Binational Geospatial Software Developers Summit: Implementation of CSRS and NSRS Modernization

November 30 & December 1, 2022

NOAA's National Geodetic Survey
NRCan's Canadian Geodetic Survey

1. Background

National Geodetic Survey (NGS) and Canadian Geodetic Survey (CGS) worked together to host a binational geospatial software developers summit on the implementation of the Modernized National Spatial Reference System (NSRS) and the Canadian Spatial Reference System (CSRS) on November 30 and December 1, 2022. Representatives from 13 private sector geospatial companies participated in more than 7 hours of presentations and discussions over 2 days. Market leading companies along with open-source community representatives provided updates on their progress toward implementing new file formats and gave valuable feedback to NGS and CGS.

Surveyors and other geospatial professionals will need to change their current workflows when they transition to using the modernized NSRS and CSRS. NGS and CGS are proactively engaging surveying and mapping equipment manufacturers and geospatial software developers to help ensure that our mutual customers can transition smoothly to our modernized systems.

A particular focus of the summit was on geospatial tools for dynamic datum transformations, since both NGS and CGS will include new dynamic components and standards with NATRF2022. Another goal was to gather information from software developers on what they require from NGS and CGS to support their preparedness for 2025.

2. Invitations and Responses

Summit participation was intended for partners in the geospatial software industry in Canada and the US, and was by invitation only. NGS and CGS sent invitations to 98 industry representatives from 22 private sector companies and open source software organizations. CGS public sector partners from provinces and other federal departments were also invited.

The invitation list was populated and vetted by all Divisions and included NGS and CGS Leadership and Subject Matter Experts (SMEs), nearly all of whom participated.

Thirty-six representatives from 12 companies and 5 government organizations registered for the event and nearly all participated (see participant list in Section 3). Parts of the workshop featured robust dialog and Q&A sessions. NGS and CGS SMEs responded to many questions verbally.

Most of the participants were sent a pre-event set of questions about their company's interests and concerns regarding geospatial software needs and readiness in anticipation of the adoption of NATRF2022, a dynamic datum. Feedback to pre-summit questions is summarized in Section 5.

Registered participants were also asked whether they were interested in presenting their answers to these questions on behalf of their organizations. Three organizations agreed to do so.

The summit agenda is in Appendix 1, presentations are linked to in Appendix 2, and results from Poll Questions asked during the workshop are in Appendix 3.

3. Registered Participants

Agency Name	# of Reps
aiworldwide.com	1
bluemarblegeo.com	3
carlsonsw.com	1
chcnav.com	1
esri.ca	1
esri.com	2
hexagon.com	1
leicaus.com	1
microsurvey.com	2
safe.com	1
teledyne.com	1
trimble.com	2
noaa.gov	13
mern.gouv.qc.ca	2
nrcan-rncan.gc.ca	2
ontario.ca	1
gov.ab.ca	1
Total Participants	36
Government	19
Private Sector	17

Titles of Private Sector Participants:

- Engineer
- Director, SDI
- Geodetic Engineer
- Geodesist
- Geodetic Advisor
- Market Manager
- Product Engineer
- Product Manager
- Senior Analyst
- Senior Software Developer
- Senior Developer / Technical Manager
- Software Development Manager
- Software Developer
- Software Engineer
- Support Engineer
- Technology Manager

4. General Notes

The event opened with remarks from NGS and CGS Directors, highlighting the importance of the summit for the delivery of their national mandates and for their clients and stakeholders. NGS and CGS technical presentations were well received and generated questions and discussion during the Q&A period. Three industry presentations on Day 2 were well prepared, and served to guide NGS and CGS on next steps to support the preparation of geospatial software tools for 2025. Both days ran for the full time, with questions raised in the chat and live.

5. Responses to pre-summit questions and summary of discussions:

Information gathered from this event is documented in this report as responses to the pre-summit questions, which includes feedback received through the industry presentations, live Q&A and discussions, and the Poll Questions (Appendix 3).

In general, the three industry presenters were confident in their ability to provide tools for working in the new CSRS and NSRS for 2025. Other poll respondents were less so. It was noted that the number of responses to the Poll Questions was low, likely because many of the summit participants represented public organizations and therefore were not able to answer the questions.

Transformations between epochs
Blueprint for the Modernized NSRS, Part 3: Working in the Modernized NSRS provides a high-level outline of methodologies for using a dynamic reference frame, including the intraframe deformation models (IFDM). Will your company be ready to implement a deformation model for epoch transformations when NATRF2022 is released in 2025? What do you need from us to help you implement this?

> Feedback: PROJ and Trimble already make epoch transformations available in their software (see presentations). ESRI is developing this capacity and expects this functionality to be ready for 2025. Other participants were less sure (see Poll Question 1). CGS and NGS should prepare documentation for which algorithms are used and recommended.

Grid formats and model representation standards
A. The standardized GGXF format is expected to be available from OGC in 2023. CGS and NGS plan to use this for geodetic grids, including deformation and geoid models. Do you plan to adopt this grid format once it is available? What do you need from us to implement this?

B. The IFDM is planned to follow the Deformation Model Functional Model (DMFM) standard for representing deformation models in the GGXF grid format. Do you plan to adopt this standard once it is available? What do you need from us to implement this?

Feedback: all three presenters plan to adopt GGXF/DMFM if they are adopted by NGS and CGS as a common standard; other poll respondents were undecided (see Poll Question 2 and 3). Some software may require a tool to convert between these and their proprietary formats. To prepare their software suites for 2025, they require confirmation of adopted standards, standard specifications, documentation, and test data. These should be provided by NGS, CGS, and the OGC CRS SWG.

Timelines
Geospatial software version upgrades are planned years ahead in some jurisdictions. GGXF should be available next year, and DMFM has an abstract specification available (see References). How long do you estimate it will take to make these tools available to users?

Feedback: Most poll respondents indicated they could make tools available within 1 to 2 years once specifications and beta products are released (Poll Question 4). ESRI, Trimble and PROJ all plan to have these tools available by 2025 if the standards and test datasets are released by 2024. Functionality is anticipated to become increasingly automated after the initial release of new geospatial tools.

Projected Coordinates format
What format should be used for projected coordinate reference system definitions? We plan to use Well Known Text (WKT) version 2. The definitions will also be available in the EPSG Geodetic Parameter Dataset and the ISO Geodetic Register. Will this suffice?

Feedback: Discussions, industry presentations and responses to Poll Question 5 indicated that WKTv2 should be used. This was in part because it is an established OGC standard and supported by the ISO and EPSG Geodetic Registries. Some would prefer more test points per zone. Documentation for new transformation methods could be included in IOGP Guidance Note 7-2. GGXF will be a joint standard with ISO and OGC, and will therefore be available to more users.

Data and tool Access
Should we provide access to official products (such GGXF grids and transformations) to perform the computation in your software? Or do you plan to use NGS and CGS web services for these calculations? Or both? Note that web services may not be able to handle large datasets.

Feedback: All presenters and poll respondents will use the official products (Poll Questions 6 and 7). Web services may be used for testing and validation.

Do you have any additional questions or comments?

Feedback:

The OGC WG's should ensure that file naming is meaningful and follow a common standard; this could also be developed through the geodetic registry working groups.

Will the static and dynamic geoids come out in a common grid? GEOID2022 is already supported in some software.

Will GGXF have interpolation methods specified? These need to be used to compare with NGC/CGS calculations. Registers can also specify interpolation methods.

- ➢ GGXF has the ability to optionally specify the required interpolation method (bilinear, spline, biquadratic)

Geodetic algorithms will have to be adapted for efficiency on large datasets (e.g. projections and transformations). Software will specify which are used.

6. Summary

With a combination of structured format and open discussion, summit participants were able to communicate their readiness and requirements for reference frame modernization in 2025. Based on these discussions, NGS and CGS feel confident that software developers will be able to make tools for dynamic datum transformation available to clients for 2025 if standards and products are available sufficiently in advance. The following opportunities, concerns, and recommendations were drawn from this event.

Opportunities include:

- Ongoing communication between NGS/CGS and the geospatial software community.
- NGS and CGS can seek to influence and keep abreast of the development of gridding and deformation model standards through participation in the OGC Coordinate Reference System (CRS) Domain/Standards Working Group (DWG/SWG).
- NGS & CGS should encourage development of open source libraries of tools for time-dependent coordinate transformations and transformations between new and existing gridding standards.

Concerns include:

- Timely availability of alpha and beta products from NGS/CGS for software development and testing, including the Intra-frame deformation models (IFDM).
    - NGS and CGS plan to use a phased roll out approach for their NATRF2022 and NAPGD2022/CGVD2023 products. The roll out of deformation models is expected to be progressive; early versions may not make use of the full complexity available in standards such as the DMFM. Complex models may be available for test purposes.
- Agreement on common grid formats and model representation standards for the delivery of products from both NGS and CGS.

- NGS/CGS recommended interpolation methods may not be applicable for large datasets processed by geospatial software users.

Recommendations:

- CGS and NGS should continue to communicate phased roll out plans.
- CGS and NGS should agree on common gridding and deformation model standards.
- CGS and NGS should communicate the release of standards specifications.
- CGS and NGS should work on making test data sets available.
- CGS and NGS should hold another event in 2024 for summit participants and other industry partners.

Appendix 1 - Summit Agenda

Binational Geospatial Software Developers Summit:
Implementation of CSRS and NSRS Modernization

November 30 & December 1, 2022
Agenda

Day 1: NGS & CGS Plans (4 hours)

1. Welcome and Introductions: Summit Goals and Overview (10 minutes) Juliana Blackwell and Calvin Klatt

2. NGS & CGS: Overview of NSRS and CSRS Modernization (30 minutes) - Dru Smith and Catherine Robin
    a. Product Overview
    b. Consistency across the Border and with International Standards
    c. Timelines, Sequencing, Roll Outs
    d. Challenges (e.g. Adoption Plans & Regulatory Dependencies)

3. Update on Frame Definitions (20 minutes) Philip McFarland (Start ~12:40pm)
    a. Global Consistency through Ties to ITRF
    b. Euler Pole Parameter Studies

4. CGS & NGS: Dynamic Geometric Reference Frames (45 mins) Michael Dennis & Catherine Robin (Start ~1pm)
    a. The NGS IntraFrame Deformation Model - (10 mins)
    b. Canadian Deformation (Velocity) Model — Lessons Learned (10 mins)

Break (30 minutes) Start Break ~1:20-30

c. GGXF - Kevin Kelly (10 mins)
d. DMFM - Richard Stanaway (15 mins) (2:45 pm Eastern)

5. NGS & CGS: Products, Tools & Timelines (75 minutes) - Dru Smith and Brian Donahue
   Including: Transformation Tools; Networks & Coordinates; Common Geoid; Projections; New OGC Grid Formats.

   Wrap up with Summary table of products and timelines
   Questions (30 minutes)

Binational Geospatial Software Developers Summit:
Implementation of CSRS and NSRS Modernization
Day 2 Agenda - December 1, 2022

Day 2: Software Developers plans and requirements (2.5 hours)

1. Welcome and Review of Day 1 (5 min) - Galen Scott

2. Address Remaining Questions from Day 1 (15 min)

3. Discuss Summary Table of Products and Timelines & Open Questions (30 Min) - Dru Smith and Brian Donahue

4. Brief Presentations by Industry Representatives (60 min)
   - PROJ - Even Rouault
   - ESRI - Kevin Kelly
   - Trimble - Chris Pearson

5. NGS & CGS Questions & Discussion (30 min)

6. Wrap up and Next Steps (10 minutes)

Close

Appendix 2 - Summit material

Session presentations are available here:
https://cgrsc.ca/natrf-2022-landing-page/natrf-2022-webinars/canada-u-s-geospatial-software-developers-summit/

Recordings of the event will be made available online by NGS.

Appendix 3 - Poll Question Results

STANDARD

NGS & CGS Binational Geospatial Software Developers Summit

Thursday, Dec 01, 2022 11:31 AM EST - 03:08 PM EST

Polls | Survey | Q&A

DOWNLOAD

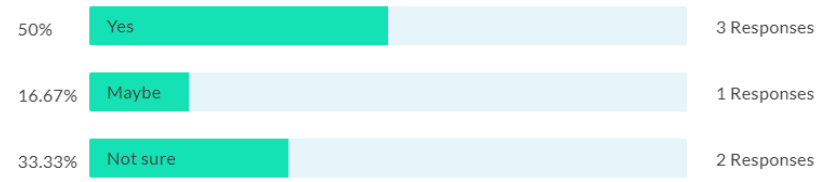
7	28	26 %
Poll questions	Attendees	Avg. Response Rate

Search poll questions or answers

1 of 7. Will your company be ready to implement a deformation model for epoch transformations when NATRF2022 is released in 2025?

6 of 28 Attendees responded

Multiple choice with single answer



2 of 7. Do you plan to adopt the GGXF grid format once it is available from OGC?

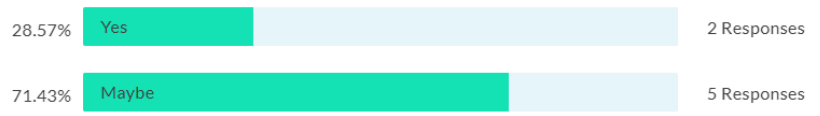
8 of 28 Attendees responded

Multiple choice with single answer

3 of 7. Will you adopt Deformation Model Functional Model (DMFM) standard for representing deformation models in the GGXF grid format?

7 of 28 Attendees responded

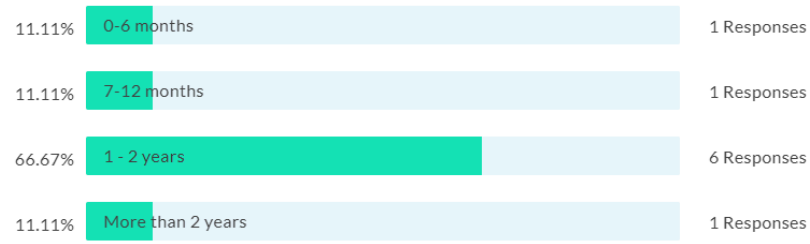
Multiple choice with single answer



4 of 7. How long do you estimate it will take your company to make GGXF and DMFM tools available to your users?

9 of 28 Attendees responded

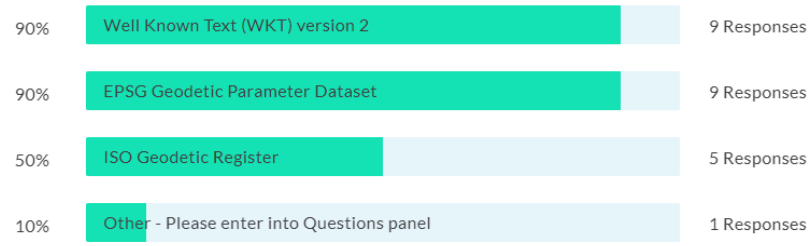
Multiple choice with single answer



5 of 7. What format should be used for projected coordinate reference system definitions?

10 of 28 Attendees responded

Multiple choice with multiple answers



6 of 7. Should we provide access to official products (such GGXF grids and transformations) to perform the computation in your software?

8 of 28 Attendees responded

Multiple choice with single answer

7 of 7. Do you plan to use NGS & CGS web services to perform calculations on official GGXF / DMFM grids & transformations?

9 of 28 Attendees responded

Multiple choice with single answer