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OGC Tile Matrix Set Standard Candidate

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Abstract

The OGC Tile Matrix Set standard defines the rules and requirements for a tile matrix set as a way to index space based on a set of regular grids defining a domain (tile matrix) (tile matrix) for a limited list of scales in a Coordinate Reference System (CRS) as defined in the OGC 08-015r2 Abstract Specification Topic 2: Spatial referencing by coordinates. Each tile matrix is divided into regular tiles. In tile matrix set, a tile can be univocally identified by a tile column a tile row and a tile matrix identifier. This document presents a data structure defining the properties of the tile matrix set, in both UML diagrams and in tabular form. This document also presents a data structure to define a subset of a tile matrix set where it is expected to find data. XML and JSON encodings are suggested both for tile matrix sets and tile matrix set limits. Finally, the document offers practical examples of tile matrix sets both for common global projections and for specific regions.

Keywords

The following are keywords to be used by search engines and document catalogues.

ogcdoc, OGC document, tiles, maps, tile matrix set

Preface

In 2007 OGC approved and released the Web Map Tile Service standard [OGC 07-057r7]. This OGC standard provides a definition of a Tile Matrix Set. Over time other OGC standards dealing with tiles in other ways needed to use the same definition. Unfortunately these OGC standards could not use the definition directly because it was formally linked to the tile service. This document frees the concept of a tile matrix set from the WMTS standards so that other standards can reference the concept directly. This standard also adds an informative list of commonly used tile matrix sets. We believe that others will emerge in the future. This document is anticipated to impact future revisions of other OGC standards such as GeoPackage.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. The Open Geospatial Consortium shall not be held responsible for identifying any or all such patent rights.

*Recipients of this document are requested to submit, with their comments, notification of any relevant patent claims or other intellectual property rights of which they may be aware that might be infringed by any implementation of the standard set forth in this document, and to provide supporting documentation.*

Security Considerations

The correct definition of a tile matrix set is crucial to be able to correctly geo-reference a tile. The application of the wrong tile matrix set could result in an incorrect geo-referencing of the tiles and the features represented in it. In an emergency situation this could result sending first responders to the wrong location.

In a normal service interaction, the client requests the TileMatrixSet once and requests one or more tiles afterwards. The client needs to ensure that the TileMatrixSet definition has not been tempered and corresponds to the correct one. In practice this means that the client and server must to use a mechanism to ensure that the service is really who claims to be and that the message that travels from the server to the client has not been altered.

If a server points to a definition of a TileMatrixSet that is hosted elsewhere, in addition to the precautions stated in before, the client must ensure that the service providing the definition of the TileMatrixSet is a trusted service. In addition, the synchronization of the tiles and the tile matrix set definition need to be ensured, guaranteeing that the tile matrix set definition has not been updated afterwards without the tile service knowing it.

Submitting organizations

The following organizations submitted this Document to the Open Geospatial Consortium (OGC):

UAB-CREAF

Image Matters LLC

Natural Resources Canada NRCan

Submitters

All questions regarding this submission should be directed to the editor or the submitters:

|  |  |
| --- | --- |
| Name | Affiliation |
| Joan Masó | UAB-CREAF |
| Jeff Yutzler | Image Matters LLC |
| Peter Rushforth | Canada Centre for Mapping and Earth Observation, Natural Resources Canada |

# Scope

This document specifies the concept of a tile matrix set and tile matrix set limits and its implementation in 2D space. This standard also provides both a XML and a JSON encoding. The Tile Matrix Set concept, initially developed in OGC Web Map Tile Service (WMTS) 1.0, is now provided as an independent standard that can be referenced by other standards such as WMTS 2.0 and GeoPackage, or the NRCan promoted standard candidate Map Markup Language (MapML). This document also contains an informative Annex with a library of proposed tile matrix set definitions for Mercator, Transverse Mercator, Polar Stereographic, Lambert Azimuthal Equal Area, and Lambert Conformal Conic.

# Conformance

This standard defines tile matrix set, tile matrix set limits and tile matrix set link.

Requirements for the following standardization target types are considered:

* TileMatrixSet2D: This abstract class defines a data model for tile matrix sets in 2D [http://www.opengis.net/spec/tilematrixset/1.0/req/tilematrixset2d]. This abstract class has a single conformance class: [http://www.opengis.net/spec/tilematrixset/1.0/conf/tilematrixset2d]
* TileMatrixSetLimits2D: This abstract class defines a data model for tile matrix sets limits in 2D [http://www.opengis.net/spec/tilematrixset/1.0/req/tilematrixsetlimits2d]. This abstract class has a single conformance class: [http://www.opengis.net/spec/tilematrixset/1.0/conf/tilematrixsetlimits2d]
* TileMatrixSetLink2D: This abstract class defines a data model for tile matrix links in 2D [http://www.opengis.net/spec/tilematrixset/1.0/req/tilematrixsetlink2d]. This abstract class has a single conformance class: [http://www.opengis.net/spec/tilematrixset/1.0/conf/tilematrixsetlink2d]
* XMLTileMatrixSet2D: This class defines a encoding in XML for tile matrix sets in 2D [http://www.opengis.net/spec/tilematrixset/1.0/req/xml-tilematrixset2d]. This class has a single conformance class: [http://www.opengis.net/spec/tilematrixset/1.0/conf/xml-tilematrixset2d]
* XMLTileMatrixSetLimits2D: This class defines a encoding in XML for tile matrix sets limits in 2D [http://www.opengis.net/spec/tilematrixset/1.0/req/xml-tilematrixsetlimits2d]. This class has a single conformance class: [http://www.opengis.net/spec/tilematrixset/1.0/conf/xml-tilematrixsetlimits2d]
* XMLTileMatrixSetLink2D: This class defines a encoding in XML for tile matrix links in 2D [http://www.opengis.net/spec/tilematrixset/1.0/req/xml-tilematrixsetlink2d]. This class has a single conformance class: [http://www.opengis.net/spec/tilematrixset/1.0/conf/xml-tilematrixsetlink2d]
* JSONTileMatrixSet2D: This class defines a encoding in JSON for tile matrix sets in 2D [http://www.opengis.net/spec/tilematrixset/1.0/req/json-tilematrixset2d]. This class has a single conformance class: [http://www.opengis.net/spec/tilematrixset/1.0/conf/json-tilematrixset2d]
* JSONTileMatrixSetLimits2D: This class defines a encoding in JSON for tile matrix sets limits in 2D [http://www.opengis.net/spec/tilematrixset/1.0/req/json-tilematrixsetlimits2d]. This class has a single conformance class: [http://www.opengis.net/spec/tilematrixset/1.0/conf/json-tilematrixsetlimits2d]
* JSONTileMatrixSetLink2D: This class defines a encoding in JSON for tile matrix links in 2D [http://www.opengis.net/spec/tilematrixset/1.0/req/json-tilematrixsetlink2d]. This class has a single conformance class: [http://www.opengis.net/spec/tilematrixset/1.0/conf/json-tilematrixsetlink2d]
* JSONLDTileMatrixSet2D: This class defines a encoding in JSON-LD for tile matrix sets in 2D [http://www.opengis.net/spec/tilematrixset/1.0/req/jsonld-tilematrixset2d]. This class has a single conformance class: [http://www.opengis.net/spec/tilematrixset/1.0/conf/jsonld-tilematrixset2d]
* JSONLDTileMatrixSetLimits2D: This class defines a encoding in JSON-LD for tile matrix sets limits in 2D [http://www.opengis.net/spec/tilematrixset/1.0/req/jsonld-tilematrixsetlimits2d]. This class has a single conformance class: [http://www.opengis.net/spec/tilematrixset/1.0/conf/jsonld-tilematrixsetlimits2d]
* JSONLDTileMatrixSetLink2D: This class defines a encoding in JSON-LD for tile matrix links in 2D [http://www.opengis.net/spec/tilematrixset/1.0/req/jsonld-tilematrixsetlink2d]. This class has a single conformance class: [http://www.opengis.net/spec/tilematrixset/1.0/conf/jsonld-tilematrixsetlink2d]

Conformance with this standard shall be verified using all the relevant tests specified in Annex A (normative) of this document. The framework, concepts, and methodology for testing, and the criteria to be achieved to claim conformance are specified in the OGC Compliance Testing Policies and Procedures and the OGC Compliance Testing web site[[1]](#footnote-1).

All requirements-classes and conformance-classes described in this document are owned by the standard(s) identified.

# References

The following normative documents contain provisions that, through references in this text, constitute provisions of this document. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the normative document referred to applies.

1. OGC 06-121r9 Web Service Common Implementation Specification, version 2.0 http://portal.opengeospatial.org/files/?artifact\_id=38867
2. OGC 08-015r2 Abstract Specification Topic 2: Spatial referencing by coordinates. http://portal.opengeospatial.org/files/?artifact\_id=39049
3. OGC 09-146r6 Coverage Implementation Schema ("CIS") Version 1.1. http://docs.opengeospatial.org/is/09-146r6/09-146r6.html
4. IETF RFC7159, The JavaScript Object Notation (JSON) Data Interchange Format. <https://www.ietf.org/rfc/rfc7159.txt>
5. W3C JSON-LD 1.0, A JSON-based Serialization for Linked Data. <http://www.w3.org/TR/json-ld/>

# Terms and Definitions

This document uses the terms defined in Sub-clause 5.3 of [OGC 06-121r9], which is based on the ISO/IEC Directives, Part 2, Rules for the structure and drafting of International Standards. In particular, the word “shall” (not “must”) is the verb form used to indicate a requirement to be strictly followed to conform to this standard.

For the purposes of this document, the following additional terms and definitions apply:

coordinate reference system

coordinate system that is related to the real world by a datum [ISO 19111]



coordinate system

set of mathematical rules for specifying how coordinates are to be assigned to points [ISO 19111]

1. domain

well-defined set [ISO/TS 19103:2005]

NOTE A mathematical function may be defined on this set, i.e. in a function f:A-->B, A is the domain of the function f.

grid

network composed of two or more sets of curves in which the members of each set intersect the members of the other sets in an algorithmic way [ISO 19123:2005]

NOTE The curves partition a space into grid cells.

range set

set of all values a function f can take as its arguments vary over its domain [OGC 07-036]

regular grid

grid whose grid lines have a constant distance along each grid axis [OGC 09-146r6]



tile

a rectangular pictorial representation of geographic data, often part of a set of such elements, covering a spatially contiguous extent and sharing similar information content and graphical styling, which can be uniquely defined by a pair of indices for the column and row along with an identifier for the tile matrix.



tile matrix

a regular grid defined on top of a more detailed raster regular grid that groups matrices of cells into tiles. Also, all tiles corresponding to a fixed scale.



tile matrix set

a collection of tile matrices defined at all different scales

well-known scale set

a well-known combination of a coordinate reference system and a set of scales that a tile matrix set declares support for

# Conventions

This sections provides details and examples for any conventions used in the document. Examples of conventions are symbols, abbreviations, use of XML schema, or special notes regarding how to read the document.

## Identifiers

The normative provisions in this specification are denoted by the URI

http://www.opengis.net/spec/TileMatrixSet/1.0

All requirements and conformance tests that appear in this document are denoted by partial URIs which are relative to this base.

# Tile Matrix Set concept

As stated in OGC 08-015r2 Abstract Specification Topic 2: Spatial referencing by coordinates, a coordinate system is a set of mathematical rules for specifying how coordinates are to be assigned to points in space. A Coordinate Reference System (CRS) is a coordinate system that is related to the real world by a reference datum. An example of mathematical rules is the application of a sphere or an ellipsoid centered in the datum and the use of a projection to transform the sphere or the ellipsoid into a planar representation of the world. Usually, the resulting planar coordinates are expressed as real numbers that express distances to the origin of the projection. This section introduces how a Tile Matrix Set is defined on top of a CRS.

## Tile Matrix

A Tile Matrix is defined on top of a regular grid coverage. The [OGC 09-146r6] CIS GeneralGridCoverage the domain set of a grid describes the direct positions in multi-dimensional coordinate space, depending on the type of grid. In the class grid-regular, simple equidistant grids are established. When a regular grid coverage is used to represent the world, the space becomes discrete in each dimension of the grid in a *domain range*; e.g. it divided into regular intervals that can be assigned to integer numbers that enumerate and identify *grid cells*. This regular grid domain range can be defined by:

1. The extreme corner (called top left corner in a two dimensional space) of the bounding box of regular grid coverage (*e.g*, the CRS coordinates of the top left corner of the top left extreme where the integer coordinates are 0).
2. A scale (or scale denominator) that determines the grid spacing size in each dimension.

The scale denominator is defined here with respect to a "standardized rendering pixel size" of 0.28 mm × 0.28 mm (millimeters). The definition is the same as used in Web Map Service WMS 1.3.0 [OGC 06-042] and in Symbology Encoding (SE) Implementation Specification 1.1.0 [OGC 05-077r4] and later adopted by WMTS 1.0 [OGC 07-057r7]. Frequently, the true pixel size is unknown and 0.28 mm is a common actual size of the common displays in 2005. This value is still being used as reference even if current display devices are built with pixel sizes much smaller.

NOTE Since the 1980s, the Microsoft Windows operating system has set the default display pixels per inch (PPI) to 96. This value results in an approximated 0.264 mm per pixel. The similarity of this value with the actual 0.28 mm adopted in this standard can create some confusion.

If the size of the grid spacing is small and the bounding box of the area to covert is large, the resulting file format that contains the *range set* (i.e. the set of all values corresponding to the grid cells covering its domain) becomes impractically too big to be transmitted as a single file e.g. for visualization purposes. This is especially true when only a small fragment is to be represented on the screen.

The solution described in this document is to define another regular tile grid that is coincident with the original regular grid coverage domain range but more coarse (with bigger cell size). Each grid cell of this new lower resolution grid is called a *tile* and the new grid is called a *Tile Matrix*. The Tile Matrix is defined by regularly grouping equal number of original grid cells into tiles. The Tile Matrix space is defined by:

1. The same top left corner as the original grid.
2. The size of each tile expressed in the number of division of the original grid. 256 or 512 are common grouping values. Frequently the sizes of the two first dimensions are called tile width and tile height.
3. The size of the tile matrix in tile units (*i.e.*, number of tiles) that closes the bounding box of the space. Frequently the sizes of the two first dimensions are called matrix width and matrix height.

### Tile matrix in a two dimensional space

For the case of a two dimensional space, given the top left point of the tile matrix in CRS coordinates (tileMatrixMinX, tileMatrixMaxY), the width and height of the tile matrix in tile units (matrixWidth, matrixHeight), the width and height of a tile (tileWidth, tileHeight) in original grid cells (often referred to as pixels),, the coefficient to convert the coordinate reference system (CRS) units into meters (metersPerUnit) and the scale (1:scaleDenominator), the bottom right corner of the bounding box of a tile matrix (tileMatrixMaxX, tileMatrixMinY) can be calculated as follows:

*pixelSpan = scaleDenominator* × *0.28 10-3 / metersPerUnit(crs);*

*tileSpanX = tileWidth* × *pixelSpan;*

*tileSpanY = tileHeight* × *pixelSpan;*

*tileMatrixMaxX = tileMatrixMinX + tileSpanX* × *matrixWidth;*

*tileMatrixMinY = tileMatrixMaxY - tileSpanY* × *matrixHeight;*

The tile space therefore looks like this:

TileMatrixMinX

Tile indices (TileCol,TileRow)

TileRow axis

TileMatrixMaxY

TopLeftCorner

TileMatrixMaxX

TileMatrixMinY

TileCol axis

0,0

1,0

...

0,1

1,1

...

MatrixWidth-1,1

...

...

...

...

MatrixWidth-1, ‌MatrixHeight-1

1,   
MatrixHeight-1

...

0,   
MatrixHeight-1

TileWidth  
(in pixels)

TileHeight  
(in pixels)

MatrixWidth-1,0

Figure — Tile Space

Each tile in a tile matrix is identified by its TileCol and TileRow indices that have their 0,0 origin in the tile next to the top left corner of the tile matrix and that increases towards the right and towards the bottom respectively, as shown in Figure 1. Annex G in this document includes pseudo code that illustrates the process for obtaining the tile indices that cover a bounding box rectangle and also the computation to get the CRS coordinates that bound a tile.

NOTE 1 Non-square pixels are not supported. This is different from WMS, which does allow non-square pixels (although many implementations fail to support this properly).

## Tile Matrix Set

Depending on the range of scales needed to be represented in the screen of a client, a single tile matrix is impractical and might force the software to spend too much time simplifying the dataset prior to rendering.

Commonly, several tile matrices are progressively defined covering the expected ranges of scales needed for the application. A *Tile Matrix Set* is composed of a collection of tile matrices, each one with a cell size (scale) optimized for a particular scale and identified by a tile matrix identifier. Each Tile Matrix Set has an optional approximated bounding box but each tile matrix has an exact bounding box that is deduced indirectly from other parameters. Tile matrix bounding boxes at each scale will usually vary slightly due to their pixel alignment.

Coarse resolution  
Highest scale denominator

Detailed resolution  
Lowest scale denominator

Figure — Tile Matrix Set representation

A Tile Matrix has a unique alphanumeric identifier in the Tile Matrix Set. Some tile based implementations prefer to use a *zoom level* number which has the advantage of suggesting some order in the list of tile matrices. This standard does not user the *zoom level* concept but, to ease adoption of this standard, many Tile Matrix Sets defined in Annex D use numbers as Tile Matrix identifiers. If this is not the case, the order in the list of tile matrices defined in a Tile Matrix Set could still be used as a *zoom level* orderinginternally.

In some other standards, this way of dividing the space is called *image pyramid* like in clause 11.6 of the OGC KML 2.2 [OGC 07-147r2]. JPEG2000 (ISO/IEC 15444-1) and JPIP (ISO/IEC 15444-9) also use a similar division of the space called *resolution levels*. Nevertheless, in those cases the pyramid is self defined starting from the more detailed tile matrix that uses square tiles, and constructing tiles of the next scales by successively aggregating 4 tiles of the previous scale and so on (see Figure 2). That approach involves a more rigid structure which has scales related by powers of two and tiles that perfectly overlap tiles on the inferior scale denominators. Tile Matrix Sets presented in this document are more flexible but include KML *superoverlays* or JPEG2000 based implementations that can use this document standard with some extra rules to describe their tile matrix sets. Actually, this document describes some tile matrix sets with scale sets related by powers of two in the Annex D.

Each of the WMTS procedure oriented architectural style operations and resource oriented architectural style resources are described in more detail in subsequent clauses in this standard.

NOTE 2 Clients and servers have to be careful when comparing floating numbers with tolerance (double precision, 16 digit numbers, has to be used).

## Well-known scale sets

When overlaying and presenting tiles encoded in different tile matrix sets in an integrated client, rescaling of tiles to the common scale of the view might result in re-sampling calculations that result visual quality degradation. To prevent this situation a common coordinate reference system and a common set of scales shared by as many layers and services as possible is desirable. Thus, this standard defines the concept of well-known scale sets.

Note that a well-known scale set only defines a small subset of what is needed to completely define a Tile Matrix Set. A well-known scale set is an optional feature that does not replace the need to define the Tile Matrix Set and its Tile Matrices. The original purpose of well-known scale set might not be longer necessary if services start referencing common Tile Matrix Sets such as the ones in Annex D.

A Well-Known Scale Set (WKSS) is a commonly used combination of a CRS and a set of scales. A tile matrix set can declare support for a well-know scale set by referencing if. A client application can confirm that tiles in one tile matrix set are compatible with tiles in another tile matrix set merely by verifying that they declare a common well-known scale set. The informative Annex C provides several well-known scale sets and others could be incorporated in the future.

A tile matrix set conforms to a particular well-known scale set when it uses the same CRS and defines all scale denominators ranging from the largest scale denominator in the well-known scale set to some low scale denominator (in other words, it is not necessary to define all the lower scale denominators to conform to a well-known scale set).

## Tile based coordinates in a tile matrix set

A tile in a tile based coordinate can be referred by its tile position in the tile matrix dimensions and the tile matrix identifier in tile matrix set. In a two dimension space, a tile is identified by these 3 discrete values: tile row, tile column and tile matrix identifier.

A grid cell in a tile matrix set can be identified in two ways:

* By the tile indices the grid cell is contained by (referred by its tile position in the tile matrix dimensions and the Tile Matrix identifier in the Tile Matrix Set) and the position inside the tile. In a two dimension space, a tile is identified by these 5 discrete values: tile row, tile column, tile matrix identifier, i and j. This is how GetFeatureInfo works in WMTS. We call them “*tile*” coordinates.
* By position of the cell in the original grid of the tile matrix and the identifier of the Tile Matrix in Tile Matrix Set. In a two dimension space, a grid cell is identified by these 3 discrete values: i′, j′ and tile matrix identifier. Note that i′ and j′ can be very big numbers and for very detailed scale tile matrices might require integer 64 bit notation if stored as binary numbers. We call them “*tilematrix*” coordinates.

Tile indices (TileCol,TileRow)

TileRow axis

TileCol axis

2,1

*i*= 209

*j*=164

TileRow axis

TileCol axis

*i*′=2\* 256+209

*j*′=1\*192+164

TileWidth=256

TileHeight=192

Tile matrix identifier = “ZoomLevel3”

a)

b)

Figure —Tile coordinates (a) and Tile matrix coordinates (b) to identify grid cells

## Tile matrix set limits

If the tile matrix set for a dataset covering a bounding box defines the extreme corner adjusted to the actual content of this dataset, and later the bounding box needs to be extended, then the extreme corner of each TileMatrix will change and that will end up changing the tile indices of any previous tile invalidating any previously cached tile. To overcome this problem, a dataset can optionally use a more generic TileMatrixSet that covers a bigger (or even global) area. In fact, that TileMatrixSet that defines an area that might be covered by the dataset in a future could easily be shared for many datasets and become a common TileMatrixSet.

To inform the client about the valid range of tile indices, the TileMatrixSetLimits concept is introduced. TileMatrixSetLimits informs that the minimum and a maximum limits of these indices for each TileMatrix that contains actual data. The area outside these limits is considered empty space.

TileMatrixMinX

TileMatrixMaxY

TopLeftCorner

TileMatrixMaxX

TileMatrixMinY

0,0

1,0

MatrixWidth-1,0

0,1

1,1

MatrixWidth-1,1

...

...

MatrixWidth-1, ‌MatrixHeight-1

...

0,   
MatrixHeight-1

minTileCol‌minTileRow

maxTileCol‌maxTileRow

**2,2**

**5,4**

Figure —TileMatrix Limits

# TileMatrixSet2D model

## TileMatrixSet2D requirements class

Requirements class tilematrixset2D establishes how to describe a TileMatrixSet for a two-dimensional tile space. It is expected that tile matrix sets are defined once and that data structured in tiles will declare the usage of a tile matrix set by linking to it. The identifying URI for this class is http://www.opengis.net/spec/tilematrixset/1.0/req/tilematrixset2d.

1. **req/tilematrixset2d/model:**  
   A tile matrix set 2D *shall* be defined following the UML model as shown in Figure 1 and the model description in Table 1 and Table 2.  
   **Dependency**: [http://www.opengis.net/spec/owscommon/2.0/req](http://www.opengis.net/spec/wmts/1.0/req)



Figure — TileMatrixSet UML model

The structure in Table 1 defines the structure of the TileMatrixSet.

Table — Parts of TileMatrixSet data structure

| **Names** | **Definition** | **Data type and values** | **Multiplicity and use** |
| --- | --- | --- | --- |
| identifier  Identifier | Tile matrix set identifier g | ows:CodeType, as adaptation of MD\_Identifier class ISO 19115 | One (mandatory) |
| title a  Title | Title of this tile matrix set, normally used for display to a human | LanguageString data structure, see Figure 15 in OWS Common [OGC 06-121r9] | Zero or more (optional) Include when available and useful  Include one for each language represented f |
| abstract a  Abstract | Brief narrative description of this tile matrix set, normally available for display to a human | LanguageString data structure, see Figure 15 in OWS Common [OGC 06-121r9] | Zero or more (optional) Include when available and useful  Include one for each language represented |
| keywordsa  Keywords | Unordered list of one or more commonly used or formalized word(s) or phrase(s) used to describe this dataset | MD\_Keywords class in ISO 19115 | Zero or more (optional)  One for each keyword authority used |
| bounding‌Box  Bounding‌Box | Minimum bounding rectangle surrounding the tile matrix set, in the supported CRS b | BoundingBox data structure, see subclause 10.2 of OWS Common [OGC 06-121r9] | Zero or one (optional) |
| supported‌CRS  Supported‌CRS | Reference to one coordinate reference system (CRS) | URI type | One (mandatory) |
| wellKnown‌ScaleSet  WellKnown‌ScaleSet | Reference to a well-known scale sete | URI type | Zero or one (optional) c |
| tileMatrix  TileMatrix | Describes a scale level and its tile matrix | TileMatrix data structure, see Table Table 2 | One or more (mandatory) d |
| a The multilingual scoping rules in subclause 10.7.3 of OWS Common [OGC 06-121r9] SHALL apply.  b It SHOULD NOT be used to calculate the position of the tiles in the CRS space; please use topLeftCorner of the corresponding TileMatrix instead. If available, it represents the area where the data is expected to be represented. This does not necessarily indicate a complete tile boundary (and therefore does not necessarily include the TopLeftCorner of the tile matrices).  c When a tile matrix set conforms to a well-known scale set it SHOULD reference it by its URI. The well-known scale set SHALL be consistent with the supportedCRS and with the scaleDenominators of the tileMatrix parameters.  d Commonly more than one. Each tileMatrix of a tileMatrixSet SHALL have a unique (different) scaleDenominator  e Some possible values are defined the in Annex C  f If no Title is specified, a client may display the Identifier value instead  g TileMatrixSet identifies SHALL be unique (different) for each TileMatrixSet of a server | | | |

Table — Parts of TileMatrix data structure

| **Names** | **Definition** | **Data type and values** | **Multiplicity and use** |
| --- | --- | --- | --- |
| identifier  Identifier | Tile matrix identifier c | ows:CodeType, as adaptation of MD\_Identifier class ISO 19115 | One (mandatory) |
| title a  Title | Title of this style, normally used for display to a human | LanguageString data structure, see Figure 15 in OWS Common [OGC 06-121r9] | Zero or more (optional) Include when available and useful  Include one for each language represented d |
| abstract a  Abstract | Brief narrative description of this style, normally available for display to a human | LanguageString data structure, see Figure 15 in OWS Common [OGC 06-121r9] | Zero or more (optional) Include when available and useful  Include one for each language represented |
| keywordsc  Keywords | Unordered list of one or more commonly used or formalized word(s) or phrase(s) used to describe this dataset | MD\_Keywords class in ISO 19115 | Zero or more (optional)  One for each keyword authority used |
| scale‌Denominator  Scale‌Denominator | Scale denominator level of this tile matrix g | Double type | One (mandatory) |
| topLeft‌Corner  TopLeft‌Corner | Position in CRS coordinates of the top-left corner of this tile matrix | Ordered sequence of double values b | One (mandatory) |
| tileWidth  TileWidth | Width of each tile of this tile matrix in pixels | Positive integer type | One (mandatory) |
| tileHeight  TileHeight | Height of each tile of this tile matrix in pixels | Positive integer type | One (mandatory) |
| matrix‌Width  Matrix‌Width | Width of the matrix (number of tiles in width) | Positive integer type | One (mandatory) |
| matrix‌Height  Matrix‌Height | Height of the matrix (number of tiles in height) | Positive integer type | One (mandatory) |
| a The multilingual scoping rules in subclause 10.7.3 of OWS Common [OGC 06-121r9] SHALL apply.  b CRS will be inherited from the supportedCRS parameter of the parent TileMatrixSet. The order of these axes shall be as specified by the supportedCRS. These are the precise coordinates of the top left corner of top left pixel of the 0,0 tile. See Figure 1.  c This TileMatrix identifiers SHALL be unique (different) within the context of the parent TileMatrixSet. Many applications use a correlative numeric value as an identifier. Other alternatives are a rounded scale denominator or a rounded pixel size. We recommend avoiding repeating the TileMatrixSet identifier as part of the TileMatrix identifier.  d If no Title is specified, client may display the Identifier value instead.  e In XML schemas ows:PositionType data type is used. See OWS 2.0 schemas (owsCommon.xsd)  g The pixel size of the tile can be obtained from the scaleDenominator by multiplying the later by 0.28 10-3 / metersPerUnit. If the CRS uses *meters* as units of measure for the horizontal dimensions, then metersPerUnit=1; if it has degrees, then metersPerUnit=2π*a*/360 (*a* is the Earth maximum radius of the ellipsoid). | | | |

NOTE 1 It may be desirable to define a tile matrix set with some general-scale tile matrices in one CRS (*e.g.*, CRS:84) and with detailed-scale tile matrices in a different CRS (*e.g.*, LCC projection). However, this standard does not allow this. Each tile matrix set declares a single CRS. You could define two tile matrix sets for the same layer instead.

NOTE 2 The width (matrixWidth) and height (matrixHeith) in tiles of each tile matrix is explicitly given, so the range of relevant tile indexes does not have to be calculated by the client application.

NOTE 3 The bounding box of a tile matrix is not supplied explicitly because it can be calculated from topLeftCorner, tileWidth, tileHeight and scaleDenominator.

1. **req/tilematrixset2d/identifier:**  
   A tiled resource or dataset structured *shall* link to the tile matrix set definition citing tile matrix set identifier indicated in Table 1 or a URI to a tile matrix set definition.

NOTE 4 To determine if two resources or datasets use the same TileMatrixSet, we can compare their TileMatrixSet identifier. Alternatively, we can compare TileMatrixSet definitions for an equivalency (a simple calculation can be performed to verify whether or not two given tile matrices are aligned).

## TileMatrixSetLimits2D requirements class

Requirements class tilematrixsetlimits2D establishes how to describe a TileMatrixSetLimits for a two-dimensional tile space. It is expected that tile matrix sets are defined in a general way (globally if possible). Data structured in tiles could only be available in a region of in a subset of scales. This data structure allow for the declaration of a limited coverage of a tile matrix set. The identifying URI for this class is http://www.opengis.net/spec/tilematrixset/1.0/req/tilematrixsetlimits2d.

1. **req/tilematrixsetlimits2d/model:**  
   A tile matrix set limits 2D *shall* be defined following the UML model as shown in Figure 6 and model description in Table 3 and Table 4.  
   **Dependency**: [http://www.opengis.net/spec/owscommon/2.0/req](http://www.opengis.net/spec/wmts/1.0/req)



Figure — TileMatrixSetLimits UML model

Table — Parts of TileMatrixSetLimits data structure

| **Names** | **Definition** | **Data type and values** | **Multiplicity and use** |
| --- | --- | --- | --- |
| tileMatrix‌Limits  Tile‌Matrix‌Limits | Indices limits for this tileMatrix | TileMatrixLimits data structure, see Table Table 4 | one or more (mandatory) a |
| a Multiplicity SHALL be the multiplicity of tileMatrix this tileMatrixSet. | | | |

Table — Parts of TileMatrixLimits data structure

| **Names** | **Definition** | **Data type and values** | **Multiplicity and use** |
| --- | --- | --- | --- |
| tileMatrix  TileMatrix | Reference to a tileMatrix identifier | URI type  Values defined in service metadata a | One (mandatory) |
| minTile‌Row  MinTile‌Row | Minimum tile row index valid for this layer. | Non negative integer type b | One (mandatory) |
| maxTile‌Row  MaxTile‌Row | Maximim tile row index valid for this layer. | Non negative integer type c | One (mandatory) |
| minTile‌Col  MinTile‌Col | Minimum tile column index valid for this layer. | Non negative integer type d | One (mandatory) |
| maxTile‌Col  MaxTile‌Col | Maximim tile column index valid for this layer. | Non negative integer type e | One (mandatory) |
| a URI SHALL be an identifier to a tileMatrix section of this tileMatrixSet for this layer.  b From 0 to maxTileRow  c From minTileRow to matrixWidth-1 of the tileMatrix section of this tileMatrixSet  d From 0 to maxTileCol  e From minTileCol to tileHeight-1 of the tileMatrix section of this tileMatrixSet | | | |

## TileMatrixSetLink2D requirements class

Requirements class tilematrixsetlink2D establishes how to describe a TileMatrixSetLink for a two-dimensional tile space. This data structure allows for a dataset declaring the use of a tile matrix set defined elsewhere and, if needed, a limited coverage for this tile matrix set. Each tiled dataset in a dataset collection should declare the use of a tile matrix set using this data structure. The identifying URI for this class is http://www.opengis.net/spec/tilematrixset/1.0/req/tilematrixsetlink2d.

1. **req/tilematrixsetlink2d/model:**  
   A tiled dataset *shall* declare the use of a tile matrix set 2D or a part of it using atile matrix set link 2D following the UML model as shown in Figure 6 and model description in Table 5.  
   **Dependency**: req/tilematrixsetlimits



Figure — TileMatrixSetLimits UML model

Table — Parts of TileMatrixSetLink data structure

| **Names** | **Definition** | **Data type and values** | **Multiplicity and use** |
| --- | --- | --- | --- |
| tileMatrix‌Set  Tile‌Matrix‌Set | Reference to a tileMatrixSet | URI type  Values SHALL be an tileMatrixSet identifieir in service metadata document | One (mandatory) |
| tileMatrix‌Set‌Limits  Tile‌Matrix‌Set‌Limits | Index limits for this tileMatrixSet | TileMatrixSetLimits data structure, see | Zero or more (optional) Should be include when the boundary of the data is a fragment of the boundary of the tileMatrixSet a,b |
| a The absence of this parameter means that tile row and tile column indices are only limited by 0 and the corresponding matrixWidth and matrixHeight for each tileMatrix of the tileMatrixSet definition.  b Multiplicity more than one allows to defined more than one rectangular areas where there are tiles with data available. | | | |

1. **req/tilematrixsetlink2D/identifier:**  
   The TileMatrixSet2D URI in TileMatrixSetLink2D *shall* be a citation of a tile matrix set identifier of a tile matrix set defined in the same document instance or an active (resolvable) link to a TileMatrixSet definition in an external document.

Linking to the TileMatrixSet URIs defined in the Annex D, in a OGC schema repository, or in a OGC registry are valid options for TileMatrixSet URIs.

# XML encoding

## XMLTileMatrixSet2D requirements class

The identifying URI for this class is http://www.opengis.net/spec/tilematrixset/1.0/req/xml-tilematrixset2d.

1. **req/xml-tilematrixset2d/model:**  
   A TileMatrixSet2D encoded in XML *shall* implement the class TileMatrixSet2D  
   **Dependency:** req/tilematrixset2d.
2. **req/xml-tilematrixset2d/schema:**  
   A TileMatrixSet2D encoded in XML *shall* validate using the XML schema for a tile matrix set 2D.
3. **req/json-tilematrixset2d/mimetype:**  
   A TileMatrixSet2D encoded in an independent JSON document *shall* use the MIME type application/json.

NOTE: A TileMatrixSet2D description can be embedded in other file formats, such as a Service Metadata document of a WMTS service. In this case, the MIME type of the containing document prevails.

## XMLTileMatrixSetLimits2D requirements class

The identifying URI for this class is http://www.opengis.net/spec/tilematrixset/1.0/req/xml-tilematrixsetlimits2d.

1. **req/xml-tilematrixsetlimits2d/model:**  
   A TileMatrixSetLimits2d encoded in XML *shall* implement the class TileMatrixSetLimits2D  
   **Dependency:** req/tilematrixsetlimits2d.
2. **req/ xml-tilematrixsetlimits2d/schema:**  
   A TileMatrixSetLimits2D encoded in XML *shall* validate using the XML schemas for a tile matrix set limits 2D.

NOTE: A TileMatrixSetLimits2D description is normally used as embedded in other XML documents. That is the reason we do not provide a MIME Type associated with it.

## XML TileMatrixSetLink2D

The identifying URI for this class is http://www.opengis.net/spec/tilematrixset/1.0/req/xml-tilematrixsetlink2d.

1. **req/xml-tilematrixsetlimits2d/model:**  
   A TileMatrixSetLink2D encoded in XML *shall* implement the class TileMatrixSetLink2D  
   **Dependency:** req/tilematrixsetlink2d  
   **Dependency:** req/xml-tilematrixsetlimits2d.
2. **req/xml-tilematrixsetlink2d/schema:**  
   A TileMatrixSetLink2D encoded in XML *shall* validate using the XML schema for a tile matrix set link 2D.

NOTE: A TileMatrixSetLink2D description is normally used as embedded in other XML documents. That is the reason we do not provide a MIME Type associated with it.

# JSON encoding

## JSONTileMatrixSet2D

The identifying URI for this class is http://www.opengis.net/spec/tilematrixset/1.0/req/json-tilematrixset2d.

1. **req/json-tilematrixset2d/model:**  
   A TileMatrixSet2D encoded in JSON *shall* implement the class TileMatrixSet2D  
   **Dependency:** req/tilematrixset2d.
2. **req/json-tilematrixset2d/ietf:**  
   A TileMatrixSet2D encoded in JSON *shall* conform to IETF RFC7159
3. **req/json-tilematrixset2d/schema:**  
   A TileMatrixSet2D encoded in JSON *shall* validate using the JSON schema for a tile matrix set 2D.
4. **req/json-tilematrixset2d/mimetype:**  
   A TileMatrixSet2D encoded in an independent JSON document *shall* use the MIME type application/json.

NOTE: A TileMatrixSet2D description can be embedded in other file formats, such as a Service Metadata document of a WMTS service. In this case, the MIME type of the containing document prevails.

## JSON encoding of a TileMatrixSetLimits

The identifying URI for this class is http://www.opengis.net/spec/tilematrixset/1.0/req/json-tilematrixsetlimits2d.

1. **req/json-tilematrixsetlimits2d/model:**  
   A TileMatrixSetLimits2D encoded in JSON *shall* implement the class TileMatrixSetLimits2D  
   **Dependency:** req/tilematrixsetlimits2d.
2. **req/json-tilematrixsetlimits2d/ietf:**  
   A TileMatrixSetLimits2D encoded in JSON *shall* conform to IETF RFC7159
3. **req/json-tilematrixsetlimits2d/schema:**  
   A TileMatrixSetLimits2D encoded in JSON *shall* validate using the JSON schema for a tile matrix set limits 2D.

NOTE: A TileMatrixSetLimits2D description can be embedded in other file formats, such as a Service Metadata document of a WMTS service. In this case, the MIME type of the containing document prevails.

## JSON encoding of a TileMatrixSetLink

The identifying URI for this class is http://www.opengis.net/spec/tilematrixset/1.0/req/json-tilematrixsetlink2d.

1. **req/json-tilematrixsetlink2d/model:**  
   A TileMatrixSetLimits2D encoded in JSON *shall* implement the class TileMatrixSetLink2D  
   **Dependency:** req/tilematrixsetlink2d  
   **Dependency:** req/json-tilematrixsetlimits2d.
2. **req/json-tilematrixsetlink2d/ietf:**  
   A TileMatrixSetLink2D encoded in JSON *shall* conform to IETF RFC7159
3. **req/json-tilematrixsetlink2d/schema:**  
   A TileMatrixSetLink2D encoded in JSON *shall* validate using the JSON schema for a tile matrix set link 2D.

NOTE: A TileMatrixSetLink2D description can be embedded in other file formats, such as a Service Metadata document of a WMTS service. In this case, the MIME type of the containing document prevails.

# JSON-LD encoding

This section establishes how to connect the JSON encoding to linked data by providing a mapping between the JSON encoding and the RDF triples model using JSON-LD. In practice this means that a JSON file with some additional content defined in the JSON-LD syntax (http://www.w3.org/TR/json-ld) can be converted into RDF notation automatically using the JSON-LD API (http://www.w3.org/TR/json-ld-api). One implementation of this API is provided in the JSON-LD Playground (http://json-ld.org/playground/).

## JSON-LDTileMatrixSet2D

The identifying URI for this class is http://www.opengis.net/spec/tilematrixset/1.0/req/jsonld-tilematrixset2d.

1. **req/jsonld-tilematrixset2d/model:**  
   A TileMatrixSet2D encoded in JSON-LD *shall* implement the class TileMatrixSet2D  
   **Dependency:** req/tilematrixset2d.
2. **req/jsonld-tilematrixset2d/w3c:**  
   A TileMatrixSet2D encoded in JSON-LD *shall* conform to W3C JSON-LD syntax version 1.
3. **req/jsonld-tilematrixset2d/context:**  
   A TileMatrixSet2D encoded in JSON-LD *shall* include references to the JSON-LD @context for a tile matrix set 2D.
4. **req/jsonld-tilematrixset2d/mimetype:**  
   A TileMatrixSet2D encoded in an independent JSON-LD document *shall* use the MIME type application/jsonld.

NOTE: A TileMatrixSet2D description can be embedded in other file formats, such as a Service Metadata document of a WMTS service. In this case, the MIME type of the containing document prevails.

## JSON-LD encoding of a TileMatrixSetLimits

The identifying URI for this class is http://www.opengis.net/spec/tilematrixset/1.0/req/jsonld-tilematrixsetlimits2d.

1. **req/jsonld-tilematrixsetlimits2d/model:**  
   A TileMatrixSetLimits2D encoded in JSON-LD *shall* implement the class TileMatrixSetLimits2D  
   **Dependency:** req/tilematrixsetlimits2d.
2. **req/jsonld-tilematrixsetlimits2d/w3c:**  
   A TileMatrixSetLimits2D encoded in JSON-LD *shall* conform to W3C JSON-LD syntax version 1.
3. **req/jsonld-tilematrixsetlimits2d/context:**  
   A TileMatrixSetLimits2D encoded in JSON-LD *shall* include references to the @conted for a tile matrix set limits 2D.

NOTE: A TileMatrixSetLimits2D description can be embedded in other file formats, such as a Service Metadata document of a WMTS service. In this case, the MIME type of the containing document prevails.

## JSON-LD encoding of a TileMatrixSetLink

The identifying URI for this class is http://www.opengis.net/spec/tilematrixset/1.0/req/jsonld-tilematrixsetlink2d.

1. **req/jsonld-tilematrixsetlink2d/model:**  
   A TileMatrixSetLimits2D encoded in JSON-LD *shall* implement the class TileMatrixSetLink2D  
   **Dependency:** req/tilematrixsetlink2d  
   **Dependency:** req/json-tilematrixsetlimits2d.
2. **req/jsonld-tilematrixsetlink2d/w3c:**  
   A TileMatrixSetLink2D encoded in JSON-LD *shall* conform to W3C JSON-LD syntax version 1.
3. **req/jsonld-tilematrixsetlink2d/context:**  
   A TileMatrixSetLink2D encoded in JSON-LD *shall* include references to the @context for a tile matrix set link 2D.

NOTE: A TileMatrixSetLink2D description can be embedded in other file formats, such as a Service Metadata document of a WMTS service. In this case, the MIME type of the containing document prevails.

1. Conformance Class Abstract Test Suite (Normative)

A TileMatrixSet implementation of this standard must satisfy the following system characteristics to be conformant with this specification.

Conformance class: TileMatrixSet2D

The OGC URI identifier of this conformance class is:

http://www.opengis.net/spec/tilematrixset/1.0/conf/tilematrixset2d

Tests identifiers below are relative to http://www.opengis.net/spec/tilematrixset/1.0

* + 1. Model

|  |  |
| --- | --- |
| **Test id:** | **conf/tilematrixset2d/model** |
| **Test Purpose:** | **Req 1 req/tilematrixset2d/model:** A tile matrix set 2D *shall* be define following the UML model as shown in Figure 1 and model description in Table 1 and Table 2. **Dependency**: http://www.opengis.net/spec/owscommon/2.0/req |
| **Test method:** | Validate the requirements of the model  Test passes if TileMatrixSet2D instances point to the TileMatrixSet2D data type definition and follow the data model specified in Table 1 and Table 2 and its dependencies. |

* + 1. Identifier

|  |  |
| --- | --- |
| **Test id:** | **tilematrixset2d/identifier** |
| **Test Purpose:** | **Req 2 req/tilematrixset2d/identifier:** A tiled resource or dataset structured *shall* link to the tile matrix set definition citing tile matrix set identifier indicated in Table 1 or a URI to a tile matrix set definition. |
| **Test method:** | Validate the requirements of identifier  Test passes if all tiled resources in the instance cite a tile matrix set by mentioning at least one of the TileMatrixSet identifier or by using a URI. |

Conformance class: TileMatrixSetLimits2D

The OGC URI identifier of this conformance class is:

http://www.opengis.net/spec/tilematrixset/1.0/conf/tilematrixsetlimits2d

* + 1. Model

|  |  |
| --- | --- |
| **Test id:** | **tilematrixsetlimits2d/model** |
| **Test Purpose:** | **Req 3 req/tilematrixsetlimits2d/model:** A tile matrix set limits 2D *shall* be defined following the UML model as shown in Figure 6 and model description in Table 3 and Table 4. **Dependency**: http://www.opengis.net/spec/owscommon/2.0/req |
| **Test method:** | Validate the requirements of the model  Test passes if TileMatrixSetLimits2D instances point to the TileMatrixSetLimits2D data type definition and follow the data model specified in Table 3 and Table 4 and its dependencies. |

Conformance class: TileMatrixSetLink2D

The OGC URI identifier of this conformance class is:

http://www.opengis.net/spec/tilematrixset/1.0/conf/tilematrixsetlink2d

* + 1. Model

|  |  |
| --- | --- |
| **Test id:** | **tilematrixsetlink2d/model** |
| **Test Purpose:** | **Req 4 req/tilematrixsetlink2d/model:** A tiled dataset *shall* declare the use of a tile matrix set 2D or a part of it using atile matrix set link 2D following the UML model as shown in Figure 6 and model description in Table 5 — Parts of TileMatrixSetLink data structureTable 5. **Dependency**: req/tilematrixsetlimits |
| **Test method:** | Validate the requirements of the model  Test passes if TileMatrixSetLink2D instances point to the TileMatrixSetLink2D data type definition and follow the data model specified in Table 5 and its dependencies. |

* + 1. Identifier

|  |  |
| --- | --- |
| **Test id:** | **tilematrixsetlink2d/identifier** |
| **Test Purpose:** | **Req 5 req/tilematrixsetlink2d/model:** A tiled dataset *shall* declare the use of a tile matrix set 2D or a part of it using atile matrix set link 2D following the UML model as shown in Figure 6 and model description in Table 5 — Parts of TileMatrixSetLink data structureTable 5. **Dependency**: req/tilematrixsetlimits |
| **Test method:** | Validate the requirements of the model  Test passes if all TileMatrixSetLink2D elements in the instance cite a tile matrix set by mentioning at least one TileMatrixSet identifier or by using a URI that can be resolved into a TileMatrixSet2D. |

Conformance class: XML Encoding forTileMatrixSet2D

The OGC URI identifier of this conformance class is:

http://www.opengis.net/spec/tilematrixset/1.0/conf/xml-tilematrixset2d

* + 1. Model

|  |  |
| --- | --- |
| **Test id:** | **xml-tilematrixset2d/model** |
| **Test Purpose:** | **Req 6 req/xml-tilematrixset2d/model:** A TileMatrixSet2D encoded in XML *shall* implement the class TileMatrixSet2D **Dependency:** req/tilematrixset2d. |
| **Test method:** | Validate the requirements of the model  Test passes if TileMatrixSet2D instances use a TileMatrixSet2D XML data type definition that follows the data model specified in Table 1 and Table 2 and its dependencies. |

* + 1. Schema

|  |  |
| --- | --- |
| **Test id:** | **xml-tilematrixset2d/schema** |
| **Test Purpose:** | **Req 7 req/xml-tilematrixset2d/schema:** A TileMatrixSet2D encoded in XML *shall* validate using the XML schema for a tile matrix set 2D. |
| **Test method:** | Validate the requirements of the model  Test passes if TileMatrixSet2D XML instances pass validation against the tile matrix set 2D XML Schemas. |

* + 1. MIME type

|  |  |
| --- | --- |
| **Test id:** | **xml-tilematrixset2d/mimetype** |
| **Test Purpose:** | **Req 8 req/json-tilematrixset2d/mimetype:** A TileMatrixSet2D encoded in an independent JSON document *shall* use the MIME type application/json. |
| **Test method:** | Validate the requirements of the mime type  Test passes if the independent instances of TileMatrixSet2D are exposed as application/xml MIME type. |

Conformance class: XML Encoding forTileMatrixSetLimits2D

The OGC URI identifier of this conformance class is:

http://www.opengis.net/spec/tilematrixset/1.0/conf/xml-tilematrixsetlimits2d

* + 1. Model

|  |  |
| --- | --- |
| **Test id:** | **xml-tilematrixsetlimits2d/model** |
| **Test Purpose:** | **Req 9 req/xml-tilematrixsetlimits2d/model:** A TileMatrixSetLimits2d encoded in XML *shall* implement the class TileMatrixSetLimits2D **Dependency:** req/tilematrixsetlimits2d. |
| **Test method:** | Validate the requirements of the model  Test passes if TileMatrixSetLimits2D instances point to the TileMatrixSetLimits2D data type definition and follow the data model specified in Table 3 and Table 4 and its dependencies. |

* + 1. Schema

|  |  |
| --- | --- |
| **Test id:** | **xml-tilematrixsetlimits2d/schema** |
| **Test Purpose:** | **Req 10 req/ xml-tilematrixsetlimits2d/schema:** A TileMatrixSetLimits2D encoded in XML *shall* validate using the XML schemas for a tile matrix set limits 2D. |
| **Test method:** | Validate the requirements of the schema  Test passes if TileMatrixSetLimits2D XML instances pass validation against the tile matrix set limits 2D XML Schemas. |

Conformance class: XML Encoding forTileMatrixSetLink2D

The OGC URI identifier of this conformance class is:

http://www.opengis.net/spec/tilematrixset/1.0/conf/xml-tilematrixsetlink2d

* + 1. Model

|  |  |
| --- | --- |
| **Test id:** | **xml-tilematrixsetlink2d/model** |
| **Test Purpose:** | **Req 11 req/xml-tilematrixsetlimits2d/model:** A TileMatrixSetLink2D encoded in XML *shall* implement the class TileMatrixSetLink2D **Dependency:** req/tilematrixsetlink2d **Dependency:** req/xml-tilematrixsetlimits2d. |
| **Test method:** | Validate the requirements of the model  Test passes if TileMatrixSetLink2D instances use a TileMatrixSetLink2D XML data type definition that follows the data model specified in Table 5 and its dependencies. |

* + 1. Schema

|  |  |
| --- | --- |
| **Test id:** | **xml-tilematrixsetlink2d/schema** |
| **Test Purpose:** | **Req 12 req/xml-tilematrixsetlink2d/schema:** A TileMatrixSetLink2D encoded in XML *shall* validate using the XML schema for a tile matrix set link 2D. |
| **Test method:** | Validate the requirements of the model  Test passes if TileMatrixSetLink2D XML instances pass validation against the tile matrix set link 2D XML Schemas. |

Conformance class: JSON Encoding forTileMatrixSet2D

The OGC URI identifier of this conformance class is:

http://www.opengis.net/spec/tilematrixset/1.0/conf/json-tilematrixset2d

* + 1. Model

|  |  |
| --- | --- |
| **Test id:** | **json-tilematrixset2d/model** |
| **Test Purpose:** | **Req 13 req/xml-tilematrixset2d/model:** A TileMatrixSet2D encoded in XML *shall* implement the class TileMatrixSet2D **Dependency:** req/tilematrixset2d. |
| **Test method:** | Validate the requirements of the model  Test passes if TileMatrixSet2D instances follow the data model specified in Table 1 and Table 2 and its dependencies. |

* + 1. IETF

|  |  |
| --- | --- |
| **Test id:** | **json-tilematrixset2d/ietf** |
| **Test Purpose:** | **Req 14 req/json-tilematrixset2d/ietf:** A TileMatrixSet2D encoded in JSON *shall* conform to IETF RFC7159 |
| **Test method:** | Validate the requirements of the IETF  Test passes if TileMatrixSet2D JSON instances pass format validation against the IETF rules. |

* + 1. Schema

|  |  |
| --- | --- |
| **Test id:** | **json-tilematrixset2d/schema** |
| **Test Purpose:** | **Req 15 req/json-tilematrixset2d/schema:** A TileMatrixSet2D encoded in JSON *shall* validate using the JSON schema for a tile matrix set 2D. |
| **Test method:** | Validate the requirements of the model  Test passes if TileMatrixSet2D JSON instances pass validation against the tile matrix set 2D JSON Schemas. |

* + 1. MIME type

|  |  |
| --- | --- |
| **Test id:** | **json-tilematrixset2d/mimetype** |
| **Test Purpose:** | **Req 16 req/json-tilematrixset2d/mimetype:** A TileMatrixSet2D encoded in an independent JSON document *shall* use the MIME type application/json. |
| **Test method:** | Validate the requirements of the mime type  Test passes if the independent instances of TileMatrixSet2D are exposed as application/json MIME type. |

Conformance class: JSON Encoding forTileMatrixSetLimits2D

The OGC URI identifier of this conformance class is:

http://www.opengis.net/spec/tilematrixset/1.0/conf/json-tilematrixsetlimits2d

* + 1. Model

|  |  |
| --- | --- |
| **Test id:** | **json-tilematrixsetlimits2d/model** |
| **Test Purpose:** | **Req 17 req/json-tilematrixsetlimits2d/model:** A TileMatrixSetLimits2D encoded in JSON *shall* implement the class TileMatrixSetLimits2D **Dependency:** req/tilematrixsetlimits2d. |
| **Test method:** | Validate the requirements of the model  Test passes if TileMatrixSetLimits2D instances follow the data model specified in Table 3 and Table 4 and its dependencies. |

* + 1. IETF

|  |  |
| --- | --- |
| **Test id:** | **json-tilematrixsetlimits2d/ietf** |
| **Test Purpose:** | **Req 18 req/json-tilematrixsetlimits2d/ietf:** A TileMatrixSetLimits2D encoded in JSON *shall* conform to IETF RFC7159 |
| **Test method:** | Validate the requirements of the IETF  Test passes if TileMatrixSetLimits2D JSON instances pass format validation against the IETF rules. |

* + 1. Schema

|  |  |
| --- | --- |
| **Test id:** | **json-tilematrixsetlimits2d/schema** |
| **Test Purpose:** | **Req 19 req/json-tilematrixsetlimits2d/schema:** A TileMatrixSetLimits2D encoded in JSON *shall* validate using the JSON schema for a tile matrix set limits 2D. |
| **Test method:** | Validate the requirements of the schema  Test passes if TileMatrixSetLimits2D JSON instances pass validation against the tile matrix set limits 2D JSON Schemas. |

Conformance class: JSON Encoding forTileMatrixSetLink2D

The OGC URI identifier of this conformance class is:

http://www.opengis.net/spec/tilematrixset/1.0/conf/json-tilematrixsetlink2d

* + 1. Model

|  |  |
| --- | --- |
| **Test id:** | **json-tilematrixsetlink2d/model** |
| **Test Purpose:** | **Req 20 req/json-tilematrixsetlink2d/model:** A TileMatrixSetLimits2D encoded in JSON *shall* implement the class TileMatrixSetLink2D **Dependency:** req/tilematrixsetlink2d **Dependency:** req/json-tilematrixsetlimits2d. |
| **Test method:** | Validate the requirements of the model  Test passes if TileMatrixSetLink2D instances follow the data model specified in Table 5 and its dependencies. |

* + 1. IETF

|  |  |
| --- | --- |
| **Test id:** | **json-tilematrixsetlink2d/ietf** |
| **Test Purpose:** | **Req 21 req/json-tilematrixsetlink2d/ietf:** A TileMatrixSetLink2D encoded in JSON *shall* conform to IETF RFC7159 |
| **Test method:** | Validate the requirements of the IETF rules  Test passes if TileMatrixSet2D JSON instances pass format validation against the IETF rules. |

* + 1. Schema

|  |  |
| --- | --- |
| **Test id:** | **json-tilematrixsetlink2d/schema** |
| **Test Purpose:** | **Req 22 req/json-tilematrixsetlink2d/schema:** A TileMatrixSetLink2D encoded in JSON *shall* validate using the JSON schema for a tile matrix set link 2D. |
| **Test method:** | Validate the requirements of the schema  Test passes if TileMatrixSetLink2D JSON instances pass validation against the tile matrix set link 2D JSON Schemas. |

Conformance class: JSON-LD Encoding forTileMatrixSet2D

The OGC URI identifier of this conformance class is:

http://www.opengis.net/spec/tilematrixset/1.0/conf/jsonld-tilematrixset2d

* + 1. Model

|  |  |
| --- | --- |
| **Test id:** | **jsonld-tilematrixset2d/model** |
| **Test Purpose:** | **Req 23 req/jsonld-tilematrixset2d/model:** A TileMatrixSet2D encoded in JSON-LD *shall* implement the class TileMatrixSet2D **Dependency:** req/tilematrixset2d. |
| **Test method:** | Validate the requirements of the model  Test passes if TileMatrixSet2D JSON-LD encoded instances follow the data model specified in Table 1 and Table 2 and its dependencies. |

* + 1. W3C

|  |  |
| --- | --- |
| **Test id:** | **jsonld-tilematrixset2d/w3c** |
| **Test Purpose:** | **Req 24 req/jsonld-tilematrixset2d/w3c:** A TileMatrixSet2D encoded in JSON-LD *shall* conform to W3C JSON-LD syntax version 1. |
| **Test method:** | Validate the requirements of the W3C  Test passes if TileMatrixSet2D JSON-LD instances pass format validation against the W3C rules. |

* + 1. Context

|  |  |
| --- | --- |
| **Test id:** | **jsonld-tilematrixset2d/context** |
| **Test Purpose:** | **Req 25 req/jsonld-tilematrixset2d/context:** A TileMatrixSet2D encoded in JSON-LD *shall* include references to the JSON-LD @context for a tile matrix set 2D. |
| **Test method:** | Validate the requirements of the @context  Test passes if the relevant references to @context documents for tile matrix set 2D are included. |

* + 1. MIME type

|  |  |
| --- | --- |
| **Test id:** | **jsonld-tilematrixset2d/mimetype** |
| **Test Purpose:** | **Req 26 req/jsonld-tilematrixset2d/mimetype:** A TileMatrixSet2D encoded in an independent JSON-LD document *shall* use the MIME type application/jsonld. |
| **Test method:** | Validate the requirements of the mime type  Test passes if the independent instances of TileMatrixSet2D are exposed as application/jsonld MIME type. |

Conformance class: JSON-LD Encoding forTileMatrixSetLimits2D

The OGC URI identifier of this conformance class is:

http://www.opengis.net/spec/tilematrixset/1.0/conf/jsonld-tilematrixsetlimits2d

* + 1. Model

|  |  |
| --- | --- |
| **Test id:** | **jsonld-tilematrixsetlimits2d/model** |
| **Test Purpose:** | **Req 27 req/jsonld-tilematrixsetlimits2d/model:** A TileMatrixSetLimits2D encoded in JSON-LD *shall* implement the class TileMatrixSetLimits2D **Dependency:** req/tilematrixsetlimits2d. |
| **Test method:** | Validate the requirements of the model  Test passes if TileMatrixSetLimits2D JSON-LD instances follow the data model specified in Table 3 and Table 4 and its dependencies. |

* + 1. W3C

|  |  |
| --- | --- |
| **Test id:** | **jsonld-tilematrixsetlimits2d/w3c** |
| **Test Purpose:** | **Req 28 req/jsonld-tilematrixsetlimits2d/w3c:** A TileMatrixSetLimits2D encoded in JSON-LD *shall* conform to W3C JSON-LD syntax version 1. |
| **Test method:** | Validate the requirements of the W3C  Test passes if TileMatrixSetLimits2D JSON-LD instances pass format validation against the W3C rules. |

* + 1. Context

|  |  |
| --- | --- |
| **Test id:** | **jsonld-tilematrixsetlimits2d/context** |
| **Test Purpose:** | **Req 29 req/jsonld-tilematrixsetlimits2d/context:** A TileMatrixSetLimits2D encoded in JSON-LD *shall* include references to the @conted for a tile matrix set limits 2D. |
| **Test method:** | Validate the requirements of the @context  Test passes if the relevant references to @context documents for tile matrix set limits 2D are included |

Conformance class: JSON-LD Encoding forTileMatrixSetLink2D

The OGC URI identifier of this conformance class is:

http://www.opengis.net/spec/tilematrixset/1.0/conf/jsonld-tilematrixsetlink2d

* + 1. Model

|  |  |
| --- | --- |
| **Test id:** | **jsonld-tilematrixsetlink2d/model** |
| **Test Purpose:** | **Req 30 req/jsonld-tilematrixsetlink2d/model:** A TileMatrixSetLimits2D encoded in JSON-LD *shall* implement the class TileMatrixSetLink2D **Dependency:** req/tilematrixsetlink2d **Dependency:** req/json-tilematrixsetlimits2d. |
| **Test method:** | Validate the requirements of the model  Test passes if TileMatrixSetLink2D JSON-LD instances follow the data model specified in Table 5 and its dependencies. |

* + 1. W3C

|  |  |
| --- | --- |
| **Test id:** | **jsonld-tilematrixsetlink2d/w3c** |
| **Test Purpose:** | **Req 31 req/jsonld-tilematrixsetlink2d/w3c:** A TileMatrixSetLink2D encoded in JSON-LD *shall* conform to W3C JSON-LD syntax version 1. |
| **Test method:** | Validate the requirements of the W3C rules  Test passes if TileMatrixSet2D JSON-LD instances pass format validation against the W3C rules. |

* + 1. Context

|  |  |
| --- | --- |
| **Test id:** | **jsonld-tilematrixsetlink2d/context** |
| **Test Purpose:** | **Req 32 req/jsonld-tilematrixsetlink2d/context:** A TileMatrixSetLink2D encoded in JSON-LD *shall* include references to the @context for a tile matrix set link 2D. |
| **Test method:** | Validate the requirements of the @context  Test passes if the relevant references to @context documents for tile matrix set links 2D are included. |

1. Schema Documents (Normative)

In addition to this document, this standard includes several normative Schema Documents. These Schema Documents are bundled in a zip file with the present document. After OGC acceptance of a Version 1.0.0 of this standard, these Schema Documents will also be posted online at the URL http://schemas.opengis.net/tilematrixset/1.0.0. In the event of a discrepancy between the bundled and online versions of the Schema Documents, the online files SHALL be considered authoritative.

* 1. XML Schema
  2. JSON Schema

1. Well-known scale sets (Informative)

The following well-known scale sets are defined in this standard. To be conformant to these well-known scale sets, the dataset of resource should be available from the largest scale denominator on the following tables and all intermediate scale denominators down to the most detailed scale resolution of that dataset; it is therefore not required to support the smallest scale denominators in order to be conformant to a well-known scale set. Cell sizes (pixel size in terrain units) are calculated assuming 0.28 mm pixel size and the WGS84 equatorial Earth diameter.

* 1. GlobalCRS84Scale (http://www.opengis.net/def/wkss/OGC/1.0/GlobalCRS84Scale)

This well-known scale set has been defined for global cartographic products. Rounded scales have been chosen for intuitive cartographic representation of vector data. Scale denominator is only accurate near the equator.

Table C. — Definition of Well-known scale set GlobalCRS84Scale

| CRS | Scale Denominator | Pixel Size (degrees) |
| --- | --- | --- |
| http://www.opengis.net/def/crs/OGC/1.3/CRS84 | 500 106 | 1.25764139776733 |
| 250 106 | 0.628820698883665 |
| 100 106 | 0.251528279553466 |
| 50 106 | 0.125764139776733 |
| 25 106 | 6.28820698883665 10-2 |
| 10 106 | 2.51528279553466 10-2 |
| 5 106 | 1.25764139776733 10-2 |
| 2.5 106 | 6.28820698883665 10-3 |
| 1 106 | 2.51528279553466 10-3 |
| 500 103 | 1.25764139776733 10-3 |
| 250 103 | 6.28820698883665 10-4 |
| 100 103 | 2.51528279553466 10-4 |
| 50 103 | 1.25764139776733 10-4 |
| 25 103 | 6.28820698883665 10-5 |
| 10 103 | 2.51528279553466 10-5 |
| 5 103 | 1.25764139776733 10-5 |
| 2.5 103 | 6.28820698883665 10-6 |
| 1 103 | 2.51528279553466 10-6 |
| 500 | 1.25764139776733 10-6 |
| 250 | 6.28820698883665 10-7 |
| 100 | 2.51528279553466 10-7 |

* 1. GlobalCRS84Pixel (http://www.opengis.net/def/wkss/OGC/1.0/GlobalCRS84Pixel)

This well-known scale set has been defined for global cartographic products. Rounded pixel sizes have been chosen for intuitive cartographic representation of raster data. Some values have been chosen to coincide with original pixel size of commonly used global products like STRM (1" and 3"), GTOPO (30") or ETOPO (2' and 5'). Scale denominator and approximated pixel size in meters are only accurate near the equator.

Table C.2 — Definition of Well-known scale set GlobalCRS84Pixel

| **CRS** | **Scale Denominator** | **Pixel Size (degrees)** | **Approx. Pixel Size (m)** |
| --- | --- | --- | --- |
| http://www.opengis.net/def/crs/OGC/1.3/CRS84 | 795139219.9519541 | 2 | 240000 |
| 397569609.9759771 | 1 | 120000 |
| 198784804.9879885 | 0.5 (30') | 60000 |
| 132523203.3253257 | 0.333333333333333 (20') | 40000 |
| 66261601.66266284 | 0.166666666666667 (10') | 20000 |
| 33130800.83133142 | 8.333333333333333 10-2 (5') | 10000 |
| 13252320.33253257 | 3.333333333333333 10-2 (2') | 4000 |
| 6626160.166266284 | 1.666666666666667 10-2 (1') | 2000 |
| 3313080.083133142 | 8.333333333333333 10-3 (30") | 1000 |
| 1656540.041566571 | 4.166666666666667 10-3 (15") | 500 |
| 552180.0138555236 | 1.388888888888889 10-3 (5") | 166 |
| 331308.0083133142 | 8.333333333333333 10-4 (3") | 100 |
| 110436.0027711047 | 2.777777777777778 10-4 (1") | 33 |
| 55218.00138555237 | 1.388888888888889 10-4 (0.5") | 16 |
| 33130.80083133142 | 8.333333333333333 10-5 (0.3") | 10 |
| 11043.60027711047 | 2.777777777777778 10-5 (0.1") | 3 |
| 3313.080083133142 | 8.333333333333333 10-6 (0.03") | 1 |
| 1104.360027711047 | 2.777777777777778 10-6 (0.01") | 0.33 |

* 1. GoogleCRS84Quad (http://www.opengis.net/def/wkss/OGC/1.0/GoogleCRS84Quad)

This well-known scale set has been defined to allow quadtree pyramids in CRS84. Level 0 allows representing the whole world in a single tile of 256x256 pixels (where the first 64 and last 64 lines of the tile are left blank). The next level represents the whole world in 2x2 tiles of 256x256 pixels and so on in powers of 2. Scale denominator is only accurate near the equator.

Table C.3 — Definition of Well-known scale set GoogleCRS84Quad

| **CRS** | **Scale Denominator** | **Pixel Size (degrees)** |
| --- | --- | --- |
| http://www.opengis.net/def/crs/OGC/1.3/CRS84 | 559082264.0287178 | 1.40625000000000 |
| 279541132.0143589 | 0.703125000000000 |
| 139770566.0071794 | 0.351562500000000 |
| 69885283.00358972 | 0.175781250000000 |
| 34942641.50179486 | 8.78906250000000 10-2 |
| 17471320.75089743 | 4.39453125000000 10-2 |
| 8735660.375448715 | 2.19726562500000 10-2 |
| 4367830.187724357 | 1.09863281250000 10-2 |
| 2183915.093862179 | 5.49316406250000 10-3 |
| 1091957.546931089 | 2.74658203125000 10-3 |
| 545978.7734655447 | 1.37329101562500 10-3 |
| 272989.3867327723 | 6.86645507812500 10-4 |
| 136494.6933663862 | 3.43322753906250 10-4 |
| 68247.34668319309 | 1.71661376953125 10-4 |
| 34123.67334159654 | 8.58306884765625 10-5 |
| 17061.83667079827 | 4.29153442382812 10-5 |
| 8530.918335399136 | 2.14576721191406 10-5 |
| 4265.459167699568 | 1.07288360595703 10-5 |
| 2132.729583849784 | 5.36441802978516 10-6 |

NOTE: Selecting the word "Google" for this WKSS id was unfortunate and might result confusing since the "Google-like" tiles does not use CRS84.

* 1. GoogleMapsCompatible (http://www.opengis.net/def/wkss/OGC/1.0/GoogleMapsCompatible)

This well-known scale set has been defined to be compatible with many mass marked implementations such as Google Maps, Microsoft Live Map and Open Street Map tiles. Level 0 allows representing the whole world in a single 256x256 pixels. The next level represents the whole world in 2x2 tiles of 256x256 pixels and so on in powers of 2. Scale denominator and pixel size are only accurate near the equator.

Table C.4 — Definition of Well-known scale set GoogleMapsCompatible

| **CRS** | **Zoom level name** | **Scale Denominator** | **Pixel Size (m)** |
| --- | --- | --- | --- |
| http://www.opengis.net/def/crs/EPSG/6.18:3/3857  WGS 84 / Pseudo-Mercator  http://www.epsg-registry.org/export.htm?‌gml= http://www.opengis.net/def/crs/EPSG/0/3857 | 0 | 559082264.0287178 | 156543.0339280410 |
| 1 | 279541132.0143589 | 78271.51696402048 |
| 2 | 139770566.0071794 | 39135.75848201023 |
| 3 | 69885283.00358972 | 19567.87924100512 |
| 4 | 34942641.50179486 | 9783.939620502561 |
| 5 | 17471320.75089743 | 4891.969810251280 |
| 6 | 8735660.375448715 | 2445.984905125640 |
| 7 | 4367830.187724357 | 1222.992452562820 |
| 8 | 2183915.093862179 | 611.4962262814100 |
| 9 | 1091957.546931089 | 305.7481131407048 |
| 10 | 545978.7734655447 | 152.8740565703525 |
| 11 | 272989.3867327723 | 76.43702828517624 |
| 12 | 136494.6933663862 | 38.21851414258813 |
| 13 | 68247.34668319309 | 19.10925707129406 |
| 14 | 34123.67334159654 | 9.554628535647032 |
| 15 | 17061.83667079827 | 4.777314267823516 |
| 16 | 8530.918335399136 | 2.388657133911758 |
| 17 | 4265.459167699568 | 1.194328566955879 |
| 18 | 2132.729583849784 | 0.5971642834779395 |
| 19 | 1066.364791924892 | 0.2985821417389697 |
| 20 | 533.1823959624460 | 0.1492910708694849 |
| 21 | 266.5911979812230 | 0.07464553543474244 |
| 22 | 133.2955989906115 | 0.03732276771737122 |
| 23 | 66.64779949530575 | 0.01866138385868561 |
| 24 | 33.32389974765287 | 0.009330691929342805 |

* 1. WorldMercatorWGS84 (http://www.opengis.net/def/wkss/OGC/1.0/ WorldMercatorWGS84)

This well-known scale set has been defined as similar to Google Maps and Microsoft Bing Map but using the WGS84 ellipsoid. Level 0 allows representing the whole world in a single 256x256 pixels. The next level represents the whole world in 2x2 tiles of 256x256 pixels and so on in powers of 2. Scale denominator and pixel size are only accurate near the equator.

Table C.5 — Definition of Well-known scale set WorldMercatorWGS84

| **CRS** | **Zoom level name** | **Scale Denominator** | **Pixel Size (m)** |
| --- | --- | --- | --- |
| http://www.opengis.net/def/crs/EPSG/0/3395  WGS 84 / World Mercator | 0 | 559082263.9508929 | 156543.033906250 |
| 1 | 279541131.97544646 | 78271.516953125 |
| 2 | 139770565.98772323 | 39135.758476562 |
| 3 | 69885282.99386162 | 19567.8792382812 |
| 4 | 34942641.49693081 | 9783.9396191406 |
| 5 | 17471320.748465404 | 4891.9698095703 |
| 6 | 8735660.374232702 | 2445.9849047852 |
| 7 | 4367830.187116351 | 1222.9924523926 |
| 8 | 2183915.0935581755 | 611.4962261963 |
| 9 | 1091957.5467790877 | 305.7481130981 |
| 10 | 545978.7733895439 | 152.8740565491 |
| 11 | 272989.38669477194 | 76.4370282745 |
| 12 | 136494.69334738597 | 38.2185141373 |
| 13 | 68247.34667369298 | 19.1092570686 |
| 14 | 34123.67333684649 | 9.5546285343 |
| 15 | 17061.836668423246 | 4.7773142672 |
| 16 | 8530.918334211623 | 2.3886571336 |
| 17 | 4265.4591671058115 | 1.1943285668 |
| 18 | 2132.7295835529058 | 0.5971642834 |

NOTE: Mercator projection distorts the pixel size the more closer to the poles. The pixel sizes provided here are only valid next to the equator

1. TileMatrixSet definitions (Informative)

This Annex includes some definitions for TileMatrixSets that are commonly used.

Web Mercator Quad TileMatrixSet definition (http://www.opengis.net/def/tilematrixset/OGC/1.0/WebMercatorQuad).

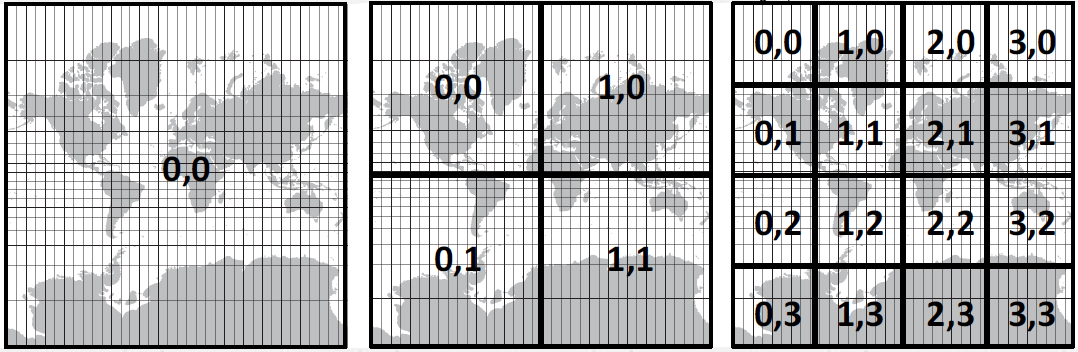
Table D.1 — Definition of the WebMercatorQuad TileMatrixSet

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CRS**: http://www.opengis.net/def/crs/EPSG/0/3857, WGS 84 / Pseudo-Mercator  **BBOX LowerCorner:** -20037508.3427892 -20037508.3427892 (lat/long: -85.0511287798,-180)  **BBOX UpperCorner:** 20037508.3427892 20037508.3427892 (lat/long: 85.0511287798,180)  **WellKnownScaleSet**: http://www.opengis.net/def/wkss/OGC/1.0/GoogleMapsCompatible  **TopLeftCorner**: -20037508.3427892 20037508.3427892  **TileWidth**: 256  **TileHeight**: 256 | | | | |
| **TileMatrix id** | **Scale Denominator** | **Pixel Size (m)** | **Matrix Width** | **Matrix Height** |
| 0 | 559082264.0287178 | 156543.0339280410 | 1 | 1 |
| 1 | 279541132.0143589 | 78271.51696402048 | 2 | 2 |
| 2 | 139770566.0071794 | 39135.75848201023 | 4 | 4 |
| 3 | 69885283.00358972 | 19567.87924100512 | 8 | 8 |
| 4 | 34942641.50179486 | 9783.939620502561 | 16 | 16 |
| 5 | 17471320.75089743 | 4891.969810251280 | 32 | 32 |
| 6 | 8735660.375448715 | 2445.984905125640 | 64 | 64 |
| 7 | 4367830.187724357 | 1222.992452562820 | 128 | 128 |
| 8 | 2183915.093862179 | 611.4962262814100 | 256 | 256 |
| 9 | 1091957.546931089 | 305.7481131407048 | 512 | 512 |
| 10 | 545978.7734655447 | 152.8740565703525 | 1024 | 1024 |
| 11 | 272989.3867327723 | 76.43702828517624 | 2048 | 2048 |
| 12 | 136494.6933663862 | 38.21851414258813 | 4096 | 4096 |
| 13 | 68247.34668319309 | 19.10925707129406 | 8192 | 8192 |
| 14 | 34123.67334159654 | 9.554628535647032 | 16384 | 16384 |
| 15 | 17061.83667079827 | 4.777314267823516 | 32768 | 32768 |
| 16 | 8530.918335399136 | 2.388657133911758 | 65536 | 65536 |
| 17 | 4265.459167699568 | 1.194328566955879 | 131072 | 131072 |
| 18 | 2132.729583849784 | 0.5971642834779395 | 262144 | 262144 |
| 19 | 1066.36479192489 | 0.2985821417389700 | 524288 | 524288 |
| 20 | 533.182395962445 | 0.1492910708694850 | 1048576 | 1048576 |
| 21 | 266.591197981222 | 0.0746455354347424 | 2097152 | 2097152 |
| 22 | 133.295598990611 | 0.0373227677173712 | 4194304 | 4194304 |
| 23 | 66.6477994953056 | 0.0186613838586856 | 8388608 | 8388608 |
| 24 | 33.3238997476528 | 0.0093306919293428 | 16777216 | 16777216 |

You can define an arbitrary number of zoom levels and do not include all the ones defined here. Here, 25 zoom levels are illustrated.

NOTE: Mercator projection distorts the pixel size the more closer to the poles. The pixel sizes provided here are only valid next to the equator in the direction E-W.

NOTE 2: The CRS code 3857 is the official code for Web Mercator. An unofficial code “900913” (GOOGLE spelled with numbers) was initially assigned and is sometimes still used.



TileCol

TileRow

TileMatrix id: 0

Number of tiles 1x1

TileMatrix id: 1

Number of tiles 2x2

TileMatrix id: 2

Number of tiles 4x4

Figure The 3 first Tile Matrix of the WebMercatorQuad TileMatrixSet (Source CCA)

This tile matrix set is the most used tile matrix set in the mass market: for example, by Google Maps, Microsoft Bing Maps and Open Street Map tiles. Nevertheless, it has been long criticized because it is a based on a spherical Mercator instead of an ellipsoid. The use of WebMercatorQuad should be limited to visualization. Any additional use (including distance measurements, routing etc) needs to use the Mercator spherical expressions to transform the coordinate to an appropriate CRS first.

NOTE3: For example the EPSG database version 8.9 says about the 3857: “Uses spherical development of ellipsoidal coordinates. Relative to WGS 84 / World Mercator (CRS code 3395) errors of 0.7 percent in scale and differences in northing of up to 43km in the map (equivalent to 21km on the ground) may arise”.

NOTE4: The risks caused by imprecision in the use of Web Mercator is also emphasized by NGA. NGA has issued an Advisory Notice on web Mercator (http://earth-info.nga.mil/GandG/wgs84/web\_mercator/index.html) that says that “it may cause geo-location / geo-coordinate errors up to 40,000 meters. This erroneous geospatial positioning information poses an unacceptable risk to global safety of navigation activities, and department of defense, intelligence community, and allied partner systems, missions, and operations that require accurate and precise positioning and navigation information”. The use of WorldMercatorWGS84Quad is recommended.

World Mercator WGS84 Quad TileMatrixSet definition (http://www.opengis.net/def/tilematrixset/OGC/1.0/WorldMercatorWGS84Quad).

Table D.2 — Definition of the WorldMercatorWGS84Quad TileMatrixSet

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CRS**: http://www.opengis.net/def/crs/EPSG/0/3395, WGS 84 / World-Mercator  **BBOX LowerCorner:** -20037508.3427892 -20037508.3427892 (lat, long: -85.08405903,-180)  **BBOX UpperCorner:** 20037508.3427892 20037508.3427892 (lat, long: 85.08405903,180)  **WellKnownScaleSet**: http://www.opengis.net/def/wkss/OGC/1.0/WorldMercatorWGS84  **TopLeftCorner**: -20037508.3427892 20037508.3427892  **TileWidth**: 256  **TileHeight**: 256 | | | | | |
| **TileMatrix id** | **Scale Denominator** | **Pixel Size (m) (true at the equator)** | **Pixel Size (m) at latitude ±31.0606963703645 (informative)** | **Matrix Width** | **Matrix Height** |
| 0 | 559082264.0287178 | 156543.0339280410 | 134217.728 | 1 | 1 |
| 1 | 279541132.0143589 | 78271.51696402048 | 67108.864 | 2 | 2 |
| 2 | 139770566.0071794 | 39135.75848201023 | 33554.432 | 4 | 4 |
| 3 | 69885283.00358972 | 19567.87924100512 | 16777.216 | 8 | 8 |
| 4 | 34942641.50179486 | 9783.939620502561 | 8388.608 | 16 | 16 |
| 5 | 17471320.75089743 | 4891.969810251280 | 4194.304 | 32 | 32 |
| 6 | 8735660.375448715 | 2445.984905125640 | 2097.152 | 64 | 64 |
| 7 | 4367830.187724357 | 1222.992452562820 | 1048.576 | 128 | 128 |
| 8 | 2183915.093862179 | 611.4962262814100 | 524.288 | 256 | 256 |
| 9 | 1091957.546931089 | 305.7481131407048 | 262.144 | 512 | 512 |
| 10 | 545978.7734655447 | 152.8740565703525 | 131.072 | 1024 | 1024 |
| 11 | 272989.3867327723 | 76.43702828517624 | 65.536 | 2048 | 2048 |
| 12 | 136494.6933663862 | 38.21851414258813 | 32.768 | 4096 | 4096 |
| 13 | 68247.34668319309 | 19.10925707129406 | 16.384 | 8192 | 8192 |
| 14 | 34123.67334159654 | 9.554628535647032 | 8.192 | 16384 | 16384 |
| 15 | 17061.83667079827 | 4.777314267823516 | 4.096 | 32768 | 32768 |
| 16 | 8530.918335399136 | 2.388657133911758 | 2.048 | 65536 | 65536 |
| 17 | 4265.459167699568 | 1.194328566955879 | 1.024 | 131072 | 131072 |
| 18 | 2132.729583849784 | 0.5971642834779395 | 0.512 | 262144 | 262144 |
| 19 | 1066.36479192489 | 0.2985821417389700 | 0.256 | 524288 | 524288 |
| 20 | 533.182395962445 | 0.1492910708694850 | 0.128 | 1048576 | 1048576 |
| 21 | 266.591197981222 | 0.0746455354347424 | 0.064 | 2097152 | 2097152 |
| 22 | 133.295598990611 | 0.0373227677173712 | 0.032 | 4194304 | 4194304 |
| 23 | 66.6477994953056 | 0.0186613838586856 | 0.016 | 8388608 | 8388608 |
| 24 | 33.3238997476528 | 0.0093306919293428 | 0.008 | 16777216 | 16777216 |

You can define an arbitrary number of zoom levels and do not include all the ones defined here. Here, 25 zoom levels are illustrated.

This Tile Matrix Set looks similar to the previous one (Web Mercator Quad) but this one is based on an ellipsoidal Mercator. Please note that the most northern latitude cover by this one is 85.08405903 (different from Web Mercator).

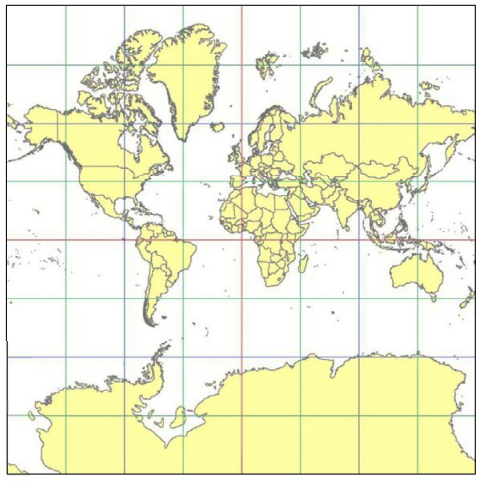


Figure Tile Matrix Id 1 (red lines; 2x2 tiles) and 3 (blue lines; 8x8 tiles) of the WorldMercatorWGS84Quad TileMatrixSet (Source NGA)

NOTE 2: The NGA Geomatics Office reminds the community to use DoD approved World Geodetic System 1984 (WGS 84) applications for all mission critical activities and encourages the use of WGS84 based tile matrix sets like this one and discourages the use of Web Mercator tiles based on Web Mercator such as WebMercatorQuad.

NOTE 3: The NGA Geomatics Office recommends the use of Universal zoom-levels scale set that are defined as true pixel size at ±31.0606963703645 degrees of latitude that implies a scale reduction at the equator of 0.857385503731176. This standard recommends the use of scale denominators at the equator for convenience.

World CRS84 Quad TileMatrixSet definition (http://www.opengis.net/def/tilematrixset/OGC/1.0/WorldCRS84Quad)

This Tile Matrix Set defines tiles in the Equirectangular projection in the CRS84 CRS for the whole world.

Table D.3 — Definition of the WorldCRS84Quad TileMatrixSet

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CRS**: http://www.opengis.net/def/crs/OGC/1.3/CRS84, CRS84  **BBOX LowerCorner:** -180 -90  **BBOX UpperCorner:** 180 90  **WellKnownScaleSet**: http://www.opengis.net/def/wkss/OGC/1.0/GoogleCRS84Quad  **TopLeftCorner**: -180 90  **TileWidth**: 256  **TileHeight**: 256 | | | | |
| **TileMatrix id** | **Scale Denominator** | **Pixel Size (degrees) (true at the equator)** | **Matrix Width** | **Matrix Height** |
| 0 | 279541132.0143589 | 0.703125000000000 | 2 | 1 |
| 1 | 139770566.0071794 | 0.351562500000000 | 4 | 2 |
| 2 | 69885283.00358972 | 0.175781250000000 | 8 | 4 |
| 3 | 34942641.50179486 | 8.78906250000000 10-2 | 16 | 8 |
| 4 | 17471320.75089743 | 4.39453125000000 10-2 | 32 | 16 |
| 5 | 8735660.375448715 | 2.19726562500000 10-2 | 64 | 32 |
| 6 | 4367830.187724357 | 1.09863281250000 10-2 | 128 | 64 |
| 7 | 2183915.093862179 | 5.49316406250000 10-3 | 256 | 128 |
| 8 | 1091957.546931089 | 2.74658203125000 10-3 | 512 | 256 |
| 9 | 545978.7734655447 | 1.37329101562500 10-3 | 1024 | 512 |
| 10 | 272989.3867327723 | 6.86645507812500 10-4 | 2048 | 1024 |
| 11 | 136494.6933663862 | 3.43322753906250 10-4 | 4096 | 2048 |
| 12 | 68247.34668319309 | 1.71661376953125 10-4 | 8192 | 4096 |
| 13 | 34123.67334159654 | 8.58306884765625 10-5 | 16384 | 8192 |
| 14 | 17061.83667079827 | 4.29153442382812 10-5 | 32768 | 16384 |
| 15 | 8530.918335399136 | 2.14576721191406 10-5 | 65536 | 32768 |
| 16 | 4265.459167699568 | 1.07288360595703 10-5 | 131072 | 65536 |
| 17 | 2132.729583849784 | 5.36441802978516 10-6 | 262144 | 131072 |

You can define an arbitrary number of zoom levels and do not include all the ones defined here. Here, 18 zoom levels are illustrated.

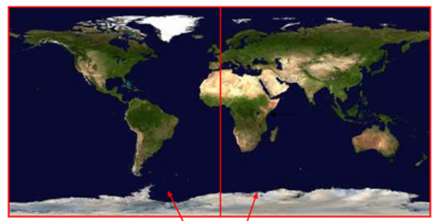


Figure Tile Matrix Id 1 (2x1 tiles) of the WorldCRS84Quad TileMatrixSet   
(Source INSPIRE technical guidance)

NOTE: The zoom level identifiers in this TileMatrixSet do not correspond to the same scales values than in Annex E.3 of WMTS 1.0. In this TileMatrixSet, the TileMatrix with identifier “-1” has only one tile with the last 128 lines left blank. For that reason, many implementers do not want to offer this level (including the INSPIRE technical guidance) and prefer to start with a TileMatrix that represents the world with just 2 tiles (one for the negative longitudes and one for the positive longitudes).

NOTE2:The scale denominators for this TileMatrixSet and WorldMercatorWGS84Quad and WebMercatorQuad are the same but the identifiers are displaced by one. This might generate confusion.

NOTE3: for INSPIRE: The Technical Guidance for the implementation of INSPIRE View Services defines a TileMatrixSet called InspireCRS84Quad that is identical. Note that the current version of the INSPIRE Technical Guidance cited in the Bibliography Annex could accidentally generate confusion because it is comparing a GoogleCRS84Quad (that is a well-known scale set name) with the InspireCRS84Quad (that is a TileMatrixSet definition that does not link to any WKSS).

NOTE4: Some implementers prefer to define this TileMatrixSet using the CRS http://www.opengis.net/def/crs/EPSG/0/4326. The definition is the same except that CRS coordinates are expressed in latitude, longitude order, affecting the TopLeftCorner and the BBox encoding only.

Universal Transverse Mercator WGS84 Quad family TileMatrixSet definition (http://www.opengis.net/def/tilematrixset/OGC/1.0/UTM##WGS84Quad)

The Universal Transversal Mercator (a special case of transverse Mercator), divides the world into 60 zones by longitude. No single zone would make a global or near-global map. Therefore we are defining a family of 60 TileMatrixSets in a single table.

Table D.4 — Definition of the UTM##WGS84Quad TileMatrixSets

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **##:** it is a number that goes from 01 to 60  **CRSs**: [http://www.opengis.net/def/crs/EPSG/0/32601, http://www.opengis.net/def/crs/EPSG/0/32660] WGS 84 / UTM  **BBOX LowerCorner:** -9501965.72931276 -20003931.4586255; lat, long: -180 -62+(##-31)\*6  **BBOX UpperCorner:** 10501965.7293128 20003931.4586255 (lat, long: 180, 68+(##-31)\*6)  **WellKnownScaleSet**: N/A  **TopLeftCorner**: -9501965.72931276 20003931.4586255  **TileWidth**: 256  **TileHeight**: 256 | | | | | |
| **TileMatrix id** | **Scale Denominator** | **Pixel Size (m) along the central meridian** | **Pixel Size (m) at a point in the Equator and at a longitude ±30.700524332812+3+(##-31)\*6** | **Matrix Width** | **Matrix Height** |
| 1 | 279072704.500914 | 78140.3572602559 | 67108.864 | 1 | 2 |
| 2 | 139536352.250457 | 39070.178630128 | 33554.432 | 2 | 4 |
| 3 | 69768176.1252285 | 19535.089315064 | 16777.216 | 4 | 8 |
| 4 | 34884088.0626143 | 9767.5446575319 | 8388.608 | 8 | 16 |
| 5 | 17442044.0313071 | 4883.772328766 | 4194.304 | 16 | 32 |
| 6 | 8721022.01565356 | 2441.886164383 | 2097.152 | 32 | 64 |
| 7 | 4360511.00782678 | 1220.9430821915 | 1048.576 | 64 | 128 |
| 8 | 2180255.50391339 | 610.471541095749 | 524.288 | 128 | 256 |
| 9 | 1090127.75195670 | 305.235770547875 | 262.144 | 256 | 512 |
| 10 | 545063.875978348 | 152.617885273937 | 131.072 | 512 | 1024 |
| 11 | 272531.937989174 | 76.3089426369687 | 65.536 | 1024 | 2048 |
| 12 | 136265.968994587 | 38.1544713184843 | 32.768 | 2048 | 4096 |
| 13 | 68132.9844972935 | 19.0772356592422 | 16.384 | 4096 | 8192 |
| 14 | 34066.4922486467 | 9.53861782962109 | 8.192 | 8192 | 16384 |
| 15 | 17033.2461243234 | 4.76930891481054 | 4.096 | 16384 | 32768 |
| 16 | 8516.62306216168 | 2.38465445740527 | 2.048 | 32768 | 65536 |
| 17 | 4258.31153108084 | 1.19232722870264 | 1.024 | 65536 | 131072 |
| 18 | 2129.15576554042 | 0.596163614351318 | 0.512 | 131072 | 262144 |
| 19 | 1064.57788277021 | 0.298081807175659 | 0.256 | 262144 | 524288 |
| 20 | 532.288941385105 | 0.149040903587829 | 0.128 | 524288 | 1048576 |
| 21 | 266.144470692553 | 0.0745204517939147 | 0.064 | 1048576 | 2097152 |
| 22 | 133.072235346276 | 0.0372602258969574 | 0.032 | 2097152 | 4194304 |
| 23 | 66.5361176731382 | 0.0186301129484787 | 0.016 | 4194304 | 8388608 |
| 24 | 33.2680588365691 | 0.00931505647423934 | 0.008 | 8388608 | 16777216 |

You can define an arbitrary number of zoom levels and do not include all the ones defined here. Here, 24 zoom levels are illustrated.

NOTE: The south hemisphere ([http://www.opengis.net/def/crs/EPSG/0/32701, http://www.opengis.net/def/crs/EPSG/0/32760]) is covered by extending the UTM Northen CRSs to the south in a way that the south hemisphere CRSs are neither used nor needed.

NOTE2: The UTM projection is supposed to be used in zones that are only 3 degrees apart from the central meridian forming 6 degree wide zones. In some parts of the world, it is useful to relax this limitation to cover a wider object (for example, Spain can be fully represented in UTM30 zone if the 3 degree limit is relaxed). The farther we go apart from the central meridian, the more deformations we experience in the projection. The top left corner of this tile matrix set has been defined 65 degrees apart of the central meridian to allow much more extreme cases but it is highly recommended that applications limit themselves to the 6 degree wide central area and use TileMatrixSetLimits to define actual boundaries of the tile indices used in this area.

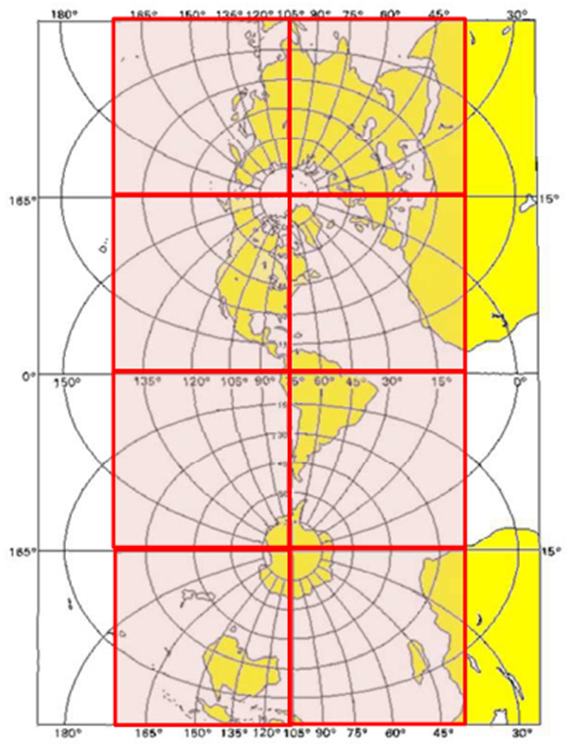


Figure Tile Matrix Id 1 (dashed blue lines; 1x2 tiles) and 2 (red lines; 2x4 tiles) of the UTM18WGS84Quad TileMatrixSet (Source NGA)

NOTE 3: The NGA Geomatics Office recommends the use of Universal zoom-levels scale set that are defined as true pixel size at ±30.700524332812 degrees of longitude at both sides of the central meridian that implies a scale reduction at the central meridian of 0.85882463752355. The tiles considering this scale are exactly the same than considering true pixel size at the equation and no scale reduction. This standard recommends the use of scale denominators at the equator for convenience.

Arctic Universal Polar Stereographic WGS 84 Quad TileMatrixSet definition (http://www.opengis.net/def/tilematrixset/OGC/1.0/UPSArcticWGS84Quad)

There is no consensus in the geospatial community for what constitutes the “best” tile matrix set for the polar stereographic projection. One reason for this is that the election of the TopLeftCorner and scale denominators is almost completely arbitrary. We selected the NGA recommendation for polar stereographic that allows for the representation of more than one hemisphere to 15 degrees into the opposite hemisphere and share a common set of pixel sizes with the WorldMercatorWGS84Quad and the UTM##WGS84Quad. The selection of a CRS for a polar stereographic is difficult and we followed several criteria (see NOTE 2). In the end, we selected the UPS North that is commonly used in conjunction with UTM.

NOTE: In Mercator or Transversal Mercator projections the first scale denominator and top left corner are selected in a way that a single tile can cover all ranges of longitudes or latitudes respectively. Due to the nature of this projection this criteria cannot be applied. The top left corner selection deeply depends on the application. Here we have selected a very distant top left corner to include as many applications as possible.

Table D.5 — Definition of the UPSArcticWGS84Quad TileMatrixSet

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CRS**: http://www.opengis.net/def/crs/EPSG/0/32661, WGS 84 Universal Polar Stereographic North  **BBOX LowerCorner:** -14440759.350252, -14440759.350252  **BBOX UpperCorner:** 18440759.350252, 18440759.350252  **WellKnownScaleSet**: N/A  **TopLeftCorner**: -14440759.350252,18440759.350252  **TileWidth**: 256  **TileHeight**: 256 | | | | | |
| **Tile**  **Matrix id** | **Scale Denominator** | **Pixel Size (m) (true at latitude ~81)** | **True Pixel Size (m) at the pole (informative)** | **Matrix Width** | **Matrix Height** |
| 0 | 458726544.4 | 128443.4324 | 129218.7449 | 1 | 1 |
| 1 | 229363272.2 | 64221.71621 | 64609.37245 | 2 | 2 |
| 2 | 114681636.1 | 32110.85811 | 32304.68622 | 4 | 4 |
| 3 | 57340818.05 | 16055.42905 | 16152.34311 | 8 | 8 |
| 4 | 28670409.02 | 8027.714526 | 8076.171556 | 16 | 16 |
| 5 | 14335204.51 | 4013.857263 | 4038.085778 | 32 | 32 |
| 6 | 7167602.256 | 2006.928632 | 2019.042889 | 64 | 64 |
| 7 | 3583801.128 | 1003.464316 | 1009.521444 | 128 | 128 |
| 8 | 1791900.564 | 501.7321579 | 504.7607222 | 256 | 256 |
| 9 | 895950.282 | 250.866079 | 252.3803611 | 512 | 512 |
| 10 | 447975.141 | 125.4330395 | 126.1901806 | 1024 | 1024 |
| 11 | 223987.5705 | 62.71651974 | 63.09509028 | 2048 | 2048 |
| 12 | 111993.7852 | 31.35825987 | 31.54754514 | 4096 | 4096 |
| 13 | 55996.89262 | 15.67912993 | 15.77377257 | 8192 | 8192 |
| 14 | 27998.44631 | 7.839564967 | 7.886886285 | 16384 | 16384 |
| 15 | 13999.22316 | 3.919782484 | 3.943443142 | 32768 | 32768 |
| 16 | 6999.611578 | 1.959891242 | 1.971721571 | 65536 | 65536 |
| 17 | 3499.805789 | 0.979945621 | 0.985860786 | 131072 | 131072 |
| 18 | 1749.902894 | 0.48997281 | 0.492930393 | 262144 | 262144 |
| 19 | 874.9514472 | 0.244986405 | 0.246465196 | 524288 | 524288 |
| 20 | 437.4757236 | 0.122493203 | 0.123232598 | 1048576 | 1048576 |
| 21 | 218.7378618 | 0.061246601 | 0.061616299 | 2097152 | 2097152 |
| 22 | 109.3689309 | 0.030623301 | 0.03080815 | 4194304 | 4194304 |
| 23 | 54.68446545 | 0.01531165 | 0.015404075 | 8388608 | 8388608 |
| 24 | 27.34223273 | 0.007655825 | 0.007702037 | 16777216 | 16777216 |

You can define an arbitrary number of zoom levels and do not include all the ones defined here. Here, 25 zoom levels are illustrated.

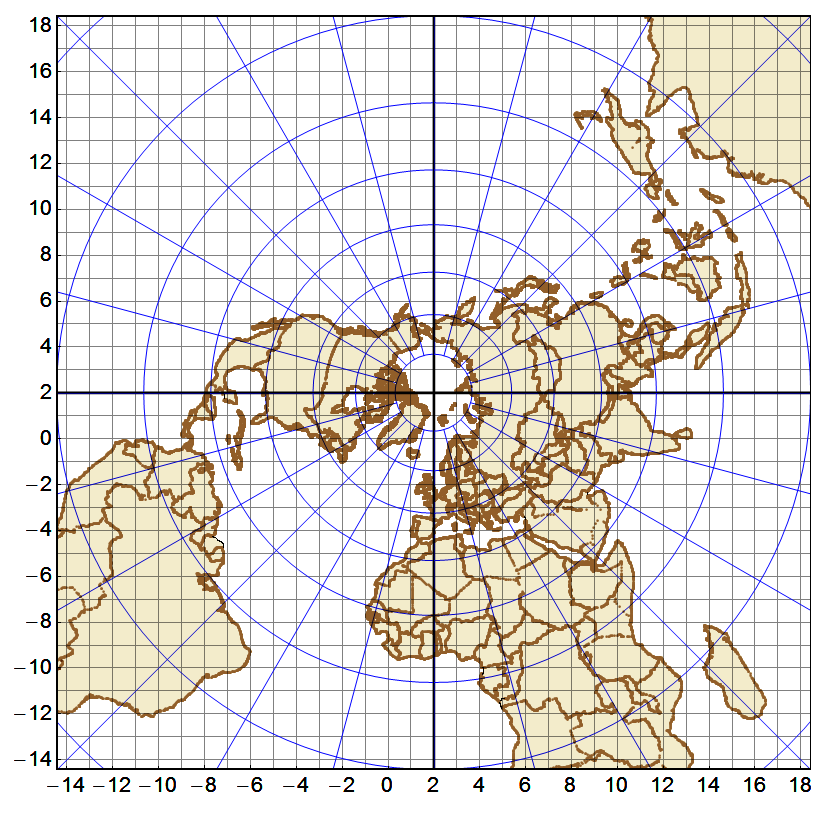
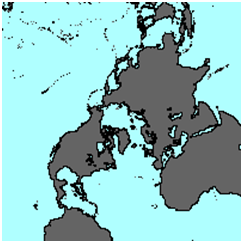
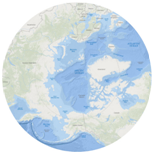


Figure Tile Matrix Id 0 (exterior line; 1x1 tile) and 1 (blank lines; 2x2 tiles) of the UPSArcticWGS84Quad TileMatrixSet (Source NGA)

NOTE2: In practice, there are many polar stereographic CRS and it is difficult to prioritize one. In many occasions the meridian of origin is selected in order to rotate the projection and allow a region to become more prominent. Examples are rotations emphasizing Greenland or Alaska. To be general, we selected 0 meridian of origin. In addition, polar projections have a variety of standard parallels and we selected 90N. In the UPS system, the North Pole is assigned the coordinates x=2000000, y=2000000.

NOTE3: NGA has suggested also another TileMatrixSet called *sixteenth tile* that covers less area by having the TopLeftCorner: at ‑2 110 189.837563, 6 110 189.837563, BBOX LowerCorner: ‑2110189.837562966 -2110189.837562966 and BBOX UpperCorner: 6110189.837562966 6110189.837562966, The same result can be achieved by using the TileMatrixSetLimits mechanism without having to define and entirely new TileMatrixSet.



a.

b.

c.



Figure Rotation of the meridian of origin to allow a region to become more prominent (a. EPSG:3995, Arctic WGS 84 Polar Stereographic, b. EPSG:3413 WGS 84 / NSIDC Polar Stereographic North, c. EPSG:5936 / Alaska Polar Stereographic). This TileMatrixSet has 0 rotation angle for the meridian of origin.

Antarctic Universal Polar Stereographic WGS84 Quad definition (http://www.opengis.net/def/tilematrixset/OGC/1.0/ UPSAntarcticWGS84Quad)

There is no consensus in the geospatial community for what constitutes the “best” tile matrix set for the polar stereographic projection. One reasons for this is that the election of the TopLeftCorner and scale denominators is almost completely arbitrary. We selected a TileMatrixSet identical to the Arctic one but with and Antarctic CRS.

Table D.6 — Definition of the UPSAntarcticWGS84Quad TileMatrixSet

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CRS**: http://www.opengis.net/def/crs/EPSG/0/32662, WGS 84 Universal Polar Stereographic South  **BBOX LowerCorner:** -14440759.350252, -14440759.350252  **BBOX UpperCorner:** 18440759.350252, 18440759.350252  **WellKnownScaleSet**: N/A  **TopLeftCorner**: -14440759.350252,18440759.350252  **TileWidth**: 256  **TileHeight**: 256 | | | | | |
| **Tile**  **Matrix id** | **Scale Denominator** | **Pixel Size (m) (true at latitude ~-81)** | **True Pixel Size (m) at the pole (informative)** | **Matrix Width** | **Matrix Height** |
| 0 | 458726544.4 | 128443.4324 | 129218.7449 | 1 | 1 |
| 1 | 229363272.2 | 64221.71621 | 64609.37245 | 2 | 2 |
| 2 | 114681636.1 | 32110.85811 | 32304.68622 | 4 | 4 |
| 3 | 57340818.05 | 16055.42905 | 16152.34311 | 8 | 8 |
| 4 | 28670409.02 | 8027.714526 | 8076.171556 | 16 | 16 |
| 5 | 14335204.51 | 4013.857263 | 4038.085778 | 32 | 32 |
| 6 | 7167602.256 | 2006.928632 | 2019.042889 | 64 | 64 |
| 7 | 3583801.128 | 1003.464316 | 1009.521444 | 128 | 128 |
| 8 | 1791900.564 | 501.7321579 | 504.7607222 | 256 | 256 |
| 9 | 895950.282 | 250.866079 | 252.3803611 | 512 | 512 |
| 10 | 447975.141 | 125.4330395 | 126.1901806 | 1024 | 1024 |
| 11 | 223987.5705 | 62.71651974 | 63.09509028 | 2048 | 2048 |
| 12 | 111993.7852 | 31.35825987 | 31.54754514 | 4096 | 4096 |
| 13 | 55996.89262 | 15.67912993 | 15.77377257 | 8192 | 8192 |
| 14 | 27998.44631 | 7.839564967 | 7.886886285 | 16384 | 16384 |
| 15 | 13999.22316 | 3.919782484 | 3.943443142 | 32768 | 32768 |
| 16 | 6999.611578 | 1.959891242 | 1.971721571 | 65536 | 65536 |
| 17 | 3499.805789 | 0.979945621 | 0.985860786 | 131072 | 131072 |
| 18 | 1749.902894 | 0.48997281 | 0.492930393 | 262144 | 262144 |
| 19 | 874.9514472 | 0.244986405 | 0.246465196 | 524288 | 524288 |
| 20 | 437.4757236 | 0.122493203 | 0.123232598 | 1048576 | 1048576 |
| 21 | 218.7378618 | 0.061246601 | 0.061616299 | 2097152 | 2097152 |
| 22 | 109.3689309 | 0.030623301 | 0.03080815 | 4194304 | 4194304 |
| 23 | 54.68446545 | 0.01531165 | 0.015404075 | 8388608 | 8388608 |
| 24 | 27.34223273 | 0.007655825 | 0.007702037 | 16777216 | 16777216 |

You can define an arbitrary number of zoom levels and do not include all the ones defined here. Here, 25 zoom levels are illustrated.

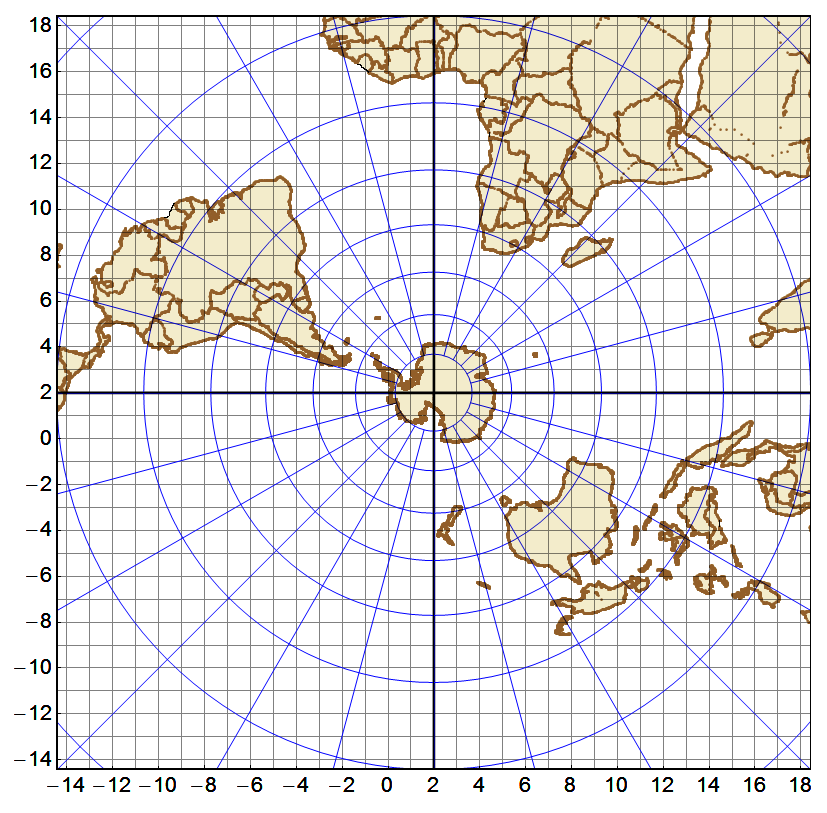


Figure Tile Matrix Id 0 (exterior line; 1x1 tile) and 1 (black lines; 2x2 tiles) of the UPSAntarcticWGS84Quad TileMatrixSet (Source NGA)

European ETRS89 LAEA Quad TileMatrixSet TileMatrixSet definition (http://www.opengis.net/def/tilematrixset/OGC/1.0/EuropeanETRS89\_LAEAQuad)

Table D.5 — Definition of the EuropeanETRS89\_LAEAQuad TileMatrixSet

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CRS**: http://www.opengis.net/def/crs/EPSG/0/3035, ETRS89  **BBOX LowerCorner:** 2000000.0 1000000.0  **BBOX UpperCorner:** 65000005500000.0  **WellKnownScaleSet**: N/A  **TopLeftCorner**: 2000000.0 5500000.0  **TileWidth**: 256  **TileHeight**: 256 | | | | |
| **TileMatrix id** | **Scale Denominator** | **Pixel Size (m)** | **Matrix Width** | **Matrix Height** |
| 0 | 62779017.857142866 | 17578.1250000000 | 1 | 1 |
| 1 | 31389508.928571433 | 8789.0625000000 | 2 | 2 |
| 2 | 15694754.464285716 | 4394.5312500000 | 4 | 4 |
| 3 | 7847377.232142858 | 2197.2656250000 | 8 | 8 |
| 4 | 3923688.616071429 | 1098.6328125000 | 16 | 16 |
| 5 | 1961844.3080357146 | 549.3164062500 | 32 | 32 |
| 6 | 980922.1540178573 | 274.6582031250 | 64 | 64 |
| 7 | 490461.07700892864 | 137.3291015625 | 128 | 128 |
| 8 | 245230.53850446432 | 68.6645507812 | 256 | 256 |
| 9 | 122615.26925223216 | 34.3322753906 | 512 | 512 |
| 10 | 61307.63462611608 | 17.1661376953 | 1024 | 1024 |
| 11 | 30653.81731305804 | 8.5830688477 | 2048 | 2048 |
| 12 | 15326.90865652902 | 4.2915344238 | 4096 | 4096 |
| 13 | 7663.45432826451 | 2.1457672119 | 8192 | 8192 |
| 14 | 3831.727164132255 | 1.0728836060 | 16384 | 16384 |
| 15 | 1915.8635820661275 | 0.5364418030 | 32768 | 32768 |

You can define an arbitrary number of zoom levels and do not include all the ones defined here. Here, 16 zoom levels are illustrated.

Canadian NAD83 LCC TileMatrixSet definition (http://www.opengis.net/def/tilematrixset/OGC/1.0/CanadianNAD83\_LCC)

Table D.5 — Definition of the CanadianNAD83\_LCC TileMatrixSet

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CRS**: http://www.opengis.net/def/crs/EPSG/0/3978, NAD83  **BBOX LowerCorner:** -7786476.885838887, -5153821.09213678  **BBOX UpperCorner:** 7148753.233541353, 7928343.534071138  **WellKnownScaleSet**: N/A  **TopLeftCorner**: -34655800, 39310000  **TileWidth**: 256  **TileHeight**: 256 | | | | | | |
| **TileMatrix id** | **Scale Denominator** | **Scale Denominator at latitudes 37.897505 and 83.3032475 (informative)** | **Cartographic product (informative)** | **Pixel Size (m) (true at the equator)** | **Matrix Width** | **Matrix Height** |
| 0 | 137016643.1 | 145000000 | World | 38364.66006 | 5 | 5 |
| 1 | 80320101.12 | 85000000 | World | 22489.62831 | 8 | 8 |
| 2 | 47247118.3 | 50000000 | Atlas SM | 13229.19313 | 13 | 14 |
| 3 | 28348270.98 | 30000000 | Atlas SM | 7937.515875 | 21 | 22 |
| 4 | 16536491.41 | 17500000 | Atlas SM | 4630.217594 | 36 | 38 |
| 5 | 9449423.661 | 10000000 | Atlas MID | 2645.838625 | 62 | 66 |
| 6 | 5669654.196 | 6000000 | Atlas MID | 1587.503175 | 103 | 110 |
| 7 | 3307298.281 | 3500000 | Atlas MID | 926.0435188 | 177 | 188 |
| 8 | 1889884.732 | 2000000 | Atlas LG | 529.167725 | 309 | 329 |
| 9 | 1133930.839 | 1200000 | Atlas LG | 317.500635 | 515 | 548 |
| 10 | 661459.6563 | 700000 | Atlas LG | 185.2087038 | 882 | 938 |
| 11 | 396875.7938 | 420000 | NTDB 250K | 111.1252223 | 1470 | 1563 |
| 12 | 236235.5915 | 250000 | NTDB 250K | 66.14596563 | 2469 | 2626 |
| 13 | 137016.6431 | 145000 | NTDB 250K | 38.36466006 | 4257 | 4528 |
| 14 | 80320.10112 | 85000 | NTDB 50K | 22.48962831 | 7262 | 7723 |
| 15 | 47247.1183 | 50000 | NTDB 50K | 13.22919313 | 12344 | 13130 |
| 16 | 28348.27098 | 30000 | NTDB 50K | 7.937515875 | 20574 | 21882 |
| 17 | 16536.49141 | 17500 | Geobase | 4.630217594 | 35269 | 37512 |
| 18 | 9449.423661 | 10000 | Geobase | 2.645838625 | 61720 | 65646 |
| 19 | 5669.654196 | 6000 | Geobase | 1.587503175 | 102866 | 109409 |
| 20 | 3307.298281 | 3500 | Geobase | 0.926043519 | 176341 | 187558 |
| 21 | 1889.884732 | 2000 | Geobase | 0.529167725 | 308596 | 328227 |
| 22 | 1133.930839 | 1200 | Geobase | 0.317500635 | 514327 | 547044 |
| 23 | 661.4596563 | 700 |  | 0.185208704 | 881703 | 937790 |
| 24 | 396.8757938 | 420 |  | 0.111125222 | 1469505 | 1562983 |
| 25 | 236.2355915 | 250 |  | 0.066145966 | 2468768 | 2625811 |

You can define an arbitrary number of zoom levels and do not include all the ones defined here. Here, 26 zoom levels are illustrated.

1. Example XML documents (Informative)

This Annex provides example XML documents than can be used to define tile matrix sets.

* 1. Web Mercator Quad TileMatrixSet definition.

This is the XML definition of the WebMercatorQuad tile matrix set that can be reproduced by other standards needing to define a tile matrix set. Not all TileMatrix elements need to be included and including other TileMatrices for more detailed scales is possible if they follow the same pattern.

<TileMatrixSet xml:id="WebMercatorQuad">

<ows:Title>Google Maps Compatible for the World</ows:Title>

<ows:Identifier>WebMercatorQuad</ows:Identifier>

<ows:BoundingBox crs="http://www.opengis.net/def/crs/EPSG/0/3857">

<ows:LowerCorner>

-20037508.3427892 -20037508.3427892

</ows:LowerCorner>

<ows:UpperCorner>

20037508.3427892 20037508.3427892

</ows:UpperCorner>

</ows:BoundingBox>

<ows:SupportedCRS>

http://www.opengis.net/def/crs/EPSG/0/3857

</ows:SupportedCRS>

<WellKnownScaleSet>

http://www.opengis.net/def/wkss/OGC/1.0/GoogleMapsCompatible

</WellKnownScaleSet>

<TileMatrix>

<ows:Identifier>0</ows:Identifier>

<ScaleDenominator>559082264.028717</ScaleDenominator>

<TopLeftCorner>-20037508.3427892 20037508.3427892</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>1</MatrixWidth>

<MatrixHeight>1</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>1</ows:Identifier>

<ScaleDenominator>279541132.014358</ScaleDenominator>

<TopLeftCorner>-20037508.3427892 20037508.3427892</TopLeftCorner>

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<TileHeight>256</TileHeight>

<MatrixWidth>2</MatrixWidth>

<MatrixHeight>2</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>2</ows:Identifier>

<ScaleDenominator>139770566.007179</ScaleDenominator>

<TopLeftCorner>-20037508.3427892 20037508.3427892</TopLeftCorner>

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<TileHeight>256</TileHeight>

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<MatrixHeight>4</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>3</ows:Identifier>

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<TopLeftCorner>-20037508.3427892 20037508.3427892</TopLeftCorner>

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<TileHeight>256</TileHeight>

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<MatrixHeight>8</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>4</ows:Identifier>

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<TopLeftCorner>-20037508.3427892 20037508.3427892</TopLeftCorner>

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<TileHeight>256</TileHeight>

<MatrixWidth>16</MatrixWidth>

<MatrixHeight>16</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>5</ows:Identifier>

<ScaleDenominator>17471320.7508974</ScaleDenominator>

<TopLeftCorner>-20037508.3427892 20037508.3427892</TopLeftCorner>

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<TileHeight>256</TileHeight>

<MatrixWidth>32</MatrixWidth>

<MatrixHeight>32</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>6</ows:Identifier>

<ScaleDenominator>8735660.37544871</ScaleDenominator>

<TopLeftCorner>-20037508.3427892 20037508.3427892</TopLeftCorner>

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<TileHeight>256</TileHeight>

<MatrixWidth>64</MatrixWidth>

<MatrixHeight>64</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>7</ows:Identifier>

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<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>128</MatrixWidth>

<MatrixHeight>128</MatrixHeight>

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<TileMatrix>

<ows:Identifier>8</ows:Identifier>

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<TopLeftCorner>-20037508.3427892 20037508.3427892</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>256</MatrixWidth>

<MatrixHeight>256</MatrixHeight>

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<TileMatrix>

<ows:Identifier>9</ows:Identifier>

<ScaleDenominator>1091957.54693108</ScaleDenominator>

<TopLeftCorner>-20037508.3427892 20037508.3427892</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>512</MatrixWidth>

<MatrixHeight>512</MatrixHeight>

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<TileMatrix>

<ows:Identifier>10</ows:Identifier>

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<TopLeftCorner>-20037508.3427892 20037508.3427892</TopLeftCorner>

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<TileHeight>256</TileHeight>

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<MatrixHeight>1024</MatrixHeight>

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<TileMatrix>

<ows:Identifier>11</ows:Identifier>

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<TopLeftCorner>-20037508.3427892 20037508.3427892</TopLeftCorner>

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<TileHeight>256</TileHeight>

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<MatrixHeight>2048</MatrixHeight>

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<TileMatrix>

<ows:Identifier>12</ows:Identifier>

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<TopLeftCorner>-20037508.3427892 20037508.3427892</TopLeftCorner>

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<TileHeight>256</TileHeight>

<MatrixWidth>4096</MatrixWidth>

<MatrixHeight>4096</MatrixHeight>

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<ows:Identifier>13</ows:Identifier>

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<TopLeftCorner>-20037508.3427892 20037508.3427892</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>8192</MatrixWidth>

<MatrixHeight>8192</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>14</ows:Identifier>

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<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>16384</MatrixWidth>

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<TileMatrix>

<ows:Identifier>15</ows:Identifier>

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<TileHeight>256</TileHeight>

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<ows:Identifier>16</ows:Identifier>

<ScaleDenominator>8530.91833539913</ScaleDenominator>

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<TileHeight>256</TileHeight>

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<ows:Identifier>17</ows:Identifier>

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<TileHeight>256</TileHeight>

<MatrixWidth>131072</MatrixWidth>

<MatrixHeight>131072</MatrixHeight>

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<TileMatrix>

<ows:Identifier>18</ows:Identifier>

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<TileHeight>256</TileHeight>

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<MatrixHeight>262144</MatrixHeight>

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<TileHeight>256</TileHeight>

<MatrixWidth>524288</MatrixWidth>

<MatrixHeight>524288</MatrixHeight>

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<TileMatrix>

<ows:Identifier>20</ows:Identifier>

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<MatrixWidth>1048576</MatrixWidth>

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<ows:Identifier>21</ows:Identifier>

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<MatrixWidth>2097152</MatrixWidth>

<MatrixHeight>2097152</MatrixHeight>

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<TileHeight>256</TileHeight>

<MatrixWidth>4194304</MatrixWidth>

<MatrixHeight>4194304</MatrixHeight>

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<TopLeftCorner>-20037508.3427892 20037508.3427892</TopLeftCorner>

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<TileHeight>256</TileHeight>

<MatrixWidth>8388608</MatrixWidth>

<MatrixHeight>8388608</MatrixHeight>

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<TileHeight>256</TileHeight>

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<MatrixHeight>16777216</MatrixHeight>

</TileMatrix>

</TileMatrixSet>

You can define an arbitrary number of zoom levels. Here, 25 zoom levels are illustrated.

* 1. World Mercator WGS84 Quad TileMatrixSet definition.

This is the XML definition of the WorldMercatorWGS84Quad tile matrix set that can be reproduced by other standards needing to define a tile matrix set. Not all TileMatrix elements need to be included and including other TileMatrices for more detailed scales is possible if they follow the same pattern.

<TileMatrixSet xml:id="WorldMercatorWGS84Quad">

<ows:Title>World Mercator WGS84 (ellipsoid)</ows:Title>

<ows:Identifier>WorldMercatorWGS84Quad</ows:Identifier>

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-20037508.3427892 -20037508.3427892

</ows:LowerCorner>

<ows:UpperCorner>

20037508.3427892 20037508.3427892

</ows:UpperCorner>

</ows:BoundingBox>

<ows:SupportedCRS>

http://www.opengis.net/def/crs/EPSG/0/3395

</ows:SupportedCRS>

<WellKnownScaleSet>

http://www.opengis.net/def/wkss/OGC/1.0/WorldMercatorWGS84

</WellKnownScaleSet>

<TileMatrix>

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<TileHeight>256</TileHeight>

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<ows:Identifier>1</ows:Identifier>

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<TileHeight>256</TileHeight>

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<MatrixHeight>4</MatrixHeight>

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<TileHeight>256</TileHeight>

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<MatrixHeight>8</MatrixHeight>

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<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>16</MatrixWidth>

<MatrixHeight>16</MatrixHeight>

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<TileMatrix>

<ows:Identifier>5</ows:Identifier>

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<TopLeftCorner>-20037508.3427892 20037508.3427892</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>32</MatrixWidth>

<MatrixHeight>32</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>6</ows:Identifier>

<ScaleDenominator>8735660.37544871</ScaleDenominator>

<TopLeftCorner>-20037508.3427892 20037508.3427892</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>64</MatrixWidth>

<MatrixHeight>64</MatrixHeight>

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<TileMatrix>

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<ScaleDenominator>4367830.18772435</ScaleDenominator>

<TopLeftCorner>-20037508.3427892 20037508.3427892</TopLeftCorner>

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<TileHeight>256</TileHeight>

<MatrixWidth>128</MatrixWidth>

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<ScaleDenominator>2183915.09386217</ScaleDenominator>

<TopLeftCorner>-20037508.3427892 20037508.3427892</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>256</MatrixWidth>

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<ScaleDenominator>1091957.54693108</ScaleDenominator>

<TopLeftCorner>-20037508.3427892 20037508.3427892</TopLeftCorner>

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<ScaleDenominator>545978.773465544</ScaleDenominator>

<TopLeftCorner>-20037508.3427892 20037508.3427892</TopLeftCorner>

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<MatrixWidth>131072</MatrixWidth>

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<ScaleDenominator>66.6477994953056</ScaleDenominator>

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<MatrixWidth>8388608</MatrixWidth>

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<ows:Identifier>24</ows:Identifier>

<ScaleDenominator>33.3238997476528</ScaleDenominator>

<TopLeftCorner>-20037508.3427892 20037508.3427892</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>16777216</MatrixWidth>

<MatrixHeight>16777216</MatrixHeight>

</TileMatrix>

</TileMatrixSet>

You can define an arbitrary number of zoom levels. Here, 19 zoom levels are illustrated but resolutions up to 24 are currently available in some mass market services.

* 1. World CRS84 Quad TileMatrixSet definition.

This is the XML definition of the WorldCRS84Quad tile matrix set that can be reproduced by other standards needing to define a tile matrix set. Not all TileMatrix elements need to be included and including other TileMatrices for more detailed scales is possible if they follow the same pattern.

<TileMatrixSet xml:id="WorldCRS84Quad">

<ows:Title>CRS84 for the World</ows:Title>

<ows:Identifier>WorldCRS84Quad</ows:Identifier>

<ows:BoundingBox crs="http://www.opengis.net/def/crs/OGC/1.3/CRS84">

<ows:LowerCorner>-180 -90</ows:LowerCorner>

<ows:UpperCorner>180 90</ows:UpperCorner>

</ows:BoundingBox>

<ows:SupportedCRS>

http://www.opengis.net/def/crs/OGC/1.3/CRS84

</ows:SupportedCRS>

<WellKnownScaleSet>

http://www.opengis.net/def/wkss/OGC/1.0/GoogleCRS84Quad

</WellKnownScaleSet>

<TileMatrix>

<ows:Identifier>1</ows:Identifier>

<ScaleDenominator>279541132.0143589</ScaleDenominator>

<TopLeftCorner>-180 90</TopLeftCorner>

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<TileHeight>256</TileHeight>

<MatrixWidth>2</MatrixWidth>

<MatrixHeight>1</MatrixHeight>

</TileMatrix>

<TileMatrix>

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<MatrixHeight>2</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>3</ows:Identifier>

<ScaleDenominator>69885283.00358972</ScaleDenominator>

<TopLeftCorner>-180 90</TopLeftCorner>

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<TileHeight>256</TileHeight>

<MatrixWidth>8</MatrixWidth>

<MatrixHeight>4</MatrixHeight>

</TileMatrix>

<TileMatrix>

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<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>16</MatrixWidth>

<MatrixHeight>8</MatrixHeight>

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<TileHeight>256</TileHeight>

<MatrixWidth>64</MatrixWidth>

<MatrixHeight>32</MatrixHeight>

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<ows:Identifier>7</ows:Identifier>

<ScaleDenominator>4367830.187724357</ScaleDenominator>

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<MatrixHeight>64</MatrixHeight>

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<MatrixHeight>128</MatrixHeight>

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<TopLeftCorner>-180 90</TopLeftCorner>

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<TileHeight>256</TileHeight>

<MatrixWidth>512</MatrixWidth>

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<MatrixWidth>1024</MatrixWidth>

<MatrixHeight>512</MatrixHeight>

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<MatrixWidth>2048</MatrixWidth>

<MatrixHeight>1024</MatrixHeight>

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<ows:Identifier>12</ows:Identifier>

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<TileWidth>256</TileWidth>

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<TileWidth>256</TileWidth>

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<MatrixWidth>262144</MatrixWidth>

<MatrixHeight>131072</MatrixHeight>

</TileMatrix>

</TileMatrixSet>

Universal Transverse Mercator WGS84 Quad for TileMatrixSet definition for zone 31

This is the XML definition of the UTM31WGS84Quad tile matrix set that can be reproduced by other standards needing to define a tile matrix set if the zone 31 is required. Not all TileMatrix elements need to be included and including other TileMatrices for more detailed scales is possible if they follow the same pattern.

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<ows:Identifier>UTM31WGS84Quad</ows:Identifier>

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-9501965.72931276 -20003931.4586255

</ows:LowerCorner>

<ows:UpperCorner>

10501965.7293128 20003931.4586255

</ows:UpperCorner>

</ows:BoundingBox>

<ows:SupportedCRS>

http://www.opengis.net/def/crs/EPSG/0/32631

</ows:SupportedCRS>

<TileMatrix>

<ows:Identifier>1</ows:Identifier>

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<MatrixHeight>2</MatrixHeight>

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<TileMatrix>

<ows:Identifier>2</ows:Identifier>

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<MatrixWidth>2</MatrixWidth>

<MatrixHeight>4</MatrixHeight>

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<TileMatrix>

<ows:Identifier>3</ows:Identifier>

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<MatrixHeight>8</MatrixHeight>

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<ows:Identifier>4</ows:Identifier>

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<ows:Identifier>5</ows:Identifier>

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<MatrixWidth>4096</MatrixWidth>

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<TileHeight>256</TileHeight>

<MatrixWidth>32768</MatrixWidth>

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<MatrixWidth>65536</MatrixWidth>

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<ows:Identifier>18</ows:Identifier>

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<TileHeight>256</TileHeight>

<MatrixWidth>131072</MatrixWidth>

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<TopLeftCorner>-9501965.72931276 20003931.4586255</TopLeftCorner>

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<MatrixWidth>262144</MatrixWidth>

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<ScaleDenominator>532.288941385105</ScaleDenominator>

<TopLeftCorner>-9501965.72931276 20003931.4586255</TopLeftCorner>

<TileWidth>256</TileWidth>

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<MatrixWidth>524288</MatrixWidth>

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<TileHeight>256</TileHeight>

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<ows:Identifier>23</ows:Identifier>

<ScaleDenominator>66.5361176731382</ScaleDenominator>

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<TileHeight>256</TileHeight>

<MatrixWidth>4194304</MatrixWidth>

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<ows:Identifier>24</ows:Identifier>

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<TopLeftCorner>-9501965.72931276 20003931.4586255</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>8388608</MatrixWidth>

<MatrixHeight>16777216</MatrixHeight>

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</TileMatrixSet>

* 1. Arctic Universal Polar Stereographic WGS 84 Quad TileMatrixSet definition.

This is the XML definition of the UPSArcticWGS84Quad tile matrix set that can be reproduced by other standards needing to define a tile matrix set. Not all TileMatrix elements need to be included and including other TileMatrices for more detailed scales is possible if they follow the same pattern.

<TileMatrixSet xml:id="UPSArcticWGS84Quad">

<ows:Title>UPSArcticWGS84Quad</ows:Title>

<ows:Identifier>Universal Polar Stereographic WGS 84 Quad for Arctic</ows:Identifier>

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<ows:UpperCorner>18440759.350252 18440759.350252</ows:UpperCorner>

</ows:BoundingBox>

<ows:SupportedCRS>

-14440759.350252 18440759.350252

</ows:SupportedCRS>

<TileMatrix>

<ows:Identifier>0</ows:Identifier>

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<MatrixWidth>2</MatrixWidth>

<MatrixHeight>2</MatrixHeight>

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<TileHeight>256</TileHeight>

<MatrixWidth>4</MatrixWidth>

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<ScaleDenominator>57340818.05</ScaleDenominator>

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<TileHeight>256</TileHeight>

<MatrixWidth>8</MatrixWidth>

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* 1. Antarctic Universal Polar Stereographic WGS84 Quad TileMatrixSet definition.

This is the XML definition of the UPSAntarcticWGS84Quad tile matrix set that can be reproduced by other standards needing to define a tile matrix set. Not all TileMatrix elements need to be included and including other TileMatrices for more detailed scales is possible if they follow the same pattern.

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<ows:Identifier> UPSAntarcticWGS84Quad </ows:Identifier>

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http://www.opengis.net/def/crs/EPSG/0/32662

</ows:SupportedCRS>

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* 1. European ETRS89 LAEA Quad TileMatrixSet definition.

This is the XML definition of the EuropeanETRS89\_LAEAQuad tile matrix set that can be reproduced by other standards needing to define a tile matrix set. Not all TileMatrix elements need to be included and including other TileMatrices for more detailed scales is possible if they follow the same pattern.

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* 1. Canadian Lambert Conformal Conic NAD83 TileMatrixSet definition.

This is the XML definition of the CanadianNAD83\_LCC tile matrix set that can be reproduced by other standards needing to define a tile matrix set. Not all TileMatrix elements need to be included and including other TileMatrices for more detailed scales is possible if they follow the same pattern.

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<ows:Identifier>2</ows:Identifier>

<ScaleDenominator>47247118.3037603</ScaleDenominator>

<TopLeftCorner>-34655800 39310000</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>13</MatrixWidth>

<MatrixHeight>14</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>3</ows:Identifier>

<ScaleDenominator>28348270.9822562</ScaleDenominator>

<TopLeftCorner>-34655800 39310000</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>21</MatrixWidth>

<MatrixHeight>22</MatrixHeight>

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<TileMatrix>

<ows:Identifier>4</ows:Identifier>

<ScaleDenominator>16536491.4063161</ScaleDenominator>

<TopLeftCorner>-34655800 39310000</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>36</MatrixWidth>

<MatrixHeight>38</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>5</ows:Identifier>

<ScaleDenominator>9449423.66075207</ScaleDenominator>

<TopLeftCorner>-34655800 39310000</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>62</MatrixWidth>

<MatrixHeight>66</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>6</ows:Identifier>

<ScaleDenominator>5669654.19645125</ScaleDenominator>

<TopLeftCorner>-34655800 39310000</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>103</MatrixWidth>

<MatrixHeight>110</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>7</ows:Identifier>

<ScaleDenominator>3307298.28126323</ScaleDenominator>

<TopLeftCorner>-34655800 39310000</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>177</MatrixWidth>

<MatrixHeight>188</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>8</ows:Identifier>

<ScaleDenominator>1889884.73215041</ScaleDenominator>

<TopLeftCorner>-34655800 39310000</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>309</MatrixWidth>

<MatrixHeight>329</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>9</ows:Identifier>

<ScaleDenominator>1133930.83929025</ScaleDenominator>

<TopLeftCorner>-34655800 39310000</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>515</MatrixWidth>

<MatrixHeight>548</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>10</ows:Identifier>

<ScaleDenominator>661459.656252643</ScaleDenominator>

<TopLeftCorner>-34655800 39310000</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>882</MatrixWidth>

<MatrixHeight>938</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>11</ows:Identifier>

<ScaleDenominator>396875.793751586</ScaleDenominator>

<TopLeftCorner>-34655800 39310000</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>1470</MatrixWidth>

<MatrixHeight>1563</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>12</ows:Identifier>

<ScaleDenominator>236235.591518802</ScaleDenominator>

<TopLeftCorner>-34655800 39310000</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>2469</MatrixWidth>

<MatrixHeight>2626</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>13</ows:Identifier>

<ScaleDenominator>137016.643080905</ScaleDenominator>

<TopLeftCorner>-34655800 39310000</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>4257</MatrixWidth>

<MatrixHeight>4528</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>14</ows:Identifier>

<ScaleDenominator>80320.1011163925</ScaleDenominator>

<TopLeftCorner>-34655800 39310000</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>7262</MatrixWidth>

<MatrixHeight>7723</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>15</ows:Identifier>

<ScaleDenominator>47247.1183037603</ScaleDenominator>

<TopLeftCorner>-34655800 39310000</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>12344</MatrixWidth>

<MatrixHeight>13130</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>16</ows:Identifier>

<ScaleDenominator>28348.2709822562</ScaleDenominator>

<TopLeftCorner>-34655800 39310000</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>20574</MatrixWidth>

<MatrixHeight>21882</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>17</ows:Identifier>

<ScaleDenominator>16536.4914063161</ScaleDenominator>

<TopLeftCorner>-34655800 39310000</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>35269</MatrixWidth>

<MatrixHeight>37512</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>18</ows:Identifier>

<ScaleDenominator>9449.42366075207</ScaleDenominator>

<TopLeftCorner>-34655800 39310000</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>61720</MatrixWidth>

<MatrixHeight>65646</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>19</ows:Identifier>

<ScaleDenominator>5669.65419645125</ScaleDenominator>

<TopLeftCorner>-34655800 39310000</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>102866</MatrixWidth>

<MatrixHeight>109409</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>20</ows:Identifier>

<ScaleDenominator>3307.29828126323</ScaleDenominator>

<TopLeftCorner>-34655800 39310000</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>176341</MatrixWidth>

<MatrixHeight>187558</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>21</ows:Identifier>

<ScaleDenominator>1889.88473215041</ScaleDenominator>

<TopLeftCorner>-34655800 39310000</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>308596</MatrixWidth>

<MatrixHeight>328227</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>22</ows:Identifier>

<ScaleDenominator>1133.93083929025</ScaleDenominator>

<TopLeftCorner>-34655800 39310000</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>514327</MatrixWidth>

<MatrixHeight>547044</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>23</ows:Identifier>

<ScaleDenominator>661.459656252643</ScaleDenominator>

<TopLeftCorner>-34655800 39310000</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>881703</MatrixWidth>

<MatrixHeight>937790</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>24</ows:Identifier>

<ScaleDenominator>396.875793751586</ScaleDenominator>

<TopLeftCorner>-34655800 39310000</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>1469505</MatrixWidth>

<MatrixHeight>1562983</MatrixHeight>

</TileMatrix>

<TileMatrix>

<ows:Identifier>25</ows:Identifier>

<ScaleDenominator>236.235591518802</ScaleDenominator>

<TopLeftCorner>-34655800 39310000</TopLeftCorner>

<TileWidth>256</TileWidth>

<TileHeight>256</TileHeight>

<MatrixWidth>2468768</MatrixWidth>

<MatrixHeight>2625811</MatrixHeight>

</TileMatrix>

</TileMatrixSet>

1. Example JSON documents (Informative)

This Annex provides example JSON documents than can be used to define tile matrix sets.

* 1. Web Mercator Quad TileMatrixSet definition.

This is the JSON definition of the WebMercatorQuad tile matrix set that can be reproduced by other standards needing to define a tile matrix set. Not all TileMatrix elements need to be included and including other TileMatrices for more detailed scales is possible if they follow the same pattern.

{

"type": "TileMatrixSet",

"title": "Google Maps Compatible for the World",

"identifier": "WebMercatorQuad",

"boundingBox":

{

"type": "BoundingBox",

"crs": "http://www.opengis.net/def/crs/EPSG/0/3857",

"lowerCorner": "-20037508.3427892 -20037508.3427892",

"upperCorner": "20037508.3427892 20037508.3427892"

},

"supportedCRS": "http://www.opengis.net/def/crs/EPSG/0/3857",

"wellKnownScaleSet": "http://www.opengis.net/def/wkss/OGC/1.0/GoogleMapsCompatible",

"TileMatrix":

[

{

"type": "TileMatrix",

"identifier": "0",

"scaleDenominator": 559082264.028717,

"topLeftCorner": "-20037508.3427892 20037508.3427892",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 1,

"MatrixHeight": 1

},

{

"type": "TileMatrix",

"identifier": "1",

"scaleDenominator": 279541132.014358,

"topLeftCorner": "-20037508.3427892 20037508.3427892",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 2,

"MatrixHeight": 2

},

{

"type": "TileMatrix",

"identifier": "2",

"scaleDenominator": 139770566.007179,

"topLeftCorner": "-20037508.3427892 20037508.3427892",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 4,

"MatrixHeight": 4

},

{

"type": "TileMatrix",

"identifier": "3",

"scaleDenominator": 69885283.0035897,

"topLeftCorner": "-20037508.3427892 20037508.3427892",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 8,

"MatrixHeight": 8

},

{

"type": "TileMatrix",

"identifier": "4",

"scaleDenominator": 34942641.5017948,

"topLeftCorner": "-20037508.3427892 20037508.3427892",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 16,

"MatrixHeight": 16

},

{

"type": "TileMatrix",

"identifier": "5",

"scaleDenominator": 17471320.7508974,

"topLeftCorner": "-20037508.3427892 20037508.3427892",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 32,

"MatrixHeight": 32

},

{

"type": "TileMatrix",

"identifier": "6",

"scaleDenominator": 8735660.37544871,

"topLeftCorner": "-20037508.3427892 20037508.3427892",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 64,

"MatrixHeight": 64

},

{

"type": "TileMatrix",

"identifier": "7",

"scaleDenominator": 4367830.18772435,

"topLeftCorner": "-20037508.3427892 20037508.3427892",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 128,

"MatrixHeight": 128

},

{

"type": "TileMatrix",

"identifier": "8",

"scaleDenominator": 2183915.09386217,

"topLeftCorner": "-20037508.3427892 20037508.3427892",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 256,

"MatrixHeight": 256

},

{

"type": "TileMatrix",

"identifier": "9",

"scaleDenominator": 1091957.54693108,

"topLeftCorner": "-20037508.3427892 20037508.3427892",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 512,

"MatrixHeight": 512

},

{

"type": "TileMatrix",

"identifier": "10",

"scaleDenominator": 545978.773465544,

"topLeftCorner": "-20037508.3427892 20037508.3427892",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 1024,

"MatrixHeight": 1024

},

{

"type": "TileMatrix",

"identifier": "11",

"scaleDenominator": 272989.386732772,

"topLeftCorner": "-20037508.3427892 20037508.3427892",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 2048,

"MatrixHeight": 2048

},

{

"type": "TileMatrix",

"identifier": "12",

"scaleDenominator": 136494.693366386,

"topLeftCorner": "-20037508.3427892 20037508.3427892",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 4096,

"MatrixHeight": 4096

},

{

"type": "TileMatrix",

"identifier": "13",

"scaleDenominator": 68247.346683193,

"topLeftCorner": "-20037508.3427892 20037508.3427892",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 8192,

"MatrixHeight": 8192

},

{

"type": "TileMatrix",

"identifier": "14",

"scaleDenominator": 34123.6733415964,

"topLeftCorner": "-20037508.3427892 20037508.3427892",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 16384,

"MatrixHeight": 16384

},

{

"type": "TileMatrix",

"identifier": "15",

"scaleDenominator": 17061.8366707982,

"topLeftCorner": "-20037508.3427892 20037508.3427892",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 32768,

"MatrixHeight": 32768

},

{

"type": "TileMatrix",

"identifier": "16",

"scaleDenominator": 8530.91833539913,

"topLeftCorner": "-20037508.3427892 20037508.3427892",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 65536,

"MatrixHeight": 65536

},

{

"type": "TileMatrix",

"identifier": "17",

"scaleDenominator": 4265.45916769956,

"topLeftCorner": "-20037508.3427892 20037508.3427892",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 131072,

"MatrixHeight": 131072

},

{

"type": "TileMatrix",

"identifier": "18",

"scaleDenominator": 2132.72958384978,

"topLeftCorner": "-20037508.3427892 20037508.3427892",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 262144,

"MatrixHeight": 262144

},

{

"type": "TileMatrix",

"identifier": "19",

"scaleDenominator": 1066.36479192489,

"topLeftCorner": "-20037508.3427892 20037508.3427892",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 524288,

"MatrixHeight": 524288

},

{

"type": "TileMatrix",

"identifier": "20",

"scaleDenominator": 533.182395962445,

"topLeftCorner": "-20037508.3427892 20037508.3427892",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 1048576,

"MatrixHeight": 1048576

},

{

"type": "TileMatrix",

"identifier": "21",

"scaleDenominator": 266.591197981222,

"topLeftCorner": "-20037508.3427892 20037508.3427892",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 2097152,

"MatrixHeight": 2097152

},

{

"type": "TileMatrix",

"identifier": "22",

"scaleDenominator": 133.295598990611,

"topLeftCorner": "-20037508.3427892 20037508.3427892",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 4194304,

"MatrixHeight": 4194304

},

{

"type": "TileMatrix",

"identifier": "23",

"scaleDenominator": 66.6477994953056,

"topLeftCorner": "-20037508.3427892 20037508.3427892",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 8388608,

"MatrixHeight": 8388608

},

{

"type": "TileMatrix",

"identifier": "24",

"scaleDenominator": 33.3238997476528,

"topLeftCorner": "-20037508.3427892 20037508.3427892",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 16777216,

"MatrixHeight": 16777216

}

]

}

You can define an arbitrary number of zoom levels. Here, 25 zoom levels are illustrated.

* 1. World Mercator WGS84 Quad TileMatrixSet definition.

This is the JSON definition of the WorldMercatorQuad tile matrix set that can be reproduced by other standards needing to define a tile matrix set. Not all TileMatrix elements need to be included and including other TileMatrices for more detailed scales is possible if they follow the same pattern.

{

"type": "TileMatrixSet",

"title": "CRS84 for the World",

"identifier": "WorldCRS84Quad",

"boundingBox":

{

"type": "BoundingBox",

"crs": "http://www.opengis.net/def/crs/OGC/1.3/CRS84",

"lowerCorner": "-180 -90",

"upperCorner": "180 90"

},

"supportedCRS": "http://www.opengis.net/def/crs/OGC/1.3/CRS84",

"wellKnownScaleSet": "http://www.opengis.net/def/wkss/OGC/1.0/GoogleCRS84Quad",

"TileMatrix":

[

{

"type": "TileMatrix",

"identifier": "0",

"scaleDenominator": 279541132.014358,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 2,

"MatrixHeight": 1

},

{

"type": "TileMatrix",

"identifier": "1",

"scaleDenominator": 139770566.007179,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 4,

"MatrixHeight": 2

},

{

"type": "TileMatrix",

"identifier": "2",

"scaleDenominator": 69885283.0035897,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 8,

"MatrixHeight": 4

},

{

"type": "TileMatrix",

"identifier": "3",

"scaleDenominator": 34942641.5017948,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 16,

"MatrixHeight": 8

},

{

"type": "TileMatrix",

"identifier": "4",

"scaleDenominator": 17471320.7508974,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 32,

"MatrixHeight": 16

},

{

"type": "TileMatrix",

"identifier": "5",

"scaleDenominator": 8735660.37544871,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 64,

"MatrixHeight": 32

},

{

"type": "TileMatrix",

"identifier": "6",

"scaleDenominator": 4367830.18772435,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 128,

"MatrixHeight": 64

},

{

"type": "TileMatrix",

"identifier": "7",

"scaleDenominator": 2183915.09386217,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 256,

"MatrixHeight": 128

},

{

"type": "TileMatrix",

"identifier": "8",

"scaleDenominator": 1091957.54693108,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 512,

"MatrixHeight": 256

},

{

"type": "TileMatrix",

"identifier": "9",

"scaleDenominator": 545978.773465544,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 1024,

"MatrixHeight": 512

},

{

"type": "TileMatrix",

"identifier": "10",

"scaleDenominator": 272989.386732772,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 2048,

"MatrixHeight": 1024

},

{

"type": "TileMatrix",

"identifier": "11",

"scaleDenominator": 136494.693366386,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 4096,

"MatrixHeight": 2048

},

{

"type": "TileMatrix",

"identifier": "12",

"scaleDenominator": 68247.346683193,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 8192,

"MatrixHeight": 4096

},

{

"type": "TileMatrix",

"identifier": "13",

"scaleDenominator": 34123.6733415964,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 16384,

"MatrixHeight": 8192

},

{

"type": "TileMatrix",

"identifier": "14",

"scaleDenominator": 17061.8366707982,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 32768,

"MatrixHeight": 16384

},

{

"type": "TileMatrix",

"identifier": "15",

"scaleDenominator": 8530.91833539913,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 65536,

"MatrixHeight": 32768

},

{

"type": "TileMatrix",

"identifier": "16",

"scaleDenominator": 4265.45916769956,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 131072,

"MatrixHeight": 65536

},

{

"type": "TileMatrix",

"identifier": "17",

"scaleDenominator": 2132.72958384978,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 262144,

"MatrixHeight": 131072

}

]

}

You can define an arbitrary number of zoom levels. Here, 19 zoom levels are illustrated but resolutions up to 24 are currently available in some mass market services.

* 1. World CRS84 Quad TileMatrixSet definition.

This is the XML definition of the WorldCRS84Quad tile matrix set that can be reproduced by other standards needing to define a tile matrix set. Not all TileMatrix elements need to be included and including other TileMatrices for more detailed scales is possible if they follow the same pattern.

{

"type": "TileMatrixSet",

"title": "World Mercator WGS84 (ellipsoid)",

"identifier": "WorldMercatorWGS84Quad",

"boundingBox":

{

"type": "BoundingBox",

"crs": "http://www.opengis.net/def/crs/EPSG/0/3395",

"lowerCorner": "-20037508.3427892 -20037508.3427892",

"upperCorner": "20037508.3427892 20037508.3427892"

},

"supportedCRS": "http://www.opengis.net/def/crs/EPSG/0/3395",

"wellKnownScaleSet": "http://www.opengis.net/def/wkss/OGC/1.0/WorldMercatorWGS84",

"TileMatrix":

[

{

"type": "TileMatrix",

"identifier": "0",

"scaleDenominator": 279541132.014358,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 2,

"MatrixHeight": 1

},

{

"type": "TileMatrix",

"identifier": "1",

"scaleDenominator": 139770566.007179,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 4,

"MatrixHeight": 2

},

{

"type": "TileMatrix",

"identifier": "2",

"scaleDenominator": 69885283.0035897,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 8,

"MatrixHeight": 4

},

{

"type": "TileMatrix",

"identifier": "3",

"scaleDenominator": 34942641.5017948,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 16,

"MatrixHeight": 8

},

{

"type": "TileMatrix",

"identifier": "4",

"scaleDenominator": 17471320.7508974,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 32,

"MatrixHeight": 16

},

{

"type": "TileMatrix",

"identifier": "5",

"scaleDenominator": 8735660.37544871,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 64,

"MatrixHeight": 32

},

{

"type": "TileMatrix",

"identifier": "6",

"scaleDenominator": 4367830.18772435,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 128,

"MatrixHeight": 64

},

{

"type": "TileMatrix",

"identifier": "7",

"scaleDenominator": 2183915.09386217,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 256,

"MatrixHeight": 128

},

{

"type": "TileMatrix",

"identifier": "8",

"scaleDenominator": 1091957.54693108,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 512,

"MatrixHeight": 256

},

{

"type": "TileMatrix",

"identifier": "9",

"scaleDenominator": 545978.773465544,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 1024,

"MatrixHeight": 512

},

{

"type": "TileMatrix",

"identifier": "10",

"scaleDenominator": 272989.386732772,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 2048,

"MatrixHeight": 1024

},

{

"type": "TileMatrix",

"identifier": "11",

"scaleDenominator": 136494.693366386,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 4096,

"MatrixHeight": 2048

},

{

"type": "TileMatrix",

"identifier": "12",

"scaleDenominator": 68247.346683193,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 8192,

"MatrixHeight": 4096

},

{

"type": "TileMatrix",

"identifier": "13",

"scaleDenominator": 34123.6733415964,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 16384,

"MatrixHeight": 8192

},

{

"type": "TileMatrix",

"identifier": "14",

"scaleDenominator": 17061.8366707982,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 32768,

"MatrixHeight": 16384

},

{

"type": "TileMatrix",

"identifier": "15",

"scaleDenominator": 8530.91833539913,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 65536,

"MatrixHeight": 32768

},

{

"type": "TileMatrix",

"identifier": "16",

"scaleDenominator": 4265.45916769956,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 131072,

"MatrixHeight": 65536

},

{

"type": "TileMatrix",

"identifier": "17",

"scaleDenominator": 2132.72958384978,

"topLeftCorner": "-180 90",

"tileWidth": 256,

"TileHeight": 256,

"MatrixWidth": 262144,

"MatrixHeight": 131072

}

]

}

Universal Transverse Mercator WGS84 Quad for TileMatrixSet definition for zone 31

This is the JSON definition of the UTM31WGS84Quad tile matrix set that can be reproduced by other standards needing to define a tile matrix set if the zone 31 is required. Not all TileMatrix elements need to be included and including other TileMatrices for more detailed scales is possible if they follow the same pattern.

TBD

* 1. Arctic Universal Polar Stereographic WGS 84 Quad TileMatrixSet definition.

TBD

* 1. Antarctic Universal Polar Stereographic WGS84 Quad TileMatrixSet definition.

This is the JSON definition of the UPSAntarcticWGS84Quad tile matrix set that can be reproduced by other standards needing to define a tile matrix set. Not all TileMatrix elements need to be included and including other TileMatrices for more detailed scales is possible if they follow the same pattern.

TBD

* 1. European ETRS89 LAEA Quad TileMatrixSet definition.

This is the XML definition of the EuropeanETRS89\_LAEAQuad tile matrix set that can be reproduced by other standards needing to define a tile matrix set. Not all TileMatrix elements need to be included and including other TileMatrices for more detailed scales is possible if they follow the same pattern.

TBD

* 1. Canadian Lambert Conformal Conic NAD83 TileMatrixSet definition.

This is the XML definition of the CanadianNAD83\_LCC tile matrix set that can be reproduced by other standards needing to define a tile matrix set. Not all TileMatrix elements need to be included and including other TileMatrices for more detailed scales is possible if they follow the same pattern.

TBD

1. Pseudocode (Informative)

This informative Annex provides pseudocode that illustrates how to get the tiles that cover a bounding box rectangle and how to get the CRS coordinates that bounds a tile.

* 1. From BBOX to tile indices

The following fragment of pseudocode could be used to convert from a desired bounding box (bBoxMinX, bBoxMinY, bBoxMaxX, bBoxMaxY) in CRS coordinates to a range of tile set indices. This pseudocode uses the same notation that subclause 6.1.1 uses. In this pseudocode we assume that bBoxMinX, bBoxMinY, bBoxMaxX, bBoxMaxY, tileMatrixMinX, tileMatrixMinY, tileMatrixMinY, tileMatrixMaxY, tileSpanX and tileSpanY are floating point variables (IEEE-754) that have accuracy issues derived from the finite precision of the representation. These accuracy issues could be amplified in a typical floor() rounding down function that could return a value ±1 than that expected. To overcome this issue this code uses a small value (epsilon) added or subtracted in a place that is not affected by CRS coordinate precision.

*// to compensate for floating point computation inaccuracies*

epsilon = 1e-6

tileMinCol = floor((bBoxMinX - tileMatrixMinX) / tileSpanX + epsilon)

tileMaxCol = floor((bBoxMaxX - tileMatrixMinX) / tileSpanX - epsilon)

tileMinRow = floor((tileMatrixMaxY - bBoxMaxY) / tileSpanY + epsilon)

tileMaxRow = floor((tileMatrixMaxY - bBoxMinY) / tileSpanY - epsilon)

*// to avoid requesting out-of-range tiles*

if (tileMinCol < 0) tileMinCol = 0

if (tileMaxCol >= matrixWidth) tileMaxCol = matrixWidth-1

if (tileMinRow < 0) tileMinRow = 0

if (tileMaxRow >= matrixHeight) tileMaxRow = matrixHeight-1

To fetch all the tiles that cover this bounding box, a client would scan through tileMinCol to tileMaxCol and tileMinRow to tileMaxRow, all inclusive. A total of (tileMaxCol- tileMinCol+1) × (tileMaxRow- tileMinRow+1) will be fetched.

* 1. From tile indices to BBOX

The following pseudocode could be used to convert from a pair of tile indices (tileCol, tileRow) to the bounding box (in CRS coordinates) of this tile defined by the upper-left corner (leftX, upperY) of the tile:

leftX = tileCol \* tileSpanX + tileMatrixMinX

upperY = tileMatrixMaxY - tileRow \* tileSpanY

and the lower-right corner (rightX, lowerY) of the tile:

rightX = (tileCol+1) \* tileSpanX + tileMatrixMinX

lowerY = tileMatrixMaxY – (tileRow+1) \* tileSpanY

.

1. : Revision history

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Date | Release | Author | Paragraph modified | Description |
| 2017-08-04 | v0.1 | Joan Masó | All | Initial draft |
|  |  |  |  |  |
|  |  |  |  |  |

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