

INTERLIS Version 2 – Reference Manual

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Information and contact: www.interlis.ch, info@interlis.ch

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This reference manual was initially drafted in German, the authors of its English version have attempted to respect as much as possible the original text.

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Preface

This reference manual has been conceived for experts concerned with information systems, especially geo information systems or land-information-systems. Above all it ought to be of interest to authorities to whom careful dealing with data is a main object.

In 1991 "INTERLIS – A Data Exchange Mechanism for Land-Information-Systems" was first published. This mechanism consists of a conceptual description language and a sequential transfer format which in particular takes into account space related data (shortly geodata), thus permitting compatibility among various systems and long-term availability, i.e. depositing in archives and documentation of data. Making use of INTERLIS when deciding, planning or administering processes may yield great profit. Very often – e.g. through multiple application and uniform output of documented and verified data – major economies can be achieved.

Five years after its publication INTERLIS, in retrospect called version 1, resp. INTERLIS 1, has come out of its "Sleeping Beauty existence". In the meantime a considerable range of software tools has become available to the user, making it possible to process geodata described and coded in INTERLIS. INTERLIS has been created out of the requirements of official survey, but its range of applications is considerably wider, as proved by more than a hundred data models and projects which work with INTERLIS ten years after its publication. The standard "INTERLIS version 1" in its form of Swiss Norm SN 612030 will remain of use for some time yet – in parallel with its successor versions.

In order to meet increased demands of our users, several extensions to INTERLIS 1 have become necessary, e.g. incremental re-export, structural object orientation or formal description of graphic illustration of objects. 1998 saw the beginning of a process which was to last several years and involved the joint efforts of half a dozen experts in research, administration, counseling and software industry. Its result is a product that may be called an extension to INTERLIS 1 and at the same time a synthesis of all the latest concepts.

In the INTERLIS reference manual we have striven to lay down only the absolute necessities; examples and figures only appear where they may complement the concise text. In this way the specification is clearly arranged and easy to implement. If some language elements, such as views and graphic descriptions seem ambitious and demanding, this is in all likelihood not due to INTERLIS itself, but to the complexity of the field. To solve this problem we rely on the following methods: good example, basic and continued education as well as so-called "profiles", i.e. sub-quantities of well-defined INTERLIS tool capacities.

For a general understanding of INTERLIS 2-concepts I should like to advise the reader to peruse at least chapter 1 Basic Principles.

Extensions in INTERLIS 2 compared with INTERLIS 1

With some few exceptions the existing description language INTERLIS 1 has only been complemented and not altered. Thus we have extended the possibilities to describe relations between objects (actual relations as association class and reference attributes with REFERENCE TO. Note: The "->"-syntax of the INTERLIS 1 relation attribute has been given a different meaning) while taking into account that the transition from INTERLIS 1 to 2 should be rendered as easy as possible (cf. chapter 2.7 Proper Relationships). Henceforth-proper relationships and reference attributes can, certain conditions applied, refer to objects in other baskets. Basket is a new term for the well-known organization of objects (i.e. data who describe reality, also called object instances or instances) in a database. We have revised the term TABLE that has become CLASS in accordance with the changeover from relational to object-oriented formalism. Without further specification any attribute is considered optional (OPTIONAL is omitted) and it has to be indicated as MANDATORY. Furthermore the uniqueness key word IDENT has been renamed UNIQUE. The new object-oriented concepts include transmission amongst others of topics, classes,

views, graphic descriptions and attribute value ranges. Other extensions of great importance are set data types (LIST, BAG), constraints, data views, graphic descriptions, descriptions of units, description of meta objects (coordinate systems and graphic symbologies) and incremental re-export. Furthermore special, user-specific extensions, such as functions and line geometries can be defined. However this will make contracts, i.e. agreements with tool providers, necessary.

From now on the eXtensible Markup Language (XML) will take over coding for our INTERLIS2 transfer format. We expect XML to become internationally widespread and universally accepted and count on a great number of compatible software products to be obtainable in the near future.

Any user well acquainted with INTERLIS 1 will not have to face many changes as long as he renounces the use of our new concepts, such as object orientation and graphic description: his present knowledge will be applicable in INTERLIS 2. Various tools, such as the commonly available INTERLIS2 compiler, will facilitate adapting to the new version. Those producers who already had flexible configuration possibilities on their minds when implementing INTERLIS 1, as well as taking into account rules and art of software development (e.g. modularization and abstraction), will find that their past investments will remain of value. Thanks to universally accessible program libraries software manufacturers will be able to concentrate fully on the integration of their systems in INTERLIS2.

Outlook

INTERLIS 1 appeared at a time when the relational data definition language SQL-92 had not yet been standardized and object orientation had not been talked of. It is thanks to Joseph Dorfschmied -originator of INTERLIS 1- acting with rare foresight, that some of these nowadays well established concepts already then were introduced. Now that INTERLIS has been revised and object-oriented and specific concepts of informatics have been included, it may be said to have achieved a new degree of maturity. Thus INTERLIS 2 may be used already today - and not only tomorrow – as an efficient tool.

Nevertheless we are well aware of the fact, that even with INTERLIS Version 2 our quest for a universal data description language is nowhere near its end. However any hesitation might lead to similar consequences as the shortsighted handling of the resources of our earth. INTERLIS deserves to be accepted not only as a data exchange format but also as an enduring tool: Thanks to INTERLIS the call for an enduring way to deal with technology has been given a name!

Each language has to be studied and embedded in its own method. Thus it is obvious that this reference manual will have to be followed by several user manuals.

Thanks

In his position as head of a team charged with the further development of INTERLIS and main editor of this document, Stefan Keller (Hochschule für Technik Rapperswil, formerly Federal Directorate for Cadastral Surveying) has fully supervised all work on INTERLIS 2 from its very beginning, and to a great extent even after his leaving for ITR. We would like to express our thanks to him, as well as to the entire "INTERLIS 2 hard core" for their superb and unique efforts. Members of this team are Joseph Dorfschmied (Adasys AG), Michael Germann (infoGrips GmbH), Hans Rudolf Gnägi (Federal Technical Institute), Jürg Kaufmann (Kaufmann Consulting), René L'Eplattenier (Department of Environmental Administration and Surveying, Canton of Zurich), Hugo Thalmann (a/m/t software service AG), as well as Sascha Brawer (Adasys AG), Claude Eisenhut (Eisenhut Informatik) and for its coordination Rolf Zürcher (KOGIS).

Since the beginning of 2002 all responsibility for the editing of this reference manual lies with KOGIS, Department of coordination for geo-information and geographical information systems of the Swiss Federation, in close cooperation with the Federal Directorate for Cadastral Surveying. Shortly after this change a public review of the Swiss Standardization Association SNV concerning INTERLIS 2 has taken

place. 109 comments have been entered which had to be examined and possibly adapted by the INTERLIS 2 core team over the ensuing months. This has lead to considerable changes in the language compared to version 2.1 of October 17th, 2001 – and consequently INTERLIS 2 will internally be version 2.2. End of November 2002 the final vote of INB/TK 151 has taken place, thereby declaring INTERLIS 2 to be norm SN 612031. Having completed some final textual revisions this reference manual can now be handed over to the public.

No standard can be laid down by a group of individuals only; on the contrary it needs the help of many specialists. We wish to thank all these professionals and are looking forward to more innovative products.

Wabern, April 2003

Rolf Zürcher

1 Basic Principles

1.1 Overview

INTERLIS allows co-operation between information systems, especially geographic information systems or land information systems. As its name suggests, INTERLIS stands between (inter) land information systems. It is crucial that all systems involved have a very clear notion of these concepts that are of major importance to their co-operation.

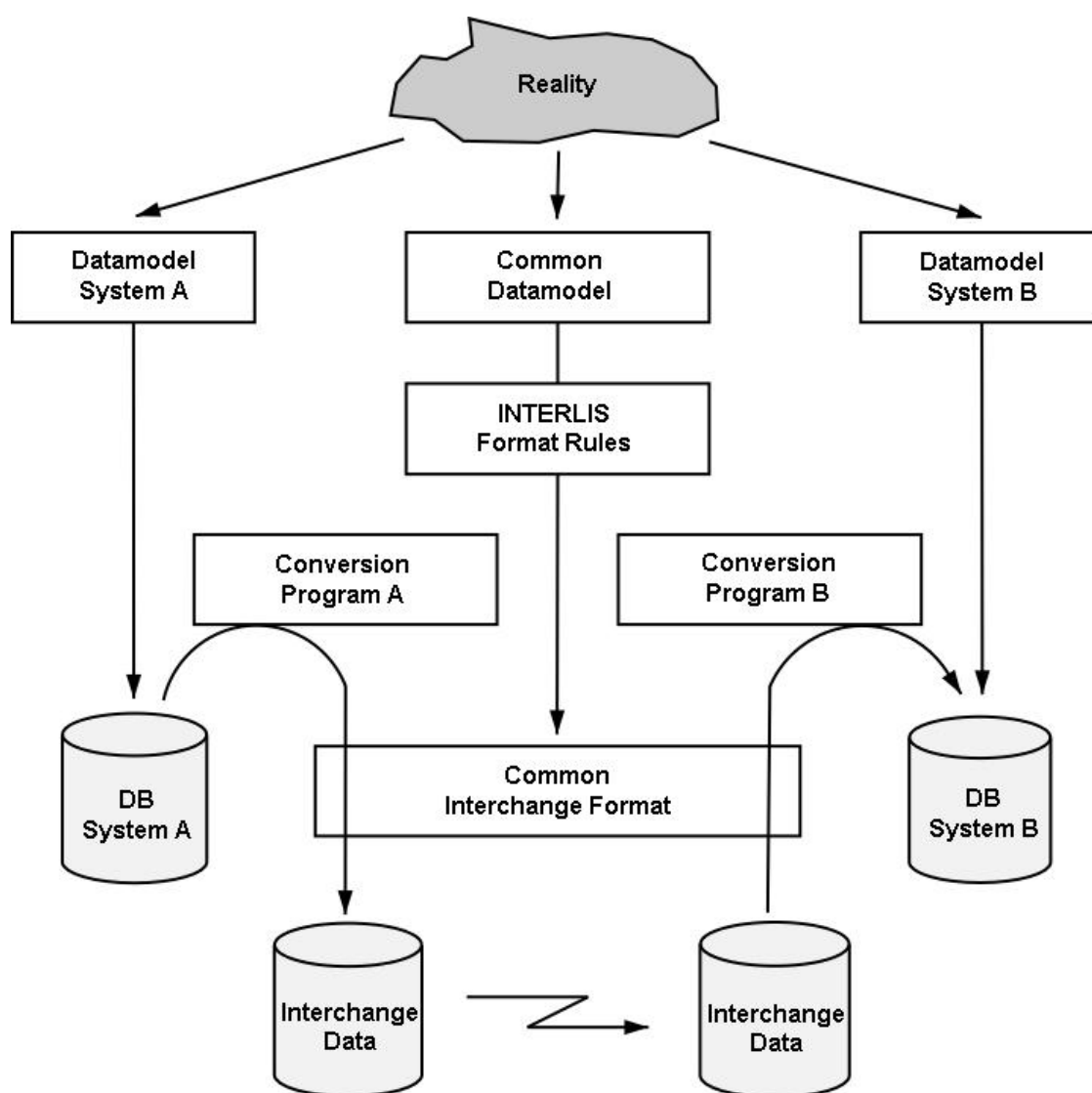


Figure 1: Data transfer between several databases via a common data model (data schema) described in a common data description language.

That is why INTERLIS comprises a conceptual description language. Thanks to this language a detail of reality may be described that is of interest for a certain application. Such a description is called (conceptual) application model or application schema, respectively in short model or schema. Some few

concepts with strictly defined meaning will describe (i.e. model) classes of objects with their respective characteristics and relations. Furthermore this INTERLIS description language permits the introduction of classes of derived objects, hence making it possible to define these as views on other classes of objects. True as well as derived classes of objects may serve as the basis of graphic descriptions, however INTERLIS assures a strict separation of graphic descriptions (representation definition) and description of the under-lying data structure (data definition).

INTERLIS does not aim at any specific application. The draft takes its bearings of common object-oriented principles, nevertheless we have tried to ascertain very good support of such concepts as are of importance to land information systems. Thus coordinates, lines, and surfaces are data types that represent basic constructs of INTERLIS and language elements describing precision of measurements and units are at your disposal. Still it is possible to use INTERLIS in non-geographic applications.

Aspects which are under-lying a field of application can be described in a basic model. Subsequently this model will be specialized according to the specific needs of a country, in further steps according to those of a certain area (county, region or community), see figure 2. INTERLIS 2 offers two object-oriented concepts as possible tools for this specialization: inheritance and polymorphism, thus assuring that already set definitions need not be repeated or accidentally be made doubtful.

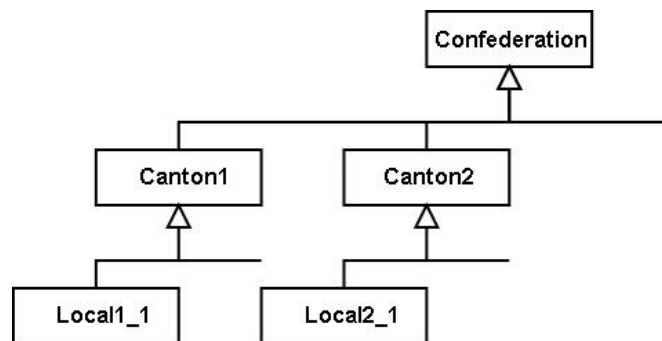


Figure 2: Specializing the modeling of a concept from the federal level, to cantonal (country specific) and local level.

Extensive applications need not be defined in one single description. On the contrary, they can be split up into several description units (models, schemas). A description unit may comprise several topics. In the interest of the readability of such models it is also possible to define a model as a simple translation of other models.

1.2 Utilization of models

In the first place an INTERLIS model (resp. INTERLIS schema) represents a means of communication for users. Its language is designed in such a way as to be readable by humans. Nevertheless INTERLIS models are precise, unequivocal and can be interpreted without any possible misunderstandings. Therefore the textual INTERLIS language offers itself as a necessary complement to the graphic description language Unified Modeling Language (UML, www.omg.org/uml).

But INTERLIS does not stop here: Since a model possesses a formal and clearly defined significance, it permits the implementation of a service in a computer system to be automatically derived from this model. For example INTERLIS comprises an XML-based transfer service, whose definitions are produced from respective models according to their rules. The utilization of data modeling in close connection with system neutral interface services is called *model-based* or *model-driven architecture*. (see "model-driven architecture" by OMG, www.omg.org/mda/).

Models may be built upon common basic concepts. Since INTERLIS allows for an explicit description through use of inheritance and polymorphism, it is obvious at any given moment, which concepts are common and which are specific. In view of aspiring to a semantic interoperability this becomes of great importance. For example, it offers the possibility for a transfer file of any community (town, village) to be interpreted by its superior administration unit (county, state), without demanding a common model agreed upon by all participants. It is sufficient that every level builds its own model upon that employed by its superior unit.

It is conceivable and moreover desirable that new services based upon INTERLIS should be developed, a task greatly facilitated by using a model compiler. This program reads and writes INTERLIS models, permits necessary changes within and examines, whether models are in accordance with syntactic and semantic conditions of INTERLIS. Amongst others this compiler can generate automatically – in accordance with the present INTERLIS transfer service with XML – XML schema documents (www.w3.org/XML/Schema) derived from INTERLIS models. By introducing adequate general XML-tools it is possible to render the concrete INTERLIS/XML-files available for an even wider range of application. As long as conditions for usage are not violated, this INTERLIS compiler is available for the producing of new tools.

1.3 A Structure of Models and Topics

A model (resp. a schema) describes an image of our world as it may be of significance for a specific application. A model is a self-contained unit, which may also use or expand parts of other models. To some extent an INTERLIS-model can be compared to modules or packages of some programming languages.

Primarily we distinguish between models which contain only type definitions (units, value ranges, structures) and others where data may exist. All descriptions with existing data are divided into topics. This division is a result of our conception in what organization units and by whom such data should be controlled or used. If as a typical feature data is controlled and used by several authorities, it should be defined in various topics. Such interdependences ought to be limited to a strict minimum. Relations between topics whose data are controlled by several authorities ought to be omitted wherever possible, as special efforts to maintain consistence are inevitable. In any case cyclic dependence is excluded. Besides data definitions as such, topics may comprise also definitions for views and graphics.

One topic may enhance another. In this way all concepts defined by the basic topic are transmitted and can be complemented.

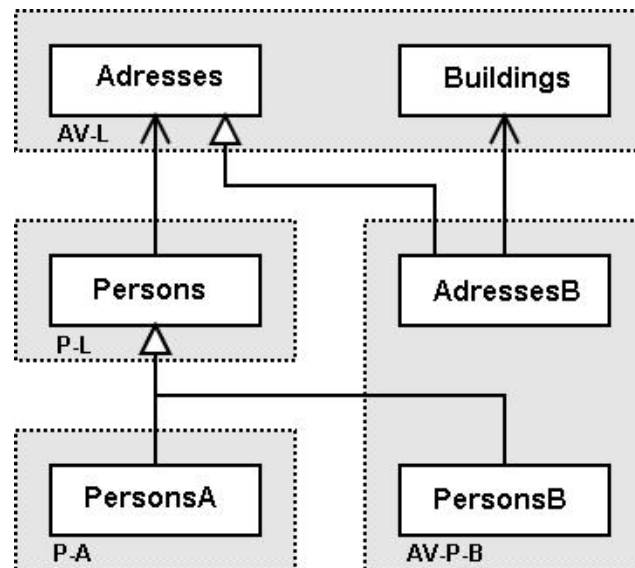


Figure 3: Inheritance hierarchy of addresses, persons and buildings.

For example a model of some country's official survey could comprise the topics "addresses" and "buildings" (figure 3). These concepts are independent; any relation is established algorithmically by way of coordinates. Individuals possess addresses; hence the person-model of this country is built upon the national model of official survey, whereby the topic "Persons" depends on the topic "Addresses" of the cadastre model.

Now it is planned to describe the inhabitants of area A more precisely than intended by the national person-model. So area A drafts its own model, transferring the topic "persons" from the nation-wide person-model and expanding it.

In area B it is planned to establish an explicit relationship between buildings and addresses on one hand, on the other the national person-model is considered inaccurate. Again the respective topics are transferred and specialized. Both expansions are combined in one single model – the "global view" of area B.

1.4 Object Concept

1.4.1 Objects and Classes

An object (otherwise called object instance or simply instance) consists of data concerning one real-world item and can be unequivocally identified. Obviously numerous objects possess similar characteristics and hence can be summarized. Such a set of objects (object set) with similar characteristics is called a class. Each characteristic has at least one corresponding attribute. In INTERLIS 1 we used the term table instead of the term class. Other expressions meaning class are: set of entities, type of entities, feature.

When describing a class we record, amongst other information, the qualities and characteristics each object possesses. These are called attributes. Attribute values of objects cannot be chosen at random, but must comply with certain conditions stipulated by the description of an attribute.

With regard to this, INTERLIS offers a series of basic data types (base data types, strings, numeric data type, enumerations, Cartesian and elliptic 2D, resp. 3D coordinates), based upon which new and more complex data structures can be defined. In order to render this statement more precise yet, numeric attributes can be further supplied with a measuring unit and related to a reference system, coordinates can be referred to a coordinate reference system.

Besides these basic data types, an attribute may also comprise sub structures. Each of these elements of a sub structure is to be treated as structural element that can only exist in relation to its main object and cannot be found in any other way than by passing by this main object. The organization of structural elements is described in a fashion similar to that of classes and it is possible to consult the definition of a class.

Besides the fact that all attribute values must correspond to their respective type, further conditions can be defined. INTERLIS distinguishes between the following conditions of constraint:

- Constraints that refer to one single object. These constraints are subdivided into requirements that must be met by each object of a class ("hard" constraints) and regulations, which in rare cases can be violated ("soft" constraints).
- Constraints which demand the clearness of attribute combinations of all objects in one class
- Constraints which demand the existence of an attribute value in an instance of a different class
- More complicated conditions, which refer to an object set and have to be defined by means of views.

1.4.2 Expansion of Class and Polymorphism

Classes are either autonomous or expand (specialize, inherit) a superclass, i.e. the description of a class is either independent or contains expansions of another inherited description. An expansion of class (also called sub-class) can provide further attributes and constraints, as well as heightening already accepted conditions (data types, constraints).

Each single object belongs to exactly one class (in other words it is object instance or instance of a class). At the same time it always meets with all the requirements of its superclasses, i.e. its super-classes. Therefore there can be found, corresponding to each class, a set of objects, which are instances of the class itself, or one of its expansions. In the case of concrete classes we usually find a smaller sub-set of instances, which belongs exactly to this class.

An expanded class is *polymorph* in relation to its superclasses. Wherever instances of a superclass can be expected, instances of an expansion may occur (so-called partial set polymorphism or substitution principle). INTERLIS has been designed in such a way as to make polymorph reading possible at any given moment. For example if a relation to a class has been defined (cf. chapter 1.4.4 Relationships Between Objects), objects of an expansion have these same relationships. Complete polymorph writing is no aim of this INTERLIS version.

Elements of sub-structures are no independent objects, but structural elements and therefore do not form part of the set of instances of any given class.

1.4.3 Meta Models, and Meta Objects

As seen from the user's point of view, coordinate systems or coordinate reference systems as well as graphic symbologies, are represented as model elements (resp. schema elements) which can be used in application definitions. Since different coordinate systems and coordinate reference systems and above all different graphic symbologies can be described in the same way, it makes sense to also describe their characteristics within models by means of classes. Thus every system, resp. every graphic symbology (e.g. a point symbol, a line type) corresponds to an object.

Meta-objects must be defined in a meta-model. Applicable objects must explicitly be identified as meta-objects (expansions of the predefined class meta-objects) and consequently can be referenced via their names. To achieve this, it is necessary that meta-objects be available to the tool, which treats the application definition by means of baskets (cf. chapter 1.4.5 Baskets, Replication and Data Transfer).

1.4.4 Relations Between Objects

INTERLIS 2 (as opposed to INTERLIS 1) distinguishes between two types of relations between objects: proper relationships and reference attribute.

The term relation refers to a set of object-pairs (resp. in general object-n-tuples). The first object of each pair belongs to a first class A, the second to a second class B. Since the attribution of objects to pairs is to be predefined, it must only be described, i.e. modeled. As shown further along in chapter 1.5. View-Concept, it is however also possible to compute this attribution algorithmically, e.g. based upon attribute values.

Proper relationships are described as independent constructs, so-called relationship-classes (resp. association classes) that again are expandable. INTERLIS 2 does not only support one-to-one relationships, but also permits multiple relationships and relationships with their own attributes. Thus a relation-class in return is also an object-class.

Important characteristics of such relationships are:

- *Cardinality* – how many objects of class B (resp. class A) can be ascribed to one object of class A (resp. B) within the relationship?
- *Force* – INTERLIS 2 differentiates between associations, aggregations and composition. In all cases the objects in question can be applied to independently. In the case of aggregation and association the objects exist independently of each other. In the case of aggregation and composition we find asymmetry between the classes concerned. The objects of one class (the superclass) are described as entities (resp. superobjects), the objects of the other class (subclass) are parts (resp. subobjects). In associations all objects are equal and only loosely connected. Both aggregation and composition are conceptually directed associations: An entity (superobject of the superclass) is ascribed several parts (sub-objects of the sub-class). When dealing with an aggregation all ascribed parts are automatically copied when copying the entity, however when deleting the entity the corresponding parts remain untouched. Compared to an aggregation you will find that a composition further implies, that when deleting the entity all parts are deleted at the same time. How copying effects relationships to other objects is described in chapter 2.7.2 Force of Relationship. Note: Sub-objects (parts) of compositions are identifiable objects as opposed to structural elements of sub-structures.
- *Role* - What significance have the classes involved seen from the viewpoint of the relationship? This is determined for each class involved by means of its role. INTERLIS 2 (as opposed to INTERLIS 1) also admits relationships exceeding the limits of one subject. This however on condition that the relation attribute is defined within such a class as belongs to a subject depending on the class it is referred to.

By using a *reference attribute* we create a relationship between one object, resp. structural element to another object. However such a relationship is only known to the referring object and not the object referred to. Hence it is one-sided.

Without violating the independence of topics it is possible to also define relationships (i.e. proper relationships and reference attributes) by means of a special mark (EXTERNAL), these will create a relationship with objects of a *different basket* of the same or a different topic. However only on condition that the structure within which the relationship is defined belongs to a topic which depends on the topic whose class it is referring to.

In the interest of a clear structure, relationships can only refer to classes already known when defining relation classes (resp. reference attributes).

1.4.5 Basket, Replication and Data Transfer

A basket is a compact collection of objects, which form part of a topic or its expansion. Compact means that a basket contains all objects related to each other within one topic. A typical example may be a certain area (town, county or even a country as a whole) whose objects in their entirety are contained in a basket. Above all a basket may contain data supplied by various expansions (e.g. different cantons with their own topic expansions), provided that within such a transfer community all labels of models, topics and topic expansions are unequivocal.

Within the scope of constraints we often speak of "all" objects of a class. Basically this includes all objects that have the quality desired and actually exist, i.e. basket-spanning. For various reasons (efficiency, availability, access rights etc.) it is obvious that control is only possible within locally accessible baskets. In the case of baskets with meta-objects we state explicitly that constraints only apply within a basket, since we presume that meta-data are of descriptive character and have to be at the user's free disposal in a basket (much in the way of a library).

- We distinguish different types of baskets: *data-baskets* – comprises all instances of classes of one topic
- *View-baskets*: comprises all instances of views of one topic
- *Baskets with basic data for graphics* – comprises instances of all data or views necessary for the graphics of one topic. Permits use of graphic application software.
- *Baskets with graphic elements* – comprises the instances of all graphic objects (= symbologies), which are necessary according to the graphics of one topic. Permits use of a graphic representation software (renderer, cf. figure 5).

INTERLIS does not set rules on how objects must be kept within their systems. Rules only apply to the intersection between systems. At present an intersection for the transfer of baskets as XML-files is defined. Support is not only granted to the complete transfer of the entire basket, but also to the incremental data transfer. We proceed on the assumption that in the case of complete transfer the receiver will create new, independent object copies without any immediate connection with the original object. Within the scope of complete transfer, objects must only be marked with a temporary transfer identification (TID). TID's are used for transferring relations.

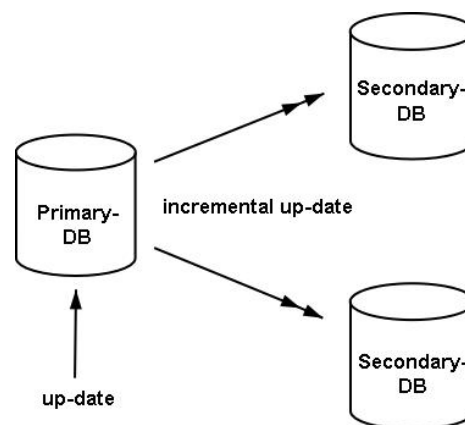


Figure 4: Up-dating of a primary database and subsequent transfer to secondary databases (a double arrow means incremental up-date).

In the case of incremental transfer we presume that to start with the sender supplies the initial state of a data-basket (all other types of baskets are excluded) and subsequently provides up-dates, which will allow actualizing the data received (cf. figure 4). Thus the objects are replicated and keep their

connection with the original object, i.e. they cannot be altered independently of the original and will not be given a new identification.

We proceed on the assumption that there exist contracts between the management of primary and secondary databases (extent, frequency of updates etc.) which at present cannot be covered by tools provided by INTERLIS. For the up-date itself INTERLIS places the necessary tools at your disposal. New objects are displayed in the same way as when first making a transfer and they are assigned an unequivocal object identification (OID) – which must be up-kept at all times. Whenever changes occur, this unequivocal OID is used as a point of reference and all attributes of the object (including all structural elements of structure attributes) are up-dated. In the same way deleted objects are brought to your notice. It is primarily the sender's responsibility to assure the consistency of objects (e.g. observance of constraints, correctness and cardinality of relationships). To that end he notifies the receiver of any alterations: objects deleted, up-dated, newly created. In the interest of independence of topics, we do not assume that integrity is guaranteed at all times where several topics are concerned. It is up to the receiver to cope with temporary inconsistencies between base topics and dependent topics, i.e. that an object referred to does not exist.

INTERLIS does not determine the limits within which clearness of OID is guaranteed. See appendix E for an example of how such an OID may be structured – yet other possibilities definitely are conceivable. However it is of primordial importance that all data recorders of one transfer community correctly apply the rules governing the structure of an OID, thus assuring that at all times the OID remains unequivocal within the scope of the transfer community. Depending on the structure of the OID incremental data exchange is possible within a wider (e.g. world-wide) or smaller (e.g. within one organization) circle. Hence the method used to determine an OID also defines the potential transfer community.

Any alteration on an object other than within its original basket strictly depends on the permission of its administration. All other secondary baskets can alter an object only as a result of an up-date. That is why INTERLIS demands – within the limits of incremental up-date - that not only objects but also baskets must be identifiable in an unequivocal and permanent manner. Then an OID is also assigned to baskets. Likewise in the case of a complete transfer the basket only needs a transfer identification (TID). Whenever it is important to clearly distinguish between OID and OID of a basket, we speak of BOID (resp. basket identification BID).

We must assume that to start with various objects are registered in baskets, e.g. of one town, then these baskets as a whole are transmitted to the canton and subsequently will be integrated into baskets which contain topic-wise the entire canton. Maybe these baskets will then be further transferred, e.g. to state authorities. In order to have at any moment definite assurance as to the original basket, its BOID is supplied with each replica of an object. This will allow the receiver to create his own basket-administration by stating in which of his own baskets are stored replicated objects supplied by which original basket. (INTERLIS also provides the necessary tools to label such baskets with INTERLIS itself and thus permits their exchange much in the way of normal objects). It is one of the characteristics of INTERLIS 2 that when dealing with relationships concerning several topics not only the OID's of the reference object but also the BOID's of its original baskets are transferred. If the receiver makes full use of this INTERLIS 2-feature which in the case of topic-spanning relationships allows not only to transfer the OID of reference objects but also the BOID of their original baskets, he may determine in an efficient way in which of his baskets the reference object is to be found.

1.5 View Concept

INTERLIS 2 enables the user not only to model objects themselves but also views. Views really are virtual classes whose instances are not data originated from a real object, but data derived mathematically from other objects.

A view definition consists of the following parts:

- *Base sets* which classes resp. views supply the objects that are introduced into the calculation of view objects? In the case of classes not only the respective instances are taken into consideration, but in the sense of polymorphism all instances of expansions as well. INTERLIS does not define the baskets that have to be taken into account by a system when calculating a view.
- *Interrelationship rules* - INTERLIS 2 distinguishes joins, unions, aggregations and inspections of sub-structures. In the terms of set theory, *joins* represent cross over products and *unions* the combination of base sets. *Aggregation* allows you to combine elements of the base set in a new view object, provided they fulfill definable criteria. Inspection of sub-structures allows you to view the structural elements of a sub-structure as a set of structural elements. Joins and aggregations may also be conceived as virtual associations.
- *Selection* – Which of the calculated objects should actually form part of the view? INTERLIS allows you to define complex conditions concerning this aspect.

1.6 Graphic Concept

Graphic descriptions are based upon classes or views – using a certain projection - and declare – in so-called graphic definitions (cf. figure 5 and appendix L glossary) which graphic symbols (e.g. point symbol, line, area symbol or text label) are to be assigned to the objects of a view, thus permitting the graphic user to create presentable graphic objects. The graphic symbols themselves have been defined in an extra symbology model – symbol characteristics can be found there as well.

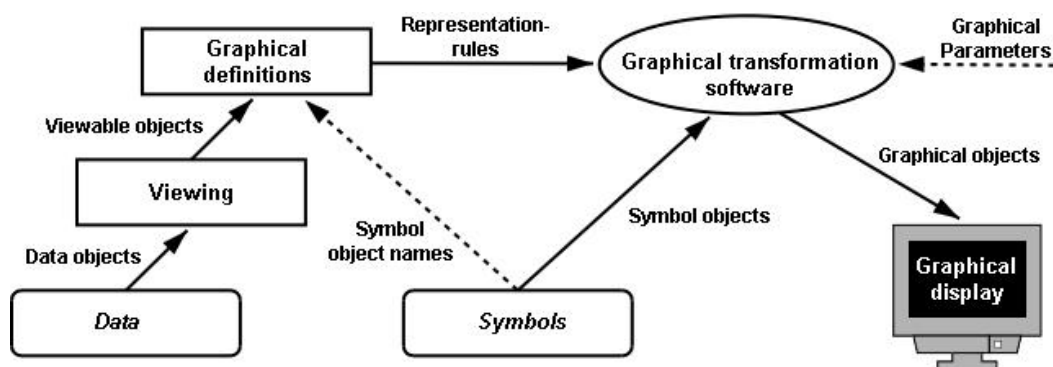


Figure 5: Graphic definitions, on one hand built upon data and views, on the other upon symbols permitting generation of graphics (abstract diagram).

The reference to the graphic symbols in question ensues by using names; see symbol object names in figure 5. The graphic symbols as such (also named symbol objects) are contained like objects (data) in their respective meta-objects-baskets. A basket with such symbol objects is also known as a symbology library.

A symbology model determines for every symbol type within its respective symbology class, which additional parameters (e.g. position and orientation of a symbol) are necessary for its representation. Thus the intersection with the graphic-subsystem (graphic application software) of the respective systems is not determined by INTERLIS itself, but by the symbology models. To this extent it is possible at any moment to declare further global parameters (e.g. scale of representation), at the time are known to the graphic sub-system and able to influence the decision, which symbols are to be used in the representation. Since such determinations are closely related to the actual possibilities of the systems, these parameters as well as characteristics of symbols must be subjects of contractual agreement with suppliers (cf. following chapter 1.7 Contracts).

A graphic description need not regulate the conversion into symbols in a final way. On the contrary, it can be inherited from a different graphic description. It is then possible to supplement parameters left undefined in base definitions, or existing directions can be replaced.

1.7 Contracts

In order for INTERLIS 2 to be able to meet all kinds of demands, it contains also constructs whose implementation is not regulated by the definition, e.g. functions, line types, symbols (details will be treated in chapter 2 Description Language). Without undertaking further efforts, the goal that an INTERLIS 2 description automatically ought to be convertible into a service could not be achieved. In the interest of simplicity however, INTERLIS does not offer any further possibilities of definitions for such cases (as for example an actual programming language for the definition of functions).

In order to render feasible the automatic conversion within at least certain limits (e.g. a country or a certain range of application), such constructs should only be admissible within models covered by contracts.

Contracts are agreements between parties who define models and parties who supply tools based upon INTERLIS. Typically it is only basic models of one line of industry or one country that are object of such an agreement. In order to achieve the definition of these basic models, modelers and tool providers work together and sign an agreement. Henceforth tool providers can realize the elements demanded by these models (e.g. functions) independently of the concrete form of application. Thereupon the concrete models can be converted automatically (i.e. without the help of a tool provider).

It is of great importance, that such supplementary constructions be generally discussed and neutral of any specific system, as well as being at public disposal in much the same way as the model itself. Otherwise one of the most important aims of INTERLIS, that is to say openness and interoperability, cannot be guaranteed.

1.8 Services, Tool Capacities and Conformity

INTERLIS 2 permits a conceptual description of data and defines a system-neutral transfer. INTERLIS 2 explicitly renounces all directions concerning implementation in order to remain system-independent. Thus often in practical operation the question will arise whether a certain tool or a required service is in conformity with INTERLIS or not.

INTERLIS does not stipulate that only the extremities of complete conformance or non-conformance are conceivable. On the contrary one service will conform to INTERLIS in some aspects while not fulfilling other requirements.

In the simplest of cases a certain system meets the INTERLIS specifications in one particular case (for a fixed set of models, only read or only write or both, etc.).

Ideally a set of INTERLIS models can be handed over to an INTERLIS tool, whereupon the tool automatically adapts its services and capacities in accordance with the situation defined by the models. In many cases however this adaptation will demand further manual efforts such as system configuration or even programming. No doubt an essential requirement in such tools is their capacity to read INTERLIS model descriptions correctly. Above all this means that system abilities are offered correctly according to INTERLIS constructs, especially inheritance constructs.

From the standpoint of INTERLIS, the capacities of such tools may be classified as follows (so-called tool capabilities, functionalities or services):

- Read data (including views memorized, no generating of view-objects)
- Read data (including views memorized plus generating of view-objects)

- Examine consistencies
- Write views
- Produce graphics (including the reading of views)
- Treat and write data
- Produce object identifiers (OID)
- Read updates (incremental updates)
- Write updates (incremental updates)

It is quite conceivable that a certain tool or some service will have certain capacities (e.g. incremental update) for one model or topic (data or views), but will not support them in other models or topics.

Moreover the question arises which contracts (i.e. which basic models) should be supported by a tool.

When observing an example of joint efforts of various parties concerned, it becomes obvious that different INTERLIS 2 tool capabilities or services will be in demand – depending on the operational area and role of the user. Within one application (i.e. INTERLIS model) with different topics (TOPICS) one single user may have various roles:

- *Collector of primary data*: work with and write data, produce OID, if the occasion should arise
- *Changer of geodata* (up-date, supplement): collect data, write and work with data, produce OID, produce increments, read increments, examine consistencies (locally).
- *Administrator of geodata, geodata center*: collect data, write and work with data, produce OID, read increments, examine consistencies (globally)
- *User of geodata*: collect data, read increments
- *Viewer of geodata*: collect data, produce view objects and graphic representations
- *Producer of map*: collect data, read increments; read views and produce graphic representations.

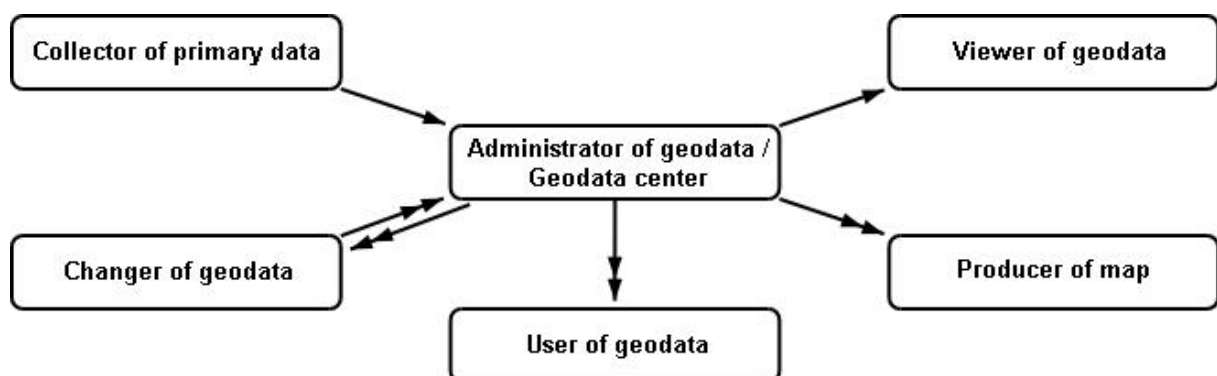


Figure 6: The various ranges of application of INTERLIS. A double arrow means that data can be incrementally transferred.

1.9 A Small Example As An Introduction

Appendix C supplies a small example that presents the most important elements of INTERLIS within the limits of a simple application.



Figure 7: Roads - a small example.

1.10 How this document is structured

This reference manual is subdivided as follows: In chapter 2 our description language is formally defined. In chapter 3 the sequential transfer of geodata is specified. This chapter is divided into a more general part concerned with the present and future sequential transfer services of INTERLIS 2, and a more specific part regarding the INTERLIS 2 transfer service with XML.

The Appendixes are arranged in *two normative* appendixes A and B, complemented by an *informative* appendix C, an index D and *several standard-expansion suggestions* E through to K, as well as a glossary (appendix L).

The normative appendixes are integrating part of this specification. We strongly recommend the standard expansion suggestions (appendixes E through to K) for implementation. These are informative (non-normative) appendixes, however of autonomous character. Implementations may find different answers to these questions; they will still remain INTERLIS 2 conformant. In such a case it is up to the parties involved in the transfer to reach an agreement concerning the specification. Most ranges of application will be object of a contract.

2 Description Language

2.1 Syntax Applied

In order to determine a conceptual data model (data schema) and transfer parameters of a data transfer, a formal language will be defined in the following chapters. This language itself has been formally defined. Therein rules of syntax set the admissible sequence of symbols.

Thus this description is analogous to the ones generally employed in modern programming languages. Hence we only give you the briefest of outlines needed for basic understanding and advise you to consult technical literature for further details (e.g. a short introduction can be found in "Programming in Modula-2 by Niklaus Wirth).

In the sense of the expanded Backus-Naur-Notation (EBNF) a formula is structured as follows:

Formula-Name = Formula-Expression

This formula-expression is a combination of:

- Fixed words (including special characters) of the language. They are enclosed in apostrophes, e.g. 'BEGIN'
- References of other formulas by indicating the formula-name.

Valid combinations are the following

Sequential composition

a b c **first a, then b, then c.**

Grouping

(a) **round brackets group formula-expressions**

Choice

a | b | c **a, b or c**

Option

[a] **a or nothing (void)**

Optional repetition

{ a } **any chosen sequence of a or nothing (void)**

Obligatory repetition (as supplement to EBNF)

(* a *) **any chosen sequence of a, minimum one.**

Examples:

(a b)(c d)	ac, ad, bc or bd
a[b]c	abc or ac
a{ba}	a, aba, ababa, abababa, ...
{a b}c	c, ac, bc, aac, abc, bbc, bac, ...
a(*b*)	ab, abb, abbb, abbbb, ...
(*ab [c]d*)	ab, d, cd, abd, dab, cdab, ababddd, cdababddcd, ...

Often one would like to use a syntactically identical formula in different contexts, for different purposes. In order to express this correlation, an additional formula would have to be written:

```
Example = 'CLASS' Classname '=' Classdef.
Classname = Name.
```

In order to avoid this detour, we rather use the following shortened notation:

```
Example = 'CLASS' Class-Name '=' Classdef.
```

The formula Class-Name is not defined. Syntactically the rule "Name" is directly applied (cf. chapter 2.2.2 Names). Considering its meaning, name however is a class-name. Thus "class" virtually becomes a comment.

2.2 Basic Symbols of the Language

Our description language features the following classes of symbols: Names, strings, figures, explanations, special symbols, reserved words and comments.

2.2.1 Character Codes Utilized, Blanks and Line Ends

The language itself only uses the printable US-ASCII symbols (32 to 126). What other symbols besides the blank space are considered as interspaced, has to be determined by the actual compiler implementation. It is also up to this implementation to determine what symbols or combination of symbols mark the end of a line. Likewise it is the compiler implementation that determines the memorization of symbols (character set). This might differ depending on the platform used.

As far as comments are concerned, it is also admissible to apply further symbols such as umlauts and accent marks, etc.

2.2.2 Names

A name is defined as a sequence of a maximum of 256 letters, digits and underlines, wherein the first symbol has to be a letter. We distinguish between capitals and small letters. Names that coincide with reserved words of this language (cf. chapter 2.2.7 Special Symbols and Reserved Words) are inadmissible.

Syntax rules:

```
Name = Letter { Letter | Digit | '_' }.
Letter = ( 'A' | .. | 'Z' | 'a' | .. | 'z' ).
Digit = ( '0' | '1' | .. | '9' ).
HexDigit = ( Digit | 'A' | .. | 'F' | 'a' | .. | 'f' ).
```

Further information regarding uniqueness and validity domain of names is to be found in chapter 2.5.4 Namespaces.

2.2.3 Strings

Strings appear in connection with constants. They begin and end with quotation marks and may not exceed one line. \" Represents a quotation mark, \\ a backslash within a string.

A sequence of \u, immediately followed by exactly four hexadigits represents any chosen Unicode sign. Symbols beyond U+10000 are to be marked, as in the UTF-16-Coding, with two surrogate codes (cf. www.unicode.org).

Syntax rule:

```
String = ''' { <any character except '\\' or ''>
           | '\\' }
```

```

| '\\\
| '\u' HexDigit HexDigit HexDigit HexDigit
} '""'.

```

2.2.4 Digits

Digits may appear in different ways: positive whole numbers including 0 (PosNumber), numbers (Number), decimals (Dec) and structured numbers. With decimal numbers the scaling may be shown to the power of ten (e.g. 1E2 is 100, 1E-1 is 0.1). Structured numbers only make sense in relation with corresponding units and value ranges (e.g. time). It is only the value of a number that is of importance and not its representation, e.g. 007 is the same as 7.

Syntax rules:

```

PosNumber = (* Digit *).
Number = [ '+' | '-' ] PosNumber.
Dec = ( Number [ '.' PosNumber ] | Float ).
Float = [ '+' | '-' ] '0.' (('1'|'2'|...|'9') [PosNumber] | (* '0' *))
        Scaling.
Scaling = ( 'e' | 'E' ) Number.
StructDec = Number (* ':' PosNumber *) [ '.' PosNumber ].

```

Examples:

PosNumber:	5134523	1	23
Number:	123	-435	+5769
Dec:	123.456	0.123456e4	-0.123e-2
Float:	0.1e7	-0.123456E+4	0.987e-100
StructDec:	23:59.10	02:11:07	

2.2.5 Sets of Properties

For several purposes it is necessary to assign properties to a subject matter. To this aim use the general syntax:

Syntax rule:

```

Properties = [ '('Property { ',' Property } ')' ].

```

In order to define that at a certain place within a syntax rule such properties ought to be defined, the following construct is inserted into the syntax:

```

'Properties' '<' Property-Keyword { ',' Property-Keyword } '>'

```

Hence you write "Properties" and define in brackets (< and >) the admissible keywords. If you take for example the rule ClassDef (cf. chapter 2.5.3 Classes and Structures), with "Properties<ABSTRACT, EXTENDED, FINAL>" the keywords "ABSTRACT", "EXTENDED", "FINAL" are accepted terms for the description of properties. Within an INTERLIS 2-Definition amongst others the following definitions would be possible:

```

CLASS A (ABSTRACT) = .....
CLASS A (EXTENDED, FINAL) = .....

```

2.2.6 Explanations

Explanations are required wherever circumstances have to be described more closely. From the viewpoint of the standard mechanism, this explanation will not be interpreted any further, i.e. it is considered a comment. But it is quite permissible to formalize explanations in more detail, so as to prepare them for further mechanical processing. We have chosen // to mark the beginning and the end of an explanation. Within an explanation two subsequent diagonal strokes may never occur.

Syntax rule:

Explanation = `'//'` any character except `//` `'//'`.

2.2.7 Special Symbols and Reserved Words

In connection with the syntax rules of the language (however not where a data description is concerned), special symbols as well as reserved words always appear between apostrophes e.g. `'` or `'MODEL'`. On principle, all reserved words are written in capitals. In order to avoid conflicts between names and reserved words, we advise you not to compose names in capitals.

The following reserved words have been used (some of them already in INTERLIS 1, these remain reserved for reasons of compatibility; they are not represented in bold and italics):

ABSTRACT	ACCORDING	AGGREGATES	AGGREGATION
ALL	AND	ANY	ANYCLASS
ANYSTRUCTURE	ARCS	AREA	AS
ASSOCIATION	ATTRIBUTE	ATTRIBUTES	BAG
BASE	BASED	BASKET	<i>BLANK</i>
BOOLEAN	BY	CIRCULAR	CLASS
CLOCKWISE	<i>CODE</i>	CONSTRAINT	CONSTRAINTS
<i>CONTINUE</i>	CONTINUOUS	<i>CONTOUR</i>	CONTRACT
COORD	<i>COORD2</i>	<i>COORD3</i>	COUNTERCLOCKWISE
DATA	<i>DATE</i>	<i>DEFAULT</i>	DEFINED
<i>DEGREES</i>	DEPENDS	<i>DERIVATIVES</i>	DERIVED
<i>DIM1</i>	<i>DIM2</i>	DIRECTED	DOMAIN
END	EQUAL	EXISTENCE	EXTENDED
EXTENDS	EXTERNAL	FINAL	FIRST
<i>FIX</i>	<i>FONT</i>	FORM	<i>FORMAT</i>
<i>FREE</i>	FROM	FUNCTION	<i>GRADS</i>
GRAPHIC	HALIGNMENT	<i>I16</i>	<i>I32</i>
<i>IDENT</i>	IMPORTS	IN	INSPECTION
INTERLIS	ISSUED	JOIN	LAST
LINE	<i>LINEATTR</i>	<i>LINESIZE</i>	LIST
LNBASE	LOCAL	MANDATORY	METAOBJECT
MODEL	NAME	<i>NO</i>	NOT
NULL	NUMERIC	OBJECT	OF
OID	ON	<i>OPTIONAL</i>	OR
ORDERED	OTHERS	OVERLAPS	PARAMETER
PARENT	<i>PERIPHERY</i>	PI	POLYLINE
PROJECTION	<i>RADIANS</i>	REFERENCE	REFSYSTEM
REQUIRED	RESTRICTED	ROTATION	SIGN
STRAIGHTS	STRUCTURE	SURFACE	SYMBOLGY
<i>TABLE</i>	TEXT	THATAREA	THIS
THISAREA	<i>TID</i>	<i>TIDSIZE</i>	TO
TOPIC	<i>TRANSFER</i>	TRANSIENT	TRANSLATION
TYPE	UNDEFINED	UNION	UNIQUE
UNIT	UNQUALIFIED	URI	VALIGNMENT
VERTEX	<i>VERTEXINFO</i>	VIEW	WHEN
WHERE	WITH	WITHOUT	

Table 1: Reserved words in INTERLIS 2.

2.2.8 Comments

Two forms of comments are at your disposal:

2.2.8.1 Line Comment

Two exclamation marks, one immediately after the other, mark the beginning of a line comment. The line end closes the line comment.

Syntax rule:

!! Line comment; goes until end of line

2.2.8.2 Block comment

A diagonal stroke and a star introduce a block comment; a star and a diagonal stroke mark its end. It can extend over several lines and may contain itself line comments; involved block comments are not permissible.

Syntax rule:

```
/* Block comment,  
   additional line comment */
```

2.3 Principal Rule

Each description unit starts by indicating the language version. Thus we lay the basis for language supplements at a later date. In this document we describe version **2.2** of INTERLIS.

Subsequently you will find model descriptions.

Syntax rule:

```
INTERLIS2Def = 'INTERLIS' Version-Dec ';'   
              { ModelDef }.
```

2.4 Inheritance

Different constructs of INTERLIS may be expanded in the sense of the object-oriented way of thinking: Firstly a definition sets a basis that thereafter can be specialized in several steps.

Topics, classes, views, graphic definitions, units and domains can expand their corresponding basic constructs (keyword EXTENDS, resp. EXTENDED) and therewith inherit all their properties. In certain cases it may be possible that indicating EXTENDED expand a primarily defined construction, and yet keep its name.

FINAL prevents the expansion of a definition. Some constructions can be defined in a still incomplete form (keyword ABSTRACT); in an extension supplied at a later time they will be complemented and become concrete definitions.

In order to indicate all admissible keywords within a certain context, we use the general property – notation (cf. chapter 2.2.5 Sets of Properties).

2.5 Models, Topics, Classes

2.5.1 Models

The term 'model' means a self-contained, complete definition. According to the type of model it may contain several constructions.

A pure type model (TYPE MODEL) may only declare measure units, domains, functions and types of lines.

A reference-system model (REFSYSTEM MODEL) should declare definitions of a type model, as well as topics and classes related to the extensions of the predefined classes AXIS, resp. REFSYSTEM (cf. chapter 2.10.3 Reference Systems). The language cannot reinforce the observation of this rule. It is up to the user to abide by it.

A symbology model should declare definitions of a type model, as well as topics and classes related to the extensions of the predefined class SIGN, and furthermore run time parameters (cf. chapter 2.16 Graphic Descriptions, resp. 2.11 Run Time Parameters). It is up to the user to observe this rule.

Symbology models can only be permitted in connection with contracts, as they have to be adapted to their treatment by the system.

Where no restrictive model properties are defined, a model may contain any conceivable construct.

Following the model name the language can be indicated (optional). Whenever possible this should be done according to ISO-Norm 639 , i.e. in two letters and using small letters (cf. www.iso.ch/), e.g. "de" stands for German, "fr" for French, "it" for Italian, "en" for English. According to ISO-Norm 3166 a country code can be added separated by an under line to indicate a variety of language used in a specific country: "de_CH" stands for the written High German used in Switzerland. This indication is of documentary value, in connection with the possibility to declare one model translation of another (TRANSLATION OF). In their structure both models must be exactly identical, hence they can only differ in the names employed. However the declaration 'translation' is not tied to the indication of language. For example in order to support local use of language or particular trade vocabulary it is admissible to add translations in the original language.

Syntax rule:

```
ModelDef = [ 'TYPE' | 'REFSYSTEM' | 'SYMBOLGY' ]
           'MODEL' Model-Name [ '('Language-Name ')'] ]
           [ 'TRANSLATION' 'OF' Model-Name ] '='
           { 'CONTRACT' 'ISSUED' 'BY' Issuer-Name [ Explanation ] ';' }
           { 'IMPORTS' [ 'UNQUALIFIED' ] Model-Name
           { ',' [ 'UNQUALIFIED' ] Model-Name } ';' }
           { MetadataUseDef
           | UnitDef
           | FunctionDef
           | LineFormTypeDef
           | DomainDef
           | RunTimeParameterDef
           | ClassDef
           | TopicDef }
           'END' Model-Name '...'.
```

Where a model is linked to a contract, the editor of the contract is named. An explanation may provide further details such as the editor's postal address and e-mail address.

Whenever an INTERLIS construction refers to a definition stated in another model, this model has to be imported (keyword IMPORTS). Thus topics can be extended and references to classes created. IMPORTS only offers the possibility of use. When using imported definitions they still have to be referred to with a qualified name (model, topic), unless the keyword UNQUALIFIED is applied.

A pre-defined base model "INTERLIS" (cf. appendix A The internal INTERLIS data model) is connected to the language. It need not be imported. Nevertheless its elements are only available with unqualified names, if the model is introduced with IMPORTS UNQUALIFIED INTERLIS.

2.5.2 Topics

A topic (keyword TOPIC) contains all definitions necessary to describe a specific part of reality. A topic can also define types such as measure units, domains or structures or it may use those belonging to the enveloping model or an imported model.

Put in brackets () properties of inheritance can be defined. Since an extension of a topic always refers to a topic of a different name, EXTENDED would not make sense and hence is not admissible.

Syntax rule:

```
TopicDef = [ 'VIEW' ] 'TOPIC' Topic-Name
           Properties<ABSTRACT,FINAL>
```

```

        [ 'EXTENDS' TopicRef ] '='
        [ 'OID' 'AS' OID-DomainRef ]
        { 'DEPENDS' 'ON' TopicRef { ',' TopicRef } ';' }
        Definitions
    'END' Topic-Name ';'.

Definitions = { MetaDataUseDef
                | UnitDef
                | DomainDef
                | ClassDef
                | AssociationDef
                | ConstraintsDef
                | ViewDef
                | GraphicDef }.

TopicRef = [ Model-Name '.' ] Topic-Name.

```

Concerning a certain topic, which contains concrete classes, there may exist an indefinite number of baskets (databases etc.) They all possess a structure corresponding to the topic but contain different objects.

A data basket only features instances of classes (and their sub-structures). If a topic contains graphic descriptions, three types of baskets can be set up.

- Data baskets.
- Baskets with basic data for graphics. Such baskets contain the instances of classes or views which lay the foundation for graphic descriptions.
- Graphic baskets. These baskets contain graphic objects that have been realized (according to the parameter definition of the symbols employed).

In relation with topics featuring only views but no classes or graphic definitions and if moreover these are explicitly marked as view topics (keyword VIEW), there may exist baskets that contain instances of the views of this topic.

Identifications of the baskets and their identifiable objects must correspond with the domain that has been assigned to the topic (OID AS. Once an OID-domain has been assigned to a topic, this attribution cannot be altered in extensions. No attribution implies application of the OID-domain STANDARDOID (cf. chapter 2.8.8 Domain of Object Identifications, as well as appendixes A and E). Explicit definitions are only admissible within the scope of contracts.

With exception of specific indications, one topic is, where data are concerned, independent of other topics. Data-related dependencies arise as a consequence of relationships, resp. reference attributes, which refer to a different basket, through special constraints or by means of construction of views or graphic-definitions on classes or other views. In the interest of clear recognizability of such dependencies these must be explicitly declared already in topic heading (keyword DEPENDS ON). Detailed definitions (e.g. definitions of relationships) may not violate declarations of dependencies. Cyclic dependencies are inadmissible. Without further declaration an extended topic features the same dependencies as its base-topic.

2.5.3 Classes and Structures

A class definition (keyword CLASS) declares the properties of all its pertinent objects. Class definitions can be extended whereby an extension primarily inherits all attributes of its basic class. Its domain can be limited and more attributes can be defined.

As part of a class definition constraints can be indicated. These conditions represent additional rules all objects have to comply with. Inherited constraints can never be suspended, but always are in force in addition to those declared locally.

Objects of a class are always independent and individually identifiable. Structures (keyword STRUCTURES) formally are defined in the same way as classes, however their structural elements are dependent and cannot be identified individually. They either occur within sub-structures of objects (cf. chapter 2.6 Attributes) or they only exist temporarily as a result of functions. Wherever structures are applied, we can also refer to a class definition. This is what we call the structural use of class. Yet in this context classes have to be interpreted as structure definitions, hence their objects are dependent.

Specific classes such as those for reference systems; coordinate system axis and graphic symbology (in other words extensions of the predefined class METAOBJECT) will be treated in chapter 2.10.

In brackets (rule Properties) characteristics of inheritance can be defined. All possibilities are admissible. Whenever a class or structure contains abstract attributes, it has to be declared ABSTRACT. Abstract attributes must be put into concrete terms within the concrete extension of the class. Yet it is also permissible to declare classes as abstract even though their attributes are fully defined. Object instances can only exist for concrete classes that have been defined within a topic. Classes that have been defined out of topics (i.e. directly within the model) may not contain reference attributes. Furthermore it is not admissible to define associations to such classes.

If only an individual class and not the entire a class are inherited, no relations (cf. chapter 2.7 Proper Relationships) may be defined.

If one topic extends another, all classes of the inherited topic are transferred. Thus they become classes of the current topic and have the same name as in the inherited topic. Such a class may be extended even while keeping its name (EXTENDED). For example if a topic T2 expands the topic T1 that contains the class C, there is only one class with C (EXTENDED) within T2, and that is C. New classes that have to differ in name from those inherited may also extend inherited classes. Consequently with C2 EXTENDS C there are two such classes in T2 (C and C2). Since INTERLIS, in the interest of simplicity and clarity only supports simple inheritance, EXTENDED is only admissible when neither in the basic topic nor in the current topic the basic class has been extended with EXTENDS. EXTENDED and EXTENDS exclude one another in the same class definition.

Classes and structures that are not built upon a class or structure already defined need no EXTENDS-part.

Syntax rule:

```

ClassDef = ( 'CLASS' | 'STRUCTURE' ) Class-Name
           Properties<ABSTRACT,EXTENDED,FINAL>
           [ 'EXTENDS' StructureRef ] '='
           [ 'ATTRIBUTE' ] { AttributeDef }
           { ConstraintDef }
           [ 'PARAMETER' { ParameterDef } ]
           'END' Class-Name ';'

ClassRef = [ Model-Name '.' [ Topic-Name '.' ] ] Class-Name.

StructureRef = [ Model-Name '.' [ Topic-Name '.' ] ]
               ( Structure-Class-Name | Class-Name ).

```

Which names have to be qualified (by model-name, resp. model-name.topic-name) will be explained at the end of the following paragraph (2.5.4 Namespaces). Classes and structures that are not built upon an already defined class or structure do not need an EXTENDS-part.

2.5.4 Namespaces

The term namespace signifies a set of (unequivocal) names. Each modeling element (data model, topic, class element), as well as all meta data-baskets provide their respective namespace for their name categories (type name, part name, meta object name).

Modeling elements exist on three hierarchy levels:

- Model (MODEL is sole modeling element at top level)
- Topic (TOPIC is sole modeling element on this level)
- Class elements are CLASS, STRUCTURE, ASSOCIATION, VIEW and GRAPHIC

Meta data-basket names give access to meta objects (cf. chapter 2.10 How to Deal with Meta Objects).

There are three name categories that contain the following names:

- Type names are abbreviations (names) of units and the names of functions, line types, domains, structures, topics, classes, associations, views, graphics, baskets.
- Part names are the names of run time parameters, attributes, rules for drawing, parameters, relation accesses and basic views.
- Meta object-names are the names of meta objects. They only exist within meta data-baskets.

In order to avoid misunderstandings modeling elements take over the name of the superior modeling elements in accordance with the name category. If one modeling element extends another, all names of the basic modeling element are added to its namespaces. A name locally defined within the modeling element may not collide with a name that has been transmitted unless it is specifically termed as an extension (EXTENDED).

If you want to reference description elements of the data model, their name is usually to be qualified, i.e. it has to be indicated with preceding model and topic name. Unqualified it is possible to use the names of the namespaces of the respective modeling element.

2.6 Attributes

2.6.1 General Remarks

Its name and its type define each attribute. In brackets (rule Properties) characteristics of inheritance can be defined. Whenever an attribute is an extension of an inherited attribute, this must be explicitly indicated with EXTENDED. If the domain of this attribute is abstract, the attribute must be declared ABSTRACT.

Syntax rule:

```
AttributeDef = Attribute-Name Properties<ABSTRACT,EXTENDED,FINAL>
              ':' AttrTypeDef
              [ ':' Factor { ',' Factor } ] ';'.
```

If the attribute value has been determined by means of a factor (cf. chapter 2.13 Expressions), its result type must be compatible with the defined attribute, i.e. it must either feature the same domain or an extended, i.e. specialized domain. Within the scope of views – especially in the case of unions and view extensions (cf. chapter 2.15 Views) – it is possible to determine several factors and in additional view extensions further factors can be added yet. It is the last factor (base first, extension following) with defined value that is valid.

In extensions it is possible to override an attribute by the following means:

- Limited domain.

- A constant out of the required domain. Such a definition is implicitly final, i.e. it can no longer be overridden.
- A factor, if the type of result would be admissible as extension of an attribute. Could still be overridden.

Syntax rule:

```

AttrTypeDef = ( 'MANDATORY' [ AttrType ]
               | AttrType
               | ( ( 'BAG' | 'LIST' ) [ Cardinality ]
                 'OF' RestrictedStructureRef ) ).

AttrType = ( Type
            | DomainRef
            | ReferenceAttr
            | RestrictedStructureRef ) .

ReferenceAttr = 'REFERENCE' 'TO'
               Properties<EXTERNAL> RestrictedClassOrAssRef .

RestrictedClassOrAssRef = ( ClassOrAssociationRef | 'ANYCLASS' )
                        [ 'RESTRICTED' 'TO' ClassOrAssociationRef
                          { ',' ClassOrAssociationRef } ].

ClassOrAssociationRef = ( ClassRef | AssociationRef ).

RestrictedStructureRef = ( StructureRef | 'ANYSTRUCTURE' )
                       [ 'RESTRICTED' 'TO' StructureRef
                         { ',' StructureRef } ].

```

Within the scope of extensions it is permissible to indicate only MANDATORY. In this case the already defined attribute type is valid. However it is strictly required that the value be defined.

2.6.2 Attributes with Domain as Type

Direct type definition (rule Type) and the use of already defined domains (rule DomainRef) are conceivable as types of attribute. Various possibilities are listed in chapter 2.8. Domains and Constants.

2.6.3 Reference Attributes

By using a reference attribute we create a reference to another object. Reference attributes are only admissible within structures. A structure, which directly or indirectly (via sub-structures) contains reference attributes, cannot be extended to a class. Links between independent objects have to be defined by means of proper relationships (cf. chapter 2.7).

Classes, whose elements are in consideration for reference, may be concrete or abstract object or relation classes, but not structures (since these are dependent objects). All concrete classes come in question, provided they correspond to the listed primary class, resp. one of the listed restricting (RESTRICTED TO) classes (class itself or one of its sub-classes). On all restriction levels (initial definition or steps of extension) all classes that are still admissible must be listed. Each class defined as a restriction must be sub-class of a class hitherto admissible. However such a class is only admissible if it belongs to the same topic as the reference attribute or to a topic the referenced topic is depending on (DEPENDS ON). If it is required that the reference may refer to the object of a different basket of either the same or a different topic (prerequisite: DEPENDS ON), the property EXTERNAL must be indicated. In extensions it is possible to omit and thus exclude this property, however it cannot be added. Unless the reference attribute has been declared abstract, there must be a minimum of one admissible concrete sub-class.

2.6.4 Structure Attributes

Structure attribute values (rule Restricted StructureRef) are composed of one (neither LIST nor BAG required) or several (admissible number within the scope of the cardinality indicated) ordered (LIST) or disordered (BAG) structural elements. Structural elements have no OID, exist only in connection with their main object and can only be found by passing via the former. Their composition is a result of the structure or class indicated. The structure elements of all structure attributes of a class which are borrowed from the totality of all structure elements are called sub-structure.

If structure or class of the sub-structure are arbitrary (ANYSTRUCTURE or ANYCLASS), the structure attribute has to be declared abstract, provided it is compulsory, resp. has a minimum cardinality greater than zero. ANYSTRUCTURE can be specialized in extension to ANYCLASS as long as no restrictions (RESTRICTED TO) are defined.

Sub-structures may be defined with concrete or abstract structures. In the first place, such concrete structures could be all classes listed as primary or restricting (RESTRICTED TO), resp. classes and their extended classes, resp. extended structures. Within the current topic these would be without further restrictions all concrete and extended classes, resp. extended structures. Out of the current topic the required classes or structures must be listed explicitly. At any restriction level (initial definition or steps of extension) all classes or structures still admissible must be listed. Each class or structure defined as an extension must be the extension of a class or structure hitherto admissible. There must be a minimum of one concrete extension of the structure, unless the sub-structure has been declared abstract. An ordered sub-structure (LIST) may not be extended by a disordered sub-structure (BAG). The same rules as with relationships apply to cardinality (cf. chapter 2.7.3 Cardinality).

2.7 Proper Relationships

2.7.1 General Remarks

Proper relationships (as opposed to reference attributes (cf. chapter 2.6 Attributes) are described as independent constructs. The most important property of a relationship consists of the listing of object classes (a minimum of two) that are assigned in the roles, including such details as force of relationship and cardinality. Role names should typically be nouns. They can, but need not coincide with the names of the assigned object classes. Furthermore the relationship itself may feature local attributes. If the association name is not indicated it is implicitly formed by composing the role names (first, then second etc.).

In several respects a relation is a somewhat special class. Where inheritance is concerned the same stipulations apply as with classes. In order to assure that the significance of cardinality be clear and inalterable, it is prohibited to add supplementary roles in extensions. If within extensions of relationships the admissible reference classes are restricted where the basic association is concerned, only those relationships that have been listed explicitly remain permissible. If a relationship has been defined between class A and B, and the classes A and B have been extended by sub-classes A1, A2, B1, B2 etc., then to start with any number of relationships between objects of A1, A2 and B1, B2 are permissible. However if there is a relation extension, e.g. whose roles restrict the relation to A1 and B1, then only such relationships are admissible between the objects of the classes A1 and B1. However it is permitted to define several of these relation extensions, e.g. even between A1 and B3. Thus an object of A1 could be related to objects of B1 or B3, but not to B2.

Syntax rule:

```
AssociationDef = 'ASSOCIATION' [ Association-Name ]
                Properties<ABSTRACT,EXTENDED,FINAL>
                [ 'EXTENDS' AssociationRef ]
                [ 'DERIVED' 'FROM' RenamedViewableRef ] '='
```



```

        { RoleDef }
        [ 'ATTRIBUTE' ] { AttributeDef }
        { ConstraintDef }
    'END' [ Association-Name ] ';'

AssociationRef = [ Model-Name '.' [ Topic-Name '.' ] ] Association-Name.

RoleDef = Role-Name Properties<ABSTRACT,EXTENDED,FINAL,ORDERED,EXTERNAL>
        ( '--'|'-<>'|'-<#>' ) [ Cardinality ]
        RestrictedClassOrAssRef
        [ ':' Role-Factor ] ';'

Cardinality = '{' ( '*' | PosNumber [ '..' ( PosNumber | '*' ) ] ) '}'

```

The same rules as with reference attributes (cf. chapter 2.6.3) apply to object and relationship classes that have been defined permissible within the scope of roles.

A concrete relationship between objects may be considered an independent object. It will receive its own object identification if one of the following conditions is complied with:

- The relationship has more than two roles.
- The relationship has two roles and in both cases a maximum cardinality greater than one.

If the maximum cardinality of at least one role of a relationship between two classes equals one, and this already in the basic definition and not only in an extension, then the relation object does not receive its own object identification (but the OID of the enveloping object). The reference object is considered to be the structure attribute of that object which corresponds to the role with maximum cardinality greater one, resp. the second role if both roles feature maximum cardinality one. A further condition implies that the class which has to accept the structure attribute has to be defined in the same topic as the relationship class. On the one hand we thus achieve that implementations need not have unnecessary object identifications. On the other hand this offers the possibility of compatibility with INTERLIS 1 (cf. chapter 3 Sequential Transfer).

Normally concrete relationships between objects must be established explicitly by means of an application and subsequently be fixed as instances by the processing system. A relationship can also be derived from a view without being instanced (DERIVED FROM). Such a relationship can be an extension of an abstract relation, but cannot be abstract itself. If it is extended, the extension must build upon the same view or upon one of its extensions. One object path has to be indicated (cf. chapter 2.13 Expressions) which designates a class or association corresponding to the role. The cardinality must be in accordance with the performance of the view. This however can only be checked during run time.

A typical case of an application might be the derivation of a relationship from its geometrical conditions: within a view (union) which is referred to in the association and based upon the geometry of the real estates they are situated on, e.g. buildings are brought in relation with these estates (cf. chapter 2.15 Views).

2.7.2 Force of Relationship

In accordance with UML we distinguish different forces of relation. In order to explain these we mainly describe the influence the force of relation possesses when copying or deleting objects. In addition there are other considerations that influence the force of relation. Above all it is up to the individual software to set more refined forces of relation or even other criteria for the processing of certain operations.

- Association: The objects concerned are loosely connected. If one of the objects is copied, the copy is connected to the same objects as the original. If an object is deleted, the relation is deleted at the same time, however the object itself remains. Syntactically we indicate '--' with all roles.

- **Aggregation:** There is only a feeble relationship between the entirety and its parts. Aggregations are only permitted in relationships with two roles. Syntactically the role that leads to the entirety must come first and be indicated with a rhombus (-<>). The role that leads to the part is defined with '-'. An object class may appear in several aggregations in the role of a part. Hence to a certain object of a part there can be assigned different objects of the entirety. As opposed to associations, when making a copy of the entirety corresponding copies of the parts are established. When several entireties are defined for one part, then the copy will only maintain the reference to the entirety which initiated the copy. When deleting the entirety, parts and possible relationships to other entireties remain intact.
- **Composition:** A strong relationship exists between the entirety and its parts. An object class may appear in the part-role in more than one composition. However only one entirety may be assigned to a certain part-object. Other than that compositions are the same as aggregations, except that when deleting the entirety its parts are likewise deleted. The role that leads to the entirety is indicated with a filled rhombus (-< #>).

Associations can be extended to aggregations, these can be extended to compositions, but the reverse is not permissible.

2.7.3 Cardinality

Cardinality defines the minimum and maximum number of permissible objects, where only one value is indicated minimum and maximum are the same. If for the maximum an asterisk replaces the number, there is no upper limit for the number of sub-objects. The indication of cardinality with {*} is the equivalent of {0..*}. If there is no indication of cardinality then normally {0..*} is in force. With aggregation and composition roles only {0..1} or {1} are admissible (one part can only belong to one entirety). Where there is no indication {1} is in force.

In Extensions cardinality can only be restricted but not extended. Hence if in the first place a cardinality of {2..4} has been indicated, an extension cannot declare {2..5}, {7} or {*}. If in extended attributes the indication of cardinality is omitted, it means that the inherited value has been taken over.

Depending on the form of application, cardinality has the following significance:

- With sub-structures: number of admissible elements.
- With relationships between two classes: number of objects of the class in accordance with the role the cardinality belongs to, which can be assigned to each instance of the class of the other role.
- With multiple relationships: number of objects of the class in accordance with the role the cardinality belongs to, which may be assigned to a certain combination of objects of the classes of all other roles.

2.7.4 Ordered Relationships

If you want to achieve that a relationship from the viewpoint of a certain reference class is set up in a certain order, this property (ORDERED) has to be required within the role. This order is defined when establishing the relationship and has to be maintained throughout transfers and copies (provided the relationship is also copied).

2.7.5 Relationship Access

The term relationship access signifies the possibility to obtain access to all objects assigned to an object via a certain relationship, resp. to obtain access to all assigned reference objects.

Relation accesses need not be defined; they originate in the definition of a relationship for all classes assigned via roles, which have been defined in the same topic as the relationship. Whenever a class involved in a relationship has been defined in a different topic (topic-spanning relationship or inherited

class) it will not obtain relation access. Thus we avoid any alteration at a later stage (i.e. outside the limits of its definition).

If within a role definition the classes permitted are restricted to (RESTRICTED TO) certain sub-classes of the superclass referred to, relationship accesses ensue for the superclass and will be inherited by all sub-classes. Thus the relationship access will even exist for such sub-classes as have been excluded by the restriction. However it will never be possible to refer to an object, since the restriction explicitly rules out this assignment.

On the condition mentioned above, association accesses will ensue in the assigned superclass that correspond to the other roles of the relationship and contain its name. The names of these relationship accesses belong to the same namespace as the names of the attributes of this class, thus they may not collide. The access to the relationship itself does not obtain its own name, but is a result of the relationship access and a preceding back slash ('\').

If the classes A, B and C are linked via the relationship ABC, whereby role a is assigned to class A, role b to class B and role c to class C, the names of the relationship accesses of class A are b and c. Via these accesses it is possible to attain the assigned objects of class C, resp. class C. Access to the relation objects of the class ABC is attained equally via \a, resp. \b.

2.8 Domains and Constants

Different aspects are linked to the idea of a domain. Primarily a data type has to be defined. INTERLIS data types are independent of their implementation. That is why we do not speak of integer or real for example, but simply of numeric data types (cf. chapter 2.7.5 Numeric Data Types).

Once the data type has been determined, further specifications can be necessary or possible, depending on the data type in question. If a domain definition is yet incomplete (e.g. the length is lacking with a string domain), it has to be declared as abstract (key word ABSTRACT, rule Properties).

Domains can be – as other constructs – inherited and thereafter expanded, provided they have not been defined FINAL. In such a case the basic principle that extended definitions must always be compatible with their base definition, is of great importance. Thus in domains, extensions (keyword EXTENDS) really are specifications, resp. restrictions. The keyword EXTENDED (rule Property) is not admissible. In the interest of readability we suggest that parts of definitions in base domains (such as measure units) be repeated in the extension, even if they are unchanged. Example:

```
DOMAIN
Text (ABSTRACT) = TEXT;           !! abstract domain
GenName EXTENDS Text = TEXT*12;    !! concrete extension
SpezName EXTENDS GenName = TEXT*10; !! ok
SpezName EXTENDS GenName = TEXT*14; !! false, since incompatible
```

An important issue in the definition of domains is whether the value "undefined" belongs to the domain or not. Without any specific indication it does form a part, yet it is possible to demand its exclusion, i.e. an attribute with this domain must always be defined (keyword MANDATORY). MANDATORY alone is only admissible in extensions.

When defining the attribute of a class or structure (and only then), MANDATORY may occur if the domain has been declared FINAL and consequently ought not to be restricted any further.

Syntax rule:

```
DomainDef = 'DOMAIN'
           { Domain-Name Properties<ABSTRACT,FINAL>
             ['EXTENDS' DomainRef ] '='
             ('MANDATORY' [ Type ] | Type ) ';' }.
```

```
Type = ( BaseType | LineType ).
```

```
DomainRef = [ Model-Name '.' [ Topic-Name '.' ] ] Domain-Name.
```

```
BaseType = (
    | TextType
    | EnumerationType
    | AlignmentType
    | BooleanType
    | NumericType
    | StructuredUnitType
    | CoordinateType
    | OIDType
    | BasketType
    | ClassType ).
```

In comparison operations (cf. chapter 2.11 Logical Expressions), attribute values can also be compared with constants. These are defined as follows:

```
Constant = (
    | 'UNDEFINED'
    | NumericConst
    | TextConst
    | StructUnitConst
    | EnumerationConst ).
```

Every data type defines its own specific constants.

2.8.1 Strings

With the data type string (TEXT), it is primarily the length of the string that is of interest. Depending on the form of definition, it is indicated explicitly or implicitly. In its explicit form (TEXT*...), the maximum length is determined in number of symbols (exceeding 0). If only the keyword TEXT is indicated, the definition is considered abstract. If a string domain has been defined with its length, it can only be shortened within the limits of an extension (its lengthening would lead to a domain that no longer is compatible with the base domain).

An INTERLIS string length features the number of symbols as perceived by the user, but not the maximum number of memory storage spaces a system would need for the representation of such a string.

Note: In connection with INTERLIS the length of a string is defined as the number of those symbols which, according to Unicode-Standard, possess the canonical combination class n° 0, after the string has been put into its canonically decomposed form of Unicode (cf. www.unicode.org/unicode/reports/tr15/). Thus a string consisting of <LATIN CAPITAL LETTER C WITH CIRCUMFLEX><COMBINING CEDILLA> possesses the length 1, the same as the equivalent string <LATIN CAPITAL LETTER C>< COMBINING CIRCUMFLEX ACCENT><COMBINING CEDILLA>. According to the definition above, ligatures for "fl" or "ffi" possess the length 1. However we advise you against using such representation forms for string attributes.

The name string type (keyword NAME) defines a domain that corresponds exactly to the one of INTERLIS-names. It is applied in the predefined class METAOBJECT and above all in the classes for reference systems, as well as symbologies (cf. chapter 10.3 Reference Systems, as well as chapter 2.16 Graphic Descriptions), because that is where data attributes have to coincide with description elements of models.

URI (Uniform Resource Identifier) represents a further string type, e.g. http-, ftp- and mailto-addresses (cf. chapter 1.2 in internet standard IETF RFC 2396 at www.w3.org). The length of a URI in INTERLIS is limited to 1023 symbols and hence corresponds to the following definition:

```

DOMAIN
  URI (FINAL) = TEXT*1023;  !! ATTENTION: according to IETF RFC 2396
  NAME (FINAL) = TEXT*255;  !! ATTENTION: according to chapter 2.2.2 Names

```

Syntax rule:

```

TextType = ( 'TEXT' [ '*' MaxLength-PosNumber ]
            | 'NAME'
            | 'URI' ).

```

```
TextConst = String.
```

2.8.2 Enumerations

By means of an enumeration, all values admissible for this type are determined. However an enumeration is not simply linear, but features a tree-like structure. The leaves of this tree (but not its knots) for the set of admissible values. Example:

```

DOMAIN
  Colors = (red (dark, carmine, orange),
            yellow,
            green (light, dark));

```

Produces the following admissible values – described by means of constants:

```
#red.dark #red.carmine #red.orange #yellow #green.light #green.dark
```

A subdivision level is indicated in brackets (). The element names of each subdivision level must be unequivocal. You are at liberty to choose whatever tree depth seems convenient.

In an ordered enumeration (keyword ORDERED), the sequence of elements is clearly defined. If the enumeration is circular (keyword CIRCULAR), the sequence of elements is defined as if the enumeration were ordered. Moreover it is stated that the last element will again be followed by the first.

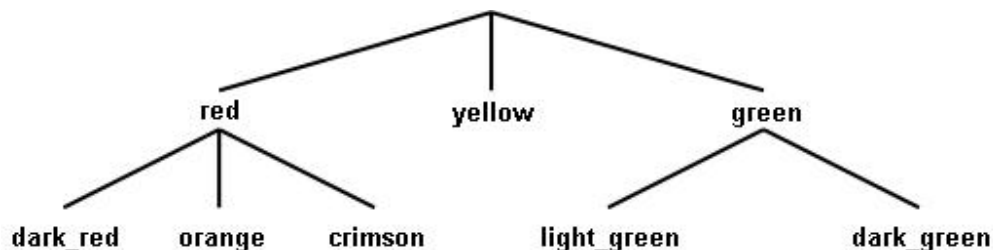


Figure 8: Example of an enumeration.

Examples

```

DOMAIN
  Position = (bottom, center, top) ORDERED;
  Week days = (Working days (Monday, Tuesday, Wednesday, Thursday,
                          Friday, Saturday),
              Sunday) CIRCULAR;

```

Syntax rules:

```
EnumerationType = Enumeration [ 'ORDERED' | 'CIRCULAR' ].
```

```
Enumeration = '(' EnumElement { ',' EnumElement } [ ':' 'FINAL' ]
              | 'FINAL' ')'.

```

```
EnumElement = EnumElement-Name { '.' EnumElement-Name } [Sub-Enumeration].
```

```
EnumerationConst = '#' ( EnumElement-Name { '.' EnumElement-Name }
                        [ '.' 'OTHERS' ]
                        | 'OTHERS' ).
```

Within the scope of new definitions of enumerations (primary definitions, supplementary elements of extensions), the EnumerationConst of the EnumElement may only consist of one name. Several names are only admissible in order to identify a prevailing enumeration element for an extension.

On the one hand enumerations can be extended by defining sub-enumerations for leafs of hitherto existing enumerations (in other words enumeration elements which do not feature sub-enumerations). In the extended definition former leaves now become knots for which no values may be defined.

On the other hand each individual part-enumeration in extensions can be supplemented with further elements (knots or leaves). Thus the basic enumeration comprises besides the elements mentioned more potential elements that will only be defined in extensions. At basic level such potential values can be approached via the value OTHERS in expressions, function arguments and symbology assignments (cf. chapter 2.13 Expressions, 2.14 Functions, 2.16 Graphic Descriptions). However OTHERS is no admissible value within the scope of the class that the object belongs to. The possibility to add supplementary elements of enumeration in extensions can be restricted by declaring the partial enumeration as final (FINAL). This is done either after the last element listed or within the scope of an extension even without adding new elements.

Circular enumerations (keyword CIRCULAR) cannot be extended.

```
DOMAIN
  Color = (red,
           yellow,
           green);
  ColorPlus EXTENDS Color = (red (dark, carmine, orange),
                             green (light, dark: FINAL),
                             blue);
  ColorPlusPlus EXTENDS ColorPlus = (red (FINAL),
                                      blue (light, dark));
```

for Color Plus this results in the following admissible values – described via constants:

```
#red.dark #red.carmine #red.orange #yellow #green.light #green.dark #blue
```

and furthermore for ColorPlusPlus:

```
#blue.light #blue.dark
```

By indicating FINAL with the shades of green in ColorPlus it is not admissible to define further shades of green in ColorPlusPlus. FINAL in the sub-division of red in ColorPlusPlus prevents the addition of more varieties of red in possible extensions of ColourPlusPlus.

2.8.3 Text Orientation

For the processing of plans and maps text positions must be determined. It has to be stated which point of the text the position corresponds to. The horizontal alignment determines whether the position is situated on the left hand or right hand margin or in the center of the text. The vertical alignment determines the position in the direction of the text size.

The distance between cap and base corresponds to the size of capital letters. Descenders are placed in the area base-bottom.

Horizontal and vertical alignment can be understood to signify the following, predefined enumerations:

```
DOMAIN
  HALIGNMENT (FINAL) = (Left, Center, Right) ORDERED;
  VALIGNMENT (FINAL) = (Top, Cap, Half, Base, Bottom) ORDERED;
```

Syntax rule:

```
AlignmentType = ( 'HALIGNMENT' | 'VALIGNMENT' ).
```

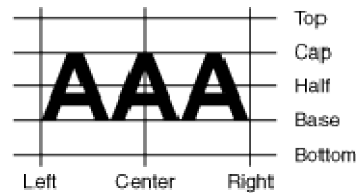


Figure 9: Text orientation horizontally (HALIGNMENT) and vertically (VALIGNMENT).

2.8.4 Boolean

The type Boolean features the values true and false. It can be interpreted as the following predefined enumeration:

```
DOMAIN
  BOOLEAN (FINAL) = (false, true) ORDERED;
```

Syntax rule:

```
BooleanType = 'BOOLEAN'.
```

2.8.5 Numeric Data Type

The most important information in connection with numeric data type are the minimum and maximum value including number of decimals, as well as the scaling factor. Additionally it can be indicated that the type is circular (keyword CIRCULAR), i.e. that in the last significant digit the maximum value increased by 1 and the minimum value technically have the same meaning (e.g. with angles 0359 degrees). If the indication of minimum and maximum value should be missing (keyword NUMERIC), the domain is regarded as abstract.

```
DOMAIN
  Angle1 = 0.00 .. 359.99 CIRCULAR [degree];  !! correct
  Angle2 = 0.00 .. 360.00 CIRCULAR [degree];  !! syntactically correct, but
                                                !! technically false, since 360.01
                                                !! subsequently corresponds to the
                                                !! minimal value 0.00
```

The number of digits must coincide in minimal and maximum value. By means of scaling it is possible to describe float-numbers, but then the minimum as well as the maximum value have to be indicated in mantissa type number representation, i.e. starting with zero (0) and followed by a decimal point (.) the first digit after the decimal point must differ from zero (0). The scaling of the minimum value must be inferior to the scaling of the maximum value. However the notation of minimum and maximum value in no way qualifies as an indication on how to transfer these values (if the domain is defined with 000..999 this does not mean that the value 7 is transferred as 007). Float-numbers are the exception to this rule. These are to be transferred in mantissa type number representation and with scaling.

With extensions the minimum, resp. maximum values can only be restricted. Thus the numeric range becomes smaller. Observe the following situation:

```
DOMAIN
  Normal = 0.00 .. 7.99;
  Exact EXTENDS Normal = 0.0000 .. 7.9949;  !! correct, since Normal
                                                !! is also representable
  Exact EXTENDS Normal = 0.0000 .. 7.9999;  !! false, since rounded
                                                !! outside of Normal
```

In order to explain more clearly the significance of a value, a measure unit can be indicated (cf. chapter 2.9 Units). Abstract measure units are only admissible as long as the domain itself remains undefined (keyword NUMERIC).

The following rules apply for extensions:

- If a concrete base domain features no measure units, then none may appear in extensions.
- Where the base domain employs an abstract measure unit, only such measure units may be used in extensions, as are extensions of the aforesaid measure unit.
- Where the base domain employs concrete measure units, they cannot be overridden in extensions.

Examples:

```
UNIT
  foot [ft] = 0.3048 [m];

DOMAIN
  Distance (ABSTRACT) = NUMERIC [Length];
  MeterDist (ABSTRACT) EXTENDS Distance = NUMERIC [m];
  FootDist (ABSTRACT) EXTENDS Distance = NUMERIC [ft];
  ShortMeters EXTENDS MeterDist = 0.00 .. 100.00 [m];
  ShortFeet EXTENDS FussDist = 0.00 .. 100.00 [ft];
  ShortFeet2 (ABSTRACT) EXTENDS ShortMeters = NUMERIC [ft]; !! false: m vs. ft
```

A scalar system (cf. chapter 2.10.3 Reference Systems) can be attributed to a numeric domain. Thereafter the values refer to the zero point determined by the scalar system. Consequently, they are absolute values in this scalar system. If in the class of the scalar system the unit is not ANYUNIT, such a unit has to be indicated with the numeric data type as will be compatible with the reference system. With regard to a reference system you may indicate the axis referred to by the values. The unit indicated must be compatible the unit of the corresponding axis. Where this information is omitted, the reference is not specified but ensues from the subject (e.g. if you refer to an ellipse when stating a height, elliptic heights are meant). If you refer to a different domain, the same reference system should be applicable as in the former. In this case the indication of the axis may only be omitted where numeric domains are concerned. With a coordinate domain, the indication of the axis is obligatory. The indication of reference systems cannot be changed in extensions.

If the numeric value represents an angle, its orientation can be determined. In the case of directions it can be specified which coordinate system they refer to (defined by its coordinate domain). Thus both zero direction (azimuth) and sense of rotation are known (cf. chapter 2.8.7 Coordinates). This indication cannot be changed in extensions.

Besides decimal numbers two more numbers are defined as numeric constants: pi (keyword PI) and e – base of the natural logarithm (keyword LNBASE).

Syntax rule:

```
NumericType = ( Min-Dec '..' Max-Dec | 'NUMERIC' ) [ 'CIRCULAR' ]
              [ '[' UnitRef ']' ]
              [ 'CLOCKWISE' | 'COUNTERCLOCKWISE' | RefSys ].

RefSys = ( '{' RefSys-MetaObjectRef [ '[' Axis-PosNumber ']' ] '}'
          | '<' Coord-DomainRef [ '[' Axis-PosNumber ']' ] '>' ).

DecConst = ( Dec | 'PI' | 'LNBASE' ).

NumericConst = DecConst [ '[' UnitRef ']' ].
```


2.8.6 Structured Domains

Structured domains are built upon structured units (cf. chapter 2.8 Units). Thus date; time etc. can be dealt with. Minimum and maximum value as well as structured unit must be indicated. In addition to this, a relation to a reference system can be stated (e.g. time zone). This specified unit must be compatible with the one defined in the reference system, i.e. it must either coincide with it, extend it or be derived from it or from one of its extensions.

The same rules as for numeric data type apply to inheritance. Example:

```
DOMAIN
  DayTime = 0:00:00.000 .. 23:59:59.999 [CET];
```

Syntax rules:

```
StructuredUnitType = Min-StructDec '..' Max-StructDec [ 'CIRCULAR' ]
                  '[' Structured-UnitRef ']'
                  [ 'CLOCKWISE' | 'COUNTERCLOCKWISE' ]
                  [ RefSys ].

StructUnitConst = StructDec [ '[' UnitRef ']' ].
```

2.8.7 Coordinates

Coordinates can be defined one, two or three dimensionally, and hence are either a single digit, double digits or triple digits. It is permissible to add the second or third dimension only in an extension. For every dimension the numeric domain, as well as perhaps a measure unit and a coordinate system (including numbers of axis) must be indicated. Only concrete measure units can be indicated. If no reference system is indicated and if furthermore measure units are not or as length units, the program system that implements the model may presume that it is dealing with Cartesian coordinates.

Whenever a rotation definition occurs (keyword ROTATION), it is possible within the scope of definitions of zero directions (cf. chapter 2.8.5 Numeric Data Types) to refer to such a coordinate reference system. The rotation definition determines which axis corresponds to the zero direction and which to the direction of a positive right angle. It may be missing in a concrete coordinate definition and could be added in an extension.

Any indication concerning definition of axis and rotation cannot be changed in extensions.

```
DOMAIN
  CHLKoord = COORD 480000.00 .. 850000.00 [m] {CHLV03[1]},
             60000.00 .. 320000.00 [m] {CHLV03[2]},
             ROTATION 2 -> 1;
```

In both defined dimensions the admissible domain is indicated as well as the units and reference system including the number of axis the coordinates refer to. The actual axes are defined within the reference system. The rotation definition determines that the zero direction leads from axis #2 to axis #1, in other words in the Swiss Federal system where value #1 corresponds to east, and value #2 to north, the zero direction shows north and turns clockwise.

```
DOMAIN
  WGS84COORD = COORD -90:00:00 .. 90:00:00 [Units.Angle_DMS] {WGS84/1},
                0:00:00 .. 359:59:59 CIRCULAR [Units.Angle_DMS] {WGS84/2},
                -1000.00 .. 9000.00 [m] {WGS84};
```

Typically geographic coordinates are represented in degrees and refer to an ellipse system (e.g. WGS84). Then again the altitude is described in meters. It refers to a special ellipse height system with one axis.

Syntax rules:


```

CoordinateType = 'COORD' NumericalType
                [ ',' NumericalType [ ',' NumericalType ]
                [ ',' RotationDef ] ].

NumericalType = ( NumericType | StructuredUnitType ).

RotationDef = 'ROTATION' NullAxis-PosNumber '->'
              PiHalfAxis-PosNumber.

```

Unless a minimum of one numeric domain is defined (with NumericalType), the corresponding attribute is to be defined abstract.

2.8.8 Domains of Object Identifications

Identifiable objects are always labeled with an object identification. In order to make it clear to the system what storage has to be supplied, corresponding domains can be defined and assigned to topics (cf. chapter 2.5.2 Topics).

Syntax rule:

```
OIDType = 'OID' ( 'ANY' | NumericType | TextType ).
```

INTERLIS 2 itself defines the following OID-domains (cf. Appendix A):

```

DOMAIN
  ANYOID (ABSTRACT) = OID ANY;
  I32OID = OID 0 .. 2147483647; !! positive integer values needing 4 Bytes memory
  STANDARDOID = OID TEXT*16;    !! according to appendix E

```

Each numeric or textual OID domain is considered a direct or indirect extension of the abstract OID-domain ANYOID.

2.8.9 Baskets

In order to model a basket administration it is useful to be able to model baskets. This is done by means of the keyword BASKET. Without further indications any basket can be described in such an attribute. It is possible to restrict the admissible baskets. On the one hand it can be indicated by use of properties which types of baskets are admissible (cf. chapter 2.5.2 Topics):

- DATA: data baskets. Only instances of classes (and their sub-structures) are comprised in these baskets.
- VIEW: view baskets. The baskets comprise the (virtual) instances of views of a view topic (keyword VIEW TOPIC).
- BASE: baskets with instances of classes and views that are used by graphic definitions.
- GRAPHIC: baskets with graphic symbologies. Such a basket is also called symbology library.

In extensions the basket types can only be restricted but not supplemented.

On the other hand admissible baskets can be restricted by indicating an admissible topic.

Syntax rule:

```

BasketType = 'BASKET' Properties<DATA,VIEW,BASE,GRAPHIC>
            [ 'OF' [ Model-Name '.' ] Topic-Name ].

```

Description of the topic (model-name, topic-name), type of basket (DATA, VIEW, BASE, GRAPHIC) and identifier of the basket are listed as data fields of a basket. Hence a basket type can be conceived as a structure with the following definition:

```

STRUCTURE Basket (ABSTRACT) =
  Model: MANDATORY NAME;

```

```

Topic: MANDATORY NAME;
Kind: MANDATORY (Data, View, Base, Graphic);
Ident (ABSTRACT): MANDATORY ANYOID;
END Basket;

```

2.8.10 Class Type

It may make sense that data objects contain references to certain classes:

Syntax rule:

```

ClassType = ( 'CLASS'
              [ 'RESTRICTED' 'TO' ClassOrAssociationRef
                { ',' ClassOrAssociationRef } ]
            | 'STRUCTURE'
              [ 'RESTRICTED' 'TO' StructureRef
                { ',' StructureRef } ] ).

```

By indicating structure any structure or class, by indicating class (also permissible as extension of STRUCTURE) any class (but no structures) are admitted. If only certain structures, resp. classes and their extensions are to be admitted, these have to be listed (RESTRICTED TO). In extensions all admissible structures, resp. classes have to be listed again. They cannot contradict the basic definition. As soon as such restrictions have been defined, STRUCTURE no longer can be extended by CLASS.

2.8.11 Line Strings

2.8.11.1 Geometry of the Line String

Practically a *curve segment* is a 1-dimensional structure which has no splits, no corners and no double points of any type (cf. figures 10 and 11). Curve segments are smooth and unique. Straight line segments, circle arcs, pieces of parabolas and clothoids are examples for curve segments. Every curve segment has two *boundary points* (start point and end point, which are not allowed to be identical). The other points of a curve segment are called *inner points*. These form the *interior* of the curve segment.

Exact definition (mathematical terms which are not explained here but whose definition can be found in textbooks are written *"in italics and in quotes"*: *Curve segment* means a subset of the "3-dimensional" "Euclidian space" (hereafter *space* for short), which is the "image" of a "smooth" and "injective" "mapping" of an "interval" (of the "straight line of numbers"). Start point and end point of the curve segment are the images of the end point of the interval. *Planar curve segment* means a curve segment lying in a *plane* ("2-dimensional "subspace" of the space).

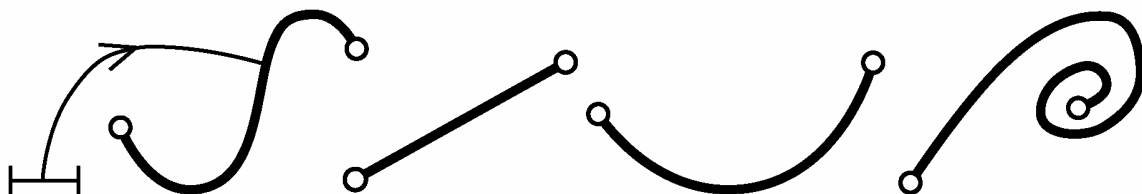


Figure 10: Examples of planar curve segments.

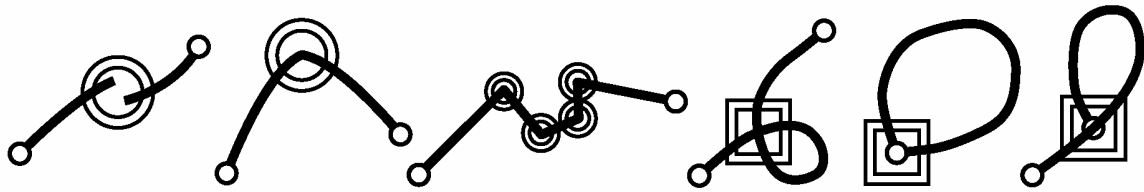


Figure 11: Examples of planar sets not being curve segments (a double circle indicates "not smooth" and a double square "not injective").

A line string is a finite sequence of curve segments. Except for the first curve segment, the start point of every curve segment corresponds to the end point of the predecessor curve segment. These points are called *control points* of the line string. Practically a line string can have multiply used curve segments, curve segments with common base points, intersecting curve segments and curve segments starting or ending in the interior of other curve segments (cf. figures 12 and 13). A *simple line string* contains no self-intersection points (cf. figure 14). In addition, for a *closed simple line* the start point of the first curve segment and the end point of the last curve segment are identical.

Exact definition (remarks on notation see first box): *Line strings* means a subset of the space, which is the "image" of a "continuous" and "partially smooth" (but not necessarily "injective") "mapping" of an "interval" (the so-called *characteristic mapping*) and which contains only a finite number of "non smooth points". A "non smooth point" is called *vertex*. With a *closed line string* start and end point are identical. A line string, whose characteristic mapping is also "injective", except for its start and end point that are identical, is called a *simple line string*.

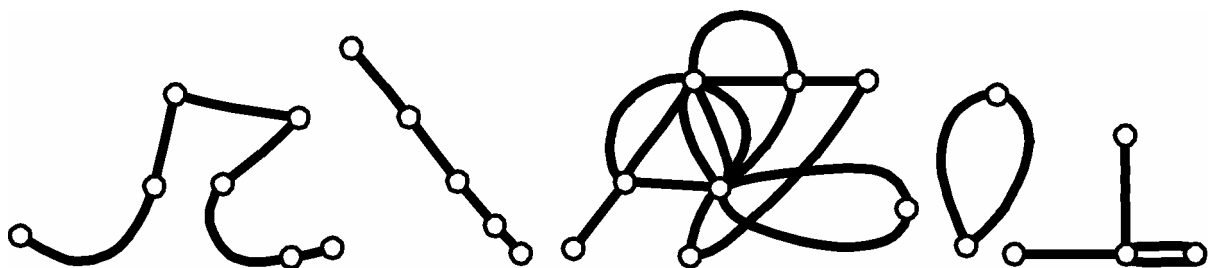


Figure 12: Examples of planar line strings.

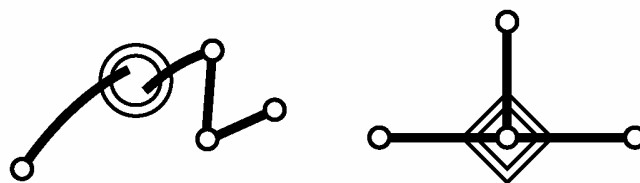


Figure 13: Examples of planar sets that are not line strings (the double circle means "not continuous" and the double rhombus "not image of an interval").

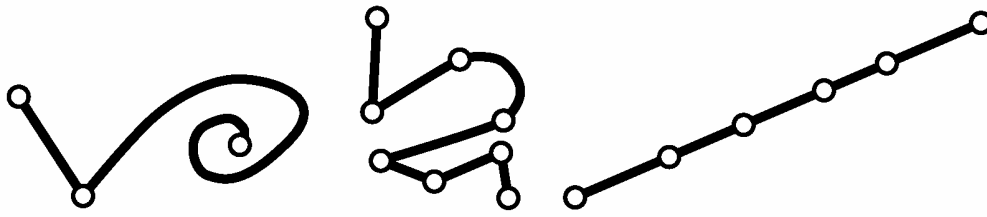


Figure 14: Examples of (planar) simple line strings.

2.8.11.2 Line Strings with Straight Line Segments and Circle Arcs as Predefined Curve Segments

Line strings exist as directed (DIRECTED POLYLINE) or undirected (POLYLINES) line strings, and may as well be used within the scope of surfaces and tiles (cf. chapter 2.8.12 Surfaces and Tiles).

The definition of a concrete value domain of a line string always requires the specification of the admissible forms of curve segments by means of enumeration, e.g. straight line segments (keyword STRAIGHTS), circle arcs (keyword ARCS) or other possibilities (cf. chapter 2.8.11.3 Other Forms of Curve Segments) and furthermore the indication of the domain of the vertices. Within an abstract value domain of a line string these specifications may be omitted. The following rules apply for domain extensions:

- A line can only be reduced but not completed by new types.
- The coordinate domain indicated within the scope of a line string value domain must be a restriction of the coordinate domain of the original line string value domain, provided the latter has been defined.

Curve segments are always considered an extension of the basic structure LineSegment. The coordinate domain applied therein is the same as the one defined after the keyword VERTEX in the definition of the line string.

```
STRUCTURE LineSegment (ABSTRACT) =
  SegmentEndPoint: MANDATORY LineCoord;
END LineSegment;

STRUCTURE StartSegment (FINAL) EXTENDS LineSegment =
END StartSegment;

STRUCTURE StraightSegment (FINAL) EXTENDS LineSegment =
END StraightSegment;

STRUCTURE ArcSegment (FINAL) EXTENDS LineSegment =
  ArcPoint: MANDATORY LineCoord;
  Radius: NUMERIC [LENGTH];
END ArcSegment;
```

The first curve segment of a line string is always a start segment. The start segment only consists of the start point itself, which at the same time is the end point of the start segment. The straight-line segment has an end point and thereby determines a straight from the end point of the predecessor curve segment to its end point. Both start segment and straight line segment do not require any further specifications. Thus the corresponding extensions of the LineSegment are void. Two successive vertices (SegmentEndPoints) may not coincide in the projection.

A circle arc segment describes a curve segment that appears as a true circle arc segment in the projection. In addition to the end point an intermediate point describes the circle arc segment. It is only of significance in connection with the geometry. With 3-dimensional coordinates we use linear interpolation for the height on the circle arc segment. You may imagine this curve as the thread of a cylindrical screw in perpendicular position on the projection plane. The intermediate point is not a vertex of the line string. It should be positioned as exactly as possible in the middle between start and end point. Since the

intermediate point is indicated with the same precision as the vertices, the calculated and the effective radius may differ widely. Whenever the effective radius is indicated it is relevant for the definition of the arc circle. Then the intermediate point will only determine which of the four possible circle arcs is the one desired. However even in this case the intermediate point may only differ by 2 units from the trace of the circle arc calculated from the radius.

It can be required that a string line must be a simple string line, i.e. practically that it neither intersects itself and above all that multiple use of the same curve segment is impossible (keyword WITHOUT OVERLAPS). If a circle arc and a straight line (resp. a second circle arc) as successive curve segments of a line string not only have a common vertex but also a common inner point (definition see above), then this is also permitted in the case of a simple string line, provided that the circle segment detached from the straight (resp. the double circle segment detached from the other circle arc) have a height of arrow smaller or equal the decimal specified after WITHOUT OVERLAPS> (cf. figure 15 a). There are two reasons for this regulation: On one hand for numeric reasons and because in certain cases small overlaps in arcs cannot be avoided (tangential arcs). On the other hand, when transferring data that originally has been registered in graphics even more important overlaps (e.g. of several centimeters) have to be tolerated, unless one would be prepared to face an enormous workload to repair these overlaps. Tolerances have to be listed in the same units as vertex coordinates. For numeric reasons they may not be inferior to 2 units of the last significant decimal. They cannot be overridden and are mandatory in the case of both surfaces and tiles.

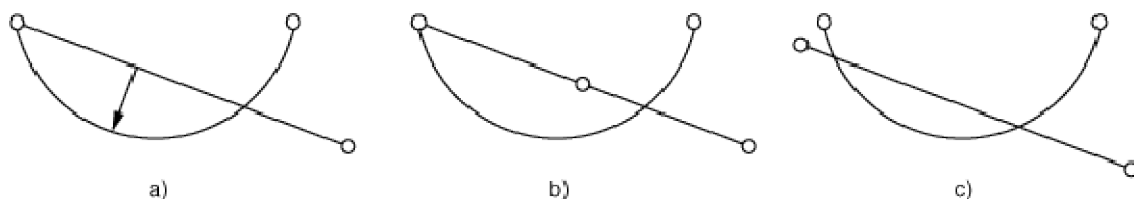


Figure 15: a) Height parameter (of arrow) may not exceed the given tolerance; b) inadmissible overlap of polylines since another vertex is situated between vertex and intersection; c) inadmissible overlap of polylines since there exists no common vertex.

Within the scope of value domain definitions and attribute extensions, undirected string lines can be expanded into directed string lines (cf. chapter 2.8.12.4 Expansibility).

When line strings are directed, their direction always has to be conserved (even when transferring data).

For vertices the value domain of the coordinates is defined. By means of the existence constraint REQUIRED IN (cf. chapter 2.12 Consistency Constraints and chapter 2.13 Expressions) it is further possible to demand that coordinates may not be arbitrary but have to correspond to the points of certain classes. Those points that have a special significance are called vertex of a line (with straights and arcs that means start, end and intermediate points). Primarily it is the coordinate domain that is defined. By means of applying the constraints BASE (cf. chapter 2.10 Constraints and chapter 2.11 Logical Expressions) it is furthermore conceivable to demand that coordinates cannot be arbitrary, but have to correspond to those of points of certain classes.

If the coordinate type of the vertices is abstract, then the line string has to be declared abstract as well.

Syntax rule:

```
LineType = ([ 'DIRECTED' ] 'POLYLINE' | 'SURFACE' | 'AREA' )
           [ LineForm ] [ ControlPoints ] [ IntersectionDef ]
           [ LineAttrDef ].
```

```

LineForm = 'WITH' '(' LineFormType {',' LineFormType} ')'.

LineFormType = ( 'STRAIGHTS' | 'ARCS'
                 | [ Model-Name '.' ] LineFormType-Name ).

ControlPoints = 'VERTEX' CoordType-DomainRef.

IntersectionDef = 'WITHOUT' 'OVERLAPS' '>' Dec.

```

In order to be able to assign different attributes to different segments of the boundary where surfaces are concerned (cf. chapter Surfaces and Tiles), it is possible to define further attributes for the actual line string objects (so-called line attributes, rule LinAttrDef only with SURFACE and AREA). The structure employed for the definition may only feature local attributes and function calls. When a surface or area division attribute for which a line attribute has been defined by means of structure, is expanded, then the extended attribute must either not feature a line attribute or its structure must be abstract extension of the basic structure. With function calls the result type must be a local attribute.

Syntax rule:

```
LineAttrDef = 'LINE' 'ATTRIBUTES' Structure-Name.
```

2.8.11.3 Other Forms of Curve Segments

Besides straight line segments and circle arcs it is possible to define other forms of curve segments. Besides their names it also has to be specified according to which structure a curve segment is described. These definitions of such curve segments are only admissible within the scope of a contract, since we may not assume that a system supports any form of curves.

Syntax rule:

```

LineFormTypeDef = 'LINE' 'FORM'
                  { LineFormType-Name ':' Line Structure-Name ';' }.

```

A line structure must always be an extension of the LineSegment as defined by INTERLIS (cf. chapter 2.8.11.2 Line Strings with Straight Line Segments and Circle Arcs as Predefined Curve Segments).

2.8.12 Surfaces and Tiles

2.8.12.1 Geometry of Surfaces

In most cases planar surfaces are sufficient for the modeling of geo-data. In addition INTERLIS also supports planar general surfaces. Practically a planar general surface is limited by one exterior and possibly by one or several interior boundaries (figure 20). The boundary lines themselves must consist of simple line strings that from a geometrical point of view can be combined into closed simple line strings. Furthermore they must be positioned in such a manner that from any point in the interior of the surface to any other point in the interior of the surface there exists a way that neither intersects a boundary line nor contains vertices of a boundary line (see figure 19). As long as this restriction is not violated, boundaries may meet in vertices. In such situations there are several conceivable possibilities that would allow dividing the boundary of the surface as a whole into individual line strings (see figure 22). INTERLIS does not insist on one specific possibility. If such a surface is transferred several times, a different possibility may occur in each different transfer.

Exact definitions (remarks on notation see first box):

Surface element means a subset of the *space*, which is the "*image*" of a "*smooth*" and "*injective*" "*mapping*" of a planar regular polygon (see figures 16 and 17).

Surface means the union F of a finite number of surface elements, which are "connected" and fulfill the following condition: For every point P of the surface there exists a "neighborhood", which is a *deformation* (i.e. a "homeomorphic mapping") of a planar regular polygon. If the point P is a deformation of a boundary point of the polygon, it is called *boundary point* of F , otherwise *inner point* of F . It holds: the "boundary" (i.e. the set of all boundary points) of a surface is the union of a finite number of curve segments, which meet only in boundary points (start or end points). A *planar surface* is a surface being a subset of a *plane*. It holds: The "boundary" of a planar surface consists of one outer *closed simple line string* (called the *outer boundary*) and of a finite number of (possibly of no) inner *closed simple strings* (the so-called *inner boundaries*). The outer and all the inner boundaries have no common points. A surface part cut out by an inner boundary is called an *enclave* (see figure 18, 19 and 20).

A *general surface* is a surface with an additional finite number of *singular points* but with "connected" interior (set of inner points). A point is called *singular point* if there exists a deformation of the point together with a "neighborhood" into a planar *propeller set*, the point itself into the *center*. *Propeller set* means the union of a finite number of triangle surfaces meeting at exactly one point called *center*. *Planar general surface* means a general surface being subset of a *plane* (see figure 21). It holds: There are different possibilities to compose the boundary of a planar general surface by a finite number of closed planar line strings which have a maximum of a finite number of common points and each a maximum finite number of double points (see figure 22).

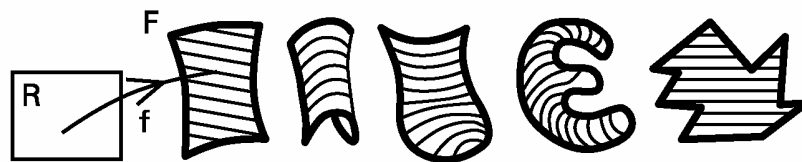


Figure 16: Examples of surface elements.

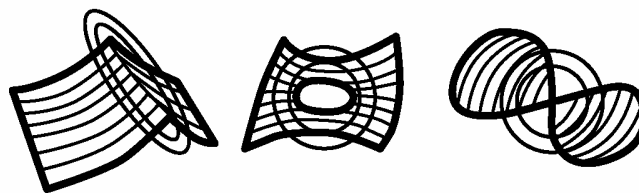


Figure 17: Examples of point sets in space, which are not surface elements (here a double circle means "not smooth").

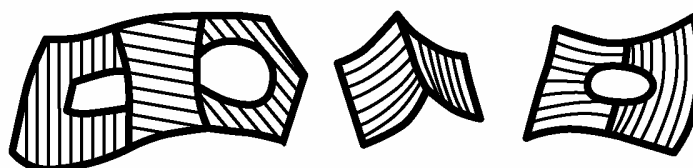


Figure 18: Examples of surfaces in the space.

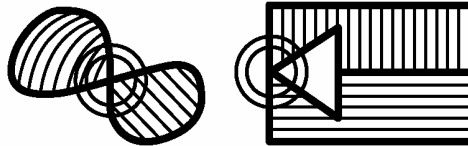


Figure 19: Examples of planar point sets that are not surfaces (a double circle marks a "singular point").

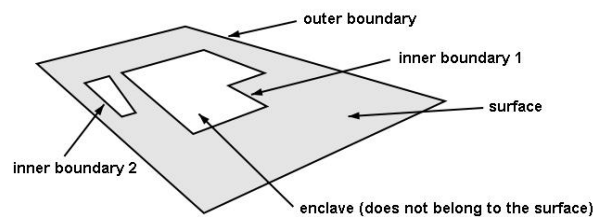


Figure 20: Planar surface with boundaries and enclaves.

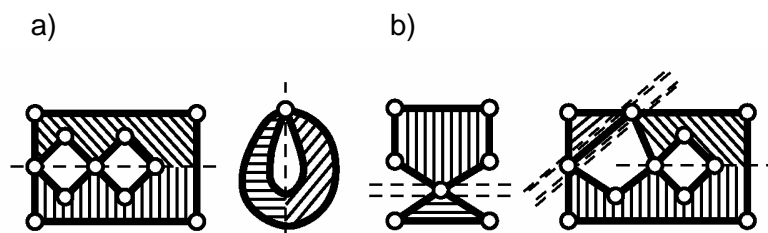


Figure 21: a) Examples of planar general surfaces; b) Examples of planar sets that are not general surfaces, because their interior is not connected. But these planar sets can be subdivided into general surfaces ("---" shows the subdivision into surface elements and "===" the subdivision into general surfaces).

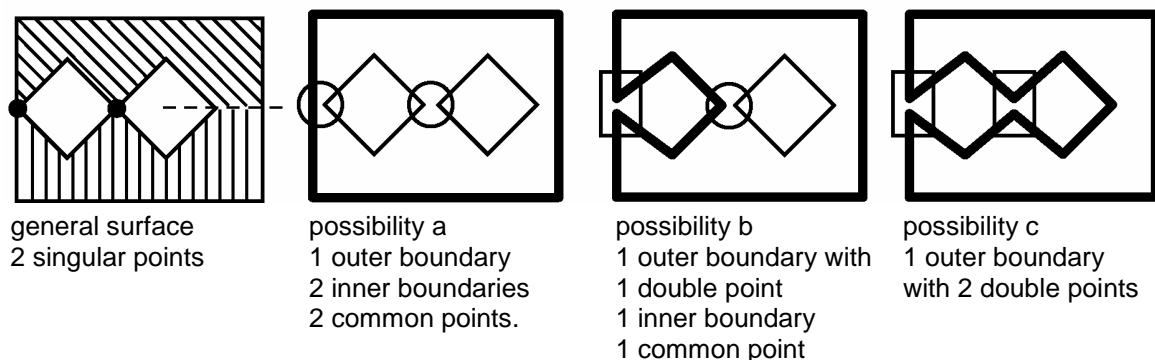


Figure 22: Different possible subdivisions of the boundary of a general surface.

Along with the definition of (general) surfaces, resp. (general) surfaces of an area division we determine beyond which tolerance curve segments of the boundary may not overlap (for all concrete definitions of surfaces and area divisions, WITHOUT OVERLAPS must either be directly specified or inherited). With

surfaces prohibition of overlaps, resp. intersection does only apply to curve segments of one individual line string but to all curve segments of all line strings of the surface boundary. In the case of surfaces of an area division it even applies to all line strings connected with the area division. Furthermore and in accordance with the definition of the (general) surface, line strings that are not part of the boundary of a (general) surface are excluded.

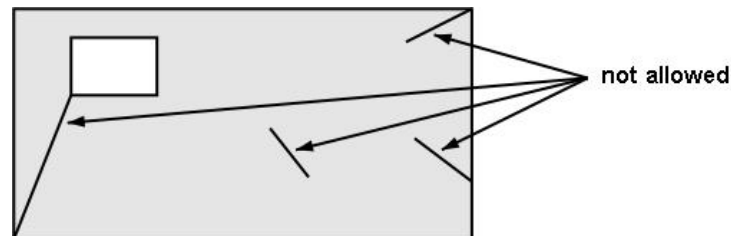


Figure 23: Disallowed boundary configurations for tessellations.

2.8.12.2 Surfaces

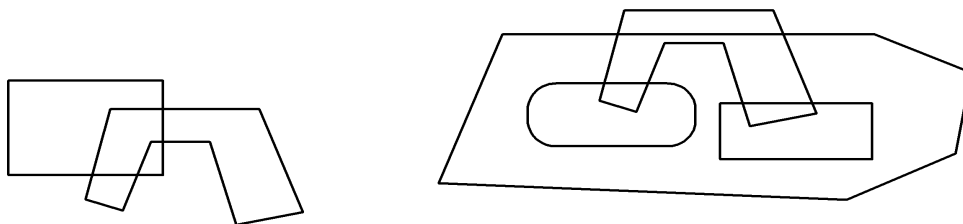


Figure 24: Individual surfaces (SURFACE).

For surfaces that partially or entirely overlap, i.e. which do not only have boundary points in common, the geometrical attribute type SURFACE is available (see figure 24). This type is called surface. A surface consists of one outer and possibly several inner boundaries (around enclaves). Each boundary consists of at least one line string. Besides its geometry each line string features the defined attributes (cf. rule LineAttrDef).

2.8.12.3 Surfaces of an Area Division

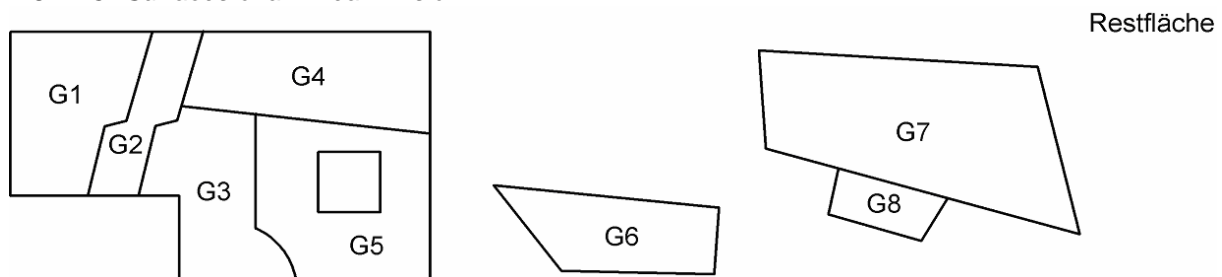


Figure 25: Area division (AREA).

Area division (area tessellation) signifies a finite set of (general) surfaces and environments that cover a layer without overlaps.

For area divisions the geometrical attribute type AREA is at your disposal.

A maximum of one surface of the area division (or exactly one with the additional keyword MANDATORY), but never its environment, is assigned to the area object. It is not admissible that each of two surfaces of the area division with a common boundary does not correspond to an area object.

Thus each individual area object corresponds to a surface. As a result the same implicit structure applies to surfaces and to area objects. However additional consistency constraints apply:

- String lines of an area division must always be true boundaries. Hence there are no line strings with the same surface on either side (figure 23). This is also ruled out by the definition of a surface.
- If there are defined area objects on either side of a line string, then each curve segment (join between two vertices) of one area object must in terms of geometry and attributes correspond exactly to the curve segment of the other area object.

Area divisions may not occur within substructures.

In order to be able to refer to line strings of an area division as individual objects (and namely as object even if the line string is the boundary of two area objects), then AREA INSPECTION is at your disposal (cf. chapter 2.15 Views).

2.8.12.4 Extensibility

Surfaces may be extended into areas. The extension of a string line into an area is inadmissible, since with a surface several string lines have to be expected, whereas the definition of the line string only implies one line string.

Independent surfaces and surfaces of an area division can be extended in two respects:

- When it is 'SURFACE' that is primarily defined and hence overlaps are allowed, this can be replaced by 'AREA' in extensions, since this will not violate the basic definition.
- Further line attributes can be attached.

2.9 Units

Units are always described as a term and (in [] brackets) a contraction. Both term and contraction must be names. Where the contraction is omitted it is the same as the term itself. Depending on the type of unit further specifications may follow. In actual use of a unit it is always the contraction that occurs. Hence the term itself is only of documentary character.

2.9.1 Base Units

Base units are meters, seconds etc. They need not be specified any further. However base units can also be defined as abstract (keyword ABSTRACT), if the unit itself is yet unknown, but the matter described is clear (e.g. temperature, money). No contraction is assigned to abstract units. Concrete units cannot be extended.

Examples:

```
UNIT
  Length (ABSTRACT);
  Time (ABSTRACT);
  Money (ABSTRACT);
  Temperature (ABSTRACT);
  Meter [m] EXTENDS Length;
  Second [s] EXTENDS Time;
  SwissFranc [CHF] EXTENDS Money;
  Celsius [C] EXTENDS Temperature;
```

INTERLIS itself defines the abstract unit ANYUNIT. All other units inherit this directly or indirectly (cf. chapter 2.9 Coordinate Systems and Coordinate Reference Systems). The following units have been defined directly (internally) by INTERLIS:

```
UNIT
  ANYUNIT          (ABSTRACT);
  DIMENSIONLESS    (ABSTRACT);
  LENGTH           (ABSTRACT);
  MASS             (ABSTRACT);
  TIME             (ABSTRACT);
  ELECTRIC_CURRENT (ABSTRACT);
  TEMPERATURE      (ABSTRACT);
  AMOUNT_OF_MATTER (ABSTRACT);
  ANGLE            (ABSTRACT);
  SOLID_ANGLE      (ABSTRACT);
  LUMINOUS_INTENSITY (ABSTRACT);
  MONEY            (ABSTRACT);

  METER [m]        EXTENDS LENGTH;
  KILOGRAM [kg]     EXTENDS QUANTITY;
  SECOND [s]        EXTENDS TIME;
  AMPERE [A]        EXTENDS ELECTRIC_CURRENT;
  DEGREE_KELVIN [K] EXTENDS TEMPERATURE;
  MOLE [mol]        EXTENDS AMOUNT_OF_MATTER;
  RADIAN [rad]      EXTENDS ANGLE;
  STERADIAN [sr]    EXTENDS SOLID_ANGLE;
  CANDELA [cd]      EXTENDS LUMINOUS_INTENSITY;
```

Remark: In Appendix G Unit Definitions the most common units have been assembled in an extended type model.

2.9.2 Derived Units

Multiplying or dividing derived units with constants or functions can convert them converted into different units. Example:

```
UNIT
  Kilometer [km] = 1000 [m];
  Centimeter [cm] = 1 / 100 [m];
  Inch [in] = 0.0254 [m];          !! 1 inch equals 2.54 cm
  Fahrenheit [oF] = FUNCTION // (oF + 459.67) / 1.8 // [K];
```

Data in kilometers have to be multiplied by one thousand to become the equivalent in meters. Data in inches have to be multiplied by 2.54 to become the equivalent in centimeters. Add 456.67 to data in degrees Fahrenheit and then divide the result by 1.8 in order to calculate the same temperature in degrees Kelvin.

A derived unit automatically is considered an extension of the same abstract unit it can be converted into.

2.9.3 Combined Units

Combined units (e.g. km per hour) are the result of a multiplication or division of other units (basic units, derived or combined units). Combined units can also be defined as abstract units. They then must refer entirely to other abstract units.

The units used in the concrete extension must therefore be a concrete extension of the units appearing in the abstract definition. Example:

```
UNIT
  Velocity (ABSTRACT) = ( Length / Time );
  Kilometer per hour [kmph] EXTENDS Velocity = ( km / h );
```

2.9.4 Structured Units

Structured units are composed of several other concrete units that directly or indirectly (derived unit) build up on a common base unit (e.g. time). With low-value parts of a structured unit it is compulsory to indicate in what domain the indication has been made. Both the respective minimum and maximum must always be positive numbers. Decimals can be indicated with the last part, but not with others. No indications of scaling are permissible.

There are structured units that are not constants, for example not every month has 31 days. Other units (such as the clock time) have been defined over the whole continuum, signaled by the keyword CONTINUOUS. Example:

```
UNIT
  Time (ABSTRACT);
  Second [s] EXTENDS Time;
  Minute = 60 [s];
  Hour = 60 [Minute];
  Day EXTENDS Time;
  Month EXTENDS Time;
  Year EXTENDS Time;
  Clock Time = {Hour:Minute[0..59]:s[0..59]} CONTINUOUS;
  Date = {Year:Month[1..12]:Day[1..31]};
```

Syntax rules:

```
UnitDef = 'UNIT'
        { Unit-Name
          [ '(' 'ABSTRACT' ')' | '[' UnitShort-Name ']' ]
          [ 'EXTENDS' Abstract-UnitRef ]
          [ '=' ( DerivedUnit | ComposedUnit | StructuredUnit ) ]
          ';' }.

DerivedUnit = [ DecConst { ( '*' | '/' ) DecConst }
              | 'FUNCTION' Explanation ] '[' UnitRef ']'.

ComposedUnit = '(' UnitRef { ( '*' | '/' ) UnitRef } ')'.

StructuredUnit = '{' UnitRef
                { ':' UnitRef '[' Min-Dec '..' Max-Dec ']' }
                '}'
                [ 'CONTINUOUS' ].

UnitRef = [ Model-Name '.' [ Topic-Name '.' ] ] UnitShort-Name.
```

Remark: In Appendix H Time Definitions a standard extension suggestion can be found which features an application example for Swiss time indications.

2.10 Dealing with Meta Objects

2.10.1 General Remarks

In the sense of INTERLIS 2 meta objects are objects that are of significance within the scope of descriptions of application models. This is of use in reference systems and graphic symbolologies. In application models reference systems and graphic symbolologies are referred to by their names.

The construction of reference system objects or symbology objects must be defined with the usual means of classes and structures in either a REFSYSTEM MODEL or SYMBOLOGY MODEL. Reference system classes, axis classes, resp. symbology classes must be extensions of the classes CCORDSYSTEM, REFSYSTEM, AXIS, resp. SIGN supplied by INTERLIS. These again are extensions of the class

METAOBJECT. This class possesses an attribute name that must be unequivocal within the scope of all meta objects of one basket.

As all other objects, meta objects are parts of a basket. A basket– and thus its meta objects – is made available in an application model by introducing a basket-name and indicating the topic in question (rule `MeatData UseDef`). Objects in meta data-baskets have names and correspond with schema elements such as attributes or classes. A basket corresponds with a topic and hence has a name domain. Consequently extension (specialization) of a basket means exclusively extension (specialization) of its namespace. The basket- name can be defined as extension of an already introduced name (`EXTENDS`). The corresponding topic must be same as with the base name or one of its extensions.

If a meta object is referred to (rule `MetaObjectRef`) under the extended basket-name, it is first searched for in the corresponding basket. If no such meta object is found the search continues in accordance with the basket-names that have been directly or indirectly inherited. Thus meta objects can be prepared and refined on several levels. For example to begin with common graphic symbologies can be defined, which later on are refined and supplemented at regional level. How to refer to the concrete basket depending on the basket-name is up to the tool employed.

In a translated application model (cf. chapter 2.5.1 Models) a basket-name can be assigned to a concrete basket that only contains translations (`METAOBJECTS_TRANSLATION` objects, cf. appendix A), thereby translating those meta objects that have been introduced by the corresponding basket in the model taken as a basis. If this model itself is a translation it is also possible to assign to this basket name a concrete basket that only contains translations. If the model is not a translation, then the basket name can be assigned a concrete basket that contains no translations (i.e. no `METAOBJECT_TRANSLATION` objects).

Syntax rules:

```

MetaDataUseDef = ( 'SIGN' | 'REFSYSTEM' ) 'BASKET' Basket-Name
                  Properties<FINAL>
                  [ 'EXTENDS' MetaDataUseRef ]
                  '~' Model-Name '.' Topic-Name ';'

MetaDataUseRef = [ Model-Name '.' [ Topic-Name '.' ] ] Basket-Name.

MetaObjectRef = [ MetaDataUseRef '.' ] Metaobject-Name.

```

If in the current context only one meta data basket name is necessary, this reference (`MetaDataUseRef`) must not be indicated in the meta object reference.

2.10.2 Parameters

By means of parameters those properties can be designated in the meta model that do not concern the meta object itself but its use within the application. Their definition is introduced by the keyword `PARAMETER` and it is constructed in a manner similar to the definition of attributes.

2.10.2.1 Parameters for Reference and Coordinate Systems

For reference and coordinate systems, resp. their axis only the predefined parameter `Unit` is admissible.

If you refer to a reference or coordinate system (rule `RefSys`) within the definition of a numeric data type (cf. chapter 2.8.5 Numeric Data Type) or a coordinate type (cf. chapter 2.8.7 Coordinates), then a unit must be indicated which is compatible with the unit of the corresponding axis of the coordinate system, resp. the sole axis of the reference system (cf. chapter 2.10.3 Reference Systems).

2.10.2.2 Parameters of Symbologies

Definitions of parameters of symbologies are arbitrary. These parameters correspond to the specifications (e.g. point symbol identification, position, rotation) that have to be supplied to a graphic system in order to

enable graphic representation. To start with the symbology has to be selected. This is done by defining a parameter for the reference to the symbology class within which the parameter is defined (METAOBJECT). Such a parameter of a symbology may also be a reference to another metaobject (METAOBJECT OF). In both cases a metaobject-reference will be indicated within the application (cf. chapter 2.16 Graphic Descriptions), i.e. both basket reference-name and metaobject-name will be indicated. Thus the respective tool can determine the real basket-identification and metaobject-identification.

Besides these special cases of parameters, parameters can be defined in the same way as attributes.

Syntax rule:

```
ParameterDef = Parameter-Name Properties<ABSTRACT,EXTENDED,FINAL>
               ':' ( AttrTypeDef
                   | 'METAOBJECT' [ 'OF' MetaObject-ClassRef ] ) ';'.
```

2.10.3 Reference Systems

Without further specifications numeric values and coordinates indicate differences, they do not have a defined absolute reference. To achieve this, a coordinate system, resp. a scalar system must be defined. The model definition will be executed in a REFSYSTEM MODEL. In INTERLIS the following classes are at your disposal:

```
CLASS METAOBJECT (ABSTRACT) =
  Name: MANDATORY NAME;
  UNIQUE Name;
END METAOBJECT;

STRUCTURE AXIS =
  PARAMETER
  Unit: NUMERIC [ ANYUNIT ];
END AXIS;

CLASS REFSYSTEM (ABSTRACT) EXTENDS METAOBJECT =
  END REFSYSTEM;

CLASS COORDSYSTEM (ABSTRACT) EXTENDS REFSYSTEM =
  ATTRIBUTE
  Axis: LIST {1..*} OF AXIS;
END COORDSYSTEM;

CLASS SCALSYSTEM (ABSTRACT) EXTENDS REFSYSTEM =
  PARAMETER
  Unit: NUMERIC [ ANYUNIT ];
END SCALSYSTEM;
```

In extensions it is possible to add other typical attributes for this kind of scalar and coordinate systems and even the unit can be replaced by extensions (syntax for parameter definitions cf. chapter 2.10.2 Parameters and chapter 2.5.3 Classes and structures. However this unit will have to be compatible with a unit defined in the value domain (cf. chapter 2.9 Units).

2.11 Run Time Parameters

Besides the actual data and meta-data, individual data elements can be defined that ought to be supplied by a system for processing, evaluating or graphic representation. They are called run time parameters.

Syntax rule:

```
RunTimeParameterDef = 'PARAMETER'
                      { RunTimeParameter-Name ':' AttrTypeDef ';' }.
```


Area divisions (keyword AREA) are not admissible for run time parameters. Since run time parameters define conditions for systems that go beyond the language INTERLIS 2, they can only be defined within those systems that contracts have been signed for.

Typical run time parameters are for example scale of representation or current date.

2.12 Constraints

Constraints serve to define restrictions the objects have to comply with.

Constraints referring to one single object are described by a logical expression relating to the attributes of the objects (cf. next chapter). Therein it is possible to define constraints that are obligatory and apply peremptorily to all objects (keyword MANDATORY), and others which only apply as a general rule. In the latter case it is indicated which percentage of the instances of a class must normally comply with the constraint (rule PlausabilityConstraint).

By stating an existence-constraint (Rule ExistenceConstraint) we require that the value of an attribute of each object of the constraint-class exists in a certain attribute of an instance of another class. This is only possible if the constraint attribute is compatible with the other attribute and has the following effects:

- If the domain of the constraint attribute equals the domain of the other attribute or one of its extensions, the constraint value must exist in the required attribute of another instance.
- If the domain of an attribute is a structure, all attributes contained therein are compared.
- If the domain of the other attribute is a coordinate or the domain of the constraint attribute a polyline, surface or area division with the same or extended coordinate domain, then all coordinates of the vertices of the polyline, surface or area division must occur within the required attribute of another instance.

Uniqueness constraints are introduced with the keyword UNIQUE (rule UniquenessConstraint).

It is possible to demand that within a class or association (thereafter named current class) a certain combination of attributes, resp. of roles be globally unequivocal. Conceivable are all attributes, resp. roles that can be attained by an object-path, i.e. which can be unequivocally assigned to the current object.

Conceptually signifies "globally" that all existing objects in any basket must fulfill these requirements.

It is possible to demand that within a structure, class or association, a certain combination of attributes of sub-structures defined by BAG of or LIST OF or one of the geometrical domains POLYLINE, SURFACE or AREA be locally (LOCAL) unequivocal, i.e. within the scope of all structural elements assigned to the current object or structural element.

Example:

```
CLASS A =  
  K: (A, B, C);  
  ID: TEXT*10;  
  UNIQUE K, ID;  
END A;
```

A constraint is considered fulfilled, if an attribute whose domain is undefined is connected with a uniqueness constraint.

More extensive constraints must be defined within views (e.g. a view which connects a certain class with itself and thus allow to compare any attribute combination with all other objects of the class). It is peremptory that such views be defined within the data model.

Constraints that extend to a multitude of objects (above all uniqueness constraints) are not always entirely controllable, since this control can only be executed with locally available baskets. Nevertheless

conceptually they apply globally (except with meta-models), see also appendix F Uniqueness of user keys.

Syntax rule:

```

ConstraintDef = ( MandatoryConstraint
                  | PlausibilityConstraint
                  | ExistenceConstraint
                  | UniquenessConstraint ).

MandatoryConstraint = 'MANDATORY' 'CONSTRAINT'
                     Logical-Expression ';'.

PlausibilityConstraint = 'CONSTRAINT'
                        ( '<=' | '>=' ) Percentage-Dec '%'
                        Logical-Expression ';'.

ExistenceConstraint = 'EXISTENCE' 'CONSTRAINT'
                     AttributePath 'REQUIRED' 'IN'
                     ViewableRef ':' AttributePath
                     { 'OR' ViewableRef ':' AttributePath } ';'.

UniquenessConstraint = 'UNIQUE' ( GlobalUniqueness
                                  | LocalUniqueness ) ';'.

GlobalUniqueness = UniqueEl.

UniqueEl = ObjectOrAttributePath { ',' ObjectOrAttributePath }.

LocalUniqueness = '(' 'LOCAL' ')'
                 StructureAttribute-Name
                 { '->' StructureAttribute-Name } ':'
                 Attribute-Name { ',' Attribute-Name }.

```

It is possible to only subsequently define consistency constraints for a certain class or association (typically following the definition of an association).

Syntax rule:

```

ConstraintsDef = 'CONSTRAINTS' 'OF' ClassOrAssociationRef '='
                { ConstraintDef }
                'END' ';'.

```

2.13 Expressions

Generally expressions are used for example in constraints and selections amongst others as arguments of functions and logical expressions (the result type must be Boolean). They refer to a context object (i.e. an object that constraints are formulated for). Proceeding from this object it is possible to refer to an attribute, a structure element, a function etc. Such items as well as comparison values such as constants and run time parameters are interlaced as factors in predicates. A predicate is a statement that can either be correct or false. By means of Boolean operators predicates can be made into a logical expression.

Syntax rules:

```

Expression = Term.

Term = Term1 { 'OR' Term1 }.

Term1 = Term2 { 'AND' Term2 }.

```

```

Term2 = Predicate [ Relation Predicate ].

Predicate = ( Factor
              | [ 'NOT' ] '(' Logical-Expression ')'
              | 'DEFINED' '(' Factor ')' ).

Relation = ( '==' | '!=' | '<>' | '<=' | '>=' | '<' | '>' ).

```

Remarks concerning the significance of these syntax rules:

- In accordance with the syntax rules for terms the most forcible obligation is the comparison (relation), followed by AND and last OR.
- NOT followed by the logical expression in brackets demands the negation of this expression.
- Comparison of factors. Depending on the type of factor, certain comparisons are inadmissible:
 - With string types equal to (==) and not equal to (!=, <>) have the usual meaning. Greater than (>) signifies that the first factor begins according to the second indication, and then (possibly [>=]) shows further symbols. In the same way less than (<) signifies that the second element begins according to the first element, and then (possibly [<=]) shows further symbols.
 - With numeric data type and structured domains comparisons are defined as usual. More and less comparisons are not practical with circular data type.
 - Coordinates as a whole can only be examined with respect to their equality or inequality. All other comparisons are only available for their separate components (see syntax rule Factor).
 - With enumerations more and less comparisons are only admissible if the enumeration has been defined as ordered. Two enumeration values are considered equal even if one is an extension of the other. Thus according to the example in chapter 2.7.2 Enumerations, "working days" and "working days.Tuesday" are the same.
 - Lines can only be tested as to whether they are undefined (== UNDEFINED).
 - A factor can also designate an object. Then it is possible to examine in terms of Definition, Equality and Inequality.
- If a factor not only consists of the item itself but also of the path leading to it, the item is always considered undefined provided any attribute of the path is undefined. Thus the built-in function DEFINED (a.b) is equal to (a.b != UNDEFINED).
- It is up to each system to set the order in which predicates (but not the association rule!) linked with AND resp. OR are to be evaluated.

Factors can be formed according to the following syntax rules:

```

Factor = ( ObjectOrAttributePath
           | FunctionCall
           | 'PARAMETER' [ Model-Name '.' ] RunTimeParameter-Name
           | Constant ).

ObjectOrAttributePath = PathEl { '->' PathEl }.

AttributePath = ObjectOrAttributePath.

PathEl = ( 'THIS'
           | 'THISAREA' | 'THATAREA'
           | 'PARENT'
           | ReferenceAttribute-Name
           | AssociationPath
           | Role-Name
           | Base-Name
           | AttributeRef ).

```

```
AssociationPath = [ '\ ' ] AssociationAccess-Name.
```

```
AttributeRef = ( Attribute-Name ( [ '[' ( 'FIRST'
                                     | 'LAST'
                                     | AxisListIndex-PosNumber ) ']' ] )
                | 'AGGREGATES' ).
```

```
FunctionCall = [ Model-Name '.' ] Function-Name
                '(' Argument { ',' Argument } ') '.
```

```
Argument = ( Expression | ViewableRef ).
```

Factors can refer to objects and their attributes. Step by step it is possible to set up entire object-paths within this procedure. Each construction opens the path from the at the time current object to the next. The first current object results from the context, e.g. an object of the class that a constraint is being defined for.

- THIS: Designates the so-called context-object, i.e. the current object of a class, a view or a graphic definition, which requires an object-path. THIS e.g. is to be indicated when calling a function that features ANYCLASS or ANYSTRUCTURE as parameter.
- THISAREA and THATAREA: Designate those area objects that are bordered by the current line-object. These are of the type Surface. The application of THISAREA and THATAREA is only possible within the scope of the inspection of an area division (cf. chapter 2.15 Views).
- PARENT: Designates super structure-element or super-object of the current structure element or object. The view must be an ordinary inspection (no area inspection) (cf. chapter 2.15 Views).
- Indication of reference attributes: designates the object that is assigned to the current object that is assigned from the current object, resp. the current structure via the indicated reference attribute.
- Relation path: Designates the associated (data)-object or the associated object of the association class. It holds:
 - In order to attain a (data)-object linked through the relationship, we indicate the corresponding relationship access (cf. chapter 2.7.5 Relationship Accesses). This is only admissible if the assignation is unequivocal, i.e. if based upon cardinality there is a maximum of one assigned object. In relationships between two classes we indicate admissibility, if the role of the required relationship access has maximum cardinality one, in multiple relationships if the roles to all reference classes have maximum cardinality one.
 - In order to attain the relation-object itself (i.e. the object of the association class), a back-slash ('\') precedes the relation access. This is only admissible if based upon cardinality there is only a maximum of one assigned relation object.
- Indication of role: Designates the object that is assigned from the current object of the association class via a role. This path is only admissible if the maximum cardinality of the role does not exceed 1.
- Indication of basic view: By means of the (local) name of the basic view we designate the corresponding (virtual) object of the basic view in the current view, resp. in the current derived relation.

When referring to an attribute we mean the value of the attribute of either the context-object or the object designated by the path. In addition all paths that end with an attribute are named attribute paths and can be used in different syntax rules independently of factors.

- Under ordinary circumstances it is sufficient to indicate the attribute name.
- When dealing with a coordinate attribute, we indicate the number of the axis in order to designate the corresponding component of the coordinate. The first component has index 1.

- The implicit attribute AGGREGATES is defined within aggregation views (cf. chapter 2.15. Views) and designates the set (BAG OF) of the aggregated base-objects.

In ordered sub-structures (LIST) individual elements can be approached. Admissible indices are:

- FIRST: the first element.
- LAST: the last element.
- Index number: The index indicated must be smaller than or equal the maximum number determined within the cardinality. The first element has index 1. If it is smaller than or equals the minimum number determined within the cardinality, there is always a corresponding element in existence; if it is greater the existence of such an element cannot be guaranteed. Subsequently the factor can be undefined.

Factors can also be function calls. As their arguments we can consider:

- Factors: Type of factor and argument-type must be compatible.
- The name of a required class (rule ViewableRef) or a function that supplies a class as result: The formal parameter must be of type CLASS.

As comparison values the following items come into questions: function calls, run time parameters (cf. chapter 2.16 Graphic description) and constants.

2.14 Functions

By means of its name, formal parameters as well as a short function description, a function is defined as an explanation. The names of the parameters are only of documentary value. This definition is only admissible within contracts, since otherwise an automatic evaluation of models no longer would be guaranteed.

As formal parameters or function results we may consider:

- All those types admissible for attributes, above all also structures. Corresponding factors (see rule Factor) come into question as arguments (i.e. current parameters).
- If a structure is indicated it is primarily structure elements that are in consideration as arguments. It is also possible to indicate object paths that lead to objects that are an extension of the structure. Above all with ANYSTRUCTURE it is possible to indicate any kind of object path.
- If OBJECT OF OF is indicated, then arguments can be all these objects that are attainable via object path and which correspond to the definition. Above all with OBJECT OF ANYSTRUCTURE it is possible to indicate any kind of object path. In a similar way as with references to other objects (cf. chapter 2.6.3) it is possible to define the admissible superclass and eventual restrictions and to specialize them in extensions. ANYSTRUCTURE can thus be specialized to ANYCLASS, provided that no restrictions (RESTRICTED TO) have been defined.

Syntax rules:

```
FunctionDef = 'FUNCTION' Function-Name
              '(' Argument-Name ':' ArgumentType
              {';' Argument-Name ':' ArgumentType } ')'
              ':' ArgumentType [ Explanation ] ';'.

ArgumentType = ( AttrTypeDef
                | 'OBJECT' 'OF' (RestrictedClassOrAssRef
                                | RestrictedStructureRef
                                | ViewRef ) ).
```

The following standard functions have been defined:

```
FUNCTION myClass (Object: OBJECT OF ANYSTRUCTURE): STRUCTURE;
```

Supplies the class of the object.

```
FUNCTION isSubClass (potSubClass: STRUCTURE; potSuperClass: STRUCTURE): BOOLEAN;
```

Supplies true, if the class of the first argument of the corresponds to the class or a sub-class of the second argument.

```
FUNCTION isOfClass (Object: OBJECT OF ANYSTRUCTURE; Class: STRUCTURE): BOOLEAN;
```

Supplies true if the object of the first argument belongs to the class or a sub-class of the second argument.

```
FUNCTION elementCount (bag: BAG OF ANYSTRUCTURE): NUMERIC;
```

Supplies the number of elements contained within the bag (or the list).

```
FUNCTION convertUnit (from: NUMERIC): NUMERIC;
```

Converts the numeric value of the parameter "from" into the numeric return value and takes into consideration the units that are linked with the parameter and with the application of the result value (typically with the attribute the result is assigned to). This function can only be employed if the arguments of "from" are compatible with these of the return parameter, i.e. if their units have been derived from a common unit.

2.15 Views

Views are classes and structures whose objects are not original, but virtual, since they have been derived from objects of other views or classes, resp. structures. Amongst others, views are used to formulate the basics for graphics and special constraints. A further application consists of transmitting data in its derived, mostly simplified form to receiving systems.

Views are only transferred if they have been defined in a VIEW TOPIC. In this case their transmission takes place in much the same way as the complete transfer (keyword FULL) of normal classes, subsequently the data-receiver (cf. chapter 3 Sequential Transfer) need not be concerned with how the (virtual) objects have been created. Views can also be explicitly excluded from any transfer (TRANSIENT), if they are only of local significance, i.e. if they only serve as base for other views. All incremental transfer of views is explicitly excluded, since no object identification can be assigned to view-objects.

Views can be abstract (ABSTRACT) or concrete. Concrete can also be founded on abstract bases. Therein it is only possible to approach base attributes that are concrete. If this is not the case, the view itself must be declared abstract.

Views can also be extended (EXTENDED or EXTENDS). However it is impossible to alter the formation definition. Thanks to the extension it is possible to conceive extensions of views, classes and structures that serve as foundation to the view in such a way, that further selections, attributes and constraints can be formulated.

Syntax rule:

```
ViewDef = 'VIEW' View-Name
          Properties<ABSTRACT,EXTENDED,FINAL,TRANSIENT>
          [ FormationDef | 'EXTENDS' ViewRef ]
            { BaseExtentionDef }
            { Selection }
          '='
          [ ViewAttributes ]
            { ConstraintDef }
          'END' View-Name ';'.

```

```
ViewRef = [ Model-Name'.' [ Topic-Name '.' ] ] ( View-Name ).
```

By means of the formation definition (FormationDef) of a view we define how and on what basis the virtual objects of a view can be formed.

The view-projection (keyword PROJECTION OF) is the simplest form of a view. It allows the viewing of the superclass (class, structure or view) in altered form (e.g. attributes only partly or in altered order).

With a *join* (keyword JOIN OF) we produce the Cartesian product (or cross-product) of the superclasses (class or view), i.e. there are as many objects of the join-class as there are combinations of objects of the different superclasses. It is also possible to define so-called "outer joins", in other words joins of objects of the first superclass with (virtually inexistent) void objects of further superclasses (indication "(OR NULL)"). Such void objects are added if no object of the desired other class could be found that might correspond to a certain combination of preceding objects. All attributes of the void object are undefined. Thus the corresponding view-attributes may not be compulsory.

The use of *union* (keyword UNION OF) allows merging different superclasses into one single class. Typically all attributes of the different superclasses are assigned to one attribute of the union class. The attribute type of the superclass must be compatible with the attribute type of the union view (same type or one of its extensions).

By means of an *aggregation* (keyword AGGREGATION OF) it is possible to combine in one instance either all instances of a basic set or those whose required attribute combination is identical. Within the aggregation view the implicit attribute AGGREGATES (cf. chapter 2.13 Expressions) renders available the corresponding set of original objects in the form of BAG. This implicit attribute does not belong to the actual attributes of the view and thus will not be transferred even if a transfer is required. For example it can be assigned to the corresponding attribute of the aggregation view or in the form of an argument it can be consigned to a function.

By means of *inspection* (keyword INSPECTION OF) we obtain the set of all structure elements (with BAG OF or LIST OF or defined according to polyline, surface or area division) which belongs to a sub-structure attribute of an object class. When applying the inspection of area divisions (keyword AREA DIVISION) we obtain the edges of the area division (as structure SurfaceEdge) exactly once. Areas that border the edges can be approached via THISAREA, resp. THATAREA (cf. chapter 2.13 Expressions). It is up to the implementation to determine how finely the lines be subdivided. Thus it is admissible to state one line-object per join of two vertices without further intermediate vertex or to reunite joins as far as possible (attributes must be identical).

However a normal inspection of an area division attribute supplies (much the same as the inspection of a surface attribute) all boundary elements (structure SurfaceBoundary). If a further inspection is executed on the attribute Lines, we also obtain all polylines (structure SurfaceEdge). This signifies that they will occur twice in the case of the area division (once for each area object involved).

```
STRUCTURE SurfaceEdge =
  Geometry: DIRECTED POLYLINE;
  LineAttrs: ANYSTRUCTURE;
END SurfaceEdge;

STRUCTURE SurfaceBoundary =
  Lines: LIST OF SurfaceEdge;
END SurfaceBoundary;
```

The inspection of a polyline (POLYLINE) supplies the following structure:

```
STRUCTURE LineGeometry =
  Segments: LIST OF LineSegment;
MANDATORY CONSTRAINT isOfClass (Segments[FIRST], INTERLIS.StartSegment);
```



```
END LineGeometry;
```

INTERLIS only aspires to the conceptual description of a view. It is explicitly omitted to support an efficient realization of views. Thus the generating of views is part of a special degree of conformance.

Syntax rules:

```
FormationDef = ( Projection | Join | Union | Aggregation | Inspection ).
```

```
Projection = 'PROJECTION' 'OF' RenamedViewableRef ';'.
```

```
Join = 'JOIN' 'OF' RenamedViewableRef
      (* ',' RenamedViewableRef
       [ '(' 'OR' 'NULL' ')' ] *) ';'.
```

```
Union = 'UNION' 'OF' RenamedViewableRef
        (* ',' RenamedViewableRef *) ';'.
```

```
Aggregation = 'AGGREGATION' 'OF' RenamedViewableRef
              ( 'ALL' | 'EQUAL' '(' UniqueEl ')' ) ';'.
```

```
Inspection = [ 'AREA' ] 'INSPECTION' 'OF' RenamedViewableRef
              '->' StructureAttribute-Name
              { '->' StructureAttribute-Name } ';'.
```

All basic views employed in a view receive a name within the view in use; they can be referred to under this name. This name also corresponds to the basic view as long as it is not renamed by means of an explicit (local) base-name definition. Above all renaming becomes necessary where joins are defined which refer repeatedly to the same superclass.

Syntax rules:

```
RenamedViewableRef = [ Base-Name '~' ] ViewableRef.
```

```
ViewableRef = [ Model-Name '.' [ Topic-Name '.' ] ]
              ( Structure-Name
                | Class-Name
                | Association-Name
                | View-Name ).
```

If within a view, resp. the extension of a view extensions of superclasses ought to be taken into account, thus allowing the formulation of further attributes, selections or constraints, a corresponding extension definition (BaseExtensionDef) has to be listed. It proceeds from an already defined basic view and in turn describes its extensions (which must be extensions of former basic views) as basic views. If such a view extension is employed within expressions the value "UNDEFINED" occurs, if the basic object belonging to the virtual object does not match this view extension.

Syntax rule:

```
BaseExtensionDef = 'BASE' Base-Name 'EXTENDED' 'BY'
                  RenamedViewableRef { ',' RenamedViewableRef }.
```

By means of constraints (keyword WHERE) it is possible to apply further restrictions to the set of view objects defined by the formation definition.

Syntax rule:

```
Selection = 'WHERE' Logical-Expression ';'.
```

As far as attributes (and thus receiver views) and constraints are concerned, on principle views are built in the same way as classes and structures. For the purpose of facilitating the writing-process we further

offer the possibility to transfer all attributes of a view-base in the same order (ALL OF). However this would not make sense in unions and consequently is inadmissible.

Syntax rule:

```
ViewAttributes = [ 'ATTRIBUTE' ]
                  { 'ALL' 'OF' Base-Name ';'
                  | AttributeDef
                  | Attribute-Name Properties <ABSTRACT,EXTENDED,FINAL>
                  | ':' Factor ';' }.

```

In those simple cases where an attribute is transferred from the basic view, it is sufficient to indicate the attribute name and the assignation to the basic attribute. Such definitions are always final, that means they cannot be extended any further.

In unions it is compulsory to indicate for each attribute from which attributes of the basic class it has been derived. However an attribute must not refer to all basic classes as long as the attribute type permits undefined values. It is regarded as undefined for all missing basic objects.

The following example demonstrates how a view can be described which permits the definition of a proper relationship by means of the construct DERIVED FROM (cf. chapter 2.7.1 General Remarks in connection with 2.7 Proper Relationships).

```
DOMAIN
  CHSurface = ... ;

FUNCTION Intersect (Surface1: CHSurface;
                   Surface2: CHSurface): BOOLEAN;

CLASS A =
  a1: CHSurface;
END A;

CLASS B =
  b1: CHSurface;
END B;

VIEW ABIntersection
  JOIN OF A,B;
  WHERE Intersect (A.a1,B.b1);
  =
END ABIntersection;

ASSOCIATION IntersectedAB
  DERIVED FROM ABIntersection =
  ARole -- A := ABIntersection->A;
  BRole -- B := ABIntersection->B;
END IntersectedAB;

```

2.16 Graphic Description

A graphic description consists of graphic definitions that are always based upon a view or a class (keyword BASED ON). By means of a graphic definition we conceptionally attempt to assign a graphic symbology (point, line, area symbol, text label) through one or several drawing rules (cf. rule DrawingRule) to each object of this view or class— unless such an object has been ruled out by a specific selection (keyword WHERE). Thus one or several graphic objects are created, which in turn will produce the respective representation (see figure 5). To this purpose each drawing rule must select a graphic symbology (with meta-object name) and determine arguments for the corresponding parameters.

In brackets (rule Properties) inheritance characteristics can be defined. Whenever a graphic description is abstract, it can produce no symbol objects. The extension of a graphic must be based upon the same class as the base graphic (BASED ON lacks) or upon one of its extensions.

The drawing rule is identified by a name, in order to be traced in extensions and subsequently refined. (Note: in the sense of specialization it refines also additional parameter values). Where there are extensions to a drawing rule in existence (in extending graphic descriptions), these will not create new graphic objects, but will only influence the symbology parameters of the graphic object determined by the basic definition. It is admissible to define several extensions to one graphic definition. They all are evaluated (in the order of their definition). This is especially of use when planning several extension piles for various aspects (e.g. various drawing rules). Subsequently, the different symbology parameters are determined. This definition may be produced in several steps. It is the value defined last that applies to each respective parameter. Firstly the primary definition is evaluated, and only then possible extensions. Furthermore it is possible to link parameter-assignments to a constraint (see rule CondSignParamAssignment), i.e. the assignment is only in force if the constraint is fulfilled. If the selection constraint is not complied with, eventual sub-extensions are no longer taken into consideration.

As soon as drawing rules are concrete, we must define what class the graphic symbologies that are to be assigned belong to. In extensions of drawing rules this class of graphic symbologies must be replaced by a class which is an extension of the former. Primarily the "responsible" class of graphic symbologies is the class to which the assigned graphic symbology object (a meta-object) belongs. Concrete values must be assigned to the parameters introduced in the "responsible" class. If the parameters indicated correspond to an extended class of graphic symbologies, this becomes the "responsible" class, provided it is in accordance with the class of the graphic symbology of the drawing rule or is one of its extensions.

In the constraints mentioned above object-attributes (see AttributePath in rule SignParamAssignment) can also be compared with run time parameters (cf. chapter 2.11 Run Time Parameters). Run time parameters which are of significance for the graphics (e.g. scale of the required graphic) typically are defined in symbology models, since they describe - much in the same way as parameter of symbologies - graphic competences that are expected of a system. For the parameter of a graphic symbology which requires a meta-object, a meta-object reference has to be indicated (cf. chapter 2.10. Dealing with Meta Objects).

The value of the ordinary parameter of a graphic symbology is indicated in terms of a constant or reference to an object-attribute (cf. factor in rule SignParamAssignment). Thereby we always refer to the attribute of an object from the basic class or basic view which has been specified by means of BASED ON.

Since the representation often depends on attributes which have been defined by means of enumerations, a special construct is available to this purpose: the enumeration domain. An enumeration domain is either a single knot of the enumeration-type tree or an interval between knots defined by two knots of the same level. Interval definitions are only admissible when dealing with ordered enumeration-types. If the attribute value lies within the indicated enumeration domain, the corresponding parameter value is set. Concrete symbologies are a result of the symbology model. Therein all symbology-classes plus the necessary run time parameters (keyword PARAMETERS) for their application are defined. It is admissible to define numeric data-types only in an abstract way.

Syntax rules:

```
GraphicDef = 'GRAPHIC' Graphic-Name Properties<ABSTRACT,FINAL>
            [ 'EXTENDS' GraphicRef ]
            [ 'BASED' 'ON' ViewableRef ] '='
            { Selection }
            { DrawingRule }
            'END' Graphic-Name ';'.
```

```

GraphicRef = [ Model-Name '.' [ Topic-Name '.' ] ] Graphic-Name.

DrawingRule = DrawingRule-Name Properties<ABSTRACT,EXTENDED,FINAL>
              ['OF' Sign-ClassRef ]
              ':' CondSignParamAssignment
              { ',' CondSignParamAssignment }';'.

CondSignParamAssignment = ['WHERE' Logical-Expression ]
                          '(' SignParamAssignment { ';' SignParamAssignment } ')'.

SignParamAssignment = SignParameter-Name
                      ':'= ( '{' MetaObjectRef '}'
                          | Factor
                          | 'ACCORDING' Enum-AttributePath
                          '(' EnumAssignment { ',' EnumAssignment } ')'
                          ).

EnumAssignment = ('{' MetaObjectRef '}' | Constant ) 'WHEN' 'IN' EnumRange.

EnumRange = EnumerationConst [ '..' EnumerationConst ].

```

For the application in symbology models the class SIGN has been predefined by INTERLIS:

```

CLASS SIGN (ABSTRACT) EXTENDS METAOBJECT =
  PARAMETER
    Sign: METAOBJECT;
END SIGN;

```

For concrete symbology classes this basic class has to be expanded, thereby defining on the one hand concrete data, on the other parameters.

The following example outlines how the corresponding graphics (point symbols and text labels) are defined from a point class with coordinates, string and an enumeration as attribute.

The symbology model is to be defined as follows:

```

SYMBOLGY MODEL SimpleSignsSymbology (en) =

  CONTRACT ISSUED BY Unknown;

  DOMAIN
    S_COORD2 (ABSTRACT) = COORD NUMERIC, NUMERIC;

  TOPIC SignsTopic =

    CLASS Symbol EXTENDS INTERLIS.SIGN =
      PARAMETER
        Pos: MANDATORY S_COORD2;
      END Symbol;

    CLASS Textlabel EXTENDS INTERLIS.SIGN =
      PARAMETER
        Pos: MANDATORY S_COORD2;
        Text: MANDATORY TEXT;
      END Textlabel;

  END SignsTopic;

END SimpleSignsSymbology.

```

In addition to this symbology model concrete (symbology) objects are supposed to have been listed and filed under the symbology library name (i.e. basket name) SimpleSignsBasket. The symbology objects

listed (class symbol) are named dot-symbolology, square-symbolology, circle-symbolology; the font-types (class text label) labeling1 and labeling2.

```

MODEL DataModel (en) =

  DOMAIN
    LCoord = COORD
      0.000 .. 200.000 [m],
      0.000 .. 200.000 [m],
      ROTATION 2 -> 1;

  TOPIC DotTopic =

    DOMAIN
      DotType = (Stone
        (large,
         small),
        Bolt,
        Pipe,
        Cross,
        nonmaterialized) ORDERED;

    CLASS Dot =
      Position: LCoord;      !! LCoord be a coordinate value domain
      Type: DotType;
      DotName: TEXT*12;
    END Dot;

  END DotTopic;

END DataModel.

MODEL SimpleGraphic (en) =

  CONTRACT ISSUED BY Unknown;

  IMPORTS DataModel;
  IMPORTS SimpleSignsSymbology;

  SIGN BASKET SimpleSignsBasket ~ SimpleSignsSymbology.SignsTopic;

  TOPIC DotGraphicsTopic =
    DEPENDS ON DataModel.DotTopic;

    GRAPHIC SimpleDotGraphic BASED ON DataModel.DotTopic.Dot =

      Symbol OF SimpleSignsSymbology.SignsTopic.Symbol: (
        Sign := {DotSymbolology};
        Pos := Position
      );

    END SimpleDotGraphic;

  END DotGraphicsTopic;

END SimpleGraphic.

```

By means of this graphic (based upon the symbology-model SimpleSignsSymbology and the graphic representation SimpleGraphic) for all dots of class dot simple dot-symbolologies are drawn.

It is also conceivable that an improved graphic is desirable. Such an improvement can be made in different respects, e.g.:

- Additional symbologies are desired (point-symbologies, cross-symbologies, triangle-symbologies). This requires a supplementary symbology library by name of SimpleSignsPlusBasket. Since it is an extension of the library SimpleSignsBasket, the symbology objects (resp. meta-objects) will be searched for in both libraries. If the library SimpleSignBasket were directly extended (EXTENDED), then for all graphics created with GraphicPlus within the model – including those that have been inherited from the model SimpleGraphic – the symbologies would be first searched for in the extended library and only then in the basic library SimpleSignsBasket.
- Symbologies should be scalable, thus permitting the creation of small and big squares with the same point-symbology. This requires an extended symbology-model that contains a parameter defining the scaling of symbologies. Since symbology-classes do not feature any additional attributes, it is not compulsory that corresponding libraries are in existence.
- Depending on the type of point, various point-symbologies should be drawn: stones as big or small squares, bolts as circles and crosses and pipes with the cross-symbology. The actual point-symbology can be directly derived from the point-type. The scaling factor for small squares for the representation of small stones is obtained by means of an additional assignment. Non-materialized points remain simple dots; hence in this case no new assignment ensues.

```

SYMBOLGY MODEL ScalableSignsSymbology (en) =

  CONTRACT ISSUED BY Unknown;

  IMPORTS SimpleSignsSymbology;

  TOPIC ScalableSignsTopic EXTENDS SimpleSignsSymbology.SignsTopic =

    CLASS Symbol (EXTENDED) =
      PARAMETER
        ScaleFactor: 0.1 .. 10.0;  !! Default 1.0
      END Symbol;

    END ScalableSignsTopic;

END ScalableSignsSymbology.

MODEL GraphicPlus (en) =

  CONTRACT ISSUED BY Unknown;

  IMPORTS SimpleGraphic;
  IMPORTS SimpleSignsSymbology;
  IMPORTS ScalableSignsSymbology;

  SIGN BASKET SimpleSignsPlusBasket EXTENDS
    SimpleGraphic.SimpleSignsBasket ~ ScalableSignsSymbology.ScalableSignsTopic;

  TOPIC DotGraphicsPlusTop EXTENDS SimpleGraphic.DotGraphicsTopic =

    GRAPHIC DotGraphicPlus EXTENDS SimpleDotGraphic =

      Symbol (EXTENDED) OF ScalableSignsSymbology.ScalableSignsTopic.Symbol: (
        Sign := ACCORDING Art (
          {SquareSymbology} WHEN IN #Stone,
          {CircleSymbology} WHEN IN #Bolt,
          {CrossSymbology} WHEN IN #Pipe .. #Cross
        )
      ),
      WHERE Type == #Stone.small (
        ScaleFactor := 0.5
      );

```

```
Text OF SimpleSignsSymbology.Signs.Textlabel: (  
  Sign := {Labeling1};  
  Pos := Position;  
  Text := DotName  
);  
  
END DotGraphicPlus;  
  
END DotGraphicsPlusTop;  
  
END GraphicPlus.
```


3 Sequential Transfer

3.1 Introduction

In this chapter we describe the sequential INTERLIS-transfer service. It permits the system-neutral exchange of data stores between different systems. Our INTERLIS-transfer service supports the complete as well as the incremental (resp. differential) exchange of data stores (replication). This transfer service is applicable to every INTERLIS-model. Thus it is possible to transfer data (data model) and symbology objects (symbology models) by means of the same mechanism.

At present the INTERLIS-transfer service is defined as an exchange of XML-files (www.w3.org/XML/). For more extensive utilization of these INTERLIS/XML-files it is, amongst others, also possible to create XML-schema-documents (www.w3.org/XML/Schema). Nevertheless it is conceivable that further INTERLIS-transfer services will be defined in the future (e.g. based upon web-services or COBRA). For this reason the description of our INTERLIS-transfer service has been subdivided into the paragraphs *General Rules* and *XML-Coding*. General rules apply to *every sequential* INTERLIS-transfer service, independently of the concrete coding or transmission. Rules stated under *XML-Coding* apply especially to XML-formatted transfer files.

3.2 General Rules for the Sequential Transfer

3.2.1 Derivation from the Data Model

Each INTERLIS-transfer can be derived from the corresponding data model by applying rules (model-based data transfer).

3.2.2 Reading of Expanded Models

An INTERLIS-transfer is always structured in such a way as to allow a reading program intended and configured for a specific data model, to also read data of extensions of this data model without any knowledge of the expanded model definitions.

3.2.3 Organization of a Transfer: Preliminaries

An INTERLIS-transfer is a sequential object-current. The object-current is subdivided into preliminaries and data domain.

- Indication of the current INTERLIS-version number (cf. chapter 2.3 Principal Rule).
- Reference to the corresponding data model(s).
- Indication of the sender (SENDER).

The preliminaries may contain comments (optional).

The organization of the data domain will be described more accurately in the following paragraphs.

3.2.4 Transferable Objects

Within the data-domain objects (i.e. object instances) of concrete classes, relations, views and graphic definitions can be transferred. Within the transfer, objects of views are treated in the same way as objects of concrete classes. At present the incremental transfer of views is not yet possible. Objects of views are only transferred provided the pertinent views have been declared within a VIEW TOPIC, otherwise they will not be transmitted. Furthermore views will not be transferred if they have been marked TRANSIENT.

3.2.5 Order of Objects Within the Data Domain

A data domain consists of a series of baskets (topic instances). Baskets can only be transferred as a whole. With incremental transfers only altered, resp. deleted objects will be transferred. However even with incremental transfers conceptionally it is the entire basket that is transferred along with the prehistory. On principle it is possible that a transfer contains basket provided by different models. In turn each basket contains all its objects. Within the transfer any order of objects is permitted, above all the objects need not in any case be ordered according to relation or grouped in classes within a basket (as opposed to INTERLIS 1). Void baskets need not be transferred.

3.2.6 Coding of Objects

Within the object current each basket and each object receives an identification. The basket identification must be a general and stable object-identifier (OID). The identifier of baskets and objects must be unequivocal along the entire transfer. Furthermore with every object a basket-identification is supplied within which the object has originally been created (original basket). With incremental transfers, resp. with initial transfers the identification of both basket and object must be a general and stable object-identifier (cf. Appendix E Organisation of Object Identifiers (OID)).

All object attributes (including COORD, SURFACE, AREA, POLYLINE, STRUCTURE, BAG OF, LIST OF; etc.) are memorized directly with the object. Attributes of the type AREA are coded as attributes of the type SURFACE. Attributes of the type BAG are coded as attributes of the type LIST. STRUCTURE is coded as LIST {1}.

For the transmission of attribute values only the printable symbols of the US-ASCII character set (32 to 126) and the symbols according to the table of symbols in Appendix B are available.

3.2.7 Transfer-Types

Along with each basket the following informations must be supplied:

- Details concerning the type (KIND) of transfer: FULL, INITIAL or UPDATE.
- Details concerning the STARTSTATE resp. ENDSTATE of the transfer (only with the types INITIAL or UPDATE).

It is admissible to have baskets with different types of transfer (Full, INITIAL and/or UPDATE) within the same transfer. The various types of transfer have the following significance:

- FULL – complete transfer. Upon receipt of a FULL-basket the receiver must first initialize a new basket and then insert all object into the basket by means of INSERT. FULL is inappropriate as base for transfers since the object identifications are only valid for this transfer. Transfer-files in accordance with INTERLIS 1 correspond to FULL. Within the transfer-type FULL only the operation INSERT may occur.
- INITIAL – Primary transfer. Corresponds to the transfer type FULL with the sole difference that both basket and objects contained must feature general and stable OID's. Likewise within the transfer-type FULL only the operation INSERT may occur.
- UPDATE – Transfer. An UPDATE-basket contains objects with INSERT, UPDATE or DELETE operations. All objects and the basket feature general and stable OID's. UPDATE baskets may only be processed by the target system, if the start-state of the basket has already been received with INITIAL or UPDATE.

In addition the following transfer-rules apply to the transfer-type UPDATE:

- The receiving system may proceed on the assumption that after complete processing of all data of one UPDATE-basket a consistent has been re-established, i.e. an UPDATE-basket transfers a basket from a consistent start-state to a consistent end-state.

- An UPDATE-basket itself is not consistent, since in most cases references can only be resolved together with former transfers.

Furthermore to each object a corresponding transfer operation must be indicated (cf. chapter 1.4.5 Basket, Replication and Data transfer). The operations INSERT, UPDATE and DELETE have the following significance:

- The operation INSERT signifies "insert a new object" (insert object).
- The operation UPDATE signifies "update object attribute values" (update object). All attributes (not only these that have been altered) must be transferred.
- The operation DELETE signifies "delete objects" (delete object). All attributes (not only those of OID's) should be transferred.

3.3 XML-Coding

3.3.1 Introduction

As opposed to the rules in chapter 3.2. General Rules for Sequential Data Transfer, the rules under XML-coding apply only to transfer files formatted according to XML-0.1 standard (see also www.w3.org/XML). For formalizing the derivation rules of transfer formats we use the EBNF-notation already introduced in chapter 2.1 Syntax Applied. Hereby the following rules are already predefined:

```
XML-Text = beliebiger freier Text.
XML-String = beliebiger einzeiliger Text.
XML-Value = '"' XML-String '"'.
XML-ID = '"' x { Letter | Digit } '"'.
```

With the rule XML-ID 'x' is not part of the ID-value, but part of the coding.

In order to enhance readability of each individual derivation rule we suggest additional use of the macros TAG and ETAG.

```
TAG ( Tagwert )
```

Generates an EBNF-partial rule of the form:

```
'<%Tagwert%>'
```

```
TAG ( Tagwert, Attribut1, Attribut2,...)
```

Generates an EBNF-partial rule of the form:

```
'<%Tagwert%' %Attribut1% %Attribut2% etc. '>'
```

```
ETAG ( Tagwert )
```

Generates an EBNF-partial rule of the form:

```
'</%Tagwert%>'
```

In each case the sequence %argument% has to be replaced by the current content of the argument.

Examples:

```
TAG ( DATASECTION )           produce '<DATASECTION>'
TAG ( HEADERSECTION, 'VERSION="2.2"' ) produce '<HEADERSECTION' 'VERSION="2.2"' '>'
ETAG ( DATASECTION )         produce '</DATASECTION>'
```

3.3.2 Symbol Coding

The only available symbols for the coding of XML-texts, resp. XML-strings are ASCII signs 32 to 126, resp. symbols stated in appendix B. These symbols are coded in accordance with the coding rule UTF-8 or as XML Character Reference, resp. XML Entity reference. In addition the XML special symbols '&', '<' and '>' must be coded as follows:

- '&' must be replaced by the sequence '&';
- '<' must be replaced by the sequence '&lt;';
- '>' must be replaced by the sequence '&gt;';

A complete summary of this symbol coding with all possible forms of coding per symbol is to be found in appendix B. If several coding forms per symbol are available it is up to an INTERLIS 2 writing program to select a pertinent form. An INTERLIS 2 reading program must be able to recognize all coding forms. Note: Various coding forms per symbol are admitted in order to achieve maximum compatability with existing XML-tools.

3.3.3 General Structure of a Transfer File

An INTERLIS-transfer file is structured in accordance with the following EBNF-main rule:

```
Transfer = '<?xml version="1.0" encoding="UTF-8" ?>'
          TAG ( TRANSFER, 'xmlns="http://www.interlis.ch/INTERLIS2.2"' )
          HeaderSection
          DataSection
          ETAG ( TRANSFER ).
```

The rule HeaderSection generates the header section of the transfer file and the rule DataSection generates the data section.

At any time an INTERLIS-transfer file generated by the transfer rule is also a valid (well formed) XML 1.0-transfer file. Thus in an INTERLIS-transfer file any number of comment lines in the form of

```
<!-- Comment -->
```

may occur at places assigned by XML 1.0. However the contents of these comment lines may not be interpreted by the transfer software. UTF-8-coding is applied for the coding of all symbols of the transfer file. As a standard however it is only the set of symbols displayed in appendix B that can be used.

Data are transferred as XML-objects. The tag names of XML-objects are derived from their respective object names in the INTERLIS-data model. For translated data models (TRANSLATION OF) this implies that tag names exist in the translated language within the transfer (however additional entries must be made in the alias-table).

3.3.4 Header Section

A header section is structured as follows:

```
HeaderSection = TAG ( HEADERSECTION,
                     'VERSION="2.2"',
                     'SENDER=' XML-Value )
                     Alias
                     [ Comment ]
                     ETAG ( HEADERSECTION ).

Alias = TAG ( ALIAS )
        { Entries }
        ETAG ( ALIAS ).

Entries = TAG ( ENTRIES,
               'FOR=' XML-Value )
```

```

        { Tagentry | Valentry | Delentry }
    ETAG ( ENTRIES ).

Tagentry = TAG ( TAGENTRY,
    'FROM=' XML-Value, 'TO=' XML-Value )
    ETAG ( TAGENTRY ).

Valentry = TAG ( VALENTY,
    'ATTR=' XML-Value, 'FROM=' XML-Value, 'TO=' XML-Value )
    ETAG ( VALENTY ).

Delentry = TAG ( DELENTY,
    'TAG=' XML-Value )
    ETAG ( DELENTY ).

Comment = TAG ( COMMENT )
    XML-Text
    ETAG( COMMENT ).

```

In the HeaderSection-element the following values (XML-attributes) must be entered:

- VERSION. Version of the INTERLIS-coding (currently 2.2)
- SENDER. Sender of the data set.

In the element Alias all entries are made which allow polymorph reading of a data set (see also next paragraph). In Comment a comment can be added which further describes the transfer (optional).

3.3.4.1 Significance and Contents of the Alias-Table

The element Alias in the HeaderSection is a special table which enables a reading program to read extended models without any knowledge of the extensions (so-called polymorph reading). Since XML does not know inheritance and consequently no polymorphism, the alias table is used to transmit necessary additional information to a reading program.

Alias must contain one representation table (entries-element) per data model X which occurs within the transfer. Via xxxEntry-entries (TAGENTRY, VALENTY, DELENTY) it is indicated in each relationship table which transferable objects (i.e. inherent, resp. extensions thereof) may occur in the baskets of data model X (resp. may not occur in the case of DELENTY-entries). If there should exist translations (TRANSLATION OF) of the data model X within the transfer, then also all tags of the translated data model must be entered with either TAGENTRY or VALENTY in the representation table of data model X. Representation tables of each individual data model must be arranged in such a way that representation tables of base models are entered before the representation tables of extended, resp. translated models. The individual entries of the Alias-table have the following significance:

- TAGENTRY. The tag is entered according to the original model in the FROM-attribute (e.g. 'Canton.TCanton.K1'), in the TO-attribute it is the tag according to the model currently viewed (e.g. 'Federation.TFederation.B1'). Also all tags must be entered according to current model. In this case the same value is entered in the FROM- resp. TO-tag. The TAGENTRY must be indicated for concrete topics, classes, structures, relationships and graphic definitions, resp. transferable views.
- VALENTY. The name of the enumeration-attribute is indicated in the ATTR-attribute (e.g. 'Canton.TCanton.Color'). The value according to the original model is entered in the FROM-attribute (e.g. 'red.carmine'), in the TO-attribute it is the tag according to the current model (e.g. 'red'). All values must be entered according to the current model. In this case the same value is indicated for the FROM- resp. TO-tag. The VALENTY must be indicated for all enumeration types.

- DELENTY. In the TAG-attribute we indicate the tag which cannot occur from the view-point of the current model, but which could exist in extensions. The DELENTY must be indicated for concrete topics, classes, structures, relationships and graphic definitions, resp. transferable views as well as for attributes of classes, structures and transferable views. If an entire class (resp. structure, relationship or transferable view) can not exist from the view-point of the current model, it is admissible to only designate the non-existent class with DELENTY. In this case the attributes of the class (resp. structure, relationship or transferable view) must not be transferred with DELENTY.
- Note concerning relationships without proper identity: The rules above also apply analogously to relationships without proper identity. Hence e.g. the values of an enumeration attribute must be listed in the same class in which the role is listed (i.e. under class.role.attribute).
- In the following example the characteristics of the Alias-table are once more illustrated, resp. commented.

The following data description:

```

INTERLIS 2.2;

MODEL Federation =

  CLASS B (ABSTRACT) =
    END B;

  TOPIC TFederation =

    CLASS B1 EXTENDS B =
      Color : (red, green, blue);
    END B1;

  END TFederation;

END Federation.

MODEL TFederation TRANSLATION OF Federation =

  CLASS TB (ABSTRACT) =
    END TB;

  TOPIC TTFederation =

    CLASS TB1 EXTENDS TB =
      TColor : (tred, tgreen, tblue);
    END TB1;

  END TTFederation;

END TFederation.

MODEL Canton =

  IMPORTS Federation;

  TOPIC TCanton EXTENDS Federation.TFederation =

    CLASS K (ABSTRACT) EXTENDS Federation.B =
      END K;

    CLASS K1 EXTENDS Federation.TFederation.B1 =
      Color (EXTENDED): (red (dark, carmine, light));

```

```

        Txt: TEXT*40;
    END K1;

    CLASS K2 =
        Txt: TEXT*40;
    END K2;

    END TCanton;

END Canton.

MODEL County =

    IMPORTS Canton;

    TOPIC TCounty EXTENDS Canton.TCanton =
    END TCounty;

END County.

```

leads to the following Alias-table:

```

<ALIAS>

<ENTRIES FOR="Federation">

    <!--Entries according to personal model -->
    <TAGENTRY FROM="Federation.TFederation" TO="Federation.TFederation"></TAGENTRY>
    <TAGENTRY FROM="Federation.TFederation.B1"
TO="Federation.TFederation.B1"></TAGENTRY>
    <VAENTRY ATTR="Federation.TFederation.B1.Color" FROM="red"
TO="red"></TAGENTRY>
    <VAENTRY ATTR="Federation.TFederation.B1.Color" FROM="green"
TO="green"></TAGENTRY>
    <VAENTRY ATTR="Federation.TFederation.B1.Color" FROM="blue"
TO="blue"></TAGENTRY>

    <!-- Entries for TFederation (TRANSLATION OF) -->
    <TAGENTRY FROM="TFederation.TTFederation"
TO="Federation.TFederation"></TAGENTRY>
    <TAGENTRY FROM="TFederation.TTFederation.TB1"
TO="Federation.TFederation.B1"></TAGENTRY>
    <VAENTRY ATTR="TFederation.TTFederation.TB1.TColor" FROM="tred"
TO="red"></TAGENTRY>
    <VAENTRY ATTR="TFederation.TTFederation.TB1.TColor" FROM="tgreen"
TO="green"></TAGENTRY>
    <VAENTRY ATTR="TFederation.TTFederation.TB1.TColor" FROM="tblue"
TO="blue"></TAGENTRY>

    <!--Entries according to model Canton -->
    <TAGENTRY FROM="Canton.TCanton" TO="Federation.TFederation"> </TAGENTRY>
    <TAGENTRY FROM="Canton.TCanton.K1" TO="Federation.TFederation.B1"> </TAGENTRY>
    <DEENTRY TAG="Canton.TCanton.K1.Txt"> </DEENTRY>
    <DEENTRY TAG="Canton.TCanton.K2"> </DEENTRY>
    <VAENTRY ATTR="Canton.TCanton.K1.Color" FROM="red.dark" TO="red"> </VAENTRY>
    <VAENTRY ATTR="Canton.TCanton.K1.Color" FROM="red.carmine" TO="red"> </VAENTRY>
    <VAENTRY ATTR="Canton.TCanton.K1.Color" FROM="red.light" TO="red"> </VAENTRY>
    <VAENTRY ATTR="Canton.TCanton.K1.Color" FROM="green" TO="green"> </VAENTRY>
    <VAENTRY ATTR="Canton.TCanton.K1.Color" FROM="blue" TO="blue"> </VAENTRY>

    <!-- Entries according to model County -->
    <TAGENTRY FROM="County.TCounty" TO="Federation.TFederation"> </TAGENTRY>
    <TAGENTRY FROM="County.TCounty.K1" TO="Federation.TFederation.B1"> </TAGENTRY>
    <DEENTRY TAG="County.TCounty.K1.Txt"> </DEENTRY>
    <DEENTRY TAG="County.TCounty.K2"> </DEENTRY>
    <VAENTRY ATTR="County.TCounty.K1.Color"

```



```

        FROM="red.dark" TO="red"> </VALENTY>
<VALENTY ATTR="County.TCounty.K1.Color"
  FROM="red.carmine" TO="red"> </VALENTY>
<VALENTY ATTR="County.TCounty.K1.Color"
  FROM="red.light" TO="red"> </VALENTY>
<VALENTY ATTR="County.TCounty.K1.Color"
  FROM="green" TO="green"> </VALENTY>
<VALENTY ATTR="County.TCounty.K1.Color"
  FROM="blue" TO="blue"> </VALENTY>

</ENTRIES>

<ENTRIES FOR="Canton">

  <!--Entries according to personal model -->
  <TAGENTRY FROM="Canton.TCanton" TO="Canton.TCanton"> </TAGENTRY>
  <TAGENTRY FROM="Canton.TCanton.K1" TO="Canton.TCanton.K1"> </TAGENTRY>
  <TAGENTRY FROM="Canton.TCanton.K2" TO="Canton.TCanton.K2"> </TAGENTRY>
  <VALENTY ATTR="Canton.TCanton.K1.Color"
    FROM="red.dark" TO="red.dark"> </VALENTY>
  <VALENTY ATTR="Canton.TCanton.K1.Color"
    FROM="red.carmine" TO="red.carmine"> </VALENTY>
  <VALENTY ATTR="Canton.TCanton.K1.Color"
    FROM="red.light" TO="red.light"> </VALENTY>
  <VALENTY ATTR="Canton.TCanton.K1.Color"
    FROM="green" TO="green"> </VALENTY>
  <VALENTY ATTR="Canton.TCanton.K1.Color"
    FROM="blue" TO="blue"> </VALENTY>

  <!-- Entries according to model County -->
  <TAGENTRY FROM="County.TCounty" TO="Canton.TCanton"> </TAGENTRY>
  <TAGENTRY FROM="County.TCounty.K1" TO="Canton.TCanton.K1"> </TAGENTRY>
  <TAGENTRY FROM="County.TCounty.K2" TO="Canton.TCanton.K2"> </TAGENTRY>
  <VALENTY ATTR="County.TCounty.K1.Color"
    FROM="red.dark" TO="red.dark"> </VALENTY>
  <VALENTY ATTR="County.TCounty.K1.Color"
    FROM="red.carmine" TO="red.carmine"> </VALENTY>
  <VALENTY ATTR="County.TCounty.K1.Color"
    FROM="red.light" TO="red.light"> </VALENTY>
  <VALENTY ATTR="County.TCounty.K1.Color"
    FROM="green" TO="green"> </VALENTY>
  <VALENTY ATTR="County.TCounty.K1.Color"
    FROM="blue" TO="blue"> </VALENTY>

</ENTRIES>

<ENTRIES FOR="County">

  <!-- Entries according to personal model -->
  <TAGENTRY FROM="County.TCounty" TO="County.TCounty"> </TAGENTRY>
  <TAGENTRY FROM="County.TCounty.K1" TO="County.TCounty.K1"> </TAGENTRY>
  <TAGENTRY FROM="County.TCounty.K2" TO="County.TCounty.K2"> </TAGENTRY>
  <VALENTY ATTR="County.TCounty.K1.Color"
    FROM="red.dark" TO="red.dark"> </VALENTY>
  <VALENTY ATTR="County.TCounty.K1.Color"
    FROM="red.carmine" TO="red.carmine"> </VALENTY>
  <VALENTY ATTR="County.TCounty.K1.Color"
    FROM="red.light" TO="red.light"> </VALENTY>
  <VALENTY ATTR="County.TCounty.K1.Color"
    FROM="green" TO="green"> </VALENTY>
  <VALENTY ATTR="County.TCounty.K1.Color"
    FROM="blue" TO="blue"> </VALENTY>

</ENTRIES>

</ALIAS>

```

Thus a reading program, written resp. configured for the Federate model, can now read data provided by Federation, TFederation, Canton or County as follows:

- All tags provided by Federation are mapped onto itself (e.g. Federation.TFederation to Federation.TFederation).
- All tags of TFederation (TRANSLATION OF) are mapped to their counter-part in Federation (e.g. T.Federation.TTFederation to Federation.TFederation).
- Via its tag-entry an XML-object <Canton.TCanton.K1> is mapped to <Federation.TFederation.B1>. The object <Federation.TFederation.B1> is known to the reading program for the Federate model, thus it can interpret the the object accordingly.
- By means of a tag entry an XML-Object <County.TCounty.K1> is transferred to and represented in <Federation.TFederation.B1>. The object <Federation.TFederation.B1> is known to the reading program for the federal model, thus the object can be interpreted correspondingly.
- The value "red.carmine" of the enumeration-attribute Canton.TCanton.K1.Color resp. County.TCounty.Color is mapped via its VALENTY to "red". The value "red" is a valid value according to the Federate model.
- The abstract class Canton.TCanton.K, resp. County.TCounty.K need not be entered as a tag-entry, since in its data set no instances of Canton.TCanton.K, resp. County.TCounty.K may occur.
- The attribute <Canton.TCanton.K1.Txt>, resp. <County.TCounty.K1.Txt> must be ignored, since this attribute does not exist within the Federate model.
- The class <Canton.TCanton.K2>, resp. <County.TCounty.K2> must be ignored, since from the view-point of the Federal model instances of <Canton.TCanton.K2>, resp. <County.TCounty.K2> do not exist. Note: The attribute <Canton.TCanton.K2.Txt>, resp. <County.TCounty.K2.Txt> need not be entered specifically with DELENTY, since from the view-point of the Federate model this entire class does not exist.

Notes:

- The alias table can be generated with the INTERLIS 2-compiler.
- For each data model contained in the data set (including all base models) an entry-element must be entered. The name of the model must be entered in the XML-attribute FOR.
- Tag names, which after their mapping via the Alias-table do not lead to any known tag name as far as the reading model is concerned, must be declared as errors by the reading program.
- Attribute values, which after their mapping via the Alias-table do not lead to any known value as far as the reading model is concerned, must be declared as errors by the reading program.

3.3.5 Data Section

The data section is structured as follows:

```
DataSection = TAG ( DATASECTION )
               { Basket }
               ETAG ( DATASECTION ).
```

3.3.6 Coding of Topics

Baskets are instances of a concrete TOPIC, resp. VIEW TOPIC. Baskets are coded as follows:

```
Basket = TAG (%Model.Topic%,
              'BID=' XML-ID,
              [ 'TOPICS=' XML-Value ],
              [ 'KIND=' XML-Value ],
              [ 'STARTSTATE=' XML-Value ],
              [ 'ENDSTATE=' XML-Value ] )
              { Object }
```

```
ETAG ( %Model.Topic% ).
```

The value %Model.Topic% has to be substituted correspondingly for each concrete topic (e.g. basic data of official surveying control points). XML-attributes of the basket have the following significance:

- **BID.** In BID the basket identification must be entered. With incremental up-date the basket identification must be an OID.
- **TOPICS.** In TOPICS all topics, except basic topics, actually existing within the basket are indicated in a list, separated by commas (e.g. "Canton1.Topic1, Canton2.Topic2"). the topics indicated must be extensions of the common basic topic %Model.Topic% (possibly inherited via several levels).
- **KIND.** Transfer-type (possible values: FULL, UPDATE, INITIAL. Where the attribute is omitted, FULL is presumed).
- **STARTSTATE.** Initial state of the basket before the transfer (only in connection with incremental up-date).
- **ENDSTATE.** Final state of the basket after the transfer (only in connection with incremental up-date).

3.3.7 Coding of Classes

Object instances of a concrete class are coded as follows:

```
Object = TAG ( %Model.Topic.Class%,
               'TID=' XML-ID,
               [ 'BID=' XML-ID ],
               [ 'OPERATION=' XML-Value ] )
          (* Attribute | Role | RoleStruct | ReferenceAttribute *)
ETAG ( %Model.Topic.Class% ).
```

The value %Model.Topic.Class% must be substituted correspondingly for each concrete class (e.g. basic data of official surveying control points LFP). In addition to the attributes defined within the model each class – and thus each object instance – is assigned implicitly a transfer identification (XML-attribute TID). In connection with the transfer-type 'FULL' all TID's incl. all BID's must be unequivocal along the entire transfer. In connection with the transfer-type INITIAL or UPDATE all TID's and BID's must be OID's. In BID the basket-identification refers to the basket in which the object originally had been created (original basket). If the object should be located within its original basket, then BID can be omitted. Furthermore in connection with the transfer-types INITIAL and UPDATE each object is assigned an attribute for the update-operation (XML-attribute OPERATION). The XML-attribute OPERATION can adopt the values INSERT, UPDATE or DELETE. Whenever OPERATION is not indicated, the value INSERT will be presumed.

Parameters are not transferred with the sole exception described in chapter 3.3.11 Coding of Graphic Definitions. The sequence of the individual attributes within the transfer is the same as the definition sequence of the attributes within the corresponding class. If classes are extensions of superclasses, the attributes of the extended classes appear after the attributes of the superclasses in the transfer.

3.3.8 Coding of Views

For the coding of views see chapter 3.2.4 Transferable Objects. The XML-attributes TID and BID are transmitted, however not OPERATION. In terms of attributes of the view-object only those attributes are transmitted which have been indicated within the view explicitly under ATTRIBUTES, resp. implicitly with ALL OF.

3.3.9 Coding of Relationships with Proper Identity

Object instances of concrete relations with proper identity (cf. also chapter 2.7.1) are transferred in the same way as object instances of classes. Note: For relationships without explicit names the (class)name is a result of combining the individual rolenames (i.e. e.g. %RoleName1RoleName2%)

Roles are treated as attributes. Roles themselves are coded as follows:

```
Role = TAG ( %RoleName%,
            ('REF=' XML-ID | 'EXTREF=' XML-ID 'BID=' XML-ID),
            [ 'NEXT_TID=' XML-ID ] )
      ETAG ( %RoleName% ).
```

If the reference points to an object within the same basket the reference is coded with REF. It is the transfer identification of the object that has been referred to that is stated in REF.

If the reference points to an object in a different basket (within the same transfer or even outside), the reference will be coded with EXTREF and BID, thereby stating the transfer identification in EXTREF, resp. the basket identification in BID of the object that has been referred to.

In ordered relationships the attribute NEXT_TID refers to the next relation object.

3.3.10 Coding of Relationships without Proper Identity

Object instances of concrete (Zweier) relationships without proper identity (see also chapter 2.7.1) are coded as substructures of the reference-object. The substructure has the following structure:

```
RoleStruct = TAG ( %RoleName%,
                  ('REF=' XML-ID | 'EXTREF=' XML-ID 'BID=' XML-ID),
                  [ 'NEXT_TID=' XML-ID ] )
              [ StructureValue ]
              ETAG ( %RoleName% ).
```

For %RoleName% the name of the role which refers to the main object has to be indicated (the other role will not be coded). In StructureValue eventual attributes of the relationship are coded. The XML-attributes REF, EXTREF, NEXT_TID and BID have the same significance as with relations with proper identity. In 1-1 relationships the second role replaces %RoleName%.

3.3.11 Coding of Graphic Definitions

In the transfer the symbology classes referred to by the graphic definition (Sign-ClassRef) are transmitted for each graphic definition. The object instances of the symbology classes are created by executing graphic definitions on a concrete input data-set. Parameters are coded in the same way as attributes.

3.3.12 Coding of Attributes

3.3.12.1 General Rules

Each attribute of an object instance (including complex attributes such as POINT, POLYLINE, SURFACE AREA, STRUCTURE, LIST OF; BAG OF, etc.) is coded as follows:

```
Attribute = [ TAG ( %AttributeName% )
             AttributeValue
             ETAG ( %AttributeName% ) ].

AttributeValue = ( TextValue | EnumValue | NumericValue | StructDecValue |
                  BasketValue | ClassTypeValue | StructureValue | BagValue |
                  ListValue | CoordValue | PolylineValue | SurfaceValue ).
```

With undefined attribute values the attribute is not transferred. The measuring unit of the attribute value is not coded. Example of a simple attribute:

```
<Nummer>12345</Nummer>
```

3.3.12.2 Coding of Strings, URI and NAME

Attributes of the base type TEXT*N are coded as follows:

```
TextValue = XML-String.
```

3.3.12.3 Coding of Enumerations

Enumerations are coded as follows:

```
EnumValue = ( EnumElement-Name { '.' EnumElement-Name } ) | 'OTHERS'.
```

For the coding of enumerations the syntax of enumeration constants is applied (rule EnumValue). The sign # is omitted. The pre-defined text orientation-types HALIGNMENT and VALIGNMENT are coded in the same way as enumerations. Equally the type BOOLEAN is transmitted like an enumeration.

3.3.12.4 Coding of Numeric Data Types

Numeric values are coded as follows:

```
NumericValue = NumericConst.
```

Note: With whole numbers no noughts placed in front are admissible (007 is transferred as 7). With real numbers a maximum of one leading nought is permitted (e.g. not 00.07 but 0.07). Float numbers can be transferred in different representations (with or without Mantissen), as long as the value domain of the float number corresponds with its declaration; e.g. 100 could be transferred as 10.0e1 or 1.0e2.

3.3.12.5 Coding of Structured Domains

Structured domains are coded in the same way as structured constants:

```
StructDecValue = StructDec.
```

3.3.12.6 Coding of BASKET

Attribute values of the type BASKET are coded as follows:

```
BasketValue = TAG ( BASKETVALUE,
                    'TOPIC=' XML-Value,
                    'KIND=' XML-Value,
                    'BID=' XML-ID )
              ETAG ( BASKETVALUE ).
```

The individual XML-attributes have the following meaning:

- TOPIC. Description of the topic under the form Model.Topic.
- KIND. Type of basket. (Possible values: DATA, VIEW, BASE and GRAPHIC).
- BID. Basket identification.

3.3.12.7 Coding of Class

Attributes of the type CLASS are coded as follows:

```
ClassTypeValue = XML-String.
```

The XML-string contains the complete qualified class-name (e.g. basic data of official surveying.control points.LFP).

3.3.12.8 Coding of STRUCTURE

Attribute values of the type STRUCTURE are coded as follows:

```

StructureValue = TAG ( %StructureName% )
                  (* Attribute *)
                  ETAG ( %StructureName% ).

```

StructureName is formed either as Model.StructureName at the level Model or as Model.Topic.StructureName at the level Topic.

3.3.12.9 Coding of BAG OF and LIST OF

Attribute values of the type BAG OF and LIST OF are coded as follows:

```

BagValue = (* StructureValue *).
ListValue = (* StructureValue *).

```

The sequence of the ListValue-Elements may not be altered during transfer.

3.3.12.10 Coding of Coordinates

Attribute values of the type COORD are coded as follows:

```

CoordValue = TAG ( COORD ),
              TAG ( C1 ) NumericConst ETAG ( C1 )
              [ TAG ( C2 ) NumericConst ETAG ( C2 )
                [ TAG ( C3 ) NumericConst ETAG ( C3 ) ]
              ]
              ETAG ( COORD ).

```

The individual XML-subobjects must be filled as follows:

- C1. First component of the coordinate (coded as numeric value).
- C2. Second component of the coordinate (only with 2D- and 3D- coordinates, coded as numeric value).
- C3. Third component of the coordinate (only with 3D-coordinates, coded as numeric value).

3.3.12.11 Coding of POLYLINE

Attribute values of the type POLYLINE are coded as follows:

```

PolylineValue = TAG ( POLYLINE )
                 [ LineAttr ]
                 SegmentSequence
                 ETAG ( POLYLINE ).

```

```
StartSegment = CoordValue.
```

```
LineSegment = CoordValue.
```

```

ArcSegment = TAG ( ARC )
              TAG ( C1 ) NumericConst ETAG ( C1 )
              TAG ( C2 ) NumericConst ETAG ( C2 )
              [ TAG ( C3 ) NumericConst ETAG ( C3 ) ]
              TAG ( A1 ) NumericConst ETAG ( A1 )
              TAG ( A2 ) NumericConst ETAG ( A2 )
              [ TAG ( R ) NumericConst ETAG ( R ) ]
              ETAG ( ARC ).

```

```
LineFormSegment = StructureValue.
```

```

SegmentSequence = StartSegment { LineSegment
                                   | ArcSegment
                                   | LineFormSegment}.

```

```

LineAttr = TAG ( LINEATTR )
            StructureValue
            ETAG ( LINEATTR ).

```

Straight segments of a line string are coded in accordance with the rule LineSegment, for arc segments the rule ArcSegment applies. Line segments defined with LINE FORM are coded as structures (LineStructure).

Note: For arc segments (rule ArcSegment) the radius (optional XML-attribute R) is transmitted redundantly to the intermediate point coordinate (A1/A2). The intermediate point of an arc is only of significance for its position. Its höhe must be interpolated linearly between start and end point. If the arc has been defined clockwise (from start to end point), the radius will have a positive sign, otherwise negative. If differences occur between radius and coordinate values, it is the radius that prevails (cf. chapter 2.8.11.2 Line strings with straight line segments and circle arcs as predefined curve segments). The vertex height (C3) only has to be transferred with 3D-line strings.

3.3.12.12 Coding of SURFACE and AREA

SURFACE and AREA are coded as follows:

```

SurfaceValue = TAG ( SURFACE )
                OuterBoundary
                { InnerBoundary }
                ETAG ( SURFACE ).

```

```

OuterBoundary = Boundary.

```

```

InnerBoundary = Boundary.

```

```

Boundary = TAG ( BOUNDARY )
            (* PolylineValue *)
            ETAG ( BOUNDARY ).

```

Surfaces are transmitted as a sequence of boundaries. A boundary is a sequence of boundary lines, the next boundary line starting with the end point of the preceding boundary line. The end point of the last boundary line is identical with the start point of the first boundary line. Thus the boundary lines form a closed line string (polygon).

The first boundary of a surface (OuterBoundary) is the outer boundary of a surface, possibly followed by inner boundaries (InnerBoundary) of the surface which limit the enclosures of the surface. The inner boundaries must be located completely within the outer boundaries. The individual boundaries of a surface may not overlap.

If SURFACE or AREA have been defined with line attributes, the structure element of the line attribute must be transmitted with each PolylineValue (rule LineAttr in PolylineValue).

With area tessellation (AREA) all boundary lines of the surface must coincide with the boundary lines of the neighbouring surface(s), unless they form part of the perimeter of the area network. Two boundary lines are considered identical if in every segment of the boundary line all vertices are identical with the corresponding segment of the neighbouring surface. With arc vertices merely the sign of the arc radius may differ. If line attributes have been defined for the area network, the line attribute values for the boundary lines must be identical in pairs of two.

3.3.12.13 Coding of References

Attributes of the type REFERENCE TO are coded as follows:

```

ReferenceAttribute = [ TAG ( %AttributeName%,
                          ('REF=' XML-ID |

```



```
'EXTREF=' XML-ID 'BID=' XML-ID))  
ETAG ( %AttributeName% ) ].
```

The XML-attributes REF, EXTREF and BID have the same significance as with eigentlichen relations.

3.3.12.14 Coding of METAOBJECT and METAOBJECT OF

Attributes of the type METAOBJECT (cf. the corresponding class in appendix A The Internal INTERLIS-data model) are coded in accordance with chapter 3.3.12.9 Coding of BAG OF and LIST OF. However parameters of the type METAOBJECT (syntax rule ParameterDef) are not transmitted. Parameters of the type METAOBJECT OF are transmitted as attributes of the type NAME.

3.4 Application of XML-Tools

Since the INTERLIS 2-transfer is based entirely on XML 1.0, it is possible to use either INTERLIS or XML-tools for the processing (resp. analysis) of INTERLIS-objects. However the following differences have to be taken into consideration:

- Besides the XML-data set, INTERLIS 2-tools will also recognize the corresponding INTERLIS 2-data models. Thus e.g. an INTERLIS-controlling tool will in general be able to execute more rigorous tests than a mere XML-tool could.
- INTERLIS 2-tools know all the specific INTERLIS-data types such as COORD, POLYLINE, SURFACE etc. Hence an INTERLIS 2-browser will be able to represent data sets also graphically, whereas a mere XML-browser will only visualize the structure of the document.
- INTERLIS 2-tools support polymorph reading of data via Alias-table. Therefore an INTERLIS-import program will be able to read of an extended model much in the same way as data of a base model. With a mere XML-tool polymorph reading is not automatically possible.
- Furthermore INTERLIS 2-tools can support the translation of schema-names via Alias-table. Again this would not be possible with mere XML-tools.

Despite all these differences general XML-tools may be directly employed for several purposes. Amongst others we would like to name the filtering of data sets, the editing of data-sets with XML-editors, the examination of transfer-data sets, the translation into other formats, etc.

Appendix A (normative) The Internal INTERLIS-Data Model

Hereafter the entire internal INTERLIS 2-data model has been summarized once more. It may also be created by means of a specific call of the INTERLIS 2-compiler. If the different elements of the model are already known to the INTERLIS 2-compiler, then it cannot be compiled but only serves as an illustration. The INTERLIS 2-compiler supplied by KOGIS already knows these models.

```
!! File INTERLIS2.2.ili 2003-03-18

INTERLIS 2.2;

TYPE MODEL INTERLIS (en) =

  LINE FORM
    STRAIGHTS;
    ARCS;

  UNIT
    ANYUNIT (ABSTRACT);
    DIMENSIONLESS (ABSTRACT);
    LENGTH (ABSTRACT);
    MASS (ABSTRACT);
    TIME (ABSTRACT);
    ELECTRIC_CURRENT (ABSTRACT);
    TEMPERATURE (ABSTRACT);
    AMOUNT_OF_MATTER (ABSTRACT);
    ANGLE (ABSTRACT);
    SOLID_ANGLE (ABSTRACT);
    LUMINOUS_INTENSITY (ABSTRACT);
    MONEY (ABSTRACT);

    METER [m] EXTENDS LENGTH;
    KILOGRAM [kg] EXTENDS MASS;
    SECOND [s] EXTENDS TIME;
    AMPERE [A] EXTENDS ELECTRIC_CURRENT;
    DEGREE_KELVIN [K] EXTENDS TEMPERATURE;
    MOLE [mol] EXTENDS AMOUNT_OF_MATTER;
    RADIAN [rad] EXTENDS ANGLE;
    STERADIAN [sr] EXTENDS SOLID_ANGLE;
    CANDELA [cd] EXTENDS LUMINOUS_INTENSITY;

  DOMAIN
    URI (FINAL) = TEXT*1023;
    NAME (FINAL) = TEXT*255;
    INTERLIS_1_DATE (FINAL) = TEXT*8;
    BOOLEAN (FINAL) = (
      false,
      true) ORDERED;
    HALIGNMENT (FINAL) = (
      Left,
      Center,
      Right) ORDERED;
    VALIGNMENT (FINAL) = (
      Top,
      Cap,
      Half,
      Base,
      Bottom) ORDERED;
    ANYOID (ABSTRACT) = OID ANY;
    I32OID = OID 0 .. 2147483647;
    STANDARDOID = TEXT*16;
    LineCoord (ABSTRACT) = COORD NUMERIC, NUMERIC, NUMERIC;
```

```

FUNCTION myClass (Object: OBJECT OF ANYSTRUCTURE): STRUCTURE;
FUNCTION issubClass (potSubClass: STRUCTURE; potSuperClass: STRUCTURE):
    BOOLEAN;
FUNCTION isofClass (Object: OBJECT OF ANYSTRUCTURE; Class: STRUCTURE): BOOLEAN;
FUNCTION elementCount (bag: BAG OF ANYSTRUCTURE): NUMERIC;
FUNCTION convertUnit (from: NUMERIC): NUMERIC;

STRUCTURE LineSegment (ABSTRACT) =
    SegmentEndPoint: MANDATORY LineCoord;
END LineSegment;

STRUCTURE StartSegment (FINAL) EXTENDS LineSegment =
END StartSegment;

STRUCTURE StraightSegment (FINAL) EXTENDS LineSegment =
END StraightSegment;

STRUCTURE ArcSegment (FINAL) EXTENDS LineSegment =
    ArcPoint: MANDATORY LineCoord;
    Radius: NUMERIC [LENGTH];
END ArcSegment;

STRUCTURE SurfaceEdge =
    Geometry: DIRECTED POLYLINE;
    LineAttrs: ANYSTRUCTURE;
END SurfaceEdge;

STRUCTURE SurfaceBoundary =
    Lines: LIST OF SurfaceEdge;
END SurfaceBoundary;

STRUCTURE LineGeometry =
    Segments: LIST OF LineSegment;
MANDATORY CONSTRAINT isOfClass (Segments[FIRST],StartSegment);
END LineGeometry;

STRUCTURE Basket (ABSTRACT) =
    Model: MANDATORY NAME;
    Topic: MANDATORY NAME;
    Kind: MANDATORY (Data, View, Base, Graphic);
    Ident (ABSTRACT): MANDATORY ANYOID;
END Basket;

CLASS METAOBJECT (ABSTRACT) =
    Name: MANDATORY NAME;
    UNIQUE Name;
END METAOBJECT;

CLASS METAOBJECT_TRANSLATION =
    Name: MANDATORY NAME;
    NameInBaseLanguage: MANDATORY NAME;
    UNIQUE Name;
    UNIQUE NameInBaseLanguage;
END METAOBJECT_TRANSLATION;

STRUCTURE AXIS =
    PARAMETER
        Unit: NUMERIC [ ANYUNIT ];
END AXIS;

CLASS REFSYSTEM (ABSTRACT) EXTENDS METAOBJECT =
END REFSYSTEM;

CLASS COORDSYSTEM (ABSTRACT) EXTENDS REFSYSTEM =
    ATTRIBUTE
        Axis: LIST {1..*} OF AXIS;
END COORDSYSTEM;

```

```
CLASS SCALSYSTEM (ABSTRACT) EXTENDS REFSYSTEM =  
  PARAMETER  
    Unit: NUMERIC [ ANYUNIT ];  
END SCALSYSTEM;  
  
CLASS SIGN (ABSTRACT) EXTENDS METAOBJECT =  
  PARAMETER  
    Sign: METAOBJECT;  
END SIGN;  
  
END INTERLIS.
```

Appendix B (normative for CH) Symbol Table

In the table below you will find all available standard INTERLIS 2-symbols, as well as special symbols, umlauts and diacritic marks and their coding in an INTERLIS-transfer. For some of these symbols various forms of coding are at your disposal and in these cases all possible forms of coding of the symbol are stated. Whenever several coding possibilities exist, an INTERLIS 2-writing program will select one of these possibilities. An INTERLIS 2-reading program must be able to recognize all of these forms of coding for one symbol.

The table only applies to XML-Content (i.e. XML-String, resp. XML-Value). XML-Tags are transmitted exclusively as ASCII-coded symbols in accordance with the syntax of chapter 3.

Besides the standard symbols listed in the table other symbols can be used in INTERLIS 2-applications, provided a contract has been agreed to between the parties concerned.

UCS Hex	UCS Dec	UTF-8 Coding Octet Hex	XML Coding Character Reference Dec	XML Coding Character Reference Hex	XML Coding Entity Reference	Represented as
0020	32	20				
0021	33	21				!
0022	34	22				"
0023	35	23				#
0024	36	24				\$
0025	37	25				%
0026	38		&	&	&	&
0027	39	27				'
0028	40	28				(
0029	41	29)
002A	42	2A				*
002B	43	2B				+
002C	44	2C				,
002D	45	2D				-
002E	46	2E				.
002F	47	2F				/
0030	48	30				0
0031	49	31				1
0032	50	32				2
0033	51	33				3
0034	52	34				4
0035	53	35				5
0036	54	36				6
0037	55	37				7
0038	56	38				8
0039	57	39				9
003A	58	3A				:
003B	59	3B				;
003C	60		<	<	<	<
003D	61	3D				=
003E	62	3E	>	>	>	>
003F	63	3F				?
0040	64	40				@
0041	65	41				A

UCS Hex	UCS Dec	UTF-8 Coding Octet Hex	XML Coding Character Reference Dec	XML Coding Character Reference Hex	XML Coding Entity Reference	Represent- ed as
0042	66	42				B
0043	67	43				C
0044	68	44				D
0045	69	45				E
0046	70	46				F
0047	71	47				G
0048	72	48				H
0049	73	49				I
004A	74	4A				J
004B	75	4B				K
004C	76	4C				L
004D	77	4D				M
004E	78	4E				N
004F	79	4F				O
0050	80	50				P
0051	81	51				Q
0052	82	52				R
0053	83	53				S
0054	84	54				T
0055	85	55				U
0056	86	56				V
0057	87	57				W
0058	88	58				X
0059	89	59				Y
005A	90	5A				Z
005B	91	5B				[
005C	92	5C				\
005D	93	5D]
005E	94	5E				^
005F	95	5F				_
0060	96	60				`
0061	97	61				a
0062	98	62				b
0063	99	63				c
0064	100	64				d
0065	101	65				e
0066	102	66				f
0067	103	67				g
0068	104	68				h
0069	105	69				i
006A	106	6A				j
006B	107	6B				k
006C	108	6C				l
006D	109	6D				m
006E	110	6E				n
006F	111	6F				o
0070	112	70				p
0071	113	71				q
0072	114	72				r
0073	115	73				s
0074	116	74				t
0075	117	75				u
0076	118	76				v

UCS Hex	UCS Dec	UTF-8 Coding Octet Hex	XML Coding Character Reference Dec	XML Coding Character Reference Hex	XML Coding Entity Reference	Represented as
0077	119	77				w
0078	120	78				x
0079	121	79				y
007A	122	7A				z
007B	123	7B				{
007C	124	7C				
007D	125	7D				}
007E	126	7E				~
00C4	196	C3 84	Ä	Ä		Ä
00C6	198	C3 86	Æ	Æ		Æ
00C7	199	C3 87	Ç	Ç		Ç
00C8	200	C3 88	È	È		È
00C9	201	C3 89	É	É		É
00D1	209	C3 91	Ñ	Ñ		Ñ
00D6	214	C3 96	Ö	Ö		Ö
00DC	220	C3 9C	Ü	Ü		Ü
00E0	224	C3 A0	à	à		à
00E1	225	C3 A1	á	á		á
00E2	226	C3 A2	â	â		â
00E4	228	C3 A4	ä	ä		ä
00E6	230	C3 A6	æ	æ		æ
00E7	231	C3 A7	ç	ç		ç
00E8	232	C3 A8	è	è		è
00E9	233	C3 A9	é	é		é
00EA	234	C3 AA	ê	ê		ê
00EB	235	C3 AB	ë	ë		ë
00EC	236	C3 AC	ì	ì		ì
00ED	237	C3 AD	í	í		í
00EE	238	C3 AE	î	î		î
00EF	239	C3 AF	ï	ï		ï
00F1	241	C3 B1	ñ	ñ		ñ
00F2	242	C3 B2	ò	ò		ò
00F3	243	C3 B3	ó	ó		ó
00F4	244	C3 B4	ô	ô		ô
00F5	245	C3 B5	õ	õ		õ
00F6	246	C3 B6	ö	ö		ö
00F9	249	C3 B9	ù	ù		ù
00FA	250	C3 BA	ú	ú		ú
00FB	251	C3 BB	û	û		û
00FC	252	C3 BC	ü	ü		ü

Table 2: Unicode symbols permitted in INTERLIS and their coding.

Notes:

- In the columns UCS/Hex resp. UCS/Decimal the UCS (resp. Unicode) code of the symbol has been indicated (hexadecimal, resp. decimal).
- In the column UTF-8 coding the coding of the symbol has been indicated according to UTF-8 as 8bit bytes (octet) in hexadecimal notation. The symbols >= Hex 80 are coded as multiple byte sequences. Note: The hexadecimal notation is only used to illustrate the coding. Only binary coded octets are transmitted on the transfer-file.
- In the columns XML coding character reference (Dec), resp. character reference (Hex) the coding of the symbol is indicated as XML character reference (decimal, resp. hexadecimal variant). This

value is an ASCII-symbol sequence and must be used strictly accurate in the transfer. Whenever possible a writing program should select the character reference coding for the symbol. The advantage of character reference coding lies in its ability to be indicated, resp. edited with simple ASCII-editors on any platform (Unix, PC etc.). Note: With the hexadecimal coding variant the letters a-f can be listed in capitals or small letters (however the x in the hexadecimal variant must always be a small letter).

- The XML-coding (Entity Reference) is only admissible for some few special symbols. Its value is an ASCII-sequence which has to be used accurately in the transfer. Note: XML-entities such as ü (for the symbol ü) are not admissible in an INTERLIS 2 transfer-file, since no DTD will be referenced by an INTERLIS 2 transfer-file (permissible entities such as & have been predefined in the XML 1.0 specification).
- In the column representation you will find the representation of the symbol in a UCS, resp. Unicode compatible editor.

Appendix C (informative) A Small Example

Introduction

In order to facilitate your entry into INTERLIS 2, we provide a small but nevertheless complete example. It describes a data set designed for a complete data transfer. For examples of application with incremental update (including OID), we supply the necessary test data sets and user manuals.

The example consists of the following parts:

- Data model RoadsExdm2ben_10 and RoadsExdm2ien_10.
- XML-data set RoadsExdm2ien (file RoadsExdm2en.xml) which contains objects in accordance with the data model RoadsExdm2ien_10.
- Graphic model RoadsExgm2ien_10. One possible representation for the data model RoadsExdm2en_10 is defined in the graphic model (Note: Any number of representations is possible for one single data model).
- Collection of symbol objects (symbology library) in RoadsExgm2ien_Symbols (file RoadsExgm2ien_Symbols.xml). The symbology library is an XML-data set in accordance with the symbology model StandardSymbology (cf. also Appendix K Symbology Models). The symbol library is used in the graphic model RoadsExgm2ien_10 for the representation of exemplifying data from the RoadsExdm2ien.xml-data set.

The name "RoadsExdm2ben_10" is an abbreviation of "**R**oads**E**xample, **D**ata **M**odel, **I**nter**L**IS **2**, **B**asic Model, **e**nglish, **R**elease_10". Hereafter the individual parts will be described more in detail.

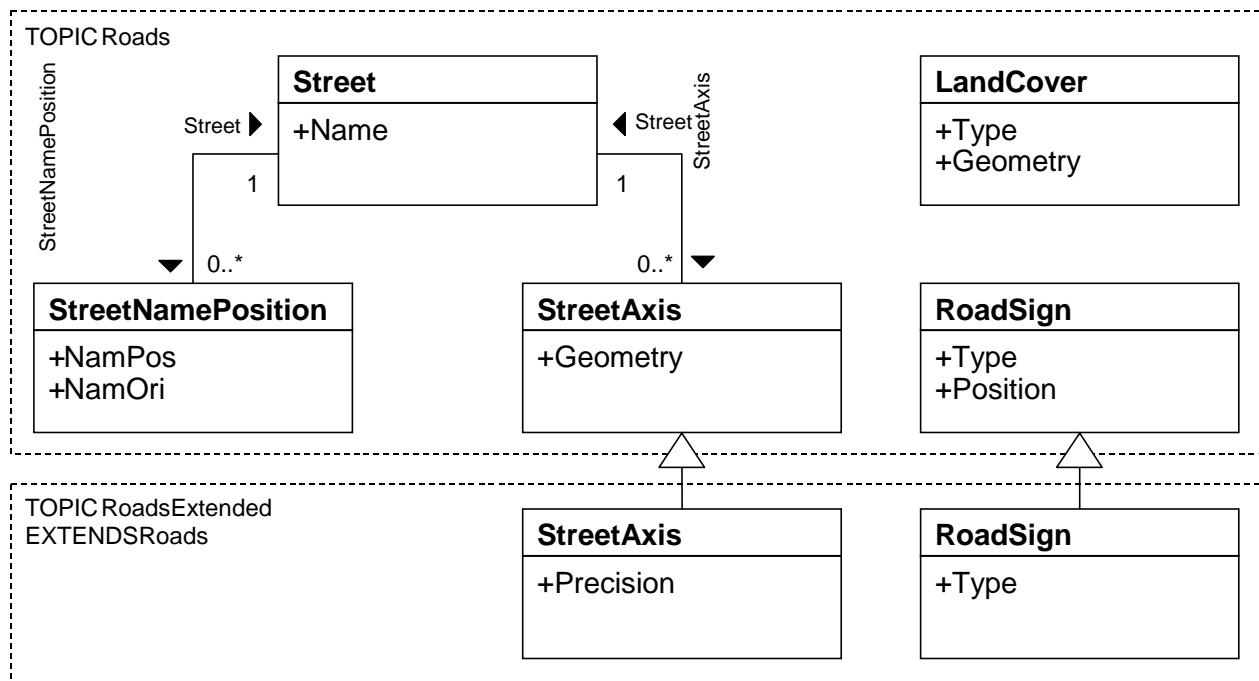


Figure 26: UML-class diagram of data model RoadsExdm2en_10.

Data Model RoadsExdm2en_10 and RoadsExdm2ien_10

The data model RoadsExdm2en_10 contains the objects LandCover, StreetAxis, StreetName and PointObject. The data model RoadsExdm2ien_10 is an extension of RoadsExdm2ben_10. The UML-class diagram above (figure 26) supplies a comprehensive over-view of the data models

Note: It is on purpose that the example chosen is very simple and we do not lay claim to completeness. The corresponding models defined in INTERLIS 2 read as follows:

```
!! File RoadsExdm2ben_10.ili Release 2003-02-26

INTERLIS 2.2;

MODEL RoadsExdm2ben_10 (en) =

  UNIT
    Angle_Degree = 180 / PI [INTERLIS.rad];

  DOMAIN
    Point2D = COORD
      0.000 .. 200.000 [INTERLIS.m], !! Min_East  Max_East
      0.000 .. 200.000 [INTERLIS.m], !! Min_North Max_North
      ROTATION 2 -> 1;
      Orientation = 0.0 .. 359.9 CIRCULAR [Angle_Degree];

  TOPIC Roads =

    STRUCTURE LAttrs =
      LArt: (
        welldefined,
        fuzzy);
    END LAttrs;

    CLASS LandCover =
      Type: MANDATORY (
        building,
        street,
        water,
        other);
      Geometry: MANDATORY SURFACE WITH (STRAIGHTS)
        VERTEX Point2D WITHOUT OVERLAPS > 0.100
        LINE ATTRIBUTES LAttrs;
    END LandCover;

    CLASS Street =
      Name: MANDATORY TEXT*32;
    END Street;

    CLASS StreetAxis =
      Geometry: MANDATORY POLYLINE WITH (STRAIGHTS)
        VERTEX Point2D;
    END StreetAxis;

    ASSOCIATION StreetAxisAssoc =
      Street -- {1} Street;
      StreetAxis -- StreetAxis;
    END StreetAxisAssoc;

    CLASS StreetNamePosition =
      NamPos: MANDATORY Point2D;
      NamOri: MANDATORY Orientation;
    END StreetNamePosition;

    ASSOCIATION StreetNamePositionAssoc =
      Street -- {0..1} Street;
      StreetNamePosition -- StreetNamePosition;
    END StreetNamePositionAssoc;
```

```

    CLASS RoadSign =
      Type: MANDATORY (
        prohibition,
        indication,
        danger,
        velocity);
      Position: MANDATORY Point2D;
    END RoadSign;

  END Roads; !! of TOPIC

END RoadsExdm2ben_10. !! of MODEL

!! File RoadsExdm2ien_10.ili Release 2003-02-26

INTERLIS 2.2;

MODEL RoadsExdm2ien_10 (en) =

  IMPORTS RoadsExdm2ben_10;

  TOPIC RoadsExtended EXTENDS RoadsExdm2ben_10.Roads =

    CLASS StreetAxis (EXTENDED) =
      Precision: MANDATORY (
        precise,
        unprecise);
    END StreetAxis;

    CLASS RoadSign (EXTENDED) =
      Type (EXTENDED): (
        prohibition (
          noentry,
          noparking,
          other));
    END RoadSign;

  END RoadsExtended; !! of TOPIC

END RoadsExdm2ien_10. !! of MODEL

```

Data set RoadsExdm2ien in accordance with data model RoadsExdm2ien_10

Below you will find an exemplary data set for the data model RoadsExdm2ien_10. The XML-formatting has been derived from the data model RoadsExdm2ien_10 by means of the rules stated in chapter 3 Sequential Transfer.

```

<?xml version="1.0" encoding="UTF-8"?>

<!-- File RoadsExdm2ien.xml 2003-02-26 -->

<TRANSFER xmlns="http://www.interlis.ch/INTERLIS2.2"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.interlis.ch/INTERLIS2.2
    RoadsExdm2ien_10.xsd">
  <HEADERSECTION VERSION="2.2" SENDER="V+D">
    <ALIAS>
      <ENTRIES FOR="RoadsExdm2ben_10">
        <TAGENTRY FROM="RoadsExdm2ben_10.Roads"
          TO="RoadsExdm2ben_10.Roads" />
        <TAGENTRY FROM="RoadsExdm2ien_10.RoadsExtended"
          TO="RoadsExdm2ben_10.Roads" />
        <TAGENTRY FROM="RoadsExdm2ben_10.Roads.LAttrs"
          TO="RoadsExdm2ben_10.Roads.LAttrs" />
      </ENTRIES>
    </ALIAS>
  </HEADERSECTION>
</TRANSFER>

```

```

<TAGENTRY FROM="RoadsExdm2ben_10.Roads.LandCover"
TO="RoadsExdm2ben_10.Roads.LandCover"/>
<TAGENTRY FROM="RoadsExdm2ben_10.Roads.Street"
TO="RoadsExdm2ben_10.Roads.Street"/>
<TAGENTRY FROM="RoadsExdm2ben_10.Roads.StreetAxis"
TO="RoadsExdm2ben_10.Roads.StreetAxis"/>
<TAGENTRY FROM="RoadsExdm2ien_10.RoadsExtended.StreetAxis"
TO="RoadsExdm2ben_10.Roads.StreetAxis"/>
<DELENTY TAG="RoadsExdm2ien_10.RoadsExtended.StreetAxis.Precision"/>
<TAGENTRY FROM="RoadsExdm2ben_10.Roads.StreetAxisAssoc"
TO="RoadsExdm2ben_10.Roads.StreetAxisAssoc"/>
<TAGENTRY FROM="RoadsExdm2ben_10.Roads.StreetNamePosition"
TO="RoadsExdm2ben_10.Roads.StreetNamePosition"/>
<TAGENTRY FROM="RoadsExdm2ben_10.Roads.StreetNamePositionAssoc"
TO="RoadsExdm2ben_10.Roads.StreetNamePositionAssoc"/>
<TAGENTRY FROM="RoadsExdm2ben_10.Roads.RoadSign"
TO="RoadsExdm2ben_10.Roads.RoadSign"/>
<TAGENTRY FROM="RoadsExdm2ien_10.RoadsExtended.RoadSign"
TO="RoadsExdm2ben_10.Roads.RoadSign"/>
<VALENTY ATTR="RoadsExdm2ben_10.Roads.LAttrs.LArt"
FROM="welldefined" TO="welldefined"/>
<VALENTY ATTR="RoadsExdm2ben_10.Roads.LAttrs.LArt"
FROM="fuzzy" TO="fuzzy"/>
<VALENTY ATTR="RoadsExdm2ben_10.Roads.LandCover.Type"
FROM="building" TO="building"/>
<VALENTY ATTR="RoadsExdm2ben_10.Roads.LandCover.Type"
FROM="street" TO="street"/>
<VALENTY ATTR="RoadsExdm2ben_10.Roads.LandCover.Type"
FROM="water" TO="water"/>
<VALENTY ATTR="RoadsExdm2ben_10.Roads.LandCover.Type"
FROM="other" TO="other"/>
<VALENTY ATTR="RoadsExdm2ben_10.Roads.RoadSign.Type"
FROM="prohibition" TO="prohibition"/>
<VALENTY ATTR="RoadsExdm2ben_10.Roads.RoadSign.Type"
FROM="indication" TO="indication"/>
<VALENTY ATTR="RoadsExdm2ben_10.Roads.RoadSign.Type"
FROM="danger" TO="danger"/>
<VALENTY ATTR="RoadsExdm2ben_10.Roads.RoadSign.Type"
FROM="velocity" TO="velocity"/>
<VALENTY ATTR="RoadsExdm2ien_10.RoadsExtended.RoadSign.Type"
FROM="prohibition.noentry" TO="prohibition"/>
<VALENTY ATTR="RoadsExdm2ien_10.RoadsExtended.RoadSign.Type"
FROM="prohibition.noparking" TO="prohibition"/>
<VALENTY ATTR="RoadsExdm2ien_10.RoadsExtended.RoadSign.Type"
FROM="prohibition.other" TO="prohibition"/>
</ENTRIES>

<ENTRIES FOR="RoadsExdm2ien_10">
<TAGENTRY FROM="RoadsExdm2ien_10.RoadsExtended"
TO="RoadsExdm2ien_10.RoadsExtended"/>
<TAGENTRY FROM="RoadsExdm2ien_10.RoadsExtended.StreetAxis"
TO="RoadsExdm2ien_10.RoadsExtended.StreetAxis"/>
<TAGENTRY FROM="RoadsExdm2ien_10.RoadsExtended.RoadSign"
TO="RoadsExdm2ien_10.RoadsExtended.RoadSign"/>
<VALENTY ATTR="RoadsExdm2ien_10.RoadsExtended.StreetAxis.Precision"
FROM="precise" TO="precise"/>
<VALENTY ATTR="RoadsExdm2ien_10.RoadsExtended.StreetAxis.Precision"
FROM="unprecise" TO="unprecise"/>
<VALENTY ATTR="RoadsExdm2ien_10.RoadsExtended.RoadSign.Type"
FROM="prohibition.noentry" TO="prohibition.noentry"/>
<VALENTY ATTR="RoadsExdm2ien_10.RoadsExtended.RoadSign.Type"
FROM="prohibition.noparking" TO="prohibition.noparking"/>
<VALENTY ATTR="RoadsExdm2ien_10.RoadsExtended.RoadSign.Type"
FROM="prohibition.other" TO="prohibition.other"/>
</ENTRIES>
</ALIAS>

<COMMENT>

```

```

    example dataset ili2 refmanual appendix C
  </COMMENT>
</HEADERSECTION>

<DATASECTION>
  <RoadsExdm2ien_10.RoadsExtended BID="xREFHANDB00000001">

    <!-- === LandCover === -->
    <RoadsExdm2ben_10.Roads.LandCover TID="x16">
      <Type>water</Type>
      <Geometry>
        <SURFACE>
          <BOUNDARY>
            <POLYLINE>
              <LINEATTR>
                <RoadsExdm2ben_10.Roads.LAttrs>
                  <LArt>welldefined</LArt>
                </RoadsExdm2ben_10.Roads.LAttrs>
              </LINEATTR>
              <COORD><C1>39.038</C1><C2>60.315</C2></COORD>
              <COORD><C1>41.200</C1><C2>59.302</C2></COORD>
              <COORD><C1>43.362</C1><C2>60.315</C2></COORD>
              <COORD><C1>44.713</C1><C2>66.268</C2></COORD>
              <COORD><C1>45.794</C1><C2>67.662</C2></COORD>
              <COORD><C1>48.766</C1><C2>67.408</C2></COORD>
              <COORD><C1>53.360</C1><C2>64.115</C2></COORD>
              <COORD><C1>56.197</C1><C2>62.595</C2></COORD>
              <COORD><C1>57.818</C1><C2>63.862</C2></COORD>
              <COORD><C1>58.899</C1><C2>68.928</C2></COORD>
              <COORD><C1>55.927</C1><C2>72.348</C2></COORD>
              <COORD><C1>47.955</C1><C2>75.515</C2></COORD>
              <COORD><C1>42.281</C1><C2>75.388</C2></COORD>
              <COORD><C1>39.308</C1><C2>73.235</C2></COORD>
              <COORD><C1>36.741</C1><C2>69.688</C2></COORD>
              <COORD><C1>35.525</C1><C2>66.268</C2></COORD>
              <COORD><C1>35.661</C1><C2>63.735</C2></COORD>
              <COORD><C1>37.957</C1><C2>61.455</C2></COORD>
              <COORD><C1>39.038</C1><C2>60.315</C2></COORD>
            </POLYLINE>
          </BOUNDARY>
        </SURFACE>
      </Geometry>
    </RoadsExdm2ben_10.Roads.LandCover>

    <RoadsExdm2ben_10.Roads.LandCover TID="x18">
      <Type>building</Type>
      <Geometry>
        <SURFACE>
          <BOUNDARY>
            <POLYLINE>
              <LINEATTR>
                <RoadsExdm2ben_10.Roads.LAttrs>
                  <LArt>welldefined</LArt>
                </RoadsExdm2ben_10.Roads.LAttrs>
              </LINEATTR>
              <COORD><C1>101.459</C1><C2>65.485</C2></COORD>
              <COORD><C1>108.186</C1><C2>69.369</C2></COORD>
              <COORD><C1>102.086</C1><C2>79.936</C2></COORD>
              <COORD><C1>95.359</C1><C2>76.053</C2></COORD>
              <COORD><C1>101.459</C1><C2>65.485</C2></COORD>
            </POLYLINE>
          </BOUNDARY>
        </SURFACE>
      </Geometry>
    </RoadsExdm2ben_10.Roads.LandCover>

    <RoadsExdm2ben_10.Roads.LandCover TID="x20">
      <Type>building</Type>

```

```

    <Geometry>
      <SURFACE>
        <BOUNDARY>
          <POLYLINE>
            <LINEATTR>
              <RoadsExdm2ben_10.Roads.LAttrs>
                <LArt>welldefined</LArt>
              </RoadsExdm2ben_10.Roads.LAttrs>
            </LINEATTR>
            <COORD><C1>60.489</C1><C2>49.608</C2></COORD>
            <COORD><C1>79.900</C1><C2>55.839</C2></COORD>
            <COORD><C1>75.351</C1><C2>70.932</C2></COORD>
            <COORD><C1>67.678</C1><C2>68.781</C2></COORD>
            <COORD><C1>69.938</C1><C2>61.721</C2></COORD>
            <COORD><C1>57.582</C1><C2>58.029</C2></COORD>
            <COORD><C1>60.489</C1><C2>49.608</C2></COORD>
          </POLYLINE>
        </BOUNDARY>
      </SURFACE>
    </Geometry>
  </RoadsExdm2ben_10.Roads.LandCover>

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              </RoadsExdm2ben_10.Roads.LAttrs>
            </LINEATTR>
            <COORD><C1>45.067</C1><C2>58.655</C2></COORD>
            <COORD><C1>50.669</C1><C2>42.579</C2></COORD>
            <COORD><C1>57.060</C1><C2>44.638</C2></COORD>
            <COORD><C1>51.432</C1><C2>60.469</C2></COORD>
            <COORD><C1>45.067</C1><C2>58.655</C2></COORD>
          </POLYLINE>
        </BOUNDARY>
      </SURFACE>
    </Geometry>
  </RoadsExdm2ben_10.Roads.LandCover>

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                <LArt>welldefined</LArt>
              </RoadsExdm2ben_10.Roads.LAttrs>
            </LINEATTR>
            <COORD><C1>114.027</C1><C2>99.314</C2></COORD>
            <COORD><C1>31.351</C1><C2>99.314</C2></COORD>
            <COORD><C1>31.140</C1><C2>92.530</C2></COORD>
            <COORD><C1>70.419</C1><C2>86.177</C2></COORD>
            <COORD><C1>86.481</C1><C2>79.710</C2></COORD>
            <COORD><C1>114.027</C1><C2>99.314</C2></COORD>
          </POLYLINE>
        </BOUNDARY>
      </SURFACE>
    </Geometry>
  </RoadsExdm2ben_10.Roads.LandCover>

  <RoadsExdm2ben_10.Roads.LandCover TID="x26">

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<Type>other</Type>
<Geometry>
  <SURFACE>
    <BOUNDARY>
      <POLYLINE>
        <LINEATTR>
          <RoadsExdm2ben_10.Roads.LAttrs>
            <LArt>welldefined</LArt>
          </RoadsExdm2ben_10.Roads.LAttrs>
        </LINEATTR>
        <COORD><C1>113.559</C1><C2>62.880</C2></COORD>
        <COORD><C1>114.027</C1><C2>99.314</C2></COORD>
        <COORD><C1>86.481</C1><C2>79.710</C2></COORD>
        <COORD><C1>94.381</C1><C2>66.289</C2></COORD>
        <COORD><C1>96.779</C1><C2>57.177</C2></COORD>
        <COORD><C1>113.559</C1><C2>62.880</C2></COORD>
      </POLYLINE>
    </BOUNDARY>
  </SURFACE>
  <BOUNDARY>
    <POLYLINE>
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      </LINEATTR>
      <COORD><C1>108.186</C1><C2>69.369</C2></COORD>
      <COORD><C1>101.459</C1><C2>65.485</C2></COORD>
      <COORD><C1>95.359</C1><C2>76.053</C2></COORD>
      <COORD><C1>102.086</C1><C2>79.936</C2></COORD>
      <COORD><C1>108.186</C1><C2>69.369</C2></COORD>
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  </BOUNDARY>
</Geometry>
</RoadsExdm2ben_10.Roads.LandCover>

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  <Geometry>
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          <LINEATTR>
            <RoadsExdm2ben_10.Roads.LAttrs>
              <LArt>welldefined</LArt>
            </RoadsExdm2ben_10.Roads.LAttrs>
          </LINEATTR>
          <COORD><C1>100.621</C1><C2>24.239</C2></COORD>
          <COORD><C1>109.729</C1><C2>24.239</C2></COORD>
          <COORD><C1>105.640</C1><C2>48.068</C2></COORD>
          <COORD><C1>96.779</C1><C2>45.088</C2></COORD>
          <COORD><C1>100.621</C1><C2>24.239</C2></COORD>
        </POLYLINE>
      </BOUNDARY>
    </SURFACE>
  </Geometry>
</RoadsExdm2ben_10.Roads.LandCover>

<RoadsExdm2ben_10.Roads.LandCover TID="x31">
  <Type>other</Type>
  <Geometry>
    <SURFACE>
      <BOUNDARY>
        <POLYLINE>
          <LINEATTR>
            <RoadsExdm2ben_10.Roads.LAttrs>
              <LArt>welldefined</LArt>
            </RoadsExdm2ben_10.Roads.LAttrs>
          </LINEATTR>
          <COORD><C1>100.621</C1><C2>24.239</C2></COORD>
          <COORD><C1>109.729</C1><C2>24.239</C2></COORD>
          <COORD><C1>105.640</C1><C2>48.068</C2></COORD>
          <COORD><C1>96.779</C1><C2>45.088</C2></COORD>
          <COORD><C1>100.621</C1><C2>24.239</C2></COORD>
        </POLYLINE>
      </BOUNDARY>
    </SURFACE>
  </Geometry>
</RoadsExdm2ben_10.Roads.LandCover>

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        </LINEATTR>
        <COORD><C1>30.900</C1><C2>24.478</C2></COORD>
        <COORD><C1>100.621</C1><C2>24.239</C2></COORD>
        <COORD><C1>96.779</C1><C2>45.088</C2></COORD>
        <COORD><C1>30.900</C1><C2>24.478</C2></COORD>
    </POLYLINE>
</BOUNDARY>
</SURFACE>
</Geometry>
</RoadsExdm2ben_10.Roads.LandCover>

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    <Geometry>
        <SURFACE>
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                            <LArt>welldefined</LArt>
                        </RoadsExdm2ben_10.Roads.LAttrs>
                    </LINEATTR>
                    <COORD><C1>31.110</C1><C2>83.750</C2></COORD>
                    <COORD><C1>31.140</C1><C2>36.458</C2></COORD>
                    <COORD><C1>50.669</C1><C2>42.579</C2></COORD>
                    <COORD><C1>45.067</C1><C2>58.655</C2></COORD>
                    <COORD><C1>51.432</C1><C2>60.469</C2></COORD>
                    <COORD><C1>57.060</C1><C2>44.638</C2></COORD>
                    <COORD><C1>87.839</C1><C2>54.138</C2></COORD>
                    <COORD><C1>85.282</C1><C2>63.410</C2></COORD>
                    <COORD><C1>78.847</C1><C2>73.433</C2></COORD>
                    <COORD><C1>67.549</C1><C2>77.788</C2></COORD>
                    <COORD><C1>31.110</C1><C2>83.750</C2></COORD>
                </POLYLINE>
            </BOUNDARY>
            <BOUNDARY>
                <POLYLINE>
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                    </LINEATTR>
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                    <COORD><C1>39.038</C1><C2>60.315</C2></COORD>
                    <COORD><C1>37.957</C1><C2>61.455</C2></COORD>
                    <COORD><C1>35.661</C1><C2>63.735</C2></COORD>
                    <COORD><C1>35.525</C1><C2>66.268</C2></COORD>
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                    <COORD><C1>58.899</C1><C2>68.928</C2></COORD>
                    <COORD><C1>57.818</C1><C2>63.862</C2></COORD>
                    <COORD><C1>56.197</C1><C2>62.595</C2></COORD>
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        <LArt>welldefined</LArt>
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    <COORD><C1>57.582</C1><C2>58.029</C2></COORD>
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    <COORD><C1>79.900</C1><C2>55.839</C2></COORD>
  </POLYLINE>
</BOUNDARY>
</SURFACE>
</Geometry>
</RoadsExdm2ben_10.Roads.LandCover>

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              <LArt>welldefined</LArt>
            </RoadsExdm2ben_10.Roads.LAttrs>
          </LINEATTR>
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          <COORD><C1>31.110</C1><C2>83.750</C2></COORD>
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          <COORD><C1>85.282</C1><C2>63.410</C2></COORD>
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          <COORD><C1>70.419</C1><C2>86.177</C2></COORD>
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        </POLYLINE>
      </BOUNDARY>
    </SURFACE>
  </Geometry>
</RoadsExdm2ben_10.Roads.LandCover>

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  <Geometry>
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          </LINEATTR>
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          <COORD><C1>105.640</C1><C2>48.068</C2></COORD>
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      </BOUNDARY>
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  </Geometry>
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  <Type>street</Type>

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                <LArt>welldefined</LArt>
              </RoadsExdm2ben_10.Roads.LAttrs>
            </LINEATTR>
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            <COORD><C1>113.811</C1><C2>51.168</C2></COORD>
            <COORD><C1>113.559</C1><C2>62.880</C2></COORD>
            <COORD><C1>96.779</C1><C2>57.177</C2></COORD>
            <COORD><C1>87.839</C1><C2>54.138</C2></COORD>
            <COORD><C1>57.060</C1><C2>44.638</C2></COORD>
            <COORD><C1>50.669</C1><C2>42.579</C2></COORD>
            <COORD><C1>31.140</C1><C2>36.458</C2></COORD>
            <COORD><C1>30.900</C1><C2>24.478</C2></COORD>
            <COORD><C1>96.779</C1><C2>45.088</C2></COORD>
            <COORD><C1>105.640</C1><C2>48.068</C2></COORD>
          </POLYLINE>
        </BOUNDARY>
      </SURFACE>
    </Geometry>
  </RoadsExdm2ben_10.Roads.LandCover>

  <!-- === Street === -->
  <RoadsExdm2ben_10.Roads.Street TID="x1">
    <Name>Austrasse</Name>
  </RoadsExdm2ben_10.Roads.Street>

  <RoadsExdm2ben_10.Roads.Street TID="x2">
    <Name>Eymattstrasse</Name>
  </RoadsExdm2ben_10.Roads.Street>

  <RoadsExdm2ben_10.Roads.Street TID="x3">
    <Name>Feldweg</Name>
  </RoadsExdm2ben_10.Roads.Street>

  <RoadsExdm2ben_10.Roads.Street TID="x4">
    <Name>Seeweg</Name>
  </RoadsExdm2ben_10.Roads.Street>

  <!-- === StreetAxis / StreetAxisAssoc === -->
  <RoadsExdm2ien_10.RoadsExtended.StreetAxis TID="x8">
    <Geometry>
      <POLYLINE>
        <COORD><C1>55.600</C1><C2>37.649</C2></COORD>
        <COORD><C1>15.573</C1><C2>25.785</C2></COORD>
      </POLYLINE>
    </Geometry>
    <Street REF="x1"></Street>
    <Precision>precise</Precision>
  </RoadsExdm2ien_10.RoadsExtended.StreetAxis>

  <RoadsExdm2ien_10.RoadsExtended.StreetAxis TID="x9">
    <Geometry>
      <POLYLINE>
        <COORD><C1>55.600</C1><C2>37.649</C2></COORD>
        <COORD><C1>94.990</C1><C2>50.109</C2></COORD>
      </POLYLINE>
    </Geometry>
    <Street REF="x1"></Street>
    <Precision>precise</Precision>
  </RoadsExdm2ien_10.RoadsExtended.StreetAxis>

  <RoadsExdm2ien_10.RoadsExtended.StreetAxis TID="x10">
    <Geometry>

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    <POLYLINE>
      <COORD><C1>94.990</C1><C2>50.109</C2></COORD>
      <COORD><C1>101.099</C1><C2>52.279</C2></COORD>
    </POLYLINE>
  </Geometry>
  <Street REF="x1"></Street>
  <Precision>precise</Precision>
</RoadsExdm2ien_10.RoadsExtended.StreetAxis>

<RoadsExdm2ien_10.RoadsExtended.StreetAxis TID="x11">
  <Geometry>
    <POLYLINE>
      <COORD><C1>101.099</C1><C2>52.279</C2></COORD>
      <COORD><C1>126.100</C1><C2>62.279</C2></COORD>
    </POLYLINE>
  </Geometry>
  <Street REF="x1"></Street>
  <Precision>precise</Precision>
</RoadsExdm2ien_10.RoadsExtended.StreetAxis>

<RoadsExdm2ien_10.RoadsExtended.StreetAxis TID="x12">
  <Geometry>
    <POLYLINE>
      <COORD><C1>94.990</C1><C2>50.109</C2></COORD>
      <COORD><C1>89.504</C1><C2>65.795</C2></COORD>
      <COORD><C1>83.594</C1><C2>75.598</C2></COORD>
      <COORD><C1>71.774</C1><C2>80.712</C2></COORD>
      <COORD><C1>11.423</C1><C2>91.154</C2></COORD>
    </POLYLINE>
  </Geometry>
  <Street REF="x2"></Street>
  <Precision>precise</Precision>
</RoadsExdm2ien_10.RoadsExtended.StreetAxis>

<RoadsExdm2ien_10.RoadsExtended.StreetAxis TID="x13">
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      <COORD><C1>107.400</C1><C2>14.603</C2></COORD>
    </POLYLINE>
  </Geometry>
  <Street REF="x3"></Street>
  <Precision>unprecise</Precision>
</RoadsExdm2ien_10.RoadsExtended.StreetAxis>

<RoadsExdm2ien_10.RoadsExtended.StreetAxis TID="x15">
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      <COORD><C1>49.359</C1><C2>56.752</C2></COORD>
    </POLYLINE>
  </Geometry>
  <Street REF="x4"></Street>
  <Precision>unprecise</Precision>
</RoadsExdm2ien_10.RoadsExtended.StreetAxis>

<!-- === StreetNamePosition / StreetNamePositionAssoc === -->
<RoadsExdm2ben_10.Roads.StreetNamePosition TID="x5">
  <NamPos>
    <COORD><C1>71.660</C1><C2>45.231</C2></COORD>
  </NamPos>
  <NamOri>15.0</NamOri>
  <Street REF="x1"></Street>
</RoadsExdm2ben_10.Roads.StreetNamePosition>

<RoadsExdm2ben_10.Roads.StreetNamePosition TID="x6">
  <NamPos>
    <COORD><C1>58.249</C1><C2>85.081</C2></COORD>

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```

    </NamPos>
    <NamOri>351.0</NamOri>
    <Street REF="x2"></Street>
  </RoadsExdm2ben_10.Roads.StreetNamePosition>

  <RoadsExdm2ben_10.Roads.StreetNamePosition TID="x7">
    <NamPos>
      <COORD><C1>106.095</C1><C2>33.554</C2></COORD>
    </NamPos>
    <NamOri>280.0</NamOri>
    <Street REF="x3"></Street>
  </RoadsExdm2ben_10.Roads.StreetNamePosition>

  <RoadsExdm2ben_10.Roads.StreetNamePosition TID="x14">
    <NamPos>
      <COORD><C1>53.031</C1><C2>51.367</C2></COORD>
    </NamPos>
    <NamOri>291.3</NamOri>
    <Street REF="x4"></Street>
  </RoadsExdm2ben_10.Roads.StreetNamePosition>

  <!-- == RoadSign == -->
  <RoadsExdm2ien_10.RoadsExtended.RoadSign TID="x501">
    <Type>prohibition.noparking</Type>
    <Position>
      <COORD><C1>69.389</C1><C2>92.056</C2></COORD>
    </Position>
  </RoadsExdm2ien_10.RoadsExtended.RoadSign>

  <RoadsExdm2ien_10.RoadsExtended.RoadSign TID="x502">
    <Type>prohibition.noparking</Type>
    <Position>
      <COORD><C1>80.608</C1><C2>88.623</C2></COORD>
    </Position>
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  <RoadsExdm2ien_10.RoadsExtended.RoadSign TID="x503">
    <Type>prohibition.noparking</Type>
    <Position>
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    </Position>
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  <RoadsExdm2ien_10.RoadsExtended.RoadSign TID="x504">
    <Type>danger</Type>
    <Position>
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    </Position>
  </RoadsExdm2ien_10.RoadsExtended.RoadSign>
</RoadsExdm2ien_10.RoadsExtended>
<!-- end of basket REFHANDB00000001 -->
</DATASECTION>
</TRANSFER>

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Graphic description RoadsExgm2ien_10

With regard to the data model a representation is defined by means of the graphic description RoadsExgm2ien_10. The graphic model reads as follows:

```

!! File RoadsExgm2ien_10.ili Release 2003-02-26

INTERLIS 2.2;

MODEL RoadsExgm2ien_10 (en) = !! Roads graphics

CONTRACT ISSUED BY Unknown; !! Contractor(s) have to be defined!

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```

IMPORTS RoadsExdm2ben_10;
IMPORTS RoadsExdm2ien_10;
IMPORTS StandardSymbology;

SIGN BASKET StandardSymbology ~ StandardSymbology.StandardSigns;

TOPIC Graphics =
  DEPENDS ON RoadsExdm2ben_10.Roads, RoadsExdm2ien_10.RoadsExtended;

GRAPHIC Surface_Graphics
  BASED ON RoadsExdm2ien_10.RoadsExtended.LandCover =

  Building OF StandardSymbology.StandardSigns.SurfaceSign:
    WHERE Type == #building (
      Sign := {Building};
      Geometry := Geometry;
      Priority := 100);

  Street OF StandardSymbology.StandardSigns.SurfaceSign:
    WHERE Type == #street (
      Sign := {Street};
      Geometry := Geometry;
      Priority := 100);

  Water OF StandardSymbology.StandardSigns.SurfaceSign:
    WHERE Type == #water (
      Sign := {Water};
      Geometry := Geometry;
      Priority := 100);

  Other OF StandardSymbology.StandardSigns.SurfaceSign:
    WHERE Type == #other (
      Sign := {Other};
      Geometry := Geometry;
      Priority := 100);

END Surface_Graphics;

VIEW Surface_Boundary
  INSPECTION OF RoadsExdm2ien_10.RoadsExtended.LandCover -> Geometry;
  =
  ATTRIBUTE
    ALL OF LandCover;
END Surface_Boundary;

VIEW Surface_Boundary2
  INSPECTION OF Base ~ Surface_Boundary -> Lines;
  =
  ATTRIBUTE
    Geometry := Base -> Geometry;
    LineAttr := Base -> LineAttrs;
END Surface_Boundary2;

GRAPHIC SurfaceBoundary_Graphics
  BASED ON Surface_Boundary2 =

  Boundary OF StandardSymbology.StandardSigns.PolylineSign: (
    Sign := {continuous};
    Geometry := Geometry;
    Priority := 101);

END SurfaceBoundary_Graphics;

GRAPHIC Polyline_Graphics
  BASED ON RoadsExdm2ien_10.RoadsExtended.StreetAxis =

  Street_precise OF StandardSymbology.StandardSigns.PolylineSign:

```

```

WHERE Precision == #precise (
  Sign := {continuous};
  Geometry := Geometry;
  Priority := 110);

Street_unprecise OF StandardSymbology.StandardSigns.PolylineSign:
  WHERE Precision == #unprecise (
    Sign := {dotted};
    Geometry := Geometry;
    Priority := 110);

END Polyline_Graphics;

GRAPHIC Text_Graphics
  BASED ON RoadsExdm2ien_10.RoadsExtended.StreetNamePosition =

  StreetName OF StandardSymbology.StandardSigns.TextSign: (
    Sign := {Linefont_18};
    Txt := Street -> Name;
    Geometry := NamPos;
    Rotation := NamOri;
    Priority := 120);

END Text_Graphics;

GRAPHIC Point_Graphics
  BASED ON RoadsExdm2ien_10.RoadsExtended.RoadSign =

  Tree OF StandardSymbology.StandardSigns.SymbolSign:
    WHERE Type == #prohibition.noparking (
      Sign := {NoParking};
      Geometry := Position;
      Priority := 130);

  GP OF StandardSymbology.StandardSigns.SymbolSign:
    WHERE Type == #danger (
      Sign := {GP};
      Geometry := Position;
      Priority := 130);

END Point_Graphics;

END Graphics;

END RoadsExgm2ien_10.

```

The graphic model RoadsExgm2ien_10 has recourse to the symbols in the symbology library Roads-Exgm2ien_Symbols (file RoadsExgm2ien_Symbols.xml). A description of the symbology library is to be found in the following paragraph.

Symbology Library RoadsExgm2ien_Symbols.xml

Hereafter the symbology library RoadsExgm2ien_Symbols is represented in the form of an XML-data set (file RoadsExgm2ien_Symbols.xml). The symbology library contains symbology definitions for fix points and trees, as well as line, text and surface symbologies. The corresponding symbology-data model is to be found in appendix K Symbology Models (StandardSymbology).

```

<?xml version="1.0" encoding="UTF-8"?>

<!-- File RoadsExgm2ien_symbols.xml 2003-04-14 -->

<TRANSFER xmlns="http://www.interlis.ch/INTERLIS2.2"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.interlis.ch/INTERLIS2.2
    RoadsExgm2ien_Symbols.xsd">
  <HEADERSECTION VERSION="2.2" SENDER="V+D">

```



```

<ALIAS>
  <ENTRIES FOR="RoadsExdm2ben">
    <TAGENTRY FROM="RoadsExdm2ben.Roads"
              TO="RoadsExdm2ben.Roads" />
    <TAGENTRY FROM="RoadsExdm2ben.RoadsExtended"
              TO="RoadsExdm2ben.Roads" />
    <TAGENTRY FROM="RoadsExdm2ben.Roads.LAttrs"
              TO="RoadsExdm2ben.Roads.LAttrs" />
    <TAGENTRY FROM="RoadsExdm2ben.Roads.LandCover"
              TO="RoadsExdm2ben.Roads.LandCover" />
    <TAGENTRY FROM="RoadsExdm2ben.Roads.Street"
              TO="RoadsExdm2ben.Roads.Street" />
    <TAGENTRY FROM="RoadsExdm2ben.Roads.StreetAxis"
              TO="RoadsExdm2ben.Roads.StreetAxis" />
    <TAGENTRY FROM="RoadsExdm2ben.Roads.StreetAxisAssoc"
              TO="RoadsExdm2ben.Roads.StreetAxisAssoc" />
    <TAGENTRY FROM="RoadsExdm2ben.Roads.StreetNamePosition"
              TO="RoadsExdm2ben.Roads.StreetNamePosition" />
    <TAGENTRY FROM="RoadsExdm2ben.Roads.StreetNamePositionAssoc"
              TO="RoadsExdm2ben.Roads.StreetNamePositionAssoc" />
    <TAGENTRY FROM="RoadsExdm2ben.Roads.RoadSign"
              TO="RoadsExdm2ben.Roads.RoadSign" />
    <TAGENTRY FROM="RoadsExdm2ben.RoadsExtended.RoadSign"
              TO="RoadsExdm2ben.Roads.RoadSign" />
    <VALENTY ATTR="RoadsExdm2ben.Roads.LAttrs.LArt"
              FROM="welldefined" TO="welldefined" />
    <VALENTY ATTR="RoadsExdm2ben.Roads.LAttrs.LArt"
              FROM="fuzzy" TO="fuzzy" />
    <VALENTY ATTR="RoadsExdm2ben.Roads.LandCover.Type"
              FROM="building" TO="building" />
    <VALENTY ATTR="RoadsExdm2ben.Roads.LandCover.Type"
              FROM="street" TO="street" />
    <VALENTY ATTR="RoadsExdm2ben.Roads.LandCover.Type"
              FROM="water" TO="water" />
    <VALENTY ATTR="RoadsExdm2ben.Roads.LandCover.Type"
              FROM="other" TO="other" />
    <VALENTY ATTR="RoadsExdm2ben.Roads.RoadSign.Type"
              FROM="prohibition" TO="prohibition" />
    <VALENTY ATTR="RoadsExdm2ben.Roads.RoadSign.Type"
              FROM="indication" TO="indication" />
    <VALENTY ATTR="RoadsExdm2ben.Roads.RoadSign.Type"
              FROM="danger" TO="danger" />
    <VALENTY ATTR="RoadsExdm2ben.Roads.RoadSign.Type"
              FROM="velocity" TO="velocity" />
    <VALENTY ATTR="RoadsExdm2ben.RoadsExtended.RoadSign.Type"
              FROM="prohibition.noentry" TO="prohibition.noentry" />
    <VALENTY ATTR="RoadsExdm2ben.RoadsExtended.RoadSign.Type"
              FROM="prohibition.noparking" TO="prohibition.noparking" />
    <VALENTY ATTR="RoadsExdm2ben.RoadsExtended.RoadSign.Type"
              FROM="prohibition.other" TO="prohibition.other" />
  </ENTRIES>

  <ENTRIES FOR="RoadsExdm2ien">
    <TAGENTRY FROM="RoadsExdm2ien.RoadsExtended"
              TO="RoadsExdm2ien.RoadsExtended" />
    <TAGENTRY FROM="RoadsExdm2ien.RoadsExtended.StreetAxis"
              TO="RoadsExdm2ien.RoadsExtended.StreetAxis" />
    <TAGENTRY FROM="RoadsExdm2ien.RoadsExtended.RoadSign"
              TO="RoadsExdm2ien.RoadsExtended.RoadSign" />
    <VALENTY ATTR="RoadsExdm2ien.RoadsExtended.RoadSign.Type"
              FROM="prohibition.noentry" TO="prohibition.noentry" />
    <VALENTY ATTR="RoadsExdm2ien.RoadsExtended.RoadSign.Type"
              FROM="prohibition.noparking" TO="prohibition.noparking" />
    <VALENTY ATTR="RoadsExdm2ien.RoadsExtended.RoadSign.Type"
              FROM="prohibition.other" TO="prohibition.other" />
  </ENTRIES>

```

```

</ENTRIES>

<ENTRIES FOR="AbstractSymbology">
  <TAGENTRY FROM="AbstractSymbology.Signs"
    TO="AbstractSymbology.Signs"/>
  <TAGENTRY FROM="AbstractSymbology.Signs.TextSign"
    TO="AbstractSymbology.Signs.TextSign"/>
  <TAGENTRY FROM="AbstractSymbology.Signs.SymbolSign"
    TO="AbstractSymbology.Signs.SymbolSign"/>
  <TAGENTRY FROM="AbstractSymbology.Signs.PolylineSign"
    TO="AbstractSymbology.Signs.PolylineSign"/>
  <TAGENTRY FROM="AbstractSymbology.Signs.SurfaceSign"
    TO="AbstractSymbology.Signs.SurfaceSign"/>
  <DELENTY TAG="StandardSymbology.StandardSigns.Color"/>
  <DELENTY TAG="StandardSymbology.StandardSigns.PolylineAttrs"/>
  <DELENTY TAG="StandardSymbology.StandardSigns.FontSymbol_Polyline"/>
  <DELENTY TAG="StandardSymbology.StandardSigns.FontSymbol_Surface"/>
  <DELENTY TAG="StandardSymbology.StandardSigns.FontSymbol"/>
  <DELENTY TAG="StandardSymbology.StandardSigns.LineStyle_solid"/>
  <DELENTY TAG="StandardSymbology.StandardSigns.DashRec"/>
  <DELENTY TAG="StandardSymbology.StandardSigns.LineStyle_dashed"/>
  <DELENTY TAG="StandardSymbology.StandardSigns.Pattern_Symbol"/>
  <DELENTY TAG="StandardSymbology.StandardSigns.LineStyle_Pattern"/>
  <TAGENTRY FROM="StandardSymbology.StandardSigns"
    TO="AbstractSymbology.Signs"/>
  <TAGENTRY FROM="StandardSymbology.StandardSigns.TextSign"
    TO="AbstractSymbology.Signs.TextSign"/>
  <TAGENTRY FROM="StandardSymbology.StandardSigns.SymbolSign"
    TO="AbstractSymbology.Signs.SymbolSign"/>
  <TAGENTRY FROM="StandardSymbology.StandardSigns.PolylineSign"
    TO="AbstractSymbology.Signs.PolylineSign"/>
  <TAGENTRY FROM="StandardSymbology.StandardSigns.SurfaceSign"
    TO="AbstractSymbology.Signs.SurfaceSign"/>
</ENTRIES>

<ENTRIES FOR="StandardSymbology">
  <TAGENTRY FROM="StandardSymbology.StandardSigns.Color"
    TO="StandardSymbology.StandardSigns.Color"/>
  <TAGENTRY FROM="StandardSymbology.StandardSigns.PolylineAttrs"
    TO="StandardSymbology.StandardSigns.PolylineAttrs"/>
  <TAGENTRY FROM="StandardSymbology.StandardSigns.FontSymbol_Polyline"
    TO="StandardSymbology.StandardSigns.FontSymbol_Polyline"/>
  <TAGENTRY FROM="StandardSymbology.StandardSigns.FontSymbol_Surface"
    TO="StandardSymbology.StandardSigns.FontSymbol_Surface"/>
  <TAGENTRY FROM="StandardSymbology.StandardSigns.FontSymbol"
    TO="StandardSymbology.StandardSigns.FontSymbol"/>
  <TAGENTRY FROM="StandardSymbology.StandardSigns.LineStyle_solid"
    TO="StandardSymbology.StandardSigns.LineStyle_solid"/>
  <TAGENTRY FROM="StandardSymbology.StandardSigns.DashRec"
    TO="StandardSymbology.StandardSigns.DashRec"/>
  <TAGENTRY FROM="StandardSymbology.StandardSigns.LineStyle_dashed"
    TO="StandardSymbology.StandardSigns.LineStyle_dashed"/>
  <TAGENTRY FROM="StandardSymbology.StandardSigns.Pattern_Symbol"
    TO="StandardSymbology.StandardSigns.Pattern_Symbol"/>
  <TAGENTRY FROM="StandardSymbology.StandardSigns.LineStyle_Pattern"
    TO="StandardSymbology.StandardSigns.LineStyle_Pattern"/>
  <TAGENTRY FROM="StandardSymbology.StandardSigns"
    TO="StandardSymbology.StandardSigns"/>
  <TAGENTRY FROM="StandardSymbology.StandardSigns.TextSign"
    TO="StandardSymbology.StandardSigns.TextSign"/>
  <TAGENTRY FROM="StandardSymbology.StandardSigns.SymbolSign"
    TO="StandardSymbology.StandardSigns.SymbolSign"/>
  <TAGENTRY FROM="StandardSymbology.StandardSigns.PolylineSign"
    TO="StandardSymbology.StandardSigns.PolylineSign"/>
  <TAGENTRY FROM="StandardSymbology.StandardSigns.SurfaceSign"
    TO="StandardSymbology.StandardSigns.SurfaceSign"/>
  <VALENTY ATTR="StandardSymbology.StandardSigns.Join"
    FROM="bevel" TO="bevel"/>

```

```

    <VALENTY ATTR="StandardSymbology.StandardSigns.Join"
      FROM="round" TO="round"/>
    <VALENTY ATTR="StandardSymbology.StandardSigns.Join"
      FROM="miter" TO="miter"/>
    <VALENTY ATTR="StandardSymbology.StandardSigns.Caps"
      FROM="round" TO="round"/>
    <VALENTY ATTR="StandardSymbology.StandardSigns.Caps"
      FROM="butt" TO="butt"/>
  </ENTRIES>
</ALIAS>

<COMMENT>
  example symbology dataset ili2 refmanual appendix C
</COMMENT>
</HEADERSECTION>

<DATASECTION>
  <StandardSymbology.StandardSigns BID="xREFHANDB00000002">

    <!-- Color Library -->
    <StandardSymbology.StandardSigns.Color TID="x1">
      <Name>red</Name>
      <L>40.0</L>
      <C>70.0</C>
      <H>0.0</H>
      <T>1.0</T>
    </StandardSymbology.StandardSigns.Color>

    <StandardSymbology.StandardSigns.Color TID="x2">
      <Name>green</Name>
      <L>49.4</L>
      <C>48.5</C>
      <H>153.36</H>
      <T>1.0</T>
    </StandardSymbology.StandardSigns.Color>

    <StandardSymbology.StandardSigns.Color TID="x3">
      <Name>light_gray</Name>
      <L>75.0</L>
      <C>0.0</C>
      <H>0.0</H>
      <T>1.0</T>
    </StandardSymbology.StandardSigns.Color>

    <StandardSymbology.StandardSigns.Color TID="x4">
      <Name>dark_grey</Name>
      <L>25.0</L>
      <C>0.0</C>
      <H>0.0</H>
      <T>1.0</T>
    </StandardSymbology.StandardSigns.Color>

    <StandardSymbology.StandardSigns.Color TID="x5">
      <Name>dark_blue</Name>
      <L>50.3</L>
      <C>43.5</C>
      <H>261.1</H>
      <T>1.0</T>
    </StandardSymbology.StandardSigns.Color>

    <StandardSymbology.StandardSigns.Color TID="x6">
      <Name>black</Name>
      <L>0.0</L>
      <C>0.0</C>
      <H>0.0</H>
      <T>1.0</T>
    </StandardSymbology.StandardSigns.Color>
  </StandardSymbology.StandardSigns BID="xREFHANDB00000002">

```

```

<StandardSymbology.StandardSigns.Color TID="x7">
  <Name>white</Name>
  <L>100.0</L>
  <C>0.0</C>
  <H>0.0</H>
  <T>1.0</T>
</StandardSymbology.StandardSigns.Color>

<StandardSymbology.StandardSigns.PolylineAttrs TID="x4001">
  <Width>0.01</Width>
  <Join>round</Join>
  <Caps>butt</Caps>
</StandardSymbology.StandardSigns.PolylineAttrs>

<StandardSymbology.StandardSigns.PolylineAttrs TID="x4002">
  <Width>0.01</Width>
  <Join>round</Join>
  <MiterLimit>2.0</MiterLimit>
  <Caps>butt</Caps>
</StandardSymbology.StandardSigns.PolylineAttrs>

<!-- Font/Symbol Library -->
<StandardSymbology.StandardSigns.FontSymbol TID="x101">
  <Name>Triangle</Name>
  <Geometry>
    <StandardSymbology.StandardSigns.FontSymbol_Surface>
      <Geometry>
        <SURFACE>
          <BOUNDARY>
            <POLYLINE>
              <COORD><C1>-0.5</C1><C2>-0.5</C2></COORD>
              <COORD><C1>0.0</C1><C2>0.5</C2></COORD>
              <COORD><C1>0.5</C1><C2>-0.5</C2></COORD>
            </POLYLINE>
          </BOUNDARY>
        </SURFACE>
      </Geometry>
    </StandardSymbology.StandardSigns.FontSymbol_Surface>
    <StandardSymbology.StandardSigns.FontSymbol_Polyline>
      <Geometry>
        <POLYLINE>
          <COORD><C1>-0.5</C1><C2>0.0</C2></COORD>
          <ARC><C1>0.5</C1><C2>0.0</C2>
            <A1>0.0</A1><A2>0.5</A2><R>0.5</R></ARC>
          <ARC><C1>-0.5</C1><C2>0.0</C2>
            <A1>0.0</A1><A2>-0.5</A2><R>0.5</R></ARC>
        </POLYLINE>
      </Geometry>
    </StandardSymbology.StandardSigns.FontSymbol_Polyline>
  </Geometry>
  <Font REF="x10"></Font>
</StandardSymbology.StandardSigns.FontSymbol>

<StandardSymbology.StandardSigns.FontSymbol TID="x102">
  <Name>NoParking</Name>
  <Geometry>
    <StandardSymbology.StandardSigns.FontSymbol_Polyline>
      <Color REF="x6">
      </Color>
      <Geometry>
        <POLYLINE>
          <COORD><C1>-0.5</C1><C2>0.0</C2></COORD>
          <ARC><C1>0.5</C1><C2>0.0</C2>
            <A1>0.0</A1><A2>0.5</A2><R>0.5</R></ARC>
          <ARC><C1>-0.5</C1><C2>0.0</C2>
            <A1>0.0</A1><A2>-0.5</A2><R>0.5</R></ARC>
        </POLYLINE>
      </Geometry>
    </StandardSymbology.StandardSigns.FontSymbol_Polyline>
  </Geometry>
  <Font REF="x10"></Font>
</StandardSymbology.StandardSigns.FontSymbol>

```

```

</StandardSymbology.StandardSigns.FontSymbol_Polyline>
<StandardSymbology.StandardSigns.FontSymbol_Surface>
  <FillColor REF="x1">
</FillColor>
  <Geometry>
    <SURFACE>
      <BOUNDARY>
        <POLYLINE>
          <COORD><C1>-0.233</C1><C2>0.325</C2></COORD>
          <ARC><C1>0.325</C1><C2>-0.233</C2>
            <A1>0.283</A1><A2>0.283</A2><R>0.4</R></ARC>
          <COORD><C1>-0.233</C1><C2>0.325</C2></COORD>
        </POLYLINE>
      </BOUNDARY>
    </SURFACE>
  </Geometry>
</StandardSymbology.StandardSigns.FontSymbol_Surface>
<StandardSymbology.StandardSigns.FontSymbol_Surface>
  <FillColor REF="x1">
</FillColor>
  <Geometry>
    <SURFACE>
      <BOUNDARY>
        <POLYLINE>
          <COORD><C1>0.228</C1><C2>-0.324</C2></COORD>
          <ARC><C1>-0.327</C1><C2>0.238</C2>
            <A1>-0.283</A1><A2>-0.283</A2><R>0.4</R></ARC>
          <COORD><C1>0.228</C1><C2>-0.324</C2></COORD>
        </POLYLINE>
      </BOUNDARY>
    </SURFACE>
  </Geometry>
</StandardSymbology.StandardSigns.FontSymbol_Surface>
<StandardSymbology.StandardSigns.FontSymbol_Surface>
  <FillColor REF="x5">
</FillColor>
  <Geometry>
    <SURFACE>
      <BOUNDARY>
        <POLYLINE>
          <COORD><C1>-0.5</C1><C2>0.0</C2></COORD>
          <ARC><C1>0.5</C1><C2>0.0</C2>
            <A1>0.0</A1><A2>0.5</A2><R>0.5</R></ARC>
          <ARC><C1>-0.5</C1><C2>0.0</C2>
            <A1>0.0</A1><A2>-0.5</A2><R>0.5</R></ARC>
        </POLYLINE>
      </BOUNDARY>
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        <ARC><C1>0.325</C1><C2>-0.233</C2>
          <A1>0.283</A1><A2>0.283</A2><R>0.4</R></ARC>
        <COORD><C1>-0.233</C1><C2>0.325</C2></COORD>
      </POLYLINE>
    </BOUNDARY>
    <BOUNDARY>
      <POLYLINE>
        <COORD><C1>0.228</C1><C2>-0.324</C2></COORD>
        <ARC><C1>-0.327</C1><C2>0.238</C2>
          <A1>-0.283</A1><A2>-0.283</A2><R>0.4</R></ARC>
        <COORD><C1>0.228</C1><C2>-0.324</C2></COORD>
      </POLYLINE>
    </BOUNDARY>
  </SURFACE>
</Geometry>
</StandardSymbology.StandardSigns.FontSymbol_Surface>
<StandardSymbology.StandardSigns.FontSymbol_Polyline>
  <Color REF="x7">

```

```

    </Color>
    <LineAttrs REF="x4001">
  </LineAttrs>
    <Geometry>
      <POLYLINE>
        <COORD><C1>-0.233</C1><C2>0.325</C2></COORD>
        <ARC><C1>0.325</C1><C2>-0.233</C2>
          <A1>0.283</A1><A2>0.283</A2><R>0.4</R></ARC>
        <COORD><C1>-0.233</C1><C2>0.325</C2></COORD>
      </POLYLINE>
    </Geometry>
  </StandardSymbology.StandardSigns.FontSymbol_Polyline>
<StandardSymbology.StandardSigns.FontSymbol_Polyline>
  <Color REF="x7">
</Color>
  <LineAttrs REF="x4001">
</LineAttrs>
  <Geometry>
    <POLYLINE>
      <COORD><C1>0.228</C1><C2>-0.324</C2></COORD>
      <ARC><C1>-0.327</C1><C2>0.238</C2>
        <A1>-0.283</A1><A2>-0.283</A2><R>0.4</R></ARC>
      <COORD><C1>0.228</C1><C2>-0.324</C2></COORD>
    </POLYLINE>
  </Geometry>
</StandardSymbology.StandardSigns.FontSymbol_Polyline>
</Geometry>
  <Font REF="x10"></Font>
</StandardSymbology.StandardSigns.FontSymbol>

<!-- interner Symbolfont "Symbols" -->
<StandardSymbology.StandardSigns.Font TID="x10">
  <Name>Symbols</Name>
  <Internal>true</Internal>
  <Type>symbol</Type>
</StandardSymbology.StandardSigns.Font>

<!-- externer Textfont "Leroy" -->
<StandardSymbology.StandardSigns.Font TID="x11">
  <Name>Leroy</Name>
  <Internal>false</Internal>
  <Type>text</Type>
  <BottomBase>0.3</BottomBase>
</StandardSymbology.StandardSigns.Font>

<!-- LineStyles -->
<StandardSymbology.StandardSigns.LineStyle_Solid TID="x21">
  <Name>LineSolid_01</Name>
  <Color REF="x6"></Color>
  <LineAttrs REF="x4001"></LineAttrs>
</StandardSymbology.StandardSigns.LineStyle_Solid>

<StandardSymbology.StandardSigns.LineStyle_Dashed TID="x22">
  <Name>LineDashed_01</Name>
  <Dashes>
    <StandardSymbology.StandardSigns.DashRec>
      <DLength>0.1</DLength>
    </StandardSymbology.StandardSigns.DashRec>
    <StandardSymbology.StandardSigns.DashRec>
      <DLength>0.1</DLength>
    </StandardSymbology.StandardSigns.DashRec>
  </Dashes>
  <Color REF="x6"></Color>
  <LineAttrs REF="x4002"></LineAttrs>
</StandardSymbology.StandardSigns.LineStyle_Dashed>

<!-- Text Signs -->
<StandardSymbology.StandardSigns.TextSign TID="x1001">

```

```

    <Name>Linefont_18</Name>
    <Height>1.8</Height>
    <Font REF="x11"></Font>
</StandardSymbology.StandardSigns.TextSign>

<!-- Symbol Signs -->
<StandardSymbology.StandardSigns.SymbolSign TID="x2001">
    <Name>GP</Name>
    <Scale>1.0</Scale>
    <Color REF="x2"></Color>
    <Symbol REF="x101"></Symbol>
</StandardSymbology.StandardSigns.SymbolSign>

<StandardSymbology.StandardSigns.SymbolSign TID="x2002">
    <Name>NoParking</Name>
    <Scale>1.0</Scale>
    <Symbol REF="x102"></Symbol>
</StandardSymbology.StandardSigns.SymbolSign>

<!-- Polyline Signs -->
<StandardSymbology.StandardSigns.PolylineSign TID="x3001">
    <Name>continuous</Name>
    <Style REF="x21">
        <StandardSymbology.StandardSigns.PolylineSignLineStyleAssoc>
            <Offset>0.0</Offset>
        </StandardSymbology.StandardSigns.PolylineSignLineStyleAssoc>
    </Style>
</StandardSymbology.StandardSigns.PolylineSign>

<StandardSymbology.StandardSigns.PolylineSign TID="x3002">
    <Name>dotted</Name>
    <Style REF="x22">
        <StandardSymbology.StandardSigns.PolylineSignLineStyleAssoc>
            <Offset>0.0</Offset>
        </StandardSymbology.StandardSigns.PolylineSignLineStyleAssoc>
    </Style>
</StandardSymbology.StandardSigns.PolylineSign>

<!-- Surface Signs -->
<StandardSymbology.StandardSigns.SurfaceSign TID="x5001">
    <Name>Building</Name>
    <FillColor REF="x4"></FillColor>
</StandardSymbology.StandardSigns.SurfaceSign>

<StandardSymbology.StandardSigns.SurfaceSign TID="x5002">
    <Name>Street</Name>
    <FillColor REF="x3"></FillColor>
</StandardSymbology.StandardSigns.SurfaceSign>

<StandardSymbology.StandardSigns.SurfaceSign TID="x5003">
    <Name>Water</Name>
    <FillColor REF="x5"></FillColor>
</StandardSymbology.StandardSigns.SurfaceSign>

<StandardSymbology.StandardSigns.SurfaceSign TID="x5005">
    <Name>Other</Name>
    <FillColor REF="x2"></FillColor>
</StandardSymbology.StandardSigns.SurfaceSign>
</StandardSymbology.StandardSigns>
<!-- end of basket REFHANDB00000002 -->
</DATASECTION>
</TRANSFER>

```

Graphic Representation of Our Example

Combining information provided by the data set RoadsExdm2ien (file RoadsExdm2en.xml), the descriptions in the graphic model RoadsExgm2ien_10 (file RoadsExgm2en_10.ili) and the symbology

library RoadsExgm2ien_Symbols (file RoadsExgm2ien_Symbols.xml), an INTERLIS 2-graphic processor will generate the following graphic:



Figure 27: Graphic generated from graphic and data descriptions.

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The index features the reserved words in capitals (cf. chapter 2.2.7 Special Symbols and Reserved Words), the syntax definitions of the description language in ordinary script (cf. chapter 2) and the syntax definitions of the transfer in italics (cf. chapter 3). The page number printed in bold indicates the passage in the reference manual which offers the most comprehensive definition of a term.

Appendix E (Standard Extension Suggestion) Organisation of Object Identifiers (OID)

Preliminary Note

The following specification is not a normative component of INTERLIS. This is a standard extension suggestion based upon the INTERLIS 2-reference manual in the sense of a recommendation. However we intend to put it up for discussion and possibly convert it into a more definite regulation. Consult the corresponding INTERLIS 2-user manuals for examples of application.

Introduction

Steadily increasing availability of geodata in turn demands its updating and integration in various databases. These are some of the reasons why there is a demand for uniform regulations concerning *object identifiers* (OID): An OID will identify an object instance from its beginning to its end, even if attribute values should alter. In contrast to user keys (cf. Appendix F *Uniqueness of User Keys* in the INTERLIS 2-reference manual) the user has to consider an OID as a non-talking ("opaque") attribute which typically will be administered by system functions.

At least within one transfer community an OID must be *unique*, *unequivocal* and *unchangeable*.

Amongst others, the following demands are made on the generation and the utilization of OID's:

- Unequivocal (in general), unique and unchangeable (stable) even with massive data collections.
- Independent of hardware and software producers.
- Independent of platforms.
- Serviceable for multiple as well as individual users, resp. in autonomous systems (e.g. in field work).
- Little space required and if need be still optimizable.
- Easy to implement.

Other possible demands are not necessarily of technical nature, e.g. a minimum of expenditure in organization, under national control, also utilizable with older systems and approval of system providers. These are high demands which partially point to opposite directions. A special requirement states that an OID can be placed at least 10 million times by a producing system; furthermore that the OID has a set length in order to facilitate its manipulation (thus excluding other well-known procedures, such as a so-called URI as a prefix). There is no call for control numbers, it is assumed that lower communication levels provide the necessary tools.

On principle, the uniqueness of an OID will always be achieved through a central mechanism. The two extremes, i.e. placing of each OID through a central authority on the one hand, and the completely decentral and autonomous generating of OID's on the other, lead to unsatisfying results. An OID placed via a MAC address of a network adapter and a time stamp for example is neither deemed practicable nor very promising, since it would mean that each computer be equipped with a MAC and it is not to be foreseen if this technology will not be outdated within the next few years.

There is a long history to the development of this specification. Over the years we have conducted studies, conferences and reviews. Some of the documents established in its course is available to interested parties (place your order with www.interlis.ch, resp. info@interlis.ch).

Structure of an Object Identifier (OID)

An object identifier (OID) consists of a prefix and a postfix and has got a set length of 16 alphanumerical characters. An OID is always treated as a unity, above all on the data interface and where the user is concerned. The OID domain STANDARDOID of the INTERLIS model corresponds precisely to this definition. However it only defines its entire length and not its detailed structure.

OIDDef = Praefix Postfix.

Prefix

A central authority generates the prefix. Thus uniqueness is guaranteed within a transfer community. Typically every basket (i.e. a database process, which administers data of a concrete topic) demands a new prefix. It is the country of the prefix-creating process that is considered to be the destination of the prefix. This process is not automatically in the same place as the producing system that creates the entire OID.

A prefix consists of 8 characters, the following symbols being admissible:

```
Prefix = Letter { Letter | Digit }.  !! sequence of 8 characters
Letter = ( 'A' | .. | 'Z' | 'a' | .. | 'z' ).
Digit = ( '0' | '1' | .. | '9' ).
```

A prefix is defined as a sequence of letters and digits, the first symbol having to be a letter (cf. also structure of XML-tag names or chapter 2.2.2 Name in the INTERLIS 2-reference manual).

Moreover, the first two prefix characters have to be determined according to the country codes of ISO-Norm 3166. Thus the letters "ch" have been selected for all prefixes created in Switzerland, "de" for Germany, "oe" for Austria etc.. Thus for the creation of a prefix 62 different varieties are available per character (0..9: ASCII 48 to 57; A..Z: ASCII 65 to 90; a..z: ASCII 97 to 122). The combining of 62 symbols with the number of 10 characters results in a number that exceeds the probable exigencies of most of the applications at present conceivable.

Postfix

A postfix is created by the data-producer, resp. the producing system itself. It consists of 8 characters, its ASCII-compatible; column-oriented approach demands that possible "void" characters on the left be filled with noughts ("0") (see also example 1 and 3 of an OID below). Thus the smallest possible ordinal value of the postfix part is depicted as "0000000000".

Postfix = { Letter | Digit }. !! sequence of 8 characters

If need be further restrictions in the prefix or postfix part can be defined in additional specifications.

Summary and Application Examples

OID	Length	Significance	Notes
Prefix	2 + 6 Char.	Country specification + a unique 'global' identification-part assigned by a central authority.	Worldwide unequivocal country specification e.g. de (Germany), oe (Austria), ch (Switzerland) according to ISO-norm 3166. Further restrictions require additional specifications.
Postfix	8 Char.	Sequence (numeric or alphanumeric) of the producing system as a 'local' identifications-part	Further restrictions such as e.g. date stamp with sequence number require additional specifications.

Examples

1234567812345678 *Comment*

-----	-----
A0000000000000000	Theoretically the smallest possible OID
zwzzzzzzzzzzzzzzzz	The maximum possible OID with zw for Zimbabwe
deg5mQXX2000004a	OID of German origin (de) selected at random
chgAAAAAAAAA0azD	OID of Swiss origin (ch) selected at random

Organization

Some authority (possibly federal), universally acknowledged by the transfer community, maintains a central service charged with the generation of OID's. Via appropriate communication channels data-producers may obtain one or several prefixes. This might be for example an Internet-page connected with an e-mail service. Such a service can be made relatively secure and safeguarded against abuse.

It is up to the implementation of the source and target system to utilize the characteristics explicitly stated in this specification and to use an OID appropriately, e.g. for sorting or internal optimizing. Administering the prefix part within the system at a central locality may attain such optimizing; furthermore the different objects would only contain the postfix part and in addition relate to a common prefix part. Other economies may result if the postfix part is memorized system internally as a binary number.

For practice exercises use:

- The OID-prefix "chB00000" with OID's for baskets.
- The Oid-prefix "ch100000" with all other OID's.

Appendix F (Standard Extension Suggestion) Uniqueness of User Keys

Note

The following specification is not a normative component of INTERLIS. This is a standard extension suggestion based upon the INTERLIS 2-reference manual in the sense of a recommendation. However we intend to put it up for discussion and possibly convert it into a more definite regulation. Consult the corresponding INTERLIS 2-user manuals for examples of application.

Modeling Alternatives

If uniqueness is a requirement in user keys, the question arises within which limits this uniqueness applies. From a purely technical point of view it is often obvious, that uniqueness can only be guaranteed within one specific basket, since all other baskets are not accessible. From a modeling point of view however, a basket is meaningless as long as no statement concerning its extent can be made.

It is doubtful whether uniqueness even is of necessity in a base model. As seen by a superior authority (e.g. Federation) it is quite conceivable that uniqueness is not the rule for all, but only for the internal (federate) data model.

Hereafter we present two possible ways of dealing with the problem of unique user keys:

- Variety central regulation.
- Variety decentralist regulation (delegation principle).

Variant Central Regulation

Without further reflection, a central regulation would probably be in the foreground. A central authority determines for all objects of one class that a certain user key has to be unique within the entire area. This may be achieved by taking certain organizational steps, or all parties concerned may have access to a central database.

```

TOPIC Property =

  CLASS Allotment =
    Number: 1 .. 99999;
    Geometry: AREA WITH (STRAIGHTS, ARCS) VERTEX CHLkoord
              WITHOUT OVERLAPS > 0.005;

    UNIQUE
      Number;
  END Allotment;

END Property.
```

Often the central authority will determine an area division and hence unique area numbers within the entire area. If allotments, which in turn are situated within these areas, should be unique in all respects, then the user key must necessarily consist of a combination of both area number and allotment number:

```

CLASS Allotment =
  Area_Number: 1 .. 9999;
  Number: 1 .. 99999;
  Geometry: AREA WITH (STRAIGHTS, ARCS) VERTEX CHLkoord
            WITHOUT OVERLAPS > 0.005;

  UNIQUE
    Area_Number, Number; !! User key
END Allotment;
```

Variant Decentralist Regulation (Delegation Principle)

If the necessary data structures have been set in a data model, it is possible to comprehend objects primarily in smaller baskets (e.g. one basket per county), which further along can be collected without any problems in bigger baskets (e.g. one for a whole canton). Supposing furthermore, that the federal authority demands allotment numbers with five digits, without determining the limits where uniqueness is required, and presuming at the same time that a canton requires uniqueness within the limits of one county, then the following modeling is possible:

```
MODEL Federation =

  TOPIC Property =

    CLASS Allotment =
      Number: 1..99999;
      Geometry: AREA WITH (STRAIGHTS, ARCS) VERTEX CHLKoord
        WITHOUT OVERLAPS > 0.005;
    END Allotment;

  END Property;

END Federation.

MODEL CantonA =

  IMPORTS Federation;

  TOPIC OrgStructure =

    CLASS County =
      Name: TEXT*30;
      UNIQUE
      Name;
    END County;

  END OrgStructure;

  TOPIC Property EXTENDS Federation.Property =
    DEPENDS ON OrgStruktur;

    ASSOCIATION CountyAllotment =
      County (EXTERNAL) -<> OrgStruktur.County;
      Allotment -- Allotment;
    END CountyAllotment;

    CONSTRAINT OF Allotment =
      UNIQUE
      Number, County;
    END;

  END Property;

END CantonA.
```

According to definition, the names of counties must be unique within the scope of all objects of one class. It is irrelevant whether the observance of this requirement can be checked in view of their distribution into concrete baskets. Nevertheless this requirement prevails.

In order to determine uniqueness of the allotment number within a county, a relation is established between allotment and county and it is required, that the combination of county and number be unique. Again it is irrelevant whether a basket comprises part of a county, a county as a whole or several counties. From the view point of modeling the requirement prevails.

Proceeding on the assumption that a system contains the allotments of a certain county, it is quite possible that system internally the relationship between county and allotments is omitted, only to be enclosed when transferring data to other systems.

Appendix G (Standard Extension Suggestion) Definition of Units

Note

The following specification is not a normative component of INTERLIS. This is a standard extension suggestion based upon the INTERLIS 2-reference manual in the sense of a recommendation. However we intend to put it up for discussion and possibly convert it into a more definite regulation. Consult the corresponding INTERLIS 2-user manuals for examples of application.

The Type Model

The following type model comprises the most common units. It extends units that have been directly defined by INTERLIS (see Appendix A The Internal INTERLIS Data Model).

```
!! File Units.ili Release 2003-03-18

INTERLIS 2.2;

TYPE MODEL Units (en) =

UNIT
  !! abstract Units
  Area (ABSTRACT) = (INTERLIS.LENGTH*INTERLIS.LENGTH);
  Volume (ABSTRACT) = (INTERLIS.LENGTH*INTERLIS.LENGTH*INTERLIS.LENGTH);
  Velocity (ABSTRACT) = (INTERLIS.LENGTH/INTERLIS.TIME);
  Acceleration (ABSTRACT) = (Velocity/INTERLIS.TIME);
  Force (ABSTRACT) = (INTERLIS.MASS*INTERLIS.LENGTH/INTERLIS.TIME/INTERLIS.TIME);
  Pressure (ABSTRACT) = (Force/Area);
  Energy (ABSTRACT) = (Force*INTERLIS.LENGTH);
  Power (ABSTRACT) = (Energy/INTERLIS.TIME);
  Electric_Potential (ABSTRACT) = (Power/INTERLIS.ELECTRIC_CURRENT);
  Frequency (ABSTRACT) = (INTERLIS.DIMENSIONLESS/INTERLIS.TIME);

  Millimeter [mm] = 0.001 [INTERLIS.m];
  Centimeter [cm] = 0.01 [INTERLIS.m];
  Decimeter [dm] = 0.1 [INTERLIS.m];
  Kilometer [km] = 1000 [INTERLIS.m];

  Square_Meter [m2] EXTENDS Area = (INTERLIS.m*INTERLIS.m);
  Cubic_Meter [m3] EXTENDS Volume = (INTERLIS.m*INTERLIS.m*INTERLIS.m);

  Minute [min] = 60 [INTERLIS.s];
  Hour [h] = 60 [min];
  Day [d] = 24 [h];

  Kilometer_per_Hour [kmh] EXTENDS Velocity = (km/h);
  Meter_per_Second [ms] = 3.6 [kmh];
  Newton [N] EXTENDS Force = (INTERLIS.kg*INTERLIS.m/INTERLIS.s/INTERLIS.s);
  Pascal [Pa] EXTENDS Pressure = (N/m2);
  Joule [J] EXTENDS Energy = (N*INTERLIS.m);
  Watt [W] EXTENDS Power = (J/INTERLIS.s);
  Volt [V] EXTENDS Electric_Potential = (W/INTERLIS.A);

  Inch [in] = 2.54 [cm];
  Foot [ft] = 0.3048 [INTERLIS.m];
  Mile [mi] = 1.609344 [km];

  Are [a] = 100 [m2];
  Hectare [ha] = 100 [a];
  Square_Kilometer [km2] = 100 [ha];
```

```

Acre [acre] = 4046.873 [m2];

Liter [L] = 1 / 1000 [m3];
US_Gallon [USgal] = 3.785412 [L];

Angle_Degree = 180 / PI [INTERLIS.rad];
Angle_Minute = 1 / 60 [Angle_Degree];
Angle_Second = 1 / 60 [Angle_Minute];
Angle_DMS = {Angle_Degree:Angle_Minute[0 .. 59]:Angle_Second[0 .. 59]}
            CONTINUOUS;

Gon = 200 / PI [INTERLIS.rad];

Gram [g] = 1 / 1000 [INTERLIS.kg];
Ton [t] = 1000 [INTERLIS.kg];
Pound [lb] = 0.4535924 [INTERLIS.kg];

Calorie [cal] = 4.1868 [J];
Kilowatt_Hour [kWh] = 0.36E7 [J];

Horsepower = 746 [W];

Techn_Atmosphere [at] = 98066.5 [Pa];
Atmosphere [atm] = 101325 [Pa];
Bar [bar] = 10000 [Pa];
Millimeter_Mercury [mmHg] = 133.3224 [Pa];
Torr = 133.3224 [Pa]; !! Torr = [mmHg]

Decibel [dB] = FUNCTION // 10**(dB/20) * 0.00002 // [Pa];

Degree_Celsius [oC] = FUNCTION // oC+273.15 // [INTERLIS.K];
Degree_Fahrenheit [oF] = FUNCTION // (oF+459.67)/1.8 // [INTERLIS.K];

CountedObjects EXTENDS INTERLIS.DIMENSIONLESS;

Hertz [Hz] EXTENDS Frequency = (CountedObjects/INTERLIS.s);
KiloHertz [KHz] = 1000 [Hz];
MegaHertz [MHz] = 1000 [KHz];

Percent = 0.01 [CountedObjects];
Permille = 0.001 [CountedObjects];

!! ISO 4217 Currency Abbreviation
USDollar [USD] EXTENDS INTERLIS.MONEY;
Euro [EUR] EXTENDS INTERLIS.MONEY;
SwissFrancs [CHF] EXTENDS INTERLIS.MONEY;

END Units.

```

Examples

Cf. chapter 2.9.1 Base Units in the INTERLIS 2 reference manual.

Appendix H (Standard Extension Suggestion) Time Definitions

Note

The following specification is not a normative component of INTERLIS. This is a standard extension suggestion based upon the INTERLIS 2-reference manual in the sense of a recommendation. However we intend to put it up for discussion and possibly convert it into a more definite regulation. Consult the corresponding INTERLIS 2-user manuals for examples of application.

The Time Model

```
!! File Time.ili Release 2003-03-18

INTERLIS 2.2;

REFSYSTEM MODEL Time (en) = !! en = 2-letter code (ISO 639)

CONTRACT ISSUED BY Unknown; !! Contractor(s) have to be defined!

IMPORTS Units;

UNIT
  HM = {Units.h : Units.min[0 .. 59]} CONTINUOUS;
  HMS = {Units.h : Units.min[0 .. 59] : INTERLIS.s[0 .. 59]} CONTINUOUS;

  Year [Y] EXTENDS INTERLIS.TIME;
  Month [M] EXTENDS INTERLIS.TIME;

  DayOfYear [MD] = {M:Units.d[1 .. 31]};
  Date [YMD] = {Y:M[1 .. 12]:Units.d[1 .. 31]};

DOMAIN
  Year = 1582 .. 2999 [Y]; !! Gregorian Calendar
  Date = 1582:10:15 .. 2999:12:31 [YMD];
  DayOfYear = 1:1 .. 12:31 [MD];

  WeekDay = (WorkingDay (Monday, Tuesday, Wednesday,
    Thursday, Friday, Saturday), Sunday);

  HMOfDay = 0:0 .. 23:59 [HM];
  DifferenceToUTC = MANDATORY -13:00 .. 13:00 [HM]; !! UTC := LocTime + Diff

FUNCTION AppropriateDate (dayOfYear: MANDATORY DayOfYear;
    weekDay: WeekDay): DayOfYear
  // returns first parameter if second is undefined
  returns first day from (incl) first parameter being the
  requested weekday //;

FUNCTION DSTOrdered (day1: DayOfYear; day2: DayOfYear) : BOOLEAN
  // returns TRUE if the second parameter comes after the
  first parameter or if both parameters are equal //;

STRUCTURE DSTransition =
  TransitionDSTime: MANDATORY HMOfDay;
  FirstDate: MANDATORY DayOfYear;
  DayOfWeek: WeekDay;
  TransitionDate: DayOfYear := AppropriateDate (FirstDate, DayOfWeek);
END DSTransition;

STRUCTURE DaylightSavingPeriod =
```

```

DSToUTC: DifferenceToUTC;
From: MANDATORY Year;
To: MANDATORY Year;
DSStart: MANDATORY DSTransition;
DSEnd: MANDATORY DSTransition;
MANDATORY CONSTRAINT
  DSTOrdered (DSStart, DSEnd);
MANDATORY CONSTRAINT
  To >= From;
END DaylightSavingPeriod;

FUNCTION DSPOverlaps (periods: BAG {1..*} OF DaylightSavingPeriod) : BOOLEAN
  // returns TRUE if any one of the periods overlap //;

TOPIC TimeZone =

  CLASS TimeZone (ABSTRACT) EXTENDS INTERLIS.SCALSYSTEM =
    PARAMETER
      Unit (EXTENDED): NUMERIC [INTERLIS.TIME];
    END TimeZone;

  CLASS BaseTimeZone EXTENDS TimeZone = !! TimeZone without daylight saving
    DiffToUTC: DifferenceToUTC;
    END BaseTimeZone;

  CLASS DaylightSavingTZ EXTENDS TimeZone =
    Periods: BAG {1..*} OF DaylightSavingPeriod;
    MANDATORY CONSTRAINT
      NOT ( DSPOverlaps (Periods) );
    END DaylightSavingTZ;

  ASSOCIATION DaylightSavingTZOf =
    BaseTZ -<> BaseTimeZone;
    DSTZ -- DaylightSavingTZ;
    END DaylightSavingTZOf;

END TimeZone;

END Time.

```

Exemplary Data for the Time-Model

The following example corresponds to the time-model above.

```

<?xml version="1.0" encoding="UTF-8"?>

<!-- File SwissTimeData.xml Release 2003-03-18 -->

<TRANSFER xmlns="http://www.interlis.ch/INTERLIS2.2"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.interlis.ch/INTERLIS2.2
    SwissTimeData.xsd">
  <HEADERSECTION VERSION="2.2" SENDER="V+D">
    <ALIAS>
      <ENTRIES FOR="Time">
        <TAGENTRY FROM="Time.DayOfYear" TO="Time.DayOfYear"/>
        <TAGENTRY FROM="Time.HMDiffWithinDay" TO="Time.HMDiffWithinDay"/>
        <TAGENTRY FROM="Time.DSTransition" TO="Time.DSTransition"/>
        <TAGENTRY FROM="Time.DaylightSavingPeriod" TO="Time.DaylightSavingPeriod"/>
        <TAGENTRY FROM="Time.TimeZone" TO="Time.TimeZone"/>
        <TAGENTRY FROM="Time.TimeZone.BaseTimeZone"
          TO="Time.TimeZone.BaseTimeZone"/>
        <TAGENTRY FROM="Time.TimeZone.DaylightSavingTZ"
          TO="Time.TimeZone.DaylightSavingTZ"/>
        <TAGENTRY FROM="Time.TimeZone.DaylightSavingTZOf"
          TO="Time.TimeZone.DaylightSavingTZOf"/>
      </ENTRIES>
    </ALIAS>
  </HEADERSECTION>
</TRANSFER>

```

```

</ALIAS>

<COMMENT>
  example dataset ili2 refmanual appendix H
</COMMENT>
</HEADERSECTION>

<DATASECTION>
  <Time.TimeZone BID="xBTimeZones">
    <Time.TimeZone.BaseTimeZone TID="xBTimeZonesMEZ">
      <Name>MEZ</Name>
      <DiffToUTC>-1:00</DiffToUTC>
    </Time.TimeZone.BaseTimeZone>

    <Time.TimeZone.DaylightSavingTZ TID="xBTimeZonesMESZ">
      <Name>MESZ</Name>
      <Periods>
        <Time.DaylightSavingPeriod>
          <DSToUTC>-2:00</DSToUTC>
          <From>1983</From>
          <To>1995</To>
          <DSStart>
            <Time.DSTransition>
              <TransitionDSTime>3:00</TransitionDSTime>
              <FirstDate>3:25</FirstDate>
              <DayOfWeek>Sunday</DayOfWeek>
            </Time.DSTransition>
          </DSStart>
          <DSEnd>
            <Time.DSTransition>
              <TransitionDSTime>3:00</TransitionDSTime>
              <FirstDate>9:24</FirstDate>
              <DayOfWeek>Sunday</DayOfWeek>
            </Time.DSTransition>
          </DSEnd>
        </Time.DaylightSavingPeriod>
        <Time.DaylightSavingPeriod>
          <DSToUTC>-2:00</DSToUTC>
          <From>1996</From>
          <To>2999</To>
          <DSStart>
            <Time.DSTransition>
              <TransitionDSTime>3:00</TransitionDSTime>
              <FirstDate>3:25</FirstDate>
              <DayOfWeek>Sunday</DayOfWeek>
            </Time.DSTransition>
          </DSStart>
          <DSEnd>
            <Time.DSTransition>
              <TransitionDSTime>3:00</TransitionDSTime>
              <FirstDate>10:25</FirstDate>
              <DayOfWeek>Sunday</DayOfWeek>
            </Time.DSTransition>
          </DSEnd>
        </Time.DaylightSavingPeriod>
      </Periods>
    </Time.TimeZone.DaylightSavingTZ>

    <Time.TimeZone.DaylightSavingTZOf TID="xDaylightSavingTZOf">
      <BaseTZ REF="xBTimeZonesMEZ"></BaseTZ>
      <DSTZ REF="xBTimeZonesMESZ"></DSTZ>
    </Time.TimeZone.DaylightSavingTZOf>
  </Time.TimeZone>
</DATASECTION>
</TRANSFER>

```

Examples

Some fundamental examples of indications of time are stated in chapter 2.9 Units in the INTERLIS 2 reference manual.

Referring to this time model and the preceding XML-data, we add the following two examples of application:

Example 1: In the following domain definition a type of time is depicted; it refers to CET, i.e Central European Time, however without taking into account the day light saving time of a certain country.

```
DOMAIN
  Time = 0:00:00.000 .. 23:59:59.999 [CET];
```

Example 2: The type of time depicted in the following domain definition refers to CET including Swiss day light saving time.

```
DOMAIN
  Time = 0:00:00.000 .. 23:59:59.999 [CETDLS];
```

Appendix I (Standard Extension Suggestion) Color Definitions

Note

The following specification is not a normative component of INTERLIS. This is a standard extension suggestion based upon the INTERLIS 2-reference manual in the sense of a recommendation. However we intend to put it up for discussion and possibly convert it into a more definite regulation. Consult the corresponding INTERLIS 2-user manuals for examples of application.

Introduction

This specification states in detail why a certain color space named $L^*C_{ab}^*h_{ab}^*$ is best suited for colour definitions. It gives an exhaustive description of this color space, cites conversion formulas related to other color spaces and gives instructions as to how a transformation of $L^*C_{ab}^*h_{ab}^*$ -coordinates into the color-coordinate system of a concrete screen or printer may be implemented. Furthermore it lays the foundation for the domains and precisions selected hereafter and indicates coordinates of especially chosen examples.

Since, amongst other faculties, INTERLIS 2 enables the description of graphics, it must be possible to specify colors. However a system and equipment neutral definition of "color" is surprisingly complex and demands comprehension of concepts that are not generally known.

Color is a product of light (= color stimulus), eye (= color valence) and brain function (= sensation). It is virtually impossible to describe colors through numbers in such a way, that two persons will conceive them identically. However color values can be measured in a universally acknowledged way, thus permitting a precise understanding amongst experts.

A method of specifying colors as strings should meet several requirements:

- **Equipment independence** — It ought to be clearly defined which color actually corresponds to a certain indication. This is the only means of ascertaining that the result will fulfill all expectations, whatever equipment is being used.
- **Expressiveness** — It ought to be possible to specify all colors that "normal" equipment (especially also good quality printers and plotters) will be able to represent. The spectrum of colors to be specified should be as wide as possible. Ideally it would comprise all colors a human being can perceive.
- **Intuition** — While reading a color description, a human being should intuitively have a notion of the color being described. An INTERLIS model always has a certain documentary character and should be understandable to those concerned without demanding major efforts.
- **System neutrality** — The ways and methods of indicating color should neither give precedence to a certain system (GIS, operating system, hardware), nor cause the acquisition of special devices.

Color space

The table below shows the suitability of different color spaces as far as application in INTERLIS-graphic descriptions is concerned:

Color	Equipment	Expressive-	Intuitive	System
-------	-----------	-------------	-----------	--------

space	Independence	ness	Intelligibility	Neutrality
RGB	–	–	–	–
HLS	–	–	++	–
HSV	–	–	++	–
CMY(K)	–	–	–	–
XYZ	+	+	--	+
SRGB	+	–	–	–
$L^* a^* b^*$	+	+	+	+
$L^* C_{ab}^* h_{ab}^*$	+	+	++	+

Figure I.1: Suitability of different colorspace for the purposes of INTERLIS.

The latter of the colorspace mentioned in figure I.1 $L^* C_{ab}^* h_{ab}^*$ (d.h. $L^* a^* b^*$ with polar coordinates) meets the requirements stated above in the most satisfactory manner.

$L^* a^* b^*$

The colorspace $L^* a^* b^*$ (sometimes also called CIELAB) widely used in the graphic industry, can be derived via transformation from XYZ as described in figure I.2.

$$\begin{aligned}
 L^* &= 116 \cdot f\left(\frac{Y}{Y_n}\right) - 16 \\
 a^* &= 500 \cdot \left[f\left(\frac{X}{X_n}\right) - f\left(\frac{Y}{Y_n}\right) \right] \\
 b^* &= 200 \cdot \left[f\left(\frac{Y}{Y_n}\right) - f\left(\frac{Z}{Z_n}\right) \right]
 \end{aligned}
 , \text{ whereby } f(x) = \begin{cases} \sqrt[3]{x} & \text{if } x > 0.008856; \\ 7.787x + \frac{16}{116} & \text{else} \end{cases}$$

Figure I.2: The conversion of XYZ to $L^* a^* b^*$.

In the calculation in figure I.2 a "reference white" is introduced by means of $\langle X_n, Y_n, Z_n \rangle$ in order to compensate an eventual tinge of light. Very often the values of CIE-standard light sources (mainly D50, occasionally D65) are employed. The XYZ-coordinates of these light sources can be found for example in [Sangwine/Horne, 1989], Table 3.1.

This range possesses a number of useful properties:

- **Equipment independence** — $L^* a^* b^*$ is derived from XYZ and hence independent of a certain equipment. It is unequivocally defined which color belongs to a $L^* a^* b^*$ -Triple.
- **Expressiveness** — In $L^* a^* b^*$ a point is assigned to each color that can be emitted by a reflecting surface.
- **Intuitive Intelligibility** — L^* means luminance, whereby a completely black surface (which reflects no light at all) possesses an L^* of 0 and a perfect reflector (which reflects all light) an L^* of 100. A human observer will judge a colour with $L^* = 50$ as average brightness. a^* is the red-green-axis: colors with $a^* = 0$ will be perceived as neither red nor green, colours with a negative a^* are red,

colors with positive a^* are green. Analogously b^* is the blue-yellow-axis. Within a plane which is spanned with a^* and b^* there is a distance from the zero point to a specific color value, the greater the distance the more saturated a color becomes.

- **System neutrality** — $L^*a^*b^*$ is absolutely system neutral; being an internationale standard the colorspace is independent of a specific firm.
- **Increasing utilization** — The utilization of $L^*a^*b^*$ in professional printing is widely spread. Programmes such as Adobe Photoshop or Acrobat (PDF) support $L^*a^*b^*$.
- **Easy transformability to RGB** — $L^*a^*b^*$ -triples can be transformed into the RGB-values of any screen via multiplication with a 3x3-matrix, followed by a raise to higher power (gamma correction), which may be carried out efficiently by means of a table (cf. [Adobe, 1992], chapter 23). Thus system developers will only have to face minimal efforts.
- **Good capacity for compression** — There is only a marginal difference between $L^*a^*b^*$ and RGB where processes are concerned that are likely to involve loss while compressing pictures. However in connection with INTERLIS this is irrelevant.

$$C_{ab}^* = \sqrt{(a^*)^2 + (b^*)^2} \quad h_{ab}^* = \tan^{-1}\left(\frac{b^*}{a^*}\right)$$

Figure I.3: Conversion of the cartesian $L^*a^*b^*$ -space to the polar form $L^*C_{ab}^*h_{ab}^*$ (according to [Sangwine/Horne, 1998]).

$L^*C_{ab}^*h_{ab}^*$

As described above, in the $L^*a^*b^*$ -space every single axis L^* (dark —light), a^* (green — red) and b^* (blue — yellow) corresponds to a property of colour which is immediately perceivable.

Nevertheless *intuitive intelligibility* can be further increased by indicating color coordinates in a polar instead of a cartesian system (cf. figure I.4).

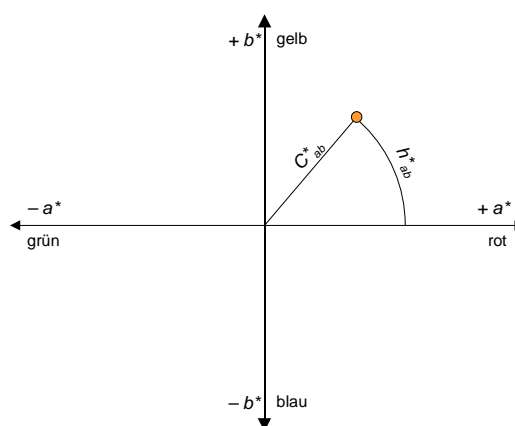


Figure I.4: The colorspace $L^*C_{ab}^*h_{ab}^*$ functions with polar coordinates onto $L^*a^*b^*$.

The formula in figure I.3 for h_{ab}^* is only applicable for positive a^* and b^* ; a correct version would provide case differentiation for every single quadrant. This polar system combines the intuitive intelligibility of HLS and HSV with the numerous advantages of $L^*a^*b^*$ described above, since it means that the axes L^* (*luminance*), C^* (*chroma*) und h^* (*hue*) become separately available.

In INTERLIS-models, whenever precise color indications are desired, they should be made based upon this color coordinate system.

Required Precision

It is part of an INTERLIS-model to indicate the degree of precision to be applied when recording numeric values. The $L^*a^*b^*$ -space is defined in such a way that the difference between two colors is only just perceptible, if the value calculated as shown in figure 1.5, equals 1.

Note: [Has/Newman, o.D.] states that the perceptibility of color differences also depends on the amount of time allowed for the comparison. The article relates an experiment, where the time needed to note differences was measured in the case of an inexperienced observer. The figures mentioned are 5 seconds for $\Delta E_{ab} = 15$, 10 seconds for $\Delta E_{ab} = 10$ and 15 seconds for $\Delta E_{ab} = 5$.

$$\Delta E_{ab} = \sqrt{\Delta L^{*2} + \Delta a^{*2} + \Delta b^{*2}}$$

Figure I.5: Calculation of color differences in the Cartesian $L^*a^*b^*$ -space.

Precision of the L^* -axis: For luminance a precision of one decimal is sufficient.

Precision of C_{ab}^* - and h_{ab}^* -axis: Theoretically a^* and b^* may be unrestricted, but in fact limits of ± 128 , rounded off to whole numbers, are considered largely sufficient (cf. [Adobe, 1992]). Thus what degree of precision is necessary for C_{ab}^* und h_{ab}^* , to ensure that inaccuracy in the a^*/b^* -surface does not exceed 1?

Inaccuracy introduced through the indication of angle augments with increasing distance from the zero point. Thus precision can still be considered sufficient as long as $\langle 127, 128 \rangle$ and $\langle 128, 128 \rangle$ within the a^*/b^* -surface can be distinguished. As can be seen in figure I.6, one decimal may suffice in this extreme case. It is a matter of two barely distinguishable hues of orange, however saturated to such a degree that it seems improbable any apparatus would be able to reproduce them.

a^*	b^*	C_{ab}^*	h_{ab}^*
127	128	180.3	45.2
128	128	181.0	45.0

Figure I.6: Cartesian and polar coordinates of a color extremely far away from the zero point (conversion cf. figure I.3).

Combination With Names

Color names are easier to handle than color codes (i.e. numbers), however this proves to be a disadvantage, as only a limited number of colors are thus available. In INTERLIS names can be combined with a numeric specification, enabling users to define their own color names and to exchange them among one another by the common means of INTERLIS.

Thanks to this definition it is also possible to employ INTERLIS — if need be — in the documenting and utilization of existing color name systems or color sample catalogues, such as the Pantone- or HKS-System.

This calls for the definition of a meta-class (cf. chapter 1.4.3 Meta-Models and Meta-Objects in the INTERLIS 2 reference manual). Its instances, so-called meta-objects, are retained in a special transfer-

file and are read by the INTERLIS 2-compiler. They are available for INTERLIS data-models and thus can be used in graphic-definitions in order to determine the color of a certain symbol, etc.

Examples of Application in INTERLIS-Models

```
!! Component of the symbology model

SYMBOLGY MODEL SymbologyExample EXTENDS BasicSymbology =

  CONTRACT ISSUED BY Unknown; !! Contractor(s) have to be defined!

  TOPIC Signs =

    CLASS LChColor EXTENDS INTERLIS.METAOBJECT =
      !! Attribute "Name" inherited from INTERLIS.METAOBJECT
      Luminance = MANDATORY 0.0 .. 100.0;
      Chroma = MANDATORY 0.0 .. 181.1;
      Hue = MANDATORY 0.0 .. 359.9 CIRCULAR [DEGREE] COUNTERCLOCKWISE;
    END LChColor;

    ...

    !! Component of the symbology class definition within the symbology model
    CLASS ColoredSymbology EXTENDS SIGN =
      ...
      PARAMETER
        Color: METAOBJECT OF SymbologyExample.LChColor;
      END ColoredSymbology;

    ...

  END Signs;

  ...
```

In a user-defined visualization command (here called SimplePointGr) the color of a user-defined colored symbology might appear as follows (cf. also chapter 2.16 Grafik Description in the INTERLIS 2 reference manual):

```
...

MODEL SimpleGraphic =

  CONTRACT ISSUED BY Unknown;

  IMPORTS SymbologyExample, Data;

  SIGN BASKET SimpleSigns ~ SymbologyExample.Signs;

  TOPIC ColoredDotGraphic =
    DEPENDS ON Data.Dots;

    GRAPHIC SimpleColoredDotGr BASED ON Data.Dots.Dot =
      Symbol OF SymbologyExample.Signs.ColoredSymbology: (
        Sign := { Dot };
        Pos := Position;
        Color := Brown;
      );
    END SimpleColoredDotGr;

  END ColoredDotGraphic;

END SimpleGraphic.

...
```

We neither give a complete example nor represent the necessary meta-table, instead we refer you to the example stated in Appendix C A Small Example in the INTERLIS 2 reference manual.

Example Values

Figure I.7 names some colors as well as their coordinates. Since it is uncertain whether this document has been conceived in a system (and most likely also printed) which is able to render colors correctly, we must at this stage do without a colorful representation.

Name	L^*	a^*	b^*	C_{ab}^*	h_{ab}^*
Black	0.0	0	0	0.0	0.0
Dark-grey	25.0	0	0	0.0	0.0
Middle-grey	50.0	0	0	0.0	0.0
Light-grey	75.0	0	0	0.0	0.0
White	100.0	0	0	0.0	0.0
Fuchsia	40.0	7 0	0	70.0	0.0
Light-blue	80.0	0	-30	30	270.0
Deep-yellow	90.0	0	100	100.0	90.0
Brown	50.0	3 0	50	58.3	59.0
Lilac	50.0	5 0	-50	70.7	315.0

Figure I.7: Cartesian and polar coordinates of some colors.

A concrete example of application with color-definitions is to be found in Appendix C A Small Example.

Notes for System Developers

System developers of INTERLIS-conforming systems have to deal with the arising question, how to transform color values from the independent $L^* C_{ab}^* h_{ab}^*$ -system into a color-coordinate-system of a specific screen or printer.

A standardized file-format will allow you to record color-distortions of a certain imaging component in so-called *component* or *color matching profiles* (so-called ICC-profile format). Amongst others, these files contain parameters needed in the conversion of an independent colour space to a component-specific color-coordinate-system. The former are either *XYZ* or $L^*a^*b^*$, the latter commonly *RGB* or *CMYK*. Format and necessary conversion functions are defined by [ICC, 1996].

Thus in his product a system developer will be able to support directly ICC-profiles. The file format is of a relatively simple structure, and the conversion functions will be easily implemented. For some platforms ready-made program libraries (such as *Apple ColorSync* or *Kodak KCMS*) are available.

In this context we would like to draw your attention to the fact that PDF directly supports the colorspace $L^*a^*b^*$. PostScript even allows you to define your own color ranges in terms of any given transformation from *XYZ*. The inversion function of the formula indicated in figure I.2 is to be found as example 4.11 in

[Adobe, 1990]. It is relatively simple to program an analogous function in PostScript which will directly accept $L^* C_{ab}^* h_{ab}^*$.

Literature

[Adobe, 1990] Adobe Systems: PostScript Language Reference Manual. 2nd Ed., 1990. ISBN 0-201-18127-4. 764 pages.

*The reference manual for PostScript, also provides recommendations for the treatment of colors and different conversion methods available in PostScript. Example 4.11 on page 191 defines the $L^*a^*b^*$ -colour range in PostScript.*

[Adobe, 1992] Adobe Developers Association: TIFF Revision 6.0.

<http://partners.adobe.com/asn/developer/PDFS/TN/TIFF6.pdf>

*Chapter 23 defines a variety of the TIFF-Format for pictures in the $L^*a^*b^*$ -color range and names a number of advantages in comparison with RGB. Furthermore you will find the outlines of a fast method for the conversion of $L^*a^*b^*$ to RGB.*

[Apple, 1998] Apple Computer, Inc.: Introduction to Color and Color Management Systems. In: *Inside Macintosh — Managing Color with ColorSync*.

<http://developer.apple.com/techpubs/macosx/Carbon/graphics/ColorSyncManager/ManagingColorSync/index.html>

Easy to understand introduction into different color spaces, with illustrated graphic.

[Apple, o.D.] Apple Computer, Inc.: A Brief Overview Of Color.

<http://www.apple.com/colors/benefits/training/overview.html>

Concise, easy to understand and rough introduction into different concepts in connection with colors. Intended for non-specialists.

[Has/Newman, o.D.] Michael Has, Todd Newman: Color Management: Current Practice and The Adoption of a New Standard. <http://www.color.org/wpaper1.html>

Names data for the red-, green- and blue reference point of two typical computer monitors and depicts that they differ widely from the xy-values of NTSC standard-phosphor-colours often quoted. Indicates a transformation from XYZ to RGB-space of a certain screen.

[ICC, 1996] International Color Consortium: ICC Profile Format Specification.

<http://www.color.org/profiles.html>

Defines a file-format which allows the characterization of any given component in respect to its colour representation. Appendix A comments on various colorspace.

[Poynton, 1997] Charles A. Poynton: Frequently Asked Questions about Color.

<ftp://ftp.inforamp.net/pub/users/poynton/doc/colour/ColorFAQ.pdf>

Explains in paragraph 36, why HLS and HSV are not suitable for the specification of colours.

[Sangwine/Horne, 1998] Sangwine, Stephen J. und Horne, Robin E. N. [Hrsg.]: The Colour Imaging Processing Handbook. Chapman & Hall: London [...], 1998. ISBN 0-412-80620-7. 440 pages.

Well-founded introduction into the scientific fundamentals of color perception and its application in image processing.

[Stokes et al., 1996] Michael Stokes, Matthew Anderson, Srinivasan Chandrasekar und Ricardo Motta: A Standard Default Color Space for the Internet — sRGB. November 1996.

<http://www.color.org/sRGB>

Specification of sRGB.

Appendix J (Standard Extension Suggestion) Coordinate Systems and Coordinate-Reference-Systems

Note

The following specification is not a normative component of INTERLIS. This is a standard extension suggestion based upon the INTERLIS 2-reference manual in the sense of a recommendation. However we intend to put it up for discussion and possibly convert it into a more definite regulation. Consult the corresponding INTERLIS 2-user manuals for examples of application.

Introduction

Coordinates describe the position of one point in space, provided a corresponding coordinate system has been set up. If a coordinate system is fixedly positioned in relation to the earth – in other terms: referenced – then it is called a coordinate reference system. However coordinates not only determine positions, but also metric quantities which can be derived from coordinates, such as distances, surfaces, volumes, angles and directions, as well as other properties, e.g. grades and curves.

There is a multitude of classes (types) of coordinate systems, and a greater number still of objects, i.e. realizations (instances) of coordinate systems (cf. also e.g. [Voser1999]). The Swiss Federal coordinates e.g. rely on a special instance (object) of a coordinate reference system [Gubler et al. 1996], which can be derived from a geodetical reference system via map projection [Snyder 1987, Bugayevskiy 1995]. These geodetical reference systems form a category of its own of coordinate reference systems that describe the geometry of the earth model. For example to describe a two-dimensional position, a sphere or an ellipsoid is used on whose surface geographical coordinates can be defined. It is slightly more complicated as soon as altitude is concerned: To serve as geometrical-physical earth model we employ either a geoid [Marti 1997] or a gravity model [Torge 1975] that defines orthometrical, resp. normal altitudes. However in practice it is very often only heights in use that are applied.

Since geodata of geometrical applications always are space-related, each geodata-set must be based upon a coordinate system. Considering that individual coordinate systems differ widely, it is necessary to supply the corresponding reference-data along with the geodata. This is why INTERLIS enables you to describe data belonging to a coordinate system.

It is only through knowledge of the underlying coordinate system that it is possible to transfer geodata into another coordinate system. This again is necessary if geodata provided by different coordinate systems is to be of common use [Voser 1996].

First we consider coordinate systems of a general type, then the relations (representations) between (general) coordinate systems, thereafter we introduce coordinate reference systems and deal with those.

Coordinate Systems

A *coordinate system* allows the "measuring" of metric space. A coordinate system possesses an origin, coordinate axis (their number corresponding to the dimension of the space spanned), as well as measure units assigned to the axis. Depending on whether the space in question is one-, two- or three-dimensional, the coordinate system assigns either a single digit, double digit or triple digit to every point in space as its coordinate(s).

The euclidian one-, two- or three-dimensional space is defined by its 1, 2 resp. 3 straight axis. Curved spaces demand additional parameters to define the embedding of their curved axis into a euclidian space.

For geodetical purposes, two-dimensional elliptic spaces as well as various systems of heights, both treated as special cases of one-dimensional Euclidian spaces are needed in addition to Euclidian spaces of different dimensions. This is when a gravity model or geoid is called for.

Slightly differing from the hitherto existing usage in geodesy we employ the term of *geodetical date* as a synonym for *geodatical reference system*, designating thus nothing but a special coordinate system, that is to say a 3D Cartesian coordinate system which has been positioned in relation to the earth. This may be achieved in two different ways:

- (a) The average center of gravity of the earth is defined as the zero point of the coordinate system, the first axis through the average rotation axis of the earth, the second axis perpendicular to the former through the average meridian of Greenwich, and the third axis again perpendicular to the former two, thus creating a clockwise-rotating system. For example the coordinate system WGS84 is defined in this manner.
- (b) The surface of the earth of a certain area (mostly a country) is approximated in an optimal way by means of a globe or rotation ellipse whose axis of rotation is set parallel to the average rotation axis of the earth. This rotation ellipsoid defines a Cartesian coordinate system through its smaller half axis which is parallel to the earth axis, through one of its longer half axis and through a third axis perpendicular to the former two, thus again creating a clockwise-rotating system.

A 3D Cartesian coordinate system positioned on the earth in accordance to (a) or (b) is called a *geodetical date* or *geodetical reference system*.

Different Origin of Coordinate Systems in Geomatics

Different backgrounds lead to various definitions of coordinate systems in:

Sensor techniques: The data capturing methods in classical geodesy (e.g. with theodolites) as well as photogrammetry and remote sensing use a (local) coordinate system in accordance with each respective method in their data capturing sensors.

Geopositioning: The description of position on the earth by means of a (geodatical) earth model. There are three different types of geodatical earth models [Voser 1999]:

- *physical:* The earth model is either described by means of a gravitational field or a geoid.
- *mathematical:* The earth model is a symmetrical body (e.g. a globe or ellipsoid).
- *topographical:* The earth model also takes into consideration mountains and valleys (earth surface model).

The above-mentioned earth models correspond to different coordinate systems.

Map positioning: Since the surfaces of the above-mentioned earth models are of curved or even more complex form, the calculation of distances, angles etc. is very difficult. Hence we employ map projections that represent the two-dimensional surface in a plane. A map projection is a geometrically clearly defined way of representing the surface of a mathematical earth model in a plane. This process involves distortions; these however can be determined and controlled in advance.

Mappings Between Coordinate Systems

Since geodata usually are recorded in different coordinate systems or are administered by different institutions in various systems, it is necessary to know the methods that permit conversion of data supplied by a source coordinate system A into a target coordinate system Z. This conversion is called mapping of coordinate system A, resp. of the space defined by A, in coordinate system Z, resp. the space defined by Z. Mappings between two coordinate systems, resp. between the spaces they define, are determined by the classes of the two coordinate systems concerned.

We have to distinguish between two fundamentally different mappings of coordinate systems as far as the origin of formulas and their parameters are concerned, these being conversion and transformation.

The term *conversion* means mapping between two coordinate systems strictly defined by formulas and their parameters. These formulas and especially the values of the necessary parameters are determined in advance [Voser 1999]. Into the category of conversions fall amongst others map projections, i.e. mappings of ellipsoid surfaces in a plane, furthermore the conversion of elliptic coordinates into the corresponding Cartesian coordinates with their origin in the center of the ellipse or vice-versa.

A *transformation* is a mapping between two coordinate systems where rules (formulas) are determined based upon hypotheses, and parameters are established by means of a statistic analysis of measurements in both coordinate systems [Voser 1999]. Typical transformations are effected when replacing one geodetical earth model with another (geodetical date transformation) or when adjusting local coordinates in a superior system, e.g. With digitizing: the transformation of map- or table-coordinates into projection-coordinates.

Coordinate Reference Systems

The term Coordinate Reference System describes a coordinate system, which can be derived from a geodetical reference system (i.e. a geodetical date) by means of conversion via a sequence of intermediate coordinate systems.

Geodetical reference systems (or geodetical dates) as such are the most important coordinate reference systems. They refer to a geodetical earth model (see above).

Survey of the Most Important Coordinate Reference Systems

In the lower part of figure J.1 some of the most important geodetical and cartographical expressions of coordinate reference systems are depicted. It is the earth itself that is at the origin of any sequence of coordinate systems or mappings. We try to assign it a geometrical earth model that would allow the describing of positions on it. To begin with we can assign to the earth as a whole a 3D Cartesian coordinate system with its zero point in the gravity center of the earth (cf. method a) in the chapter Coordinate Systems above). Subsequently however we treat the position and height of a point independently. Firstly let us consider only what needs to be done in order to determine its position. Geodetical measurements supply the necessary information to determine the size and form of a rotation ellipsoid that approaches the earth surface locally in an optimal way. According to method b) in chapter Coordinate Systems this rotation ellipsoid can be assigned a geodetical date. Many of the earth models selected for national surveying are "locally" referenced, i.e. the center of the ellipsoid does not coincide with the gravity center of the earth. However, as stated above ((a) in the chapter Coordinate Systems), there are geodetical reference systems which are referenced to the gravitation center. Thus nowadays it is relatively easy to determine the parameters of a date transformation to such a superior system. Once such a local rotation ellipsoid has been decided upon, it is on the other hand possible to represent its surface in a plane by means of an appropriate map projection and in accordance with all requirements.

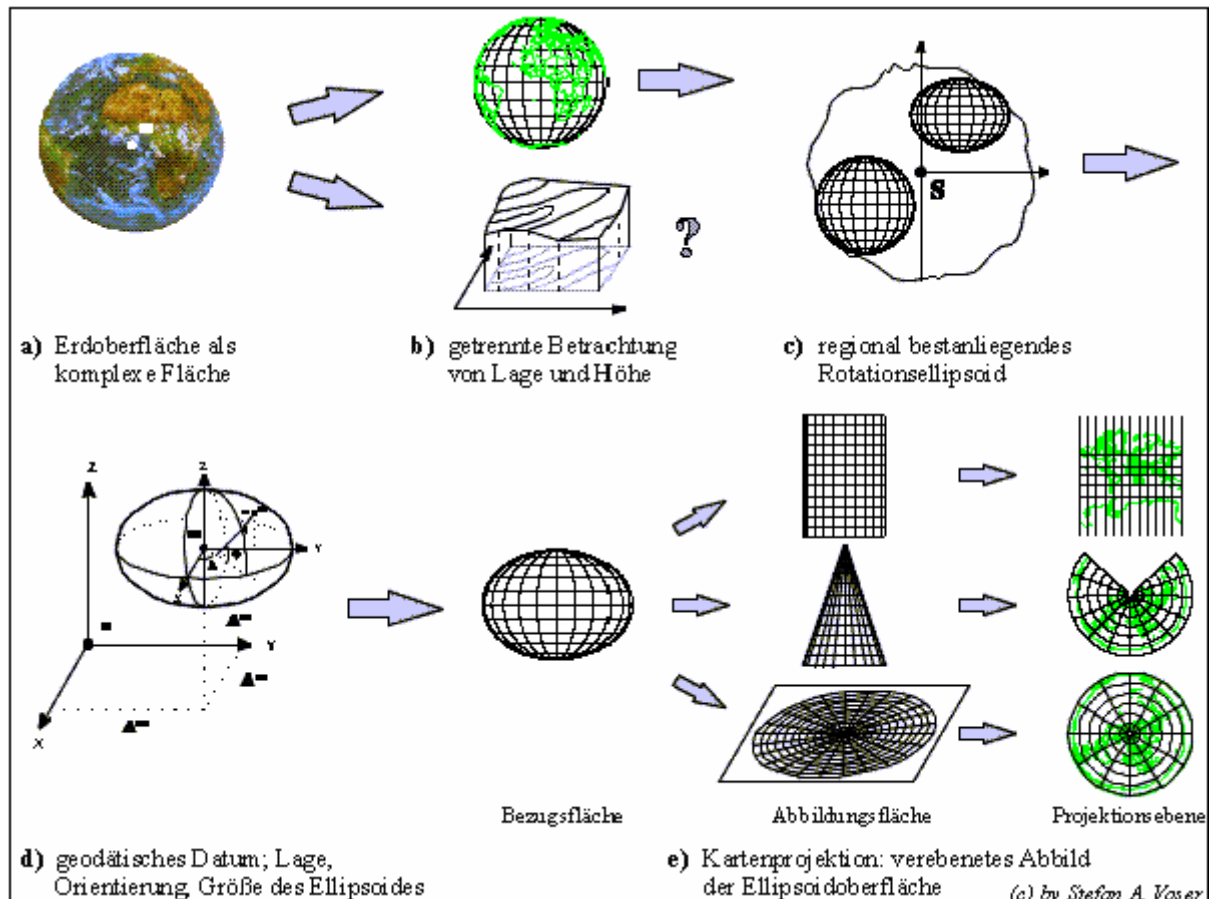


Figure J.1: How to transform the earth surface into 2D horizontal coordinates.

Data Structure for Coordinate Systems and Mappings Between Them

The proposed structure for data necessary for the description of coordinate systems and mapping between them is *not* limited to coordinate reference systems, but on purpose has been conceived for coordinate systems in general. It is our intention to also permit the description of digitizer- and screen coordinate systems or symbology coordinate systems without any explicit reference to the surface of the earth.

Coordinate systems and mapping between them are the two key-concepts for the exact characterization of spatial referencing of geodata. Accordingly the conceptual model (resp. the conceptual schema) of the data structure features two major groups of classes, these being "Coordinate systems for geodetic purposes" and "Mappings between coordinate systems". The third dimension, height, is treated as follows: In a 3D Cartesian coordinate system the height has been implicitly integrated as the third coordinate. However in daily use coordinate systems usually are a combination of a 2D horizontal coordinate systems and an additional 1D height system. The (meta) data of coordinate systems of this type are described by two independent data sets, firstly by the data of a 2D coordinate system (2D Cartesian or elliptic) and secondly by the data of a height system of appropriate type (normal, orthometric or elliptic).

How do the proposed data structures help to effect mapping between coordinate systems? In the following way: Coordinate systems form nodes and mappings between them constitute edges in a graph structure. In the DOMAIN section of an application model (application schema) the name of the coordinate system in use is to be found. If the given coordinates are to be mapped into another coordinate system or for example if GeoTIFF-parameters, which correspond to such a mapping are to be calculated, then an appropriate program within the graph-structure of coordinate systems and mappings

has to find the shortest possible way from the node of the given coordinate system (according to DOMAIN) to the node of the target system. Thereafter the necessary mappings from the source system via possible intermediate coordinate systems to the target system have to be calculated.

For the description of coordinate systems two internal classes and key words are available in INTERLIS, these being: AXIS and COORDSYSTEM. These are employed within the conceptual data model (the coordinate system model or coordinate system schema) "CoordSys" (see below). Further details are to be found in chapter 2.10.3 Reference Systems in the INTERLIS 2 reference manual.

Literature

- [Bugayevskiy 1995] Bugayevskiy Lev M., Snyder John P.: Map Projections, A Reference Manual, Taylor&Francis, London, Bristol 1995.
- [Gubler et al. 1996] Gubler E., Gutknecht D., Marti U., Schneider D. Signer Th., Voge B., Wiget A.: Die neue Landesvermessung der Schweiz LV95; VPK 2/96.
- [Marti 1997] Marti, Urs: Geoid der Schweiz 1997. Geodätisch-geophysikalische Arbeiten in der Schweiz, Schweizerische Geodätische Kommission, Volume 56, Zürich, 1997.
- [Torge 1975] Torge, Wolfgang: Geodäsie. Sammlung Götschen 2163, de Gruyter, Berlin – New York, 1975.
- [Snyder 1987] Snyder, John P.: Map Projections – A Working Manual, U.S. Geological Survey Professional Paper 1395, Washington, 1987.
- [Voser 1996] Voser, Stefan A; Anforderungen an die Geometrie zur gemeinsamen Nutzung unterschiedlicher Datenquellen; 4. deutsche Arc/Info-Anwender-Konferenz, Proceedings, März 1996, Freising.
- [Voser 1999] Voser, Stefan. A.: MapRef - The Internet Collection of Map Projections and Reference Systems for Europe; 14. ESRI European User Conference, Presentation and Proceedings; 15.-17. Nov. 1999; Munich: www.mapref.org/.

The Reference System Model

Data structure for coordinate systems and coordinate reference systems as well as mapping between them. Conceptual data model (conceptual schema) with INTERLIS.

```
!! File CoordSys.ili Release 2003-03-18

INTERLIS 2.2;

REFSYSTEM MODEL CoordSys (en) = !! 2-letter code (ISO 639)

UNIT
  Angle_Degree = 180 / PI [INTERLIS.rad];
  Angle_Minute = 1 / 60 [Angle_Degree];
  Angle_Second = 1 / 60 [Angle_Minute];
  Angle_DMS = {Angle_Degree:Angle_Minute[0 .. 59]:Angle_Second[0 .. 59]}
              CONTINUOUS;

TOPIC CoordsysTopic =

  !! Special space aspects to be referenced
  !! *****

  CLASS Ellipsoid EXTENDS INTERLIS.REFSYSTEM =
    EllipsoidAlias: TEXT*70;
    SemiMajorAxis: MANDATORY 6360000.0000 .. 6390000.0000 [INTERLIS.m];
    InverseFlattening: MANDATORY 0.00000000 .. 350.00000000;
    !! The inverse flattening 0 characterizes the 2-dim sphere
    Remarks: TEXT*70;
  END Ellipsoid;

  CLASS GravityModel EXTENDS INTERLIS.REFSYSTEM =
    GravityModAlias: TEXT*70;
    Definition: TEXT*70;
  END GravityModel;

  CLASS GeoidModel EXTENDS INTERLIS.REFSYSTEM =
    GeoidModAlias: TEXT*70;
    Definition: TEXT*70;
  END GeoidModel;

  !! Coordinate systems for geodetic purposes
  !! *****

  STRUCTURE LengthAXIS EXTENDS INTERLIS.AXIS =
    ShortName: TEXT*12;
    Description: TEXT*255;
  PARAMETER
    Unit (EXTENDED): NUMERIC [INTERLIS.LENGTH];
  END LengthAXIS;

  STRUCTURE AngleAXIS EXTENDS INTERLIS.AXIS =
    ShortName: TEXT*12;
    Description: TEXT*255;
  PARAMETER
    Unit (EXTENDED): NUMERIC [INTERLIS.ANGLE];
  END AngleAXIS;

  CLASS GeoCartesian1D EXTENDS INTERLIS.COORDSYSTEM =
    Axis (EXTENDED): LIST {1} OF LengthAXIS;
  END GeoCartesian1D;

  CLASS GeoHeight EXTENDS GeoCartesian1D =
    System: MANDATORY (
      normal,
```

```

        orthometric,
        ellipsoidal,
        other);
    ReferenceHeight: MANDATORY -10000.000 .. +10000.000 [INTERLIS.m];
    ReferenceHeightDescr: TEXT*70;
END GeoHeight;

ASSOCIATION HeightEllips =
    GeoHeightRef -- {*} GeoHeight;
    EllipsoidRef -- {1} Ellipsoid;
END HeightEllips;

ASSOCIATION HeightGravit =
    GeoHeightRef -- {*} GeoHeight;
    GravityRef -- {1} GravityModel;
END HeightGravit;

ASSOCIATION HeightGeoid =
    GeoHeightRef -- {*} GeoHeight;
    GeoidRef -- {1} GeoidModel;
END HeightGeoid;

CLASS GeoCartesian2D EXTENDS INTERLIS.COORDSYSTEM =
    Definition: TEXT*70;
    Axis (EXTENDED): LIST {2} OF LengthAXIS;
END GeoCartesian2D;

CLASS GeoCartesian3D EXTENDS INTERLIS.COORDSYSTEM =
    Definition: TEXT*70;
    Axis (EXTENDED): LIST {3} OF LengthAXIS;
END GeoCartesian3D;

CLASS GeoEllipsoidal EXTENDS INTERLIS.COORDSYSTEM =
    Definition: TEXT*70;
    Axis (EXTENDED): LIST {2} OF AngleAXIS;
END GeoEllipsoidal;

ASSOCIATION EllcSEllips =
    GeoEllipsoidalRef -- {*} GeoEllipsoidal;
    EllipsoidRef -- {1} Ellipsoid;
END EllcSEllips;

!! Mappings between coordinate systems
!! *****

ASSOCIATION ToGeoEllipsoidal =
    From -- {1..*} GeoCartesian3D;
    To -- {1..*} GeoEllipsoidal;
    ToHeight -- {1..*} GeoHeight;
MANDATORY CONSTRAINT
    ToHeight -> System == #ellipsoidal;
MANDATORY CONSTRAINT
    To -> EllipsoidRef -> Name == ToHeight -> EllipsoidRef -> Name;
END ToGeoEllipsoidal;

ASSOCIATION ToGeoCartesian3D =
    From2 -- {1..*} GeoEllipsoidal;
    FromHeight -- {1..*} GeoHeight;
    To3 -- {1..*} GeoCartesian3D;
MANDATORY CONSTRAINT
    FromHeight -> System == #ellipsoidal;
MANDATORY CONSTRAINT
    From2 -> EllipsoidRef -> Name == FromHeight -> EllipsoidRef -> Name;
END ToGeoCartesian3D;

ASSOCIATION BidirectGeoCartesian3D =
    From -- {1..*} GeoCartesian3D;

```

```

To2 -- {1..*} GeoCartesian3D;
Precision: MANDATORY (
    exact,
    measure_based);
ShiftAxis1: MANDATORY -10000.000 .. 10000.000 [INTERLIS.m];
ShiftAxis2: MANDATORY -10000.000 .. 10000.000 [INTERLIS.m];
ShiftAxis3: MANDATORY -10000.000 .. 10000.000 [INTERLIS.m];
RotationAxis1: -90:00:00.000 .. 90:00:00.000 [Angle_DMS];
RotationAxis2: -90:00:00.000 .. 90:00:00.000 [Angle_DMS];
RotationAxis3: -90:00:00.000 .. 90:00:00.000 [Angle_DMS];
NewScale: 0.000001 .. 1000000.000000;
END BidirectGeoCartesian3D;

ASSOCIATION BidirectGeoCartesian2D =
    From -- {1..*} GeoCartesian2D;
    To -- {1..*} GeoCartesian2D;
END BidirectGeoCartesian2D;

ASSOCIATION BidirectGeoEllipsoidal =
    From4 -- {1..*} GeoEllipsoidal;
    To4 -- {1..*} GeoEllipsoidal;
END BidirectGeoEllipsoidal;

ASSOCIATION MapProjection (ABSTRACT) =
    From5 -- {1..*} GeoEllipsoidal;
    To5 -- {1..*} GeoCartesian2D;
    FromCo1_FundPt: MANDATORY -90:00:00.00 .. +90:00:00.00 [Angle_DMS];
    FromCo2_FundPt: MANDATORY -90:00:00.00 .. +90:00:00.00 [Angle_DMS];
    ToCoord1_FundPt: MANDATORY -10000000 .. +10000000 [INTERLIS.m];
    ToCoord2_FundPt: MANDATORY -10000000 .. +10000000 [INTERLIS.m];
END MapProjection;

ASSOCIATION TransverseMercator EXTENDS MapProjection =
END TransverseMercator;

ASSOCIATION SwissProjection EXTENDS MapProjection =
    IntermFundP1: MANDATORY -90:00:00.00 .. +90:00:00.00 [Angle_DMS];
    IntermFundP2: MANDATORY -90:00:00.00 .. +90:00:00.00 [Angle_DMS];
END SwissProjection;

ASSOCIATION Mercator EXTENDS MapProjection =
END Mercator;

ASSOCIATION ObliqueMercator EXTENDS MapProjection =
END ObliqueMercator;

ASSOCIATION Lambert EXTENDS MapProjection =
END Lambert;

ASSOCIATION Polyconic EXTENDS MapProjection =
END Polyconic;

ASSOCIATION Albus EXTENDS MapProjection =
END Albus;

ASSOCIATION Azimutal EXTENDS MapProjection =
END Azimutal;

ASSOCIATION Stereographic EXTENDS MapProjection =
END Stereographic;

ASSOCIATION HeightConversion =
    FromHeight -- {1..*} GeoHeight;
    ToHeight -- {1..*} GeoHeight;
    Definition: TEXT*70;
END HeightConversion;

END CoordsysTopic;

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END CoordSys.

The file MiniCoordSysData, whose names might occur in MetadataUseDef, contains the following data in the INTERLIS 2-transfer format.

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  xsi:schemaLocation="http://www.interlis.ch/INTERLIS2.2
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  example dataset ili2 refmanual appendix J
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    <CoordSys.CoordsysTopic.GeoidModel TID="xBCoordSysCHGeoid">
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        <CoordSys.CoordsysTopic.LengthAXIS>
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          <Description>CHOrthometricAlt</Description>
        </CoordSys.CoordsysTopic.LengthAXIS>
      </Axis>
      <System>orthometric</System>
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      <ReferenceHeightDescr>Pierre du Niton</ReferenceHeightDescr>
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</CoordSys.CoordsysTopic.GeoHeight>

<CoordSys.CoordsysTopic.GeoCartesian2D TID="xBCoordSysCOORD2">
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  </Axis>
  <Definition>Mathematisches 2D Refsystem</Definition>
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<CoordSys.CoordsysTopic.GeoCartesian2D TID="xBCoordSysCHLV03">
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  <Axis>
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      <ShortName>Y</ShortName>
      <Description>Ost-Wert</Description>
    </CoordSys.CoordsysTopic.LengthAXIS>
    <CoordSys.CoordsysTopic.LengthAXIS>
      <ShortName>X</ShortName>
      <Description>Nord-Wert</Description>
    </CoordSys.CoordsysTopic.LengthAXIS>
  </Axis>
  <Definition>Geodaetisches 2D Refsystem</Definition>
</CoordSys.CoordsysTopic.GeoCartesian2D>

<CoordSys.CoordsysTopic.GeoCartesian3D TID="xBCoordSysCOORD3">
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  <Axis>
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      <ShortName>X</ShortName>
      <Description>X-Axis</Description>
    </CoordSys.CoordsysTopic.LengthAXIS>
    <CoordSys.CoordsysTopic.LengthAXIS>
      <ShortName>Y</ShortName>
      <Description>Y-Axis</Description>
    </CoordSys.CoordsysTopic.LengthAXIS>
    <CoordSys.CoordsysTopic.LengthAXIS>
      <ShortName>Z</ShortName>
      <Description>Z-Axis</Description>
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  </Axis>
  <Definition>Mathematisches 3D Refsystem</Definition>
</CoordSys.CoordsysTopic.GeoCartesian3D>

<CoordSys.CoordsysTopic.GeoCartesian3D TID="xBCoordSysCH1903">

```

```

<Name>CH1903</Name>
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    <Description>Aequator Greenwich</Description>
  </CoordSys.CoordsysTopic.LengthAXIS>
  <CoordSys.CoordsysTopic.LengthAXIS>
    <ShortName>YC</ShortName>
    <Description>Aequator East</Description>
  </CoordSys.CoordsysTopic.LengthAXIS>
  <CoordSys.CoordsysTopic.LengthAXIS>
    <ShortName>ZC</ShortName>
    <Description>North</Description>
  </CoordSys.CoordsysTopic.LengthAXIS>
</Axis>
<Definition>Geodaetisches 3D Refsystem CH</Definition>
</CoordSys.CoordsysTopic.GeoCartesian3D>

<CoordSys.CoordsysTopic.GeoCartesian3D TID="xBCoordSysWGS84">
  <Name>WGS84</Name>
  <Axis>
    <CoordSys.CoordsysTopic.LengthAXIS>
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      <Description>Aequator Greenwich</Description>
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    <CoordSys.CoordsysTopic.LengthAXIS>
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      <Description>Aequator East</Description>
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    <CoordSys.CoordsysTopic.LengthAXIS>
      <ShortName>ZW</ShortName>
      <Description>North</Description>
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  </Axis>
  <Definition>World Geodetic System 1984</Definition>
</CoordSys.CoordsysTopic.GeoCartesian3D>

<CoordSys.CoordsysTopic.GeoEllipsoidal
  TID="xBCoordSysSwitzerland">
  <Name>Switzerland</Name>
  <Axis>
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    <CoordSys.CoordsysTopic.AngleAXIS>
      <ShortName>Long</ShortName>
      <Description>Laenge</Description>
    </CoordSys.CoordsysTopic.AngleAXIS>
  </Axis>
  <Definition>Koordinaten auf dem CH Ellipsoid 1903</Definition>
  <EllipsoidRef REF="xBCoordSysBessel"/>
</CoordSys.CoordsysTopic.GeoEllipsoidal>

<CoordSys.CoordsysTopic.ToGeoEllipsoidal
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  <To REF= "xBCoordSysSwitzerland"></To>
  <ToHeight REF= "xBCoordSysSwissEllipsoidalAlt"></ToHeight>
</CoordSys.CoordsysTopic.ToGeoEllipsoidal>

<CoordSys.CoordsysTopic.ToGeoCartesian3D
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  <FromHeight REF="xBCoordSysSwissEllipsoidalAlt"></FromHeight>
  <To3 REF="xBCoordSysCH1903"></To3>
</CoordSys.CoordsysTopic.ToGeoCartesian3D>

```

```

<CoordSys.CoordsysTopic.BidirectGeoCartesian3D
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  <To2 REF= "xBCoordSysCH1903"></To2>
  <Precision>measure_based</Precision>
  <ShiftAxis1>-660.077</ShiftAxis1>
  <ShiftAxis2>-13.551</ShiftAxis2>
  <ShiftAxis3>-369.344</ShiftAxis3>
  <RotationAxis1>-0:0:2.484</RotationAxis1>
  <RotationAxis2>-0:0:1.783</RotationAxis2>
  <RotationAxis3>-0:0:2.939</RotationAxis3>
  <NewScale>0.99444</NewScale>
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<CoordSys.CoordsysTopic.BidirectGeoCartesian3D
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  <To2 REF= "xBCoordSysWGS84"></To2>
  <Precision>measure_based</Precision>
  <ShiftAxis1>660.077</ShiftAxis1>
  <ShiftAxis2>13.551</ShiftAxis2>
  <ShiftAxis3>369.344</ShiftAxis3>
  <RotationAxis1>0:0:2.484</RotationAxis1>
  <RotationAxis2>0:0:1.783</RotationAxis2>
  <RotationAxis3>0:0:2.939</RotationAxis3>
  <NewScale>1.00566</NewScale>
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<CoordSys.CoordsysTopic.TransverseMercator
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  <To5 REF= "xBCoordSysCHLV03"></To5>
  <FromCol_FundPt>46:57:08.66</FromCol_FundPt>
  <FromCo2_FundPt>7:26:22.50</FromCo2_FundPt>
  <ToCoord1_FundPt>600000</ToCoord1_FundPt>
  <ToCoord2_FundPt>200000</ToCoord2_FundPt>
</CoordSys.CoordsysTopic.TransverseMercator>

<CoordSys.CoordsysTopic.HeightConversion
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</CoordSys.CoordsysTopic.HeightConversion>

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  <ToHeight REF= "xBCoordSysSwissEllipsoidalAlt"></ToHeight>
</CoordSys.CoordsysTopic.HeightConversion>
</CoordSys.CoordsysTopic>
</DATASECTION>
</TRANSFER>

```

Example

What information within an application model (resp. application schema) is needed in order to identify unequivocally the coordinate system employed, resp. the coordinate reference system?

```

!! File CoordSysEx.ili Release 2003-03-18

INTERLIS 2.2;

MODEL Beispiel (de) = !! 2-letter code (ISO 639)

IMPORTS CoordSys;

REFSYSTEM BASKET BCoordSys ~ CoordSys.CoordsysTopic;

```

```
UNIT
  Meter = [INTERLIS.m];

DOMAIN
  LKoord = COORD
    480000.000 .. 850000.000 [INTERLIS.m] {CHLV03[1]},
    60000.000 .. 320000.000 [INTERLIS.m] {CHLV03[2]},
    ROTATION 2 -> 1;
  Hoehe = COORD
    -200.000 .. 5000.000 [INTERLIS.m] {SwissOrthometricAlt[1]};
  HKoord = COORD
    480000.000 .. 850000.000 [INTERLIS.m] {CHLV03[1]},
    60000.000 .. 320000.000 [INTERLIS.m] {CHLV03[2]},
    -200.000 .. 5000.000 [INTERLIS.m] {SwissOrthometricAlt[1]},
    ROTATION 2 -> 1;

TOPIC T =

  CLASS Fixpunkt =
    Name: TEXT*20;
    Position: LKoord;
  END Fixpunkt;

END T;

END Beispiel.
```

Appendix K (Standard Extension Suggestion) Symbology Models

Note

The following specification is not a normative component of INTERLIS. This is a standard extension suggestion based upon the INTERLIS 2-reference manual in the sense of a recommendation. However we intend to put it up for discussion and possibly convert it into a more definite regulation. Consult the corresponding INTERLIS 2-user manuals for examples of application.

Abstract Symbology Model

Description of the abstract symbology model.

```
!! File AbstractSymbology.ili Release 2003-03-18

INTERLIS 2.2;

SYMBOLGY MODEL AbstractSymbology (en) =

  CONTRACT ISSUED BY Unknown; !! Contractor(s) have to be defined!

  UNIT
    Millimeter [mm] = 0.001 [INTERLIS.m];
    Angle_Degree = 180 / PI [INTERLIS.rad];

  DOMAIN
    Style_COORD2 (ABSTRACT) = COORD NUMERIC, NUMERIC;
    Style_COORD3 (ABSTRACT) = COORD NUMERIC, NUMERIC, NUMERIC;
    Style_POLYLINE (ABSTRACT) = POLYLINE WITH (STRAIGHTS, ARCS)
      VERTEX Style_COORD2; !! {Planar}?
    Style_SURFACE (ABSTRACT) = SURFACE WITH (STRAIGHTS, ARCS)
      VERTEX Style_COORD2;
    Style_INT (ABSTRACT) = NUMERIC; !! [Units?]
    Style_FLOAT (ABSTRACT) = NUMERIC; !! [Units?]
    Style_ANGLE (ABSTRACT) = 0.000 .. 359.999 CIRCULAR [Angle_Degree]
      COUNTERCLOCKWISE; !! RefSystem?

  TOPIC Signs =

    !! Graphic interface

    CLASS TextSign (ABSTRACT) EXTENDS INTERLIS.SIGN =
      PARAMETER
        Txt      : MANDATORY TEXT;
        Geometry : MANDATORY Style_COORD2;
        Rotation  : Style_ANGLE; !! Default 0.0
        Hali      : HALIGNMENT;  !! Default Center
        Vali      : VALIGNMENT;  !! Default Half
      END TextSign;

    CLASS SymbolSign (ABSTRACT) EXTENDS INTERLIS.SIGN =
      PARAMETER
        Geometry : MANDATORY Style_COORD2;
        Scale     : Style_FLOAT;
        Rotation  : Style_ANGLE; !! Default 0.0
      END SymbolSign;

    CLASS PolylineSign (ABSTRACT) EXTENDS INTERLIS.SIGN =
      PARAMETER
```

```

    Geometry : MANDATORY Style_POLYLINE;
END PolylineSign;

CLASS SurfaceSign (ABSTRACT) EXTENDS INTERLIS.SIGN =
PARAMETER
    Geometry : MANDATORY Style_SURFACE;
END SurfaceSign;

END Signs;

END AbstractSymbology.

```

Standard Symbology Model

Description of the extended standard symbology model built upon its abstract version.

```

!! File StandardSymbology.ili Release 2003-03-18

INTERLIS 2.2;

SYMBOLGY MODEL StandardSymbology (en) =

    !! Extended symbology model with symbol libraries and priorities.

    CONTRACT ISSUED BY Unknown; !! Contractor(s) have to be defined!

    IMPORTS AbstractSymbology;

    UNIT
        Angle_Degree = 180 / PI [INTERLIS.rad];

    DOMAIN
        SS_Priority = 0 .. 9999;
        SS_Float    = -2000000000.000 .. 2000000000.000;
        SS_Angle    = 0.000 .. 359.999
                    CIRCULAR [Angle_Degree] COUNTERCLOCKWISE;
        SS_Coord2   = COORD -2000000000.000 .. 2000000000.000 [INTERLIS.m],
                    -2000000000.000 .. 2000000000.000 [INTERLIS.m],
                    ROTATION 2 -> 1;
        SS_Polyline = POLYLINE WITH (STRAIGHTS, ARCS)
                    VERTEX SS_Coord2;
        SS_Surface  = SURFACE WITH (STRAIGHTS, ARCS)
                    VERTEX SS_Coord2;

    TOPIC StandardSigns EXTENDS AbstractSymbology.Signs =

        !! StandardSigns contains symbol libraries and symbol interfaces.
        !! The libraries (colors, fonts/symbols and line patterns) form the
        !! base for the construction of concrete symbols. The symbol interfaces
        !! extend the symbol interfaces of AbstractSymbology by priorities.

        !! Library section
        !! ++++++

        !! Color library
        !! =====
        !! Colors are defined by LCh values with transparency.

        CLASS Color =
            Name: TEXT*40; !! name of color, i.e. "light green"
            L: MANDATORY 0.0 .. 100.0; !! Luminance
            C: MANDATORY 0.0 .. 181.1; !! Chroma
            H: MANDATORY 0.0 .. 359.9 CIRCULAR [Angle_Degree] COUNTERCLOCKWISE; !! Hue
            T: MANDATORY 0.000 .. 1.000; !! Transparency: 0=totally transparent, 1=opaque
        END Color;

        !! Polyline attributes

```

```

!! ++++++
!! Presentation parameters for simple continuous lines. Polyline attributes
!! are used by all other polyline definitions (see also below).

CLASS PolylineAttrs =
  Width      : SS_Float;
  Join       : ( !! connection form for line segments
    bevel,
    round,
    miter
  );
  MiterLimit : 1.0 .. 1000.0; !! only for Join = miter
  Caps       : ( !! termination form at end of line
    round,
    butt
  );
END PolylineAttrs;

!! Font- and symbol library
!! =====
!! Symbols are a collection of lines and surfaces. Symbols are
!! organized in fonts. A font can be either a text font or a symbol
!! font. If the font is a text font (Type = #text), every symbol
!! (Character) has an UCS4 code (Unicode) and a spacing parameter assigned.

STRUCTURE FontSymbol_Geometry (ABSTRACT) =
  !! Basic structure for uniform treatment of all symbol geometries.
END FontSymbol_Geometry;

STRUCTURE FontSymbol_Polyline EXTENDS FontSymbol_Geometry =
  Color      : REFERENCE TO Color; !! only for symbols
  LineAttrs  : REFERENCE TO PolylineAttrs;
  Geometry   : MANDATORY SS_Polyline;
END FontSymbol_Polyline;

STRUCTURE FontSymbol_Surface EXTENDS FontSymbol_Geometry =
  FillColor  : REFERENCE TO Color; !! only for symbols
  Geometry   : MANDATORY SS_Surface;
  !! Remark: Has no line symbology, because the boundary is *not* part
  !! of the surface. With FillColor you define only the color of the
  !! surface filling.
END FontSymbol_Surface;

CLASS FontSymbol =
  !! All font symbols are defined for size 1.0 and scale 1.0.
  !! The value is measured in user units (i.e. normally [m]).
  Name       : TEXT*40; !! Symbol name, if known
  UCS4       : 0 .. 4000000000; !! only for text symbols (characters)
  Spacing    : SS_Float; !! only for text symbols (characters)
  Geometry   : LIST OF FontSymbol_Geometry;
END FontSymbol;

CLASS Font =
  Name       : MANDATORY TEXT*40; !! Font name or name of external font
  Internal   : MANDATORY BOOLEAN; !! Internal or external font
  !! Only for internal fonts the geometric
  !! definitions of the symbols is contained
  !! in FontSymbol.
  Type       : MANDATORY (
    symbol,
    text
  );
  BottomBase : SS_Float; !! Only for text fonts, measured relative to text
  !! height 1.0
END Font;

ASSOCIATION FontAssoc =
  Font -<#> {1} Font;

```

```

    Symbol -- {0..*} FontSymbol;
END FontAssoc;

!! Line symbology library
!! =====
!! With the line sybology library the user can define continuos, dashed or
!! patterned lines. It is also possible to define multi line symbologies.
!! Each line in a multi line symbology can be continuous, dashed or patterned
!! for itself. The offset indicates the distance from the middle axis. All
!! are stored in the library relative to the width 1.0. The width can be over
!! written by the symbology parameter Width in the symbology interface. For
!! continuous lines the Width parameter defines the total width of the line,
!! for multi lines the parameter Width scales the attribute value offset.

CLASS LineStyle (ABSTRACT) =
    Name      : MANDATORY TEXT*40;
END LineStyle;

CLASS LineStyle_Solid EXTENDS LineStyle =
END LineStyle_Solid;

ASSOCIATION LineStyle_SolidColorAssoc =
    Color -- {0..1} Color;
    LineStyle -- {1} LineStyle_Solid;
END LineStyle_SolidColorAssoc;

ASSOCIATION LineStyle_SolidPolylineAttrsAssoc =
    LineAttrs -- {0..1} PolylineAttrs;
    LineStyle -- {1} LineStyle_Solid;
END LineStyle_SolidPolylineAttrsAssoc;

STRUCTURE DashRec =
    DLength      : SS_Float; !! Length of dash
END DashRec;

CLASS LineStyle_Dashed EXTENDS LineStyle =
    Dashes      : LIST OF DashRec; !! 1. dash is continuous
                                           !! 2. dash is not visible
                                           !! 3. dash is continuous
                                           !! etc.
END LineStyle_Dashed;

ASSOCIATION LineStyle_DashedColorAssoc =
    Color -- {0..1} Color;
    LineStyle_Dashed -- {1} LineStyle_Dashed;
END LineStyle_DashedColorAssoc;

ASSOCIATION LineStyle_DashedLineAttrsAssoc =
    LineAttrs -- {0..1} PolylineAttrs;
    LineStyle_Dashed -- {1} LineStyle_Dashed;
END LineStyle_DashedLineAttrsAssoc;

STRUCTURE Pattern_Symbol =
    FontSymbRef : MANDATORY REFERENCE TO FontSymbol;
    ColorRef    : REFERENCE TO Color;
    Weight      : SS_Float; !! Width for symbol lines
    Scale       : SS_Float; !! Default: 1.0
    Dist        : MANDATORY SS_Float; !! Distance along polyline
    Offset      : MANDATORY SS_Float; !! Vertical distance to polyline axis
END Pattern_Symbol;

CLASS LineStyle_Pattern EXTENDS LineStyle =
    PLength      : MANDATORY SS_Float;
    Symbols      : LIST OF Pattern_Symbol;
    !! after PLength the pattern is repeated
END LineStyle_Pattern;

!! Symbology interface

```



```

!! ++++++

!! Text interface
!! =====

CLASS TextSign (EXTENDED) =
  Height      : MANDATORY SS_Float;
  Weight      : SS_Float; !! line width for line fonts
  Slanted     : BOOLEAN;
  Underlined  : BOOLEAN;
  Striked     : BOOLEAN;
  ClipBox     : SS_Float; !! Defines a rectangular surface around the text
                        !! with distance ClipBox from text.
PARAMETER
  Priority    : MANDATORY SS_Priority;
END TextSign;

ASSOCIATION TextSignFontAssoc =
  Font -- {1} Font;
  TextSign -- {0..*} TextSign;
MANDATORY CONSTRAINT
  Font -> Type == #text;
END TextSignFontAssoc;

ASSOCIATION TextSignColorAssoc =
  Color -- {0..1} Color;
  TextSign -- {0..*} TextSign;
END TextSignColorAssoc;

ASSOCIATION TextSignClipFontAssoc =
  ClipFont -- {0..1} Font;
  TextSign2 -- {0..*} TextSign;
END TextSignClipFontAssoc;

!! Symbol interface
!! =====

CLASS SymbolSign (EXTENDED) =
  Scale       : SS_Float;
  Rotation     : SS_Angle;
PARAMETER
  Priority    : MANDATORY SS_Priority;
END SymbolSign;

ASSOCIATION SymbolSignSymbolAssoc =
  Symbol -- {1} FontSymbol;
  SymbolSign -- {0..*} SymbolSign;
END SymbolSignSymbolAssoc;

ASSOCIATION SymbolSignClipSymbolAssoc =
  ClipSymbol -- {0..1} FontSymbol;
  SymbolSign2 -- {0..*} SymbolSign;
END SymbolSignClipSymbolAssoc;

ASSOCIATION SymbolSignColorAssoc =
  Color -- {0..1} Color;
  SymbolSign -- {0..*} SymbolSign;
END SymbolSignColorAssoc;

!! Polyline interface
!! =====

CLASS PolylineSign (EXTENDED) =
  !! The parameter Width of the interface influences the width *and*
  !! the scale of start- and endsymbols.
PARAMETER
  Priority    : MANDATORY SS_Priority;
  Width      : SS_Float; !! Width of line symbology, default = 1.0

```

```

END PolylineSign;

ASSOCIATION PolylineSignLineStyleAssoc =
  Style -- {1} LineStyle;
  PolylineSign -- {0..*} PolylineSign;
ATTRIBUTE
  Offset      : SS_Float; !! Default 0.0
END PolylineSignLineStyleAssoc;

ASSOCIATION PolylineSignColorAssoc =
  Color -- {0..1} Color;
  PolylineSign -- {0..*} PolylineSign;
END PolylineSignColorAssoc;

ASSOCIATION PolylineSignClipStyleAssoc =
  ClipStyle -- {0..1} LineStyle; !! Used as a mask for clipping
  PolylineSign2 -- {0..*} PolylineSign;
END PolylineSignClipStyleAssoc;

ASSOCIATION PolylineSignStartSymbolAssoc =
  StartSymbol -- {0..1} SymbolSign; !! Symbol at start of line in opposite
                                     !! direction of line
  PolylineSign -- {0..*} PolylineSign;
END PolylineSignStartSymbolAssoc;

ASSOCIATION PolylineSignEndSymbolAssoc =
  EndSymbol -- {0..1} SymbolSign; !! Symbol at end of line in same
                                     !! direction as line
  PolylineSign3 -- {0..*} PolylineSign;
END PolylineSignEndSymbolAssoc;

!! Surface interface
!! =====

CLASS SurfaceSign (EXTENDED) =
  Clip      : (
    inside,
    outside
  );
  HatchOffset : SS_Float;
PARAMETER
  Priority    : MANDATORY SS_Priority;
  HatchAng    : SS_Angle; !! Default 0.0
  HatchOrg    : SS_Coord2; !! Default 0.0/0.0, Anchor point for hatching
                                     !! or filling
END SurfaceSign;

ASSOCIATION SurfaceSignColorAssoc =
  FillColor -- {0..1} Color; !! Fill color
  SurfaceSign -- {0..*} SurfaceSign;
END SurfaceSignColorAssoc;

ASSOCIATION SurfaceSignBorderAssoc =
  Border -- {0..1} PolylineSign; !! Border symbology
  SurfaceSign -- {0..*} SurfaceSign;
END SurfaceSignBorderAssoc;

ASSOCIATION SurfaceSignHatchSymbAssoc =
  HatchSymb -- {0..1} PolylineSign; !! Hatch symbology
  SurfaceSign2 -- {0..*} SurfaceSign;
END SurfaceSignHatchSymbAssoc;

END StandardSigns;

END StandardSymbology.

```

Example

See Appendix C The small example Roads.

Appendix L (informative) Glossary

Common abbreviations, abbreviation of technical terminology see definitions

Abbr.	Abbreviation
Art.	Article (in legal texts).
Par.	Paragraph (in legal texts).
Def.	Definition.
de	deutsch (german).
en	english.
fr	français (french).
Syn.	Synonym.
INTERLIS	The note INTERLIS e.g. INTERLIS 2.6.4 signifies that in paragraph 2.6.4 of this INTERLIS Version 2-Reference Manual (SN 612031) further information concerning this term can be found.
→ A	A is a term that has been defined in this glossary.

Definitions

Abstract Class

→ class, which cannot contain → objects.

Syn. classe abstraite (fr).

Note: An abstract class is always incomplete and forms the base for → sub-classes (i.e. → specializations) whose object set then need not be void.

Aggregation

Directed → proper relationships between a superior → class and an inferior → class. Several parts (sub-objects) of an inferior → class are assigned to an entity (meta-object of the superior → class). It is also possible to assign several entities to a part. When copying an entity all assigned parts are copied as well. When deleting an entity assigned parts may continue existing.

Note 1: By means of an A. the → relation between an entity and its parts is described (e.g. car/ motor). The → role of the → sub-class can be termed with "is-part-of".

Note 2: In → INTERLIS 2 an A. is indicated analogous to the UML-class diagram notation with a (void) rhombus (-<>).

Note 3: see also → composition.

Amendment

Consistency-saving → operation on a → database.

Argument

→ value of a → parameter.

Association

Proper relationship, which does not restrict the independence of the → classes concerned. Assigned → objects can, independently of each other, be copied or deleted.

Syn. association (fr).

Note 1: In → INTERLIS 2 the → association class is available for describing an A.

Note 2: See also → reference attribute, → aggregation and → composition.

Association Class

→ Class element to describe an → association, → aggregation or → composition.

Attribute

Data (elements) corresponding to a specific characteristic of → objects of a → class and of → structure elements of a → structure (INTERLIS 2.6.4). Each a. has an a. name and a → domaine.

Syn. for → Merkmal (de), property (en).

Note: Each → object of a → class likewise contains a → data element of an a. with an individual → value. Graphically an attribute corresponds to the column of a → table.

Attribute Specialization

Restriction of the → domain of an → attribute.

Note: A. is also employed when defining → inheritance relations.

Basic Class

→ Class whose → objects contribute to the set-up of → a view.

Basic Data Type

Predefined → value domain such as TEXT or BOOLEAN (→ INTERLIS 2).

Basic View

→ View whose → objects contribute to the set-up of a new → view.

Basket

Collection of → objects that belong to a → topic or to its → extensions.

Syn. Behälter (de).

Bi-directional Association

Def. cf. → Association.

Cardinality

Number of → objects of → class B (resp. A) which can be assigned to an → object of → class A (resp. B) through the → relationship between the → classes A and B.

Syn. for → Multiplizität, Kardinalität (de), multiplicity (en).

Note: In → UML the term → multiplicity is also employed; in which case "cardinality" means the concrete number of → object relations between → object instances.

Cartesian Coordinate System

→ Coordinate system of the Euclidian space whose axes are straights set perpendicularly and in pairs.

Cartographic Sign System

Set of graphical representation possibilities for → graphic symbology.

Note 1: A concrete → graphic element shown on screen or printed on paper is the result of a multi-level process whereby → objects are selected (selection), then represented on → graphic symbologies (mapping) and assembled, graphically rendered (rendering) and represented (display).

Note 2: In → INTERLIS 2 the first two levels are determined by means of a → graphic description, all other levels are subject to the implementation of each system resp. "driver", in some cases certain graphic standards exist such as PostScript, HPGL, OpenGL, Java2D, SVG.

Change Database

Temporary → database with whose → objects → amendments can be executed. A change database receives its → objects from a → primary database and returns them after their processing (→ up-date).

Note: A change database may operate on the same → system as the → primary database (internal c.) or on another → system (external c.).

Class

Set of → objects with the same properties and → operations. Each property is described by an → attribute, each → operation by an → interface symbology.

Syn. for → Objektklasse, → Entitätsmenge, Objekttyp (de), feature type, feature (en), classe (fr).

Note 1: A class described with INTERLIS corresponds to a UML-c. with nothing but "public", i.e. visible → attributes.

Note 2: cf. → superclass, → subclass, → table as well as → class element.

Note 3: Classes need not necessarily contain → objects. If they do contain → objects we speak of → concrete c., if not of → abstract classes.

Class Diagram

Graphic representation of → classes and their → relationships.

Syn. Klassendiagramm (de); diagramme des classes (fr).

Class Element

→ modeling element "of the modeling level class". To be exact: class elements are called → class, → structure, → association class, → view, → view-projection and → graphic definition.

Class Interface

Access to a part or the entirety of the → operations of a → class.

Syn. for → Schnittstelle (de), interface (en, fr).

Note 1: One → class may have several class interfaces. For each of them a separate → interface class can be defined. The → conceptual → schema of an → interface class consists only of → interface symbologies.

Note 2: see also → user interface and → data interface.

Class Specialization

Restrictions of a → class through additional → attributes, → relations, → consistency restraints or → attribute specialization.

Note: Class specializations are used for defining → inheritance relationships.

Complete Data Transfer

→ data transfer of a complete → state of database from → sender (source) to → receiver (target).

Composition

Directed → proper relationship between a superior → class and a subordinate → class (resp. a subordinate → structure). Several parts (sub-objects of the subordinate → class resp. → structure elements of the → structure) are assigned to an entirety (super-object of the superior → class), while there is a maximum of one entirety that can be assigned to one part. When copying an entirety all assigned parts are copied at the same time. Likewise when deleting an entirety all assigned parts are also deleted.

Syn. composition (fr), Komposition (de).

Note 1: All parts are dependent; they inalterably form part of the entirety. Thus all classes involved do not lead equal → relationships, but form a consists-of hierarchy.

Note 2: In → INTERLIS 2 a c. is defined as an → association class.

Note 3: cf. → structure attribute.

Conceptual Schema

Syn. for conceptual → data schema. Def cf. → data schema note 2.

Syn. Konzeptionales Schema (de), schéma conceptionnelle (fr).

Concrete Class

→ class which can contain → objects.

Syn. Konkrete Klasse (de); classe concrète (fr).

Note: cf. → abstract class.

Consistency Constraints

Restrictions all → objects must comply with.

Syn. Bedingung, Randbedingung, Zusicherung (de), constraint (en); contrainte (fr).

Note: Certain constraints are predefined in → INTERLIS 2. Other constraints can be formally defined by means of → functions, → logical expressions or rules and are subject to a contract.

Constraints

Syn. for → consistency constraints.

Constraint Attribute

→ attribute for which a → constraint has been defined.

Constraint Class

→ class, for which a → constraint has been defined.

Contract

Agreement with software-tool suppliers.

Conversion

→ Mapping of a → coordinate system (resp. of its space) to another → coordinate system (resp. to its space), strictly defined by formulas and their → parameters.

Syn. conversion (en, fr).

Note: The term c. occasionally is used for the reformatting of → transfer files.

Coordinate Reference System

Syn. for → reference system.

Coordinate System

Base of a Euclidian vector space, resp. original base of the assigned Euclidian vector space when dealing with map homomorphism of a diversity (for details see vector analysis).

Syn. Koordinatensystem (de).

Note: From the viewpoint of data a c. is defined by its axes which either are straights (in → INTERLIS 2 so-called LengthAXIS) or curves (so-called AngleAXIS) depending on the type of space they permit to measure.

Data Abstraction

Abstracting (amongst others omitting) of unimportant details via → data.

Syn. Datenabstraktion (de); abstraction de données (fr).

Note 1: Separating What? (→ class interface → type) from How? (→ class, concrete implementation). → generalization and → specialization are possible principles of abstraction.

Note 2: The actual realization of the → operations and the inner structure of the → object or → structure element are hidden, i.e. characteristics are considered in an abstract way and no attention is being paid to the actual implementation.

Database

Logical administration unit for the treatment and long-term memorization of → objects.

Note: It is possible to run several databases on one → system. It is also conceivable that one database has been divided into several → systems.

Database State

Totality of all → data and → relationships → of a database at one given moment. Each d. has its name.

Note: By means of one or several → mutations a → database is transferred from one database state to the next (→ up-date).

Data Catalogue

Syn. for → Object Catalogue.

Data Description

Syn. for → data schema.

Data Description Language

Formal language for the exact description of data structures.

Syn. Data description language (DDL), conceptual schema language (CSL).

Data Element

Definition see Informatics, cf. → domain.

Data Interface

Program for the reformatting of → transfer files or → protocol for the → data transfer.

Syn. Schnittstelle (de).

Note: see also → class interface and → user interface.

Data Model

Exact description of a data structure (so-called → conceptual → data schema), which is a complete and self contained unit. From the hierarchy point of view a d. is the highest → modeling element.

Syn. for → model, → data description.

Note 1: Beware! In database theory d. is a common syn. for conceptual formalism (i.e. a d. is considered as a → method for the creating of a → conceptual schema).

Note 2: A d. consists of at least one → topic.

Note 3: In → INTERLIS 2 described by the key word MODEL. The → package, which corresponds to this d., is above all other → packages, which correspond to the → topics of a data model.

Data Schema

Description of content and organization of → data characterizing a user-specific facet of reality, as well as rules governing these and of → operations which can be executed with such → data.

Syn. for → schema, → data model (for conceptual d.), → ontology.

Note 1: Depending on the abstraction level at which the → data are described, we distinguish between the conceptual schema, the logical schema and the physical schema. When formulating a data schema we dispose of appropriate → data description languages.

Note 2: When dealing with → databases the logical schema formulated in accordance with the → conceptual schema and the system specific possibilities of organization, is also called internal schema. Logical as well as physical schemas of peripheral instruments or exchange files are often called external schemas or format schemas.

Data transfer

Transfer of → data from one → database A to another → database Z. A is known as primary system, source, → sender, sender system, Source, Z as → target system, → receiver, target. The delivery of → data to be transferred by → system A is also called export; its acceptance by → system Z is called import. Syn. transfer.

Data Transfer Mechanism

(conceptual) → data description language and (physical) → transfer format as well as rules governing the derivation of such a → transfer format of a data structure that is described by means of a → data description language.

Data Type

Syn. for → domain.

Date

Ambiguous synonym for → geodetical date and indication of time (e.g. 2002-06-25).

Date Transformation

→ Transformation of a → geodetical date (resp. of the space defined thereby) on another → geodetical date (resp. its space).

Derived Attributes

→ attribute, whose → domain is calculated by means of a function regulation (expression, calculation).

Syn. attribut dérivé (fr).

Note 1: Derived attributes cannot be altered.

Note 2: In → INTERLIS 2 the function regulation is defined via a function.

Directed Relationship

→ aggregation or → composition or → reference attribute or → inheritance relationship.

Domain

Set of homogeneous → data elements. A → data element of a domain is called → value.

Syn. for → data type.

Note 1: cf. → basic data type.

Note 2: A value can also consist of → structure elements of a → sub-structure.

Domain of a name

→ namespace of the → name category of this name corresponding to the → modeling element, in which this name is defined.

Note 1: Within the d. each name may only have one definition/meaning. However the same name can be defined once within the → namespace of every → name category of the same → modeling element.

Note 2: D. is part of the → visibility domain of a name.

Drawing Rule

Language element of a → graphic definition. A Z. assigns a → graphic symbology to the → objects) of a → class and determines the corresponding → graphic symbology arguments according to the → attribute values (i.e. → data) of the → objects.

Syn. for → symbology attribute.

Element

Fundamental idea of the set theory. A set consists of elements.

Syn: instance.

Note: see also → modeling element or → graphic element.

Ellipsoid Coordinate System

→ Coordinate system on the 2-dimensional boundary surface of a 3-dimensional (rotation-) ellipsoid.

Ellipsoid Height

Euclidian distance of a point measured from the ellipsoid along the normal line to surface through this point.

Entity

Syn. for → object.

Expression

Syn. for → logical expression.

Extension

Syn. for → specialization.

Feature

Syn. for → object, resp. often also for → class.

Feature Type

Syn. for → class.

File

Def. see informatics.

Syn. Datei (de), fichier (fr).

Force

Link between parts (sub-objects of the subordinate → class) and the entirety (super object of the superior → class) in a → proper relationship.

Function

→ mapping of → value domains of input-parameters into → a value domain of an output-parameter by means of a calculation-rule (→ parameter).

Syn. Funktion (de); fonction (fr).

Note: In → INTERLIS 2 certain functions are predefined, others are subject to a → contract.

Official height

Sum of all levelling measurements (height differences) along a levelling run of one point of → height 0 to a point with wanted G.

Generalization

→ role of the → superclass in an → inheritance relationship.

Syn: Generalisierung (de); généralisation (fr).

Note 1: G. is occasionally used as Syn. for → inheritance (eventhough it actually means the opposite direction).

Note 2: In cartography g. describes all activities due to the scaled and reduced → mapping of → real-world objects.

General Identification

→ Identification for all (modelled) → objects of a → transfer community.

Note: cf. also → object identification.

Geodetical Date

3-dimensional → Cartesian coordinate system, whose axes have a fixed position and orientation as to the center of gravity and the rotation axis of the earth.

Syn. for → Datum (de).

Geodetical Reference System

Syn. for → geodetical date.

Geoide

Equipotential surface of the field of gravity.

Note: A g. supplies a physical earth model that adjusts to the gravity field of the earth. It is of irregular form since it takes into consideration the irregular mass distribution of the earth. It has to be imagined as if the average ocean surface were to continue beneath the continents.

GIS

Abbr. for geo-information system or geographical information system.

Graphic Definition

→ class element of a graphic → topic, i.e. each graphic → topic of a → graphic description is a collection of graphic descriptions (not of → classes!). Each g. belongs to a → class (BASED ON) of the corresponding data - → topic, assigns by means of → drawing rules → one or several → graphic symbologies to objects of this → class and determines the → graphic symbology → for arguments according to the → data of the → objects.

Graphic Description

→ conceptual → schema, which describes the assignment of → graphic symbologies to → objects and consists of graphic → topics. The → objects can be selected in a → view.

Syn. graphic model, graphic description.

Note 1: A D. in → INTERLIS 2 consists of graphic → topics each of which corresponds to a data topic (DEPENDS ON). A graphic → topic is a collection of → graphic definitions (not of → classes!). Each → graphic definition belongs to a → class or → view (BASED ON) of the corresponding data, assigns by means of a → drawing rule one → graphic symbology each to the → objects of this → class or → a view → and determines the graphic symbology → arguments in accordance with the → data of the → objects. The → data of these → graphic symbologies, i.e. their names and graphic visualization are comprised in a → symbology library described in the corresponding → symbology model.

Note 2: The d. itself can also contain → data schemas (e.g. → classes which describe text positions).

Graphic Element

Graphic description of an → object taking into consideration its 2-dimensional geometry and further → attributes of this → object, after possibly necessary processing ready for output by a suitable peripheral device.

Syn. Grafikobjekt (de).

Graphic Model

Syn. for → Graphic description.

Graphic Object

Syn. for → Graphic element.

Graphic Parameter

Syn. for → Parameter of a → Graphic symbology.

Graphic Topic

Def. see → Symbolization.

Graphic Symbology

→ Data for the graphic representation of → objects still independent of 2-dimensional geometry and further → attribute values of these → objects. → graphic parameters, short for → parameters of graphic symbology.

Syn. for → signature, symbol, style (en).

Note 1: There are four types of g.: Fonts, resp. text symbologies (sometimes called text labels or simply labels), point symbols (sometimes also called point signs or simply symbols or pictograms), line signs and (single) surface signs.

Note 2: In → INTERLIS 2 the data structure and possible → parameters of a g. are specified within a → symbology model and the corresponding → data are comprised within a → symbology library. All g. are referenced via g.name within a → graphic definition thereby defining → corresponding arguments for eventual → parameters.

Gravity Model

Description of the gravity field of the earth.

Height

Either → ellipsoid height or → normal height or → orthometrical height.

Help line

Linear → graphic element which links two → graphic elements or one → graphic element and a label.

Syn. Hilfslinie (de); trait de rappel (fr).

Note: A typical case of a help line is the representation of a join from a line or surface symbol to a label or its corresponding measurement line.

IDDL

Abbr. for INTERLIS-Data Description Language.

Identification

→ attribute or combination of attributes whose → value unequivocally determines an → object within its → class.

Syn. Identifier, Identity.

Note: Within an INTERLIS-transfer file each → object is assigned an i. in addition to the attribute values described in the → data schema, thus being unequivocally identified within the → transfer file. This is a so-called → transfer identification (→ TID). If such a → TID is a → general and → stable i., then it is called an → object identification (→ OID).

Identifier

Syn. for → Identification.

Identity

Syn. for → Identification.

ILI

Abbr. for INTERLIS.

Note: Also common as data name extension of → files which contain a → data schema conceived in INTERLIS (version 1 and 2).

Implemented Class

Executable software module with → operations → realized as methods.

Incremental Data Transfer

→ Data transfer of the difference between two → states of database from a → sender to a → target system.

Incremental Up-Date

→ complete or → incremental → data transfer of a → database state of the → primary database to a → secondary database.

Note 1: An incremental up-date always proceeds sequentially, i.e. one → secondary database will never have to receive several up-dates at the same time.

Note 2: cf. → Synchronization.

Information Layer

Non-void set of → topics.

Inheritance

→ method for the definition of → inheritance relationships between → superclasses and → subclasses. These → methods are → class specialization and → attribute specialization.

Syn. Vererbung (de), héritage (fr).

Note 1: → subclasses correspond to the same idea; they have the same properties as their → superclasses that they specialize.

Note 2: We distinguish between → single inheritance and → multiple inheritance. In the case of a → single inheritance (de: Einfachvererbung; fr: héritage singulaire) one → subclass inherits → only from one direct → superclass. In the case of a → multiple inheritance one → class inherits from several → superclasses.

Note 3: → INTERLIS 2 only admits simple inheritance (such as Java).

Inheritance Relationship

→ Directed → relationship between a superior → class, called → superclass, and a subordinate → class, called → subclass, defined by → inheritance. The → role of the → superclass is called → generalization; the → role of the → subclass is called specialization.

Note 1: The → objects of the → superclass are → generalizations of the → objects of the → subclass. The → objects of the → subclass are restrictions (→ specializations) of the → objects of the → superclass.

Note 2: The i. is a sub-set relationship, the → objects of the → subclass form a sub-set of the → objects of the → superclass. Thus in the case of → objects of the → subclass we do not deal with new → objects, but with a part or sub-division of the → objects of the → superclass. Both → objects of an object pair of the i. possess the same → OID.

Instance

Syn. for \rightarrow element (concrete specimen) of a set (abstraction).

Syn. instance (fr), Instanz (de).

Note: Examples of an instance: $A \rightarrow$ value is an i. of a \rightarrow data type. An \rightarrow object is an i. of a \rightarrow class. $A \rightarrow$ basket is an i. of a \rightarrow topic. An object pair is an i. of an \rightarrow association class.

Interface

Ambiguous syn. for \rightarrow class interface, \rightarrow user interface and \rightarrow data interface.

Syn. interface (fr), Schnittstelle (de).

Interface Class

Syn. for class of class interfaces. Def. cf. \rightarrow class interface.

Interface Symbology

Describing the call of an \rightarrow operation, consisting of the name of the \rightarrow operation, its \rightarrow data types and possible names of their \rightarrow parameters and possibly indication of a return-data type.

Syn. Signatur (de).

INTERLIS 2

\rightarrow Data transfer mechanism for geo data consisting of \rightarrow INTERLIS data description language (\rightarrow IDDL) and the INTERLIS-XML transfer format (IXML) as well as rules for the derivation of IXML for a data structure described with \rightarrow IDDL. \rightarrow IDDL, IXML and conversion rules are defined in the Swiss \rightarrow Norm SN 612031.

Abbr. For "INTER land information systems" (i.e. between \rightarrow GIS).

INTERLIS-Compiler

Program that derives from a \rightarrow data schema the description of the corresponding ITF in \rightarrow IDDL. At the same time the syntactic correctness of the data schema is examined (so-called parsing), cf. INTERLIS appendix A.

INTERLIS-Data Description Language (IDDL)

(Conceptual) \rightarrow data description language of the \rightarrow data transfer mechanism INTERLIS.

Note: A \rightarrow data schema described in \rightarrow IDDL can be memorized as a text file. For such schema files it is common to add the abbreviation "ILI" to the file name. Example: The schema file of the database set of official surveying is thus called DM01AV.ILI.

Layer

Within the scope of CAD a common term for the collection of graphic \rightarrow data of a certain \rightarrow type. Occasionally used in GIS for \rightarrow topic.

Layout of the Plan

Description of plan by means of \rightarrow meta data title, \rightarrow legend, producer description, issue date, definition of sign type and graphic representation of further \rightarrow elements such as grid intersections and north direction.

Syn. Kartenrahmen, Planlayout (de); layout of the plan (en), bord de plan (fr).

Map Frame

Cofines the limits within which the contents of a plan are represented.

Syn. Kartenspiegel.

Note: Towards the exterior edge it is possible to define graded covering regions.

Legend

Labeling and explanation of a map, resp. plan and the → graphic symbology employed therein.

Syn. Legende (de).

Note: cf. → graphic description as well as → symbology library.

Line Form Type

Form of curves that make up a line string (straights, arcs and other connecting geometries). For the definition of object geometries supported by INTERLIS, cf. paragraphs 2.8.11 and 2.8.12 of the reference manual.

Logical Expression

Predicates joined by means of Boolean operators.

Syn. (Logischer) Ausdruck (de), expression logique (fr).

Map Frame I

Confines the limits within which the contents of a plan are represented.

Syn. Kartenspiegel.

Note: Towards the exterior edge it is possible to define graded covering regions.

Map Projection

→ Conversion of an elliptic or spherical space into a Euclidian plane.

Mapping

(from space A, defined by a → coordinate system in another space Z, defined by a second → coordinate system:) regulation which assigns exactly one point z of Z to each point a of A.

Note: Special cases of m. are → transformation and → conversion.

Metadata

→ Data dealing with → data.

Syn. Metadaten (de), métadonnées (fr).

Note: Especially in geo-informatics m. is → data that indicate amongst others object-descriptions in colloquial language, of → objects, organization, space reference, quality, availability and origin, etc.

Metamodel

→ Data model of → metadata.

Metaobject

→ Object, whose subject of the real world is a set of → objects.

Note 1: Thus an m. consists of → metadata. M. Exist for individual → objects and/or for all → objects of a → modeling element.

Note 2: → metadata for the → values of individual → attributes of → objects are additional → attributes of the → class of these → objects.

Metaobject-names

→ Name category that solely consists of names of → metaobjects.

Method

Implementation of an → operation → by a series of instructions (i.e. by a program).

Syn. Methode (de); méthode (fr).

Note: ambiguous term, often used as synonym for → operation.

Model

Syn for → data model.

Note: The object-oriented modeling distinguishes between object m. (as syn. for the part of a → data schema which describes content and organization of → data) and models of behavior (as syn. for the part of a → data schema which describes → operations that can be executed with the → data).

Modeling Element

Special → schema element. There are three m. namely → data model, → topic and → class element.

Note: m. and → name category define the → namespace.

Multiple Inheritance

→ inheritance relation that assigns more than one → superclass to one → sub-class.

Multiplicity

Syn. for → cardinality.

Name Category

Sub-set of the names of a conceptual → data schema. There are three n., namely → type names, → part names and → metaobject names.

Note: N. and → modeling element define the → namespace.

Namespace

Set of (unequivocal) names of a → name category in a → modeling element.

Syn. Namensraum (de).

Note: The n. is of importance when determining the → domain and the → visibility domain of a name.

Normal Height

Call t the curve through point P , where t is the orthogonal trajectory to the family of normal-ellipsoids. Call Q the point at which t passes through the null-normal-ellipsoid. The normal height of point P is the weighted curve length of t between P and Q , weighted by the standard gravity acceleration.

Object

→ data of a real-world object together with the → operations that can be executed with these → data and with an → object identification.

Syn. for → entity, tuple, → object instance, feature, feature instance (en), Objektinstanz (de), instance d'un object (fr).

Note 1: cf. → instance, → class.

Note 2: As opposed to a → value, an o. possesses an → identity, exists in time and space, can be altered while keeping its → identity and by means of a reference it can be of common use. An o. is concrete. It is tightly connected with the existence of real things.

Note 3: In object-oriented literature we find the following flowery definition of the term object: A concrete existing → unit with its own (unchangeable) → identity and defined limits (in the figurative sense of the word) which kapselt state and characteristics. Its state is represented by → attributes and → relations, its characteristics by → operations. Each o. belongs exactly to one → class. The defined → structure of their → attributes, as well as their characteristics, apply likewise to all o. of one → class. However the → values of the → attributes are specific for each o.

Object Identification

→ general and → stable identification.

Abbr. → OID.

Syn. for → Objektidentifikator, Objektidentität (de), object identifier, object identity (en).

Note 1: Usually the o. is only altered by a → system and not by a user. An o. is a property that distinguishes one → object from all others, even though it may possess the same attribute values.

Note 2: cf. → transfer identification.

Note 3: In Appendix E of the INTERLIS reference manual you will find a suggestion for an o.

Object Identifier

Syn. for → object identification.

Object Instance

Syn. for → object.

Object Catalogue

Informal enumeration of → classes with colloquial definitions (name and description of the → class) of all data objects relevant for one utilization.

Abbr. OC.

Syn. for → Data catalogue, Objekt-, Datenkatalog (de).

Note 1: An OC comprises indications concerning degree of detailed description quality requirements (mainly geometrical quality) as well as rules for recording.

Note 2: An OC is a preliminary and a complement of the conceptual → data model.

Object Class

Syn. for → class.

Object Type

Syn. for class

OID

Abbr. for → object identification.

One-sided relationship

Syn. for → reference attribute.

Ontology

Syn. for → data schema.

Note 1: O. is an "explicit formal specification of a shared conceptualization", i.e. in graphic terms, a repository of concepts.

Note 2: O. use UML/OCL or their own languages such as DAM/OIL (DARPA Agent Markup Language + Ontology Interchange Language). Typically o. consist of conceptual data schema, a taxonomic hierarchy of classes (vocabulary, thesaurus) and axioms, which restricts possible interpretations of the defined terms (in most cases with a logic-language). (In the future) o. should be used as higher abstractions of data schemas for the specification of software and for the communication between individuals.

Operation

→ mappings from the attribute domains of a → class and/or from → domains of input-parameters into the → domain of a output-parameter.

Note 1: The implementation of an o. by means of a series of instructions (i.e. by a program) is called → method.

Note 2: The description of an o. is called → interface symbology and consists of operation names and description of the → parameters.

Optional

Not compulsory, need not exist or be applicable. Contrary: mandatory.

Note 1: → attributes are optional, unless it is stated that they are to be mandatory. For mandatory attributes we dispose of the keyword MANDATORY in IDDL.

Note 2: In → IDDL the term "not mandatory" refers to the → transfer file.

Orthometric Height

Length of curve of the (curved) perpendicular between → geoid and point.

Package

Element of the UML-language for the description of → models, → topics and parts of topics.

Syn. Paket (de).

Note 1: A p defines a → namespace, i.e. within a p. the names of the → schema elements contained must be unequivocal. Each designated → schema element can be referenced in a different p., but it belongs to exactly one (source-) P.

Note 2: In the case of → UML p. themselves can contain other p. The top p. contains the entire system according to the → data model of INTERLIS 2.

Parameter

Data (elements), whose → values are transmitted to a → function, an → operation or a → meta object and/or have been returned by → functions or → operations. Each p. is supplied with a name, a → domain and - where → functions or → operations are concerned - a transfer direction (in, out, inout). The concrete → value of a p. is called → argument.

Note 1: cf. → run time parameter.

Note 2: By means of p. we describe those properties of → meta objects which do not concern the → meta object itself, but its use within the application.

Part Names

→ name category consisting of names of → run time parameters, → attributes, → drawing rules, → parameters, → roles, → relation access and → basic views.

Path

Series of names of → attributes and/or → classes and/or → roles of → association classes, which define an → object or the → value of an → attribute which are to be processed by a logical expression.

Polymorphism of Objects

Wherever → objects of a → superclass are expected it is also possible to have → objects of an → extension.

Syn. Teilmengen-Polymorphismus, Teilmengen-Polymorphie, Substitutionsprinzip (de), polymorphism (en).

Note 1: see also → p. of operations.

Note 2: In → INTERLIS 2 we refer mainly to p. of → objects.

Polymorphism of Operations

Based upon the → interface symbology it is conceivable that → objects of different → classes respond to identical operation names (messages), i.e. they are processed by → operations with identical names.

Syn. Polymorphie (de), polymorphism (en).

Primary Database

→ database that deals with long-term administration of → objects of certain → topics of a certain field.

Proper Relationship

Def. cf. → Relationship.

Protocol

Set of → operations that belong to a set of → classes.

Reference Attribute

→ relationship which is only known to the first → object of each object pair of the → relationship.

Syn. One-sided → relationship.

Reference System

→ coordinate system, appearing at the end of a series of → coordinate systems and → conversions where exactly one → geodetical date occurs and which stands at the start of the series.

Syn. Referenzsystem (de), system de référence (fr).

Referential Integrity

Rule, which determines what is to happen with an \rightarrow object relationship, resp. with the \rightarrow objects concerned, if the \rightarrow objects involved or the \rightarrow relationship itself is deleted.

Syn. Referentielle Integrität (de).

Relation

Syn. for \rightarrow table.

Relation Access

Conditions and possibilities to refer to \rightarrow relation objects and by these means also \rightarrow objects of (ordinary) \rightarrow classes via \rightarrow paths.

Relation Object

Def. cf. \rightarrow relationship.

Relationship

Set of object pairs (resp. in the general case of object-n-tuples also known as \rightarrow relation objects). The first \rightarrow object of a pair belongs to a first \rightarrow class A, the second object to a second \rightarrow class B. The attribution of \rightarrow objects to such pairs shall be predefined; hence it must only be described, i.e. modeled. We distinguish between \rightarrow proper relationship (that is \rightarrow association, \rightarrow aggregation, \rightarrow composition), \rightarrow inheritance relationship and \rightarrow reference attribute.

Syn. Beziehung (de); relation (fr).

Note 1: As proved by the view concept, it is on the other hand also possible to calculate such assignments by means of algorithms, e.g. based upon attribute values.

Note 2: cf. \rightarrow object relation.

Note 3: For a proper relationship both \rightarrow force and \rightarrow cardinality are defined.

Replicate

To copy whereby the copied \rightarrow object may not be altered independently of the original.

Note: term mainly used in connection with \rightarrow up-date.

Role

Significance of the \rightarrow objects of a \rightarrow class within a \rightarrow relationship.

Run Time Parameter

\rightarrow parameter whose \rightarrow value is supplied at run time by a treatment, evaluation or representation system.

Examples: representation scale, \rightarrow date.

Schema

Syn. for \rightarrow data schema.

Schema Element

Partial schema of a conceptual \rightarrow data schema that possesses a name.

Note: All \rightarrow modeling elements are s.

Secondary Database

Copy of the \rightarrow state of a database of a \rightarrow primary database.

Note: Usually a S. cannot be found on the same → system as the → primary database.

Sender

Def. cf. → data transfer.

Set of entities

Syn. for → class.

Simple Inheritance

Def. cf. → Inheritance.

SN

Abbr. for Swiss → Norm.

Specialization

→ role of the → subclass of an → inheritance relationship, often also syn. for → inheritance.

Syn. for → Erweiterung (de), extension (en), spécialisation (fr).

Note 1: cf. → class specialization und → attribute specialization.

Note 2: Since more text will be necessary for the description of a → class or → attribute specialization than for → the superclass or the original attribute, we often rather speak of → extension than of specialization.

Stable Identification

→ Identification which is independent of time, i.e. it cannot be altered during the life cycle of an → object. Once an → object has been deleted, its s.i. no longer can be used.

Note: cf. → object identification.

Standard

A 'de jure' s. (or short s.) is a technical regulation laid down by national or international committees for standardization. A 'de facto' s. is a generally acknowledged and majority used technical regulation, but less binding than a 'de jure' s.

Syn. Norm (de), norme (fr).

Syn. (de) for 'de facto' → norm and (en) for 'de facto' or 'de jure' → norm.

Note: A law is a regulation superior to both 'de jure' and 'de facto' standards.

Structure

Set of → structure elements with the same properties and → operations. Only such → operations are permitted which will not alter the → data of the → structure elements. Each property is described by an → attribute, each → operation by its → interface symbology.

Note 1: S. occur either within LIST- or BAG-attributes (→ substructure) or exist only temporarily as the result of → functions.

Note 2: cf. → class element.

Structure Attribute

→ attribute with the INTERLIS 2-datat type BAG or LIST.

Note As opposed to the definition of a \rightarrow composition by means of the \rightarrow association class, with a structure attribute \rightarrow structure elements cannot be referenced, i.e. outside of the \rightarrow object to whose structure value they belong to, they have no identity.

Structure Element

\rightarrow data of an object of the real world with \rightarrow operations that could be executed with these \rightarrow data, however without permission to alter them, and without \rightarrow object identification.

Note: A structure element is the \rightarrow instance of a \rightarrow structure.

Structured Domain

INTERLIS language element for the description of compound \rightarrow attributes such as \rightarrow date or time.

Subclass

Def. Cf. \rightarrow inheritance relationship.

Syn. Unterobjektklasse, Subobjektklasse (de), classe inférieure (fr).

Substructure

\rightarrow domain that has been defined by means of a \rightarrow structure.

Note: cf. \rightarrow structure attribute.

Superclass

Def. cf. \rightarrow inheritance relations.

Syn. Superklasse, Oberklasse (de), classe supérieure (fr).

Note: In a \rightarrow proper relationship the role of each \rightarrow class involved is described by its name, its \rightarrow force and its \rightarrow cardinality. A \rightarrow reference attribute describes the role of the \rightarrow class with this \rightarrow attribute. Within an \rightarrow inheritance relationship roles are implicitly defined.

Symbol

Ambiguous syn. for \rightarrow graphic symbol, language symbol or semiotic symbol.

Symbology

Sub-set of elements of a \rightarrow cartographical drawing system consisting of \rightarrow graphic symbologies, fonts, diagrams, half-tones.

Note: cf. \rightarrow symbology library.

Symbology

Ambiguous syn. for \rightarrow interface symbology resp. \rightarrow graphic symbology.

Symbology Attribute

Syn. for \rightarrow drawing rule.

Symbology Library

Collection of \rightarrow graphic symbologies, structured according to a \rightarrow symbology model.

Syn. Symbolbibliothek (de).

Note 1: A symbology library always is a \rightarrow basket, i.e. an XML-file.

Note 2: In most cases a symbology library is a concrete, user-specific collection of → graphic symbologies.

Symbology Model

→ conceptual → schema which describes → graphic symbologies and their → parameters.

Syn. for → Symbologiemodell (de).

Note 1: S. always demand → contracts.

Note 2: In appendix K of the INTERLIS 2-reference manual you will find a suggestion for an extended s.

Note 3: cf. → symbology library.

Symbology Object

Syn. for → Graphic symbology.

Synchronization

Automatic and regular adjustment of the → states of database of two → databases.

System

Totality of all components (hard and software) forming a data processing-system and being put to a certain use.

Table

→ class for whose → objects it is impossible to explicitly define → operations.

Syn. → relation.

Target

Def. cf. → data transfer.

Syn. for → target system.

Target System

Syn. for → receiver.

TID

Abbr. for → transfer identification.

Topic

Set of → classes whose → data in a certain sense belong together, e.g. they have a relationship, belong to the same data processing authority or possess a similar rhythm of up-dates. → Instances of topics are → baskets (recipients).

Syn. Thema (de), thème (fr).

Note 1: In → UML, a → topic is described by a → package beneath a → data model described, with the additional significance that this → package (a) possesses its own → namespace and (b) may depend (be an extension) of other → packages. A UML-package, assigned to a t., may contain other → packages.

Note 2: Beware: With → layer, in CAD terms a commonly used expression for "surface", we mean a collection of graphic → data. A t. may comprise several (graphic) → layers plus additional structured object data thematic data.

Transfer

Syn. for → data transfer.

Transfer File

→ File prepared for → data transfer → in an appropriate → transfer format.

Transfer Format

System of data fields within a transfer file.

Syn. for format.

Transfer Community

Community of → senders and → receivers who both participate in a → data transfer.

Transfer Identification

Def. cf. → identification.

Abbr. → TID.

Transformation

→ mapping from one → coordinate system (resp. from its space) to another → coordinate system (resp. to its space), where the mapping regulation (formula) is based on hypotheses and the → parameters are established by means of mostly statistical analysis of measurements in both → coordinate systems.

Syn. transformation (fr), Transformation (de).

Tuple

Syn. for → object.

Type

Ambiguous syn. for → data type (i.e. → domain), → class interface, and → interface symbology.

Type name

→ name category consisting of → topics → classes, → associations, → views, → graphic definitions, → baskets, → units, → functions, → line form types, → domains, → structures.

UML

Abbr. for Unified Modeling Language.

Def. cf. www.omg.org/.

Unit

Syn. for → Einheit (de).

Unit

Basic element of a measuring scale (Examples: meters, seconds).

Syn. Einheit (de).

Up-Date

One or several → amendments on a → primary database. By means of an u. the → primary database is transferred from one → database state to the next.

Note: Several → amendments on the → primary database may occur parallel at the same time. In the case of parallel → amendments, the primary database must guarantee the consistency of the result.

User Interface

Syn. for → graphic user interface (en), Schnittstelle (de).

Note: see also → class interface and → data interface.

Value

→ data element of a → domain.

View

→ class whose → objects are created by combining and selecting (to be exact by → view operations) → objects of other → classes or views.

Syn. Sicht (de).

Note 1: → objects of a view are not "original" in the sense that they do not directly correspond to a real world object. Thus a view is sort of a virtual → class.

Note 2: cf. → class element.

View Operation

Regulation for the definition of a new → object from the → objects of → basic classes resp. → basic views. View operations of → INTERLIS 2 are joins, unions, selections, aggregations and inspections. Subsequently the object set can be restricted by means of a selection.

View projection

→ class whose → objects are determined by complementing → attributes selected from → objects of another → class, → view or → view projections. In particular it is possible to define further (virtual) → attributes whose → values are determined by → functions.

Syn: Sicht-Projektion (de).

Note 1: → Extensions of view projections are possible. However their → objects will always remain sub-sets of the object-set of the → basic class, → basic view or basic view projection.

Note 2: cf. → class element.

Visibility Domain of a Name

Set of all → namespaces out of which the name may be referenced in an unqualified manner. The visibility domain of the name consists of its → definition domain and of the → namespaces of its → name category in all → modeling elements that hierarchically are subordinated to the modeling element of its definition domain.

Note: Besides the → namespace of its definition domain a name can be newly defined in each → namespace of its visibility domain. Thus this → namespace will become the new → definition domain of this name. This new → definition domain and its assigned visibility domain "override" part of the original visibility domain in so far as in this subdomain (which forms a subtree of the modeling element-hierarchy) only the new definition/ meaning of the name will apply.