Release Notes for OGC Two Dimensional Tile Matrix Set and Tile Set Metadata v.2.0

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Standard.**Preface**

This document provides the set of revision notes for OGC Two Dimensional Tile Matrix Set and Tile Set Metadata [OGC 17-083r3]> and does not modify that Standard.

This document provides the details of edits, deficiency corrections, and enhancements of the above-referenced Standard. It also documents those items that have been deprecated. Finally, this document provides implementations details related to issues of backwards compatibility.

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Keywords

ogcdoc,

Chapter 1. Introduction

1.1. Scope

The OGC Two Dimensional Tile Matrix Set and Tile Set Metadata v.2.0 (OGC 17-083r3) is a revision to the OGC Two Dimensional Tile Matrix Set v.1.0 (OGC 17-083r2) that is currently published. The new document is designed to replace OGC 17-083r2 completely. The revision defines a data model for tile matrix sets and how to encode in XML and in JSON. This revision adds a new data model to describe tilesets and how to encode in XML and in JSON.

1.2. Document contributor contact points

All questions regarding this document should be directed to the contacts provided below or the referenced Standard editor(s).

Table 1. Contacts

Name	Organization
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Chapter 2. References

The following normative documents are new or updated references in the Standard to which these Release Notes apply.

OGC: OGC 17-083r3 OGC Two Dimensional Tile Matrix Set and Tile Set Metadata (2021)

Chapter 3. Terms and definitions

This document uses the terms defined in Sub-clause 5.3 of [OGC 06-121r8], 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.

3.1. administrative change

An administrative change is a change that does not alter the conformance abstract tests for any requirements. It includes typographical errors, changes in wording to improve clarity or consistency, and perfunctory changes such as changes in version numbers.

3.2. critical change

A critical change is a change that alters requirements in a way that is known to cause reverse compatibility issues.

3.3. substantive change

A substantive change is a change that alters requirements in a way that is not deemed to have a high risk for causing reverse compatibility issues.

3.4. abbreviated terms

TMS: Tile Matrix Set

Chapter 4. Change Log

4.1. KEY

- Source:
  - Change Request (CR)
  - GitHub Issue
  - Editor - The TileMatrixSet document Editor
  - OGC-NA - OGC Naming Authority review
  - Public - Public Comment period
  - SWG decision
  - User - The TileMatrixSet User Community
  - Other
- Identifier: Change Request number or issue number and pull request/commit in GitHub
- Type:
  - A=Administrative
  - S=Substantive
  - C=Critical

See Description of Critical Changes for more information on critical changes, Description of Substantive Changes for more information on substantive changes and Description of Administrative Changes for more information on administrative changes.

- Section: Section number in the updated document
- Description: Brief text describing the change
- Purpose: the reason for the change:
  - Clarity
  - Consistency
  - Interoperability
  - Perfunctory
  - Readability
  - Usability
  - Completeness

4.2. Change Table

Table 2. Change Log

Source	Identifier	Type	Section	Description	Purpose
GitHub	#11	Administrative	Title	Title was renamed to include "tileset metadata"	Clarity
GitHub	#1	Substantive	4	Align with the Abstract specification Topic 22 - Core Tiling Conceptual and Logical Models for 2D Euclidean Space OGC 19-014r3	Consistency
GitHub	#13	Substantive	5	OWS Common dependency removed	Interoperability
GitHub	#12	Substantive	5	Allowing embedded WKT2 CRS definition in addition to CRS by reference	Interoperability
GitHub	#34	Critical	6	Identifying with `uri` a well-known TileMatrixSet in the official OGC registry	Usability
GitHub	#5	Critical	6	Replacing `topLeftCorner` by `pointOfOrigin`	Usability
GitHub	#30	Critical	6	Renaming `supportedCRS` to `crs`	Consistency
GitHub	#4, #5	Substantive	6	Adding `cellSize` and `cornerOfOrigin`	Usability
GitHub	#18	Substantive	6	Making `boundingBox` optional	Usability
GitHub	#18	Substantive	6	Adding optional `orderedAxes` to highlight CRS axis ordering	Usability
Editor	NA	Critical	7	JSON encoding rules to derive a more natural JSON encoding from UML	Interoperability
GitHub	#7	Substantive	7	Removing `type` object properties	Consistency
Editor	NA	Substantive	7	Removing the JSON-LD due lack of interest and concerns on real use cases. It can be reintroduced at later stage	Interoperability
GitHub	#10, #11, #30	Critical	8	New data model for tileset metadata that includes the TileMatrixSetLimits and replaces TileMatrixSetLink	Completeness
GitHub	#34	Critical	8	Linking to (rel: `tiling-scheme`) or embedding a TileMatrixSet definition, and identifying use of registered TileMatrixSet with `tileMatrixSetURI`	Completeness

Source	Identifier	Type	Section	Description	Purpose
GitHub	#10, #11	Substantive	9	New XML and JSON encoding for tileset metadata. It could be useful for the new OGC API Tiles	Completeness
GitHub	#31	Administrative	Annex D, F	Correcting axis order confusion for the EuropeanETRS89_LAEAQuad TMS	Consistency
GitHub	#22	Substantive	Annex E	New annex with variable width TMS definitions	Completeness
GitHub	#17	Substantive	Annex G	Added example encodings of CDB variable width TMS	Completeness
GitHub	#26	Substantive	Annex J	New annex with consideration for Extending TileMatrixSets for additional dimensions	Completeness
GitHub	#6, #7	Administrative	All	Correction of mistakes and inconsistencies in UML, XML and JSON encodings	Consistency

Chapter 5. Description of Critical Changes

This section enumerates changes from the previous version of this Standard which break compatibility and justified an increase of the major revision number for this new version. Because of these changes, clients expecting the old version of the definition of a TileMatrixSet or of a TileMatrixSetLink (replaced) will not be able to readily handle the new version, and clients expecting the new version will not be able to readily handle the old version. Neither the JSON encoding nor the XML encoding of the previous version will validate against the schemas of the new version, and vice-versa. However, from a conceptual standpoint, there is a simple and clear mapping from the previous encoding to the new version, and only few minor changes are required.

5.1. Identifying with `uri` a well-known TileMatrixSet in an authoritative registry

A TileMatrixSet registered on e.g. the official OGC NA TileMatrixSets registry now identifies itself as such with a `uri` property pointing to the canonical definition.

5.2. Replacing `topLeftCorner` by `pointOfOrigin`

The `topLeftCorner` property is replaced by `pointOfOrigin` to reflect the fact that tile matrix rows can now be counted starting from the bottom (based on the enumeration value of `cornerOfOrigin` property).

5.3. Renaming `supportedCRS` to `crs`

The `supportedCRS` property was renamed to the more appropriate `crs`, since it identifies the one CRS in which the TileMatrixSet is defined. Additionally, a new clause clarifies the compatibility between a TileSet CRS and its TileMatrixSet CRS, facilitating the re-use of common registered TileMatrixSets.

5.4. JSON encoding rules to derive a more natural JSON encoding from UML

Some extra rules for deriving JSON encodings from UML that results in a more natural output were introduced.

As a result, some properties were renamed. For example in the JSON encoding, `identifier` was renamed to `id`, `tileMatrix` was renamed to the plural `tileMatrices` (since its value is an array of multiple tile matrices), and `variableMatrixWidth` was renamed to plural `variableMatrixWidths` as well.

5.5. Data model for tileset metadata

In version 1.0 there was a concept of TileMatrixSetLink (and data structure) designed to allow a tiled dataset (tileset) to declare the use of a tile matrix set defined elsewhere and, if needed, a limited coverage for this tile matrix set. In this standard, this concept has been extended into a

much more comprehensive TileSetMetadata structure that contains the metadata describing a set of tiles representing the same geospatial data and conforming to the same tile matrix set (a tileset). This metadata includes among other things the inherited description of the tileset limits with respect to the often well-known TileMatrixSet, the source data layers either used to render the tiles (e.g. for map tiles) or contained within the tiles (e.g. for vector tiles) as well as associated schemas for their properties, and an optional center point suggesting where to start visualization. Even if the new data structure looks different and covers more use cases, the previous functionality provided by the TileMatrixSetLink data structure is still included in the TileSetMetadata structure.

Equivalences from the old version into the new version are:

Table 3. Equivalences between the old and new data structures

Previous version (1.0)	Current version (2.0)
TileMatrixSetLink	TileSetMetadata

5.6. Linking to (rel: `tiling-scheme`) or embedding a TileMatrixSet definition, and identifying use of registered TileMatrixSet with `tileMatrixSetURI`

A `tileMatrixSetURI` is now used for the tileset metadata to reference a TileMatrixSet registered on an authoritative TileMatrixSets registry, such as the OGC NA's. In addition, either a link to a TileMatrixSet (using a `rel`=tiling-scheme), or an embedded TileMatrixSet definition (for offline use cases) must be provided. This link can be either to an authoritative registry TileMatrixSet definition (such as the OGC NA's), or to the server's own local definition (e.g. at `/tileMatrixSets/{tileMatrixSetID}`).

Chapter 6. Description of Substantive Changes

This section enumerates the main changes done from the previous version of this Standard which are significant, but do not affect backward compatibility. If only for these changes, unmodified existing clients would have been able to use existing TileMatrixSet definitions without any changes. However, since this version also introduces critical changes, both clients (consumers) and servers (producers) will require modifications to conform to the new version, and the encodings of the previous version will not validate against the schemas of this new version, and vice-versa.

6.1. Align with the Abstract specification Topic 22

Significant effort has been done to align the terminology with the Abstract specification Topic 22 - Core Tiling Conceptual and Logical Models for 2D Euclidean Space OGC 19-014r3. The most significant addition is the "tile set concept" ("set of tiles - a collection of subsets of the space being partitioned. [OGC 19-014r3]").

6.2. OWS Common dependency removed

We removed the dependency to OWS common and imported the necessary element in the document instead: LanguageString, Description Title Keyword data elements and Bounding Box.

6.3. Allowing embedded WKT2 CRS definition in addition to CRS by reference

In this version of the standard, the possibility to define a CRS using a full description in addition to a reference to an external CRS catalogue is introduced. For backwards compatibility, CRSType still defaults to a URI but is extended to a union of three possibilities (URI, WKT2 CRS, or ISO 19115 MD_ReferenceSystem).

6.4. Adding `cellSize` and `cornerOfOrigin`

The `cellSize` of a tile matrix is added to complement the existing `scaleDenominator` of a tile matrix. They are related by the use of the standard 0.28mm pixel size so they are complementary. `cornerOfOrigin` was added to allow for bottom-left origin of the tile rows indices, in addition to the common top-left.

6.5. Making `boundingBox` optional

The `boundingBox` property was made optional, highlighting the fact that the space occupied by tiles is really defined by the `pointOfOrigin` as well as the `scaleDenominator` / `resolution`, and the `matrixWidth` and `matrixHeight` of **each** TileMatrix, not the `boundingBox` of the overall TileMatrixSet. Examples were updated to not define the bounding box, which should not be relied upon by clients.

6.6. Adding optional `orderedAxes` to highlight CRS axis ordering

An optional `orderedAxes` property can be used to highlight the axis ordering of the TileMatrixSet's CRS without having to look up the CRS definition. It should also help avoid mistakes where the axis ordering used for specifying the TileMatrices `pointOfOrigin` is inconsistent with the CRS axis ordering. However, this property cannot be used to modify the axis ordering defined by the CRS. Examples were updated to include this property.

6.7. Removing `type` object properties

The `type` property of the JSON encoding (e.g. `TileMatrixSetType`) were removed, as they were superfluous because wherever it was used, each property could only be of a s single type (no polymorphism is required). Additionnally, it was agreed that when such `type` property would be used in future specifications, the enumeration values would avoid a `Type` suffix.

6.8. Removing the JSON-LD

Due to the lack of interest and concerns on real use cases the JSON-LD encoding was removed. It can be reintroduced at later stage if there is demand.

6.9. XML and JSON encoding for tileset metadata

An XML and JSON encoding for tileset metadata was included. The JSON encoding will likely constitute a basis for the upcoming *OGC API - Tiles* specification's *TileSet* conformance class.

6.10. New annex with variable width TileMatrixSets definitions

This new Annex E includes the description of variable width TileMatrixSets that complements some already existing examples which have been moved to the Annex G. It also mentions a possible relationship to axis-aligned DGGS.

6.11. Added example encodings of CDB variable width TileMatrixSet

JSON and XML definitions of the CDB tile matrix set are added to Annex G as another example of Variable width tile matrix sets.

6.12. New annex with consideration for Extending TileMatrixSets for additional dimensions

The informative Annex J proposes approaches for extending TileMatrixSets and TileSet metadata

for indexing and accessing 3D, 4D and n-D (n > 2) data as tiles, regardless of whether a simple file-based data store, a database (e.g. a GeoPackage) or a web API is used. All of these approaches assume that the multi-dimensional content spans the two dimensions defined by 2D TileMatrixSets, which are usually either latitude and longitude for geographic CRSes, or X/Easting or Y/Northing for projected CRSes, as well as other extra dimensions.

Chapter 7. Description of Administrative Changes

This section enumerates the editorial and corrective changes done from the previous version of this Standard. The corrections address issues in the previous version which could result in interoperability issues, and as a result implementations are encouraged to migrate to this newer version. The previous version will likely be deprecated.

7.1. Title was renamed to include "tileset metadata"

The title of the document was renamed from "Two Dimensional Tile Matrix Set" to "Two Dimensional Tile Matrix Set and Tile Set Metadata" to reflect the fact that the TileMatrixLink class which served the simple purpose of identifying a TileMatrixSet being used, as well as the limits of a particular tile set, has been replaced by a more comprehensive set of metadata about the tile set, including the description of data layers to better support vector tiles use cases.

The document has also been re-organized to more clearly separate into dedicated sections the concepts, schemas, encodings and examples treating with either the definition of the tile matrix set or of the tile set metadata.

7.2. Correcting axis order confusion for the EuropeanETRS89_LAEAQuad TileMatrixSet

The previous version of this Standard mistakenly assumed a wrong CRS axis order for the *EuropeanETRS89_LAEAQuad* TileMatrixSet encoding examples.

This was partly because unlike most projected CRS, EPSG:3035 (Lambert Azimuhal Equal Area for Europe, based on ETRS89) defines a *Northing, Easting* axis order. In hope of minimizing the re-occurrence of such axis order confusion in the future, an optional `orderedAxes` was added to the TileMatrixSet definition which can highlight the CRS order (without overriding it) to help ensure the consistency and correct interpretation of encoded definitions.

The order of the bounding box coordinates (which should actually be ignored by clients, and was made optional) as well as that of the `pointOfOrigin` (`topLeftCorner` in previous version) coordinates should have been flipped, `[ 5500000.0, 2000000.0 ]` being the correct `pointOfOrigin` for all tile matrices. The correct bounding box would be northing / Y going from 1,000,000.0 to 5,500,000.0, and easting / X going from 2,000,000.0 to 6,500,000.0, i.e. `lowerLeft` being `[ 1000000.0, 2000000.0 ]` and `upperRight` being `[ 5500000.0, 6500000.0 ]`.

7.3. Correction of mistakes and inconsistencies in UML, XML and JSON encodings

In addition to the *EuropeanETRS89_LAEAQuad* axis order confusion, a number of reported mistakes and inconsistencies were corrected in this new version:

- The encoding examples used curved quotes rather than straight quotes, making them invalid JSON and XML.

- The *WorldMercatorWGS84Quad* tile matrices were wrongly assigned to a `tileHeight` property rather than `tileMatrices` in its JSON encoding.

- The *WorldMercatorWGS84Quad* tile matrix definitions were off by one (`scaleDenominator`, `matrixWidth` and `matrixHeight` would have been correct for the following TileMatrix identifier).

- The *WorldMercatorWGS84Quad* `topLeftCorner` (now `pointOfOrigin`) were wrong (geographic coordinates rather than projected coordinates).

- The `WorldCRS84QuadVariableWidth.json` example encoding of a TileMatrixSet with variable widths had the same identifier as the regular *WorldCRS84Quad* tile matrix set. This example is not registered on the OGC NA registry, and has been removed as it was mostly a duplication of the *GNOSISGlobalGrid* tile matrix set, with the only exception of adding an additional tile matrix. That extra lower zoom level tile matrix 0 made tile matrices correspond with the registered *WorldCRS84Quad* tile matrix set definition, except for the variable width coalescence factors. The *CDBGlobalGrid* was added as an additional example of a variable width tile matrix set instead.

Chapter 8. Future Work

The future work will now focus on leveraging the concepts and encodings of TileMatrixSets and TileSet metadata defined in this standard as the basis for the OGC API - Tiles specification. We do not expect immediate changes to this standard in the near future. However the need for harmonization with other approaches for multidimensional tiles has been detected.

Appendix A: Revision History

Table 4. Revision History

Date	Release	Editor	Primary clauses modified	Descriptions

Date	Release	Editor	Primary clauses modified	Descriptions

Appendix B: Bibliography