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STANDARD-CENTRIC AUTHORING AND PUBLICATION FOR CARTOGRAPHIC CONTENT

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ABSTRACT:
Within the nascent GeoWeb, democratization of GIS and cartographic practices is on the way with more and more map makers and map consumers looking for answers to their geographic and cartographic needs. This paper explains how standards are used as common languages to open the doors of collaborative edition of cartographic content. As more and more users get stuck in the making of maps, this paper describes some solutions to create adequate mapping tools adapted to various user profiles of skills. Especially for thematic mapping, until now the field of specialists, map makers want to take benefits of the analytical power of such maps. This paper brings some elements to anticipate this phenomena. Also, this paper explains how structuring cartographic content helps to make publication easier. The aim of this paper is to develop an innovative method of cartographic publication based on a polypublishing/crossmedia approach : one source, many media, many targets. It defines a cartographic document that needs to be adapted to these different media and targets while benefiting from all the winning cards of each.

1. INTRODUCTION

While the concept of Digital Earth (Gore, A., 1988) is becoming reality through the nascent GeoWeb, democratization of GIS and cartographic practices is on the way with more and more map makers and map consumers looking for answers to their geographic and cartographic needs. Geospatial data are now widely available through web services and are the base material to create cartographic products useful for stakeholders. Based on best practices like use of standards and content structuring, the web is the ultimate platform to discover, explore, share, and create content by combining distributed informations and services. GeoWeb becomes a new paradigm for GIS and cartography to produce collective geospatial knowledge. By way of proof the growing of webmapping applications through geographic mashups (Programmableweb).

These applications offer new ways to explore and use geodata through the web medium, but printed maps stays important, while maps on mobile combined with location bases services becomes usual, and with no doubt, new channels for geodata and maps will appear in the future (Crawford, G.P., 2005). In this context, it is a matter of fact that web mapping applications are tuned for one media and usually one target, for instance well done for screen display but poorly built up to provide also high quality printing. Still too often, for such applications, printing is secondary and when available, does not really fit the result expected, in term of resolution quality and layout. Many cartographic publication platforms are following the right direction with real printing functionalities (MapFish Print; GeoAdmin), but printing maps is still rather a desktop application functionality. However, online and offline worlds are coming closer so as cartographic publication platforms must now be able to adapt their contents in a multi-channels and multi-targets context. This is the main focus of this paper.

The red dot fever continues on one's way, leading to crowd-sourcing, geospatial data infrastructures are built up, from local to global, and the next step is now to feed the geospatial knowledge infrastructure. It's time to create and share geospatial cognition, in the form of "mapping products" with the intend to synthesize informations, to communicate a message or to uphold a line of argument for taking decisions.

Thematic mapping represents an essential mechanism to absorb geodata whose volume is growing day by day on the GeoWeb. Even if this type of maps are more complex to build, until now the field of specialists, more and more map makers wants to take benefits of the analytical power of such maps. This paper brings some elements to anticipate this phenomena.

2. GEOSPATIAL KNOWLEDGE PRODUCTION

By extension of Spatial Data Infrastructure (Nebert, D., 2004), which concerns the discovering and sharing of geodata, a map product is a form of geospatial knowledge build up from geodata. And before mapping, a process can also produce the indicators and results to map. Finally, maps are published within cartographic documents.

The process to transform geodata into cartographic document for publication involves different types of actors :

1. data owner : to acquire and organize data according to a business logic;
2. data analyst : to process and transform “raw data” so as to extract indicators and results ready for mapping;
3. cartographer : to build map in respect of cartographic rules and best practices (Bucher, B., 2007);
4. cartopublisher : to transform maps into a cartographic document combined with other maps and enriched with external contents.

A geospatial knowledge infrastructure is driven by a collaborative context in which each actor pushes results of know-how in order to share with other actors :

1. push geodata on a GeoServer and push geo-statistical data on a StatServer;
2. push complex processes on a ProcessingServer;
3. push maps for rendering on a MapServer;
4. push cartographic document for publication on a CartoServer.

Within such an infrastructure, use of standards defined by Open Geospatial Consortium (OGC) is essential (Iosifescu-Enescu, I., 2009). First, as shown in Figure 1, actors interact together through server components, so as standards are the engine oils for smooth-running transformation of geodata into cartographic document. Second, because actors want to work with their prefered tools, these have to be conform with these standards.

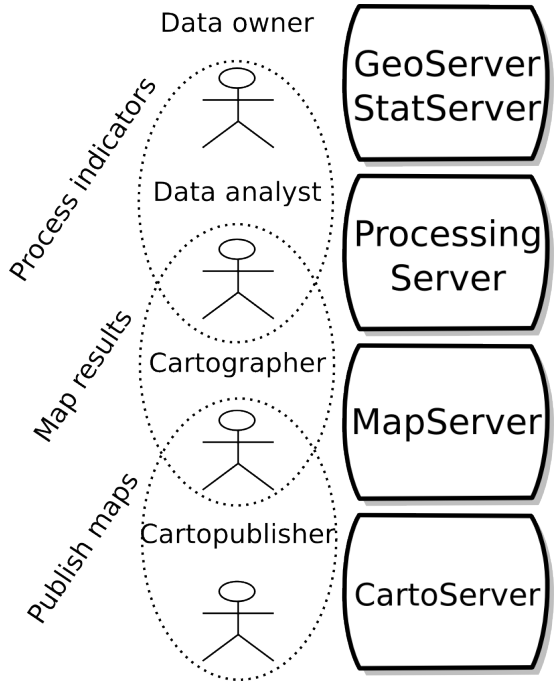


Figure 1. GeoCognition, many skills are in action to transform geodata into cartographic document

While geodata can be accessed and processed in a standardized way using OGC standards like Web Feature Service (WFS), Geographic Markup Language (GML) and Web Processing Service (WPS), the following of this chapter will likely focus on mapping and publication of cartographic document using standards.

3. COLLABORATIVE CARTOGRAPHIC EDITION

In such a collaborative context, the use of a common language for cartographic description opens the doors of collaborative cartographic edition.

3.1 Map layer description

The OGC standard Symbology Encoding (SE) gives to several cartographers the ability to share the cartographic description of a map layer (see Figure 2).

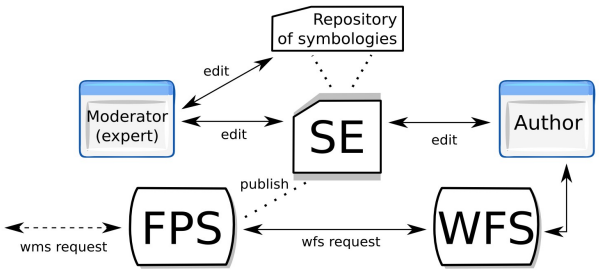


Figure 2. Symbology Encoding, a common language to describe a map layer

Indeed, the task of mapping indicators can involve both data analyst and cartographer profiles of actors. As an example, Figure 2 shows the use of SE, first to share symbologies that an expert have pre-defined, and to share a map layer built by an author but moderated (controlled) by an expert. As soon as the description is edited and validated, it is pushed for the rendering engine (FPS stands for Feature Portrayal Service) so as to style features retrieved from Web Feature Server.

Figure 3 shows a short diagram of Symbology Encoding model : a *FeatureTypeStyle* defines a pass to be applied on a map layer. Several *Rules* can then filter the features of the layer according spatial, logical, or comparison operators (e.g. st_area(the_geom) < 1000 AND name = 'Basel-Stadt'). Each *Rule* is activated according domain constraints (e.g. 1:5000 < scale < 1:25000) and describes the symbolizer used to style the features that run in the filter.

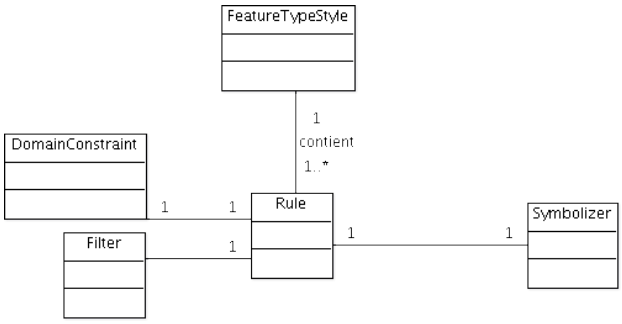


Figure 3. Symbology Encoding model

Several symbolizers can be defined :

1. AreaSymbolizer for the representation of areas given outline and filling values;
2. LineSymbolizer for the representation of lines given a type of stroke;
3. PointSymbolizer for the representation of points to put a graphic on (i.e. an image);
4. TextSymbolizer for the representation of text labels according placement options.

With OGC conform tools, a cartographer can then export the result of his(her) work according the Symbology Encoding standard model which has the capacity to formalize several types of maps. Currently, OGC is preparing the next release of the standard by reviewing Change Requests and Engineering Reports (OGC Charter document, 2010) that proposes improvements and new abilities. One Change Request is especially in interest for this chapter and concerns improvements for thematic mapping. To summarize, it suggests to add classification methods and a new type of graphic

providing an internal way to describe charts like pie chart. In opposition with external approaches which does not guarantee a common language of description (Mays, J., 2008), the latest will extend the standard so as to be self-contained for such type of thematic maps.

3.2 Map context description

While the cartographer is defining the symbology of each layer, it is done with a map context in mind. Thus, a Map Context is a list of map layers that results in a map when put together. It is the base input material for the rendering phase to deliver a mapview. Rendering ability is either server-side or client-side.

Fro the image case, a layer can be a ready-to-view image (see Figure 4) produced by a server-side rendering engine with a Web Map Service (WMS) : a WMS request using default server-defined, a WMS-SLD* request with a custom symbology description by use of SE, or a FPS request combining a custom symbology with a WFS request (see Figure 2). The result is then an image in form of a formatted bitmap graphic like PNG or a vector graphic like SVG.

For the feature case, at the other side (Figure 4), a layer can be a WFS or TJS (Table Joining Service) request providing GML-encoded features that, associated with a symbology description, can be transformed into an image given the rendering abilities of the client.

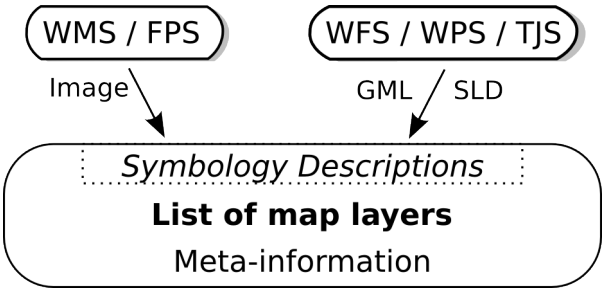


Figure 4. Map Context

In a middle situation, a WPS request can provide a layer in the form of SLD description which combines inline features with a ready-to-use symbology description. Either it can then be rendered server-side through a FPS request or client-side. As an example, wpsPAL (Ertz, O,. 2009) is such an OGC standards compliant cartographic service, it gives access to advanced labelling functionalities for any application that needs to produce cartographic content of high quality.

The second main important purpose of using a map context structured document concerns the description of meta-information useful for the final publications. It is essential to have title, source, date and so on for each map layer, but also layer-independent information such as the initial map extent, spatial reference system and some information describing the document itself such as title, abstract, source, author, etc.

The OGC Map Context standard is currently a candidate able to fulfil the description needs listed above. Thus several cartographers can share their work using this common language to describe a map. As soon as it is edited and validated, the map is pushed forward to be inserted in a cartographic document. At this time, it's up to the cartopublisher to complete the publication process.

* SLD stands for the OGC standard Styled Layer Descriptor

3.3 Authoring tools for map makers.

While more and more users get stuck in the making of maps, it's essential to create adequate mapping tools adapted to various user profiles of skills. Especially for thematic mapping which implies the respect of precise cartographic rules, some wizard tools would guide the creation of such type of maps but could also help to control the aptness of the map expression.

For thematic maps, with the OGC Geographic Data Attribute Set formatting standard (GDAS), used in conjunction with TJS, editing tools are able to get the attribute data but also its associated meta-data. This attribute typology (nominal, ordinal, count, measure) facilitates then automated determination of appropriate forms of mapping.

Also, some smart interactive visual widgets could help map makers. For instance concerning the creation of a choropleth map, the systematic use of an histogram to visualize the distribution is first required. Moreover, when choosing a classification method, providing a way to adjust threshold and visualize “live on” the results on the map would enrich the user experience and ease the work. Also, a systematic use of a “ColorBrewer”-like tool (Brewer, C,. 2010) helps for selecting good colour schemes. And another smart mapping widget could help to automate and assist the user for the calculation of proportional symbol sizes.

4. CARTOGRAPHIC POLYPUBLISHING/CROSSMEDIA

Using common languages for map layer symbology and map context descriptions allows to put in practice collaborative edition of cartographic content. But also, structuring content make publication easier. This section aims to develop an innovative method of cartographic publication based on a polypublishing/crossmedia approach : one source, many media, many targets.

4.1 Cartographic document definition

A map context describes the information needed to create a map while a cartographic document can encapsulate several maps. In a multiple maps situation, there are then some document-specific information like document title, sub-title, author, date, logo and so on. Moreover, a cartographic document is also the right place to enrich encapsulated maps with external content like text, images, etc. As maps are visualizations to support a line of argument expressed by the cartographic document, often some text is joined to bring some explanations. Below are use cases to illustrate this definition.

CartoExplorer case : considering the data owner has pushed a GPS track with its waypoints and some descriptive attributes (name, author, distance, height variation, etc) on a GeoServer.

The cartographer build up the map context :

- define one or more possible base layers;
- define one overlay for the track and one for waypoints;
- define a layer of point of interests (POI) provided by a remote POI search service through a WPS request;
- define the symbology of each layer by use of Symbology Encoding according eventually a set of pre-defined symbologies;
- define initial map extent and spatial reference system;

- describe meta-information, layer name, date, author, source, etc.

The cartopublisher build up the cartographic document :

- insert one or more prepared map contexts;
- enrich the document with photos in relation with the cartographic theme;
- describe more meta-information if needed, especially if multiple maps are encapsulated.

Thematic mapping case : considering data owners have pushed geodata on a GeoServer and some data statistics on a StatServer with common geocodes.

The cartographer build up the map context :

- define a base layer;
- define thematic overlays through TJS requests;
- define the thematic symbology by use of Symbology Encoding with thematic mapping level of conformance;
- define initial map extent and spatial reference system.

The cartopublisher build up the cartographic document :

- insert one or more prepared map contexts;
- enrich the document with analytical explanations, article from newspaper, graphical charts, etc.;
- describe document-specific meta-information.

In collaboration with the cartographer, the cartopublisher creates the cartographic logic. As soon as the cartographic document is edited and validated, it represents one source ready for publication.

4.2 Polypublishing/crossmedia approach

This approach is synonym to multi-channels and multi-targets publications, meaning that a source document is described one time, containing all the base material, and published for many media and many targets. Crossmedia means for print medium, for screen display, for mobile, etc. each device-specific. Polypublishing means from one source to many targets depending on final user needs and publication context.

Let's apply this approach for cartographic content publication.

For different channels :

- print : high-quality maps and statical, offline content;
- screen : online and interactive content through a webmapping application.

For different targets :

- only maps : rapid and synthetic for publication in a newspaper;
- maps with tables and charts : detailed and analytical for stakeholders.

Media and targets have their specificities, advantages and drawbacks. Print medium offers high-quality of rendering which enforces the principle to describe a cartographic document in complete independence with the final publication device. This means that all measures, especially for symbology description have to be defined with absolute units (e.g. not pixel). At the other side, web medium offers low resolution rendering but have a strong advantage with the ability to offer interactions for rich user experience when exploring maps.

Thus, a cartographic document needs then to be adapted to these different media and targets, and it is to benefit from all the winning cards of each.

4.3 Publishing process

A cartographic document must be transformed to be adapted according media and targets. The principle is that such a transformation knows the advantages and drawbacks of the targeted media so as to adapt the publication the best according specificities like resolution, interactive context, online/offline content, etc.

It's up to the cartopublisher to configure these transformations which first need a formatting language to fit the final targeted container. For print medium, the final container is a printer, thus a page description language is used like PDF, XPS or PostScript to formalize the result. For web medium, the final container is a screen display running a browser with a webmapping framework, using W3C standards and JavaScript language, like OpenLayers does.

Finally, each information element defined by the cartographic document has to take place within a presentation through a layout template. For instance, either it is a page layout to be printed or a web page layout to display on a screen. Using a template system allows then the reuse of the same template to publish other cartographic documents. It makes sense for an organization which has a pre-defined corporate template so as to standardize all cartographic publications produced by its members.

Templating	**Language**	**Engine**	**Result**
XSL	XSL-FO	FOP	PDF file
Server-side templating (e.g. Smarty)	HTML/CSS +JavaScript	OpenLayers AJAX mapping framework	Client-side webmapping application

Table 1. Two publishing processes with technologies, one for print medium, one other for screen display

Several technologies can be used to implement and execute the transformation chain. Table 1 shows two examples, one for print medium using the well-known XSL-FO language. It is a W3C recommendation that stands for Extensible Stylesheet Language Formatting Objects. It is a language for formatting XML data for output to screen, paper or other media. Mainly used for printed publications in conjunction with Apache FOP processor which produces output formats like PDF, PS, etc.

The second publishing process from Table 1 shows the transformation of a cartographic document towards a webmapping application in a client/server publication context. Thus, server-side, Smarty, a template system for PHP manages the presentation while HTML, CSS and Javascript are the used formatting languages for running within OpenLayers, a well-known AJAX mapping framework that makes it easy to put a dynamic map in any web page.

Among other technologies, GeoPDF and KML would be also interesting candidate for publication.

Let's zoom into the process. For each map context described, it has to be drawn, and this is where it comes to know about the

targeted resolution which is essential for high-quality printing. The good news for a WMS map layer is that the OGC Standard Working Group is currently considering suggestions to have a resolution parameter (i.e. dpi) within a WMS request. This, in addition to absolute units for Symbology Encoding, would then lead to a device-independent context. Also, one other solution would be to request an image using a scalable format like SVG.

Next step is to apply the template and to place the different content elements at the right place using the right form. This step is driven by a publication layout combined with configurable publication modules. Together they define the final user interface.

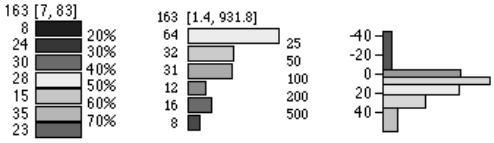


Figure 5. different types of map-legend

Modules are containers able to present content in a given form depending on how they are configured. For instance, a map-legend module is in charge of generating map-legends according Symbology Encoding descriptions and configuration parameters like the type of representation (Figure 5).

It goes the same for the configurations of an orientation module to display the north arrow, a scale-bar module, etc. It's up to the cartopublisher to configure the publication through these modules.

Independently of the media or target, transformations are built so as to automate and guide the cartopublisher to apply the cartographic best practices, like the mandatory presentation of a title, a scale-bar, a north arrow, all map-legends, sources, dates, authors and so on.

4.4 One source, many specific transformations

As introduced previously, transformations adapt the content publication according final medium and target. While transformations will have a focus on rendering quality for print medium, one major advantage of a webmapping publication is the ability to provide map interactions. This means that modules can deploy specific elements of interactivity.

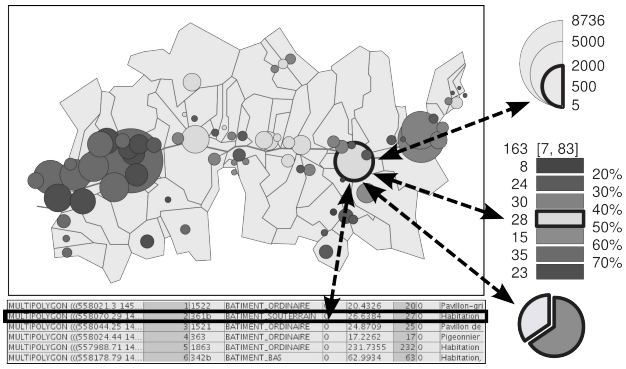


Figure 6. Specific elements of interactivity for thematic mapping

The interactive context can be used to activate the usual navigation tools to zoom, to pan and to switch layers, but also some interactions to better analyse a thematic map. Figure 6 shows possible interactions between a map-view, map-legends, a data table and a graphic chart to help the user to identify all the information about an object selected on the map. The equivalent printed publication can present all this information, but in a statical manner.

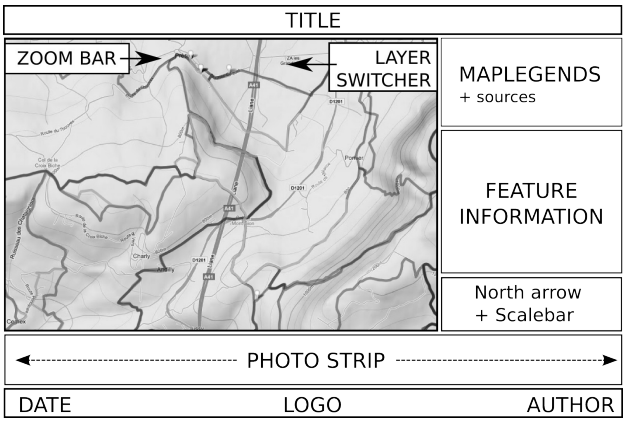
To illustrate the method, let's come back to the first case described previously with its cartographic document and complete the publishing process with some transformations.

4.5 Example of transformations

The webmapping transformation needs a template layout to organize the presentation and distribute the content among the usual mapping modules.

First, let's consider a classical webmapping layout and some modules (Figure 7) :

1. Annotation module to style meta-information like title, date, author, etc.;
2. Zoom-bar module to allow map navigation;
3. Layer-switcher module to control layer visibility;
4. Feature-info module to allow object selection on the map and visualization of its descriptive attributes (needs configuration to associate a label to each attribute);
5. Map-legend module providing visual description of visible layers with sources information and interaction to zoom into a specific layer;



6. Photo strip module to provide an interactive way to explore external content like photos.

Figure 7. Webmapping layout and modules

One complementary module can be added for another target, an advanced publication, by including a profiler visualization (Figure 8). Interactive synchronization between the track on the map and the profile is a way to enrich user experience.

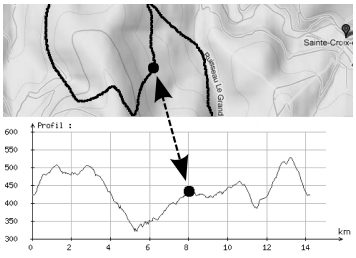


Figure 8. A map synchronized profiler module

For a printed publication of the same content, there will be no interactivity, but the cartopublisher has to think the publication in a different way.

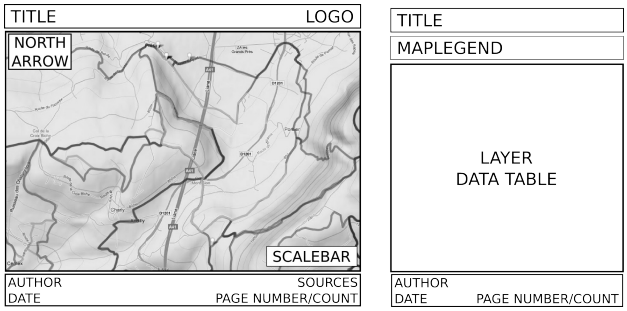


Figure 9. Multi-pages printed publication

First, the map is printed on a full landscape page so as to intensify the reading experience. Then one page per layer is printed to lay down feature attributes. The latest will need a clean template, not just a raw table. For instance, if the layer is styled using a categorization, the table should list ordered features by classes with colours.

5. CONCLUSIONS

Use of standards for map layer symbology and map context descriptions is essential to put in practice collaborative edition of cartographic content. Moreover, cartographic editing tools can be improved to better suit user skills by a systematic use of attribute typology and smart mapping widgets to automate or at least guide the cartographic production.

Cartographic content structuring favour publication over the GeoWeb and allows easy syndication for derived geospatial analysis and knowledge production. Moreover, it opens the doors for multi-channels and multi-targets cartographic content publication. Such an approach is central for the design of a platform when it comes to publish cartographic content over various media, from usual high-quality printed maps to webmapping applications on mobile, and for various targets, depending on targeted technologies and final user profiles, from stakeholder to newspaper reader.

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