DGIWG – 202

NATO Geospatial Entity Catalogue (NGEC)

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Abstract:	This standard provides information on the purpose and structure of data within the NATO Geospatial Entity Catalogue (NGEC) part of the NATO Geospatial Information Framework (NGIF).
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Table of Contents

List of Tables

List of Figures

i. Submitting organizations

Nation	Organization
The Netherlands	Royal Netherlands Army Geographic Agency
Germany	Bundeswehr Geoinformation Centre (BGIC)
France	Institut Géographique National (IGN)
Sweden	Swedish Armed Forces Geo SE
United Kingdom	Joint Forces Intelligence Group - Defence Geographic Centre (JFIG-DGC)
United States	National Geospatial-Intelligence Agency (NGA)

ii. Document contributor contact points

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iii.Revision history

Date	Release	Editors	Primary clauses modified	Description
2013-10-18	1.0	NLD, DEU	All	Final editing for publication.

iv.Future work

As the NGIF programme of work continues and business and technical process mature it is expected that the NGIM will evolve and this specification reviewed and updated accordingly.

Introduction

This Standard has been developed as part of the NATO Geospatial Information Framework (NGIF) suite of standards.

The NGIM is an NGIF-wide logical model for geospatial data that is technology neutral. This *Platform Independent Model* determines the syntactic structure. The NATO Geospatial Entity Catalogue (NGEC) is a simplified view on the content using a catalogue structure.

The NATO Geospatial Real World Index (NGRWI) provides a Real World Index for the NATO Geospatial Information Model (NGIM).

Within the NGIM, the NATO Geospatial Feature Concept Dictionary (NGFCD) is the authoritative source for valid concepts in the NGIM, which itself is a profile of the DGIWG Feature Data Dictionary (DFDD)

1 Scope

The NATO Geospatial Entity Catalogue (NGEC) is a simplified view on the NATO Geospatial Information model or its profiles. The NGIM specifies an NATO-wide semantic model for geospatial data. This semantic model includes: feature information concepts with their allowed geometric representations and related constraints, attributes with their domain types, associations with their roles, and accompanying metadata.

The NGEC conforms to ISO 19110, *Geographic information – Methodology for feature cataloguing,* and its information schema. The NGEC leverages and integrates geospatial information modelling practices from multiple community models (*e.g.,* MGCP, AIXM, ENC, AML, and others) whose data are used and exchanged by NATO systems.

ISO 19101, *Geographic information – Reference model,* defines a feature as an abstraction of real world phenomena. Such abstractions may be represented in information systems using a variety of spatial modelling methods, including representations such as vectors, grids and images. The NGEC supports this breath of geometric representations for "feature data" in the NGIF. The NGEC also supports modelling entities that may represent other geospatially-located information that does not correspond to "real world phenomena". Unless otherwise specifically stated, the terms *feature* and (modelling) *entity* are used interchangeably in this standard.

Individual items of feature and/or attribute information that are used in the NGEC are specified by the NATO Geospatial Feature Concept Dictionary (NGFCD). Through the NGFCD the NGEC draws upon recognized content standards, specifications and profiles from both the military (*e.g.*, DGIWG, NATO/MGID) and civilian sectors (*e.g.*, IHO, ICAO/EUROCONTROL, WMO).

Real world phenomena are described in the NATO Geospatial Real World Object Index (NGRWI) which can be used as an entry point to the NGEC.

Information traceability is established from concepts in the NGEC to their specification in the supporting NGFCD, and from there back to appropriate authoritative concept sources, where possible, to maximize semantic integrity when geospatial data is exchanged between NGIF-based and external systems. The NGIM, the NGFCD and the NGRWI taken together answer the information exchange questions of "*what do we mean?*" and "*how do we represent it?*"

2 Conformance

The NGEC conforms to ISO 19110, *Geographic Information – Methodology for feature cataloguing* and the ISO 191xx family in general. See for more information in chapter 3.

3 Normative references

The documents listed in **Fehler! Verweisquelle konnte nicht gefunden werden.** are indispensable to understanding and using this standard. For dated references, only the cited edition or version applies. For undated references, the latest edition or version of the referenced document (including any amendments) applies.

Table 1: Normative References

Standard or Specification
DGIWG STD-13-020-ed1.0.0 - *NATO Geospatial Entity Catalogue (NGEC) – Normative Content* https://portal.dgiwg.org/files/?artifact_id=8628
DGIWG STD-13-014-ed1.0.0 - *NATO Geospatial Information Model (NGIM)*
DGIWG STD-13-016-ed1.0.0 - *NATO Geospatial Feature Concept Dictionary (NGCFD)*
DGIWG STD-13-017-ed1.0.0 - *NATO Geospatial Real World Object Index (NGRWI)*
ISO 19107:2003, *Geographic information – Spatial schema*
ISO 19108:2002, *Geographic information – Temporal schema*
ISO 19109:2005, *Geographic information – Rules for application schema*
ISO 19110:2005, *Geographic information – Methodology for feature cataloguing*
ISO 19111:2003, *Geographic information – Spatial referencing by coordinates*
ISO 19112:2003, *Geographic information – Spatial referencing by geographic identifiers*
ISO 19123:2005, *Geographic information – Schema for coverage geometry and functions*
ISO 19115:2003, *Geographic information – Metadata*
OMG Object Constraint Language (OMG OCL), Version 2.2, February 2010

4 Terms, definitions, and abbreviations

4.1 Definitions

The terms and definitions specific to this standard are given in Table 2.

Table 2: Definitions Applicable to this Standard

Term	Definition
Entity	A modelling class that may represent either a feature or other geospatially-located information.
Entity Association	A relationship that links instances of one entity type with instances of the same or a different entity type.
Entity Attribute	A characteristic of an entity.
Feature	An abstraction of real world phenomena.
NGEC	A structured collection of feature information (features, attributes, associations, and ancillary data) whose schema conforms to the conceptual model of a feature catalogue as specified in ISO 19110:2005 Annex B.

4.2 Abbreviations

The acronyms that are used in this standard are specified in the following list.

- **AIXM** Aeronautical Information Exchange Model
- **AML** Additional Military Layers
- **DGIWG** Defence Geospatial Information Working Group
- **ENC** Electronic Navigational Chart
- **EUROCONTROL** European Organisation for the Safety of Air Navigation
- **FACC** Feature and Attribute Coding Catalog
- **GML** Geography Markup Language
- **ICAO** International Civil Aviation Organization
- **IEC** International Electrotechnical Commission
- **IHO** International Hydrographic Organization
- **ISO** International Organization for Standardization
- **JGSWG** Joint Geospatial Standards Working Group
- **KML** Keyhole Markup language
- **MDA** Model Driven Architecture
- **METOC** Meteorology and Oceanographic
- **MGCP** Multinational Geospatial Coproduction Program
- **MGID** Military Geographic Information & Documentation
- **MIME** Multipurpose Internet Mail Extension
- **NATO** North Atlantic Treaty Organization
- **NGIF** NATO Geospatial Information Framework
- **OASIS** Organization for the Advancement of Structured Information Standards
- **OCL** Object Constraint Language
- **OGC** Open Geospatial Consortium
- **OMG** Object Management Group
- **PIM** Platform Independent Model
- **PSM** Platform Specific Models
- **SI** International System of Units
- **UML** Unified Modeling Language
- **URI** Uniform Resource Identifier
- **W3C** World Wide Web Consortium
- **WMO** World Meteorological Organization

5 Logical Structure

5.1 Conceptual Metamodel

The NATO Geospatial Entity Catalogue (NGEC) specifies a simplified view on the NATO Geospatial Information Model (NGIM), a NATO-wide semantic model for geospatial data. This semantic model includes: feature information concepts, their allowed geometric representations and related constraints, attributes with their domain types, associations with their roles, and accompanying metadata.

The NGEC is maintained as a collection of feature information whose conceptual metamodel conforms to the conceptual model of a feature catalogue as specified in ISO 19110:2005, *Geographic information – Methodology for feature cataloguing*, Annex B. This metamodel is illustrated in **Fehler! Verweisquelle konnte nicht gefunden werden.**. As necessary, the metamodel specified in ISO 19110 has been extended based on the object modelling

component of *OMG Unified Modeling Language (OMG UML), Superstructure*, Version 2.2, September 2009.

The ISO 19110 metamodel has also been simplified in some regards by removing overlap with the metamodel of the NGFCD; in particular the NGFCD handles all concept referencing – thus the classes FC_DefinitionSource and FC_DefinitionReference are not implemented. The remaining classes are explicitly included in the metamodel with the following exceptions:

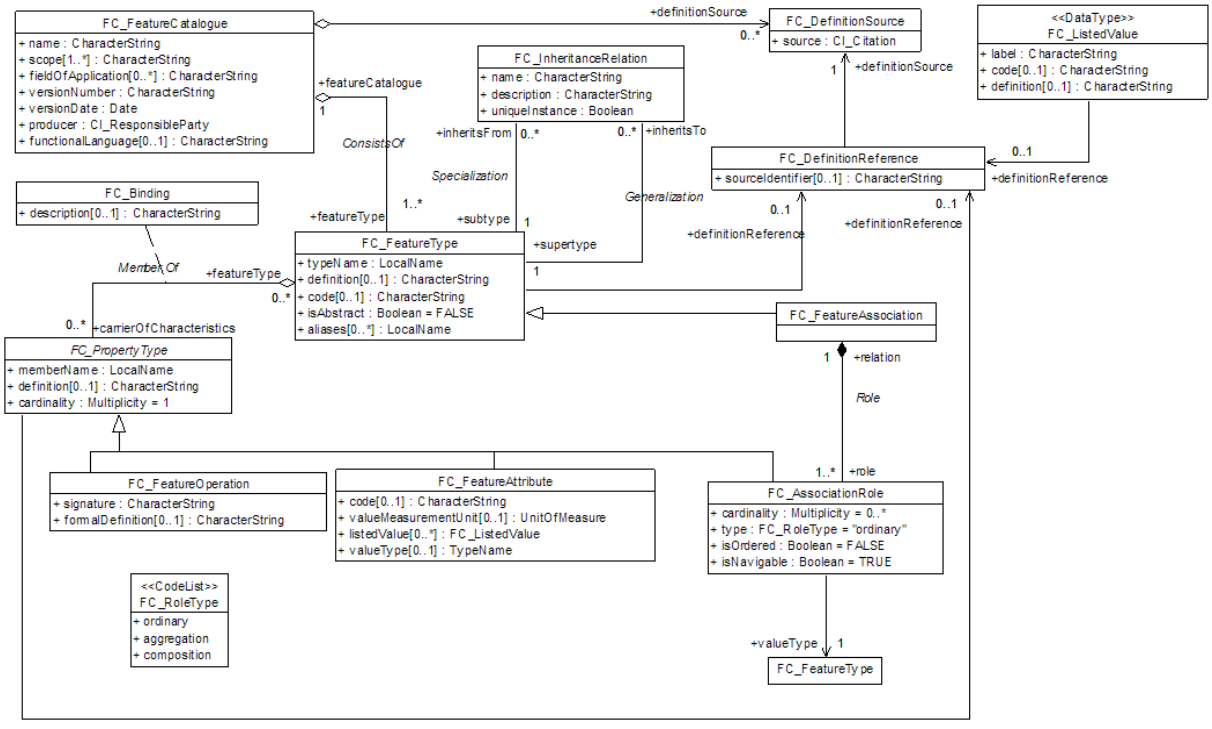
FC_FeatureOperation is not used.

FC_Binding is merged into FC_FeatureType, FC_FeatureAssociation, FC_FeatureAttribute, and FC_AssociationRole.

FC_Constraint (not shown in **Fehler! Verweisquelle konnte nicht gefunden werden.**, but which may be used to constrain both FC_FeatureType and FC_PropertyType) is specifically implemented. Constraints are expressed in "machine readable" form using *Object Constraint Language (OCL)*, Version 2.2, February 2010.

Two additional classes are added to support the organization and presentation of NGEC content.

Figure 1: ISO 19110 Conceptual Model of a Feature Catalog



5.2 Logical Metamodel

The NGEC logical metamodel is organized as follows. There are seven basic categories of concepts: Entity Types, Inheritance Relations, Entity Attributes, Listed Values, Entity Associations, Association Roles and Constraints. Each such concept has the following information specified:

1. **Item Identifier**: This integer value identifies the concept uniquely within the scope of the NGEC.
2. **AlphaCode**: A unique alphanumeric value that conforms to the DGIWG-developed FDD and may be used to designate this concept for the purposes of data interchange in conformance with DGIWG standards.
3. **531 Code**: A unique alphanumeric value that may be used to designate this concept for the purposes of data interchange within the NGIF in technology-specific limited circumstances.
4. **Name**: A compact and human-readable designator that is used to denote the concept.
5. **Definition**: A precise statement of the nature, properties, scope, or essential qualities of the concept.[1]
6. **Description**: An optional statement of the nature, properties, scope, or non-essential qualities of the concept that are not specified by the definition.
7. **Note**: Additional information regarding the concept, *e.g.*, constraints on creation of instances.

Depending on the type of concept, additional information may be specified. This additional information is specified in the following subsections of this standard.

Constraints identify their applicable Entity Type and, as applicable, property (Entity Attribute or Association Role).

Additionally, there is information documenting the NATO Geospatial Entity Catalogue as a whole.

5.3 Content Rules

Spelling conventions in the NGIM are generally those internationally agreed and adopted by the Defence Geospatial Information Working Group (DGIWG) in their DGIWG Feature Data Dictionary (DFDD). The DFDD uses the *Oxford English Dictionary*, 6th Edition, Version 3.0, as the basis for all spelling.

The preferred units of measure are in accordance with ISO 31 *Quantities and units* (multiple parts).

The presentation of numbers follow U.S. convention in which the period (‘.’) is used as the radix marker (the decimal point”), and the comma (‘,’) is used to delimit groups of three digits to the left of the radix marker.

Additional rules apply to specific types of information for each concept. These are specified in Section 5.4.

5.4 Content Information and Examples

5.4.1 NGEC

The NGEC is represented as a table named “Entities”.

[1] In the case of Constraint concepts this information is specified by the field “oclDefinition”, named so as to emphasize that the statement is a well-formed Object Constraint Language (OCL) expression.

It shows all Entities, their properties and relations.

Information includes:

1. **AlphaCode:** A unique alphanumeric value that conforms to the DGIWG-developed FDD and may be used to designate this concept for the purposes of data interchange in conformance with DGIWG standards.
2. **Name**: A compact and human-readable designator that is used to denote the entity and is derived from the NGFCD (represented in the Info Type Table).
3. **Type:** The Type of information:
    - <empty> for the feature itself
    - **geometry** for the description of the geometry.
    - **attribute** for information on an attribute of the entity.
    - **soc** and **son** for associations
    - **subclassOf** for the relation to a super- or subclass
4. **Property Code**: The Designation of the property/attribute by combining the AlphaCode of the Entity and tha AlphaCode of the Attribute Concept separated by a "."
5. **Modeling Entity Property Name**: Name of the Property as defined in the NGFCD (represented in the Info Attributes Table).
6. **Code:** Depending on the type of information**:**
    - an information on the geometry (point, curve, surface)
    - an AlphaCode of the enumeration value of a enumeration
    - a "+" in the case of a property with a simple datatype.
    - "FeatureEntity" in the case of a inheritance
7. **Multiplicity**: Defining the multiplicity of the property attached to the entity (the times a property is allowed at this entity). A multiplicity starting with "1" defines a mandatory property for the entity.
8. **UoM, Enumerant Name, or Association Information (if applicable)**: Depending on the type of information either information on
    - a unit of measurement
    - a link to the enumeration value concept
    - a link to the geometry information
    - a link to a super- subclass
9. **Association type or datatype information**: Information on the type of relation to other entities or information about the datatype (e.g. ordering of lists).
10. **UML Stereotype**: Specifies how this Entity Type is stereotyped, *e.g.,* as "featureType".
11. **Constraints and/or Notes**: Information on constraints or notes.

5.4.2 Entity Types

This table represents an excerpt of the NGFCD showing all entity concepts.

1. **AlphaCode:** A unique alphanumeric value that conforms to the DGIWG-developed FDD and may be used to designate this concept for the purposes of data interchange in conformance with DGIWG standards.

2. **Name**: A compact and human-readable designator that is used to denote the concept.
3. **Definition**: A precise statement of the nature, properties, scope, or essential qualities of the concept.
4. **Description**: An optional statement of the nature, properties, scope, or non-essential qualities of the concept that are not specified by the definition.
5. **Note**: Additional information regarding the concept, *e.g.*, constraints on creation of instances.
6. **5-3-1 Code**: A unique alphanumeric value that may be used to designate this concept for the purposes of data interchange within the NGIF in technology-specific limited circumstances.

5.4.3 Properties/Attributes

The table Entity Attributes represents shows all properties used in the NGIM with more detailed information.

1. **AlphaCode:** A unique alphanumeric value that conforms to the DGIWG-developed FDD and may be used to designate this concept for the purposes of data interchange in conformance with DGIWG standards by combining the AlphaCode of the Entity and the AlphaCode of the Attribute Concept separated by a "."
2. **Name**: A compact and human-readable designator that is used to denote the concept by combining the name of the Entity and the name of the Property separated by a colon ":".
3. **Definition**: A precise statement of the nature, properties, scope, or essential qualities of the property.
4. **Description**: An optional statement of the nature, properties, scope, or non-essential qualities of the property that are not specified by the definition.
5. **Note**: Additional information regarding the property, *e.g.*, constraints on creation of instances.
6. **Multiplicity**: Defining the multiplicity of the property attached to the entity (the times a property is allowed at this entity). A multiplicity starting with "1" defines a mandatory property for the entity.
7. **Constraints**: Information on constraints of the representation of the property, e.g. the ordering.
8. **Datatype AlphaCode**: The AlphaCode to the appropriate datatype used by the property.
9. **Datatype Primitive**: A characterization of the value type of the Entity Attribute as based on one of {Boolean, CodeList, Enumeration, Number, String, Unspecified}.
10. **Physical Quantity**: A character string specifying a reference physical quantity for allowed values that may be assigned to the Entity Attribute if its Datatype is based on the Numeric representation.
11. **Measure (Recommended)**: A character string specifying a recommended unit of measure for allowed values that may be assigned to the Entity Attribute if its Datatype is based on the Numeric representation.

12. **Measure (Noncomparable)**: A character string specifying a noncomparable unit of measure for allowed values that may be assigned to the Entity Attribute if its Datatype is based on the Numeric representation. A noncomparable unit of measure is one that is not a strict member of the specified physical quantity, but is related to that physical quantity through a complex context-sensitive computation.
13. **Complete**: An indication that if the datatype is an enumeration list the list is complete.
14. **Character Length**: A positive integer (*i.e.,* greater than zero) that specifies the maximum length of character string values that may be assigned to the Entity Attribute if its Value Type is based on the String Value Primitive.
15. **Lexical?**: A Boolean value indicating the range of character values that may be used in character string values that may be assigned to the Entity Attribute if its Value Type is based on the String Value Primitive.
16. **Structure Specification**: A character string that specifies a scheme of one or more constraints on the structure of the text values that may be assigned to the Entity Attribute if its Value Type is based on the String Value Primitive.
17. **Range Minimum**: A value that specifies the minimum end of the range of allowed values that may be assigned to the Entity Attribute if its Value Type is based on the Number Value Primitive.
18. **Range Maximum**: A value that specifies the maximum end of the range of allowed values that may be assigned to the Entity Attribute if its Value Type is based on the Number Value Primitive.

5.4.4 Listed Values

The table Info Values shows all listed values used in datatypes of the type enumeration used in the NGIM with more detailed information.

1. **Attribute AlphaCode:** A unique alphanumeric value that conforms to the DGIWG-developed FDD and may be used to designate the attribute for the purposes of data interchange in conformance with DGIWG standards by combining a dot (".") with the AlphaCode of the attribute concept.
2. **Attribute Name:** The compact and human-readable designator for the attribute.
3. **Value AlphaCode:** A unique alphanumeric value that conforms to the DGIWG-developed FDD and may be used to designate the Listed Value.
4. **Name**: A compact and human-readable designator that is used to denote the Listed Value.
5. **Definition**: A precise statement of the nature, properties, scope, or essential qualities of the Listed Value.
6. **Description**: An optional statement of the nature, properties, scope, or non-essential qualities of the Listed Value that are not specified by the definition.
7. **Note**: Additional information regarding the Listed Value, *e.g.*, constraints on creation of instances.

5.4.5 Associations

The table Association represents shows all properties used in the NGEC with more detailed information.

1. **Association AlphaCode:** A unique alphanumeric value that conforms to the DGIWG-developed FDD and may be used to designate this association for the purposes of data interchange in conformance with DGIWG standards by combining the AlphaCode of both the Entities.
2. **Association Name**: A compact and human-readable designator that is used to denote the concept by combining the name of both Entities separated by a double slash ("//").
3. **Role AlphaCode**: A unique alphanumeric value that conforms to the DGIWG-developed FDD and may be used to designate this role for the purposes of data interchange in conformance with DGIWG.
4. **Role Name**: A compact and human-readable designator that is used to denote the role.
5. **Definition**: A precise statement of the nature, properties, scope, or essential qualities of the association.
6. **Description**: An optional statement of the nature, properties, scope, or non-essential qualities of the association that are not specified by the definition.
7. **Note**: Additional information regarding the association, *e.g.*, constraints on creation of instances.
8. **Multiplicity**: Defining the multiplicity of the role of the Entity.
9. **Constraints**: Information on constraints of the representation of the role, e.g. the ordering.
10. **Target AlphaCode**: The AlphaCode of the participating Entity in the association.
11. **Target Name**: A compact and human-readable designator that is used to denote a participating Entity in the association.

5.4.6 Constraints

Each constraint has the following information specified:

1. **Class**: Identifies an Entity Type.
2. **Item**: Identifies either a property (an Entity Attribute or an Association Role) of the Entity Type or the Entity Type itself – to which the constraint applies.
3. **Sequence Number**: Unique index of the Constraint within the Entity Type; may be used to used to tag derived products in order to ensure consistent Constraint ordering.

The definition is given as a well-formed Object Constraint Language (OCL) expression precisely defining the constraint. The description consists of a human-readable statement of the constraint that is being applied.

6 Conformance

The NATO Geospatial Entity Catalog (NGEC) specifies a simplified view on the NATO Geospatial Information model (NGIM), an NGIF-wide semantic model for geospatial data. Conformance to this semantic model requires that when a concept from the NGEC is employed within an information system or data set that the meaning of the concept be preserved and that information regarding the concept that is specified in the NGEC be honoured.

The first two types of information are alternative means to denote the concept. Conformance to each of these may be determined as follows:

1. **AlphaCode**: A unique alphanumeric value that conforms to the DGIWG-developed Feature Data Dictionary (DFDD) and may be used to designate this information modelling concept for the purposes of data interchange within the NGIF. When this NGIF alphanumeric code is used in an information system or dataset then the intended semantic structure of the information system or data set information modelling concept shall exactly correspond with the identified NGIM concept. Whereas an information system may use other codes to denote the concept within its boundaries, data sets used in information exchange shall only use either the NGIM-specified or (in technology-specific limited circumstances) the NGIF 531 code.
2. **531 Code**: A unique alphanumeric value that conforms to the DGIWG-developed Feature Data Dictionary (DFDD) and may be used in technology-specific limited circumstances to designate this information modelling concept for the purposes of data interchange in conformance with DGIWG standards. When this NGIF 531 Code is used in an information system or data set then the intended semantic structure of the information system or dataset concept shall exactly correspond with the identified NGIM concept.

The remaining four types of information are primary means of specifying the concept. Conformance to each of these can only be determined by inspection and subjective judgment.

3. **Name**: A compact and human-readable designator that is used to denote the concept. Aliases may be defined for use within the scope of an information system, but data sets used in information exchange shall only use the NGEC-specified name.
4. **Definition**: A precise statement of the nature, properties, scope, or essential qualities of the concept. Information systems and data sets shall preserve this meaning, neither narrowing, broadening, nor otherwise altering the specified semantic.
5. **Description**: An optional statement of the nature, properties, scope, or non-essential qualities of the concept that are not specified by the definition. Information systems and data sets should consider this information in their design, implementation, and operations, but explicitly honouring this additional information is optional.
6. **Note**: Additional information regarding the concept, *e.g.*, constraints on creation of instances. Information systems and data sets should consider this information in their design, implementation, and operations, but explicitly honouring this additional information is optional unless the note states a condition that is therein specified as mandatory.

Depending on the type of concept the NGEC may specify additional information. This additional information is presented in Section 5.4 and each item of additional information for a concept shall be honoured.

Constraints on Entity Types (and their properties – either Entity Attributes or Association Roles) shall be honoured by both conforming information systems and conforming data sets.