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GeodesyML – A GML Application Schema for Geodetic Data Transfer in Australia and New Zealand

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ABSTRACT

In recent years, Australia and New Zealand, under the auspices of the Intergovernmental Committee on Surveying and Mapping (ICSM), have continued to develop a standards-based data model to facilitate the encoding and transfer of geodetic data. This has led to the creation of a draft Geography Markup Language (GML) Application Schema known as GeodesyML, which defines an application-neutral format for the encoding of geodetic information. The focus for this draft version has been to incorporate the geodetic elements most commonly transferred between state and national geodetic agencies. While GeodesyML doesn't cover all aspects of geodesy, it has been developed in such a way to make it both extensible and compatible with other XML schemas relating to geodesy. This paper summarises the fundamental elements of the GeodesyML logical data model and its implementation as a GML application schema. An overview of the current status of the model documentation is also provided. Finally, this paper gives a brief synopsis of developments in other countries in the area of geodetic data transfer standardisation.

KEYWORDS:

Geodesy data modelling GeodesyML eGeodesy XML Schema GML

1 INTRODUCTION

This paper presents an update on the work undertaken by the eGeodesy working group of the Permanent Committee on Geodesy (PCG), formerly known as the Geodesy Technical Sub-

Committee (GTSC), of the Australian and New Zealand Intergovernmental Committee on Surveying and Mapping (ICSM) to develop a data model for the exchange of geodetic data and metadata.

PCG is comprised of representatives from state, territory and federal government agencies that are responsible for the management of geodetic information and systems in Australia and New Zealand. Typically, a member agency is responsible for the geodetic system within their respective jurisdiction, or for a particular aspect of the geodetic system. For example, Geoscience Australia is responsible for establishing the fundamental geodetic coordinate datum for Australia. This datum is propagated by state and territory agencies to supply a suitably dense network of survey marks to enable surveyors and spatial scientists to connect to the national datum. PCG also drives a number of collaborative projects, such as the national geodetic adjustment of Australia which requires data to be transferred efficiently and unambiguously among several state, territory and federal Government agencies.

However, a geodetic data transfer mechanism which is useful only to PCG members is of limited long-term value. For this reason, one of the principal objectives of the eGeodesy project has been to yield data transfer efficiencies for all users of geodetic data. While there is presently a large amount of geodetic data being transferred globally among a range of public and private organisations, a comprehensive exchange standard for geodetic data is still unavailable. Consequently, an inordinate amount of time is being invested across the world in reformatting and merging data between software systems and organisations. A handful of reasonably mature standards for exchanging specific types of geodetic data exist, such as the Receiver INdependent EXchange (RINEX) format for GNSS data. However, many other forms of geodetic data are encoded using a myriad of custom and proprietary formats. It is envisaged that the work of PCG, combined with the work of a number of other international agencies could eventually form the basis of a comprehensive, openly-available, internationally-accepted geodetic data transfer standard.

This paper describes the efforts over recent years to develop such a standard, and introduces the key components of the data model and its encoding in XML as a GML Application Schema.

2 BACKGROUND

Since the commencement of the eGeodesy project in 2004, the eGeodesy working group has undertaken several activities towards the development of a geodetic data model. Picco et al. (2006) discuss the early investigations into the need for a data model to handle the exchange of geodetic information, the establishment and aims of the eGeodesy project, and the initial work to analyse geodetic business and user needs from state, territory and federal perspectives. Building upon this work, Fraser and Donnelly (2010) summarise the work undertaken to standardise the vocabulary and meaning of fundamental data types and behavioural processes used across Australia and New Zealand, and report on the development of a draft logical data model. Section 3 provides an overview of the latest version of the logical data model.

Since that time, the eGeodesy working group has focussed its efforts on two related areas of development. Firstly, the full range of geodetic processes associated with reference frame maintenance has been analysed and documented in Unified Modeling Language (UML). In documenting these processes, the proposed functionality required for collaborative reference frame maintenance (using both manual and automated processes) was also defined. The second area of work has involved developing a Geography Markup Language (GML) Application Schema known as GeodesyML. Section 4 summarises the UML Use Case documentation, and Section 5 provides an overview of the GML application schema.

3 LOGICAL DATA MODEL

As discussed previously, a logical data model has been prepared on the basis of an extensive review of the vocabulary and meaning of fundamental data types and behavioural processes used across Australia and New Zealand. It is not possible to cover all aspects of the model here and so only a subset of the fundamental elements of the data model will be reviewed. In particular, this paper focuses on the phenomena that are of interest to geodesists in the context of geodetic datum establishment and maintenance.

3.1 The Station Class

As shown in Figure 1, the Station class contains a Node class. The node represents the basic element with which physical marks, estimated coordinates, coordinate velocities and coordinate uncertainties are associated. The node is also the primary element with which all measurements and adjustments are associated. Each node may have multiple sets of coordinates, one of which will be flagged as 'Authoritative' for a particular coordinate system while all others (if available) will be flagged as either 'Decommissioned' or 'Pending'. Each time a set of coordinates is estimated, it receives a status of 'Pending' until such time as it has been verified and thereby marked as 'Authoritative'. In this case, the previous set of 'Authoritative' coordinates will then be marked as 'Decommissioned', providing the ability for incident roll-back and the estimation of behaviour over time.

Each set of coordinates is defined in terms of a coordinate system. For GeodesyML, the Datum and Coordinate System classes are defined by the GML implementation of AS/NZS ISO 19111: 2008 Geographic information – Spatial referencing by coordinates. In future versions of the schema, a temporal element will also be incorporated, allowing the 'Authoritative' definition of the coordinates of a node at different epochs in time.

Each set of coordinates must be associated with an indication of its quality. As shown by Figure 1, the coordinate class is associated with a mandatory quantitative measure of uncertainty, which is represented by the upper triangular component of the estimated variance matrix. The number of elements within the coordinate set indicates whether the node is 1D, 2D, 3D and hence the dimensions of the matrix. Optionally, one or more (qualitative) attribute statements can be provided to describe the assumed or estimated quality. The meaning of these quality statements will be discussed in more detail in Section 3.3.

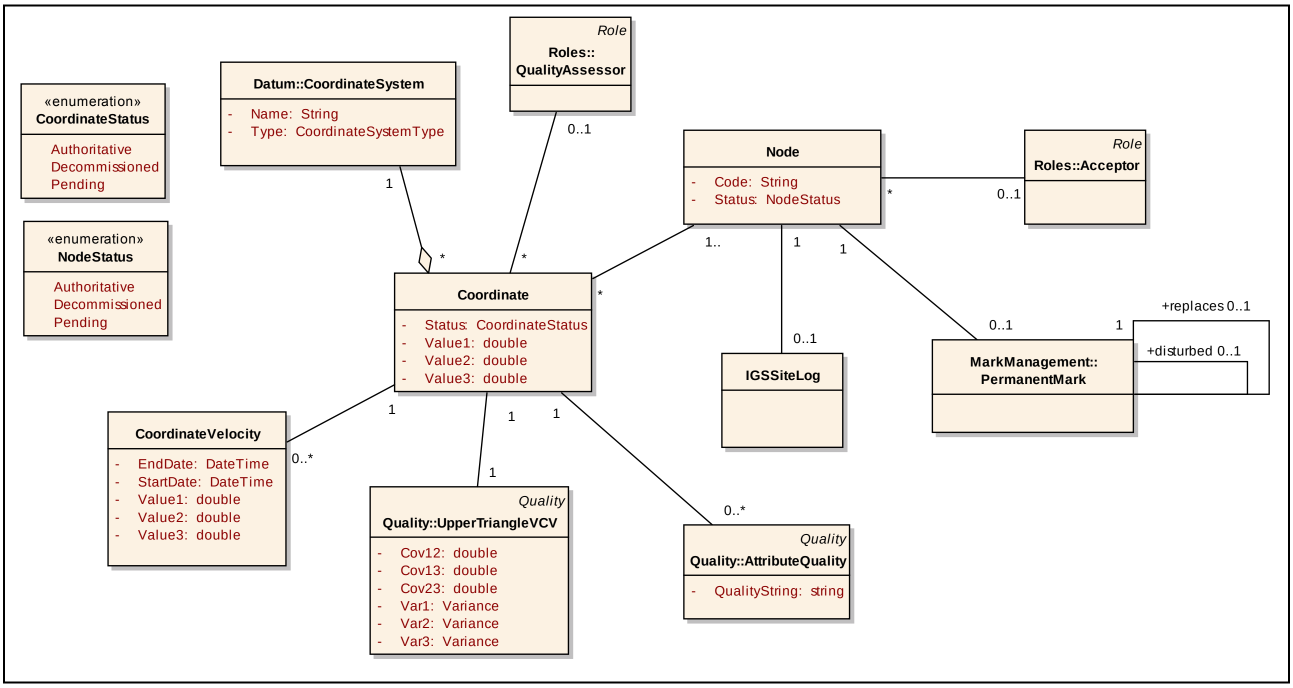

Figure 1: Station Class

As required, every set of coordinates for a node may be associated with one or more coordinate velocity sets to indicate the linear velocity of that set of coordinates from one epoch to another. The CoordinateVelocity class is not intended to be a comprehensive construct for all forms of station movement, discontinuity or deformation. Rather, it can be seen as a basic means for describing known, observed or predicted, behaviour, or specific epochal movements defined in terms of a velocity model that is associated with a dynamic reference frame, such as the International Terrestrial Reference Frame of 2008 (ITRF2008). The development of a sophisticated deformation model is not a simple task and is presently the subject of CRCSI Project 1.02 research (CRCSI, 2013). Accordingly, this aspect of the model is deliberately vague.

Each node may also be associated with one or more permanent marks (discussed in more detail later). Depending on whether the node and monument refers to a GNSS CORS site for which a detailed site log is required, a node may have one or more site log files in the specified International GNSS Service (IGS) format. In this case, the IGSSiteLog class is intended to be implemented by the IGS site log data model developed by SOPAC. The Role of Acceptor denotes the person (or organisation) who has authorised changes in a node's coordinate values, uncertainty, status or site log.

3.2 The Measurements Class

The Measurements class is shown in Figure 2. The Measurement class is the abstract class for all geodetic measurements. Geodetic measurements may take the form of single measurements, such as a distance, or clustered measurements, such as a GNSS baseline cluster. At this stage, the MeasurementType enumeration caters for horizontal angles, geodetic azimuths, direction sets, ellipsoid chord distances, Mean Sea Level arc distances, ellipsoid arc distances, slope (or direct) distances, single GNSS baselines, GNSS baseline clusters, GNSS point clusters, ellipsoidal heights, orthometric heights, orthometric height differences, astronomic latitudes, astronomic longitudes, astronomic (Laplace) azimuths, geodetic latitudes, geodetic longitudes, zenith angles, vertical angles, absolute gravity and gravity difference.

To support the management of reference frame dynamics, each measurement is attributed with a date value. Depending on whether the measurement has been reduced according to a specific datum and epoch, such as would be the case for GNSS measurements, each measurement may be associated with a coordinate system. As discussed previously, the CoordinateSystem class is based upon AS/NZS ISO 19111: 2008.

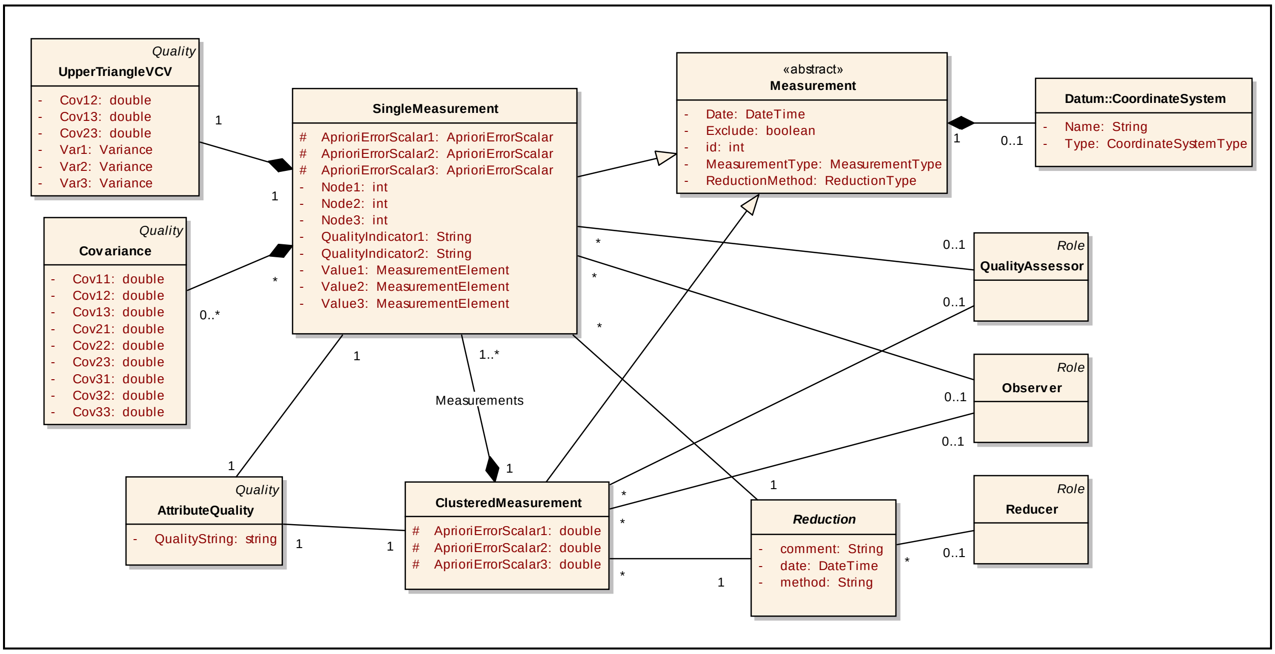

Figure 2: Measurement Class

Similar to station coordinates, every measurement must be accompanied by an indication of its quality. This quality is represented by the relevant 1D, 2D or 3D variance matrix and optionally, one or more (qualitative) attribute statements.

3.3 The Quality Class

All quality statements associated with stations and measurements are derived from the abstract Quality class shown in Figure 3. This abstract class defines quality in terms of a specified standard and may be used in qualitative or quantitative contexts. For GeodesyML implementation in Australia, the appropriate standard upon which to base the classification of quality and uncertainty is ICSM's Standard for the Australian Survey Control Network – Special Publication 1 (SP1). For New Zealand, the appropriate standard is LINZ's Standard for tiers, classes and orders for LINZ data – LINZS25006. The purpose of the Type attribute within the abstract Quality class is to describe the context of the uncertainty held by UpperTriangularVCV, Covariance and AttributeQuality. For instance, UpperTriangularVCV may relate to estimated values of Survey Uncertainty, Positional Uncertainty or Relative Uncertainty, whereas AttributeQuality may relate to a qualitative statement such as CLASS, ORDER, PPM or misclose ratio.

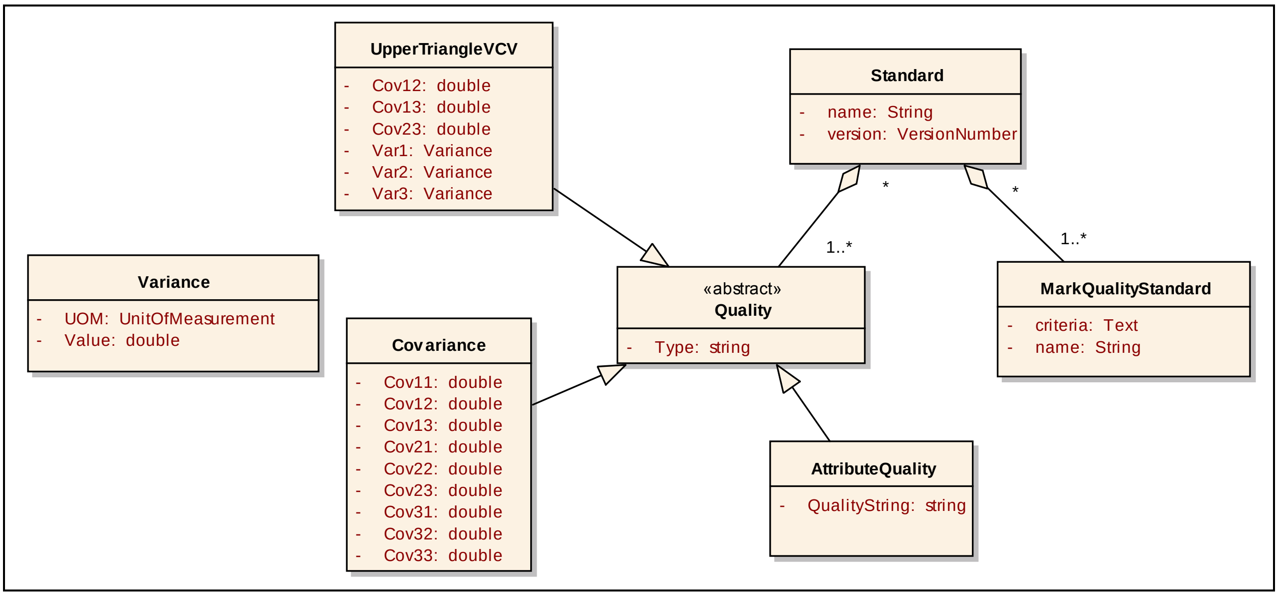

Figure 3: Quality Class

The MarkQualityStandard class is used to define the quality of a permanent mark or monument, the vocabulary and meaning of which is based upon a particular Standard.

3.4 The Adjustment Class

Figure 4 shows the Adjustment class. This class attempts to encapsulate the minimum amount of information that is required to undertake or repeat a geodetic network adjustment from a set of measurements and associated uncertainties, station constraints and adjustment parameters. It also encapsulates the estimated coordinates and coordinate changes, adjusted measurements and basic statistics needed for adjustment verification purposes.

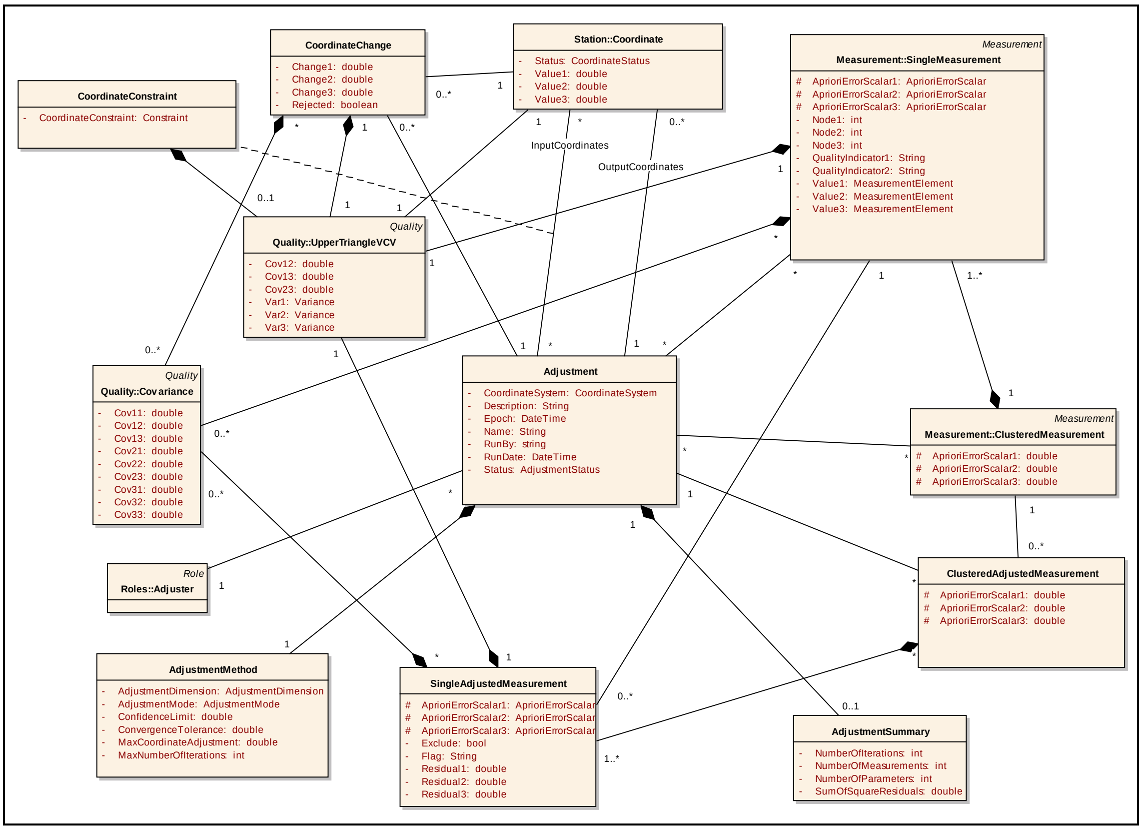

Figure 4: Adjustment Class

4 USE CASE DOCUMENTATION

Subsequent to developing the logical data model, the eGeodesy working group identified a number of primary scenarios for which eGeodesy would be employed in the contexts of datum maintenance in Australia and New Zealand. The draft UML documentation described in Fraser and Donnelly (2010) was extended and refined to describe in detail all actions and activities associated with these scenarios. These activities include the gathering and translation of novel measurements and metadata, the request and transfer of data from other organisations, the adjustment and validation of data at the campaign, jurisdictional and national levels and the archiving of all of the above.

The UML documentation now includes a comprehensive collection of ‘use cases’ which describe the expected interactions between an actor (or multiple actors) and an existing system in order to achieve the specific actions listed above. An actor in this context is any human or machine (e.g. a person, organisation, computer program or even another system) that is external to the system in consideration, can make a decision, and affects or is affected by the processes described. Using the simple example of withdrawing money from an ATM, both the Bank Customer and the Bank would be considered as actors and the ATM is the system under consideration. The associated use case describes the interaction between the ATM and both actors to dispense the requested currency and sum, or explain why the task cannot be successfully completed.

The eGeodesy use case documentation takes the form of high-level ‘use case diagrams’ followed by detailed description of the use case as shown in Figure 5 and Figure 6 respectively. Use case diagrams illustrate the actor(s) and their possible actions, but do not necessarily dictate the order in which actions are undertaken. For example, Figure 5 demonstrates the actions undertaken to complete a Constrained Adjustment. The Adjustment System (actor), either automatically or by instruction from the Adjustor (actor) undertakes to perform a Constrained Adjustment. Sub-tasks which are common to several use cases but are not directly initiated by the listed actors are ‘included’ in the diagram for readability. If an included action is deemed complex or involves several sub-actions, that action is defined in a use case diagram of its own.

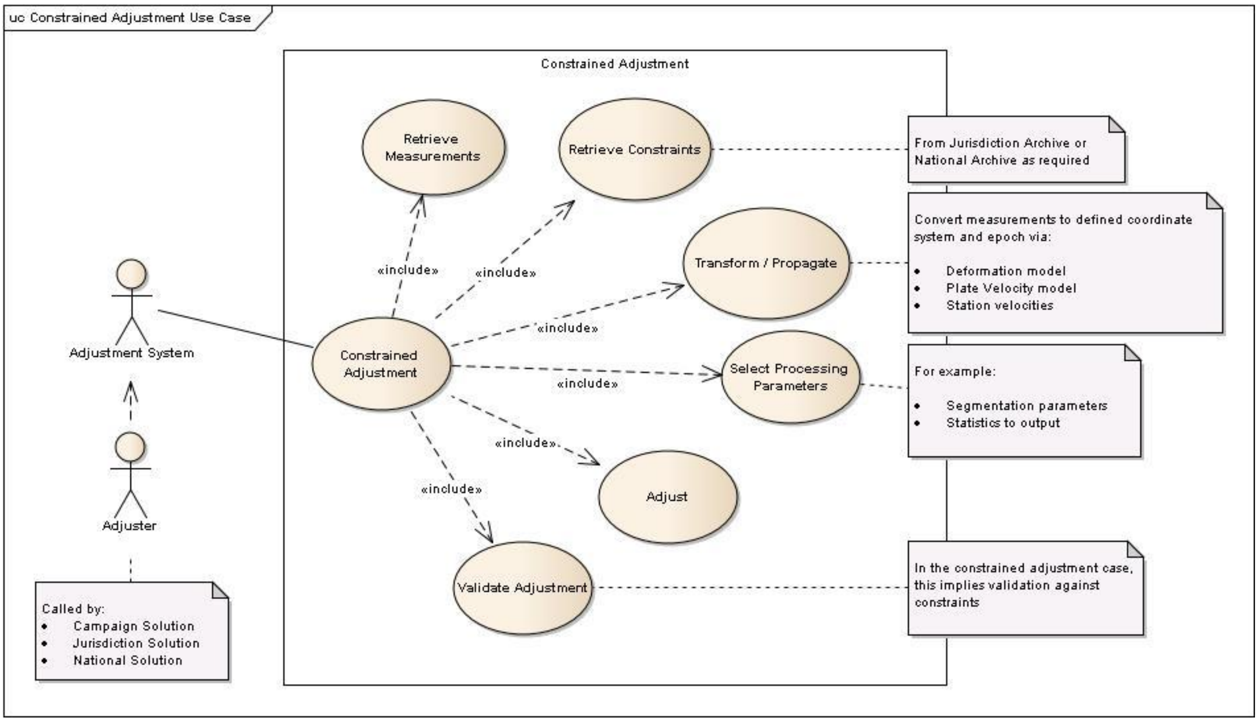

Figure 5: Use Case Diagram for Constrained Adjustment

Each of the actions in a use case diagram is described in its own use case specification, as illustrated in Figure 6. This specification includes a clear definition of the purpose and preconditions of the process, and a step-by-step scenario which describes how to successfully complete the process and what to do if exceptional circumstances are encountered.

Use Case	Constrained Adjustment
Primary actor	Adjustment System (Campaign, Jurisdiction, or National)
Secondary actor(s)	Adjuster
Purpose	Perform and validate an adjustment (WITH constraints) on a select set of measurements and constraints, resulting in an update of measurement quality indicators (inclusion/exclusion and VCV), and adjustment information, in the appropriate archive. [NB: Coordinate solutions are not updated to the archive from this use case. See Campaign, Jurisdiction, or National Solution.]
Preconditions	Measurements, Approximate Station Coordinates and Constraints are available. Adjuster has access to read / modify the archive.
Triggers	Triggered by 'Calling Use Cases' upon new / modified measurements and or constraints. No direct triggers.
Calling Use Case(s)	Campaign Solution, Jurisdiction Solution, National Solution
Scenario	1. Manually or Automatically begin constrained adjustment using parameters supplied by Adjuster. 2. Define criteria for inclusion of measurements (e.g. Limit by project, geographic extents, date, quality) **(include Retrieve Measurements).** 3. Define criteria for inclusion of constraints (e.g. Limit by geographic extents, quality, etc) **(include Retrieve Constraints).** 4. Prepare measurements for adjustment at common epoch via Velocity or Deformation models **(include Transform / Propagate).** 5. Define processing parameters for adjustment (e.g. segmentation settings, station inclusion, station constraints, output statistics,) **(include Select Processing Parameters).** 6. Perform Adjustment **(include Adjust).** 7. Review output statistics, **(include Validate Adjustment).** 8. **Repeat steps 6 and 7 until Adjustment is successful**
Exceptions	Measurements not available or accessible. Station coordinates (approx) not available or accessible. Constraints not available or accessible.

Figure 6: Use Case Specification for the Constrained Adjustment

As in the use case diagrams, the 'included' tasks represent a series of instructions that are repeated in several other use cases, or are sufficiently complex to warrant extraction into a use case of their own. These 'include' use cases must also be completed, in sequence, for successful completion of the original use case.

The use cases developed as part of the eGeodesy project include: Import Measurements; Retrieve Constraints and Measurements; Process GNSS Data and APREF Solution; Submit and Retrieve RINEX; Validate RINEX and Adjustment; Unconstrained and Constrained Adjustment; Campaign, Jurisdiction and National Solutions; Notify Jurisdiction Adjuster; Update Archive. By detailing these business processes in UML, clear specifications can later be created for the development of software, database models and/or web services that are required to interface with existing or proposed users and systems.

5 GEODESYML SCHEMA IMPLEMENTATION IN GML

One of the core requirements to support national geodetic adjustments for Australia is an efficient and automated method of transferring geodetic information between jurisdictions. To support this transfer of information, ICSM PCG has chosen to develop an XML transfer schema based on the OpenGIS GML encoding standard (OGC, 2013).

GML is an ISO standard (ISO, 2007) XML grammar for expressing geographical features and serves as a modelling language for geographic systems as well as an open interchange format for geographic transactions on the Internet. GML has been adopted for major spatial information infrastructures including the European Union INSPIRE initiative (INSPIRE, 2013), the CSIRO SEEGrid technologies (SEEGrid 2013), and GeoSciML which is used for the delivery of geoscience information (GeoSciML 2013). Within GML there is a well-defined feature type pattern that provides a standard set and usage of attributes for schema elements (e.g. Node). The pattern also provides for the further inclusion of additional schema elements within other GML based schemas.

The current draft GeodesyML schema implements the core components of the eGeodesy logical model required to satisfy ICSM's immediate data transfer requirements for the national adjustment. While the schema focuses on the requirements of Australian and New Zealand jurisdictions, it has been developed in such a way that enables widespread adoption and by other jurisdictions and agencies for the transfer of geodetic information. It is also intended that subsequent versions of GeodesyML will be shaped by feedback from other jurisdictions and the public.

To date the eGeodesy logical model packages that have been fully or partially implemented within the GeodesyML transfer schema include Station, Quality, Measurement, Adjustment and Mark Management. As discussed previously, the Datum package is to be implemented using the GML Coordinate Reference System schema elements (see Figure 7).

Where feasible existing GML constructs have been used. For example the GML methodology of defining and describing coordinate values using a gml:pos element and associated attributes has been adopted within in the GeodesyML schema (see Figure 8).

At this stage, certain parts of the eGeodesy logical model have not been implemented in the XML schema due to research being undertaken in CRCSI Project 1.02 (CRCSI, 2013). For example the draft GeodesyML schema has a place-holder to attach a velocity map to a position. The structure and content of a generic velocity vector (or vectors) is being defined within this project

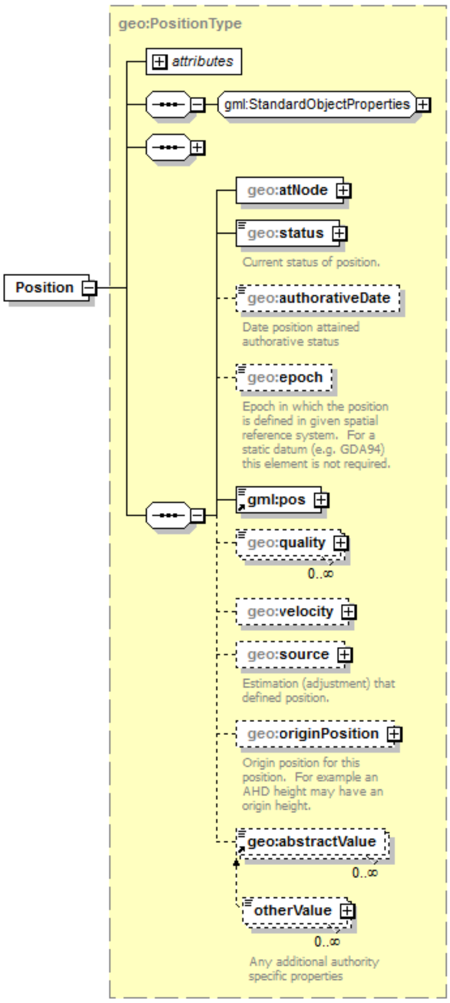

Figure 7: Top Level GeodesyML Element

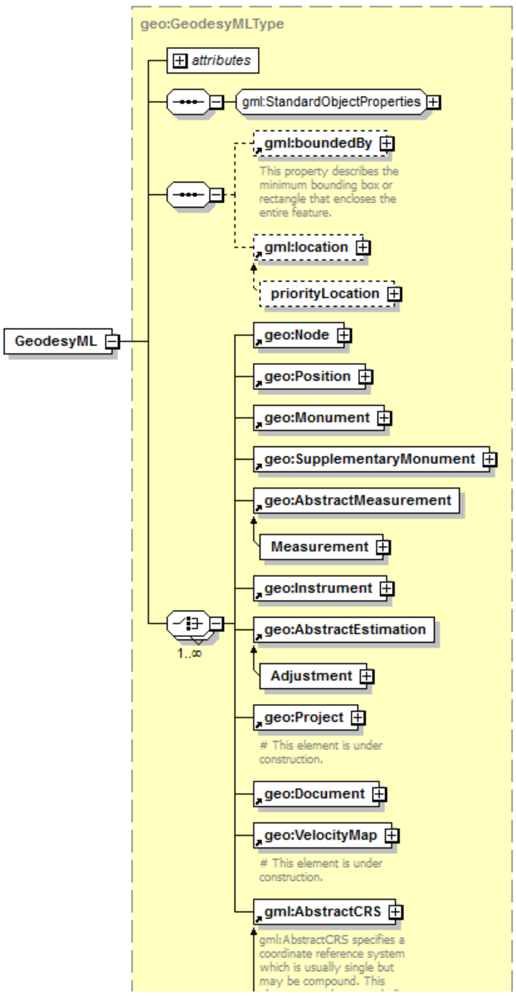

Figure 8: Position Element

One of the implementation principles for the schema was to permit a jurisdiction or agency to define and use its own enumeration values for selected element values. For this purpose, the GeodesyML schema makes use of the GML codeSpace attribute and Dictionary element constructs for defining the domain of selected element values. In the following example (Figure 9), the type of a survey monument is defined, in which case the monument is a 'Standard' monument type. The codeSpace attribute on the monument type element identifies a dictionary (urn:qld-gov-au:egeodesy_monument-type) that defines the valid survey monument types in Queensland. The GML Dictionary construct is used to create this XML dictionary document.

```
<geo:Monument ...>
   ...
   <geo:type codeSpace="urn:qld-gov-au:egeodesy_monument-type">Standard</geo:type>
   ...
</geo:Monument>
```

Figure 9: codeSpace Example

Generic abstract types for Estimation and Measurement have been included within the schema under the top level GeodesyML element. This allows for an agency to create its own domain-specific estimation and measurement elements and substitute them within the GeodesyML schema structure for these abstract elements.

For the abstract Estimation and Measurement types described above, concrete adjustment and measurement elements have been defined and together they encapsulate the information required for undertaking a least squares geodetic adjustment and returning the results. Figure 10 shows an example of an adjustment element and position and measurements elements within a typical geodetic network adjustment.


```xml
<?xml version="1.0" encoding="utf-8"?>
<geo:GeodesyML xmlns:geo="urn:xml-gov-au:icsm:egeodesy:0.0" xmlns:gml="http://www.opengis.net/gml/3.2"
    xmlns:gmd="http://www.isotc211.org/2005/gmd" xmlns:xlink="http://www.w3.org/1999/xlink"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" gml:id="id1">
  <geo:Node gml:id="id2">
    <gml:identifier codeSpace="urn:qld-gov-au:egeodesy">33771</gml:identifier>
    <geo:status codeSpace="urn:xml-gov-au:icsm:egeodesy:geodesyml_node-status">Authorative</geo:status>
  </geo:Node>
  ...
  <geo:Adjustment gml:id="id8">
    <geo:status codeSpace="urn:xml-gov-au:icsm:egeodesy:geodesyml_adjustment-status">Pending</geo:status>
    <geo:adjustmentPosition constraint="Free">
      <geo:usesPosition>
        <geo:Position gml:id="id9" srsDimension="3" uomLabels="deg deg m" srsName="urn:ogc:def:crs:EPSG::4283">
          <geo:atNode xlink:href="id2"/>
          <geo:status codeSpace="urn:xml-gov-au:icsm:egeodesy:geodesyml_position-status">Authorative</geo:status>
          <gml:pos>148.580574322 -23.627347975 222.890</gml:pos>
        </geo:Position>
      </geo:usesPosition>
    </geo:adjustmentPosition>
    ...
    <geo:adjustmentMeasurement include="true">
      <geo:usesMeasurement>
        <geo:Measurement gml:id="id56">
          <gml:description><![CDATA[MSL Arc   COMC94.DAT   53]]></gml:description>
          <geo:type codeSpace="urn:xml-gov-au:icsm:egeodesy:dynanet_type">MSL Arc Distance</geo:type>
          <geo:MeasurementLine gml:id="id57">
            <geo:atNode xlink:href="#id4"/>
            <geo:toNode xlink:href="#id6"/>
            <geo:value uom="m">175.979</geo:value>
            <geo:quality codeSpace="urn:xml-gov-au:icsm:egeodesy:sp1v17_std-deviation" uomLabels="m">0.006</geo:quality>
          </geo:MeasurementLine>
          <geo:sourceDocument xlink:href="#id17"/>
        </geo:Measurement>
      </geo:usesMeasurement>
    </geo:adjustmentMeasurement>
    ...
  </geo:Adjustment>

  <geo:Document gml:id="id17">
    <gml:identifier codeSpace="urn:qld-gov-au:egeodesy">COMC94</gml:identifier>
    <geo:type codeSpace="urn:xml-gov-au:icsm:egeodesy:geodesyml_document-type">Unknown</geo:type>
    <geo:body>
      <geo:fileReference xlink:href="COMC94.DAT"/>
    </geo:body>
  </geo:Document>
</geo:GeodesyML>
```


Figure 10: Document Instance Showing Adjustment Information

The GeodesyML draft schema is presently being tested by ICSM member jurisdictions for the transfer of legacy geodetic information and the aggregation of measurement datasets for the national geodetic adjustment. It is anticipated that through this process, further refinements will be undertaken and new versions will be made available for public release via the ICSM Website (available from http://www.icsm.gov.au).

6 IMPLEMENTATION EXAMPLE

The Canterbury, New Zealand earthquake sequence which started with the Darfield Earthquake on 4 September 2010 is an excellent example of where GeodesyML would have been very useful. Since the Darfield Earthquake, there have been four significant earthquakes (from a surveying perspective). After each quake, Land Information New Zealand (LINZ) has led a significant effort among a number of public and private organisations to re-establish the survey control system.

Figure 11 shows the data flows that occurred as the recovery effort proceeded. Multiple organisations were involved, each of which had its own databases, processing software and data delivery format. While LINZ has a format that its contractors use to supply geodetic data, it is not supported by commercial software and there are no readily-available automated tools to produce this format. Furthermore, much of the data was being donated to LINZ to support the recovery effort. For these reasons, it was not considered appropriate to force partner organisations to use the LINZ format.

Consequently, data was received in numerous formats, which took a substantial amount of effort to standardise. The necessity to standardise formats slowed the processing and dissemination of data, and distracted staff from more important tasks at a critical time. The distribution of data was also hampered by the lack of a standard data transfer format. Various Excel spreadsheet formats were used before a CSV format was developed, this being the simplest format for customers to import into their survey of GIS software.

Figure 12 shows the much simpler process that would result if GeodesyML were adopted by the spatial community. The most substantial advantage lies in the ability to receive data from multiple organisations in a common format for loading into processing software. A further benefit is the ease of metadata transfer using GeodesyML. This enables data from different sources to be efficiently and reliably integrated on the basis of metadata values, such as observation accuracy, measurement type and so on.

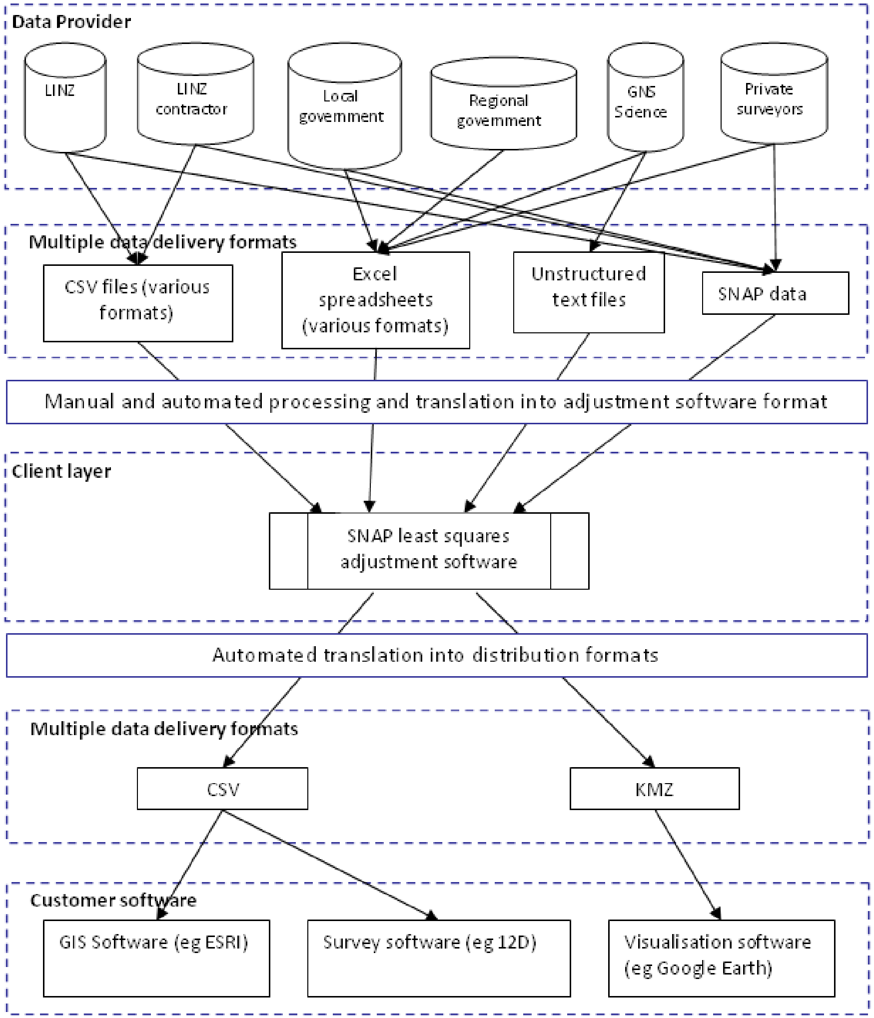

Figure 11 Current Process for Transferring and Processing Canterbury Earthquake Data

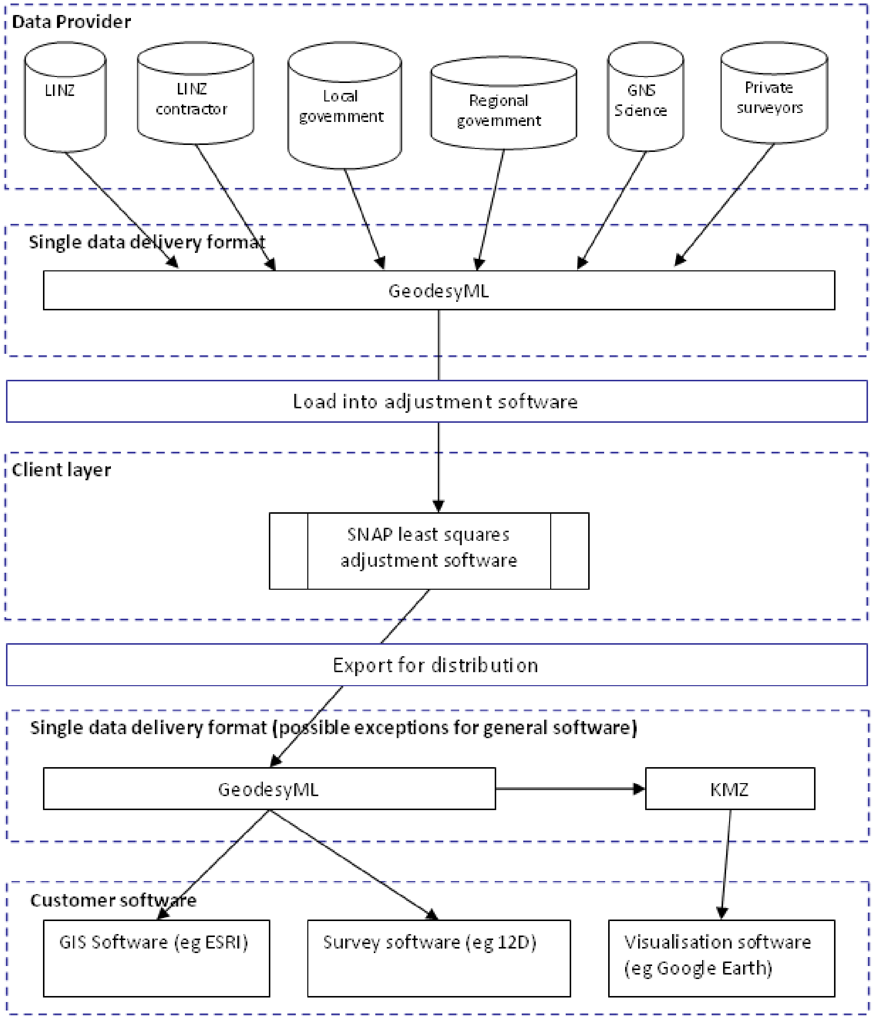

Figure 12 Simplified Process using GeodesyML for Transferring and Processing Canterbury Earthquake Data

7 INTERNATIONAL DATA TRANSFER STANDARDS WORK

Internationally, there are several data encoding and transfer standardisation projects underway in the area of surveying, geospatial and earth sciences. Few however, deal specifically and/or comprehensively with geodetic phenomena. The following is a brief synopsis of two known standardisation projects known as GeodeticML and Geodesy Seamless Archive Centers (GSAC) which are taking place in the United States.

7.1 IGSSiteLogXML and GeodeticML

The Scripps Orbit and Permanent Array Center (SOPAC), part of Scripps Institute of Oceanography (SIO) at the University of California San Diego (UCSD) has done a substantial amount of work developing an XML schema for certain types of geodetic data. One of the first schema documents produced was for IGS Site Log, encompassing all the metadata required by the International GNSS Service (IGS) (SOPAC, 2013a). A subsequent version of this schema modularised and extended it to include information about stations streaming real-time data (SOPAC, 2013b).

SOPAC has also published an alpha version of its GeodeticML schema (SOPAC, 2013c). This includes the capacity to record information about:

- Geodetic Files
- Monuments (including positions)
- Processing (for example, components of a station prediction model)
- Velocities (velocities at a mark, including estimated errors)

One of the key features of GeodeticML is that it includes information about “higher order” products derived from geodetic data, rather than just the data itself. For example, there is the ability to unambiguously transfer station prediction models, which is important for accurate estimation of current coordinates at CORS (SOPAC, 2013c). GeodesyML has been designed to include the GeodeticML schema rather than to redefine or duplicate its fundamental elements.

7.2 Geodesy Seamless Archive Center – Web Services

The GSAC – Web Services (GSAC-WS) project is a NASA-funded collaborative effort involving UNAVCO, the Crustal Dynamics Data information System (CDDIS) and SOPAC. The aim of the project is to enable users to obtain geodetic data files and metadata via web services from a number of repositories using a single search. As well as GNSS data, the service includes data from other space geodesy techniques such as VLBI, SLR and DORIS.

A repository implements the GSAC software, thereby making their data holdings available to users. Metadata can be supplied to users in a number of formats, including SOPAC’s GeodeticML and IGSSiteLogML.

The GSAC-WS project has moved beyond simply providing a data transfer format or standard, by providing a suite of software that can be implemented to make the holdings of various repositories more easily accessible.

7.3 International Collaboration

In 2012, a group of representatives from ICSM PCG, SOPAC, UNAVCO and NASA met to investigate a pathway towards an international geodetic data model. While there was a strong desire for an internationally accepted standard, it was felt that at efforts are not yet mature enough to proceed through a formal standards-setting body such as the Open Geospatial Consortium (OGC) or the International Standards Organisation (ISO) Technical Committee for Geographic Information (TC211). The key to eventually achieving an international standard (de-facto or formal) is that each group which is developing data transfer standards in their area of geodetic interest should use existing recognised standards where possible, and communicate their new developments effectively. It is anticipated that through joint adoption of open standards, ongoing collaboration between the individual groups and the modular and extensible nature of XML, eventual harmonisation of the various international efforts should be possible.

8 CONCLUSION

A draft GeodesyML data transfer schema has been produced and will shortly be made available for public comment via the ICSM website. The schema is GML-compliant, which greatly increases the chances of it receiving widespread adoption and support beyond Australian and New Zealand geodetic agencies. It follows that it is modular, extensible and has been designed to enable organisations to incorporate their individual requirements.

While the initial beneficiaries of this work will be ICSM member jurisdictions, it is expected that other jurisdictions and agencies will investigate using this schema and contribute to its development. Allowance has already been made in anticipation of future research developments, such as improved deformation modelling and the need to support 4D geodetic applications.

For the full value of GeodesyML to be realised, widespread implementation is required. This includes implementation within commercially available geodetic software and within land information agencies. While this will take time, the building blocks are in place for the development of a truly international geodetic data transfer standard.

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