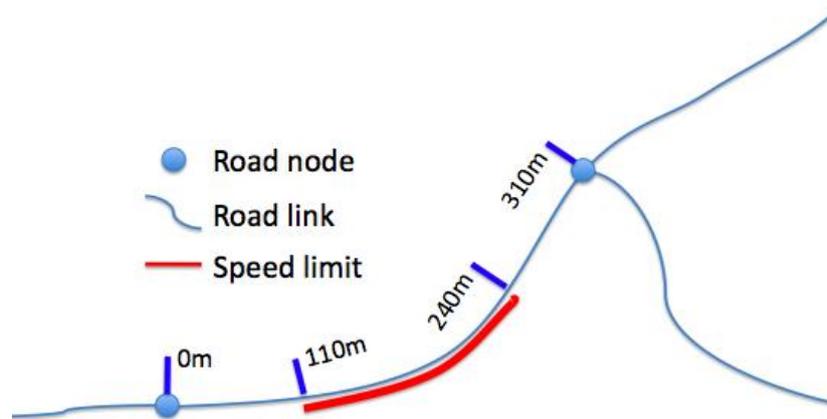
Figure 2 – Linear referencing example
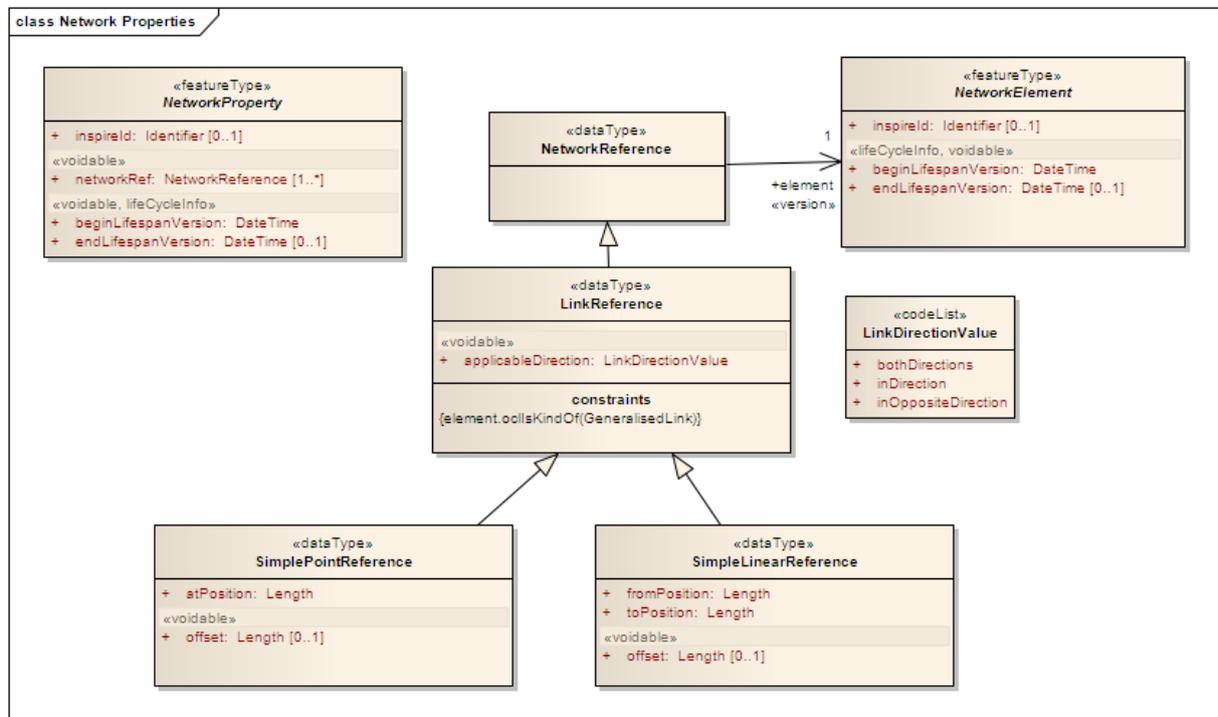
Figure 3 – Network properties

NOTE The data types shown in Figure 3 may also be used to specify network properties in an application schema as attributes of spatial object types instead of as spatial object types in their own right.

Table 1 – Network types

Type Name	Package Name	Stereotypes	Section
ConnectionTypeValue	Network	«codeList»	4.4.1
CrossReference	Network	«featureType»	4.2.1
DirectedLink	Network	«dataType»	4.3.1
GeneralisedLink	Network	«featureType»	4.2.2
GradeSeparatedCrossing	Network	«featureType»	4.2.3

Type Name	Package Name	Stereotypes	Section
Link	Network	«featureType»	4.2.4
LinkDirectionValue	Network	«codeList»	4.4.2
LinkReference	Network	«dataType»	4.3.2
LinkSequence	Network	«featureType»	4.2.5
LinkSet	Network	«featureType»	4.2.6
Network	Network	«featureType»	4.2.7
NetworkArea	Network	«featureType»	4.2.8
NetworkConnection	Network	«featureType»	4.2.9
NetworkElement	Network	«featureType»	4.2.10
NetworkProperty	Network	«featureType»	4.2.11
NetworkReference	Network	«dataType»	4.3.3
Node	Network	«featureType»	4.2.12
SimpleLinearReference	Network	«dataType»	4.3.4
SimplePointReference	Network	«dataType»	4.3.5

4.2 Spatial Object Types

4.2.1 Network.CrossReference

Class: «featureType» Network.CrossReference	
Definition:	Represents a cross reference between two elements in the same network.
Description:	The cross reference may represent the case where two elements are different representations of the same spatial object.
Subtype of:	
Status:	Proposed
Stereotypes:	«featureType»

4.2.2 Network.GeneralisedLink

AbstractClass: «featureType» Network.GeneralisedLink	
Definition:	Abstract base type representing a linear network element that may be used as a target in linear referencing.
Subtype of:	NetworkElement
Status:	Proposed
Stereotypes:	«featureType»

4.2.3 Network.GradeSeparatedCrossing

Class: «featureType» Network.GradeSeparatedCrossing	
Definition:	Indicator which of two or more intersecting elements is/are below and which is/are above, to be used if elevation coordinates are not present or cannot be trusted.

Description:	NOTE 1 In most cases, the number of elements will be two.
	NOTE 2 In the normal case this is when elements intersect in the x/y-plane when the z coordinate is not present or is not accurate enough.
Subtype of:	NetworkElement
Status:	Proposed
Stereotypes:	«featureType»

Association role: element

Definition:	Sequence of crossing links. The order reflects their elevation; the first link is the lower link.
Value type:	Link
Multiplicity:	2..*
Stereotypes:	

4.2.4 Network.Link

AbstractClass: «featureType» Network.Link

Definition:	Curvilinear network element that connects two positions and represents a homogeneous path in the network. The connected positions may be represented as nodes.
Subtype of:	GeneralisedLink
Status:	Proposed
Stereotypes:	«featureType»

Attribute: centerlineGeometry

Definition:	The geometry that represents the centerline of the link
Value type:	GM_Curve
Multiplicity:	1
Stereotypes:	

Attribute: fictitious

Definition:	Indicator that the centerline geometry of the link is a straight line with no intermediate control points – unless the straight line represents the geography in the resolution of the data set appropriately.
Value type:	Boolean
Multiplicity:	1
Stereotypes:	

4.2.5 Network.LinkSequence

AbstractClass: «featureType» Network.LinkSequence

Definition:	A network element which represents a continuous path in the network without any branches. The element has a defined beginning and end and every position on the link sequence is identifiable with one single parameter such as length.
Description:	EXAMPLE A link sequence may represent a route.
Subtype of:	GeneralisedLink
Status:	Proposed
Stereotypes:	«featureType»

Attribute: link

Definition:	The ordered collection of directed links that constitute the link sequence.
Value type:	DirectedLink
Multiplicity:	1..*
Stereotypes:	
Collection Constraints:	ordered

4.2.6 Network.LinkSet

AbstractClass: «featureType» Network.LinkSet

Definition:	A collection of link sequences and/or individual links that has a specific function or significance in a network.
Description:	NOTE This spatial object type supports the aggregation of links to form objects with branches, loops, parallel sequences of links, gaps, etc. EXAMPLE A dual carriageway road, as a collection of the two link sequences that represent each carriageway.
Subtype of:	NetworkElement
Status:	Proposed
Stereotypes:	«featureType»

Association role: link

Definition:	The set of links and link sequences that constitute the link set.
Value type:	GeneralisedLink
Multiplicity:	1..*
Stereotypes:	

4.2.7 Network.Network

Class: «featureType» Network.Network

Definition:	A network is a collection of network elements.
Description:	The reason for collecting certain elements in a certain network may vary (e.g. connected elements for the same mode of transport)
Subtype of:	
Status:	Proposed
Stereotypes:	«featureType»

Attribute: geographicalName

Definition:	Geographical name for this network.
Value type:	GeographicalName
Multiplicity:	0..*
Stereotypes:	«voidable»

Association role: elements

Definition:	The collection of elements that constitutes the network.
Value type:	NetworkElement
Multiplicity:	0..*
Stereotypes:	

4.2.8 Network.NetworkArea

AbstractClass: «featureType» Network.NetworkArea	
Definition:	A 2-dimensional element in a network.
Subtype of:	NetworkElement
Status:	Proposed
Stereotypes:	«featureType»

Attribute: geometry	
Definition:	Represents the geometric properties of the area
Value type:	GM_Surface
Multiplicity:	1
Stereotypes:	

4.2.9 Network.NetworkConnection

Class: «featureType» Network.NetworkConnection	
Definition:	Represents a logical connection between two or more network elements in different networks.
Description:	In the case where the networks are in different spatial data sets, a network connection object may exist in both data sets.
Subtype of:	NetworkElement
Status:	Proposed
Stereotypes:	«featureType»

Attribute: type	
Definition:	Categorisation of the network connection.
Value type:	ConnectionTypeValue
Multiplicity:	1
Stereotypes:	«voidable»

Constraint: Elements in different networks	
Natural language:	All elements have to be in different networks
OCL:	inv: element->forAll(e1, e2	e1<>e2 implies e1.inNetwork->excludesAll(e2.inNetwork))

4.2.10 Network.NetworkElement

AbstractClass: «featureType» Network.NetworkElement	
Definition:	Abstract base type representing an element in a network. Every element in a network provides some function that is of interest in the network.
Subtype of:	
Status:	Proposed
Stereotypes:	«featureType»

Attribute: beginLifespanVersion	
Definition:	Date and time at which this version of the spatial object was inserted or changed in the spatial data set.
Value type:	DateTime
Multiplicity:	1

Stereotypes:	«lifeCycleInfo,voidable»

Attribute: endLifespanVersion	
Definition:	Date and time at which this version of the spatial object was superseded or retired in the spatial data set.
Value type:	DateTime
Multiplicity:	0..1
Stereotypes:	«lifeCycleInfo,voidable»

Attribute: inspireId	
Definition:	External object identifier of the spatial object.
Description:	NOTE An external object identifier is a unique object identifier published by the responsible body, which may be used by external applications to reference the spatial object. The identifier is an identifier of the spatial object, not an identifier of the real-world phenomenon.
Value type:	Identifier
Multiplicity:	0..1
Stereotypes:	

Association role: inNetwork	
Definition:	The networks in which a network element is a member.
Value type:	Generic Conceptual Model.Base Models.Network.Network
Multiplicity:	1..*
Stereotypes:	«voidable»

4.2.11 Network.NetworkProperty

AbstractClass: «featureType» Network.NetworkProperty	
Definition:	Abstract base type representing phenomena located at or along a network element. This base type provides general properties to associate the network-related phenomena (network properties) with the network elements.
Description:	In the simplest case (NetworkReference), the network property applies to the whole network element. In the case of a Link, the spatial reference may be restricted to part of the Link by using a linear reference. ISO/TC 211 is currently in the early stages of developing a standard for Linear Referencing (ISO 19148). A simple mechanism to express linear references is provided in this version of the network model; it is expected that the model will be extended once ISO 19148 is stable. The current simple model requires for all linear references two expressions representing a distance from the start of the Link along its curve geometry. The network property applies to the part of the Link between fromPosition and toPosition.
Subtype of:	
Status:	Proposed
Stereotypes:	«featureType»

Attribute: beginLifespanVersion	
Definition:	Date and time at which this version of the spatial object was inserted or changed in the spatial data set.
Value type:	DateTime
Multiplicity:	1
Stereotypes:	«voidable,lifeCycleInfo»

Attribute: endLifespanVersion

Definition:	Date and time at which this version of the spatial object was superseded or retired in the spatial data set.
Value type:	DateTime
Multiplicity:	0..1
Stereotypes:	«voidable,lifeCycleInfo»

Attribute: inspireId

Definition:	External object identifier of the spatial object.
Description:	NOTE An external object identifier is a unique object identifier published by the responsible body, which may be used by external applications to reference the spatial object. The identifier is an identifier of the spatial object, not an identifier of the real-world phenomenon.
Value type:	Identifier
Multiplicity:	0..1
Stereotypes:	

Attribute: networkRef

Definition:	Spatial reference of the network-related property.
Description:	This attribute provides an indirect spatial reference based on a reference to an element of an underlying network. See the chapter on Object Referencing in the Generic Conceptual Model for a discussion on modelling object references.
Value type:	NetworkReference
Multiplicity:	1..*
Stereotypes:	«voidable»

4.2.12 Network.Node

AbstractClass: «featureType» Network.Node

Definition:	Represents a significant position in the network that always occurs at the beginning or the end of a link.
Description:	NOTE if a topological representation of the network is used the road node is either a topological connection between two or more links or the termination of a ink. If a geometric representation of the network is used road nodes are represented by points or alternatively another geometric shape. [EuroRoadS]
Subtype of:	NetworkElement
Status:	Proposed
Stereotypes:	«featureType»

Attribute: geometry

Definition:	The location of the node.
Value type:	GM_Point
Multiplicity:	1
Stereotypes:	

Association role: spokeEnd

Definition:	The links that enter the node.
Description:	NOTE In the INSPIRE context, this spoke property is to be published when this information is published in current exchange formats of the data set.

Value type:	Generic Conceptual Model.Base Models.Network.Link
Multiplicity:	0..*
Stereotypes:	«voidable»

Association role: spokeStart	
Definition:	The links that leave the node.
Description:	NOTE In the INSPIRE context, this spoke property is to be published when this information is published in current exchange formats of the data set.
Value type:	Generic Conceptual Model.Base Models.Network.Link
Multiplicity:	0..*
Stereotypes:	«voidable»

4.3 Data Types

4.3.1 Network.DirectedLink

Class: «dataType» Network.DirectedLink	
Definition:	A link either in its positive or negative direction.
Subtype of:	
Status:	Proposed
Stereotypes:	«dataType»

Attribute: direction	
Definition:	Indicates if the directed link agrees (positive) or disagrees (negative) with the positive direction of the link.
Value type:	Sign
Multiplicity:	1
Stereotypes:	

4.3.2 Network.LinkReference

Class: «dataType» Network.LinkReference	
Definition:	A network reference to a linear network element.
Subtype of:	NetworkReference
Status:	Proposed
Stereotypes:	«dataType»

Attribute: applicableDirection	
Definition:	The directions of the generalised link to which the reference applies.
	In cases where a property does not apply to a direction along a link, but represents a phenomenon along a link, "inDirection" refers to the right side in the direction of the link.
Description:	EXAMPLE A speed limit is a property that applies to a direction of the link (or both directions) while a house number is a phenomenon along a link.
Value type:	LinkDirectionValue
Multiplicity:	1
Stereotypes:	«voidable»

Constraint: element.oclIsKindOf(GeneralisedLink)

Natural language:	Linear reference targets must be linear network elements. That is, if linear referencing is used or direction is relevant, the target of the network reference shall be a link or a link sequence.
OCL:	inv: element.oclIsKindOf(GeneralisedLink)

4.3.3 Network.NetworkReference

Class: «dataType» Network.NetworkReference	
Definition:	A network reference to a network element.
Subtype of:	
Status:	Proposed
Stereotypes:	«dataType»
Association role: element	
Definition:	
Value type:	Generic Conceptual Model.Base Models.Network.NetworkElement
Multiplicity:	1
Stereotypes:	«version»

4.3.4 Network.SimpleLinearReference

Class: «dataType» Network.SimpleLinearReference	
Definition:	A network reference that is restricted to part of a linear network element. The part is the part of the network element between the position along the network element between fromPosition and toPosition.
Subtype of:	LinkReference
Status:	Proposed
Stereotypes:	«dataType»
Attribute: fromPosition	
Definition:	The start position of the linear element, expressed as the distance from the start of the linear network element along its curve geometry.
Value type:	Length
Multiplicity:	1
Stereotypes:	
Attribute: offset	
Definition:	An offset from the centerline geometry of the generalised link, where applicable; a positive offset is to the right in the direction of the link, a negative offset is to the left.
Value type:	Length
Multiplicity:	0..1
Stereotypes:	«voidable»
Attribute: toPosition	
Definition:	The end position of the linear element, expressed as the distance from the start of the linear network element along its curve geometry.
Value type:	Length
Multiplicity:	1
Stereotypes:	

4.3.5 Network.SimplePointReference

Class: «dataType» Network.SimplePointReference	
Definition:	A network reference that is restricted to a point on a linear network element. The point is the location on the network element at the position atPosition along the network.
Subtype of:	LinkReference
Status:	Proposed
Stereotypes:	«dataType»
Attribute: atPosition	
Definition:	Position of the point, expressed as the distance from the start of the linear network element along its curve geometry.
Value type:	Length
Multiplicity:	1
Stereotypes:	
Attribute: offset	
Definition:	An offset from the centerline geometry of the generalised link, where applicable; a positive offset is to the right in the direction of the link, a negative offset is to the left.
Value type:	Length
Multiplicity:	0..1
Stereotypes:	«voidable»

4.4 Enumerations and Codelists

4.4.1 Network.ConnectionTypeValue

Class: «codeList» Network.ConnectionTypeValue	
Definition:	Types of connections between different networks.
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:ConnectionTypeValue
Value: crossBorderConnected	
Definition:	Connection between two network elements in different networks of the same type, but in adjacent areas. The referenced network elements represent the different, but spatially connected real-world phenomena.
Value: crossBorderIdentical	
Definition:	Connection between two network elements in different networks of the same type, but in adjacent areas. The referenced network elements represent the same real-world phenomena.
Value: intermodal	
Definition:	Connection between two network elements in different transport networks that use a different transport mode. The connection represents a possibility for the transported media (people, goods, etc) to change from one transport mode to another.

4.4.2 Network.LinkDirectionValue

Class: «codeList» Network.LinkDirectionValue	
Definition:	List of values for directions relative to a link
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:LinkDirectionValue

Value: bothDirections	
Definition:	In both directions.

Value: inDirection	
Definition:	In direction of the link.

Value: inOppositeDirection	
Definition:	In the opposite direction of the link.

4.4.2 Network.LinkDirectionValue

Class: «codeList» Network.LinkDirectionValue	