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Report on multi-scale representations

WIRADAII Geofabric Deliverable 2.5 Client Report

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The work contained in this report is collaboration between CSIRO's Water for a Healthy Country Flagship and the Bureau of Meteorology's Water Division under the Water Information Research and Development Alliance (WIRADA).

WIRADAII is the follow-on project from WIRADA, a five-year, $50 million partnership that will use CSIRO's R&D expertise to help the Bureau of Meteorology report on availability, condition and use of Australia's water resources.

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Copyright and disclaimer

Important disclaimer

Foreword

This report is a client report by the Geofabric project team. It constitutes the deliverable 2.5 of the WIRADAII Geofabric project.

It is authored jointly by CSIRO and Bureau of Meteorology Geofabric team members.

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1 Introduction

1.1 Scope

From the WIRADAII Geofabric Project Plan, Deliverable 2.5 is a:

> ***Report****: Report on multi-scale representations detailing business model & business rules to develop and maintain relationships between multi scale representations of important hydrological features between V2.x and V3.x products. Testing and update of conceptual model as required.*

1.2 Executive Summary

The Geofabric has multiple scale representations tied to the two Digital Elevation Model (DEM) base products with resolutions at 3 & 1 arc second (90m and 30m respectively). As they are known, Version 2 products are derived from the 3" DEM, Version 3 and beyond from the 1" DEM. As of June, 2014, Version 2 products are in public release and a test set of Version 3 products for the Namoi catchment are available. These include contracted catchments and some contracted nodes that retain identity (IDs) across versions.

The Geofabric product set currently has several types of versioning beyond the macro "Version 2" and "Version 3" products which generally indicate changes in product scale. Changes in processing algorithms and changes in non-scale-related input data also occur and need to be indicated to users. This report recommends some methods to handle these concepts and provide mechanisms such as naming conventions, to avoid confusion when referring to Geofabric data by version informally (in speech) and formally (in written statements and data product IDs, including URIs used to access data via services).

These methods, which are business rules, ask for the separation of the various axes of product classification currently bound in the single concept of *versions* and for the use of different terminology to describe product differences according to each axis.

These multiple axes of classification then describe how the series of Geofabric products are technically presented via web services and in other forms. They allow the concurrent delivery of multiple scale representations of products, as well as multiple representations according to other classification axes.

This document presents its recommendations in numbered list format in order that specific recommendations be referenced easily.

2 Recommendations

2.1 Recommendations summary

This report's specific recommendations are:

R.1. Use the term 'phase' for major releases of the total Geofabric product set. Phase 2 and Phase 3 then replace terms such as Version 2 and Version 3 commonly used to talk about the 3 arcsecond and 1 arcsecond products respectively;

R.2. Implement a `_version` keyword with a single integer value (2, 3, 4…) in data product URIs to indicate a product phase;

   a. Absence of `_version` defaults to latest stable phase product;

R.3. Use the terms 'spatial resolution' when referring to spatial differences in data (3 arcsecond and 1 arcsecond). *phase* (above) captures more differences than spatial resolution alone and future *phase* products may have varying spatial resolution if additional DEM data, such as LIDAR, are used;

R.4. Implement a `_spatialres` keyword in data product URIs to indicate a specific spatial resolution;

   a. Absence of `_spatialres` defaults to latest stable product with highest spatial resolution – currently the 3 arcsecond data for all of Australia with 1 arcsecond data available for the Namoi catchment area;

R.5. Implement additional minor & build portions of a `_version` keyword in data product URIs to indicate minor versions and build numbers within a phase;

   a. Phase and major version number are equivalent, i.e. version 2.1.1 products are phase 2 products, minor release 1 and build 1;

   b. Some product parts are un-versioned thus choice of them is determined by phase alone;

   c. Absence of `_version` defaults to latest stable version of the product;

R.6. The alternates view of data products will list the different `_spatialres` and `_version` options available;

R.7. Implement an information model views for features that persist across phases, using the `_view` query string argument, that lists multiple phase, version and spatial resolution instances.

   a. This implementation may be a subset of/equivalent to or share the same resources as, Recommendation R.6.

2.2 Recommendation justifications

R.1.

The overloading of the term 'version' is confusing in the context of the Geofabric products. 'version' has a specific interpretation in software engineering and software product delivery, often formalised through versioning schema such as that describe in Preston-Werner, 2014 [2].

The Geofabric has specified versioning schema along similar lines with the use of {MAJOR}.{MINOR}.{BUILD} versioning however the major versions are not entirely analogous to "Version 2" and "Version 3" release since those releases are dependent on input products, timing and other non-build-related factors. For this reason the recommendation stands to refer to these major 'builds' by another term, namely *phase*.

R.2.

In order to grant choice to the user between different phases and spatial resolutions of a contracted feature product, new derived URIs for features need to be implemented and those new derived URIs need linking to from a contracted feature's *alternates* view web page.

A choice of *phase* for a particular contracted feature, explicitly referenced by a single digit valued `_version` query string argument addition to a contracted feature URI, should be implemented. This will result in derived URIs as follows:

http://environment.data.gov.au/water/id/catchment/110535?_version=2

and

http://environment.data.gov.au/water/id/catchment/110535?_version=3

The above URIs give access to Phase 2 and Phase 3 expressions of the contracted catchment with ID 110535.

At the time of writing, the above URIs do not resolve as they have not been approved by all Geofabric parties, they are included as examples only.

R.3.

Since spatial resolution is of particular interest to users of spatial products, it would seem appropriate that explicit selection of spatial resolution can be made by users. Spatial resolution cannot be bound to version or *phase* as it is possible that products within a single *version* or at least *phase* may in the future have different spatial resolutions. This may be the case when products beyond Phase 3 incorporate LIDAR data in non-continent-wide portions.

R.4.

A choice of *spatial resolution* for a particular contracted feature, explicitly referenced by a `_spatialres` query string argument addition to a contracted feature URI, should be implemented. This will result in derived URIs as follows (using the test namespace at test.data.gov.au/environment):

http://environment.data.gov.au/water/id/catchment/110535?_spatialres=90m
(approximately Phase 2 products)

and

http://environment.data.gov.au/water/id/catchment/110535?_spatialres=30m
(approximately Phase 3 products)

The value of the `_spatialres` query string argument (QSA) is here given in metres. Alternate units could be used if other values, perhaps arc seconds, are found to be of more utility to the Geofabric user community.

Range expressions may be considered, for example any products with a resolution finer than 50m (perhaps 30m or finer products, if they exist) may be selectable via range prefixes to the `_spatialres` QSA or other key/value pair filter mechanism. No further consideration of this issue has been undertaken yet.

It is possible that Phase 4 products may vary in spatial resolution thus it may be possible to see the following URIs:

http://environment.data.gov.au/water/id/catchment/110535?_spatialres=30m

and

http://environment.data.gov.au/water/id/catchment/110923?_spatialres=15m

In this example, even though new underlying DEM products were used to calculate a higher-resolution feature date for catchment 110923, both catchment 110535 and 110923 could be in the same phase (e.g. Phase 4). They will likely start the phase at the same resolution and as new DEM products are added, versions are increased therefore the Version 4.0.0 data for catchment 110923 might differ in resolution from Version 4.3.5 for the same catchment.

R.5.

The geoprocessing algorithms for various Geofabric products change and this minor versions and build numbers should be retained in product attribution. If a particular minor/build version needs to be explicitly referenced, it could be indicated by a `_version` QSA.

Consistent with previous Geofabric product versioning, the version number should take the for:

{MAJOR}.{MINOR}.{BUILD}

The major build number should be equated with the Geofabric product *phase*. The *phase*/*version* distinction still remains relevant when considering Geofabric product components, such as the DEM, which are not subject to minor versions and builds.

The following example URIs demonstrate the use of *version* choice:

http://test.data.gov.au/environment/water/id/catchment/110535?_version=2.1

http://test.data.gov.au/environment/water/id/catchment/110535?_version=2.1.1

http://test.data.gov.au/environment/water/id/catchment/110535?_version=2.1.2

http://test.data.gov.au/environment/water/id/catchment/110535?_version=2
(equivalent to http://test.data.gov.au/environment/water/id/catchment/110535?_phase=2)

R.6.

The current *alternates* view of a contracted product looks similar to the image in Figure 1.

Additional links for each phase, version and spatial resolution expression of catchment 110535 need to be added to the alternates view of it given in Figure 1. Without this listing (and the listings describe below) there may be no way for users to discover multiple phase, version spatial resolution expressions of a feature.

Table 1 supplies a possible configuration for such additional view listings that may be appended to the list of views in Figure 1.

Table 1: Listing of additional Views to be added to the listing in a feature's *alternate* view

View	Description	Value
Phase	A particular phase release of this product	2
		3
Version	A particular minor build version of this product	2 (previous stable)
		2.1.1 (current stable)
		3 (future experimental)
		3.1 (future stable)
Spatial Resolution	A particular spatial resolution of the underlying Digital Elevation Model of this product	90m
		30m

When a user clicks on the values of the phase, version and spatial resolution views in Table 1, they are taken to a web page that looks almost identical to that in Figure 1 except that the title or subtitle of the page may inform them that the page is “Information resources available for specified object: http://environment.data.gov.au/water/id/catchment/110535, Phase 2” or “Information resources available for specified object: http://environment.data.gov.au/water/id/catchment/110535, Spatial Resolution 30m”.

When one of these phase/version/resolution-specific web pages are encountered, the range of non-phase/version/resolution view, such as SimpleFeatures, ahgf:AHGFCarto & listaltlids etc. may differ depending on the views available for that resource at that phase/version/resolution. The HTML interface (and the underlying RDF) should unambiguously indicate this to the user.

Hydrologic Reporting Catchments

Information resources available for specified object: http://environment.data.gov.au/water/id/catchment/110535

View	Description	Resources
alternates	lists available information resources for a concept identifer	[html] [json] [ttl] [rdf]
lid	Default description view of identified object	[html] [json] [ttl] [rdf]
ahgf:AHGFCarto	Carto Details within Catchment	[gml3] [kml]
idresolver	SIRF interim LDAID Service	[html] [json] [xml]
listaltids	SIRF Alternate IDs	[html] [json] [ttl] [rdf]
related	Related	[html] [json] [ttl] [rdf]
qrcode	QRCODE	[png]
ahgf:AHGFContractedCatchment	WFS	[gml3] [kml]
SimpleFeatures	WFS-SF	[csv] [gml3] [kml]
ahgf:AHGFManmade	Geofabric WFS for SH_Cartographic manmade canals and structures	[gml3] [kml]
	WFS (Mapped Stream)	[gml3] [kml]
	Geofabric WFS for SH_Cartographic waterbodies	[gml3] [kml]
ahgf:sh_network	LID view: WFS (SH_Network)	[gml3] [kml]
mapPreview	WMS	[png]
ahgf:cartographic	Mapped streams (LID)	[kml] [png]
ahgf:network	WMS (DEM derived streams)	[kml] [png]

Information resources available for the containing register (dataset): http://environment.data.gov.au/water/id/catchment

View	Description	Resources
alternates	lists available information resources for a concept identifer	[html] [json] [ttl] [rdf] [xml]
lid	Default description view of identified object	[html] [json] [ttl] [rdf] [xml]

Figure 1: *Alternates* view of catchment 110535

R.7.

A likely query that a human or machine user agent might make of a Geofabric product is “what are the phases/versions/resolutions available for this product?” and they should be provided with a simple mechanism to get the answer. Parsing the alternates view is one what to answer this, another is to provide a dedicated phase/version/resolution variant listing view.

The reason for this second approach is that the availability of multiple phases/versions/resolutions for a single resource constitute another axis of resource classification and thus another dimension to the resource availability. Where the alternates view is 2-dimentional (products * views), phase/version/resolution per product are 3 or more dimensional (not just products * phases & products * resolutions but products * phases * resolutions etc.). Traversing this hypercube one axis at a time could be achieved with a view as follows:

http://environment.data.gov.au/water/id/catchment/110535?_view=availableversions → gives a list of versions for catchment 110535. May return ‘2.1.1’, ‘2.1.2’, ‘2.2’, ‘2.2.1’, ‘3.0.0’, ‘3.0.1’ etc.

http://environment.data.gov.au/water/id/catchment/110535?_view=availablespatialres → gives a list of versions for catchment 110535. May return ‘90m’, ‘30m’.

3 Implementation

3.1 Versioning concepts

Figure 2 below shows a concept diagram of multi-scale and other classification of Geofabric products. It indicated that the major classification of products is *phase* followed by linked minor and release *version* with *spatialres* classification on a separate axis. This separation of spatial resolution allows products in a particular phase to have different spatial resolutions, as is likely to be the case with Phase 3 and certainly the case with Phase 4 product.

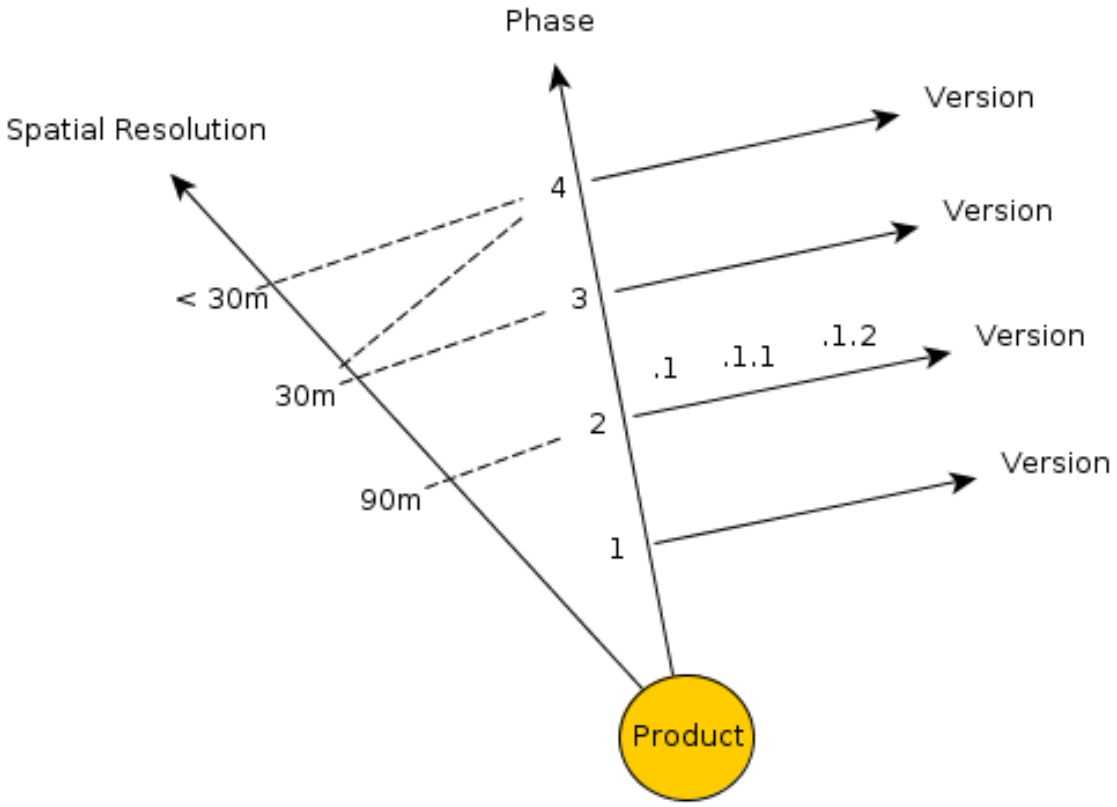

Figure 2: A concept diagram of Geofabric product classification on 3 axes

A refined drawing of Figure 2 could be used in describing to users of Geofabric products the relations between products' phases, versions and spatial resolutions.

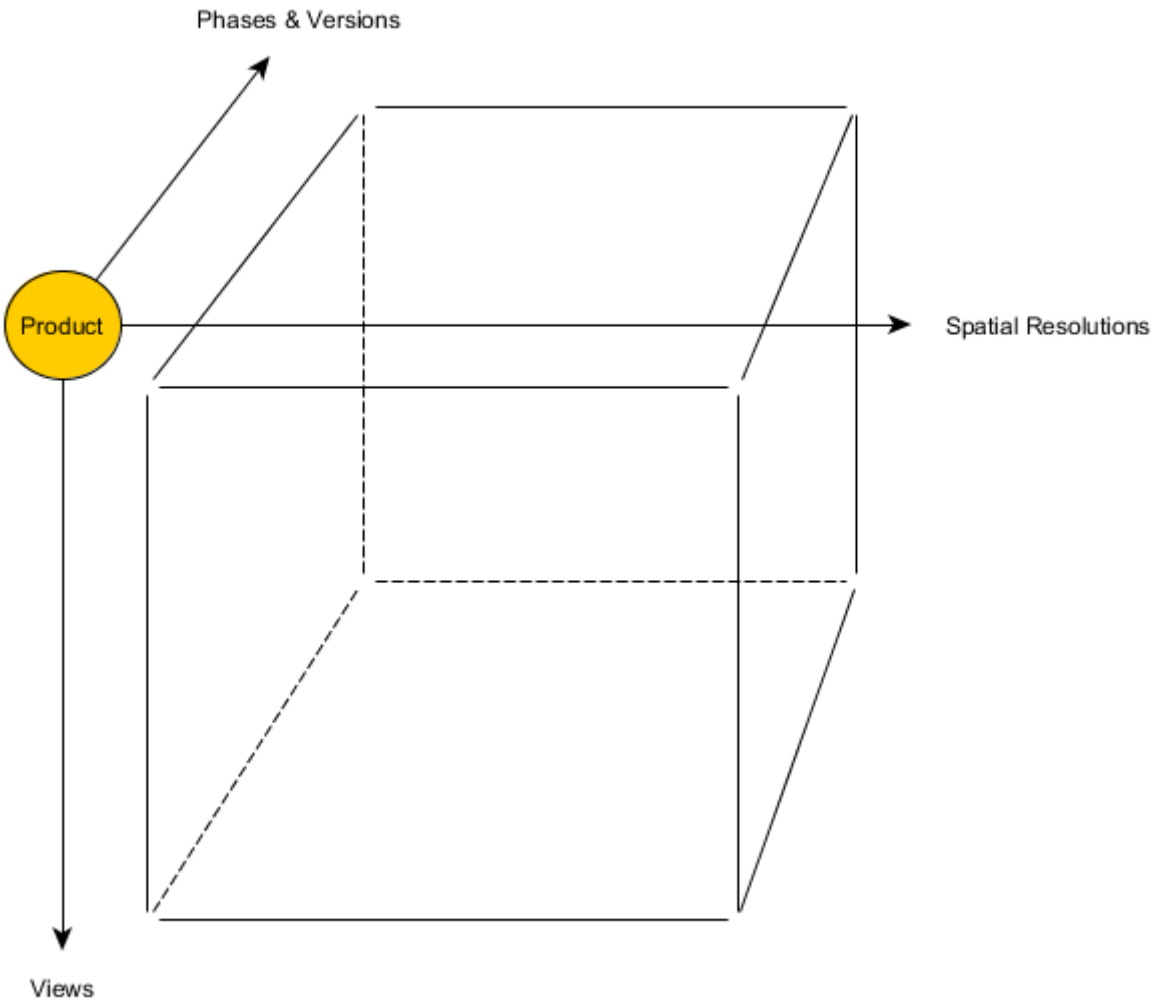

Figure 3: Product variants' conceptual axes: 'views' * phases & versions * spatial resolutions

Figure 3 shows a conceptual cube of the range of products' variants with the sides of the cube made by views – there are a range of views per product and they are expected to grow over time, phases and version which will also grow – and spatial resolutions which may also grow albeit more slowly than view and phases/versions.

3.2 Contracted feature – catchment example

Contracted features (nodes and catchments) retain their identifiers across different core and additional Geofabric products and different phases of Geofabric products. Representations of a catchment with the ID 110535 are dereferenceable[1] via URIs of the form:

http://{BASE_DOMAIN}/{CATCHMENT_FEATURE_REGISTER}[{/SUBREGISTER}+]/110535

Currently contracted catchments are delivered through the namespace environment.data.gov.au so a resolvable URI for catchment 110535 is:

http://environment.data.gov.au/water/id/catchment/110535

That URI resolves, as of July 2014, to an identity description page for the catchment with links to other views of the catchment, such as its perimeter, given by the latest stable contracted catchment release.

The perimeter data – the AHGF Contracted Catchment 'view' of the above catchment – is available via the following URI derived from the catchment's identity URI:

http://environment.data.gov.au/water/id/catchment/110535?
_view=ahgf:AHGFContractedCatchment&_format=gml3

The AHGF Contracted Catchment polygon data is delivered via a Web Feature Service[2] (WFS) server with the above URI currently redirecting to:

http://geofabric.bom.gov.au/simplefeatures/ows?
request=GetFeature&service=WFS&version=1.1.0&
typeName=ahgf_hrc:AHGFContractedCatchment&
Filter=<Filter><PropertyIsEqualTo><PropertyName>
ahgf_hrc:ConCatID</PropertyName><Literal>
110535</Literal></PropertyIsEqualTo></Filter>

If the current stable release of the product containing the AHGF Contracted Catchment polygon data, the Hydrological Reporting Catchments product, is version 2.1.2, according to the Recommendations in the previous section of this report, the following URIs are will therefore all lead to this WFS query:

http://environment.data.gov.au/water/id/catchment/110535?
_view=ahgf:AHGFContractedCatchment&_format=gml3
(the basic URI)

http://environment.data.gov.au/water/id/catchment/110535?
_view=ahgf:AHGFContractedCatchment&_format=gml3&**_version=2**
(indication of major version or phase)

http://environment.data.gov.au/water/id/catchment/110535?
_view=ahgf:AHGFContractedCatchment&_format=gml3&**_version=2.1.2**
(indication of version)

http://environment.data.gov.au/water/id/catchment/110535?
_view=ahgf:AHGFContractedCatchment&_format=gml3&**_spatialres=90m**
(indication of spatial resolution)

The `_version` and `_spatialres` QSAs should ***not*** be used together. In the case of a URI such as

[1] http://en.wikipedia.org/wiki/Dereferenceable_Uniform_Resource_Identifier
[2] http://en.wikipedia.org/wiki/Web_Feature_Service

http://environment.data.gov.au/water/id/catchment/110535?_view=ahgf:AHGFContractedCatchment&_format=gml3&_version=3&_spatialres=90m

where `_version=3` would indicate a product with 30m resolution differing from that indicated in the `_spatialres` QSA, it should be made known which QSA will 'win' or an HTTP Response with Status Code 400 'Bad Request' could be delivered to the user. The authors suggest this latter approach since it should be made known to the user that an illegal choice of QSA or at least an illogical one, has been made.

A test implementation of Phase 3 data is available for Geofabric features in the Namoi river catchment area. The contracted catchment 110535 used as an example above has Phase 3 polygon data delivered via a WFS available via the query:

http://cgeo-data2.csiro.au/geoserver/v3/ows?
request=GetFeature&service=WFS&version=1.1.0&
typeName=v3:ahgfcontractedcatchment&
Filter=<Filter><PropertyIsEqualTo><PropertyName>
concatid</PropertyName><Literal>
110923</Literal></PropertyIsEqualTo></Filter>

If this Phase 3 data was the latest stable release, the URI

http://environment.data.gov.au/water/id/catchment/110535?
_view=ahgf:AHGFContractedCatchment&_format=gml3
(the basic URI)

would resolve to the above WFS. Whether stable or not, the following URI will:

http://environment.data.gov.au/water/id/catchment/110535?
_view=ahgf:AHGFContractedCatchment&_format=gml3&**_version=3**
(indication of major version or phase)

as will the following:

http://environment.data.gov.au/water/id/catchment/110535?
_view=ahgf:AHGFContractedCatchment&_format=gml3&**_spatialres=30m**
(indication of spatial resolution)

The Contracted Catchment ID of 110535 is retained in both web service but, due to layer name clashes in the WFS implementation, the typeName (name of the feature class) does not match but likely will in a stale Phase 3 release cycle.

References

1. Bureau of Meteorology (2012) Australian Hydrological Geospatial Fabric (Geofabric) Product Guide version 2.1 – November 2012. Online at http://www.bom.gov.au/water/geofabric/documents/v2_1/ahgf_productguide_V2_1_release.pdf. Accessed 30th Jun 2014.

2. Preston-Werner, T. (2014) Semantic Versioning 2.0.0. http://semver.org/

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