S-100 Maintenance - Change Proposal Form

Organisation: S-412 project team

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Change Proposal Type *Select only one option*

1.Clarification	2.Correction	3.Extension
		X

Location *Identify all change proposal locations*

S-100 Version No.	Part No.	Section No.	Proposal Summary
3.0.0	7	7-1	Added 3rd item to list to cover new curve types and updated figure 7-1 to reference the new draft of ISO 19107.
	7	7-3.1	New non-normative reference to the new 19107 draft
	7	7-4.1.1	Added new types to the table
	7	7-4.1.1.1	New section relating the spline modeling to ISO 19107 editions
	7	7-4.2	Figure 7-3 updated to include new spatial types
	7	7-4.2.1.1	New curve interpolation types
	7	7-4.2.2.2	New subsection explaining blended parabolic interpolation
	7	7-4.2.6.1	insertions at end of section clarifying that product specifications may constrain interpolation types
	7	7-4.2.22 to 7-4.2.26	New material describing the classes added for spline modeling
	7	various	Figure numbers should be updated following the insertion of a new figure in the new section 7-4.2.2.2
	7	7-4.3.2	Captions re-positioned to appropriate figures (incidental change not related to the subject of this proposal)
	10a	10a-5.4.10 10a-5.4.11	Fields for knots and (curve) derivatives – used by spline segments specified later
	10a	10a-5.7.2	Extend curve record with spline parameters
	10a	10a-5.7.2.4	Added interpolation types for splines and parabolic blend
	10a	10a-5.7.6	New spline parameter fields
	GML profile	S100_gmlProfile.xsd CurveInterpolation enumeration	Added ‘blendedParabolic’, ‘none’ and ‘loxodromic’; removed ‘clothoid’ ‘circularArc2PointWithBulge’ to harmonize better with part 7. (New 19107 draft says the enumeration in the standard does not limit the values of curve interpolation.)

	GML profile	S100_gmlBase.xsd	Added types for S100_GM_SplineCurve, S100_GM_PolynomialSpline and types used by them (knot, vector, and knotType). Also added a generic S100_GM_Curve type for other interpolations, specifically blended or fitted curves.

Change Proposal

Please provide a detailed change proposal.
Extends the spatial primitives in Part 7 of Edition 3.0 with types to allow encoding of BSpline, cubic spline, polynomial spline, and/or Bezier curve segments. Also adds blended parabolic interpolation as an additional interpolation type, since this is also being used for weather information. Considering the anomalies in ISO 19107:2003 and consequently in GML 3.2.1, this proposal takes into account the most recent draft update to ISO 19107 and adapts the GML 3.2.1 model slightly to resolve anomalies in ISO 19107:2003 and bridge the gap between the 2003 and current drafts of ISO 19107. Corresponding updates to the S-100 ISO 8211 and GML encoding formats to allow encoding of spline curve segments are included.

The updated GML profile includes only the segment types for SplineCurve and PolynomialSpline since it should be possible to encode the more specialized types of splines using only these types. For example cubic splines (i.e., curve segments that are cubic splines) can be encoded using polynomial splines with degree = 3.
The updated GML profile also adds a generic S100_GM_Curve type in the S100 namespace to allow encoding of curve segments with interpolations other than those fixed in GML 3.2.1. The PolynomialArc interface from the new draft of 19107 is not used because it is modeled as being accompanied by a specified polynomial function which is not (yet?) needed in S-100.

See the accompanying redline markup of Parts 7 and 10a for the specific changes.

Change Proposal Justification

Please provide a suitable explanation for the change and where applicable supporting documentation.

The GML profile defined in S-100, version 3.0 does not satisfy the needs of the World Meteorological Organization on two accounts. First, the current drawing capabilities limit data visualizations and introduce false vertices, which can be incorrectly interpreted by a user and contribute to incorrect avoidance maneuvers around dangerous environmental conditions. Second, the current drawing capabilities increase GML file sizes, which will raise the price of S-412 files downloaded from satellite based internet providers. This proposal requests that the S-100 GML profile be extended to include spline curve options and a curve fitting method that amounts to blending piecewise quadratic (parabolic) curves to accurately display lines as smooth curves and be a representation of the source data, to mitigate these two issues. Given that the GML profile must conform to Part 7 of S-100, extensions to the geometry model in Part 7 are a pre-requisite for updating the GML profile.

The following factors have been taken into consideration and the proposed changes attempt to bridge the current spatial model of S-100 and the direction in which the new draft of ISO 10107 is heading:

- ISO TC211 is currently working on an update to ISO 19107 and publication of the final version is still a year or more away. This makes some basic changes to modeling spatial primitives as well as some terminological and data type changes to the part that deals with splines. Full integration of the new model would require a comprehensive overhaul of Part 7 but this activity should probably await finalization of the new edition of ISO 19107 and initial results from S-100 test-beds.

- Additionally, ISO 19107:2003 assigns weights to 'knots,' which is inconsistent with spline theory.

Visualization Concern

The physical relationship between atmospheric pressure, wind, and fronts outline the importance of visualizing these features correctly. Atmospheric pressure is equivalent to the weight of a vertical column of air extending from the surface to the outer limit of the atmosphere (WMO 182, A2930). This weight is a representation of the density of the air; as atmospheric pressure changes, the density of the air changes. Wind is the movement of air masses and is caused by these changes.

Isobars are traditionally used to represent lines of equal atmospheric pressure across a geographic area. These smooth curves are drawn around high and low pressure centres, in any direction, and connect to themselves if the scale is accommodating. They cannot intersect. Air flow around these pressure centres is dictated by various physical forces (friction, coriolis force, pressure gradient force, etc) and can be thought of as spiraling into low pressure centres and out of high pressure centres. However, the general rule is that air flow into and out of pressure centres is more or less parallel to isobars. In areas where isobars change direction rapidly, the wind direction is expected to change dramatically.

The location where successive isobars change direction rapidly marks the interface or transition zone between air masses of different densities (WMO 182, F1290) and represents the location of a front. Density differences are more concentrated in these areas. Because isobars are directly related to the density of an air mass, specific isobar changes represent the position of fronts.

The geometry primitives outlined in S-100, version 3.0 Part 7 require that curves be represented by an aggregation of straight lines, circular arcs, or circles. False vertices develop where line segments begin and end, and imply wind speed increases or decreases, wind direction changes, and conditions typically associated with a front. Thunderstorms, precipitation, lower visibility, dramatic wind changes, and even dramatic changes in wave height often accompany fronts. Fronts and similar convergent boundaries are traditionally displayed with smooth curved lines. If these features are incorrectly drawn and overlaid incorrectly on isobars, the state of the atmosphere is misrepresented, which endangers the end user.

Ensuring meteorological features are displayed properly in an S-100 environment will give mariners the information to make life-saving decisions around hazardous environmental conditions. Without proper visual representation of these features, a mariner's decision may have unintentional and dangerous consequences.

File Size Concern

The GML profile defined in S-100, version 3.0 displays false vertices to represent the state of the atmosphere. In order to draw smooth curves, a forecasting agency could use an aggregation of many small straight lines. This would create the perception of a smooth curve if viewed at small scale.

Initial testing of this methodology indicates that the GML file size is approximately 3 times larger than what would be needed for spline curve geometries. This approximation was determined for one feature type at a small scale. It is anticipated that future S-412 GML files will include multiple curved features types that vary in resolution. Additionally, geographic coverages within one S-412 GML file may vary, and may span entire ocean basins.

The end user of future S-412 analysis and forecast products will need to access the most up-to-date files multiple times a day using satellite based internet services. If a forecasting agency uses an aggregation of many small straight lines to represent the state of the atmosphere, then the cost to download these files will likely be higher. S-100 version 3.0 potentially increases the financial commitment for mariners to receive future S-412 GML files, which will include information about potentially dangerous and rapidly changing weather systems.

Please send completed forms and supporting documentation to the secretary S-100.