OGC CDB Core Model and Physical Structure Annexes (Best Practice)

Open Geospatial Consortium

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i. Abstract

This document provides the Annexes for the CDB Core: Model and Physical Structure Standard. The only exception is Annex A, Abstract Test Suite (ATS). The CDB ATS Annex is in Volume 1: Core document.

ii. Keywords

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

ogcdoc, OGC document, ogcdoc, CDB, annexes

iii. Preface

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.

iv. Submitting organizations

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

Organization name(s)

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- Carl Reed, OGC Individual Member
- Envitia, Ltd
- Glen Johnson, OGC Individual Member
- KaDSci, LLC
- Laval University
- Open Site Plan
- University of Calgary
- UK Met Office

The OGC CDB standard is based on and derived from an industry developed and maintained specification, which has been approved and published as OGC Document 15-003: OGC Common Data Base Volume 1 Main Body. An extensive listing of contributors to the legacy industry-led CDB specification is at Chapter 11, pp 475-476 in that OGC Best Practices Document (https://portal.opengeospatial.org/files/?artifact_id=61935).

v. Submitters

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

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Chapter 1. Scope

This document contains a number of annexes related to the OGC CDB Core standard.

For the purposes of being able to cross reference this OGC Best Practice with the previous versions of the CDB standard, the following annex “crosswalk” is provided.

OGC Best Practice and CDB 3.2	OGC CDB Standard Version 1.0
Formerly Annex A10 in Volume 2	Annex B Rationale: Sensor Simulation - Achieving Device-Independence
Main Body: Rationale for using JPEG	Annex C Reasons for Using JPEG
Formerly Annex B in Volume 2	Annex D: TIFF Implementation Requirements
Formerly Annex D in Volume 2	Annex E: ShapeFile dBASE III Guidance
Formerly Annex A.11 in Volume 2	Annex F: Annex F Rationale: Partitioning the Earth into Tiles
Formerly Annex A.12	Annex G Rationale: Importance of Level of Detail
Formerly Annex A.17 Volume 2	Annex H: JPEG Informative annex
Was Annex U, Volume 2	Annex I ZIP File Informative annex
Formerly Annex E, Volume 2	Annex J: Light Hierarchy
Formerly Annex M, Volume 2	Annex M: CDB Directory Naming and Structure
Formerly Annex O, Volume 2	Annex O: List of Texture Component Selectors
Formerly Annex Q, Volume 2	Annex Q: Table of Dataset Codes
Formerly Annex R, Volume 2	Annex R: Derived Datasets within the CDB
Formerly Annex S, Volume 2	Annex S: Default Read and Write values to be used by Simulator Client-Devices

For ease of editing and review, the standard has been separated into 12 Volumes and a schema repository.

- Volume 0: OGC CDB Companion Primer for the CDB standard (Best Practice).
- Volume 1: OGC CDB Core Standard: Model and Physical Data Store Structure. The main body (core) of the CDB standard (Normative).
- Volume 2: OGC CDB Core Model and Physical Structure Annexes (Best Practice).
- Volume 3: OGC CDB Terms and Definitions (Normative).
- Volume 4: OGC CDB Rules for Encoding CDB Vector Data using Shapefiles (Best Practice).
- Volume 5: OGC CDB Radar Cross Section (RCS) Models (Best Practice).
- Volume 6: OGC CDB Rules for Encoding CDB Models using OpenFlight (Best Practice).
- Volume 7: OGC CDB Data Model Guidance (Best Practice).
- Volume 8: OGC CDB Spatial Reference System Guidance (Best Practice).

- Volume 9: OGC CDB Schema Package: http://schemas.opengis.net/cdb/ provides the normative schemas for key features types required in the synthetic modelling environment. Essentially, these schemas are designed to enable semantic interoperability within the simulation context (Normative).
- Volume 10: OGC CDB Implementation Guidance (Best Practice).
- Volume 11: OGC CDB Core Standard Conceptual Model (Normative).
- Volume 12: OGC CDB Navaids Attribution and Navaids Attribution Enumeration Values (Best Practice).
- Volume 13: OGC CDB Rules for Encoding CDB Vector Data using GeoPackage (Normative, Optional Extension).
- Volume 14: OGC CDB Guidance on Conversion of CDB Shapefiles into CDB GeoPackages (Best Practice).
- Volume 15: OGC CDB Optional Multi-Spectral Imagery Extension (Normative).

Chapter 2. Conformance

This section is not applicable to this document.

Chapter 3. References

The following normative documents contain provisions that, through reference 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.

Chapter 4. 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 Best Practice.

Other Terms and Definitions may be found in Volume 3: OGC CDB Terms and Definitions (normative) of Best Practice.

Chapter 5. Conventions

This section 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.

5.1. Identifiers

The normative provisions in this Best Practice are denoted by the URI

http://www.opengis.net/spec/CDB/1.0/annexes

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

Annex A: Conformance Class Abstract Test Suite (Normative)

Not applicable for this document.

Annex B: Rationale: Sensor Simulation - Achieving Device-Independence

Formerly Annex A10 in Volume 2

One of the primary objectives of the CDB Standard is to provide and integrate all of the data required by all sensor devices, not just Image Generators producing the Out the Window (OTW) scenes. The purpose of this integration, among other things, is to achieve and maintain a high level of correlation among the many client-devices (subsystems) within a simulator. Furthermore, this integration must be done independently of the client-device or the sensor type, with little or no duplication of data amongst clients. In addition to the OTW, many simulator client-devices are required to simulate the synthetic environment over different portions of the electromagnetic spectrum, infrared (e.g. FLIR, NVG), microwaves (e.g. radar), audio (e.g. sonar), etc. Up to now, the current state of the art approaches to the simulation of sensors has typically been quite proprietary to the client-device implementation of the various vendors. There have been no universally accepted simulation models suitable for use in simulation.

Sensor simulation typically requires a simulation of the device itself, supplemented by a complete simulation of the synthetic environment over the portion of the electromagnetic spectrum that is relevant to this device. The former simulation is referred to as the **S**ensor **S**imulation **M**odel (SSM) while the latter is called the **S**ensor **E**nvironmental **M**odel (SEM). In the past, the SEM relied heavily on environmental databases whose content was designed to match the functionality, fidelity, structure and format requirements of the SEM. The level of realism possible by the SEM depended **heavily** on the quality, quantity and completeness of the data available. The environmental database was highly device-specific and could not be readily ported to other platforms.

A SEM is usually based on mathematical model of the environment for the portion of the electromagnetic spectrum of interest. The SEM acts much as a black box that produces a response in accordance to input data. A significant portion of this data must come from the CDB; however, the key is to segregate all device-dependent data and all SEM-dependent data from the modeling data that represents the synthetic environment. In order to accommodate the most different kind of sensors possible, a common denominator must be chosen. In the CDB standard, this common denominator is called a material. This is the subject of this annex.

One of the fundamental issues of sensor simulation involves the handling of material properties. As discussed earlier, the determination of which material properties should be supported heavily depends on:

1. the sensor types to be supported;
2. the vendors' sensor simulation implementations to be supported; and
3. the level of fidelity, functionality and precision of the SEMs to be supported.

Clearly, the task of determining a definitive list of material properties that would accommodate all of the above requirements for the today's sensor types, vendor implementations and SEMs would be a significant challenge. Furthermore, once released, the materials properties would limit any SEM innovation by the industry. As a result, the CDB Standard limits its jurisdiction over the material properties.

Instead, the CDB standard defines and publicly defines a list of materials that can be used in a CDB. It is the responsibility of each vendor to define the properties (that satisfies the sensor type) for these CDB materials. As a result, vendors are totally free to select material properties that satisfy the fidelity, functionality and precision requirements of the SEM for the sensor type of interest. Alternately, if the vendors have their own list of materials, they can create a mapping between CDB materials and their internally supported list of materials. This approach allows client-devices to retain their SEMs as well as their own sets of material properties.

The materials.xsd and materials.xml schema in the CDB schema package enumerates the base materials supported by this standard.

Annex C: Reasons for Using Jpeg

(Formerly from body of Best Practice Volume 1)

The CDB Standard prescribes the use of an industry standard compression algorithm for its storage intensive raster imagery datasets. This not only provides a substantial reduction in storage, but also reduces the data transmission bandwidths associated with simulator's access to the synthetic environment database at runtime. As a result of its storage efficiency, the CDB Standard relies on relatively few data formats for storing its datasets. There is no benefit (other than storage efficiency) to be gained in supporting any other specialized data formats whose underlying objective is only for storage efficiency. The CDB Standard embodies the JPEG 2000 industry standard format for raster imagery because it has comparable storage efficiency to all of these image formats without sacrificing any generality. JPEG 2000 has been chosen by the CDB Standard as a format for the storage of OTW raster imagery because of the following characteristics.

1. High compression efficiency: Compression better than 0.25 bits per pixels. Virtually indiscernible loss in image quality for 10:1 – 20:1 compression.
2. Lossless and lossy compression: Lossless compression ratios approx. 1.7:1
3. Perceptual color space internal coding: Allow dark images to be reconstructed without banding artifacts.
4. High dynamic range: Compress and decompress images with various dynamic ranges (e.g., 1-bit to 16-bit) for each color component.
5. Large images sizes: Up to (2^32 - 1)

There are other characteristics of the JPEG 2000 that are worth mentioning but are not directly beneficial to the CDB Standard. Those are:

1. Progressive image reconstruction: Allow images to be reconstructed with increasing pixel accuracy and resolution.
2. Region of interest coding: Permits certain Region of Interest (ROI's) in the image to be coded and transmitted with better quality and less distortion than the rest of the image.
3. Seamless quality and resolution scalability: Without having to download the entire file
4. Error resilience during transfers.

JPEG 2000 will be solely targeted at Raster Imagery data only. The reason is simply because of its highly efficient compression scheme that fits well with the goal of reducing the huge datasets associated with Imagery. Other raster-based datasets defined in the CDB will solely be using the TIFF format due to their more manageable size.

Annex F: Rationale: Partitioning the Earth into Tiles

Formerly Appendix A11 in Volume 2 of the CDB Best Practice.

This section provides rationale for partitioning the world into tiles.

The design of the CDB standard tile representation is centered on three primary considerations.

1. A tile representation comprehensive enough to accommodate the entire earth.
2. A tile representation that lends itself to real-time implementation by a CDB system and all of its attached simulator client-devices.

   A numerically straightforward mapping (such as a simple scaling) to map lat-long coordinates into CDB coordinates and vice versa is highly desirable for real-time implementation considerations.

3. A tile representation with a system of units that conforms as much as possible to geographic standards.

   One of the underlying motivations driving the CDB tile representation is the need for a system that will remain as close to the raw source data as possible which currently is DTED and GeoTIFF; DTED uses a geographic coordinate system defined by latitudes and longitudes. The basic unit in DTED is a geo-cell, which always has a height and width of one degree. In order to maintain a density of data that does not increase inordinately when moving towards the poles, the grid post intervals (measured in degrees or arc-sec) along the longitudinal axis are increased at specific latitudes; for instance, at DTED level 2, the latitude interval is always one second of arc but the longitude interval is one second of arc at latitudes from 0 to 50 degrees, from latitudes 50 to 70 the interval is two arc seconds and so on as shown in Table A-3. INTERVALS FOR DTED LEVEL 2.

Table A-3. INTERVALS FOR DTED LEVEL 2

DTED Zone	Latitude Range (Degrees)	Latitude Interval (Arc seconds)	Longitude Interval (Arc seconds)
I	0 – 50 N-S	1	1
II	50 – 70 N-S	1	2
III	70 – 75 N-S	1	3
IV	75 – 80 N-S	1	4
V	80 – 90 N-S	1	6

Before going into the detailed design of the CDB tile representation, it is worth stating the guiding principles that constrain the approach used by the CDB tile representation.

1. The earth model is divided (in latitude) into slices.

2. The slice's x-axis is aligned to WGS-84 lines of latitude.
3. The slice's y-axis is aligned to WGS-84 lines of longitude.
4. The number of units along the slice's y-axis for a given level of detail is the same for all slices.

   The earth surface geodetic dimension in arc-second of y-axis units within an earth slice and in all earth slices is exactly the same, regardless of latitude.

5. The geodetic dimension of an x-axis unit in arc-second is constant within a zone, but is re-defined at pre-selected latitudes to achieve a greater level of spatial sampling uniformity in all tiles; this overcomes the narrowing effect of increased latitudes on longitudinal distances. The definition of zones in the CDB is the same as those in DTED (with the exception of the poles).
6. The number of units along the slice's x-axis for a given level of detail is the same within each zone.
7. The number of units along the slice's y-axis is constrained to a 2^n-multiple in all slices.

   Many simulator client devices impose constraints related to the run-time use of binary pyramidal structures (such as mip-maps, quadtrees, etc.). A binary pyramidal structure is simply a collection of two-dimensional arrays; each array represents the same content but at successively finer levels of resolution.

8. The number of units along the slice's x-axis will vary depending on which zone the latitude of the slice belongs. At this point we introduce the concept of a CDB Geocell, which differs slightly from a DTED Geocell. A DTED cell is always 1 × 1 degrees. In contrast, a CDBGeocell always has a height of 1 degree but has a varying width depending on its latitude. Table A-4. Size of CDB Geocell per zone shows the dimensions of a CDB Geocell per zones of latitude. For instance, in latitude zone 5, which goes from –50 to 50 degrees latitude, a CDB Geocell is 1 × 1 degree, in zone 4 and 6 which goes from latitude 50 to 70 degrees the cell size is 1 × 2 degrees. The main reason to introduce this concept is to maintain a reasonable eccentricity between the sides by trying to keep them as close to a square as possible. Two criteria are used to define the size of a CDB Geocell.
   1. A CDB Geocell must contain a whole number of DTED Geocells; in other words a CDB Geocell must start and end on a whole degree along the longitudinal axis. This is done so as to facilitate mapping from CDB Geocells to DTED Geocells.
   2. The length of the CDB Geocell must be a whole factor of 180, in other words length of 1, 2, 3, 4, 6 and 12 degrees are legal but lengths of 7 and 8 degrees would not be since these are not exact factors of 180.

Table A-4. Size of CDB Geocell per zone

CDB Zone	Latitude Range (Degrees)	CDBGeocell size (deg Lat × deg Lon))	Number of DTED Geocells
0	–90 ≤ lat < –89	1 X 12	12
1	–89 ≤ lat < –80	1 X 6	6
2	–80 ≤ lat < –75	1 X 4	4
3	–75 ≤ lat < –70	1 X 3	3

CDB Zone	Latitude Range (Degrees)	CDBGeocell size (deg Lat × deg Lon))	Number of DTED Geocells
4	–70 ≤ lat < –50	1 X 2	2
5	–50 ≤ lat < +50	1 X 1	1
6	+50 ≤ lat < +70	1 x 2	2
7	+70 ≤ lat < +75	1 x 3	3
8	+75 ≤ lat < +80	1 x 4	4
9	+80 ≤ lat < +89	1 x 6	6
10	+89 ≤ lat < +90	1 x 12	12

The variable CDB Geocell size in the CDB standard has the following benefits.

1. Reduces the simulator client processing overheads associated with the switching from one zone to another. (Due to the small number of zones across the earth.)
2. Reduces the variation of longitudinal dimensions (in meters) to a maximum of 50%.
3. Improves storage efficiency.

Annex G: Rationale: Importance of Level of Detail

Formerly Appendix A-12 of Volume 2 of the OGC CDB Best Practice.

The availability of LODs for most datasets is critical for real-time performance. Many simulator client-devices can readily take advantage of an LOD structure because many clients naturally require less detail with increasing distance away from the simulated own ship position. For example, the projection of screen pixels (i.e. pixels in an IG image plane) onto near-field terrain subtends much less area than the projection of screen pixel onto far-field terrain near the horizon; as a result, much less detail is required at far range. In addition, clients may need to revert to an alternate coarser representation if they cannot cope with the paging bandwidths, memory footprint or computational requirements of finer LODs. This provides a solid basis on which client-devices can build paging managers, load management and memory management algorithms.

The following example illustrates the important performance considerations and the inherent performance advantage that can be achieved with an LOD structure. Consider a simulator client-device, with a capability to display terrain imagery out to 128 km; the imagery is 1m at its finest available resolution and the simulated ownship is flying at 100 m/s. Under these conditions, and without the benefit of an LOD organization (as illustrated in Figure A-15: Paging of Terrain Imagery without an LOD Structure), the client-device would require access to the imagery at a rate of ~100 Mpixels/sec. Consider on the other hand the same operating conditions but with the client-device accessing LOD-organized imagery (as illustrated in Figure A-14: Paging of Terrain Imagery with an LOD Structure). Furthermore, assume that the client-device only requires 1m imagery for ranges less than 1/2 km, 2m for ranges less than 1km, 4m for ranges less than 2km, and so on. With the benefit of an LOD structure, the client-device would require access to the imagery at a much lower rate of ~1 Mpixels/sec, reducing access bandwidth by a factor of ~100x over the non-LOD approach. Clearly, such performance gains cannot be ignored for real-time applications such as flight simulators, especially when one realizes that access bandwidth increases as the square of the imagery resolution.

In addition to a reduction in access bandwidth, the LOD structure also benefits simulator client-devices that have a requirement to dynamically filter the data to control aliasing. In effect, part of the client-device filtering process is relegated to an off-line process.

The CDB standard does not enforce, nor does it specify the type of filter used to compute the data element values of raster-organized or list-organized datasets. Yet, it is clear that inadequate off-line filter may affect the rendering quality of the affected client-devices. As a result, the CDB standard provides guidelines to govern the quality of the off-line LOD process; these guidelines are provided with each of the raster-organized dataset (or list-organized datasets in future releases of the CDB standard).

Figure A-14: Paging of Terrain Imagery with an LOD Structure

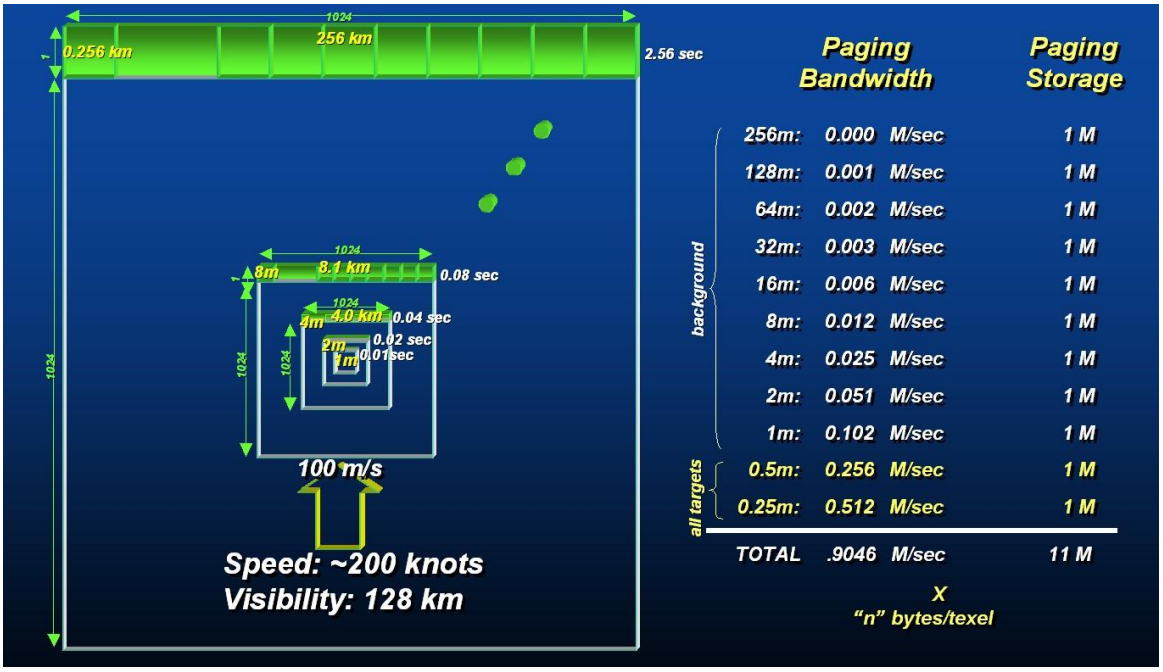
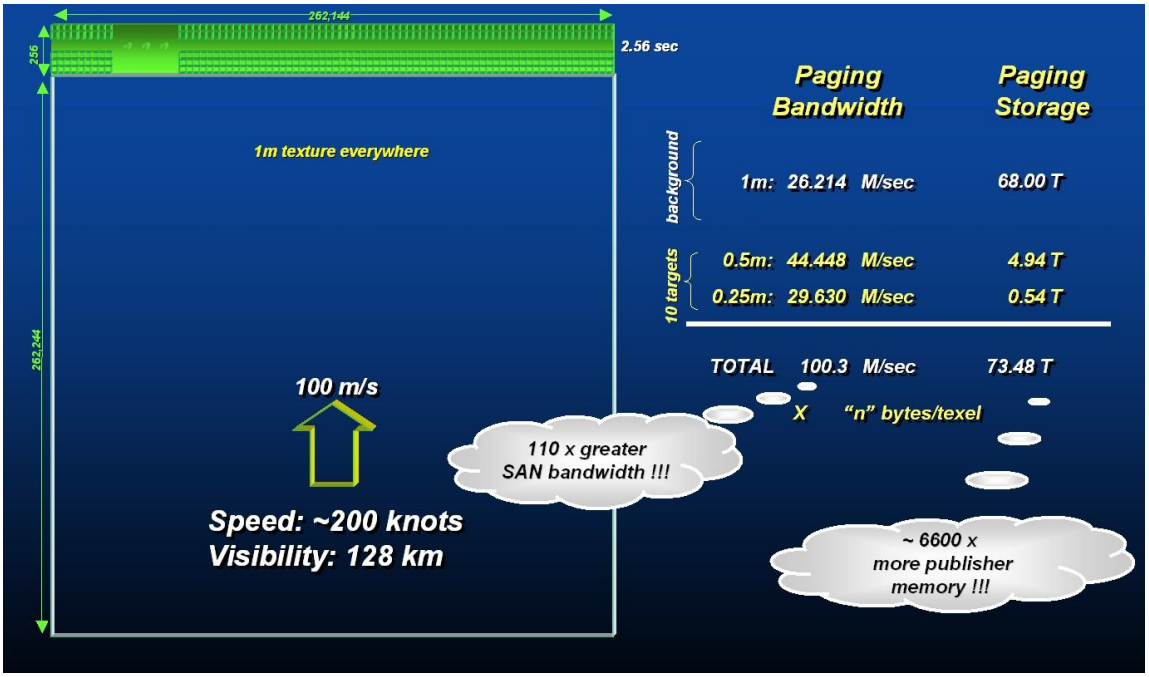


Figure A-15: Paging of Terrain Imagery without an LOD Structure



Annex H: Informative: JPEG

Formerly Appendix A.17 in Volume 2 of the OGC CDB Best Practice

The CDB standard supports JPEG2000 for both VSTI and VSTLM component data.

As a result of the high rates of compression there are no real advantages to be gained in supporting a broad range of alternate color representations (such as single channel representations, indexed color representations, RGB-triplet color encoding such as 5-6-5, etc.). The underlying motivation behind all such schemes is driven by a desire to reduce storage and transmission bandwidths. JPEG-2000 achieves these goals and many others, refer to Table A-8 JPEG 2000 Features.

Table A-8 JPEG 2000 Features

High compression efficiency: Compression better than 0.25 bits per pixels, 20% compression efficiency improvement over JPEG.	**High dynamic range: Compress images with various dynamic ranges (e.g. 1-16 bit) for each color component.**
Lossless and lossy compression: Lossless compression ratios approx. 1.7:1.	**Seamless quality / resolution scalability:** Without having to download the entire file.
Progressive image reconstruction: Allows images to be reconstructed with increasing pixel accuracy and resolution.	**Large images sizes - up to (2^{32} - 1).**
Perceptual color space internal coding.	**Single decompression architecture.**
Region of interest coding: Permits certain ROI's in the image to be coded and transmitted with better quality and less distortion than the rest of the image.	**Error resilience during transfers.**

Annex I: Informative: ZipFile Format Notes

Formerly Annex U in Volume 2 of the OGC CDB Best Practice

The archive zip format used in the CDB standard is based on

```
APPNOTE.TXT - .ZIP File Format Specification

URL: http://www.pkware.com/documents/APPNOTE/APPNOTE-6.3.1.TXT

Version: 6.3.1

Revised: April 11, 2007

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The use of certain technological aspects disclosed in the currentAPPNOTE
is available pursuant to the below section entitled "Incorporating
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```

CDB zip compliant reader is required to support as a minimum the following features defined in APPNOTE.TXT:

- Local file header (Note: Extra field can be inserted but not required to be read)
- File data
- Data descriptor:
- Central directory structure (Note: Digital signature is supported but will not be read)
- End of central directory record: (Note: ZIP file comments are supported but will not be read)

The compression methods supported:

- No compression
- Deflate (Enhanced Deflate is not required to be supported)

The following features are not required to be supported thus are optional and left to the implementation:

- Archive decryption header
- Archive extra data record.
- Zip64 end of central directory record
- Zip64 end of central directory locator
- Splitting and Spanning ZIP files
- Encryptions of any type

Note that anything not listed in this section is by default assumed not to be supported.

Annex M: CDB Directory Naming and Structure

Formerly Appendix M, Volume 2 of the OGC CDB Best Practice

With CDB version 3.2 (prior to the submission into the OGC), Appendix M was used to present the complete list of names allowed to construct the directories of the CDB. As of version 3.2 (as submitted into the OGC standards process), the appendix has been replaced by a combination of folder hierarchy and metadata files and controlled vocabularies delivered with the CDB Distribution Package.

The /CDB folder hierarchy provides a complete list of directory and file name patterns of the CDB; it summarizes the structure of the CDB presented in chapter 3, Volume 1: Core. The following files are necessary to expand the patterns:

- /CDB/Metadata/Feature_Data_Dictionary.xml provides the list of directory names associated with feature codes;
- /CDB/Metadata/Moving_Model_Codes.xml provides the list of names for DIS Entity Kinds, Domains, and Categories; and
- /CDB/Metadata/DIS_Country_Codes.xml contains the list of DIS Country Names.

Together, these files provide all the information required to build the names of all directories permitted by the CDB standard.

Annex O: List of Texture Component Selectors

Formerly Appendix O, Volume 2 of the OGC CDB Best Practice

The following table provides the list of codes to use to build CDB model texture filenames.

Texture Kind CS1 (Sxxx)	Texture Index CS2 (Txxx)	Description
002 – Month	001	January
	002	February
	003	March
	004	April
	005	May
	006	June
	007	July
	008	August
	009	September
	010	October
	011	November
	012	December
003 – Season	001	Spring
	002	Summer
	003	Autumn
	004	Winter

Texture Kind CS1 (Sxxx)	Texture Index CS2 (Txxx)	Description
004 – Uniform Paint Scheme	001	Grey
	002	White
	003	Green
	004	Black
	005	Beige
	006	Blue
	007	Red
	008	Yellow
	009	Brown
	010	Pink
	011	Purple
	012	Burgundy
	013	Orange
	014	Light Blue
	015	Khaki
	016	Dark Grey
	017	Amber
	018	Gold
	019	Silver
	020	Copper
005 – Camouflage Paint Scheme	001	Desert
	002	Winter
	003	Forest
	004	Generic
	005	Urban

Texture Kind CS1 (Sxxx)	Texture Index CS2 (Txxx)	Description
006 – Airline Paint Scheme		

Texture Kind CS1 (Sxxx)	Texture Index CS2 (Txxx)	Description

Texture Kind CS1 (Sxxx)	Texture Index CS2 (Txxx)	Description

Texture Kind CS1 (Sxxx)	Texture Index CS2 (Txxx)	Description

Texture Kind CS1 (Sxxx)	Texture Index CS2 (Txxx)	Description

Texture Kind CS1 (Sxxx)	Texture Index CS2 (Txxx)	Description

Texture Kind CS1 (Sxxx)	Texture Index CS2 (Txxx)	Description

Texture Kind CS1 (Sxxx)	Texture Index CS2 (Txxx)	Description

Texture Kind CS1 (Sxxx)	Texture Index CS2 (Txxx)	Description

Texture Kind CS1 (Sxxx)	Texture Index CS2 (Txxx)	Description

	286	RAR Air Rarotonga
	287	CJR Caverton Helicopters
Texture Kind CS1 (Sxxx)	**Texture Index CS2 (Txxx)**	**Description**
	288	OZR Ozrana
	289	ROU Air Canada Rouge
	290	DWT Darwin Airline
	291	UTA UTair Aviation
	292	AZN Amaszonas
	293	FDB Flydubai
	294	UZB Uzbekistan Airways
	295	PGT Pegasus Airlines
	296	ABY Air Arabia
	297	AXB Air India Express
009 – Quarter	001	First quarter of the year
	002	Second quarter of the year
	003	Third quarter of the year
	004	Fourth quarter of the year
054 – Contaminant	001	Wet Surface
	002	Snowy Surface
	003	Icy Surface
	004	Slushy Surface
	005	Patchy Wet Surface
	006	Patchy Snowy Surface
	007	Patchy Icy Surface
	008	Patchy Sandy Surface
	009	Patchy Dirty Surface
	010	Volcanic Ash
	011	Patchy Volcanic Ash
055 – Skid Mark	001	Tire Mark

Examples:

- A geospecific City Hall especially decorated for the Halloween during the month (S002) of October (T010) could have a texture named Geocell_D301_S002_T010_LOD_UREF_RREF_City-Hall.rgb.
- The texture of a geotypical house used during the first (T001) quarter (S009) of the year could be named D501_S009_T001_Wxx_House.rgb.
- Similarly, the uniform (S004) grey (T001) texture used with a Cobra helicopter could be named D601_S004_T001_Wxx_Cobra.rgb.
- A 1024 by 1024 (W10) texture representing an M1A2 tank desert (T001) camouflage (S005) could

be stored in a file named D601_S005_T001_W10_M1A2.rgb.

- An Airbus 380 model 800 operated by the Emirates (T221) Airlines (S006) could be stored in a file named D601_S006_T221_Wxx_A380-800.rgb.

Notes:

- Texture Kind 002 and 009 are complete; the number of months and quarters will not change.
- Texture Kind 004 will expand as new colors are added. Color names are defined here: http://en.wiktionary.org/wiki/Appendix:Colors.
- Texture Kind 005, the Camouflage Paint Scheme, follows a similar numbering scheme as the HLA's RPR-FOM Version 2 Draft 17. The list will expand as new camouflages are needed or new values added to the RPR-FOM.
- Texture Kind 006 will expand as ICAO assigns new airline acronyms.
- Texture Kind 054 and 055 will expand as new contaminants and skid marks are deemed necessary.

Annex Q: Table of Dataset Codes

Formerly Appendix Q in Volume 2 of the OGC CDB Best Practice.

The table below summarizes the CDB dataset codes along with their names and their applicability to the community 3.0 specification and the OGC standard, which is based on CDB version 3.2.

Dataset		**Specification**	
Name	**Code**	**3.0**	**OGC**
Elevation	001	√	√
MinMaxElevation	002	√	√
MaxCulture	003	√	√
Imagery	004	√	√
RMTexture	005	√	√
RMDescriptor	006	√	√
Reserved	007		
Reserved	008		
Reserved	020		
GSFeature	100	√	√
GTFeature	101	√	√
GeoPolitical	102	√	√
VectorMaterial	200	√	√
RoadNetwork	201	√	√
RailRoadNetwork	202	√	√
PowerLineNetwork	203	√	√
HydrographyNetwork	204	√	√
GSModelGeometry	300	√	√
GSModelTexture	301	√	√
GSModelSignature	302	√	√
GSModelDescriptor	303	√	√
GSModelMaterial	304		√
GSModelInteriorGeometry	305		√
GSModelInteriorTexture	306		√

Dataset		Specification	
GSModelInteriorDescriptor	307		√
GSModelInteriorMaterial	308		√
GSModelCMT	309		√
T2DModelGeometry	310		√
GSModelInteriorCMT	311		√
T2DModelCMT	312		√
T3DModelGeometry	320		√
T3DModelTexture	321		√
T3DModelMaterial	322		√
T3DModelInteriorGeometry	323		√
T3DModelInteriorTexture	324		√
T3DModelInteriorMaterial	325		√
NavData	400	√	√
Navigation	401	√	√
GTModelGeometry	500	√	√
	510		√
GTModelTexture	501	√	
	511		√
GTModelSignature	502	√	
	512		√
GTModelDescriptor	503	√	√
GTModelMaterial	504		√
GTModelCMT	505		√
GTModelInteriorGeometry	506		√
GTModelInteriorTexture	507		√
GTModelInteriorDescriptor	508		√
GTModelInteriorMaterial	509		√

Dataset		Specification	
GTModelInteriorCMT	513		√
MModelGeometry	600	√	√
MModelTexture	601	√	√
MModelSignature	602	√	
	606		√
MModelDescriptor	603	√	√
MModelMaterial	604		√
MModelCMT	605		√
Metadata	700		√
ClientSpecific	701		√
Reserved for CDB Extensions	9xx		

	Dataset Code is not used
√	Dataset Code is in use
	Dataset Code is deprecated
	Dataset Code is reserved

Annex R: Derived Datasets within the CDB

By using Industry Standards throughout this document, the CDB Standard defines the means and mechanisms to populate all the simulation datasets without involving data duplication. However, there are situations where a specific dataset information type needs to be derived from another existing one in order to specialize further the information into another dataset type or form.

This consideration becomes a grey area where the off-line tools' capability and the run-time simulation clients' performance levels enforces this data derivation.

It is such a case with the Mip-Map data, Min-Max Elevation data, Tile Presence data, RCS data, and Raster Material data for example.

Source Dataset	**Data Manipulation Description**	**Resulting Dataset(s)**
Elevation Dataset	In order to produce the various Level Of Details within the Elevation Dataset, it is often necessary to over-sample or sub-sample a primary set of data values. Since those values within the LOD hierarchy may come from a single data source, the LODs can be seen as derived information which can better accommodate the client needs based on their performance level.	Elevation LODs

Source Dataset	Data Manipulation Description	Resulting Dataset(s)
Elevation Dataset	For clients that need to compute line of sights (LOS) between simulation entities spread across a vast terrain area, it is imperative to have a fast way of knowing the minimum and maximum elevations within a tile without loading the entire elevation data grid. The min/max elevation dataset can be used to ensure a fast pre-determination of entities occultation state with the terrain. The min/max data is stored in the form of a quad-tree pyramid and is based on the area covered at the given depth level of the quad-tree. For example, for the maximum dataset the top will contain the maximum for the whole of the geocell, the next pyramid level contains maximum data for each the quarter geocells and so on. Similarly for the minimum the top represents the minimum for the whole of the geocell going down as for maximums. Currently the pyramid size is fixed and goes down to level 9 which covers areas that are approximately 256x256 meters square; note that the depth level can be modified to a finer or coarser level but level 9 is suggested as a reasonable compromise of performance vs. storage. A tool will pre-determine the minimum and maximum elevations within a geocell's elevations and generate the quad-trees described previously; note that the tool will use all of the elevation data that is present in the elevation dataset to determine the maximums or minimums in a	Min-Max Elevation

Source Dataset	Data Manipulation Description	Resulting Dataset(s)
Vector Datasets (Point, Lineal and Areal Features)	The Max Culture Height data is produced for clients that need to compute line of sights (LOS) between simulation entities spread across a vast terrain area that take into account the maximum cultural feature heights. The dataset helps rapidly assess an intersection status of line-of-sight with cultural features. This dataset is derived from the Vector Datasets of the CDB for corresponding tiles. The storage is done via a quad-tree similar to that of the min/max elevation the top of the pyramid represents the height of the highest cultural feature in the dataset going down to a suggested depth level of 9.	Max Culture Height
3D Model (GT, GS, MM) Datasets	The polar diagram data (covering all aspect angles) of the RCS dataset for Geotypical, Geospecific or Moving Models cannot readily be computed at run-time due to the complex mathematical computing algorithms and resources required to determine the Electro-Magnetic Energy absorption levels by the model's materials, the corner reflections, the multi-path reflections, EM parameters (frequency, polarization) effects, and so on. Therefore, off-line COTS tools are used to analyze the 3D model geometry and its materials in order to produce the RCS dataset specifically for different frequencies and polarizations.	RCS (Radar Cross Section)

Source Dataset	Data Manipulation Description	Resulting Dataset(s)
Vector Datasets (Point, Lineal and Areal Features)	Since the material attribution is normally done in the vector data, a rasterization operation among all features is required to come up with a raster grid of attributed materials.	Raster Material

Annex S: Default Read and Write values for Simulator Client-Devices

As seen throughout this document, the CDB standard provides guidelines with respect to default values in cases where no data could be read from the CDB for requested datasets. Those default parameters are captured in a Metadata file within the CDB. The Table below summarizes all the Default Parameters Names and the suggested initial values to be used by client-devices. In cases where the default parameter would be missing altogether from **\CDB\Metadata\Defaults.xml**, Client-Devices shall use the "Default Value" found in the fourth column. A "Read" default refers to the value being assumed while reading the CDB data. A "Write" default refers to the value being written to the file when content-generation tools have partial source data.

Parameter Name	Dataset	Type	Default Value	R/W
Default_Elevation-1	001_Elevation	float	0 m	R
Default_Elevation-[2-99]	001_Elevation	float	0 m	R
Default_Primary_Elevation_Control	001_Elevation	integer	INSIDE (1)	R
Default_Subordinate_Elevation_Control	001_Elevation	integer	NO_ELEVATION (0)	R
Default_Bathymetry	001_Elevation	float	0 m	R
Default_Tide	001_Elevation	float	2.5 m	R
Default_MinElevation_CaseI	002_MinMaxElevation	float	Default_Elevation-1	R
Default_MaxElevation_CaseI	002_MinMaxElevation	float	Default_Elevation-1	R
Default_MinElevation_CaseII	002_MinMaxElevation	float	-400 m	R
Default_MaxElevation_CaseII	002_MinMaxElevation	float	8846 m	R
Default_MinElevation_CaseIII	002_MinMaxElevation	float	8846 m	W
Default_MaxElevation_CaseIII	002_MinMaxElevation	float	-400 m	W
Default_MaxCulture_CaseI	003_MaxCulture	float	600 m	R
Default_MaxCulture_CaseII	003_MaxCulture	float	0 m	R

Parameter Name	Dataset	Type	Default Value	R/W
Default_VSTI_Y_Mono	004_Imagery	float	0.5	R
Default_VSTI_Y_Red	004_Imagery	float	0.5	R
Default_VSTI_Y_Green	004_Imagery	float	0.5	R
Default_VSTI_Y_Blue	004_Imagery	float	0.5	R
Default_VSTLM_Mono	004_Imagery	float	0.0	R
Default_VSTLM_Red	004_Imagery	float	0.0	R
Default_VSTLM_Green	004_Imagery	float	0.0	R
Default_VSTLM_Blue	004_Imagery	float	0.0	R
Default_Imagery_Gamma	004_Imagery	float	1.0	R
Default_RoadNetwork_LTN	201_RoadNetwork	integer	2	R
Default_RailRoadNetwork_LTN	202_RailRoadNetwork	integer	1	R
Default_GSModelTexture_Gamma	301_GSModelTexture	float	1.0	R
Default_GSModelInteriorTexture_Gamma	306_GSModelInteriorTexture	float	1.0	R
Default_GTModelTexture_Gamma	511_GTModelTexture	float	1.0	R
Default_GTModelInteriorTexture_Gamma	507_GTModelInteriorTexture	float	1.0	R
Default_MModelTexture_Gamma	601_MModelTexture	float	1.0	R
Default_Base_Material		string	BM_LAND-MOOR	R
Default_Material_Layer		integer	0	R
Default_AO1		float	0.0	R

Parameter Name	Dataset	Type	Default Value	R/W
Default_SCAL[x,y,z]		float	1.0	R
Default_TRF		integer	4	R

Annex Y: Revision History

Date	Release	Editor	Primary clauses modified	Description
2017-02-23	1.0	C. Reed	All	
2018-08-28	1.1	C. Reed	All	
2019-12-16	1.2	C. Reed	Various	Changes for version 1.2

Annex Z: Bibliography