GDF, A LINGUA FRANCA FOR GEOGRAPHIC INFORMATION

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Abstract

(to be inserted)

A need for digital (road) maps

"With a digital map, Columbus would have discovered America much earlier"

The last five years have shown an enormous activity in the field of computer assisted driver information systems and road transport informatics: the first generation car navigation systems are available now; fleet management systems begin to appear; the first coded traffic messages are being broadcasted.
All those systems have one important thing in common: their performance depends into a large extent on the availability on structured geographic information in digital form, more often referred as digital maps, road maps in particular. That is the reason why currently much effort is spent in the creation of detailed digital road maps.

A need for standards

If you ever had the pleasure to translate geographic data from one system into another, then you will be convinced that a certain standardization is highly desirable.
From a technical viewpoint it is a wish, from a commercial viewpoint it is even a must: several market analysis studies that there is no room for different road data bases of the same kind of the same area which are created and maintained independently of each other. That is why it is absolutely required that the data of region X can be used by all kind of systems, indifferent of their make.
Two different approaches exist to achieve such a goals: one approach is to

standardize the finished "article", for instance the CD. This is the solution currently chosen by the Japanese car and electronic industry [NSSG, 1990]. The other approach it to standardize the semi manufactured article, which can be used by system manufacturers to create their own dedicated road maps at low additional expenses [Heres, de Winter 1990]

Short history of GDF

"GDF" lisped Romeo when he saw Julia for the first time, not realising that he just had invented a new swear-word.

Bosch and Philips, both working on navigation systems, already reckognized in an early stage the need for a road an traffic information standards. They first attempt to standrdize the finished article, the CD. However, soon it appeared more realistic to start with a standard for the semi manufactured product: road data stored in the form of a not-dedicated data structures, more often called an exchange or a transfer format.
At that moment (1986), the only transfer standard that was ready and that could be used as a basis, was the British NTF [NTF,1986]. The SDTS , the standard now in use in the USA, was at that time only available in the form of a series incompleted drafts; nevertheless many ideas have been borrowed from it. DIGEST , the standard now in use by NATO partners, was at that time not existing.
That is why Bosch and Philips, working together in the DEMETER project, chose for the NTF as the basis for their later GDF. However, the NTF had some limitations. Therefore it was needed to adapt and to extend the NTF specifications to the needs of car navigation systems. The main limitations were the following:

- The NTF defines the very generic concepts "feature" and "attribute" but does not define how these generic concepts have to be splitted into a number of less generic feature and attribute classes, but leaves this to the NTF users.

- The NTF did not provide the possibility to represent (non-spatial) relationships between features

- The possibilities that the NTF provided to represent annotational information, were not enough for multi-national use. Eg the NTF missed the possibility to represent details of the used geodetic reference system. This information is ofcourse not important as long the data come from one country, all based on the same reference system. However, it becomes important when data come from different countries.

In the GDF, these gaps have been filled. The first release was published in october 1988.

In the DRIVE projects PANDORA and Task Force EDRM , GDF 1.0 was extensively tested in various areas [McCallum 1991, Möhlenbrink 1991]. Based on these experiences, the GDF specifications have been improved. In the same time, the number of partners in the GDF standardization group increased considerabely. The wishes of these new partners (in particular in the field of tourist information and transport logistics) has resulted in an extension of the Feature and Attribute Catalogue.

Semiotic background of GDF

"We dissect nature along lines laid down by our native languages. The categories and types we isolate from the world of phenomena we do not find there because they stare every observer in the face; on the contrary, the world is presented in a kaleidoscopic flux of impressions which has to be organized by our minds - and this means largely by the linguistic systems in our minds. We cut nature up, organize it into concepts, and ascribe significances as we do, largely because we are partners to an agreement to organize it in this way"

Lee Whorf

From: [David Chrystal, 1987, p.15]

From a semiotic point of view, a datafile can be seen as an aggregated symbol having a particular meaning. This compound symbol can be considered as being built up from other smaller symbols, with are again built up from smaller symbols etc. This hierarchical decomposition continues untill the symbols are reached that have the meaning of "binary zero" or "binary one". All symbols can be situated at a particular symbol level, indicating howfar they are removed from the lowest level, the bit level.

Each symbol at each symbol level designates a particular concept. In a well designed file, all symbols of a particular level corresponds with concepts of related nature so that these form together a level of meaning. In such a well designed file, the one but lowest symbol level typically corresponds to elementary concepts as "digits", "letters" and "graphic characters". The next higher level corresponds with elementary data as eg : "date", "coordinate", "name", "identification number" etc. Next, symbols can be formed which designate elementary geometrical concepts as "node", "edge" and "face". These symbols can be used in combination with the symbols for names and attribute values to form symbols that mean as eg. "building" "municipality" etc. With these feature symbols, more complex feature symbols can be constructed etc.
See table 1 for an overview.

The specification for data files as GDF can in fact be splitted into two major areas

- The definition of a set of concepts, the subdivision of this set into a number of concept areas and the relations between these concepts.

- The definition of a nested set of symbols (data structures), meant to represent the concepts.

The definition of concepts

The concepts addressed by the lower symbol levels are not very problematic and already quite standardized: latin alphabet users are all used to the fact that this alphabet has, conceptually spoken, exactly 26 letters, this inspite of the fact that each of these letters may have an infinit number of different manifestations (Hofstädter, 1982)
Into a certain extent, this is also true for concepts as "coordinate", "date", "line", "point", "area". Centuries of education have done their work.

Problems arise when one tries to define geographic concepts as "building", "forest", "bridge", "crossroads" . What is so confusing for many people, is the fact that these terms are so commonplace. "Why is it so difficult to define what a bridge is; everybody knows that etc."
However, the more one tries to analyse the concepts behind the "word-symbols",

the more one discovers how many different concepts are designated by one and the same word. Take eg. the term "road". Analysis shows that this term has a different meaning for a postman, a cadfastral surrveyor, the man conducting the asphalt machine, the surveyor extending the road axis, a car driver etc.
Tens, maybe hundreds of concepts are all designated by one of the same word-symbol "road".
As already stated, the task of analysing all the geographical concepts used in everyday life and trying to standardize these concepts is a challinging task, which is considered by everybody having some experience in this field as very difficult or even impossible (Molenaar, 1990).

The definition of symbols

The other area, the definition of a nested set of symbols, is in fact a much more straightforward activity. One may say that each symbol set that is complete (ie. has the power to represent all defined concepts), is acceptable.
A file used for data transfer (we restrict here the discussions to data structures meant for data transfer only) has no special requirements concerning dataprocessing speed. This doesnot mean that a transfer file should not meet any constraints at all. In particular a transfer file format that has the pretention to become a standard should have the following properties:

- the documentation belonging to it must be easy to understand
- it must be easy to produce the format and to read it, independent of the make of the computer where it runs on
- must avoid redundancy as much as possible
- must be self descriptive as much as possible
- must be based on existing standards

Existing, already wide used standards, are the character code standards as eg ISO 646, ISO 2022, ISO 4873, ISO 6429, ISO 6937/2 and ISO 8859

Also tape and flexible disk label standards as ISO 1001, ISO 4341 and ISO 7665 are already well established. These standards reserve some particular byte positions and some particular byte values for control purposes so that the rest of the symbol structure can be processed and reconstructed in a correct way. Note that these control symbols themselves do not belong to the higher symbol level that they help to establish. They are implementation dependent.

Control symbols of one level higher are specified by IS0 8211: This standard defines that bytes can be grouped into "subfields", these into "fields" and the latter into "records". It defines how each record should start with a Record Leader, followed by a directory. Leader and directory contain information about field "tags", field lengths and field position. There is one special record, called the Data Descriptive Record (DDR). When used in a file, the DDR describes the fields that are used in the companion data records. Each field description shall contain the field's tag (a short internal reference name of the field), the way whether and how the field is subdivided into subfields and a field control specifying the nature of the field. Furthermore ISO 8211 reserves a number of non-printable characters (byte values) for the purpose to indicate the end of a (variable length) subfield or field. Note here too that the ISO 8211 symbols themselves do not belong to the higher order symbol level that they help to construct.

For the higher order symbol levels, no worldwide accepted and applicated standards exist, except related to some subitems as eg. country codes (ISO 3166), representation of latitude and longitude (ISO 6709), bibliographic references (ISO 690.2), and the ISBN and ISSN numbering systems (ISO 2108 and ISO 3297).

Structure of the GDF

The structure of the GDF documentation corresponds in a large extent to the dichotomy described in the foregoing section. Volume 2,3,4,5 and 7 are dedicated to the definition of concepts and the relations between them.
Volume 8 and 9 are dedicated to the symbols that are meant to represent these concepts.
Volume 1 and 6 are the only ones that do not completely match with this dichtomy. Volume 1 is an introductory volume that introduces and explains the Conceptual Data Model. This model is in fact the root of all the other detailed models worked out in the conceptual volumes.
Volume 6 is dedicated to content and quality application related to a particular field of application.

The Conceptual Data Model

This model plays a key role in the conceptual volumes. It has been defined by an ad hoc standardization initiative comprising members of the French AFNOR , the British Ordnance Survey, the CERCO and the DRIVE community.
The same model is also used in DIGEST, EDIGéO and will be one of the models supported by the BS 7567 (NTF). So this Conceptual Data Model can be said to be the first European standard.

What does this Conceptual Data Model specify? To explain this, look at figure 1.
In the first place, the model defines three very generic geographic concepts : the feature, the attribute and the relationship . The idea is that all kind of geographic information can be represented by means of subtypes of these three arche-concepts. The model also defines that a feature may have one or more attributes and may belong to one or more relationships.

Another part of the Conceptual Data Model is that features can be divided into four different feature categories: the point feature, the line feature, the area feature and the complex feature. The first three categories correspond to a very old tradition in cartography to disstinguish between points, lines and areas. The last one, the complex feature, is relatively young but already well established in the GIS community and based on the common feeling that geographic objects may be considered as being built up from other objects; eg a village as an aggregation of houses and other objects of the same order of magnitude..

Furthermore, the Conceptual Data Model defines three "topological primitives": the Node, the Edge and the Face. If metric information is added, these concepts may also be seen as "geometric primitives".
The topological primitives are strongly related and have some built in constraints. The fact that the model requires that the representation should have Faces (implicit or explicit) implies that the graph formed by the Nodes and Edges should be planar, in other words Euler's rule should apply: (number of Nodes) + (number of Edges) - (number of Faces) = 2.

Apart from these basic concepts, the Conceptual Data Model defines a number of fact types (also often called relations) between the concepts. It specifies

amongst others that a Line Feature can only be represented by one or more
Edges and not eg by a Node. It defines also that a complex feature is not
directly related to the toplogical primitives.

The Feature Catalogue

The second volume of GDF expands the concept "feature" by defining a number of
subtypes called "feature classes".
The development of standard feature definitions often leads to serious
discussions. Some people even profess that it is impossible to create a
feature taxonomy that fits to the needs of everybody [Molenaar].
Nevertheless, the GDF team claims to have defined a Feature Catalogue (and a
mechanism to extend this catalogue) which maybe do not fit the needs of all
possible users but nevertheless the needs of many of them.

The GDF has two taxonomic levels: feature themes and feature classes.
Feature themes are still quite generic and only distinguish between features
on some bais properties. Examples of themes are: Land Use Units,
Administrative Areas, Settlements, Road furniture, Services, Roads & Ferries
and Brunnels .

Each feature theme is subdivided into a number of feature classes. The feature
theme "Service" is eg subdidivided into the classes "Police Station", "City
Hall", "Sports Activity" etc.
How is the decision taken to conceptualize something as a feature (class) and
other things not. The GDF team has used the following rules of a thumb:

- the candidate feature should in natural language be addressed by a noun

- the candidate feature must have a location in space; that means that there
  are locations where the feature "is" and other locations where it "is not".
  This excludes non spatial entities as eg "marriage", "propagation" etc.

- the candidate feature should be crisp; some fuzzyness is allowed but it
  should not be more than a few procent of the total extent of the feature.

- two feature instances of the same class should be disjunct (do not overlap)

- the candidate feature should be fixed for a longer period; this excludes fast moving objects as cars and other vehicles

- the feature must have its own set of (possible) attribute types which is different from the other classes belonging to the same theme. This is to avoid endless subtyping. Eg. it makes sense to distinguish between a feature class "Hotel" and "Petrol Station" because these features can be expected to have other attibute types. For a hotel attributes as "number of rooms" or "breakfast served" can be considered as relevant, but not for a petrol station.
  However, it makes less sense to subdivide "otel" further in sub-classes as eg "Inn, Guesthouse, Motel, Grand Hotel etc.". Though quite different of nature ,these candidate features do not not clearly have different attribute types and therefore must be rejected as candidates. Their diiferences can be perfectly expressesed by means of different attribute values (eg room price).

These rules of a thumb have shown that it is possible to come with a reasonable stable set of feature classes which is felt by the majority as "natural". However, ambigeous situations always will remain and it is here that a standardization body is needed to take and to fix a final decision.

The Feature Catalogue gives for each feature class a short definition. Where relevant this definition is illustrated by means of figures.
Some features are always very strongly related, e.g. Road Element and Junction, Road and Road Elemnt. Aggregation relations (is composed of), subtype relations (is subtype of) and topological relations (is bounded by) are illustrated by NIAM diagrams . See for instance figure 2.

The NIAM diagram of the feature classes belonging to the theme "Road & Ferries" is shown in Figure 3. The diagram shows that there is a feature "Road Element" and a feature "Junction". These both features allow for a detailed representation of the road network. Besides the features "Road" and "Intersection" have been defined. These feature allow for a more coarse and generalised view of the network. A "Road" can be seen as an aggregation of one or more "Road Elements" and an "Intersection" as an aggregation of "Road Elements" and "Junctions".

You may notice that the relation between Road Element and Junction and between Road and Intersection are very similar to the relation between Node and Edge in the Conceptual Data Model. This is correct: Road Elements and Junctions can be considered as forming together a graph, and the same is true for Roads and Intersections. However, there is one important exception. The constraint of Euler does not apply to the Road - Intersection and the Road Element - Junction graphs. This means that these graphs may be non planar. This implies that the road network topology, including all the grade separate crossings, can be represented correctly by only a set of instances of Road/Intersection or Road Element/Junction. There is no need to include artificial attributes as "turn impossible" etc.
Note that ferry connections are completely interwoven with the road features. This is a requirement of route planning and transport logistics systems.

The Attribute Catalogue
Volume 3 of the GDF expands the generic concept of attribute. A clear distinction is made between attribute types and attribute values. An attribute type is a finit or infinit set of closely related attribute values.
A guideline in the design of GDF attribute types is that, when used, its attribute values must result in a partition of the instances of a particular feature class where it is attached to. This means that each instance must have exactly one attribute value of that type.
It has to be reckoginized that this requirement is met by many GDF attributes, but not by all.

Note that this guideline is in fact the counterpart of the "feature parsimony rule" as discussed above. When a feature class can be divided into say N equivalent subclasses (all having the same set of attributes), then these subclasses must be not created and replaced by one attribute type with exactly N values.

Other guidelines for the definition of attributes:

- in natural language the information is often represented as an adjective.

- the candidate attribute should have no location (eg "colour")

- the candidate attribute represents a characteristic of a feature and not a link between features. The latter is better expressed by means of a relationship.

The Relationship Catalogue

Some geographic information can better be modelled in the form of facts between features than by means of a attribute of a feature. GDF calls these fact types relationships. In other sources, the term assocation may be encountered.

One class of relationships are the "belongs_to" relationships as eg. "Road Element in Settlement and Settlement in Administrative Area. Another category are the "adjacency" relationship as eg. "Building along Road Element" and "Signpost along Road Element". Again another category of relations are the "above" relationships as "Transportation Element over Transportation Element through Brunnel, which is a ternary relationship instead of a binary.

The last category are the "turn" relationships as "Prohibited Turn", "Right of Way" and "Signpost Information (To Turn)". A "Turn" can in fact be considered as an objectified relationship which may have attributes and participate in other relationships.

The Feature Representation Scheme

The Conceptual Data Model says that a feature (instance) may be conceptualized either as a point feature, a line feature, an area feature or as a complex feature. If a choice is made the other categories is excluded.

The Feature Catalogue defines feature classes, but does not say anything about the feature categories.

These rules can be found in the Volume 5, the Feature Representation Scheme.

This volume has been kept apart from the Feature Catalogue in order to allow for alternative representations of the same feature classes, required by other application fields. It is possible that another application can perfectly live with the feature classes as defined in the Feature Catalogue, but requires other feature categories (eg. Road Elements as areas instead of lines as specified in the current volume 5). In that case another Feature Representation Scheme (eg. volume 5B) could be added to the GDF documentation, leaving the other documents unchanged. Up till now, the need for alternative representations have not yet been encountered. But the option is there.

As said, the Feature Representation Scheme gives the rules to which feature
category a feature instance may or must belong.
In many cases, all instances of the same feature class will and must be of the
same category (eg all Settlements are area features), but there are exceptions. Junctions are seen either as a point feature or as an area
feature, depending of their size. Municipalities (Order-8 Areas) are considered either as area features or as complex features, depending of the
fact whether they contain Order-9 Areas or not.

The Global Data Catalogue
A GDF dataset, and its subdivisions (section, layer) can be seen as as
information entities in their own right, of which data can be gathered.
These data are called "global information". It concerns here mainly "data
about the other data" and could therefore also be called "meta-information.
Global information places the geographic information stored in the individual
sections and layers in it's appropriate context. Global information becomes
important when data producers and data purchasers start to sell and buy data
at industrial quantities.

The GDF distinguishes four different global entities. Three have already been
mentioned: the dataset, the section and the layer. Number four is the volume.
A volume is the set of data that can be stored on one single medium unit, as
eg a magnetic tape, a floppy disk. etc. A dataset may be stored on several
volumes and a volume may contain several datasets. When a dataset is not
stored on a physical medium, but transferred via a communication channel, a
volume contains by definition exactly one dataset.
A dataset is information that themeticaly and geographicaly belongs together
and that is produced, transferred and delivered all at the same time.
A section is a geographical subdivision of a dataset , a little bit in the
same way as a map sheet is a subdivision of the mapseries to which it belongs.
A layer is a thematical subdivision of a section. One layer consists of all
information of a set of features of which the Nodes, Edges and Faces together
form one single planar graph. Several themes may be combined in one layer. Eg

all the features belonging to the themes Roads and ferries, Waterways, Railways and Administrative Areas,should go in on single layer.

Global Information covers the following aspects:

- unique identifiers for the individual global entities
- information about the producer, date of production
- contents of a dataset, both in geographical as in thematical sense
- bibliographic description of the source material that is used (maps, documents
- geodetical information: datum, ellipsoid, projection method, projection parameters
- quality: geometric accuracy, feature and attribute completeness, attribute and relationship correctness, up-to-dateness
- format: a formal description of the data fields and record types used in the transfer

Logical Symbols Specification
This is GDF Volume 8, which currently makes not yet part of the GDF documentation, but which is in the draft stage and which will be added to one of the future releases.
The aim of this volume is to describe the data structures (or symbols in semiotic terms) leaving out the implementation dependent auxiliary structures which are needed.
A few examples to explain what is meant: in the current GDF a feature instance is represented by one of the socalled "feature records" (eg the Line Feature Record). This record has fields which may refer to other records the Edge Record, the Attribute Record and the Name Record. This is done by storing in these fields the same value as those in the identifier fields of the of records to be referred. This technique is known as "value based linking". How ever, it is not the only possible technique: the same result can also achieved by placing the required "chunks" of information, sequentially together.
Therefore this technique is implementation dependent and should be left out the logical symbol specifications.
Second example: the GDF records allow for fields or field groups that may repeat. Howmany times such a field (group) repeats is indicated by an auxiliarly field, immediately preceeding the repeating field (group). However, many other techniques exists to realise this, eg the use of socalled "information separators": small (mostly 1 character) auxiliarly symbols indicating the begin and/or end of a particular data structure.

When all implementation dependent ausxiliarly data structures are left out,
the specification of a logical data structure (eg for the Line Feature) may
look like follows:

LINE FEATURE

```
[
        Feature Class Indicator        FEATURE CLASS CODE
        Edge List      [EDGE]*
        Proper Name List       [PROPER NAME]*
        Attribute List [ATTRIBUTE]*
]
```

Terms written with capital letters only, represent symbol names and terms
wriiten with uppercase first letters, represent concept names. An asterix
behind a symbol name indicates that the symbol may have more than occurence.

Media Record Specifications

Volume 9 describes how the logical data structures of Volume 8, are
implemented by a set of records and fields, including auxiliarly structures as
mentioned in the section above.
Currently, the "old" NTF technique is used, which has the following characteristics:

- the use of fixed size "medium records" of 80 bytes long followed by a Carriage Return and/or Line Feed character

- one or more medium records can form one "logical record"

- a logical record contains a number of fields. Fields or field groups may repeat but have then to be preceeded by an auxiliarly "counter field". Fields must have fixed sizes except the last one, which may have a variable size. In that case it may not repeat

- the first two bytes of a medium record are reserved for a "record type code". In case the medium record is the first of a logical record, the record type code contains two digits other than "00". The medium record shall contain that value when it is a socalled "continuation record".

- field types get names and record types get names to facilitate their reference in the documentation.

Data Contents and Quality Requirements

This Volume of GDF (Volume 6) is a by-blow in the GDF standards family in that sense that it does not define concepts nor symbols for those concepts. This volume is based on the general feeling that apart from standardization of the specifications of how the world has to be conceptualized and symbolized, it is also worthwile to harmonize the contents and quality of the datasets. However, there is also a general feeling that the harmoniziation of contents and quality can not be so broad as the standardization of the form, but must be restricted to groups of applications having data needs that are close together. That means that several Data Contents and Quality Requirements can be developed all using the rest of the GDF specifications. Currently, only one Volume 6 has been written, which is based on the needs of car navigation systems.

What GDF distinguishes from other standards

The difference between GDF and the other (inter)national standards in the field of digital cartography, is that GDF emphasizes the definition of geographical concepts, whereas other standards starts with the specification of the format and put features and attribute definition and codes in an appendix, if they are specified at all. The reason is that the other standards are still very strongly "map display oriented", ie their main concern is to standard the data files at such a level, that the data supplied by A can be displayed by B without much additional effort. This is illustrated by the fact that all these standards define records for "font size" and "text position". These standards typically are situated at the "point, line and area" level, which are, as pointed out earlier, already quite standardized concepts. Feature and attribute standardization is of less concern, because differences here in only influence the symbols displayed, but does not influence the functionality (dispalying information) itself.

For GDF this is different. GDF supports applications for which the display function is only a secondary function or even not a function at all. For these applications, standardization of the geographical concepts is extremely important, because this has a very strong impact on the functionality of these

systms.
Ofcourse, a standard format is also important, but it comes on the second place. If you have two files, both representing the same concepts, but in another format, than this is annoying and it will cost you some money, but a clever programmer will always be able to write a conversion program from on format into the other. However, when there are differences between the concepts, then, no matter how clever your programmer is, it will be often be impossible to convert one set into the other in a reliable way. Perhaps in a far future, when artificial intelligence has made considerable progress, but not now.

Standard feature occurences and identifiers.
Suppose that two persons, let us call them A and B, want to create a datatfile with information of all post offices of Brussels. A and b want to speed up this activity and therefore decide to split up the tasks: A takes the telephone book of Brussels and collects data as address an telephone number. B takes an other guide and and collects data as address, opening hours and service available. The data is keyed in separately and then merged together.
This only works when the following conditions are fullfilled:

- the feature instances as selected by A and B must be identical
- identical feature instances must be referenced by the same (unique identifier)

In the post office example, both conditions will probably be fulfilled: post offices are features that are spatially disjunct and also their classification will be ambigeous. Their addresses can fulfill the role of the unique identifier.

A and B, supported by this succes, now intend to make a datafile of all forests in and around Brussels. They decide to proceed in the same way. A selects data as forest name and forest size and B collects data as forest name and kind of trees.
Now they will run into problems. They suddenly will discover that the instances selected by A are not always the same. Some instances will be identical but there will be also many situations where A has defined eg 2 forest instances and B 3.
Also the referencing will cause problems. They will discover that A has

sometimes has given a different name to the same forest instance as B or that he has used the same name as B but given to a (partially) different.

Let A now be the supplier of the "static" data of an on board driver information system, where all data relate to a set of "Road Elements". Let B now be the supplier of dynamic traffic data, broadcasted from a traffic control center where the traffic messages also relate to "Road Elements". When these both sets artte create in the same way as A and B have create the forest datafile, one will encounter the same type of problems.
The main reason is that some features will meet the two conditions as formulated above (eg municipalities, cadastral parcels, post offices), but that most features will not: the definition of what sometimes is referenced as "the geographic individual" [Nunes, 1991] is for most feature classes not trivial. For the very same reason, they also have no unique identifiers.

The only remedy for this problem is that A and B do not create their sets of feature instances independently of each other, but coordinate their activities and divide responsibilities and accept each others results: A defines the set of instances in administrative region P and B defines the set for region Q. A gets the numbers 1 - 1000, in order to create unique identifiers and B gets the numbers 1001 - 2000. Both accept the instances defined by the other and the identifiers given by the other.
This is in fact the same approach which is followed already during almost two centuries in the definition administrative areas, cadastral parcels and (to mention another not geographic field) civil registration. This approach requires an organization to coordinate and to delegate and a law to support these activities.

Future GDF developments

Segmented attributes

An important change will be that it allows in the next release (2.1) for "segmented" or also often called "curvimetric" attributes. This consists in an other technique of attaching attributes to line features. According to the current specifications, a change of an attribute value (eg from a 8 meter width road to a 5 meter width road) can only be represented by splitting the original feature into two ones. Using the new technique, this is not longer needed. The change of the attribute value can be represented by an auxiliary sub field in the attribute field indicating the distance from the start point feature to the point where the attribute value changes, measured along the line feature.

Time domains

There is much information that is only valid for particular periods: roads that are closed on market days, shops that open at 8.00 am and closes at 6.00 pm, ferries that depart and arrive at particular moments et cetera.
The GDF had already some attribute types that could represent certain time intervals, but the possibilities were restricted and partly overlapping each other.
That is why the GDF team came with a new design for a multi purpose time domain symbol that allows to represent each simple or aggregated time interval, no matter how complex it is. It is no problem to represent the information that a particular shop is open on monday till friday from 9.00 to 18.00 h, on saturday from 9.00 to 16.00, closed from 12.00 to 13.00, closed in the first and second week of August, the third tuesday in September and January 2 and 3.

Extension of the attribute catalogue

Apart from the general purpose extensions described above, the GDF will be extended with a number of particular attribute types, to enable the representation of data that is collected by road maintenance authorities.

Porting GDF to ISO 8211

The successor of the current NTF 1.1, the BS 7567, will have two possible implementations: one using the current technique and another one, using ISO 8211.
That is why the GDF team also decided to re-implement GDF using ISO 8211.

Conclusion

The development of standards and in particular international ones takes time, because of the many parties that are involved, the linguistic obstacles that have to be taken and the opposite interests that have to be bridged.
Standardization of the representation of information has an additional

complication that it is sometimes very abstract so that it very easily leads to a confusion of tongues.
Geographic information has the extra difficulty that it deals with very common life concepts as "towns", "roads" and so on. It is often hard to explain that it is exactly this common life character of geographical concepts, which make standardization so difficult.
Nevertheless, progress is made, in particular in the field of the "cartographic primitives". The major standards currently in use are already similar in this respect and still continue to converge. With the definition of a common Conceptual Data Model an important milestone has been reached.
The emphasis of the geographic standardization now can be shifted to the standardization of the geographical concepts themselves. GDF has set a first important step with its Feature, Attribute, Relationship and Global Data Catalogues and with its Feature Representation Scheme. These catalogues now provide a general framework which can be easily extended to cover the needs of other members of the geographic information society.
The standarization of feature instances in lieu of feature classes, will become an other important item in the near future, in particular for features as roads. However, this standardization cannot be achieved in the form of writing a document only, but has to be supported by an coordinating organisation that distributes responsibilities

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