



**G-XML2.0**

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# **G-XML**

## **Geospatial-eXtensible Markup Language**

**Title: Graphics based G-XML Specification**

**Version: 2.0**

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# Geographic Information

## XML encoding for geospatial data exchange

**Introduction** This specification was established in July 2001 to prescribe the XML-based encoding method for geospatial data aiming at its transmissive use among different computer systems.

### 1. Scope

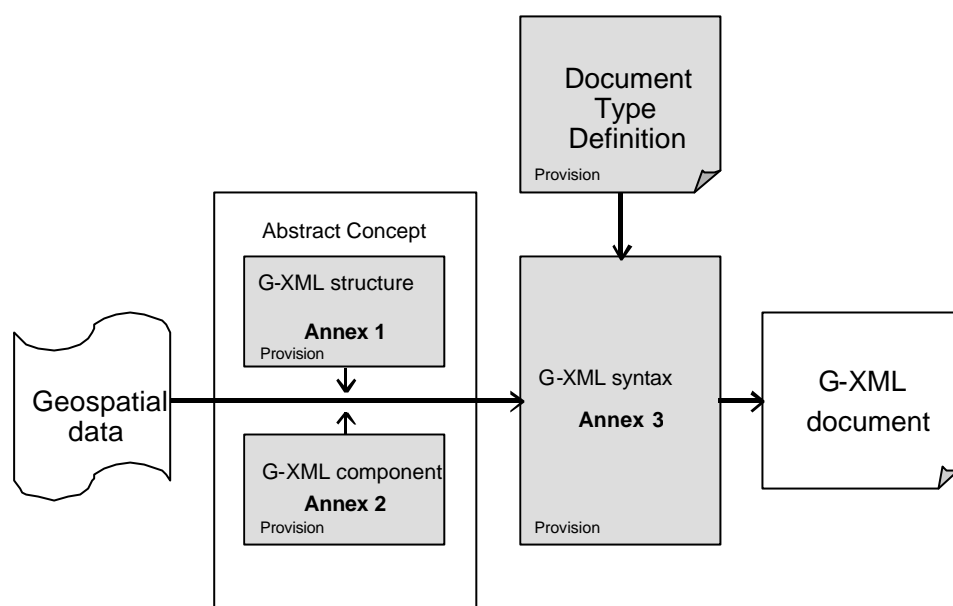
This specification specifies:

A useful encoding method (i.e. GXML) to encode simple geospatial data into XML documents, make use of that geospatial data via computers (or mobile information devices), and save, store, and exchange that data mainly on the web in an open, simple and easy manner.

**Note** This specification does not define a general encoding method for geographical information based on XML which is under discussion by ISO for international standard but a new encoding method for exchanging geospatial data.

This specification prescribes the following items. The relationship of each item is shown in Figure 1.

- a) The **Document Type Definition** for the description of geospatial data.
- b) The XML documents are based on the Document Type Definition of item (a), and must conform to the following **abstract concepts**.
  - 1) **The Compound Module of GXML** (Refer to **Annex 1**) The abstract structure necessary in describing the content of geospatial data.
  - 2) **The Components of GXML** (Refer to **Annex 2**) The abstract components which compose the geospatial data.
- c) The XML documents are based on the Document Type Definition of item (a), and must conform to the **G-XML syntax** (Refer to **Annex 3**).



**Figure 1: Relationships of G-XML provisions**

**Note** The following items are excluded.

- a) Definitions regarding XML.
- b) How to implement G-XML on a computer system & the set-up of those systems.
- c) How to solve problems related to G-XML syntax errors.
- d) The data strings, file configurations, and the choice of format in which G-XML documents are stored; The character sets or encoding methods to convert G-XML documents into them.
- e) Definitions of the spatial reference system which G-XML refers to.
- f) The system regarding the measurement unit which G-XML documents uses.
- g) Systems or symbol shapes which illustrate geographical features.
- h) The format of image file data.
- i) Systems that regard the time and date unit used by G-XML.
- j) Systems that regard the directional unit used by G-XML.

- 2. Other Standards Used in G-XML** These standards are the components of the G-XML specification. The latest versions of these standards are applied to the G-XML specification.

**JIS X 0001** Term for information processing – basic term

**JIS X 0301** shows the date and timetable format

cf. Except in the representation of “ye ars”, G-XML technically conforms to ISO 8601:1988 Data elements and interchange formats – Information interchange – Representation of dates and times.

**JIS X 4151** Document Description Language **SGML**

cf. Except in the use of Japanese characters, G-XML technically conforms to ISO 8879:1986 Information processing – Text and office systems – Standard Generalized Markup Language (SGML).

In addition, ISO 8879:1986/Cor.2:1999 prescribes the relationship between SGML and XML, and it also shows that XML is a subset of SGML. In Japan, Annex L (Reference) of JIS X 4151 Document Description Language SGML supplement 2, revised in January 2001, describes that W3C (World Wide Web Consortium) developed XML as a subset of SGML core function to interchange SGML document on WWW (World Wide Web).

**JIS X 4156** HyperText Markup Language (HTML)

cf. Except in the use of Japanese characters, G-XML technically conforms to ISO/IEC 15445:2000 Information technology – Document description and processing language – HyperText Markup Language (HTML).

**JIS X 4345** Information technology – Coding of multimedia and hypermedia information – Part 5: Support for base-level interactive applications

cf. ISO/IEC 13522-5: 1997 Information technology – Coding of multimedia and hypermedia information – Part 5: Support for base-level interactive applications: Functional description agrees with this standard.

**JIS Z 8114** drafting - drafting term

**3. Definitions** The definitions of major terms used in this specification are as follows.

**3.1 Topology** the relationship between the edges and the nodes of a feature as invariable properties, regardless of continuous transformations.

**3.2 Topological space** the space mapped topology using optional methods

**3.3 Topological geospace** the geospace mapped topology using optional methods

**3.4 Dashdot line** line made from the elements of two lines of different length that alternately repeat.

**3.5 Mover** the position of movable target objects in the actual world.

**Example:** the position of a car, the position of a person, the position in the center of a typhoon.

**3.6 Instance** a mark or data which responds to the hierarchy of elements which conform to document type definitions.

**3.7 XML query language, XQL** language used for data searching in XML documents.

**3.8 XML document** document made up of a logical element structure as well as a physical entity structure that follow the constructs of XML, a text format document.

**3.9 Edge** line that contains topological information and it is composed from multiple points that connect nodes together.

**3.10 Plumb direction** the direction of the earth's gravity.

**3.11 Parent element** element that carries at least one element that depends directly on it.

**Note** When there are two elements A and B, and element B is directly dependent on element A, it is said that element A is the parent element.

**3.12 Extended pointer, XPointer** assignment method for specifying resources which are referred to by counting character strings and elements of XML documents.

**3.13 Certainty** accuracy

**3.14 Point of interest, POI** location as a point of interest in the actual world.

**3.15 Geometry** features which are displayed geometrically.

**3.16 Geometric feature** geographical features that have geometry in the actual world.

**3.17 Boundary** line which specifies the extents of the territory.

**3.18 Record** each portion of information that composes the history.

**3.19 Spatial reference system** information system necessary for accurately giving a

location to the spatial data, and for planning the positional matching of various types of spatial data.

- 3.20 Spatial data** data that makes possible position referral.
- 3.21 Metric space** space shown on the Cartesian coordinate system.
- 3.22 Metric geospace** geospace shown on the Cartesian coordinate system.
- 3.23 Child element** element that depends on the parent element.
- 3.24 Coordinate** one of the aggregates of the real number of N with a certain attached order, which displays the position of a point in the N dimensional space.
- 3.25 Coordinate system** a regulated mathematical aggregate used for clarifying the assignment to a position using coordinates.
- 3.26 G-XML document** XML documents that uses this specification for describing geospatial data.
- 3.27 Phenomenon** an incident that can be recognized or a target object.
- 3.28 Real world** the actual world
- 3.29 Horizontal direction** the horizontal direction against the earth's gravitational direction.
- 3.30 Style** the notation style that has characteristics of color and also the geometrical structure for creating diagrams.
- 3.31 Accuracy** measure of ability that differentiates nearly equivalent values.
- 3.32 Line string** geometric form connecting coordinates of more than 2 points by line segments in order.
- 3.33 Device coordinates, DC** the coordinate system's device dependences. In other devices, the approximate unit depends on the device.
- 3.34 Geodetic coordinate system** a coordinate system of locations fixed using ellipsoid quantities (in the case of 3 dimensions) or latitude and longitude.
- 3.35 Geospatial** the space which relates to locations on the earth.
- 3.36 Geospatial data** data that has spatial attributes capable of relating to locations on the earth.
- 3.37 Georeference Name** a coding scheme that defines fixed locations on the earth.
- 3.38 Projected coordinate system** a method of representing a 3 dimensional surface as a 2 dimensional surface by using a mathematical model to transform the 3d coordinate values to 2d values.
- 3.39 Root element** element that does not have a parent element.
- 3.40 Node** end vertex or point that connects edges to other edges.

**3.41 Rendering** transformation of an object into a stylized image.

**3.42 Document Type Definition** markup rules for defined, fixed form documents depending on the application.

**3.43 Plane rectangular coordinate system** one of the projected coordinate systems and the one used in the map of Japan. The locations in the plane rectangular coordinate system partition all of Japan into 19 coordinate systems, and are shown by coordinates in each of the 2 dimensional Cartesian coordinate systems.

**Note** The following are the points of origin of the 19 coordinate systems for the whole country of Japan shown as longitude and latitude on the geodetic coordinate system.

System number	Latitude and Longitude of the point of origin	
I	North latitude 33° 0'	East longitude 129° 30'
II	North latitude 33° 0'	East longitude 131° 0'
III	North latitude 36° 0'	East longitude 132° 10'
IV	North latitude 33° 0'	East longitude 133° 30'
V	North latitude 36° 0'	East longitude 134° 20'
VI	North latitude 36° 0'	East longitude 136° 0'
VII	North latitude 36° 0'	East longitude 137° 10'
VIII	North latitude 36° 0'	East longitude 138° 30'
IX	North latitude 36° 0'	East longitude 139° 50'
X	North latitude 40° 0'	East longitude 140° 50'
XI	North latitude 44° 0'	East longitude 140° 15'
XII	North latitude 44° 0'	East longitude 142° 15'
XIII	North latitude 44° 0'	East longitude 144° 15'
XIV	North latitude 26° 0'	East longitude 142° 0'
XV	North latitude 26° 0'	East longitude 127° 30'
XVI	North latitude 26° 0'	East longitude 124° 0'
XVII	North latitude 26° 0'	East longitude 131° 0'
XVIII	North latitude 20° 0'	East longitude 136° 0'
XIX	North latitude 26° 0'	East longitude 154° 0'

**3.44 Compass** the relationship between a direction and a fixed standard direction.

**3.45 Metadata** data which describes the content of data, quality, status and other characteristics.

**3.46 UML** Unified Modeling Language for program layout in developing object oriented software

**3.47 History** set of object information assembled in a time series.

**4. Conformance** This specification prescribes a useful encoding method based on XML to encode simple geospatial data into XML documents. One must obey the following rules in order to encode geospatial data conforming to this specification.

- a) Authors have to adhere to either of the abstract concepts in **Annex 1**, or **Annex 2**.
- b) Authors should follow the syntax written in the **Annex 3** when converting geospatial data into XML documents according to the abstract concept of **(a)**.
- c) Authors must make use of the Document Type Definition prescribed in Section 5 when converting geospatial data into XML documents according to the abstract concept of **(a)**.
- d) The description methods of the date and time follow **JIS X 0301**.

**5. Document Type Definition** the following is an example of the G-XML document type definition. The description method of document type definitions depends on the **JIS X 4151**.

```

<!-- ===== -->
<!-- Geospatial data descriptive language G-XML Document Type -->
<!-- Definition -->
<!-- ===== -->

<!-- G-XML document Element -->
<!-- Encodes the structure for defining the documentation which -->
<!-- describes geospatial data -->
<!ELEMENT G-XML (
    Metadata?,
    (MetricGeospace | TopologicalGeospace | POI | Mover | Route | Picture |
    RenderingRuleList|RenderingRule)+
)>

<!-- Metadata Element -->
<!-- Encodes metadata related to geospatial data described by G-XML -->
<!ELEMENT Metadata (Metadata.gxml | Metadata.jmp)>

<!-- G-XML Metadata (Metadata.gxml) Element -->
<!-- Encodes minimal level metadata necessary for explaining -->
<!-- geospatial data described by G-XML -->
<!ELEMENT Metadata.gxml (
    Name?, Purpose?, Author?, At?, Description?, Property*
)>

<!-- Japanese Standard Metadata (Metadata.jmp) Element -->
<!-- Encodes the reference for documents which describe Japanese -->
<!-- standard metadata -->
<!ELEMENT Metadata.jmp EMPTY>
<!ATTLIST Metadata.jmp
    hyperreference          CDATA    #REQUIRED>

<!-- Name Element -->
<!-- Encodes names -->
<!ELEMENT Name (#PCDATA)>
<!ATTLIST Name
    nametype                (formal | popular | none)    "none"
    ruby                    CDATA                      #IMPLIED
>

<!-- Purpose Element -->
<!-- Encodes the purpose created by geospatial data described by G-XML -->
-->
<!ELEMENT Purpose (#PCDATA)>

<!-- Author Element -->
<!-- Encodes the information related to the author of the geospatial -->
<!-- data described by G-XML -->
<!ELEMENT Author (#PCDATA)>

```

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<!ATTLIST Author
    ruby                                CDATA    #IMPLIED
    >

<!-- Description Element                                -->
<!-- Encodes explanations or descriptions              -->
<!ELEMENT Description (#PCDATA)>

<!-- Property Element                                  -->
<!-- Encodes information which can be displayed by names, shapes as -->
<!-- well as by combination of values                 -->
<!ELEMENT Property (#PCDATA)>
<!ATTLIST Property
    propertytypename                    CDATA    #REQUIRED
    datatype                            (boolean | integer | real | string)  "string"
    >

<!-- Metric Geospace Element                            -->
<!-- Encodes the structure for including all the elements composing -->
<!-- the metric geospatial                            -->
<!ELEMENT MetricGeospace (
    Boundary?, (RenderingRuleList* | RenderingRule?),
    (GeometricFeature | POI | Mover | Route | Picture)+
    )>
<!ATTLIST MetricGeospace
    id                                  CDATA    #IMPLIED
    category                            CDATA    #IMPLIED
    spatialreferencesystem              CDATA    #REQUIRED
    unit.location                       CDATA    #IMPLIED
    unit.length                         CDATA    #IMPLIED
    unit.time                           CDATA    #IMPLIED
    unit.angle                          CDATA    #IMPLIED
    unit.speed                          CDATA    #IMPLIED
    accuracy.location.horizontal        CDATA    #IMPLIED
    accuracy.location.vertical          CDATA    #IMPLIED
    accuracy.length                    CDATA    #IMPLIED
    accuracy.time                       CDATA    #IMPLIED
    accuracy.angle                      CDATA    #IMPLIED
    accuracy.speed                      CDATA    #IMPLIED
    >

<!-- Geometric Feature Attribute Entity                -->
<!-- Encodes the attributes of geometric features    -->
<!ENTITY % GeometricFeatureAttribute
    "((Geometry | Symbol | Annotation | Picture), Property*)"
    >

<!-- Geometric Feature Element                            -->
<!-- Encodes the structure for including all elements composing -->
<!-- geometric features                                -->
<!ELEMENT GeometricFeature (
    Name*, Description?, Boundary?, (RenderingRuleList* | RenderingRule?),
    (%GeometricFeatureAttribute; | GeometricFeature)+
    )>

```

```

<!ATTLIST GeometricFeature
    id                CDATA    #IMPLIED
    category          CDATA    #IMPLIED
    spatialreferencesystem CDATA    #IMPLIED
    unit.location     CDATA    #IMPLIED
    unit.length       CDATA    #IMPLIED
    unit.angle        CDATA    #IMPLIED
    accuracy.location.horizontal CDATA    #IMPLIED
    accuracy.location.vertical   CDATA    #IMPLIED
    accuracy.length   CDATA    #IMPLIED
    accuracy.angle    CDATA    #IMPLIED
>

<!-- Geometry Attribute Entity -->
<!-- Encodes the attributes of geometry -->
<!ENTITY % GeometryAttribute
    "(Point | LineString | Rectangle | LinearRing | Polygon | Circle | Arc)"
>

<!-- Geometry Element -->
<!-- Encodes the structure for including all elements composing -->
<!-- geometry -->
<!ELEMENT Geometry (
    (RenderingRuleList*|RenderingRule?), (%GeometryAttribute;|Geometry)+
)>
<!ATTLIST Geometry
    id                CDATA    #IMPLIED
    category          CDATA    #IMPLIED
    spatialreferencesystem CDATA    #IMPLIED
    unit.location     CDATA    #IMPLIED
    unit.length       CDATA    #IMPLIED
    unit.angle        CDATA    #IMPLIED
    accuracy.location.horizontal CDATA    #IMPLIED
    accuracy.location.vertical   CDATA    #IMPLIED
    accuracy.length   CDATA    #IMPLIED
    accuracy.angle    CDATA    #IMPLIED
>

<!-- Boundary Element -->
<!-- Encodes the boundary -->
<!ELEMENT Boundary (Rectangle)>

<!-- Rectangle Element -->
<!-- Encodes one of the rectangles in geometry that can be rendered -->
<!-- in the Cartesian coordinate system -->
<!ELEMENT Rectangle ((RenderingRuleList* | RenderingRule?), Coordinates)>
<!ATTLIST Rectangle
    id                CDATA    #IMPLIED
    category          CDATA    #IMPLIED
>

<!-- Coordinate Element -->
<!-- Encodes coordinates which show locations in the metric space -->
<!ELEMENT Coordinates (#PCDATA)>

```

```

<!ATTLIST Coordinates
    decimal                CDATA    "."
    valueseparator         CDATA    ","
    tupleseparator         CDATA    " "
    spatialreferencesystem CDATA    #IMPLIED
    unit.location          CDATA    "sec"
    accuracy.location.horizontal CDATA #IMPLIED
    accuracy.location.vertical CDATA #IMPLIED
>

<!-- Point Element -->
<!-- Encodes one of the points in geometry that can be rendered in -->
<!-- the Cartesian coordinate system -->
<!ELEMENT Point ((RenderingRuleList* | RenderingRule?), Coordinates)>
<!ATTLIST Point
    id                    CDATA    #IMPLIED
    category              CDATA    #IMPLIED
>

<!-- Line String Element -->
<!-- Encodes one of the line strings in geometry that can be rendered -->
<!-- in the Cartesian coordinate system -->
<!ELEMENT LineString ((RenderingRuleList* | RenderingRule?), Coordinates)>
<!ATTLIST LineString
    id                    CDATA    #IMPLIED
    category              CDATA    #IMPLIED
>

<!-- Polygon Element -->
<!-- Encodes one of the polygons in geometry that can be rendered in -->
<!-- the Cartesian coordinate system -->
<!ELEMENT Polygon (
    (RenderingRuleList* | RenderingRule?), OuterBoundary, InnerBoundary*
)>
<!ATTLIST Polygon
    id                    CDATA    #IMPLIED
    category              CDATA    #IMPLIED
>

<!-- Outer Boundary Element -->
<!-- Encodes the outer boundary of polygons -->
<!ELEMENT OuterBoundary (LinearRing) >
<!ATTLIST OuterBoundary
    id                    CDATA    #IMPLIED
>

<!-- Inner Boundary Element -->
<!-- Encodes the inner boundary of polygons -->
<!ELEMENT InnerBoundary (LinearRing) >
<!ATTLIST InnerBoundary
    id                    CDATA    #IMPLIED
>

<!-- Linear Ring Element -->

```

```

<!-- Encodes one of the linear rings in geometry that can be rendered -->
<!-- in the Cartesian coordinate system -->
<!ELEMENT LinearRing ((RenderingRuleList* | RenderingRule?), Coordinates)>
<!ATTLIST LinearRing
    id                CDATA    #IMPLIED
    category          CDATA    #IMPLIED
>

<!-- Circle Element -->
<!-- Encodes one of the circles in geometry that can be rendered in -->
<!-- the Cartesian coordinate system -->
<!ELEMENT Circle ((RenderingRuleList* | RenderingRule?), Coordinates, Radius?)>
<!ATTLIST Circle
    id                CDATA    #IMPLIED
    category          CDATA    #IMPLIED
>

<!-- Arc Element -->
<!-- Encodes one of the arcs in geometry that can be rendered in the -->
<!-- Cartesian coordinate system -->
<!ELEMENT Arc ((RenderingRuleList* | RenderingRule?), Coordinates, Radius?)>
<!ATTLIST Arc
    id                CDATA    #IMPLIED
    category          CDATA    #IMPLIED
    startangle       CDATA    #IMPLIED
    endangle         CDATA    #IMPLIED
    unit.angle       CDATA    #IMPLIED
    accuracy.angle   CDATA    #IMPLIED
>

<!-- Radius Element -->
<!-- Encodes the radius of a circle -->
<!ELEMENT Radius (#PCDATA) >
<!ATTLIST Radius
    unit.length      CDATA    #IMPLIED
    accuracy.length  CDATA    #IMPLIED
>

<!-- Annotation Element -->
<!-- Encodes annotations graphed by basing geospatial phenomena on -->
<!-- character strings in the Cartesian coordinate system -->
<!ELEMENT Annotation (
    (RenderingRuleList* | RenderingRule?), Coordinates, Size?, Content
)>
<!ATTLIST Annotation
    id                CDATA    #IMPLIED
    category          CDATA    #IMPLIED
>

<!-- Content Element -->
<!-- Encodes annotation contents -->
<!ELEMENT Content (#PCDATA)>

<!-- Size Element -->

```

```

<!-- Encodes the size displayed by the actual dimensions -->
<!ELEMENT Size EMPTY>
<!ATTLIST Size
    width                CDATA    #IMPLIED
    height               CDATA    #IMPLIED
    unit.length          CDATA    #IMPLIED
    accuracy.length      CDATA    #IMPLIED
>

<!-- Symbol Element -->
<!-- Encodes symbols made from geospatial phenomena in the Cartesian -->
<!-- coordinate system -->
<!ELEMENT Symbol (
    (RenderingRuleList* | RenderingRule?), Coordinates, Size?, SymbolName
)>
<!ATTLIST Symbol
    id                    CDATA    #IMPLIED
    category              CDATA    #IMPLIED
>

<!-- Symbol Name Element -->
<!-- Encodes the symbol name -->
<!ELEMENT SymbolName (#PCDATA)>

<!-- Point of Interest (POI) Element -->
<!-- Encodes the structure for the description connected to a point -->
<!-- which shows a position in the geospatial and all the information -->
<!-- related to it -->
<!ELEMENT POI (
    (RenderingRuleList* | RenderingRule?), LocationRelationship*, Route*,
    History?, SpatialLocator?, TemporalLocator?, Direction*, Property*
)>
<!ATTLIST POI
    id                    CDATA    #IMPLIED
    category              CDATA    #IMPLIED
>

<!-- Spatial Locator Element -->
<!-- Encodes the location in the geospatial -->
<!ELEMENT SpatialLocator (
    Coordinates|GeoreferenceName|G-XMLReferenceID
)>
<!ATTLIST SpatialLocator
    unit.location                CDATA    #IMPLIED
    accuracy.location.horizontal CDATA    #IMPLIED
    accuracy.location.vertical   CDATA    #IMPLIED
    certainty                    (exact|maybe|perhaps|none) "none"
>

<!-- Temporal Locator Element -->
<!-- Encodes the location in time -->
<!ELEMENT TemporalLocator (At|Span|Duration)>
<!ATTLIST TemporalLocator
    unit.time                CDATA    #IMPLIED

```

```

    accuracy.time                CDATA                #IMPLIED
    certainty                    (exact|maybe|perhaps|none)  "none"
  >

<!-- Direction Element -->
<!-- Encodes directions in the geospatial -->
<!ELEMENT Direction ((Vector|Angle), Scalar*)>
<!ATTLIST Direction
    unit.angle                    CDATA                #IMPLIED
    accuracy.angle                CDATA                #IMPLIED
    certainty                    (exact|maybe|perhaps|none)  "none"
  >

<!-- Georeference Name Element -->
<!-- Encodes the reference name for a place in the geospatial -->
<!ELEMENT GeoreferenceName (
    Address?, PostalCode?, TelephoneNumber*, Keyword?
  )>

<!-- Address Element -->
<!-- Encodes the address -->
<!ELEMENT Address (#PCDATA)>
<!ATTLIST Address
    referencesystem                CDATA                #IMPLIED
    ruby                            CDATA                #IMPLIED
  >

<!-- Postal Code Element -->
<!-- Encodes the postal code -->
<!ELEMENT PostalCode (#PCDATA)>
<!ATTLIST PostalCode
    referencesystem                CDATA                #IMPLIED
  >

<!-- Telephone Number Element -->
<!-- Encodes the telephone number -->
<!ELEMENT TelephoneNumber (#PCDATA)>
<!ATTLIST TelephoneNumber
    referencesystem                CDATA                #IMPLIED
  >

<!-- Keyword Name Element -->
<!-- Encodes keywords which refer to places in the geospatial -->
<!ELEMENT Keyword (#PCDATA)>
<!ATTLIST Keyword
    referencesystem                CDATA                #IMPLIED
    ruby                            CDATA                #IMPLIED
  >

<!-- G-XML Document Locator (G-XMLReferenceID) Element -->
<!-- Encodes the identifier which refers to the displayed location -->
<!-- according to the G-XML document of other geospatial descriptive -->
<!-- languages. -->
<!ELEMENT G-XMLReferenceID EMPTY>

```

```

<!ATTLIST G-XMLReferenceID
    hyperreference          CDATA    #REQUIRED
    >

<!-- Time (At) Element -->
<!-- Encodes the time -->
<!ELEMENT At EMPTY>
<!ATTLIST At
    time                    CDATA    #REQUIRED
    frequency               CDATA    #IMPLIED
    unit.time               CDATA    #IMPLIED
    accuracy.time           CDATA    #IMPLIED
    >

<!-- Time Period (Span) Element -->
<!-- Encodes the time period starting time and completion time -->
<!ELEMENT Span EMPTY >
<!ATTLIST Span
    starttime               CDATA    #REQUIRED
    endtime                 CDATA    #REQUIRED
    frequency               CDATA    #IMPLIED
    unit.time               CDATA    #IMPLIED
    accuracy.time           CDATA    #IMPLIED
    >

<!-- Continuous Time (Duration) Element -->
<!-- Encodes the duration -->
<!ELEMENT Duration EMPTY>
<!ATTLIST Duration
    time                    CDATA    #REQUIRED
    unit.time               CDATA    #IMPLIED
    accuracy.time           CDATA    #IMPLIED
    >

<!-- Vector Element -->
<!-- Encodes the value of the directional vector -->
<!ELEMENT Vector EMPTY>
<!ATTLIST Vector
    equatorialdirection     CDATA    #REQUIRED
    meridiandirection       CDATA    #REQUIRED
    plumbdirection          CDATA    #IMPLIED
    >

<!-- Scalar Quantity (Scalar) Element -->
<!-- Encodes the given size as per direction -->
<!ELEMENT Scalar (#PCDATA)>
<!ATTLIST Scalar
    name                    CDATA    #REQUIRED
    unit.location            CDATA    #IMPLIED
    unit.speed               CDATA    #IMPLIED
    unit.userdefine          CDATA    #IMPLIED
    accuracy.location.horizontal CDATA    #IMPLIED
    accuracy.location.vertical   CDATA    #IMPLIED
    accuracy.speed           CDATA    #IMPLIED

```

```

        accuracy.userdefine                CDATA    #IMPLIED
    >

<!-- Angle Element                                -->
<!-- Encodes the directional angle degree         -->
<!ELEMENT Angle (HorizontalAngle? , VerticalAngle?)>

<!-- Horizontal Angle Element                    -->
<!-- Encodes the angle's horizontal direction    -->
<!ELEMENT HorizontalAngle (#PCDATA) >
<!ATTLIST HorizontalAngle
    angletype                (angle|compass) "angle"
    unit.angle                CDATA          #IMPLIED
    accuracy.angle            CDATA          #IMPLIED
    >

<!-- Vertical Angle Element                      -->
<!-- Encodes the angle's vertical direction      -->
<!ELEMENT VerticalAngle (#PCDATA)>
<!ATTLIST VerticalAngle
    angletype                (angle|compass) "angle"
    unit.angle                CDATA          #IMPLIED
    accuracy.angle            CDATA          #IMPLIED
    >

<!-- History Order Entity                        -->
<!-- Encodes the order of the elements which compose the history -->
<!ENTITY    % HistoryOrder    "historyorder CDATA    #IMPLIED">

<!-- History Element                            -->
<!-- Encodes the structure which includes all the elements composing -->
<!-- the history                                -->
<!ELEMENT History (
    Description?, (RenderingRuleList* | RenderingRule?),
    (Record | History)+, Property*
)>
<!ATTLIST History
    id                        CDATA    #IMPLIED
    category                  CDATA    #IMPLIED
    %HistoryOrder;
    >

<!-- Record Element                             -->
<!-- Encodes the record which composes the history -->
<!ELEMENT Record (Description?, (POI | Mover)?, Property*)>
<!ATTLIST Record
    id                        CDATA    #IMPLIED
    %HistoryOrder;
    >

<!-- Location Relationship Element                -->
<!-- Encodes the related location among objects in the geospatial -->
<!ELEMENT LocationRelationship (Neighborhood | Side | Corner)>
<!ATTLIST LocationRelationship

```

```

        myidreference          CDATA    #IMPLIED
        youridreference       CDATA    #REQUIRED
    >

<!-- Neighborhood Element                                -->
<!-- Encodes the state when certain objects in the geospatial and -->
<!-- other objects adjoin                                       -->
<!ELEMENT Neighborhood (Description?, (Vector | Angle)?, Distance?)>
<!ATTLIST Neighborhood
        yourtype              (Node | POI | Mover)    "Node"
    >

<!-- Side Element                                         -->
<!-- When some objects in the geospatial encode the condition when a -->
<!-- side is made by an edge that joins two nodes in the topological -->
<!-- geospatial                                             -->
<!ELEMENT Side (Description?, (Vector | Angle)?, Distance?)>
<!ATTLIST Side
        yourtype              CDATA    #FIXED          "Edge"
        myposition           (right   |   left   |   on)
        #REQUIRED
    >

<!-- Corner Element                                       -->
<!-- When some objects in the geospatial encode the condition near -->
<!-- nodes which are at corners that are caught between two edges n -->
<!-- the topological geospatial                             -->
<!ELEMENT Corner (Description?, (Vector | Angle)?, Distance?)>
<!ATTLIST Corner
        yourtype              CDATA    #FIXED
        "Node"
        clockwisenextedge    CDATA    #IMPLIED
        anticlockwisenextedge CDATA    #IMPLIED
    >

<!-- Distance Element                                     -->
<!-- Encodes distances in the geospatial                   -->
<!ELEMENT Distance (#PCDATA)>
<!ATTLIST Distance
        unit.length          CDATA    #IMPLIED
        accuracy.length      CDATA    #IMPLIED
    >

<!-- Mover Element                                        -->
<!-- Encodes the structure to describe a point which displays the -->
<!-- position of the mover in the geospatial and the information of -->
<!-- the mover's relation to that point                     -->
<!ELEMENT Mover (
        Description?, (RenderingRuleList* | RenderingRule?),
        LocationRelationship*, History?,
        SpatialLocator?, TemporalLocator?, Direction*, Status?, Property*
    )>
<!ATTLIST Mover
        id                    CDATA    #IMPLIED

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        category                                CDATA    #IMPLIED
    >

<!-- Status Element                                -->
<!-- Encodes the status of the mover              -->
<!ELEMENT Status (Direction?, Property*)>

<!-- Route Order Entity                            -->
<!-- Encodes the order of the elements which compose the route -->
<!ENTITY      % RouteOrder      "routeorder      CDATA    #IMPLIED">

<!-- Route Element                                -->
<!-- Encodes the structure which includes all the elements composing -->
<!-- the route                                    -->
<!ELEMENT Route (
    Description?, (RenderingRuleList* | RenderingRule?),
    (RouteNode | Route)+, Property*
)>
<!ATTLIST Route
    id                CDATA    #IMPLIED
    category          CDATA    #IMPLIED
    %RouteOrder;
>

<!-- Route Node Element                            -->
<!-- Encodes the route locations on the route      -->
<!ELEMENT RouteNode (Node | Edge | POI | SpatialLocator | Coordinates)>
<!ATTLIST RouteNode
    id                CDATA    #IMPLIED
    %RouteOrder;
>

<!-- Picture Element                                -->
<!-- Encodes the structure for describing pictures visualized in a -->
<!-- fixed range in the geospatial                -->
<!ELEMENT Picture (
    (RenderingRuleList* | RenderingRule?), Size, Transformation?, URL
)>
<!ATTLIST Picture
    id                CDATA    #IMPLIED
    category          CDATA    #IMPLIED
>

<!-- Transformation Element                        -->
<!-- Encodes the structure for description of the method for the -->
<!-- projection of objects in the local Cartesian coordinate system -->
<!-- into the metric geospatial                    -->
<!ELEMENT Transformation (DiagonalTransformation | MatrixTransformation)>

<!-- Diagonal Transformation Element                -->
<!-- Encodes the set transformation method by displaying the -->
<!-- coordinate system of the metric geospatial transformation -->
<!-- destination and the Cartesian coordinate system where objects -->
<!-- which become origins of transformation exist    -->

```

```

<!ELEMENT DiagonalTransformation (
    LocalCoordinateSystem, GlobalCoordinateSystem
)>

<!-- Local Coordinate System Element -->
<!-- Encodes the Cartesian coordinate system where objects which -->
<!-- become origins of transformation exist -->
<!ELEMENT LocalCoordinateSystem (Rectangle)>
<!ATTLIST LocalCoordinateSystem
    spatialreferencesystem          CDATA    #IMPLIED
    unit.location                   CDATA    #IMPLIED
>

<!-- Global Coordinate System Element -->
<!-- Encodes the coordinate system of the metric geospatial -->
<!-- transformation destination -->
<!ELEMENT GlobalCoordinateSystem (Rectangle)>
<!ATTLIST GlobalCoordinateSystem
    spatialreferencesystem          CDATA    #IMPLIED
    unit.location                   CDATA    #IMPLIED
>

<!-- Matrix Transformation Element -->
<!-- Encodes the method of set transformation by displaying the value -->
<!-- of the matrix -->
<!ELEMENT MatrixTransformation EMPTY>
<!ATTLIST MatrixTransformation
    a                               CDATA    #REQUIRED
    b                               CDATA    #REQUIRED
    c                               CDATA    #REQUIRED
    d                               CDATA    #REQUIRED
    e                               CDATA    #REQUIRED
    f                               CDATA    #REQUIRED
    unit.location                   CDATA    #REQUIRED
>

<!-- Uniform Resource Locator (URL) Element -->
<!-- Encodes the Uniform Resource Locator in the Internet -->
<!ELEMENT URL (#PCDATA)>

<!-- Topological Geospace Element -->
<!-- Encodes the structure which includes all the elements which -->
<!-- compose the topological geospatial? -->
<!ELEMENT TopologicalGeospace (
    (RenderingRuleList* | RenderingRule?), Node+, Edge+, Route*
)>
<!ATTLIST TopologicalGeospace
    id                               CDATA    #IMPLIED
    category                         CDATA    #IMPLIED
>

<!-- Node Element -->
<!-- Encodes the nodes which make the topological structure -->
<!ELEMENT Node (

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```

        Description?, (RenderingRuleList* | RenderingRule?),
        (SpatialLocator | Coordinates)?, LocationRelationship*, Property*
    )>
<!-- Node
  id          CDATA #REQUIRED
  category    CDATA #IMPLIED
  >

<!-- Edge Element -->
<!-- Encodes the adjoining relationship between nodes which make the -->
<!-- topological structure -->
<!-- Edge (
  Description?, (RenderingRuleList* | RenderingRule?),
  LocationRelationship*, Property*
  )>
<!-- Edge
  id          CDATA #REQUIRED
  category    CDATA #IMPLIED
  startnode   CDATA #REQUIRED
  endnode     CDATA #REQUIRED
  >

<!-- Point Style Element -->
<!-- Encodes the reference style when rendering points -->
<!-- PointStyle (Invisible*)>
<!-- PointStyle
  id          CDATA #IMPLIED
  stylename   CDATA #IMPLIED
  color       CDATA #IMPLIED
  size        CDATA #IMPLIED
  unit.length CDATA #IMPLIED
  >

<!-- Line Style Element -->
<!-- Encodes the reference style when rendering lines -->
<!-- LineStyle (Invisible*)>
<!-- LineStyle
  id          CDATA #IMPLIED
  stylename   CDATA #IMPLIED
  color       CDATA #IMPLIED
  width       CDATA #IMPLIED
  linepattern CDATA #IMPLIED
  unit.length CDATA #IMPLIED
  >

<!-- Face Style Element -->
<!-- Encodes the reference style when rendering faces or sides -->
<!-- FaceStyle (Invisible*)>
<!-- FaceStyle
  id          CDATA #IMPLIED
  stylename   CDATA #IMPLIED
  foregroundcolor CDATA #IMPLIED
  backgroundcolor CDATA #IMPLIED
  facepattern  CDATA #IMPLIED
  >

```

```

>

<!-- Text Style Element -->
<!-- Encodes the reference style when rendering text -->
<!ELEMENT TextStyle (Invisible*)>
<!ATTLIST TextStyle
    id                CDATA    #IMPLIED
    stylename         CDATA    #IMPLIED
    baseangle         CDATA    #IMPLIED
    foregroundcolor   CDATA    #IMPLIED
    backgroundcolor   CDATA    #IMPLIED
    displaysize       CDATA    #IMPLIED
    displaylowerlimit CDATA    #IMPLIED
    fontface          CDATA    #IMPLIED
    fontstyle         CDATA    #IMPLIED
    unit.angle        CDATA    #IMPLIED
    unit.length       CDATA    #IMPLIED
    disposition       (upperleft|lowerleft|upperright|lowerright|center) "lowerleft"
>

<!-- Symbol Style Element -->
<!-- Encodes the reference style when rendering symbols -->
<!ELEMENT SymbolStyle (Invisible*)>
<!ATTLIST SymbolStyle
    id                CDATA    #IMPLIED
    stylename         CDATA    #IMPLIED
    rotationangle     CDATA    #IMPLIED
    foregroundcolor   CDATA    #IMPLIED
    backgroundcolor   CDATA    #IMPLIED
    displaysize       CDATA    #IMPLIED
    displaylowerlimit CDATA    #IMPLIED
    unit.angle        CDATA    #IMPLIED
    unit.length       CDATA    #IMPLIED
>

<!-- Picture Style Element -->
<!-- Encodes the reference style when rendering pictures -->
<!ELEMENT PictureStyle EMPTY>
<!ATTLIST PictureStyle
    id                CDATA    #IMPLIED
    stylename         CDATA    #IMPLIED
    alphavalue        CDATA    #IMPLIED
>

<!-- Invisible Element -->
<!-- Encodes the state when the elements that compose geometry cannot -->
<!-- be visualized -->
<!ELEMENT Invisible EMPTY>
<!ATTLIST Invisible
    serialnumber      CDATA    #IMPLIED
>

<!-- Rendering Rule Element -->

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```

<!-- Encodes the Rendering Style Rule so that the user can easily      -->
<!-- understand via a computer system, the geospatial data described  -->
<!-- by G-XML                                                            -->
<!ELEMENT RenderingRule (
    PointStyle?, LineStyle?, FaceStyle?, TextStyle?,
    SymbolStyle?, PictureStyle?
)>
<!ATTLIST RenderingRule
    id                CDATA    #IMPLIED
    stylename         CDATA    #IMPLIED
    >

<!-- Rendering Rule List Element                                       -->
<!-- Encodes the list of rules of the referring rendering style when  -->
<!-- its applied to the geospatial data described by G-XML          -->
<!ELEMENT RenderingRuleList (ObjectReference*, RenderingRuleReference)>

<!-- Object Reference Element                                          -->
<!-- Encodes the reference condition of the geospatial data described -->
<!--by G-XML where the object applies to the rendering style rule    -->
<!ELEMENT ObjectReference (#PCDATA)>
<!ATTLIST ObjectReference
    objectreferencetype (xql|idreference|category)    "idreference"
    >

<!-- Rendering Rule Reference Element                                   -->
<!-- Encodes the reference conditions of the rendering style rule    -->
<!ELEMENT RenderingRuleReference (#PCDATA)>
<!ATTLIST RenderingRuleReference
    renderingrulereferencetype
        (idreference|stylename)    "idreference"
    >

```