A common metadata model for representing public transport at the European level

TransportDCAT-AP and Controlled Vocs 1.2

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Summary

In this document we present TransportDCAT-AP, a profile of the European standard for the representation of metadata in open data portals, DCAT-AP\(^1\), created in the context of the CEF-OASIS project\(^2\) with a focus on the representation of metadata about open public transport data. Transport data is considered a key asset for the development of many types of applications, and hence we highlight the importance of providing good metadata for open data portals that are focused on the provision of public transport data, or general-purpose open data portals that cover public transport among their datasets. We estimate that the availability of such metadata will make it possible for agents to discover Open Transport Data throughout Europe. For that reason, we have worked on a common metadata model for the metadata representation of public transport data at a European level, taking into account its special characteristics.

In this document we present:

- A report on the current situation of open data portals in Spain and Belgium.
- A brief review of current metadata models and their features.
- TransportDCAT-AP: a new profile of DCAT-AP for the public transport domain.
- A best practices guideline for the implementation of TransportDCAT-AP.
- Some examples of TransportDCAT-AP with real metadata from relevant transport organizations in Spain and Belgium.

We are also doing an external validation of the metadata model provided by 10 relevant organizations from Spain and Belgium and an adaptation process followed by CRTM\(^3\), where TransportDCAT-AP is added on top of their already existing ISO19139 metadata. On the Belgian case, we are validating 4 organizations and also adding TransportDCAT-AP over their transport data, which is provided as GTFS\(^4\) and GTFS-RT\(^5\) feeds. The involved organizations are: Localidata\(^6\), EMT\(^7\), CRTM\(^8\), Red.es\(^9\), Alcobendas council\(^10\), Caceres council\(^11\), De Lijn\(^12\), SNCB\(^13\), TEC\(^14\) and STIB\(^15\).

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1. [https://joinup.ec.europa.eu/asset/dcat_application_profile](https://joinup.ec.europa.eu/asset/dcat_application_profile)
2. [https://oasis.team/](https://oasis.team/)
12. [https://www.delijn.be/](https://www.delijn.be/)
14. [https://www.infotec.be/](https://www.infotec.be/)
15. [https://www.stib-mivb.be/](https://www.stib-mivb.be/)
Introduction

Metadata are data that describe other data, needed to be able to discover datasets within a certain domain. Simplifying, metadata describe the available information about or within a dataset(s). In the transport domain, metadata files may contain general information like the name of the distribution file or the company web page to whom data belongs. They may also contain more specific information about public transport, like the geographic area covered by a specific service.

Although there are open data portals in the domain of public transport, nowadays there are less than what we could wish for. For example, in Spain, there are organizations related to public transport, such as the Consorcio Regional de Transportes de Madrid\(^{16}\) (CRTM), the Empresa Municipal de Transportes de Madrid\(^{17,18}\) (EMT) or the Compañía de Transportes de Zaragoza\(^{19,20}\) (CTZ), among others, that publish open transport data on their own portals. Besides, the open data portals of many cities and regions also include transport data. The national technical norm UNE 178301:2015 about open data and smart cities\(^{21}\) proposes, in its annex, that public transport data has to be one of the priorities to be taken into account in the publication of open data of cities.

However, there is a clear lack of metadata in most of these open data portals, or such metadata has been created without applying the recommendations on interoperability that exist at the national and international levels.

There is a similar scenario in Belgium, companies such as De Lijn, SNCB, TEC or STIB expose their data as GTFS and GTFS-RT feeds with very limited metadata in the form of a textual description that does not follow any structured standard, therefore limiting discoverability and interoperability. Another issue regarding belgian companies is that most of them require signing a contract in order to access the datasets, which is not in accordance with the open data approach.

Current situation of public transport open data portals: Madrid and Belgium

In this section we describe the current status of public transport open data portals in the two cities/regions that are involved in our project.

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\(^{16}\) [http://datos.crtm.es/](http://datos.crtm.es/)

\(^{17}\) [http://www.emtmadrid.es/](http://www.emtmadrid.es/)

\(^{18}\) [http://opendata.emtmadrid.es/](http://opendata.emtmadrid.es/)

\(^{19}\) [http://www.consorciozaragoza.es/](http://www.consorciozaragoza.es/)

\(^{20}\) [http://www.consorciozaragoza.es/content/open-data](http://www.consorciozaragoza.es/content/open-data)

Madrid - CRTM

In the case of Madrid, we have focused on the open data portal of the Consorcio Regional de Transportes de Madrid (CRTM), which is one of the partners of this project. The portal provides open data about all means of transport in the region of Madrid (metro, trains, trams and buses). Table 1 presents a summary about the most relevant information of this open data portal.

<table>
<thead>
<tr>
<th>Number of Datasets</th>
<th>Transport</th>
<th>Metadata Files</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Interurban Bus</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>EMT Bus</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Madrid Bus</td>
<td>1</td>
</tr>
<tr>
<td>102</td>
<td>Metro</td>
<td>2</td>
</tr>
<tr>
<td>30</td>
<td>Tram</td>
<td>2</td>
</tr>
<tr>
<td>77</td>
<td>Train</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 1: Summary of datasets and metadata files from CRTM open data portal

About metadata, as we can see in the table 1, nine different files are currently representing this information in the portal. Each file provides the following data, based on ISO19139\(^\text{22}\):

- CreaDate: Date of the creation of the catalog
- idAbs: Catalog description
- Keywords: Set of important words
- idPurp: Naive catalog description
- idCredit: CRTM
- useLimit: License
- Data: Binary

It should be noted that after the analysis of the metadata, the current information provided is not enough for a portal that supplies all these data of the public transport domain. From CEF-OASIS, we perceived that a more robust and known metadata model following the European standard DCAT-AP was needed. This is why the process of adapting the metadata of CRTM to TransportDCAT-AP has been made (detailed in the last section of this document).

Datasets can be downloaded from the open data portal in different formats (GTFS, SHP, KML, SIG, and CSV). Data can be also obtained using an API. Data visualizations with graphics and tables is provided too in this portal.

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\(^{22}\) [https://www.iso.org/standard/32557.html](https://www.iso.org/standard/32557.html)
Belgium

For the Belgian scenario we have focused on four different transport companies (De Lijn, SNCF, TEC and STIB) and on the transport related datasets provided by the Open Data Portal of Ghent\(^23\) which includes bicycle statistical information, parking data, train stations, traffic data, among others.

As mentioned above, the official web portals transportation companies require the signing of a contract to allow access to the datasets. Therefore, we rely on a third party company named iRail\(^24\) which publishes the datasets as open data. Table 2 presents a general description of the different datasets provided by iRail and the Open Data Portal of Ghent.

<table>
<thead>
<tr>
<th>Company</th>
<th>Number of Datasets</th>
<th>Transport</th>
<th>Metadata Files</th>
</tr>
</thead>
<tbody>
<tr>
<td>De Lijn</td>
<td>1</td>
<td>Interurban Bus</td>
<td>0</td>
</tr>
<tr>
<td>SNCF</td>
<td>1</td>
<td>Train</td>
<td>0</td>
</tr>
<tr>
<td>TEC</td>
<td>1</td>
<td>Interurban Bus</td>
<td>0</td>
</tr>
<tr>
<td>STIB</td>
<td>1</td>
<td>Brussels Bus</td>
<td>0</td>
</tr>
<tr>
<td>Open Data Portal of Ghent</td>
<td>26</td>
<td>Miscellaneous</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 2: Summary of Belgium datasets and metadata files.

Regarding metadata, as seen on table 2 the considered transportation companies do not provide any and the only information available about these datasets is the short description provided by the third party publisher iRail. As for the metadata file available for the Open Data Portal of Ghent, we found that is structured following the DCAP-AP standard and can be found here\(^25\).

Following the same approach as for Madrid we decided to use the DCAP-AP standard to properly model and represent metadata of the belgian transportation companies datasets.

These datasets can be downloaded from the iRail data portal\(^26\) and from the Open Data Portal of Ghent. They are available in GTFS, JSON, KML, among others.

\(^{23}\) [https://data.stad.gent/](https://data.stad.gent/)

\(^{24}\) [https://hello.irail.be/](https://hello.irail.be/)

\(^{25}\) [https://datatank.stad.gent/4/api/dcat](https://datatank.stad.gent/4/api/dcat)

\(^{26}\) [https://hello.irail.be/gtfs/](https://hello.irail.be/gtfs/)
DCAT-AP, GeoDCAT-AP and Controlled Vocs

DCAT\textsuperscript{27} is an RDF vocabulary designed to facilitate interoperability between data catalogs published on the Web. Using DCAT, publishers increase discoverability and applications easily consume metadata from multiple catalogs. Besides, it facilitates federated queries across sites.

DCAT Application Profile (DCAT-AP) is an extension of DCAT developed to include classes and properties that the initial vocabulary did not take into account. DCAT-AP is an ontology that contains mandatory, recommended and optional classes and properties, so as to make it easier to adapt to different domains. The European Data Portal implements the DCAT-AP as the common vocabulary to harmonize descriptions of over 258,000 datasets harvested from 67 data portals of 34 countries. The DCAT-AP team has identified two different scenarios, one for data reusers, who find it difficult sometimes to get an overview of which datasets exist and which public administrations are maintaining them, and another one for data providers, encouraging their reuse by making them searchable and accessible. So, it is easy to think that the development of a metadata model related to the public transport domain should follow the DCAT-AP standard. This approach has been followed before by other profiles, such as GeoDCAT-AP\textsuperscript{28} o StatDCAT-AP\textsuperscript{29}, which are now standards in the European Data Portal for representing geospatial and statistical metadata.

GeoDCAT-AP provides an RDF syntax binding for the union of metadata elements defined in the core profile of ISO 19115:2003\textsuperscript{30} and those defined in the framework of the INSPIRE Directive\textsuperscript{31}, which are focused on describing geospatial datasets, dataset series, and services. The idea of this extension is to provide a way of transforming from these standards, which are widely used, to DCAT-AP. The main goal is to offer owners of geospatial data the possibility of representing this information in RDF. Note that this extension does not make any changes, nor does it add anything new to the DCAT-AP standard model, only a transformation guideline.

The main goal of StatDCAT-AP is to enhance interoperability between the metadata of statistical datasets within the statistical domain and between statistical data and open data portal.

The controlled vocabulary are restricted lists of terms that are used for labeling, indexing or categorizing. They are controlled because only terms from a list may be used for a specific domain covered by the controlled vocabulary. DCAT-AP includes references to controlled vocabularies using the SKOS vocabulary\textsuperscript{32}, that is a common data model for sharing these

\textsuperscript{27} https://www.w3.org/TR/vocab-dcat/
\textsuperscript{28} https://joinup.ec.europa.eu/node/154143/
\textsuperscript{29} https://joinup.ec.europa.eu/asset/stat_dcat_application_profile
\textsuperscript{30} https://www.iso.org/standard/26020.html
\textsuperscript{31} http://inspire.ec.europa.eu/
\textsuperscript{32} https://www.w3.org/TR/swbp-skos-core-spec
type of vocabularies. For example, the DCAT-AP web page recommends to use EuroVoc\textsuperscript{33}, but there are others about licenses\textsuperscript{34} or file types\textsuperscript{35}.

\textsuperscript{33} \url{http://eurovoc.europa.eu/}
\textsuperscript{34} \url{http://publications.europa.eu/mdr/resource/authority/licence/html/licences-eng.html}
\textsuperscript{35} \url{http://publications.europa.eu/mdr/resource/authority/file-type/html/filetypes-eng.html}
TransportDCAT-AP: metadata for public transport

As discussed above, TransportDCAT-AP is a profile of the DCAT-AP ontology focused on the public transport domain. We have made few but important changes in the standard ontology to improve the representation of the metadata in this domain:

- The relation (dcat:Catalog, dct:spatial, dct:Location) changes from optional to mandatory.
- The relation (dcat:Dataset, dct:spatial, dct:Location) changes from optional to mandatory.
- The relation (dcat:Dataset, dct:keyWord, rdfs:Literal) changes from optional to mandatory.
- The range of the relation (dcat:Dataset, dct:keyWord, rdfs:Literal) changes from a free string to a list controlled keywords properties following the format:
  - dct:keyword A, where A is the type of transport. The available types of transport are an extension of the route_type property in GTFS\(^ {36} \): Tram, Metro, Rail, Bus, Ferry, Cable car, Suspended cable car, Funicular or Other. This property can be repeated if the dataset involves multiple types of transport.
  - dct:keyword B, where B is the type of the dataset that A represents. The available types of datasets are followed GTFS\(^ {37} \) model and are: Calendar, Fare, Frequencies, Routes, Shapes, Stops, Transfers, Trips or Other. This property can be repeated if the dataset involves multiple sets.
  - dct:keyword C, where C is an INSPIRE feature for address, the AdminUnitName\(^ {38} \), where the level must be specified according to the official documentation of the framework (AdminUnitLevel3 (Province): Madrid, AdminUnitLevel4 (Municipality): Madrid).

We implement these changes since the nature of the public transport data is geospatial, so we consider that it has to be mandatory to provide this information in the generation of metadata for datasets in the catalogues of these open data portals. In addition, the modification of the keywords’ property is implemented in order to facilitate querying and data visualization, for example, consulting all the datasets of a city or country associated to a specific type of public transport could be possible. Below we describe a best practice guideline and two examples of TransportDCAT-AP.

\(^{36}\) https://developers.google.com/transit/gtfs/reference/routes-file
\(^{37}\) https://developers.google.com/transit/gtfs/reference/
Best practices guideline

In this section, we provide a guideline to generate metadata according to our TransportDCAT-AP proposal. This guideline is divided into several tables. Each table contains the properties of a class that can be either obligatory, recommended or optional. The properties in the table are described through their name, the type of property and an example.

<table>
<thead>
<tr>
<th>Property</th>
<th>Type</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>dcat:dataset</td>
<td>Mandatory</td>
<td>dcat:dataset &lt;#dataset-01&gt;</td>
</tr>
<tr>
<td>dct:description</td>
<td>Mandatory</td>
<td>dct:description “Catálogo de transporte urbano del CRTM”</td>
</tr>
<tr>
<td>dct:publisher</td>
<td>Mandatory</td>
<td>dct:publisher &lt;#agent-01&gt;</td>
</tr>
<tr>
<td>dct:spatial</td>
<td>Mandatory</td>
<td>dct:spatial <a href="http://sws.geonames.org/3117735/">http://sws.geonames.org/3117735/</a></td>
</tr>
<tr>
<td>dct:title</td>
<td>Mandatory</td>
<td>dct:title “Autobuses urbanos de la EMT”</td>
</tr>
<tr>
<td>foaf:homepage</td>
<td>Recommended</td>
<td>foaf:homepage <a href="http://datos.crtm.es/">http://datos.crtm.es/</a></td>
</tr>
<tr>
<td>dct:license</td>
<td>Recommended</td>
<td>dct:license <a href="http://www.crtm.es/licencia-de-uso">http://www.crtm.es/licencia-de-uso</a></td>
</tr>
<tr>
<td>dct:issued</td>
<td>Recommended</td>
<td>dct:issued &quot;2011-12-05&quot;^^xsd:date</td>
</tr>
<tr>
<td>dcat:themeTaxonomy</td>
<td>Recommended</td>
<td>dcat:themeTaxonomy <a href="http://datos.crtm.es/kos/vocabmetadata">http://datos.crtm.es/kos/vocabmetadata</a></td>
</tr>
<tr>
<td>dct:modified</td>
<td>Recommended</td>
<td>dct:modified &quot;2011-12-05&quot;^^xsd:date</td>
</tr>
<tr>
<td>dct:hasPart</td>
<td>Optional</td>
<td>dct:hasPartOf &lt;#catalog-02&gt;</td>
</tr>
<tr>
<td>dct:isPartOf</td>
<td>Optional</td>
<td>dct:hasPartOf &lt;#catalog-07&gt;</td>
</tr>
<tr>
<td>dcat:record</td>
<td>Optional</td>
<td>dcat:record &lt;#catalogRecord-01&gt;</td>
</tr>
<tr>
<td>dct:rights</td>
<td>Optional</td>
<td>dct:rights “public”</td>
</tr>
<tr>
<td>Property</td>
<td>Type</td>
<td>Example</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>dct:description</td>
<td>Mandatory</td>
<td>dct:description &quot;Dataset de las paradas de autobuses interurbanos&quot;</td>
</tr>
<tr>
<td>dct:title</td>
<td>Mandatory</td>
<td>dct:title “Paradas autobuses interurbanos del CRTM”</td>
</tr>
<tr>
<td>dct:spatial</td>
<td>Mandatory</td>
<td>dct:spatial <a href="http://sws.geonames.org/3117735/">http://sws.geonames.org/3117735/</a></td>
</tr>
<tr>
<td>dcat:keyword</td>
<td>Mandatory</td>
<td>dcat:keyword &quot;Bus&quot;; dcat:keyword &quot;Stops&quot;; dcat:keyword &quot;AdminUnitLevel3 (Province): Madrid, Spain&quot;;</td>
</tr>
<tr>
<td>dcat:contactPoint</td>
<td>Recommended</td>
<td>dcat:contactPoint &quot;&lt;mailto: <a href="mailto:contacto@crtm.es">contacto@crtm.es</a>&gt;&quot;</td>
</tr>
<tr>
<td>dcat:distribution</td>
<td>Recommended</td>
<td>dcat:distribution &lt;#distribution-01&gt;</td>
</tr>
<tr>
<td>dct:publisher</td>
<td>Recommended</td>
<td>dct:publisher &lt;#agent-01&gt;</td>
</tr>
<tr>
<td>dcat:theme</td>
<td>Recommended</td>
<td>dcat:theme <a href="http://datos.crtm.es/kos/vocabmetaddata/interurbanbus">http://datos.crtm.es/kos/vocabmetaddata/interurbanbus</a></td>
</tr>
<tr>
<td>dct:accessRights</td>
<td>Optional</td>
<td>dct:accessRights &quot;public&quot;</td>
</tr>
<tr>
<td>dct:conformsTo</td>
<td>Optional</td>
<td>dct:conformsTo &quot;GTFS&quot;</td>
</tr>
<tr>
<td>foaf:page</td>
<td>Optional</td>
<td>foaf:page <a href="http://data.crtm.com/datasets/dataset01">http://data.crtm.com/datasets/dataset01</a></td>
</tr>
<tr>
<td>dct:accrualPeriodicity</td>
<td>Optional</td>
<td>dct:accrualPeriodicity <a href="http://purl.org/cld/freq/monthly">http://purl.org/cld/freq/monthly</a></td>
</tr>
<tr>
<td>dct:hasVersion</td>
<td>Optional</td>
<td>dct:hasVersion &lt;#dataset-0101&gt;</td>
</tr>
<tr>
<td>dct:identifier</td>
<td>Optional</td>
<td>dct:identifier &quot;M8Estaciones&quot;</td>
</tr>
<tr>
<td>dct:isVersionOf</td>
<td>Optional</td>
<td>dct:isVersionOf &lt;#dataset-0102&gt;</td>
</tr>
<tr>
<td>dcat:landingPage</td>
<td>Optional</td>
<td>dcat:landingPage <a href="https://services5.arcgis.com/UxADft6QPcvFyDU1/archgis/rest/services/M8_Red/FeatureServer/0">https://services5.arcgis.com/UxADft6QPcvFyDU1/archgis/rest/services/M8_Red/FeatureServer/0</a></td>
</tr>
<tr>
<td>adms:identifier</td>
<td>Optional</td>
<td>adms:identifier&quot;InterUrbanBusesM8&quot;</td>
</tr>
<tr>
<td>dcat:provenance</td>
<td>Optional</td>
<td>dcat:provenance &quot;Este dataset pertenece al conjunto de todos los datos abiertos sobre autobuses interurbanos mostrados en datos.crtm.es&quot;</td>
</tr>
<tr>
<td>dct:relation</td>
<td>Optional</td>
<td>dct:relation</td>
</tr>
<tr>
<td>Property</td>
<td>Type</td>
<td>Example</td>
</tr>
<tr>
<td>---------------</td>
<td>--------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>dc:issued</td>
<td>Optional</td>
<td>dc:issued &quot;2015-01-01&quot;^^xsd:date</td>
</tr>
<tr>
<td>adms:sample</td>
<td>Optional</td>
<td>adms:sample &lt;#distribution-01&gt;</td>
</tr>
<tr>
<td>dc:source</td>
<td>Optional</td>
<td>dc:source &lt;#dataset-05&gt;</td>
</tr>
<tr>
<td>dc:temporal</td>
<td>Optional</td>
<td>dc:temporal &lt;#periodOfTime-01&gt;</td>
</tr>
<tr>
<td>dc:modified</td>
<td>Optional</td>
<td>dc:modified &quot;2015-12-05&quot;^^xsd:date</td>
</tr>
<tr>
<td>owl:versionInfo</td>
<td>Optional</td>
<td>owl:versionInfo &quot;1.0&quot;</td>
</tr>
<tr>
<td>adms:versionNotes</td>
<td>Optional</td>
<td>adms:versionNotes &quot;final version for 2016&quot;</td>
</tr>
</tbody>
</table>

### foaf:Agent - Mandatory class

<table>
<thead>
<tr>
<th>Property</th>
<th>Type</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>foaf:name</td>
<td>Mandatory</td>
<td>foaf:name &quot;Consorcio Regional de Transporte de Madrid&quot;</td>
</tr>
<tr>
<td>dc:type</td>
<td>Recommended</td>
<td>dc:type <a href="http://eurovoc.europa.eu/3060">http://eurovoc.europa.eu/3060</a></td>
</tr>
</tbody>
</table>

### dcat:Distribution - Recommended class

<table>
<thead>
<tr>
<th>Property</th>
<th>Type</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>dcat:accessURL</td>
<td>Mandatory</td>
<td>dcat:accessURL <a href="http://data-crtm.opendata.arcgis.com/datasets/19884a02ac044270b91fa478d807858_0.csv">http://data-crtm.opendata.arcgis.com/datasets/19884a02ac044270b91fa478d807858_0.csv</a></td>
</tr>
<tr>
<td>dcat:description</td>
<td>Recommended</td>
<td>dcat:description &quot;Distribucion del dataset de las paradas autobuses urbanos de la comuidad de madrid en CSV&quot;</td>
</tr>
<tr>
<td>dcat:format</td>
<td>Recommended</td>
<td>dcat:format &quot;CSV&quot;</td>
</tr>
<tr>
<td>dcat:license</td>
<td>Recommended</td>
<td>dcat:license <a href="http://www.crtm.es/licencia-de-uso">http://www.crtm.es/licencia-de-uso</a></td>
</tr>
<tr>
<td>dcat:byteSize</td>
<td>Optional</td>
<td>dcat:byteSize 1.0</td>
</tr>
<tr>
<td>spdx:checksum</td>
<td>Optional</td>
<td>spdx:checksum &lt;#checksum-01&gt;</td>
</tr>
<tr>
<td>foaf:page</td>
<td>Optional</td>
<td>foaf:page <a href="http://data-crtm.opendata.arcgis.com/datasets/19884a02ac044270b91fa478d807858_0.csv">http://data-crtm.opendata.arcgis.com/datasets/19884a02ac044270b91fa478d807858_0.csv</a></td>
</tr>
<tr>
<td>Property</td>
<td>Type</td>
<td>Example</td>
</tr>
<tr>
<td>---------------------------</td>
<td>----------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>dcat:downloadURL</td>
<td>Optional</td>
<td>dcat:downloadURL <a href="http://crtm.maps.arcgis.com/home/item.html?id=885399f83408473c8d815e40c5e702b7">http://crtm.maps.arcgis.com/home/item.html?id=885399f83408473c8d815e40c5e702b7</a></td>
</tr>
<tr>
<td>dct:conformsTo</td>
<td>Optional</td>
<td>dct:conformsTo &quot;CSV&quot;</td>
</tr>
<tr>
<td>dcat:mediaType</td>
<td>Optional</td>
<td>dcat:mediaType &quot;text/csv&quot;</td>
</tr>
<tr>
<td>dct:issued</td>
<td>Optional</td>
<td>dct:issued &quot;2015-12-05&quot;^^xsd:date</td>
</tr>
<tr>
<td>dct:rights</td>
<td>Optional</td>
<td>dct:rights &quot;public&quot;</td>
</tr>
<tr>
<td>adms:status</td>
<td>Optional</td>
<td>adms:status &quot;updated&quot;</td>
</tr>
<tr>
<td>dct:title</td>
<td>Optional</td>
<td>dct:title &quot;Paradas Autobuses Urbanos CRTM en CSV&quot;</td>
</tr>
<tr>
<td>dct:modified</td>
<td>Optional</td>
<td>dct:modified &quot;2015-12-05&quot;^^xsd:date</td>
</tr>
</tbody>
</table>

**dcat:CatalogRecord - Recommended class**

<table>
<thead>
<tr>
<th>Property</th>
<th>Type</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>foaf:primaryTopic</td>
<td>Mandatory</td>
<td>foaf:primaryTopic &lt;#dataset-01&gt;</td>
</tr>
<tr>
<td>dct:modified</td>
<td>Mandatory</td>
<td>dct:modified &quot;2015-12-05&quot;^^xsd:date</td>
</tr>
<tr>
<td>dct:conformsTo</td>
<td>Recommended</td>
<td>dct:conformsTo “TransportDCAT-AP”</td>
</tr>
<tr>
<td>adms:status</td>
<td>Recommended</td>
<td>adms:status &quot;updated&quot;</td>
</tr>
<tr>
<td>dct:issued</td>
<td>Recommended</td>
<td>dct:issued &quot;2015-12-05&quot;^^xsd:date</td>
</tr>
<tr>
<td>dct:description</td>
<td>Optional</td>
<td>dct:description&quot;Incorporación del dataset de paradas de autobuses interurbanos del CRTM al catalogo de buses interurbanos&quot;</td>
</tr>
<tr>
<td>dct:source</td>
<td>Optional</td>
<td>dct:source &lt;#catalogRecord-011&gt;</td>
</tr>
<tr>
<td>dct:title</td>
<td>Optional</td>
<td>dct:title &quot;Paradas autobuses interurbanos - Incorporación&quot;</td>
</tr>
</tbody>
</table>

**spdx:Checksum - Optional class**

<table>
<thead>
<tr>
<th>Property</th>
<th>Type</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>spdx:algorithm</td>
<td>Mandatory</td>
<td>spdx:algorithm <a href="http://spdx.org/rdf/terms#checksumAlgorithm_sha256">http://spdx.org/rdf/terms#checksumAlgorithm_sha256</a></td>
</tr>
</tbody>
</table>
In this section we provide two examples of the usage of our TransportDCAT-AP model, the first one with metadata from the Consorcio Regional de Transportes de Madrid (CRTM) and the another with metadata from four belgian transport companies. If you want to have access to the files for a better visualization of the model or to reuse them in your organization, you can download the examples and the controlled vocabularies at: https://github.com/cef-oasis/DCAT-AP, http://crtm.linkeddata.es/metadata and http://crtm.linkeddata.es/kos.

Consorcio Regional de Transportes de Madrid (CRTM)

```html
@base <http://datos.crtm.es/metadata>.  
@prefix adms: <http://www.w3.org/ns/adms#>.  
@prefix dcat: <http://www.w3.org/ns/dcat#>.  
@prefix dct: <http://purl.org/dc/terms/>.  
@prefix foaf: <http://xmlns.com/foaf/0.1/> .  
@prefix owl: <http://www.w3.org/2002/07/owl#>.  
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>.  
@prefix schema: <http://schema.org/>.  
@prefix skos: <http://www.w3.org/2004/02/skos/core#>.  
@prefix spdx: <http://spdx.org/rdf/terms#>.  
@prefix xsd: <http://www.w3.org/2001/XMLSchema#>.  
@prefix vcard: <http://www.w3.org/2006/vcard/ns#>.  

<#catalog-01> a dcat:Catalog ;  
  dcat:dataset <#dataset-01> ; #mandatory  
  dct:description "Conjunto de datos de los autobuses interurbanos del CRTM" ;  
#mandatory  
  dct:publisher <#agent-01> ; #madantory  
  dct:title "Autobuses Interurbanos del CRTM" ; #mandatory  
  dct:spatial <http://sws.geonames.org/3117735/> ; #mandatory  
  foaf:homepage <http://datos.crtm.es> ; #recommended  
  dct:language <http://id.loc.gov/vocabulary/iso639-1/es> ; #recommended
```

dct:license <http://www.crtm.es/licencia-de-uso> ; #recommended
dct:issued "2011-12-05"^^xsd:date ; #recommended
dcat:themeTaxonomy <http://datos.crtm.es/kos/vocabmetadata> ; #recommended
dct:modified "2016-12-05"^^xsd:date ; #recommended
dct:hasPartOf <#catalog-02> ; #optional
dct:isPartOf <#catalog-03> ; #optional
dcat:record <#catalogRecord-01> ; #optional
dct:rights "public". #optional

<dct:license> <http://www.crtm.es/licencia-de-uso> ; #recommended
<dct:issued> "2011-12-05"^^xsd:date ; #recommended
<dcat:themeTaxonomy> <http://datos.crtm.es/kos/vocabmetadata> ; #recommended
<dct:modified> "2016-12-05"^^xsd:date ; #recommended
<dct:hasPartOf> <#catalog-02> ; #optional
<dct:isPartOf> <#catalog-03> ; #optional
<dcat:record> <#catalogRecord-01> ; #optional
<dct:rights> "public". #optional
</#dataset-01> a dcat:Dataset;
   dct:title "Localización de las paradas por las que pasan buses interurbanos en la comunidad de madrid";   #mandatory
dct:spatial <http://sws.geonames.org/3117735/>; #mandatory
dcat:keyword "Bus";
dcat:keyword "Stops";
dcat:keyword "AdminUnitLevel3 (Province): Madrid, Spain";   #mandatory
dcat:contactPoint "mailto: contacto@crtm.es"; #recommended
dcat:distribution <#distribution-01> ;  #recommended
dcat:theme <http://datos.crtm.es/kos/vocabmetadata/interurbanbus> ;
   #recommended
dcat:theme <http://datos.crtm.es/kos/vocabmetadata/stops> ; #recommended
dct:publisher <#agent-01> ;  #recommended
dct:conformsTo "GTFS" ;   #optional
foaf:page
http://data-crtm.opendata.arcgis.com/datasets/19884a02ac044270b91fa478d80f7858_0> ;
   #optional
dct:accrualPeriodicity <http://purl.org/cld/freq/monthly> ; #optional
dct:hasVersion <#dataset-0101> ; #optional
dct:identifier "M8Estaciones"; #optional
dct:isVersionOf <#dataset-0102> ; #optional
dcat:landingPage
https://services5.arcgis.com/UxADft6QPcvFyDU1/arcgis/rest/services/M8_Red/FeatureServer/0> ;  #optional
dct:language <http://id.loc.gov/vocabulary/iso639-1/es> ; #optional
adms:identifier  "19884a02ac044270b91fa478d80f7858_0" ; #optional
dct:relation
http://data-crtm.opendata.arcgis.com/datasets?q=M8+red&sort_by=relevance> ; #optional
dct:issued "2015-01-01"^^xsd:date ; #optional
adms:sample <#distribution-01> ;  #optional
dct:source <#dataset-05> ;  #optional
dct:temporal <#periodOfTime-01> ; #optional
dct:modified "2015-12-05"^^xsd:date ;  #optional
owl:versionInfo  "1.0" ;  #optional
adms:versionNotes "final version for 2016"; #optional
dct:accessRights "public" ;   #optional
Este dataset pertenece al conjunto de todos los datos abiertos sobre autobuses interurbanos mostrados en datos.crtm.es. #optional

<#agent-01> a foaf:Organization;
foaf:name "Consortio Regional de Transporte de Madrid" ; #mandatory
dct:type <http://eurovoc.europa.eu/3060>. #recommended

<#distribution-01> a dcat:Distribution;
dcat:accessURL <http://data-crtm.opendata.arcgis.com/datasets/19884a02ac044270b91fa478d80f7858_0.csv> ; #mandatory
dct:description "Distribucion del dataset de las paradas autobuses urbanos de la comuidad de madrid en CSV" ; #recommended
dct:format "CSV" ; #recommended
dct:license <http://www.crtm.es/licencia-de-uso> ; #recommended
dcat:byteSize 1.0 ; #optional
spdx:checksum <#checksum-01> ; #optional
foaf:page <http://data-crtm.opendata.arcgis.com/datasets/19884a02ac044270b91fa478d80f7858_0>; #optional
dcat:downloadURL <http://crtm.maps.arcgis.com/home/item.html?id=885399f83408473c8d815e40c5e702b7> ; #optional
dct:language <http://id.loc.gov/vocabulary/iso639-1/es>; #optional
dct:conformsTo "text/csv" ; #optional
dcat:mediaType "text/csv" ; #optional
dct:issued "2015-12-05"^^xsd:date ; #optional
dct:rights "public" ; #optional
adms:status "updated" ; #optional
dct:title "CSV Paradas de autobuses interurbanos CRTM" ; #optional
dct:modified "2015-12-05"^^xsd:date. #optional

<#catalogRecord-01> a dcat:CatalogRecord;
foaf:primaryTopic <#dataset-01>; #mandatory
dct:modified "2015-12-05"^^xsd:date ; #mandatory
dct:conformsTo "TransportDCAT-AP"; #recommended
adms:status "updated"; #recommended
dct:issued "2015-12-05"^^xsd:date ; #recommended
dct:description "Incorporación del dataset de paradas de autobuses interurbanos del CRTM al catalogo de buses interurbanos" ; #optional
dct:language <http://id.loc.gov/vocabulary/iso639-1/es>; #optional
dct:source <#catalogRecord-011> ; #optional
dct:title "Paradas autobuses interurbanos - Incorporación". #optional
Belgian Transport Companies (De Lijn, SNCB, TEC and STIB)

@base <https://gtfs.irail.be/metadata>.
@prefix adms: <http://www.w3.org/ns/adms#>.
@prefix dcat: <http://www.w3.org/ns/dcat#>.
@prefix dct: <http://purl.org/dc/terms/>.
@prefix foaf: <http://xmlns.com/foaf/0.1/>.
@prefix owl: <http://www.w3.org/2002/07/owl#>.
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>.
@prefix schema: <http://schema.org/>.
@prefix skos: <http://www.w3.org/2004/02/skos/core#>.
@prefix spdx: <http://spdx.org/rdf/terms#>.
@prefix xsd: <http://www.w3.org/2001/XMLSchema#>.
@prefix vcard: <http://www.w3.org/2006/vcard/ns#>.

<#catalog-01> a dcat:Catalog ;
   dcat:dataset <#delijn>, <#stib-mivb>, <#snbc-nmbs>, <#tec> ;
   dcat:description "Contains 4 data set comprising different transportation systems in Belgium";
   dct:publisher <https://irail.be/#org> ;
   dct:title "iRail catalog for GTFS" ;
   dct:spatial <http://sws.geonames.org/2802361/>;
   foaf:homepage <https://hello.irail.be> ;
   dct:license <http://creativecommons.org/publicdomain/zero/1.0/> ;
   dct:issued "2017-05-24"^^xsd:date ;
   dct:themeTaxonomy <http://datos.crtm.es/kos/vocabmetadata> ;
   dct:modified "2017-05-24"^^xsd:date ;
   dct:record <#catalogRecord-01> ;
   dct:rights "public".

<https://irail.be/#org> a foaf:Organization ;
   foaf:name "iRail - Promoting digital creativity concerning mobility in Belgium";

<#delijn> a dcat:Dataset;
  dct:description "Flanders De Lijn bus information system";
  dct:title "De Lijn Bus System";
  dct:spatial <http://sws.geonames.org/3337388/>;
  dcat:keyword "Bus";
  dcat:keyword "Stops";
  dcat:contactPoint <http://www.delijn.be/en/contact/>;
  dcat:distribution <#delijn-distribution-01>;
  dcat:theme <http://datos.crtm.es/kos/vocabmetadata/interurbanbus>;
  dcat:theme <http://datos.crtm.es/kos/vocabmetadata/stops>;
  dct:publisher <https://irail.be/#org>;
  dct:conformsTo <https://developers.google.com/transit/gtfs/reference>;
  foaf:page <http://www.delijn.be>;
  dct:accrualPeriodicity <http://purl.org/cld/freq/weekly>;
  dct:hasVersion <#delijn01>;
  dct:identifier "delijn";
  owl:versionInfo "1.0";
  dct:accessRights "public";
  dct:provenance "This dataset belongs to the open data about Belgium transportation system".

<#stib-mivb> a dcat:Dataset;
  dct:description "Brussels stib-mivb bus information system";
  dct:title "MIVB/STIB public transportation agency";
  dct:spatial <http://sws.geonames.org/2800866/>;
  dcat:keyword "Bus";
  dcat:keyword "Stops";
  dcat:contactPoint <http://www.stib-mivb.be/article.html?_guid=803bdcc5-1b8e-3410-54a9-bf3b6e04a84c&l=en>;
  dcat:distribution <#stib-mivb-distribution-01>;
  dcat:theme <http://datos.crtm.es/kos/vocabmetadata/interurbanbus>;
  dcat:theme <http://datos.crtm.es/kos/vocabmetadata/stops>;
  dct:publisher <https://irail.be/#org>;
  dct:conformsTo <https://developers.google.com/transit/gtfs/reference>;
  foaf:page <http://www.stib-mivb.be>;
  dct:accrualPeriodicity <http://purl.org/cld/freq/weekly>;
  dct:hasVersion <#stib-mivb01> ;
dct:identifier "stib-mivb";
owl:versionInfo "1.0";
dct:accessRights "public";
dct:provenance "This dataset belongs to the open data about Belgium transportation system".

<#sncb-nmbs> a dcat:Dataset;
dct:description "Belgium sncb-nmbs train information system";
dct:title "De Lijn Bus system";
dct:spatial <http://sws.geonames.org/2802361/>;
dcat:keyword "Train";
dcat:keyword "Stops";
dcat:contactPoint <http://www.belgianrail.be/en/customer-service/contact.aspx>;
dcat:distribution <#stib-mivb-distribution-01>;
dcat:theme <http://datos.crtm.es/kos/vocabmetadata/train>;
dcat:theme <http://datos.crtm.es/kos/vocabmetadata/stops>;
dct:publisher <https://irail.be/#org>;
dct:conformsTo <https://developers.google.com/transit/gtfs/reference>;
foaf:page <http://www.belgianrail.be>;
dct:accrualPeriodicity <http://purl.org/cld/freq/weekly>;
dct:hasVersion <#sncb-nmbs01>;
dct:identifier "sncb-nmbs";
owl:versionInfo "1.0";
dct:accessRights "public";
dct:provenance "This dataset belongs to the open data about Belgium transportation system".

<#tec> a dcat:Dataset;
dct:description "Walloonia bus information system";
dct:title "De Lijn Bus system";
dct:spatial <http://sws.geonames.org/3337387/>;
dcat:keyword "Bus";
dcat:keyword "Stops";
dcat:distribution <#tec-distribution-01>;
dcat:theme <http://datos.crtm.es/kos/vocabmetadata/interurbanbus>;

De Lijn Bus Information System

Data set distribution for the De Lijn bus information system.

Brussels SITB-MIVB Bus Information System

Data set distribution for the Brussels SITB-MIVB bus information system.