The Design and Intended Use of the North American Profile V1.2 for Spatial Metadata

Harold Moellering, Jean Brodeur, David M. Danko, Sharon Shin, and Raphael Sussman

ABSTRACT: For the last three years a group of spatial scientists from Canada and the United States have been working to develop a Profile of the ISO 19115 Spatial Metadata standard for use in North America. This work is being conducted under the auspices of the Canadian General Standards Board Committee on Geomatics and the InterNational Committee for Information Technology Standards (INCITS) L1 - Geographic Information Systems.

The development of the North American Profile (NAP-Metadata/PNA-Metadonneés) for Spatial Metadata is the next step to go beyond the respective Canadian and USA national metadata standards now in place, specifically the USA Content Standard for Digital GeoSpatial Metadata (CSDGM), and the Canadian Directory Information Describing Digital Geo-Referenced Data Sets (CAN/CGSB 171.3-95). Several other groups in the world are also working towards developing an analogous metadata profile for their area: for example the European Community, Latin America, EIS-Africa, etc.

This paper will begin with the raison d'etre for the uses of spatial metadata in a broader operational context of a component of the Spatial Data Infrastructure. Then the examination will turn to the design of the NAP/PNA-Metadata in terms of its underlying goals to make the ISO 19115 world metadata standard more specific and directly useable in the North American context.

These broad goals are:
* Linguistic Adaptability;
* Locale flexibility for local languages;
* Extend many code lists to be more specific;
* Move away from free text;
* Make more items Mandatory to achieve better interoperability.

The examination of the NAP/PNA will begin with the central UML model of the world standard, and then compare the central North American Profile module to see where such modifications have been made. Several other modules such as Data Content, Identification and Data Quality will also be examined in this context. The final stage of the paper will look at a couple of example areas where the North American Profile could help spatial data analysts locate and evaluate candidate spatial data sets in a USA/Canadian setting: in border areas and in the area of the Great Lakes.

From this discussion it can be seen that the NAP/PNA will provide for wider use of spatial metadata that can potentially provide better opportunities for the effective search for spatial data sets in the Spatial Data Infrastructure in a more flexible linguistic and cultural setting in North America. It also provides the possibilities for future interoperability of such data set assessments.

KEYWORDS: spatial metadata, North American Profile, spatial data standards, analytical cartography, geomatics, GIS

Introduction

For several decades many countries and organizations have realized that they needed systematic spatial information about the spatial databases in their own organizations to effectively utilize the information in them. There is a similar need to share these spatial databases among organizations as well. The solution is to develop an effective set of spatial metadata elements that describe the internal structure and content of a particular spatial database.

Similarly, it was recognized that one could build a Spatial Data Infrastructure (SDI) to facilitate the identification and utilization of spatial databases for other users. Spatial metadata is the heart of these developments and involves the effective use of spatial metadata, specifically defined as "data about spatial databases". If this metadata information is defined and implemented effectively, then it can facilitate the establishment and operation of a Spatial Data Infrastructure.

In the mid 1990s many countries and organizations began working to develop effective definitions of spatial metadata for their own spatial database holdings. In 1994 these efforts rose to the World level with the establishment of the ISO/TC211 Committee on Geographic Information/Geomatics. By 2003 their Spatial Metadata Working Group had developed what we now know as the ISO 19115 World Spatial Metadata standard.

Since that time, the various National and International standards bodies have been working to harmonize their metadata standard with ISO 19115. In North America a Memorandum of Understanding was signed in 2003 between the Canadian General Standards Board (CGSB) and the USA InterNational Committee for Information Technology Standards (INCITS) to develop an North American Profile of their metadata standards as they relate to the world ISO 19115 Standard.

The work discussed here looks at the organizational and conceptual background of this effort that is in its final stages as we speak. Since September 2005 the NAP/PNA Working Group has developed the Profile for Spatial Metadata for North America. Included in this effort is the development of the Profile itself, national reviews of the Profile, and subsequent applications.

This work reflects a determined effort to test and verify the effective application and operation of the Profile as they are intended to harmonize with ISO 19115. Also included is an effort to ascertain, define, and codify a set of "best practices" for the Profile to ensure a uniform and wide applicability of its use.

Formation of the North American Profile Effort

Basic Metadata Functions

As the world ISO 19115 Spatial Metadata standard was being developed, countries and other organizations realized that after the world standard was approved, they would be obligated to harmonize their national or organizational spatial metadata standard with that of the coming ISO world standard. Many countries also realized that it would be a scientific, operational, and cooperative step forward if they could harmonize the spatial metadata standards of regions or groups of countries together. Hence, the European Community moved forward to develop a common European Profile for spatial metadata that all countries and organizations in the EC could use. This will greatly facilitate the easier and wider use of spatial datasets from the various

countries in Europe. Hence, Comité Européen de Normalisation CEN Technical Committee 287, Geographic Information, set out to develop a European Profile of ISO 19115 that all countries in Europe can use (European Commission, 2008).

A similar insight was realized in North America at about the same time. In 2002 there were discussions between the USA and Canada on the possibility of developing a common profile for spatial metadata between the two countries. In 2003 a formal Memorandum of Understanding was signed between the Committee on Geomatics of the Canadian General Standards Board (CGSB-CoG) and the Geographic Information Committee L1 of the InterNational Committee on Information Technology Standards (INCITS-L1) of the USA to cooperate on developing common profiles of ISO spatial data standards for North America.

The first such Profile to be nominated for development is the one for spatial metadata. This reflects a very logical decision because spatial metadata is the primary internal functional ingredient for spatial data systems. Out of this effort the North American Profile/Profil Nord Américan (Metadata/Metadonnées) Working Group (NAP/PNA-WG) was formed in 2005, and held its first meeting in Sherbrooke, Quebec shortly before the Montreal ISO/TC211 meetings in September 2005. Since that time several WG meetings have been held in various places in North America, and the Profile is in its final review stage now. The following discussion presents the work towards the development of the NAP/PNA Profile which is in its final review stages.

TC211 Perspective

ISO/TC211 has developed a suite of standards for geographic information. These standards have been developed to satisfy a broad set of global requirements with a broad application. ISO 19106 Geographic Information - Profiles defines the concept of developing profiles of the ISO/TC211 suite of ISO 19100 standards. It defines a profile as a subset of a standard, or several standards, tailored for a specific information community. Basing national standards on profiles of the ISO 19100 standards series ensures that national information assets will be interoperable internationally. The NAP/PNA follows this concept. Metadata produced with the NAP/PNA, European, or other profiles will allow users around the world to locate, evaluate, extract, and employ datasets produced anywhere across the globe under the mantra "think globally, act locally". If users produce local datasets and metadata based on international standards and profiles, these data can be used to not only solve local and National problems, but can also be used to provide input toward many kinds of global research.

Canadian Perspective

Early on Canada recognized the importance of metadata and published its first metadata standard in 1995 (CAN/CGSB 171.3-95). Since then, ISO/TC211 developed an international standard for metadata: ISO 19115:2003 Geographic Information Metadata. Canada participated actively in this work. The Canadian contribution was to ensure that its requirements for linguistic and cultural adaptability would be addressed in the profile, and then endorsed as a Canadian National standard. The ISO standard provides a generic description of metadata and allows for many implementation possibilities. It became obvious for Canada that a national profile had to be developed to cover Canada’s specific needs. Because Canada and the United States are neighbors and share spatial data requirements, the need for sharing metadata between the two countries has become very important. Accordingly, the North American Profile of metadata will be a key underpinning for interoperability of metadata between the two countries. The Profile also supports sharing metadata and the discovery of geospatial data within and between the countries at: Federal, Provincial, and local levels. For instance, the province of Ontario intends to use

NAP/PNA for all geospatial data at the provincial level to encourage data use at the local government level (municipalities, school boards, non- governmental organization, conservation authorities, and so on). Also, Ontario is a formal partner of Canada's GeoConnections Program. As a consequence, the use of a common metadata profile by both Canada and Ontario with NAP/PNA will make it easier to discover and gain access to geospatial data at all levels and will effectively meet the users' needs through the GeoConnections well established Discovery Portal.

USA Perspective

The broad national need for the effective access, use, analysis, and application of spatial data arises in many varied forms. There exists a very widely variegated spatial data producer community that consists of those involved in the collecting, encoding, processing, and distributing of spatial data. There is a much larger community of spatial data users who are very dependent on the producer community for completeness, accuracy, and fidelity of the spatial data that is employed for a host of user applications. It appears that the more immediate beneficiaries of the development of the NAP/PNA is the data producer community. Long-term benefits will flow to the user community in a timely fashion.

The primary rationale for geospatial metadata lies in inventorying internal geospatial resources, the condition of the inventory, and the quality of the resource. Knowing one's resources and allowing the larger geospatial community access can result in cost savings to the data producer as well as the user community. Access to these resources can allow for effective and coordinated response to incidents such as natural and human-caused disasters, airborne illnesses, and similar instances. These events often extend beyond defined boundaries whether physical or political. The need to effectively and efficiently share and access spatial data requires documentation of the resource as well as the means or systems used to access the documentation and the resource itself. Data users and providers require a metadata standard which allows one to locate, evaluate, extract, and employ data to coordinate and effectively respond to incidents, study past resource use, plan for efficient use of resources, and other spatial applications.

ICA Perspective

For many years the International Cartographic Association has been promoting the effective use spatial data throughout the world. In 1989 the ICA Spatial Data Standards Commission was founded under the leadership of Professor Harold Moellering to participate in the development of world spatial data standards, and to write several books on spatial data standards. The Commission's most recent book is on spatial metadata standards "World Spatial Metadata Standards" (Moellering et al., 2005). Many members of the ICA Standards Commission are members of ISO/TC211 and other national and international spatial data standards bodies.

Five Commission members have served in leadership roles in developing spatial metadata standards: Mr. David Danko, ESRI, as the Chair of ISO/TC211 WG3 to develop the world ISO 19115: 2003 Metadata Standard, Professor Henri Aalders, Delft University, as Chair of the CEN/TC287, Geographic Data, that is developing a European Metadata Profile, and Professor Harold Moellering, Ohio State University, who is a member of the North American Metadata Profile Working Group. Dr. Tatiana Delgado is a member of the PCIDEA group that is working to develop a Latin American Metadata Profile, and Antony Cooper who is a member of the EIS-Africa group that is developing an African Metadata Profile. Other Commission members are involved in many other standards efforts elsewhere in the world.

Conceptual Background

In its most elemental form, spatial metadata is information about spatial data, usually housed with the spatial database. As such it has been realized that in order to efficiently use and manage all kinds of spatial databases, sets of spatial metadata that pertain to the database in question are needed. Please see Moellering, Aalders and Crane (2005) for an expanded discussion of the fundamentals for spatial metadata and concepts of use.

Here one can focus on the use of spatial metadata in its fundamental forms to Locate, Evaluate, Extract, and Employ to find and utilize specific geographic datasets as articulated by Østensen and Danko (2005).

Locate: find the location of a geographical dataset that pertains to a specific set of characteristics, e.g. topography of an area; in many cases, this locating process takes place over the Web in an SDI network environment;

Evaluate: to ascertain if the geographical data in the spatial database has the desired characteristics, e.g. accuracy, currency, etc. desired by the user;

Extract: to transfer the spatial database from its home location, usually via the Web, to a location convenient to the user of the data set;

Employ: using the metadata to successfully process the geographical database to analyze, and perhaps solve the problem at hand.

Work to utilize spatial metadata is taking place on all continents of the world. To see a systematic summary of those efforts, please see Aalders, (Ed., 2005). To see metadata activities in Latin America, please see Delgado-Fernandez, Rey-Martinez, and Chaparro-Dominguez (2005).

The ISO 19115 World Spatial Metadata Standard

Out of necessity a world standard is very broad and general. So when the TC211 Working Group on Metadata began their work, they looked at all of the parameters in all of the 22 existing National and International metadata standards existing at that time (Østensen and Danko, 2005). The world metadata standard that emerged is something like an umbrella, consisting of almost 400 metadata items with many Conditional and Optional obligations. By necessity such a world data standards is very general. The strong point is that new all scientific and technical terms have been homologated by the TC211 Terminology group.

What normally follows is that the National and individual International, e.g. IHO, metadata standards are then harmonized to the new world standard to achieve world compatibility with the terminology and much of the operational framework.

What has happened with spatial metadata standards, many countries and organizations have realized that there is much to be gained by establishing Profiles on a continental basis. Hence, a European Metadata Profile has emerged, and now a North American Profile/Profil Nord Amérícan is emerging via a cooperative effort between the Canada and the USA. It is possible that Mexico may join this effort at some point.

The North American Metadata Profile

As one interoperates within spatial data communities in the respective nations, between nations,

and global communities, providing an understanding of geospatial data and services is an essential part of operating within these spatial data infrastructures. One provides this understanding by collecting and providing metadata about data and services. Providing metadata using internationally standardized metadata elements allows spatial metadata to be used by a wide range of user communities.

Metadata standards, like ISO 19115, are developed by a diverse international group to meet a wide range of requirements. ISO 19115 provides metadata elements for many purposes including: locating geospatial data and services, then evaluating them to determine if they are fit for a user's requirements. The user may then extract the data and information from the data source, and then employ the discovered data in a wide range of applications and services.

Specific information communities, or nations, may not need to use all the metadata elements found in an international standard. Typically they establish a profile, or subset, that meets their specific requirements. If all nations or information communities derive their subsets of metadata standard elements from a well known internationally recognized superset, then other nations and information communities will be familiar with the metadata and readily understand it. This enhances interoperability.

Standards are a balance between functionality and interoperability, the higher the interoperability, usually the lower the functionality; higher functionality results in lower interoperability. A profile is a standard tailored for a specific community. Where a base standard can be broad and complex, a profile usually is narrower in focus and often simpler. Standards are usually very generic to apply to a broad range of needs. Profiles, on the other hand, are specific to the user's needs. Where standards have many optional items, profiles have more mandatory items that are truly needed for specific requirements. Standards like NAP/PNA provide metadata for a wide variety of digital geographic data and applications. See Federal Geographic Data Committee (2008), and GeoConnections (2008).

An information community can be a nation, which builds a "National Geographic Metadata Profile". The NAP/PNA is a subset of a standard set of metadata elements that are applicable to the North American information community. Information communities can also be communities that focus on specific domains, field of study, or disciplines: examples are military, biological, transportation, agriculture, or navigation. Each of these information communities in North America should produce a standardized metadata profile selecting a sub-set of the full NAP/PNA standard, using only the metadata elements required for their purposes. These community profiles of metadata standards should be fully documented, identifying the metadata elements required by that community, with examples and the reason why each metadata element is required so that producers of metadata will fully understand what metadata to collect and why. Figure 1 below shows that general basis for the NAP/PNA.

Conceptual Organization of NAP/PNA Profile

The NAP/PNA Profile of the following conceptual sections:

* MD Identification - contains basic information to describe the resource;
* MD Constraints - allows reporting legal or security constrains;
* MD Data Quality - reports the information on data quality;
* MD Maintenance - contains information on resource maintenance;
* MD Spatial Identification - contains information for grid and vector spatial representation;
* MD Reference System - reports information for the reference system of the resource;
* MD Content Information - contains information about coverage description or the feature catalog for the resource;

* MD Portrayal Catalog - contains information on the resource portrayal catalog;
* MD Distribution Information - contains distribution information for the resource;
* MD Application Schema - Information on application schemas used.

Each section describes an aspect of the resource: such as Identification Information or basic resource information. Each section then allows for recording specifics such as Extent or the spatial extent of the resource. The following diagram, shown in Figure 2 below, provides the general conceptual organization of the NAP/PNA. This notation is a simplification of the formal Universal Modeling Language (UML) nomenclature.

Modifications to ISO 19115 Reflected in NAP/PNA

Restraint was exercised in profiling ISO 19115 to the NAP/PNA. Obligation changes were limited to only those deemed absolutely necessary and, as stipulated in ISO 19115 Annex C, to only more stringent obligations. No elements were omitted.

Several approaches were employed to allow easier interpretation of the NAP/PNA. The NAP/PNA developers chose to replace ISO 19115 UML notations with a simplified diagramming in the Profile to assist the non-UML user's interpretation of the Profile as shown in Figure 2.

The NAP/PNA workbook will offer implementation guidance through best practices which direct the appropriate use of NAP/PNA elements and attributes. Two best practice examples of interest to the NAP/PNA community are:

6.2.1.9: language (M, 1) Type: CodeList NAPMD_LanguageCountryCode
Description: Language of the metadata using standard ISO three letter codes.
BP: Three letter language code and country code: ISO 639-2/T three letter language code; ISO 3166-1 three letter country code e.g. FRA; CAN. This attribute constitutes the default language for description of free text attribute of this profile. When more than one language is used in the metadata, then the attribute locale (see 6.1.12) is mandatory.

6.1.12: locale (C,Repeatable) Type: PT_Locale
Description: Other languages used in metadata free text descriptions.
BP: Mandatory when more than one language is used in free text descriptions. See CodeList NAPMD_LanguageCountryCode, included in the NAP – Metadata register for a short list of language and country codes. The character encoding shall be set to the default value "UTF8".

Obligation codes specify the required levels of elements in the profile. Mandatory means required at all times, while Conditional means is conditioned on another situation, such as if Cartesian coordinates are used, then the X and Y components of that coordinate are required, otherwise not. Optional obligation means that the information will be entered if the coder deems it necessary. The following is how the obligation codes are use in the Profile itself:

(M) Mandatory, maximum 1
(C) Conditional, maximum 1
(O) Optional, maximum 1
(M, *) Mandatory, Repeatable
(C, *) Conditional, Repeatable
(O, *) Optional, Repeatable.

Example NAP/PNA Internal Modules

Beyond the central module of the metadata information, one can examine a couple of additional modules of particular interest to cartographers. They are the Identification Module, and the Data Quality Information Module.

Identification Module This module informs the user of the intended uses of the dataset, the kinds of data contained, and how one could access this dataset, legal and security constraints among others. The full rendering of the Identification Module is shown in Figure 3 below.

Data Quality Module This module contains all of the information relating to data quality, including Completeness Commission, Completeness Omission, Topological Consistency, Positional Accuracy, Thematic Classification Correctness, Attribute Accuracy, and Temporal Accuracy. These parameters specify the critical data qualities to the operational spatial scientist, critical information. The full rendering of the Data Quality Module is shown in Figure 4 below.

Example Areas of Uses of NAP/PNA in North America

Glacier/Waterton National Park, shown in Figure 5 below, is a good example area where the NAP/PNA Profile will be of great assistance for collecting spatial data. As one can see, this National Park straddles the Canada/USA border along the Montana/Alberta border. Collecting spatial metadata with one national metadata standard would not be acceptable, but now with the new NAP/PNA Profile, spatial metadata can be collected in both sectors of the National Park and be compatible, and perhaps interoperable.

The second example is a virtual map of North America, as shown in Figure 6, which includes territory of Canada, the United States, and Mexico. This visualization was created through the cooperation of agencies from all three governments. This version of the map shows three broad sources of geographic data: topographic variables, population characteristics, and geologic characteristics. It is obvious that there is a significant gain in efficiency to be made while collecting, rectifying, processing, and visualizing this data, if one has a common Profile for spatial metadata to facilitate the process. It is clear that the use of the NAP Metadata Profile will save countless hours of processing and rendering time, and reduce the overall cost of such a project. In the end, this data will be compatible and perhaps interoperable.

Summary and Conclusions

Since the formation of the NAP/PNA-Metadata Working Group in 2005, much progress has been made to develop a North American Profile for spatial metadata. The WG began with a thorough review of the World ISO 19115 Metadata Standard, and then proceeded to generalize it to the situation of North America. This will insure the shared use of many spatial databases and facilitate interoperability between them. In doing so, the NAP/PNA increases the specificity for use by organizations and agencies in the region at a wide variety of levels and settings. More directly, NAP/PNA increases the specificity of metadata encoding, and reduces the optionality of both metadata encoding and encoding conventions.

Cultural and linguistic adaptability has been enhanced by including specific items from ISO 19115 to recognize things like language, locale, and other appropriate metadata items.

The formal specification of the NAP/PNA has been made user-friendly by employing a more straightforward set of conventions to specify the Profile. This is expected promote a wider use of the profile.

This NAP/PNA work is being shared with the larger spatial data community as the final review processes proceed.

Future Work

The final step in the development of the NAP/PNA is to circulate the document to the spatial data community in North America for the ANSI/INCITS national public review. The equivalent review in Canada has already been accomplished. When the user response has been gathered during the 45 day open comment period beginning August 22, 2008, the NAP/PNA document comments will be adjudicated by the Working Group. The resulting Profile document will be presented to the respective national standards bodies in the USA and Canada for formal adoption as National standards.

Acknowledgements

The authors to express their thanks to the other members of the N. American Profile Working Group who provided comments on the Profile work itself. The authors thank Richard Menicke from the National Park Service at Glacier National Park for the image in Figure 5. The Figure 6 image comes from the U.S. National Atlas through the cooperation of the governments of Canada, the United States, and Mexico. Ms. Hyowon Ban helped to edit and prepare the final manuscript.

References

Aalders, H. (Ed.) (2005) Part 2, Regional Summaries of Spatial Metadata Developments and Associated Activities. In Moellering, H., H. Aalders and A. Crane (Eds.) ***World Spatial Metadata Standards***. London: Elsevier Ltd. ISBN 0-08-043949-7, 689 pp. + 3 Appendices + Crosstable. See: http://ncl.sbs.ohio-state.edu/ica.

European Commission (2008) ***European Commission Comitology Register***. http://ec.europa.eu/transparency/regcomitology/searchform/DocumentDetail.cfm?CL=en&DosID=92&DocID=241&Version=2 Last visited 8/28/2008.

Federal Geographic Data Committee (2008) ***North American Profile of ISO 19115:2003, Geographic Information – Metadata***. http://www.fgdc.gov/nap/metadata Last visited 8/28/2008.

Tatiana D.-F., Rey-Martinez, D. I. and Chaparro-Dominguez, M. I. (2005) Metadata Standards Development Activities in Central and South America, and the Caribbean. In Moellering, H., H. Aalders and A. Crane (Eds.) ***World Spatial Metadata Standards***. London: Elsevier Ltd. ISBN 0-08-043949-7, 689 pp. + 3 Appendices + Crosstable. See: http://ncl.sbs.ohio-state.edu/ica.

GeoConnections (2008) ***Metadata Register, North American Profile of ISO 19119:2003***. http://www.geoconnections.org/developersCorner/nap/metadata/register/index.html Last visited 8/28/2008.

ISO/TC211 (2003) ***ISO 19115: 2003 Geographic Information-Metadata***. http://www.iso.org Last visited 8/28/2008.

Moellering, H., H. Aalders and A. Crane (Eds.) (2005) ***World Spatial Metadata Standards***. London: Elsevier Ltd. ISBN 0-08-043949-7, 689 pp. + 3 Appendices + Crosstable. See: http://ncl.sbs.ohio-state.edu/ica.

Ostensen, O. and Danko, D. (2005) 2.1.1 Requirements Analysis section of chapter titled: Global Spatial Metadata Activities in the ISO/TC211 Geographic Information Domain, in Moellering, H., H. Aalders and A. Crane (Eds.) 2005, ***World Spatial Metadata Standards***. London: Elsevier Ltd. ISBN 0-08-043949-7, 689 pp. + 3 Appendices + Crosstable.

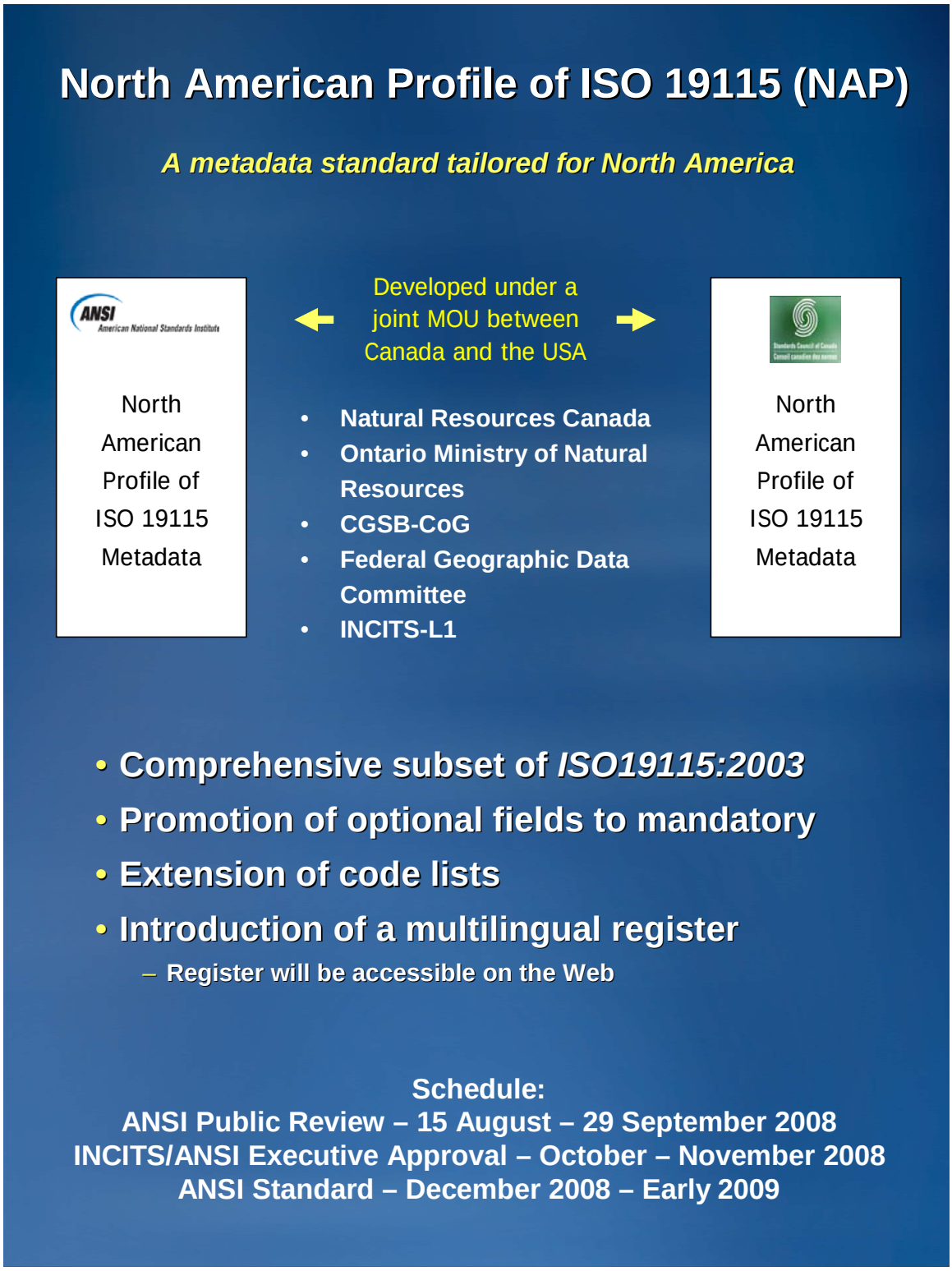

Figure 1: North American Profile of ISO 19115 (NAP).

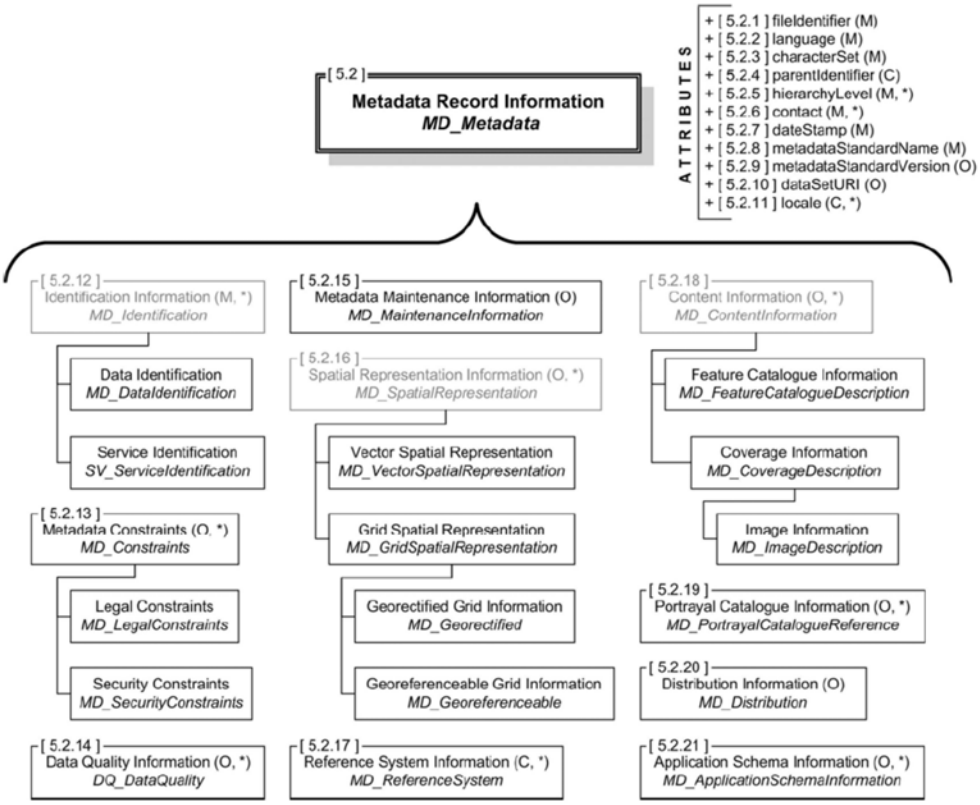

Figure 2: Conceptual NAP/PNA UML Organization Portraying the Metadata-Specific Attributes, and Resource-Specific Section and Subsections of the Profile.

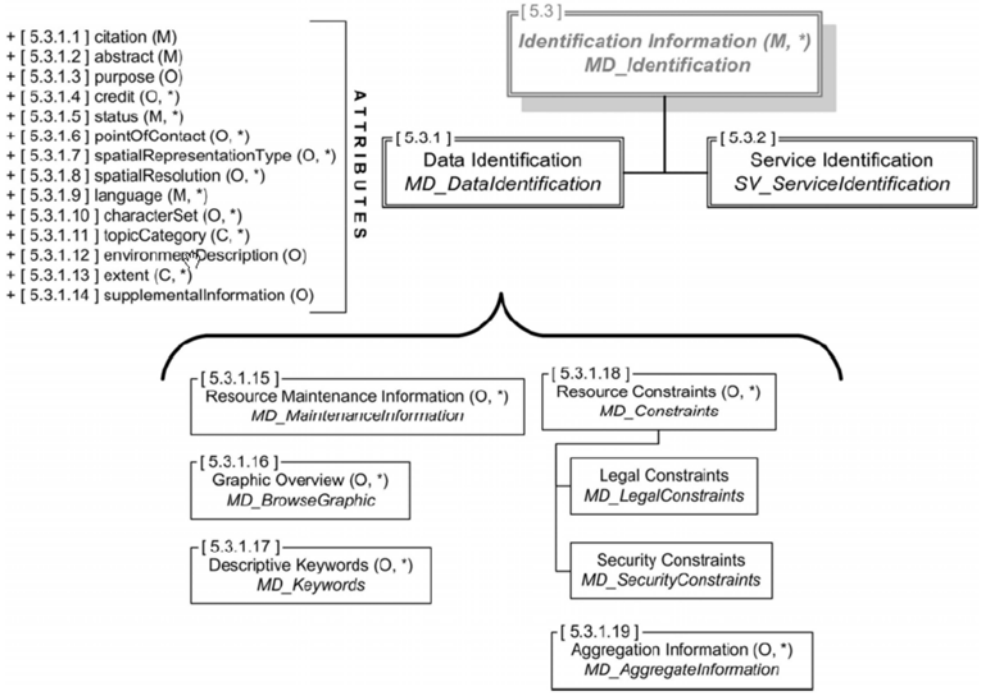

Figure 3: NAP/PNA Identification Module.

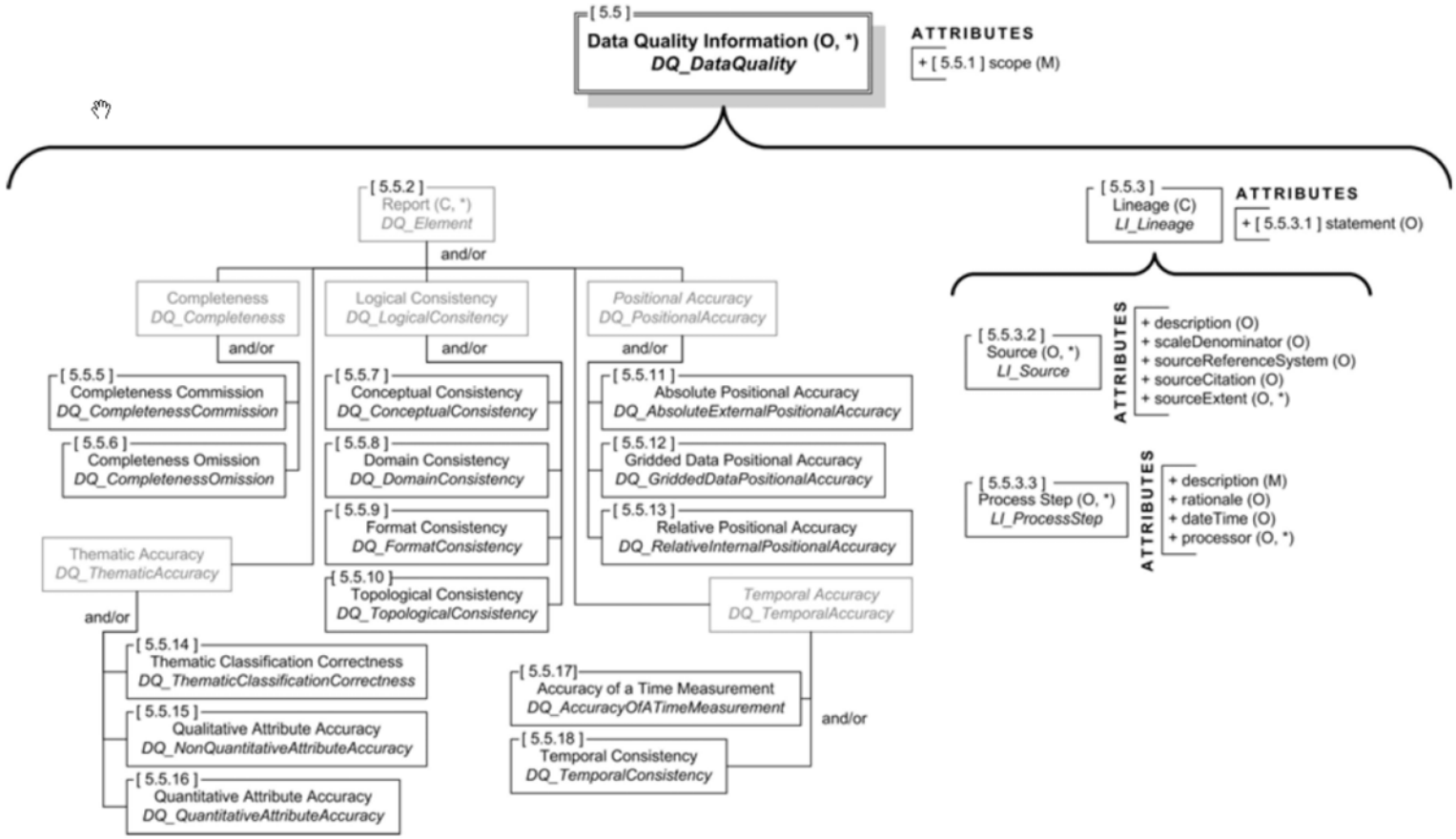

Figure 4: NAP/PNA Data Quality Module.

Figure 5: Glacier/Waterton National Park as Example of Direct Beneficiary of the Development and Use of the NAP/PNA Spatial Metadata Profile. Source: Glacier/Waterton National Park.

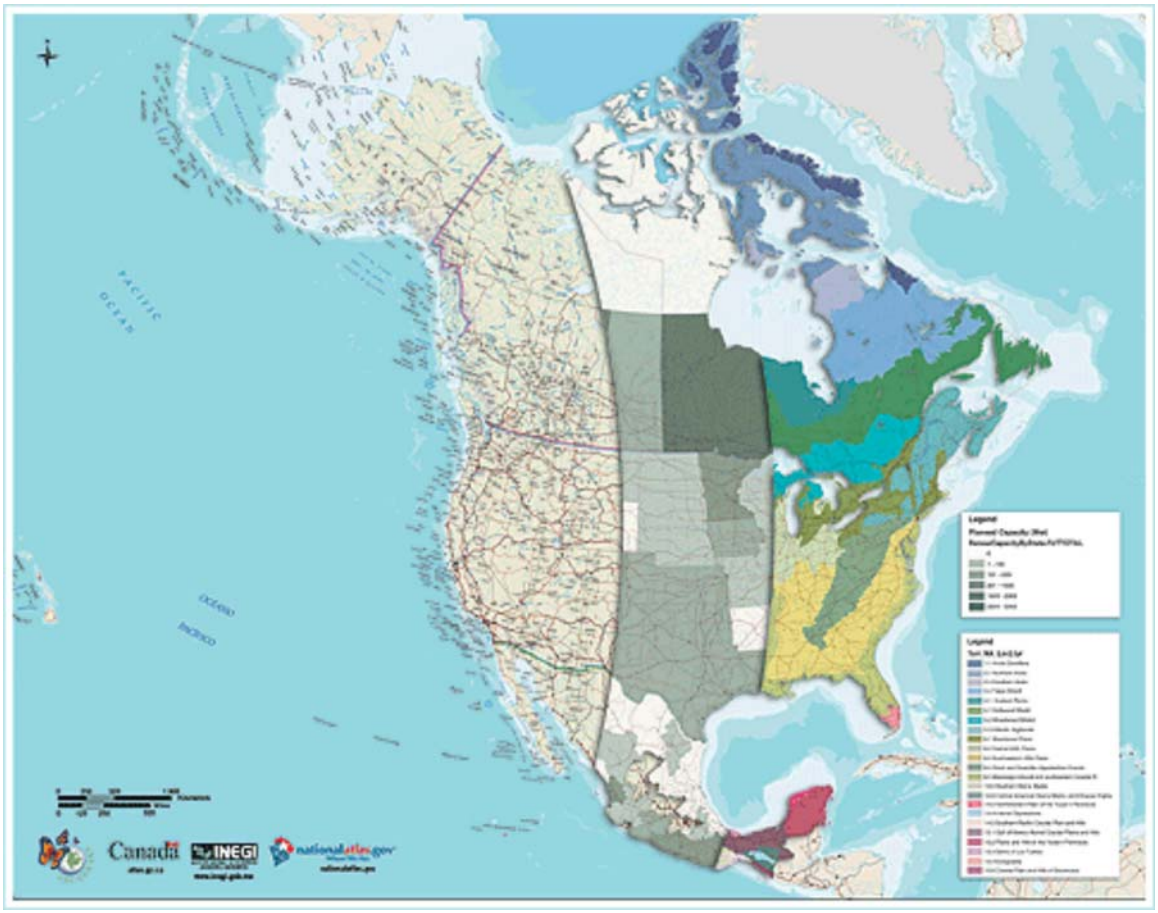

Figure 6. North America: Canada/United States/Mexico: Topography/Population Characteristics/ Geologic Characteristics. Source: U.S. National Atlas.

Harold Moellering, ICA Commission for Spatial Data Standards, Professor, Geography Department, Ohio State University. Columbus, OH, USA 43210. E-mail: <moellering.1@osu.edu>.

Jean Brodeur, Centre d'information topographique. Sherbrooke, Quebec, Canada J1J 2E8. E-mail: <brodeur@nrcan.gc.ca>.

David M. Danko, Environmental Systems Research Institute, ISO/TC211 Metadata Working Group. Washington, D.C., USA 22182-2214. E-mail: <DDanko@esri.com>.

Sharon Shin, Federal Geographic Data Committee. Denver, CO, USA 80225-0946. E-mail: <sharon_shin@usgs.gov>.

Raphael Sussman, Land information Ontario. Peterbourough, Ontario, Canada K9J 8M5. E-mail: <Raphael.Sussman@ontario.ca>.