A response to:
Request for Information on Arctic Spatial Data Infrastructure
By
The W3C Maps for HTML Community Group

Background

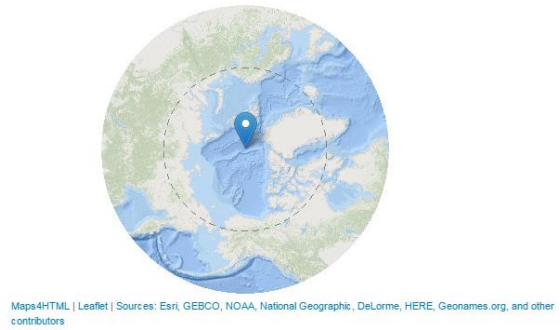
"Maps for HTML" (Maps4HTML) is a W3C Community Group (CG) formed in 2014 [1]. The big idea behind the CG is that map content can be represented as a hypermedia type (Map Markup Language ["MapML"]), similar to video or audio, which is integrated into the Web via an extension to the declarative HTML <MAP> element. The goal is to make Web mapping simpler for HTML authors by defining and relying on Web standards. The benefits of this simplicity are great and wide-ranging. In the first place, programmers and non-programmers alike are able to create maps in their Web pages without advanced skills and with accelerated productivity. By enhancing the potential of non-GIS savvy HTML authors to include maps in their content, the relevance of spatial data infrastructures is multiplied. Next, Web content is automatically "geocoded" by the extended <MAP> element markup, thus Web pages' spatial semantics are subject to analysis by different classes of user agent and search services. Finally, the map media type enhances interoperability by simplifying and unifying the interfaces whereby Web maps and map content are created, authored, programmed and used.

A Short Introduction to Web Mapping with Maps for HTML

Since the objective of Maps for HTML is to simplify the creation of Web maps by HTML authors, the following is a short introduction to how this is accomplished. The <MAP> element today represents a "client-side image map". The element works with <IMG> element(s) elsewhere in the document to allow the author to designate one or more sub-areas of the image as hyperlinks. The IMG element allows a "usemap" attribute to reference a named <MAP> element, thereby associating a <MAP> with the <IMG>. The <MAP> element's child <AREA> elements define links. The proposed future HTML syntax will allow an author to designate a <MAP> element to have progressively enhanced behaviour:

```
<img usemap="#arctic" src="images/ArcticMap.jpg" width="640" height="350">
<map name="arctic" zoom="3" lat="90.0" lon="0.0" projection="APSTILE" width="640" height="350">
  <layer src="http://geogratis.gc.ca/mapml/arctic/" label="Arctic Ocean Base Map" checked hidden>
  <area shape="rect" href='http://example.com/santa/' alt="North Pole" coords="315,170,325,180">
  <area shape="marker" href='http://example.com/santa/' alt="North Pole" coords="320,175" id="northPole">
</map>
```

The highlighted parts of the above text represent proposed new HTML syntax and semantics; that text which is plain is already well supported by browsers. Some notable aspects to note about the above markup are that it would create a rectangular map application area 640px by 350px on the page. If the browser is capable, and assuming the MapML resource at http://geogratis.gc.ca/mapml/arctic/ is available, the markup would create a dynamic Web map application within that area, which would resemble the following image:



If the browser was non-compliant with the new specification (i.e. an older browser, like IE), the markup would still produce an almost identical (but static) image, demonstrating the 'fallback' behaviour of the client-side image map (assuming the image located at `images/ArcticMap.jpg` resembled the above image).

Of course, today's browsers don't yet support the enhanced <MAP> element behaviour. However, most modern browsers *do* support the evolving "Web Components" HTML standard(s) [4]. The Web Components family of standards together allow JavaScript programmers to define the behaviour of hyphenated-name Custom Elements in HTML documents. With support from the Polymer.js library [5] today, a JavaScript programmer can define Custom Elements which display the advanced behaviour they desire. One of the goals of Custom Elements is to allow developers to experiment with or prototype new Web platform features so as to expose and demonstrate behaviours that may be good candidates for future standardization and incorporation by browsers. This allows the best proposals to be identified and incorporated into the Web platform.

This is exactly the approach that has been adopted by the Maps For HTML Community Group. We have developed a Custom Element, using Polymer.js, which implements the core specifications (defined by our CG) of the future <MAP> element. Today this is the <web-map> element, and we hope that through continued development and adoption, its characteristics and behaviour will become the reference implementation of the future <MAP> element. It is open source, ready to use, and available on Github. The *working* <web-map> element allows a syntax which foreshadows the proposed syntax of the <MAP> element:

```
<web-map zoom="3" lat="90.0" lon="0.0" projection="APSTILE" width="640" height="350">
  <map-layer src="http://geogratis.gc.ca/mapml/arctic/" label="Arctic Ocean Base Map" checked hidden></map-layer>
  <map-area shape="rect" href='http://example.com/santa/' alt="North Pole" coords="315,170,325,180"></map-area>
  <map-area shape="marker" href='http://example.com/santa/' alt="North Pole" coords="320,175" id="northPole"></map-area>
</web-map>
```

___ = syntax common to the <MAP> and <web-map> elements.

The above map and others can be found in working order on github.io, here: http://maps4html.github.io/Web-Map-Custom-Element/

The remainder of this document is structured according to the categories of response according to the RFI, and documents how the <web-map> element and related specifications can help achieve the goals of the Arctic SDI Pilot, and indeed the Arctic SDI in general.

Stakeholders

The RFI asks how to get more stakeholders involved and better served. It is worth considering who the potential stakeholders might be. Clearly there is an existing base of stakeholders who have access to geomatics software and expertise, as well as budgets. However it is the view of the Maps for HTML community that more, standardized use of the Web itself is the key to engaging and better serving more citizens or stakeholders in the issues of concern with regard to the Arctic. The Web is the fundamental standard medium of citizen-level communication in this century and moving forward. Increasing third-party use of spatial data infrastructures by citizens through *standard* Web technologies will grow the set of stakeholders because they will be able to contribute and use ideas, large or small, due to minimal barriers to sharing.

The approach advocated by Maps for HTML to achieve stakeholder growth is to educate middle- and high-school students in standards-based geomatics technology, starting with the <web-map>/<MAP> element. This will create a baseline of geographic and Web literacy that will engender demand for SDI. As students progress to higher levels of learning, the knowledge and skill required for developing advanced mapping applications and performing spatial analysis will represent a natural succession to the basics of creating Web maps taught early on. The result will be increased demand for and use of Arctic SDI.

Furthermore, by supporting the integration of maps, projections and spatial data into the core standards of the Web, the Arctic SDI stands to extend the exposure of Arctic issues beyond the narrow scope of the relatively small group of academic and geomatics professionals who are involved in Arctic studies and interests today. By fostering "mashups" of Arctic SDI content not just by traditional stakeholders with geomatics expertise and budgets, but also by any interested citizens with a point of view to share e.g. blogs, wikis and social media, the interests and challenges of the Arctic will be brought into sharper focus. It is mashups and consumer applications of spatial data that are the desired scope of the Maps for HTML initiative, and which should be a focus for the Arctic SDI with the objective of growing the demand for and use of the SDI.

Business needs

Ease of use – end users

The <web-map>/<MAP> element should provide a map end-user with an experience that is not frustrating, to the degree that this is under the control of the standards developer. In other words, Web sites with maps should behave much as other Web sites behave, and the maps should behave much as Web map users have come to expect that a Web map behaves.

Ease of access and re-use

For business-to-business transactions, WMS, WMTS, WFS etc. are appropriate technologies, insofar as they bridge computing environments by leveraging Web standards. However, the complexity inherent in GIS technologies and spatial data represent a considerable barrier, which directly affects the usability

of those standards. In principle, it should be easy for individuals whether they be commercial Web developers, casual bloggers, or even students, to use Web map services. This is where the architecture of Maps for HTML shines. By allowing *server* administrators to configure WMS or WMTS URL templates in their Map Markup Language service configurations, it is possible to reduce the complexity of *consuming* map services to a bare minimum – that is, the only map-specific knowledge required to create a map is of the URL to the service; the <web-map>/<MAP> element takes care of the rest. Some might say this does nothing more than re-locate the complexity, and this probably a fair comment. However, it puts the complexity into the hands of those best equipped to deal with it, and simplifies access and re-use for those who simply want to create a Web page with a map in it.

Federation

Web portals are important to impart a coherent message for a collaborative effort. However, a portal is not a spatial data infrastructure in and of itself. For the data supplied by a collaborative effort such as the Arctic SDI to be truly useful, it should follow the principles of open data to the greatest extent possible. One open data principle of particular concern for spatial data is that the format of production should match the formats needed by consumers [6]. Consumers should not be forced to own specialized software to consume open data. Ideally the information should be directly usable by the standard Web browser so that consumers are directly empowered by the effort to produce the data, and are not beholden to third parties to create consumable spatial data infrastructures e.g. Google Maps. That is why Maps for HTML and MapML is so important: the Web browser is the standard software vehicle to be used to consume maps directly, without the need for third party involvement.

The Arctic SDI should have layer URLs available in MapML, with each set provided by individual members. The MapML layer URLs provided by a member of the Arctic Council should be language- and projection-appropriate to that country. HTML authors from that country would be able to embed any of these URLs in <web-map/<MAP> elements as individual layers in a mashup. Of course it is essential that layers of a mashup share a common coordinate reference system and extent. The language of text used in the underlying layers may be more or less important, depending on the nature of the layer.

Federation with hyperlinks

The Arctic SDI is by nature federated. It should be as transparent as reasonable to an end-user as to where the information being accessed is sourced from within the federation. There should be no ‘wrong door’. If an American citizen accesses the infrastructure from a US organization or American citizen’s Web site, it should be possible with minimal friction or disruption to the map user experience, to use the Canadian infrastructure in situ, possibly by means of technical mechanisms such as content negotiation or hyperlinks. Such permissionless federation is a hallmark of the HTML Web, and indeed has led to its dominance as a medium of information dissemination. It is therefore considered a business need to replicate this type of user experience for users of the Arctic SDI.

The Artic SDI initiative will further the goals of widespread application and use of its federated spatial data infrastructures by helping the Maps For HTML Community Group to achieve theirs, specifically through continued development of hyperlinking mechanisms.

Customization

The user experience for a Web page should be under the control of the HTML author, however as standards-based maps are introduced into HTML and Web pages, different roles with different concerns must be recognized: HTML author, map content provider, end user, user agent. Each has a part to play in the resulting user experience.

Each role must be empowered to customize what they should be able to customize. For example, the HTML author should naturally be able to supply JavaScript or CSS to extend or augment the function or style and behaviour of their page. However, the HTML author should not be in control of map styles which should be established by the map content provider. Neither should a HTML author be able to suppress the licensing information for map content, nor alter styles assigned to features by map content providers.

The HTML author should be able to use JavaScript, the DOM and CSS to script the <web-map>/<MAP> element, but the access to the map content available to HTML author scripts should be enabled through the browser <MAP> API. The map content author should be able to supply CSS to style map content, for example setting line symbols for vectors and possibly other display characteristics, but at this time we don't anticipate having the map content provider able to supply JavaScript for any purpose, nor should the browser be required to provide access to the MapML DOM.

Standards

As mentioned above, spatial data infrastructure standards today are suitable for business-to-business integration, but they are not suitable for consumption by ordinary citizens (e.g. elementary school students). There is a need to develop standards which make maps and spatial data suitable for re-use by citizens of limited experience and resources.

The objective of the Maps for HTML community is to develop the concepts, software and community associated to the needs of developing a standard for maps suitable for adoption by browsers, and thereby for citizens who produce and consume HTML. As such, the Arctic SDI would serve as an excellent community-driven initiative which could help stimulate development of the standards and software of Map Markup Language and the <web-map>/<MAP> element. Our community exists solely to promote and develop the interests of maps and spatial data for the Web, and is therefore a good candidate for participation by the Arctic SDI community, whose interests overlap considerably.

Requirements and Constraints

Development of the Arctic SDI should optimize for consumer-level use and re-use of the infrastructure, such that the greatest benefit is derived from the investments made. The Maps for HTML community believes that continued development of the software and standards promoted by the group are aligned with that goal, and should be emphasized by the Arctic Council.

Maps for HTML and Arctic SDI Future design considerations

As it currently stands, tile and image-flavoured Map Markup Language is available through server configuration of the “MapMLServer” Java servlet, available from the Maps for HTML community organization on Github [3]. This software serves as a prototype for features that the Maps for HTML Community would like to see developed as a standard module to be available in Web servers such as Apache, for example “mod_mapml”.

Currently, feature data is served by a custom servlet and PostGIS database configuration, as a proof of concept or prototype. An open source MapML feature proxy, possibly within mod_mapml, should be developed to help origin server admins make feature data available as MapML. A key consideration in this regard is classification or possibly generalization of a feature dataset into zoom level-appropriate features. At present, this processing relies on human interaction and evaluation. It would be ideal to have GIS components capable of guiding or improving the nature of this process, so that more feature data can be made compatible with the Web of maps.

The Web was and is intended to be a read-write medium. As such, the MapML standard and the <web-map>/<MAP> API should be evolved to include forms processing for feature data, allowing transactions to originate from Web HTML clients.

Federation through hyperlinking is a core strength of the Web. One goal of Maps for HTML is to replicate this aspect of the Web within map content, so that map content providers can federate their content when appropriate. This aspect seems to align well with needs which can be imputed from the Arctic SDI social graph, and so may be a fruitful area of investment and collaboration on the part of the Arctic SDI.

The definition of MapML includes the concept of a “Tiled Coordinate Reference System”, which integrates the concepts of zoom level scales, tile rows and columns, with that of standard projection terminology. It would be ideal if a formalized standard for encoding such TCRS was defined and broadly accepted, for example as an extension to OGC 12-063r5. Since shared coordinate system definitions are fundamental to interoperability of Web maps, this may be an important future standard, and should not be left to individual server administrators to define. The lack of such a standard may be holding Web maps back from broader adoption. This is currently addressed only by the MapML standard.

Search

Currently, MapML allows a map content provider to supply <link@rel=’search’> elements in the <head> element of the MapML document. The Leaflet client should be upgraded to provide a map control which supports user search over search suggestions and services provided by the map content provider(s). This type of search is standard behaviour in many Web maps, and should be included in the standard interface and API of the <web-map>/<MAP> element, although the details of this have not been worked out. Using OpenSearch is a possibility.

Context menu

Web maps should have a default context menu that is slightly different than the normal default context menu of the Web page. It should be possible to view the source of the map content, as well as to navigate the map state via 'Back / Forward' options. The latter options would naturally make use of the browser cache. It might be a useful to have a 'Save for offline use' option, which would pre-cache a certain area and set of zoom levels for all the map layers in the current map. This could be easily accomplished with single larger extent requests at each of the required zoom levels, the responses to which are paged (by use of rel='next' link elements).

There are a great number of potential use cases yet to explore, some of which are documented in the "Use Cases and Requirements for Standardizing Web Maps" document [3].

Data

There are several Canadian Web map and map tile services currently available in MapML from Natural Resources Canada's GeoGratis Open Data directory. If desirable, other organizations could use the MapMLServer software to offer data in other projections more suitable to the Arctic, and contribute those projections and zoom resolutions back to the MapML standard.

Canada Base Map - Transport - Lambert Conic Conformal
http://geogratis.gc.ca/mapml/en/cbmtile/cbmt/
http://geogratis.gc.ca/mapml/fr/cbmtile/cbmt/

Canada Base Map - Transport - Web Mercator
http://geogratis.gc.ca/mapml/en/osmtile/cbmt/
http://geogratis.gc.ca/mapml/fr/osmtile/cbmt/

Canada Base Map - Elevation – Lambert Conic Conformal
http://geogratis.gc.ca/mapml/en/cbmtile/cbme/
http://geogratis.gc.ca/mapml/fr/cbmtile/cbce/

Toporama WMS - Lambert Conic Conformal
http://geogratis.gc.ca/mapml/en/cbmtile/toporama/
http://geogratis.gc.ca/mapml/en/cbmtile/toporama/

Toporama WMS - Web Mercator
http://geogratis.gc.ca/mapml/en/osmtile/toporama/
http://geogratis.gc.ca/mapml/fr/osmtile/toporama/

GeoBase WMS - Lambert Conic Conformal
http://geogratis.gc.ca/mapml/en/cbmtile/geobase/
http://geogratis.gc.ca/mapml/fr/cbmtile/geobase/

GeoBase WMS - Web Mercator
http://geogratis.gc.ca/mapml/en/osmtile/geobase/
http://geogratis.gc.ca/mapml/fr/osmtile/geobase/

References

[1] The Maps for HTML Community Group http://www.w3.org/community/maps4html/

[2] Maps for HTML Community Group Organization on Github https://github.com/Maps4HTML

[3] Use Cases and Requirements for Standardizing Web Maps http://maps4html.github.io/HTML-Map-Element-UseCases-Requirements/

[4] Web Components: Custom Elements http://w3c.github.io/webcomponents/spec/custom/ HTML Imports http://w3c.github.io/webcomponents/spec/imports/ HTML Templates https://html.spec.whatwg.org/multipage/scripting.html#the-template-element Shadow DOM http://w3c.github.io/webcomponents/spec/shadow/

[5] Polymer.js Library https://www.polymer-project.org/1.0/

[6] Open Data Principles http://open.canada.ca/en/open-data-principles