TSMAD27-4.3.6B

Paper for Consideration by TSMAD

Inclusion of a Temporal Model within S-100

Submitted by:	UK/Jeppesen
Executive Summary:	This paper presents an evolved version of the S-100 Temporal model as previously presented for consideration by TSMAD. The primary addition is the new indeterminate date time type to cater for indeterminate dates as requested by the SNPWG.
Related Documents:	a) TSMAD 24/DIPWG 4 AOB 1 b) TSMAD 25 4.3.6
Related Projects:	1. S-100 2.0.0

Introduction / Background

1. S-100 currently defines a number of specific attribute types to carry date time information. It also references an ISO standard (ISO 8601:2004) which defines formats for date time information. It has been noted that the S-57 ENC data model supports truncated date time types which were supported in previous versions of ISO 8601. This paper considers how truncated date time information can be supported in S-100 and therefore S-101 and other product specifications.

Analysis/Discussion

2. Jeppesen submitted reference a) to TSMAD 24 which presents the following options to support truncated date time information in S-100 product specifications;

    1. Amend S-100 and S-101 to permit use of earlier editions of ISO 8601 and continue to use the S-57 formats; or,
    2. Confirm that S-100 representations of dates and times must conform to ISO 8601:2004, and revise the dates/times model of S-101 to use a different representation for recurring intervals. Defining new attributes for “number of recurrences” and “duration” as in ISO 8601:2004 should work, but will make the model a little more complex.

3. This paper proposes a way forward based on option 2, a draft temporal model is included at annexe A. This ensures alignment with modern standards; it requires that a short profile of ISO 19108 be added to S-100 further detailing how date and time information should be used within S-100 Product Specifications. This profile will ensure consistent and clear use of temporal information between S-100 based products and support improved information interchange. It could also define a common structure for schedule information and therefore an informative section on this is included in Annexe A.

4. This paper was submitted to SNPWG 15 and was generally supported. It was then submitted to TSMAD 25 (reference b) but the use of a complex attribute was questioned. This version of the model creates a new specific type instead.

5. Value formats are different from S-57 3.1 (which conform to the truncated formats in the 1988 version of ISO 8601) as well as the corresponding XML schema built-in data types which use the ISO extended format with separators between components (e.g., 1999-01-01 for January 1, 1999). This means data convertors must convert attribute values from one format to another.

Conclusion

6. S-100 currently does not support truncated date time types. The proposed temporal model will allow S-100 to support these types and S-10x products use these as required within their data models. TSMAD is invited to consider this proposal which seeks to ensure S-100 meets the requirements and is aligned with ISO standards.

Action Required of TSMAD

- To agree the requirement for truncated date time information within S-100
- To consider the inclusion of the proposed temporal model within S-100 to reflect this

Annexe A

3-8 S-100 Temporal Information

3-8.1 Introduction

ISO 19108 provides the concepts needed to describe the temporal characteristics of geographic information as they are abstracted from the real world. Temporal characteristics of geographic information include attributes, associations and metadata elements that take a value in the temporal domain. Time provides a fundamental element within many geographic datasets. Consistent modelling of temporal information is required to ensure consistent interaction between different S-100 products and across domains.

3-8.2 Temporal Schema

The temporal schema consists of temporal objects and temporal reference system. Temporal objects defines temporal geometric and topological objects that shall be used as values for the temporal characteristics of features and data sets. The temporal position of an object shall be specified in relation to a temporal reference system. S-100 products shall use the Gregorian Calendar and 24-hour local or Coordinated Universal Time (UTC) for information interchange as specified in ISO 8601. Where local time is used the offset from UTC must be provided see Value Types.

3-8.3 TM Objects

S-100 constrains temporal objects to a subset of those defined by ISO 19108. TM_Object (see Figure 1) is an abstract class that has two subclasses defined in ISO 19108, of which S-100 uses only TM_Primitive. TM_Primitive is an abstract class that represents a non-decomposed element of geometry or topology of time. TM_GeometricPrimitive provides information about temporal position.

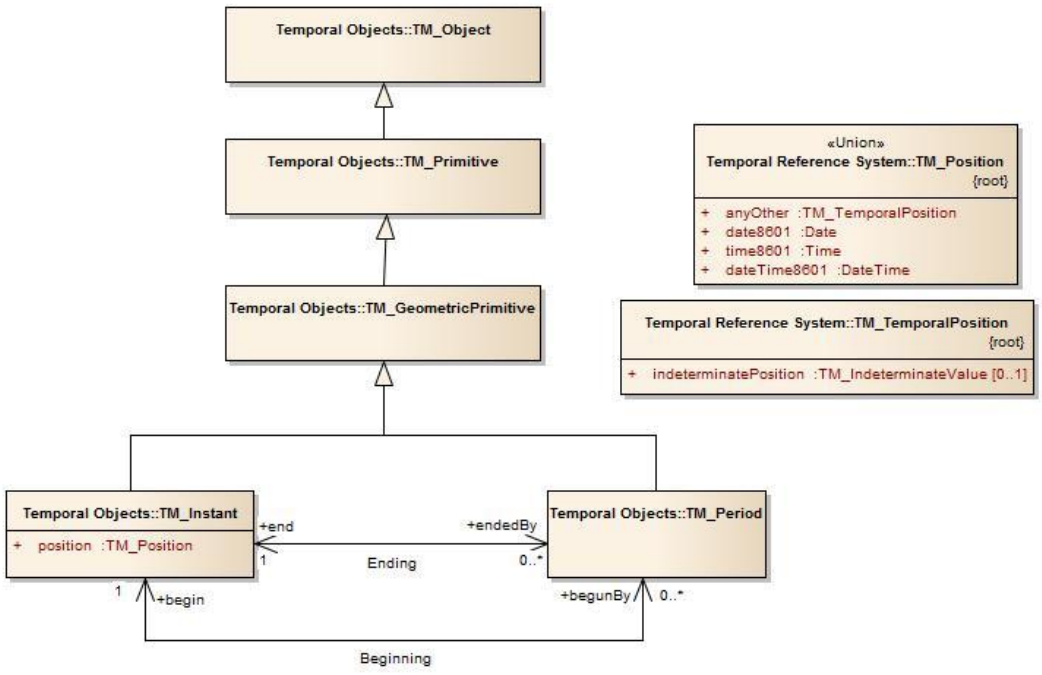

Figure 1 – Temporal Objects model extracted from ISO 19108

3-8.4 Temporal Geometric Primitives

The two geometric primitives in the temporal dimension are the instant and the period. These primitives are defined analytically in the case of time measured on an interval scale, and analogically in the case of time measured on an ordinal scale. TM_GeometricPrimitive is an abstract class with two subclasses, TM_Instant represents an instant and TM_Period represents a period (see Figure 1).

3-8.5 S100_TM_Instant

An instant is a zero-dimensional geometric primitive that represents position in time. It is equivalent to a point in space. In practice, an instant is an interval whose duration is less than the resolution of the time scale.
Attributes:

TM_Instant has one attribute

position:TM_TemporalPosition shall provide the position of this TM_Instant. An instance of TM_Instant is an identifiable object, while an instance of TM_TemporalPosition is a data value.

3-8.6 S100_TM_Period

The period is a one-dimensional geometric primitive that represents extent in time. The period is equivalent to a curve in space. Like a curve, it is an open interval bounded by beginning and end points (instants), and has length (duration). Its location in time is described by the temporal positions of the instants at which it begins and ends; its duration equals the temporal distance between those two temporal positions. Since it is impossible to measure duration on an ordinal scale, an instant cannot be distinguished from a period on this basis. In practice, the time at which a single event occurs can be considered an instant when time is measured.

a) *position:TM_TemporalPosition* shall provide the position of this TM_Instant. An instance of TM_Instant is an identifiable object, while an instance of TM_TemporalPosition is a data value. A series of consecutive events must occupy an interval of time, which is a period. The term period is commonly applied to sequences of events that have distinctive characteristics in common.

Associations:
a) *Beginning* links the TM_Period to the TM_Instant at which it starts.
b) *Ending* links the TM_Period to the TM_Instant at which it ends.

Constraints:
a) self.begin.position < self.end.position states that the temporal position of the beginning of the period must be less than (i.e. earlier than) the temporal position of the end of the period.

3-8.7 S100_TM_Position

TM_Position as defined in ISO 19108 is a union class that consists of one of the data types listed as its attributes. Date, Time, and DateTime are basic data types defined in ISO/TS 19103. S100_TM_TemporalPosition adds a type for truncated representations. Date, Time, and DateTime comply with ISO 8601 encoding of dates and times as character strings. These data types may be used for describing

temporal positions referenced to the Gregorian calendar and UTC. The data types defined in 5.4.4 specify numeric values for dates and times. They may be used for temporal positions referenced to any calendar or clock, including the Gregorian calendar and UTC.

3-8.8 S100_TM_TruncatedDateTimeType

S-100 extends ISO 19108 to include a specific data type for truncated date time. This ensures that partial dates can be used for recurring periods. The format of this type is as follows:

YYYYMMDDT*HHMMSS*

YYYY Year
MM Month
DD Day
T Time designator (character 'T')
HH Hours
MM Minutes
SS Seconds

At least one value must be present and truncated values represented with a hyphen. The time component is optional and the time designator is included if and only if a time component is present.

3-8.9 S100_TM_IndeterminateDateTime

Indeterminate instants are encoded using the complex type S100_TM_IndeterminateDateTime, derived from S100_TM_TruncatedDateTimeType. This derived type designates an instant related to a given date-time value by one of the temporal relations 'before' or 'after'. The temporal relation is given by the enumerated type attribute *indeterminatePosition*.

Example (Informative): A mariner report dated at an unknown instant before the year 1950 is dated by an attribute *reportDate* with sub-attributes shown below:

Sub-attribute	Value	Remark
indeterminatePosition	1 (before)	At an indeterminate time before January 1, 1950.
value	1950----	

3-8.10 S-100 Temporal Model

Figure 4 describes the temporal information model.

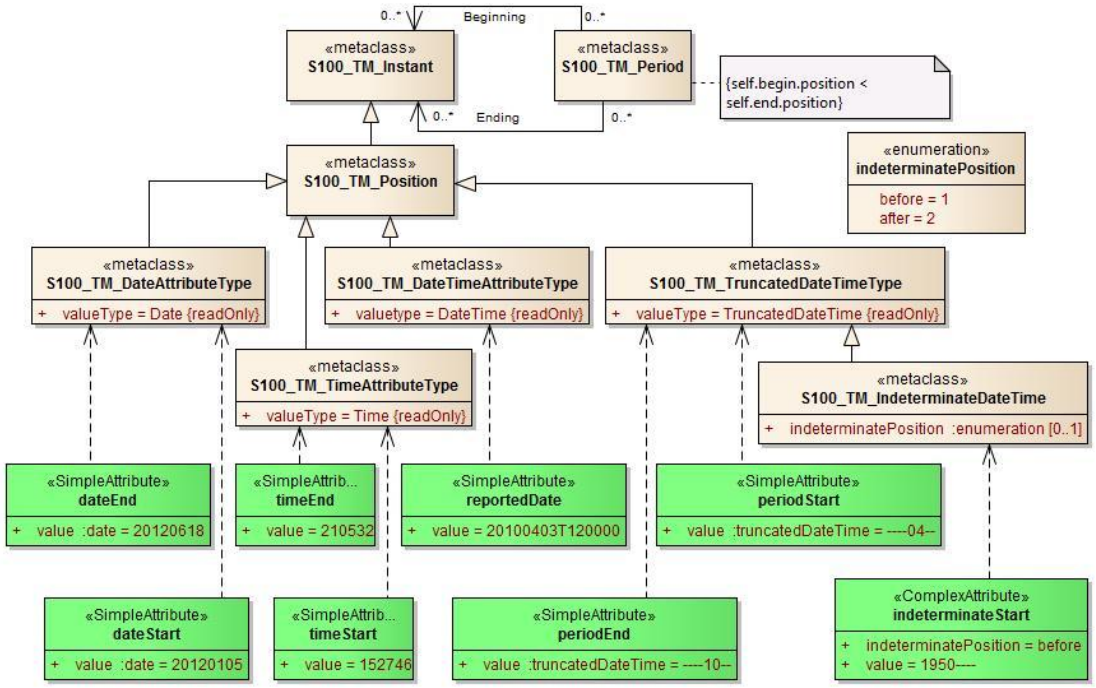

Figure 4 - S-100 Temporal Information Model – Items in green are indicative examples only.

3-8.11 Value types

Date, Time, DateTime, and S100_TruncatedDateTime are basic types described in the table below.

Table 1. Value types

Date	A date gives values for year, month and day according to the Gregorian Calendar. Character encoding of a date is a string which shall follow the calendar date format (complete representation, basic format) for date specified by ISO 8601. EXAMPLE 19980918 (YYYYMMDD)
Time	A time is given by an hour, minute and second or fractions thereof. Character encoding of a time is a string that follows any of the time of day formats defined in ISO 8601. Product specifications shall specify which formats are allowed for their domains, and where appropriate, the decimal separator and number of digits in the decimal fraction. Time zone according to UTC is optional. EXAMPLES: a) 183059 or 183059+0100 or 183059Z (complete representation, basic format) b) 18:30:59 or 18:30:59+0100 or 18:30:59Z (complete representation, extended format) c) 1830 or 1830+0100 or 1830Z (reduced accuracy with 2 digits omitted, basic format) d) 18:30 or 18:30+0100 or 18:30Z (reduced accuracy with 2 digits omitted,, extended format) e) 18 or 18Z (reduced accuracy with 4 digits omitted, basic format – extended format is not applicable when 4 digits are omitted). f) 183059.50, 1830.7, 18.50 (decimal representations, basic format) g) 18:30:59.50, 18:30.7 (decimal representations, extended format) Note that the time designated by (c) and (d) is different from the time designated by (a) and (b) and the time designated by (e) is different from both.

	The complete representation of the time of 27 minutes and 46 seconds past 15 hours locally in Geneva (in winter one hour ahead of UTC), and in New York (in winter five hours behind UTC), together with the indication of the difference between the time scale of local time and UTC, are used as examples. Geneva*:* 152746+0100 New York: 152746-0500
DateTime	A DateTime is a combination of a date and a time type. Character encoding of a DateTime shall follow ISO 8601 (see above). EXAMPLE: 19850412T101530
S100_TM_TruncatedDateTime	A TruncatedDateTime allows a partial TM Position to be given. At least one of the following components must be present with omitted elements replaced by the appropriate number of hyphens. year – integer between 0000 - 9999 month – integer between 01-12 day – integer between 01 and 28, 29, 30, or 31 depending on year and month values time – Time type (see above)

S100_IndeterminateDateTime is a complex attribute type with two sub-attributes:

Sub-attribute	label	Type	Remark
indeterminatePosition	Indeterminate time position	enumeration	1: before 2: after
value	Referenced time	S100_TruncatedDateTime	

3-8.12 Interpretation of interval start and end

The start and end instants of periods shall be included in the period unless a product specification specifies a different interpretation. This is based on ISO 8601:2004 § 2.1.3 which defines time interval as “the part of the time axis delimited by two instants” and provides that “A time interval comprises all instants between the two limiting instants and, unless otherwise stated, the two limiting instants themselves”.

The start and end instants are defined by the data/time component of smallest granularity. For example, if the month is the smallest component given in an end instant, the end instant is the whole month and the interval ends at the end of the last day of the month.

EXAMPLES: Applying this to encoding intervals using the reduced accuracy representation or the truncatedDateTimeType, results in the interpretations in Table 2. The table also indicates how the special case of leap years can be handled.

Table 2. Examples of periods

<S100_TM_TruncatedDateTimeType> periodStart	----01--	000000 on January 1 through 240000 on the 29th day of February in leap years and the 28th day of February in non-leap years
	year, day, and time not encoded	
<S100_TM_TruncatedDateTimeType> periodEnd	----02--	
	year, day, and time not encoded	
<S100_TM_TruncatedDateTimeType> periodStart	----0101	000000 on January 1 through 240000 on the 28th day of February each year
	year and time not encoded	

<S100_TM_TruncatedDateTimeType> periodEnd	----0228	
	year and time not encoded	
<S100_TM_DateAttributeType> dateStart	dateStart=20120105	000000 on January 5, 2012 through 240000 on June 18, 2012
<S100_TM_DateAttributeType> dateEnd	dateEnd=20120618	

3-8.13 Use of specific types for truncated Date Time

Data formats may utilise specific types as supported by that format in order to incorporate truncated DateTime values. Where this occurs the format description must specify the mapping between the truncatedDateTimeType values and those of the format-specific types.

Example;

An XML based encoding may use the *gMonthDay* simple attribute type (which is an XML Schema built-in type).

xs:gMonthDay: --12-17

The S-100 truncatedDateTime value is ----1217.