

GeoPackage alternative encoding for INSPIRE



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Introduction

- GeoPackage is an open, standards-based, platform-independent, portable, self-describing, compact format for transferring geospatial information
 - A SQLite database (a single file!!)
 - Current versión 1.2.1 <https://www.geopackage.org/spec121/index.html>
- It is a set of conventions for storing:
 - Vector features (with linear and non-linear geometry types)
 - Tile matrix sets of imagery, raster maps at various scales
 - Tile gridded coverage data
 - Attributes (non spatial data)
 - Metadata (coarse to fine grained) and schema constraints
- Within INSPIRE, this encoding is an *alternative* encoding for data from all themes, focused in data sharing of datasets with no loss of information between GIS desktops, network servers, corporate databases, web and mobile applications.
- Max size: approximately 140TB → Big Data sharing!!



Scope

- Use cases
 - Addresses data usability in desktop (QGIS3, ArcGIS), native mobile (NGA iOS and Android SDK), web (NGA JS), servers (NGA Java) and geoprocessing software (GDAL).
 - The encoding does not cover yet 3D geometries
 - We have tested desktop (QGIS3), geoprocessing software (GDAL) and server (NGA Java)
- Coverage of INSPIRE Themes
 - We have tested Annex I: Geographical names and Administrative units
- Technical Issues found
 - “Related tables” extension in development → Explicit associations between classifiers
 - GDAL support is not complete → workaround → NGA Java supports all extensions

Encoding rules

- UML model to GeoPackage \approx UML model to Spatial SQL
 - Classes \rightarrow SQL Tables
- Used normative references
 - GeoPackage Encoding Standard 1.2.1 <http://www.geopackage.org/spec121/>
 - INSPIRE Geographical Names
 - INSPIRE Administrative Units
- General encoding rules
 - «featureType» \rightarrow Feature Table per geometry attribute
 - «dataType» with multiplicity n \rightarrow Attribute Table + Foreign Key
 - «dataType» that may link features (e.g. Identifier) \rightarrow Attribute Table + Foreign Key
 - «dataType» with multiplicity 0..1 \rightarrow embedded in Table (nested properties flattened)
 - «codeList» \rightarrow usually embedded in Table + values constrained via Schema extension
 - «voidable» \rightarrow keep attribute in Table and void reason value stored via Metadata extension

Experience with real datasets → Datasets

Nomenclátor Geográfico Básico de España

Descripción: relación de topónimos del NGBE.

SGR: ETRS89 en la Península, Islas Baleares, Ceuta y Melilla, y REGCAN95 en las Islas Canarias (ambos sistemas compatibles con WGS84). Coordenadas longitud y latitud y UTM en su huso correspondiente.

Ud. descarga: toda España

Formato: .accdb de Access

[Ver +](#)

Base de datos con la relación de topónimos con sus correspondientes coordenadas y resto de atributos que constituye el Nomenclátor Geográfico Básico de España.

[Metadatos](#)



Geographical
Names



Descargar

Líneas límite municipales

Descripción: recintos municipales y líneas límite (municipales, provinciales y autonómicos).

SGR: ETRS89 en la Península, Islas Baleares, Ceuta y Melilla, y WGS84 en las Islas Canarias. Coordenadas geográficas longitud y latitud.

Ud. descarga: toda España

Formato: shape (.shp)

[Ver +](#)

[Metadatos](#)



Descargar

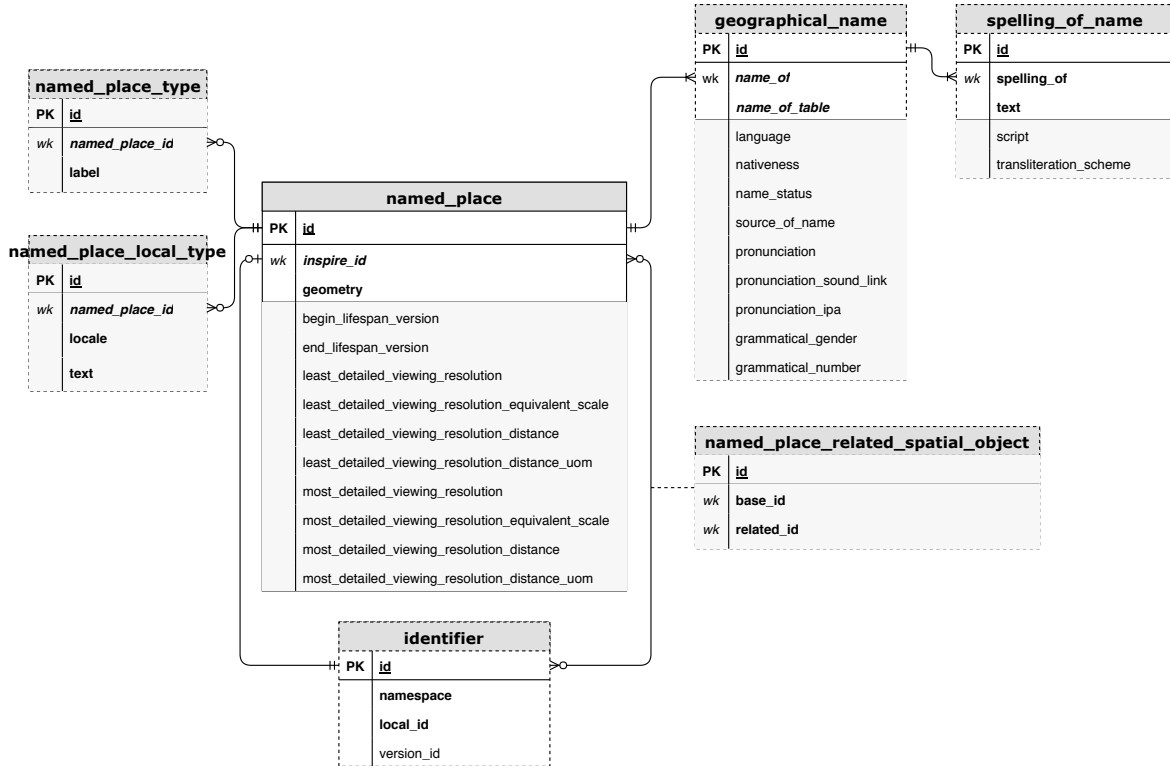


Administrative
Units

Experience with real datasets → Mapping INSPIRE to GeoPackage

IUMI	Name	Type	Min	Max	Void	Identifier	Element or Content Type		
Class	NamedPlace					NamedPlace	NamedPlace	Feature	-
Attribute	NamedPlace/geometry	GM_Object	1	1		NamedPlace/geometry	geometry	GEOMETRY	
Attribute	NamedPlace/beginLifespanVersion	DateTime	1	1	true	NamedPlace/beginLifespanVersion	beginLifespanVersion	DATETIME	Nullable
Attribute	NamedPlace/endLifespanVersion	DateTime	0	1	true	NamedPlace/endLifespanVersion	endLifespanVersion	DATETIME	Nullable
Attribute	NamedPlace/leastDetailedViewingResolution	MD_Resolution	0	1	true	NamedPlace/leastDetailedViewingResolution/MD_Resolution	leastDetailedViewingResolution	TEXT(1)	Nullable
						NamedPlace/leastDetailedViewingResolution/MD_Resolution/equivalentScale/MD_Repr	leastDetailedViewingResolutionEquivalentScale	INTEGER	Nullable
						NamedPlace/leastDetailedViewingResolution/MD_Resolution/distance/Distance	leastDetailedViewingResolutionDistance	DOUBLE	Nullable
						NamedPlace/leastDetailedViewingResolution/MD_Resolution/distance/Distance/uom	leastDetailedViewingResolutionDistanceUom	TEXT	Nullable
Attribute	NamedPlace/mostDetailedViewingResolution	MD_Resolution	0	1	true	NamedPlace/mostDetailedViewingResolution/MD_Resolution	mostDetailedViewingResolution	TEXT(1)	Nullable
						NamedPlace/mostDetailedViewingResolution/MD_Resolution/equivalentScale/MD_Repr	mostDetailedViewingResolutionEquivalentScale	INTEGER	Nullable
						NamedPlace/mostDetailedViewingResolution/MD_Resolution/distance/Distance	mostDetailedViewingResolutionDistance	DOUBLE	Nullable
						NamedPlace/mostDetailedViewingResolution/MD_Resolution/distance/Distance/uom	mostDetailedViewingResolutionDistanceUom	TEXT	Nullable
Attribute	NamedPlace/inspireId	Identifier	1	1		NamedPlace_inspireId	-	Relation "simple_attribute"	-
Attribute	NamedPlace/localType	LocalisedCharacterStr	1	*	true	NamedPlace_localType	-	Relation "simple_attribute"	-
Attribute	NamedPlace/type	NamedPlaceTypeValu	1	*	true	NamedPlace_type	-	Relation "simple_attribute"	-
Attribute	NamedPlace/relatedSpatialObject	Identifier	0	*	true	NamedPlace_relatedSpatialObject	-	Relation "simple_attribute"	-
Attribute	NamedPlace/name	GeographicalName	1	*		NamedPlace_name	-	Relation "simple_attribute"	-
						LocalType	LocalType	Attribute	-
						LocalType/locale	locale	TEXT	-
						LocalType/text	text	TEXT	-
						NamedPlaceType	NamedPlaceType	Attribute	-
						NamedPlaceType/label	label	TEXT	-
Class	GeographicalName					GeographicalName	GeographicalName	Attribute	
Attribute	GeographicalName/language	CharacterString	1	1	true	GeographicalName/language	language	TEXT	Nullable
Attribute	GeographicalName/nativeness	NativenessValue	1	1	true	GeographicalName/nativeness	nativeness	TEXT	Nullable
Attribute	GeographicalName/nameStatus	NameStatusValue	1	1	true	GeographicalName/nameStatus	nameStatus	TEXT	Nullable
Attribute	GeographicalName/sourceOfName	CharacterString	1	1	true	GeographicalName/sourceOfName	sourceOfName	TEXT	Nullable
Attribute	GeographicalName/pronunciation	PronunciationOfName	1	1	true	GeographicalName/pronunciation/PronunciationOfName	pronunciation	TEXT	Nullable
						GeographicalName/pronunciation/PronunciationOfName/pronunciationSoundLink	pronunciationSoundLink	TEXT	Nullable
						GeographicalName/pronunciation/PronunciationOfName/pronunciationIPA	pronunciationIPA	TEXT	Nullable
Attribute	GeographicalName/grammaticalGender	GrammaticalGenderV	0	1	true	GeographicalName/grammaticalGender	grammatical_gender	TEXT	Nullable
Attribute	GeographicalName/grammaticalNumber	GrammaticalNumber	0	1	true	GeographicalName/grammaticalNumber	grammatical_number	TEXT	Nullable
Attribute	GeographicalName/spelling	SpellingOfName	1	*		GeographicalName_spelling	-	Relation "simple_attributes"	Geogr
Class	SpellingOfName					SpellingOfName	-	Attribute	
Attribute	SpellingOfName/text	CharacterString	1	1		SpellingOfName/text	-	TEXT	Not null
Attribute	SpellingOfName/script	CharacterString	1	1	true	SpellingOfName/script	-	TEXT	Nullable
Attribute	SpellingOfName/transliterationScheme	CharacterString	0	1	true	SpellingOfName/transliterationScheme	-	TEXT	Nullable
Attribute	NamedPlace/inspireId/localId	CharacterString	1	1		Identifier/localId	identifier	Attribute	
Attribute	NamedPlace/inspireId/namespace	CharacterString	1	1		Identifier/namespace	namespace	TEXT	Not null
Attribute	NamedPlace/inspireId/versionId	CharacterString	0	1	true	Identifier/versionId	versionId	TEXT(25)	Nullable

Experience with real datasets → Produced SQL DDL/GeoPackage



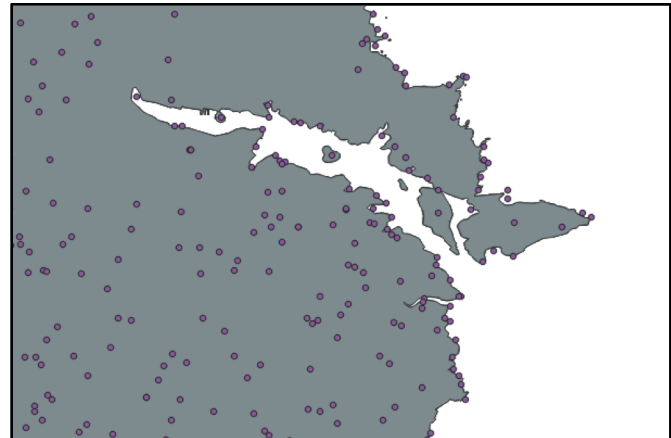
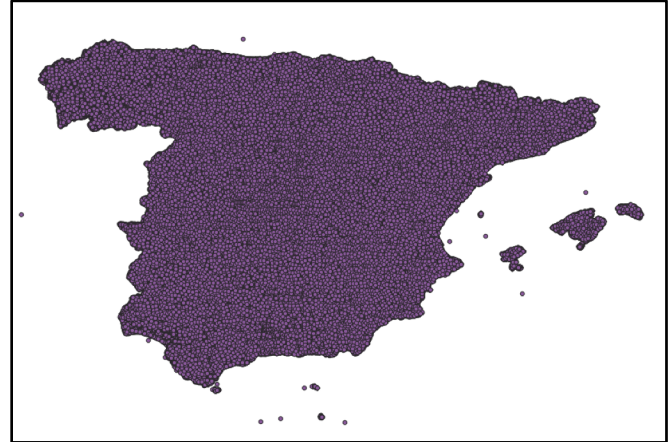
Experience with real datasets → Tools

- NGA GeoPackage Java (certified by OGC)
 - <https://github.com/ngageoint/GeoPackage>
- In-house DSL (written in Kotlin)
 - Creation of any INSPIRE schema within GeoPackage
 - ETL Postgis → GeoPackage
 - Data migration to Postgis → GeoPackage
 - INSPIRE schema creation
 - Population INSPIRE Schema
 - We can publish it as open source if requested
- Development time
 - 4 weeks model/approach analysis
 - 3 weeks DSL development and testing
 - 2 days for the ETL (per dataset)
- Lessons learned
 - Think as SQL developer, not as GIS developer → faster development
 - Performance improved if model transformation is executed within SQLite → FME-like scripts will be slow
 - INSPIRE schema templates per theme (empty GeoPackages) → Reusable by-product

```
object GeographicNamesSchema {
    fun inspireNamedPlaceSchema(effectiveSrsId: Long)
        tableName = "named_place"
        identifier = "Geographical Names:NamedPlace"
        description = "Any real world entity referred
srsId = effectiveSrsId
        column {
            name = "inspire_id"
            dataType = GeoPackageTypes.INT
            notNull = true
            indexed = true
        }
        column {
            name = "geometry"
            dataType = GeoPackageTypes.GEOMETRY
            notNull = true
        }
        column {
            name = "begin_lifespan_version"
            dataType = GeoPackageTypes.DATETIME
        }
        column {...}
        column {
            name = "least_detailed_viewing_resolution
            dataType = GeoPackageTypes.TEXT
            max = 1
        }
        column {...}
        column {...}
        column {...}
        column {...}
        column {...}
        column {...}
        column {...}
    }
}
val inspireNamedPlaceLocalTypeSchema: AttributeBu
tableName = "named_place_local_type"
identifier = "Geographical Names:NamedPlace.l
description = ""Characterization of the kin
```


Experience with real datasets → Results

- Geographical Names
 - File size 352 MB
 - Features: NamedPlace (1132583 rows)
 - Attributes: GeographicalName (1317590 rows), SpellingOfName (1317590 rows), + 3 more tables for attributes with multiplicity (localType, relatedSpatialObject, type)
- Administrative Units
 - File size 646 MB
 - Features: AdministrativeUnit (8283 rows), AdministrativeBoundary (45844 rows)
 - Attributes: Identifier (54127 rows), GeographicalName (8283 rows), SpellingOfName (8283 rows), + 1 more table for M:N relation between Boundary and Unit
- Transformation run: 40min
 - In my laptop! x5 faster in a production server!!
- Tested with QGIS3
 - View, edit... fast and satisfactory
 - Join tables feasible (NamedPlace x GeographicalName x SpellingOfName)



GeoPackage

alternative encoding
for INSPIRE



Thanks to:



GeoSLab

<https://www.geoslab.com/>

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