



IGS INTERNATIONAL
G N S S SERVICE

Collaborative Development of a Standards-Based XML System for IGS Site Log Metadata Management and Dissemination

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For 20 years the IGS has relied on the text Site Log file to document metadata

Meanwhile, the IGS Network has grown in the number of stations and the complexity (MGEX, RT)

For Data Centers the task of keeping metadata up to date, complete, and synchronized can be made more efficient

For Analysis Centers and other data users, the task of accessing metadata can be made simpler

We can achieve benefits of standards and discoverability described in N. Brown's talk



```

MAHU Site Information Form (site log)
International GPS Service
See Instructions at:
ftp://igsch.jpl.nasa.gov/pub/station/general/sitelog_instr.txt

0. Form
Prepared by (full name) : Susan Jeffries
Date Prepared : 2014-11-18
Report Type : UPDATE
If Update:
Previous Site Log : mahu_20141113.log
Modified/Added Sections : (n.n,n.n,...)

1. Site Identification of the GNSS Monument
Site Name : Mahukona
Four Character ID : MAHU
Monument Inscription :
IGRS DOMES Number : (A9)
CDP Number : (A4)
Monument Description : BEDROCK-BOLTED MAST
Height of the Monument : (m)
Monument Foundation : (STEEL RODS, CONCRETE BLOCK, ROOF, etc)
Foundation Depth : (m)
Marker Description : Top of mast
Date Installed : 2006-10-27T00:00Z
Geologic Characteristic : (BEDROCK/CLAY/CONGLOMERATE/GRAVEL/SAND/etc)
Bedrock Type : (IGNEOUS/METAMORPHIC/SEDIMENTARY)
Bedrock Condition : (FRESH/JOINTED/WEATHERED)
Fracture Spacing : (1-10 cm/11-50 cm/51-200 cm/over 200 cm)
Fault zones nearby : (YES/NO/Name of the zone)
Distance/activity : (multiple lines)
Additional Information :

2. Site Location Information
City or Town : Hawaii
State or Province : Hawaii
Country : USA
Tectonic Plate : Pacific
Approximate Position (ITRF)
X coordinate (m) : -5466400.0582
Y coordinate (m) : -2445845.7747
Z coordinate (m) : 2187682.0476
Latitude (N is +) : +21°13'.84
Longitude (E is +) : -155°34'.92
Elevation (m,ellips.) : 99.3
Additional Information :
    
```



Advantages

- Trustworthy
- Complete
- Everything in one place
- Human readable



Disadvantages

- Parsing and vetting challenges
- Metadata also needed in other formats (SINEX, station.info, etc.)
- Managing files can be a chore
- No facilitation of machine-to-machine (M2M) exchange

Text Site Log

```

MAHU Site Information Form (site log)
International GPS Service
See Instructions at:
  ftp://igsb.jpl.nasa.gov/pub/station/general/sitelog_instr.txt

0. Form
  Prepared by (full name) : Susan Jeffries
  Date Prepared          : 2014-11-18
  Report Type           : UPDATE
  If Updates:
  Previous Site Log     : mahu_20141113.log
  Modified/Added Sections : (n.n,n.n,...)

1. Site Identification of the GNSS Monument
  Site Name              : Mahukona
  Four Character ID     : MAHU
  Monument Inscription  :
  IERS DOMES Number    : (A9)
  CDP Number            : (A4)
  Monument Description : BEDROCK-BOLTED MAST
  Height of the Monument : (m)
  Monument Foundation  : (STEEL RODS, CONCRETE BLOCK, ROOF, etc)
  Foundation Depth     : (m)
  Marker Description   : Top of mast
  Date Installed       : 2006-10-27T00:00Z
  Geologic Characteristic : (BEDROCK/CLAY/CONGLOMERATE/GRAVEL/SAND/etc)
  Bedrock Type         : (IGNEOUS/METAMORPHIC/SEDIMENTARY)
  Bedrock Condition    : (FRESH/JOINTED/WEATHERED)
  Fracture Spacing     : (1-10 cm/11-50 cm/51-200 cm/over 200 cm)
  Fault zones nearby   : (YES/NO/Name of the zone)
  Distance/activity    : (multiple lines)
  Additional Information :

2. Site Location Information
  City or Town         : Hawaii
  State or Province    : Hawaii
  Country              : USA
  Tectonic Plate       : Pacific
  Approximate Position (ITRF)
  X coordinate (m)    : -5466400.0582
  Y coordinate (m)    : -2445845.7747
  Z coordinate (m)    : 2187682.0476
  Latitude (N is +)   : +201130.84
  Longitude (E is +)  : -1555340.92
  Elevation (m,ellips.) : 99.3
  Additional Information :
  
```



Advantages

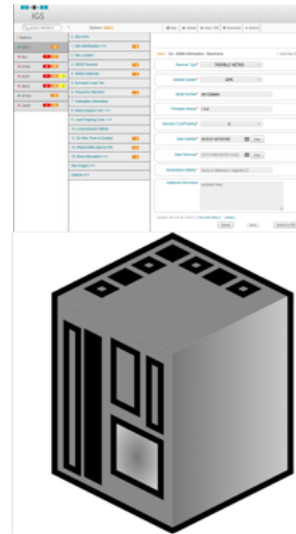
- Trustworthy
- Complete
- Everything in one place
- Human readable



Disadvantages

- Parsing and vetting challenges
- Metadata also needed in other formats (SINEX, station.info, etc.)
- Managing files can be a chore
- No facilitation of machine-to-machine (M2M) exchange

Text Site Log



```

MAHU Site Information Form (site log)
International GPS Service
See Instructions at:
ftp://igsch.jpl.nasa.gov/pub/station/general/sitelog_instr.txt

0. Form
Prepared by (full name) : Susan Jeffries
Date Prepared : 2014-11-18
Report Type : UPDATE
IT Update:
Previous Site Log : mahu_20141113.log
Modified/Added Sections : (S.N.S.N....)

1. Site Identification of the GNSS Monument
Site Name : Mahukona
Four Character ID : MAHU
Monument Inscription :
IERS DONES Number : (A9)
CIP Number : (A4)
Monument Description : BEDROCK-BOLTED MAST
Height of the Monument : (M)
Monument Foundation : (STEEL RODS, CONCRETE BLOCK, ROOF, etc)
Foundation Depth : (M)
Marker Description : Top of mast
Date Installed : 2006-10-27T00:00Z
Geologic Characteristic : (BEDROCK/CLAY/CONGLOMERATE/GRAVEL/SAND/etc)
Bedrock Type : (CONGLOMERATE/SAND/SHALE/etc)
Bedrock Condition : (FRESH/JOINTED/WEATHERED)
Fracture Spacing : (1-10 cm/1-50 cm/51-200 cm/over 200 cm)
Fault zones nearby : (YES/NO/Name of the zone)
Emission/Activity : (Multiple lines)
Additional Information :

2. Site Location Information
City or Town : Hawaii
State or Province : Hawaii
Country : USA
Tectonic Plate : Pacific
Approximate Position (ITRF)
X coordinate (m) : -5466400.0582
Y coordinate (m) : -1646840.7747
Z coordinate (m) : 2187682.0476
Latitude (W is +) : +201130.84
Longitude (E is -) : -1555340.92
Elevation (m, ellipsoid) : 99.3
Additional Information :
    
```

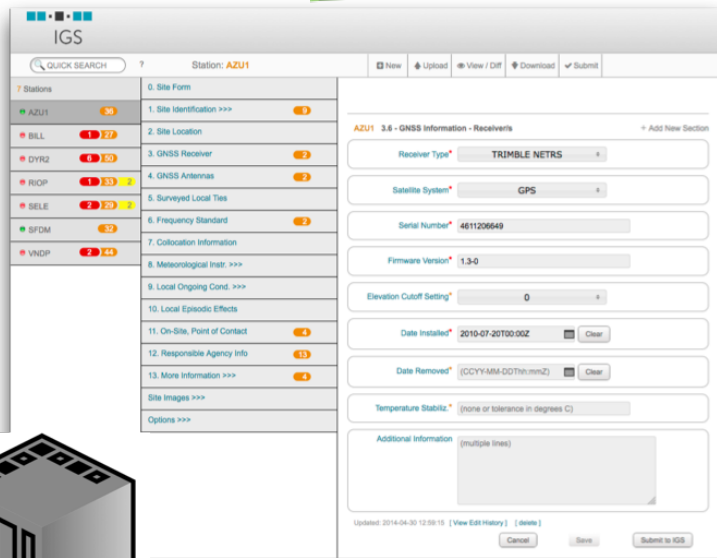
SiteLogManager System

The Site Log Manager database and interface aids in timely metadata tracking and accuracy and some vetting but does not address metadata access, i.e. access is still through text Site Logs via ftp; interoperability is not facilitated

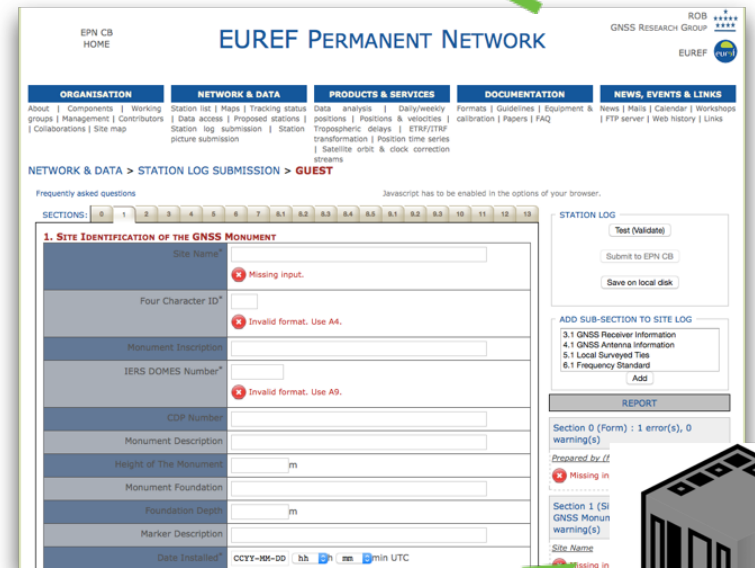
IGS Central Bureau

M2M Interoperability

European Permanent Network

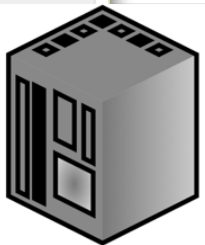
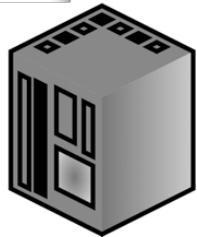


IGS website interface showing station information for AZU1. The page includes a sidebar with navigation links (7 Stations, BILL, DYP2, RIOP, SELE, SIFDM, VNDP) and a main content area with sections for Site Form, Site Identification, Site Location, GNSS Receiver, GNSS Antennas, Surveyed Local Ties, Frequency Standard, Collocation Information, Meteorological Instr., Local Ongoing Cond., Local Episodic Effects, On-Site, Point of Contact, Responsible Agency Info, More Information, and Site Images. The main content area displays details for AZU1 3.6 - GNSS Information - Receiver, including Receiver Type (TRIMBLE NETRS), Satellite System (GPS), Serial Number (4611206649), Firmware Version (1.3.0), Elevation Cutoff Setting (0), Date Installed (2010-07-20T00:00Z), Date Removed (CCYY-MM-DDThh:mmZ), and Temperature Stability (none or tolerance in degrees C).



EUREF Permanent Network website interface showing a station log submission form. The page includes a navigation menu (ORGANISATION, NETWORK & DATA, PRODUCTS & SERVICES, DOCUMENTATION, NEWS, EVENTS & LINKS) and a main content area with sections for NETWORK & DATA > STATION LOG SUBMISSION > GUEST. The form includes fields for Site Name, Four Character ID, Monument Description, IERS DOMES Number, CDP Number, Monument Description, Height of The Monument, Monument Foundation, Foundation Depth, Marker Description, and Date Installed. The form also includes a 'Test (Validate)' button and a 'Submit to EPN CB' button.

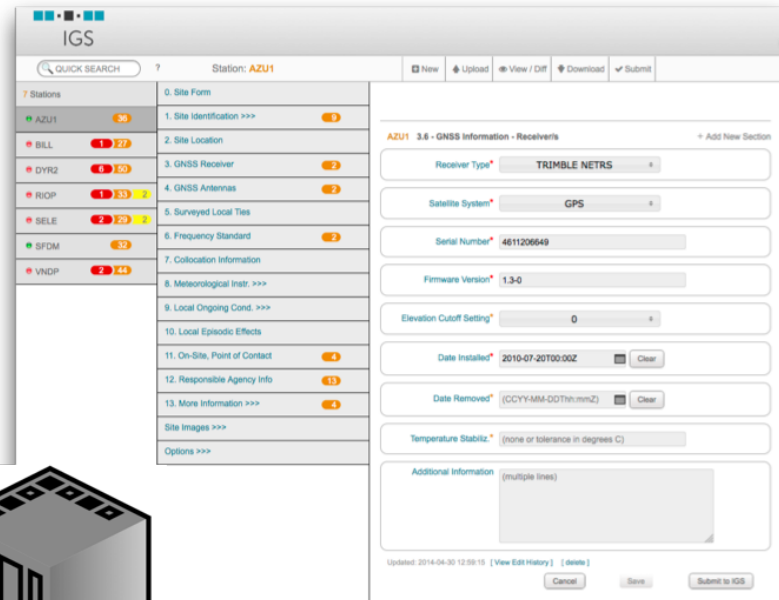
Machine-to-Machine interoperability within IGS



Simplification of updates, for example EPN to IGS Central Bureau and other metadata systems. Site Log Manager system will incorporate XML-schema-based vetting of content including parsing and validation, consistency checking, and verifying completeness.

Human-to-Machine (H2M) Interoperability

Alternate formats can be provided via web query

```

MAHU Site Information Form (site log)
International GPS Service
See Instructions at:
ftp://igs.cb.jpl.nasa.gov/pub/station/general/sitelog_instr.txt

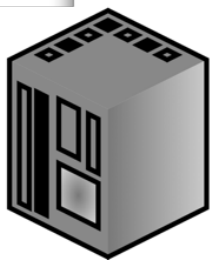
0. Form
Prepared by (full name) : Susan Jeffries
Date Prepared : 2014-11-18
Report Type : UPDATE
If Updated:
Previous Site Log : mahu_20141113.log
Modified/Added Sections : (n.n,n.n,...)

1. Site Identification of the GNSS Monument
Site Name : Mahukona
Four Character ID : MAHU
Monument Inscription :
IERS DOPUS Number : (A9)
CDP Number : (A4)
Monument Description : BEDROCK-BOLTED MAST
Height of the Monument : (m)
Monument Foundation : (STEEL RODS, CONCRETE BLOCK, ROOF, etc)
Foundation Depth : (m)
Marker Description : Top of mast
Date Installed : 2006-10-27T00:00Z
Geologic Characteristic : (BEDROCK/CLAY/CONGLOMERATE/GRAVEL/SAND/etc)
Bedrock Type : (IGNEOUS/METAMORPHIC/SEDIMENTARY)
Bedrock Condition : (FRESH/JOINTED/WEATHERED)
Fracture Spacing : (1-10 cm/11-50 cm/51-200 cm/over 200 cm)
Fault zones nearby : (YES/NO/Name of the zone)
Distance/activity : (multiple lines)
Additional Information :

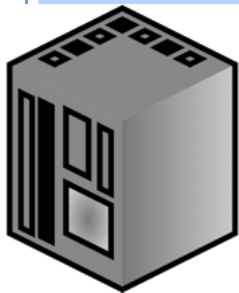
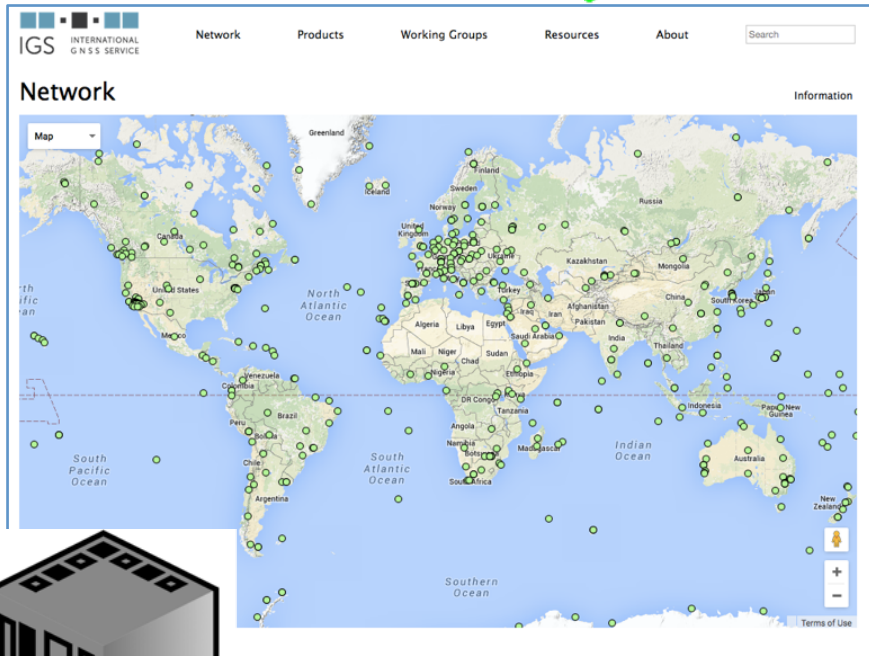
2. Site Location Information
City or Town : Hawaii
State or Province : Hawaii
Country : USA
Tectonic Plate : Pacific
Approximate Position (ITRF)
X coordinate (m) : -5466400.0582
Y coordinate (m) : -2445845.7747
Z coordinate (m) : 2187682.0476
Latitude (N is +) : +201130.84
Longitude (E is +) : -1555340.92
Elevation (m,ellips.) : 99.3
Additional Information :
    
```

```

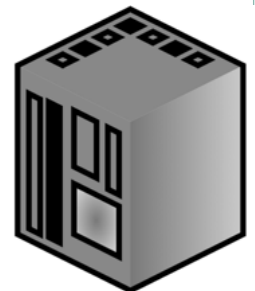
%=SNX 2.01 UNAVCO GSAC 1
*-----*
+SITE/ID
*CODE PT __DOMES__ T ST
P405 A 1 P 10:200:00000 15:346:86385
-SITE/ID
*-----*
+SITE/RECEIVER
*SITE PT SOLN T DATA START DATA END DESCRIPTION S/N FIRMWARE
P405 A 1 P 06:209:76725 10:199:86385 TRIMBLE NETRS 45422 1.1-2 19 Ap
P405 A 1 P 10:200:00000 15:346:86385 TRIMBLE NETRS 45422 1.3-0
-SITE/RECEIVER
*-----*
+SITE/ANTENNA
*SITE PT SOLN T DATA START DATA END DESCRIPTION S/N
P405 A 1 P 06:209:76725 10:199:86385 TRM29659.00 SCIT 02203
P405 A 1 P 10:200:00000 15:346:86385 TRM29659.00 SCIT 02203
-SITE/ANTENNA
*-----*
+SITE/ECCENTRICITY
*
* UP NORTH EAST
*SITE PT SOLN T DATA START DATA END AXE ARP->BENCHMARK(M)
P405 A 1 P 06:209:76725 10:199:86385 UNE 0.0083 0.0000 0.0000
P405 A 1 P 10:200:00000 15:346:86385 UNE 0.0083 0.0000 0.0000
-SITE/ECCENTRICITY
&ENDSNX
    
```



Improving discoverability of IGS Metadata, Data, and Products



To achieve this requires (1) adopting international standards that have been developed for the spatial data and broader Earth observation communities AND (2) linking the metadata definitions that encapsulate geodesy to these broader communities. GeodesyML, an XML OGC and ISO compliant application schema, is the mechanism to forge this link.



XML ESSENTIALS

What is XML?

The Extensible Markup Language (XML) is a simple text-based format for representing structured information: documents, data, configuration, books, transactions, invoices, and much more. It was derived from an older standard format called SGML (ISO 8879), in order to be more suitable for Web use.

What is XML Used For?

XML is one of the most widely-used formats for sharing structured information today: between programs, between people, between computers and people, both locally and across networks.

A short example:

```
<part number="1976">
  <name>Windscreen Wiper</name>
  <description>The Windscreen wiper
    automatically removes rain
    from your windscreen, if it
    should happen to splash there.
    It has a rubber <ref part="1977">blade</ref>
    which can be ordered separately
    if you need to replace it.
  </description>
</part>
```

<https://www.w3.org/standards/xml/core.html>

If you are already familiar with HTML, you can see that XML is very similar. However, the syntax rules of XML are strict: XML tools will not process files that contain errors, but instead will give you error messages so that you fix them. This means that almost all XML documents can be processed reliably by computer software.

Text Site Log designed for human readability

```

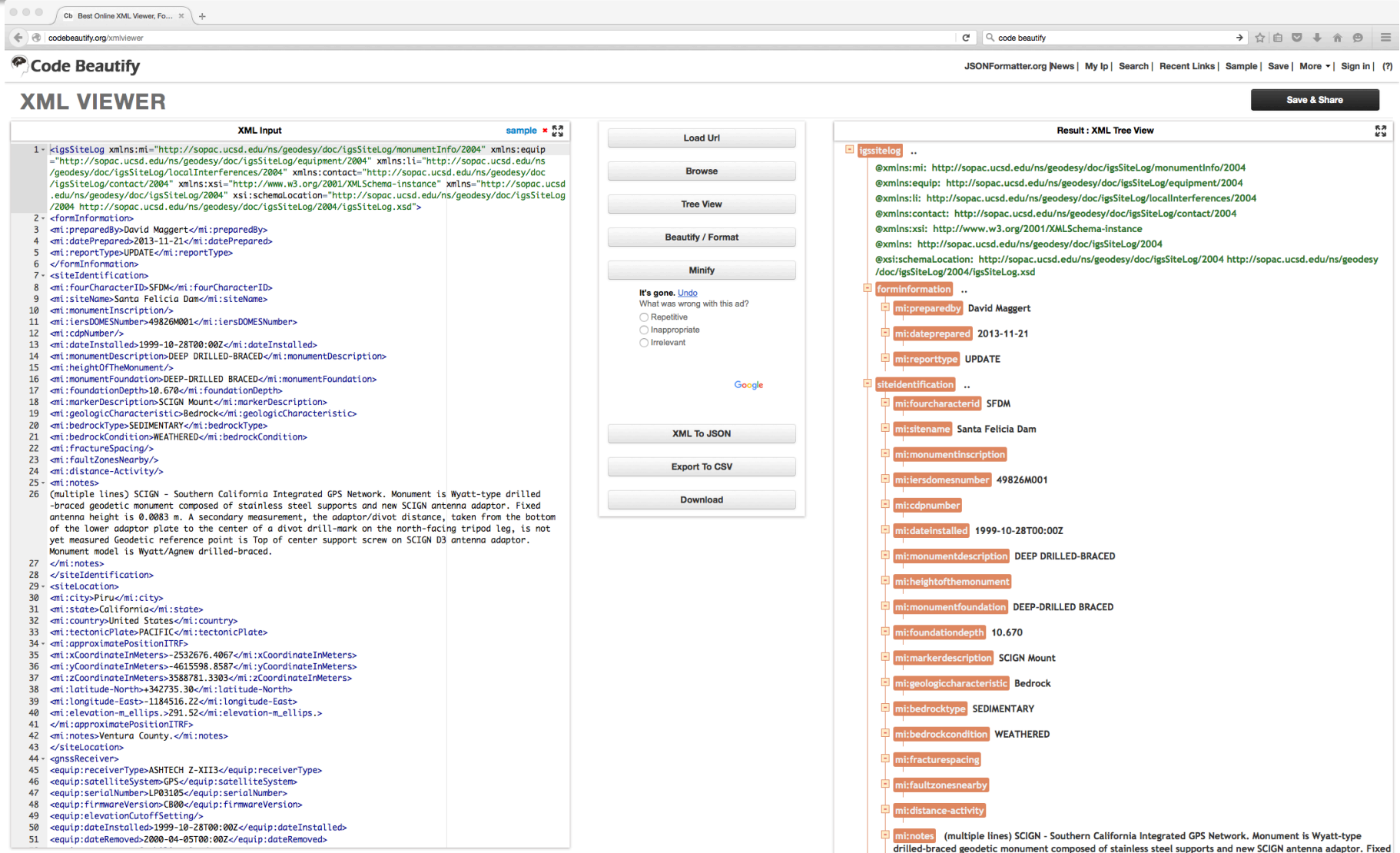
3.1 Receiver Type           : ASHTECH Z-XII3
   Satellite System        : GPS
   Serial Number           : LP03105
   Firmware Version        : CB00
   Elevation Cutoff Setting :
   Date Installed          : 1999-10-28T00:00Z
   Date Removed            : 2000-04-05T00:00Z
   Temperature Stabiliz.   :
   Additional Information   : 120 second sampling rate until telemetry
                               : established
  
```

XML Site Log encoding - human readable, but more typically handled by software

```

<gnsReceiver>
  <equip:receiverType>ASHTECH Z-XII3</equip:receiverType>
  <equip:satelliteSystem>GPS</equip:satelliteSystem>
  <equip:serialNumber>LP03105</equip:serialNumber>
  <equip:firmwareVersion>CB00</equip:firmwareVersion>
  <equip:elevationCutoffSetting></equip:elevationCutoffSetting>
  <equip:dateInstalled>1999-10-28T00:00Z</equip:dateInstalled>
  <equip:dateRemoved>2000-04-05T00:00Z</equip:dateRemoved>
  <equip:temperatureStabilization></equip:temperatureStabilization>
  <equip:notes>120 second sampling rate until telemetry established</equip:notes>
</gnsReceiver>
  
```

Site Log XML Example

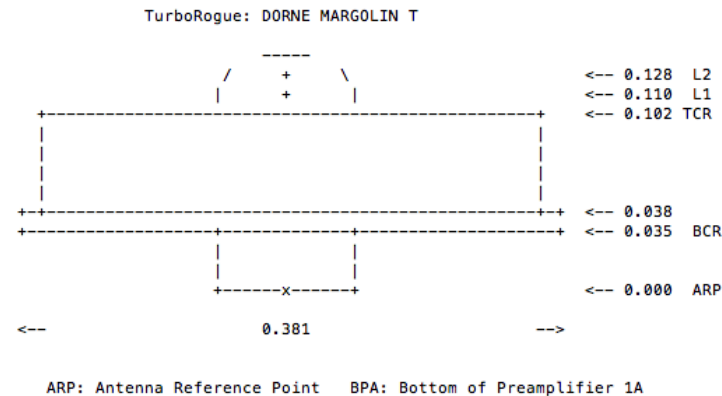


The screenshot displays the Code Beautify XML Viewer interface. On the left, the 'XML Input' pane shows the raw XML code for a site log entry, including details like monument information, site identification, location, and receiver data. The central pane contains a control menu with buttons for 'Load Url', 'Browse', 'Tree View', 'Beauty / Format', 'Minify', 'XML To JSON', 'Export To CSV', and 'Download'. On the right, the 'Result: XML Tree View' pane shows a hierarchical tree structure of the XML document, with nodes expanded to show their values, such as 'mi:preparedby' (David Maggart) and 'mi:dateset' (2013-11-21).

Similar to HTML editor/viewer software, XML viewers are available

Certain elements of the text site log will change to follow the XML schema and, where applicable, standards being used (ISO, OGC/GeodesyML)

Changes will be announced in the usual way, with text site log template and documentation available from the IGS Central Bureau



Example 1. Antenna diagrams will be dropped, and antenna information from online documentation will instead be referenced

Changes in Text Site Log Coming

Example 2. Support for 9-character RINEX3 filenames in XML and text site logs

```

<geo:siteLocation>
  <geo:city>Melbourne</geo:city>
  <geo:state>Victoria</geo:state>
  <geo:countryCodeISO>AUS</geo:countryCodeISO>
  <geo:tectonicPlate>Indian/Australian</geo:tectonicPlate>
  <geo:approximatePositionITRF>
    <geo:xCoordinateInMeters>-4130636.106</geo:xCoordinateInMeters>
    <geo:yCoordinateInMeters>2894953.089</geo:yCoordinateInMeters>
    <geo:zCoordinateInMeters>-3890531.051</geo:zCoordinateInMeters>
    <geo:latitude-North>-37.82941634</geo:latitude-North>
    <geo:longitude-East>144.9753351</geo:longitude-East>
    <geo:elevation-m_ellips.>40.674</geo:elevation-m_ellips.>
  </geo:approximatePositionITRF>
  <geo:notes>The GPS is located at the old Melbourne Observatory, located in the Royal Melbourne Botanical Gardens</geo:notes>
</geo:siteLocation>

```

2. Site Location Information

City or Town	: Melbourne
State or Province	: Victoria
Country Code	: AUS
Tectonic Plate	: AUSTRALIAN

```

<geo:Monument gml:id="MONUMENT_1">
  <gml:description>Centre of base of 5/8" spigot on GPS</gml:description>
  <gml:name codeSpace="urn:ga-gov-au:monument-siteName">Melbourne Observatory</gml:name>
  <gml:name codeSpace="urn:ga-gov-au:monument-fourCharacterID">MOBS</gml:name>
  <gml:name codeSpace="urn:ga-gov-au:monument-iersDOMESNumber">50182M001</gml:name>
  <gml:name codeSpace="urn:ga-gov-au:monument-cdpNumber">Not Available</gml:name>
  <geo:type codeSpace="urn:ga-gov-au:monument-type">CORS</geo:type>
  <geo:installedDate>2002-03-15Z</geo:installedDate>
  <geo:monumentNumber>0</geo:monumentNumber>
  <geo:receiverNumber>0</geo:receiverNumber>
</geo:Monument>

```

1. Site Identification of the GNSS Monument

Site Name	: Melbourne Observatory
Four Character ID	: MOBS
Monument Number	: 0
Receiver Number	: 0
Monument Inscription	:

Example 3. Geographic coordinates decimal degrees in XML and text site logs

```

<geo:siteLocation>
  <geo:city>Melbourne</geo:city>
  <geo:state>Victoria</geo:state>
  <geo:countryCodeISO>AUS</geo:countryCodeISO>
  <geo:tectonicPlate>Indian/Australian</geo:tectonicPlate>
  <geo:approximatePositionITRF>
    <geo:xCoordinateInMeters>-4130636.106</geo:xCoordinateInMeters>
    <geo:yCoordinateInMeters>2894953.089</geo:yCoordinateInMeters>
    <geo:zCoordinateInMeters>-3890531.051</geo:zCoordinateInMeters>
    <geo:latitude-North>-37.82941634</geo:latitude-North>
    <geo:longitude-East>144.9753351</geo:longitude-East>
    <geo:elevation-m_ellips.>40.674</geo:elevation-m_ellips.>
  </geo:approximatePositionITRF>
  <geo:notes>The GPS is located at the old Melbourne Observatory, located in the Royal Melbourne Botanical Gardens</geo:notes>
</geo:siteLocation>

```

2. Site Location Information

City or Town	: Melbourne
State or Province	: Victoria
Country Code	: AUS
Tectonic Plate	: AUSTRALIAN

```

<geo:Monument gml:id="MONUMENT_1">
  <gml:description>Centre of base of 5/8" spigot on GPS</gml:description>
  <gml:name codeSpace="urn:ga-gov-au:monument-siteName">Melbourne Observatory</gml:name>
  <gml:name codeSpace="urn:ga-gov-au:monument-fourCharacterID">MOBS</gml:name>
  <gml:name codeSpace="urn:ga-gov-au:monument-iersDOMESNumber">50182M001</gml:name>
  <gml:name codeSpace="urn:ga-gov-au:monument-cdpNumber">Not Available</gml:name>
  <geo:type codeSpace="urn:ga-gov-au:monument-type">CORS</geo:type>
  <geo:installedDate>2002-09-15Z</geo:installedDate>
  <geo:monumentNumber>0</geo:monumentNumber>
  <geo:receiverNumber>0</geo:receiverNumber>
</geo:Monument>

```

1. Site Identification of the GNSS Monument

Site Name	: Melbourne Observatory
Four Character ID	: MOBS
Monument Number	: 0
Receiver Number	: 0
Monument Inscription	:

Metadata Entry

As is the case now, IGS Site Log Manager system:

- Will accept upload of text Site Log from authenticated users
- Will accept manual entry of metadata from authenticated users
- IGS Network Coordinator vets this metadata

New functionality to be built as part of this effort, IGS Site Log Manager system:

- Will accept upload of XML Site Log from authenticated users
- Will accept input of XML metadata via web services from trusted authenticated sources (no vetting by IGS Network Coordinator required)

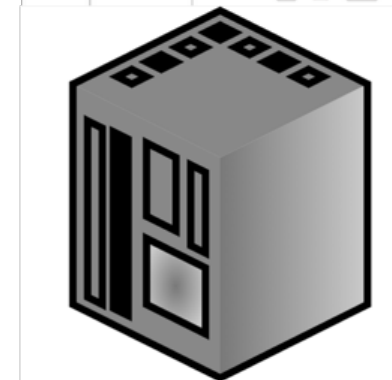
Metadata Access

As is the case now:

- Text Site Logs will be available via FTP

New functionality to be built as part of this effort, IGS Site Log Manager system:

- Will output XML via web service (full site log or selected elements)
- Will output a variety of text formats via web service
- Standalone software scripts for output of alternate formats from XML will be made available



SiteLogManager System

Adopting an XML format has these benefits within IGS:

- Solves parsing challenges of Text Site Log
- Leads to efficiencies in tracking site log metadata
 - Automated updating of Site Log Manager by trusted systems
 - Validation done by machines rather than humans
- Facilitates any desired presentation format for metadata (SINEX, station.info, etc.)
- Extensible: as metadata needs evolve, schema can be extended
 - *A proposed extension is to track quality metadata like number of available daily data files in last year; average percent of daily file completeness in last (year/month/day), etc.*

Adoption of GeodesyML, a standards-based XML schema, has these additional benefits for IGS and beyond:

- Global unification of standards for encoding geodetic data and metadata
- Machine-to-machine exchange of data and metadata over the Internet with existing web services
- Greater interoperability with the geospatial and Earth observation communities
- Enhanced discovery of IGS data and metadata
- Database and GIS vendors support international standards

Application to other geodetic techniques:

- This effort can be leveraged by ILRS, IDS, IVS

Milestones to date:

- Agreement on elements to be included in Site Log XML schema version 1.0
- Agreement on certain encoding changes for consistency
- Adoption of GeodesyML with Site Log XML schema version 1.0 as application schema

Next steps:

- Documentation of schema 1.0
- Agree on GeoServer Application Server or other exchange mechanism
- Provide list of all available software (client and server) for enabling this activity
- Agree on and implement software distribution mechanism
- Sandbox exploration
- Identify 2-3 groups to do a pilot demonstration of use cases/mechanisms
- Adoption of exchange mechanisms
- Documentation of exchange mechanisms
- Adopt a process for handling future needs
- Site Log Manager system (and others as desired) implement Application Server and supporting software

Much
of this
can
happen
in 2016

Needed from all stakeholders:

Use cases - document how would you like to interact with this metadata system

You can learn more about this effort by subscribing to the igs-dcwg mailing list

Thanks for your attention

Questions?