Science On a Sphere Program Partnership Plan

Principal and Co-Principal Investigators

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Approval Page

Science on a Sphere Program Partnership

Transition Plan

The below parties, by providing signatures, approve of the transition plan outlined in this document, which may be periodically reviewed and updated as needed.

It is acknowledged herein that transition projects have a specific set of performance metrics, milestones, and other gate conditions that must be achieved to advance the proposed capabilities into operations. Operational implementation of these new capabilities are subject to successful completion of the described research, development, and/or demonstration, review and approval through appropriate end user NOAA Line Office governance procedures, and availability of funding. Short of meeting these conditions, the transition project could be considered for divestment. Divestment from a transition project can occur in several ways, including termination of the project or transfer of the project to an extramural partner.

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*Consult NAO 216-105B and check with the relevant Line Office (LO) for appropriate transition stage signatures. Until a project matures, new R&D efforts may only require approval from a division chief or other resource manager, who may serve as both the R&D and receiving LO transition manager. R&D LO signature lines and columns (above) may be omitted, as necessary, if the transition activity occurs internally within a single LO.

1.   Purpose/Objective

The purpose of this Research to Operations Transition Plan is to describe an approach for transitioning the Science on a Sphere program from a research platform to a long-term sustained programmatic capability within the NOAA/Office of Education (OEd).

2.   Research background

SOS was originally developed by the NOAA Forecast System Laboratory (FSL) beginning in about 1999. The SOS concept was the vision of Dr. Sandy MacDonald, the Director of FSL, who saw the globe as an outreach tool to broaden scientific understanding of the Earth through a more realistic presentation than just a flat map. There were other global projection systems, both internal and external, that existed at the time, but they had significant shortcomings in flexibility, resolution, interactivity, and content. The system that was developed for SOS used the latest available technologies to provide an exhibit that was cutting-edge, flexible, beautiful, and intriguing to view.

Since that time, the SOS program has grown its reach worldwide with over 170 installations and dozens of temporary exhibits. The SOS program has expanded beyond the original global projection system through the development of the SOS Explorer desktop and mobile application, a website, and social media presence that garner tens of thousands of visits per week. Through these activities, NOAA science reaches millions of people each year across the world.

3.   Capabilities and Functions

3.1   Current capability

The SOS Program consists of 5 components.

Science On a Sphere® (SOS) is a dynamic, interactive and evolving room-sized spherical display system developed at NOAA that consists of a multifaceted ecosystem of (1) software, (2) visualizations, (3) exhibits, (4) education, (5) collaboration, and (6) tools to create content and presentations. Each part of this ecosystem is intricately related to the other, and forms the basis of an innovative, rich technology system that interfaces directly with the general public all around the world in a unique way to make advancements in Earth-system science education.

SOS Explorer® (SOSx Exhibit) is a flat-screen virtual globe that is more accessible - smaller and less expensive - than its counterpart, SOS, allowing datasets that used to be available only on a 3D room-sized display system now viewable on a laptop, desktop or touchscreen display. SOSx Exhibit also displays datasets that extend beyond the surface of a globe which is not possible on SOS.

SOS Explorer® Mobile (SOSx Mobile) is a free mobile app version of the SOSx flat-screen virtual globe, allowing datasets that used to be only available at museums now viewable from your very own tablet or smartphone.

The SOS Data Catalog is provided free to the public and any other interested parties. The Data Catalog currently includes over 550 data sets, of which 43 are real time, and 98 are narrated movies. There are also 56 scripted presentations created by scientists and educators, along with 19 SOSx-only tours and datasets. These data sets are used widely by not only the SOS network, but also by other Federal agencies, private sector users, the general public and systems similar to SOS like OmniGlobe and Magic Planet. Many private sector entities that use our Data Catalog include Omniglobe, Magic Planet, Pufferfish, and Evans and Sutherland.

The SOS Website hosts a wealth of information about the SOS program.   This includes system information such as user manuals, video tutorials and how-to guides. The website hosts the SOS Data Catalog which is easy to search to learn more about the various datasets available for display on SOS, SOSx, and SOSx mobile. The Data Catalog provides a playlist builder capability for creating presentations from a web browser and an interactive virtual sphere used to preview datasets from the web browser. A significant resource within the website is educational resources providing lesson plans, ideas, and other information to construct learning modules around NOAA science and data sets available through Science on a Sphere.

3.2   Education and Funding Activities

Post Transition Responsible Organization: NOAA/OEd

A. Funding and advocacy for SOS program

OEd is a long term supporter and advocate of the SOS Program. Through several grants, OEd helped support the early installations of SOS systems. For the SOS program to be viable, long term stable funding is needed to support the overall program. As part of this agreement, OEd will seek to secure and distribute the necessary funding annually to support the efforts outlined in this document. OEd will continue to advocate for the SOS program across NOAA.

B. Community and education engagement

The SOS User's Collaborative Network was started by OEd in collaboration with GSL and is composed of institutions who use SOS in an educational setting. The vast majority of SOS exhibits are in educational settings. The Network serves as a forum for sharing information on the creation of new content, technical improvements, and evaluations. OEd maintains this Network and hosts periodic workshops to help engage this community. As part of this agreement, OEd will continue the following activities:

- Maintain and support this connection to SOS User's Collaborative Network and other learning communities,
- Identify the needs of these communities that drive dataset development and technology development.
- Manage and maintain User Collaboration Networking engagement and meetings.
- Support education goals of users
- Ensure the needs of the Network inform the research team's efforts.

3.3   Operational and development activities

Operational and development activities consist of services and capabilities which interact directly with end users. End users include SOS and SOS Explorer installations, SOS User Network, distributors, and potential new sites or distributors.

Post Transition Responsible Organization: OEd

A. Site support for SOS and SOS Explorer installations

Prior to March of 2020, SOS was installed at sites through two different mechanisms. NOAA/GSL established a Memorandum of Understanding (MOU) process directly with end parties where NOAA/GSL was responsible for the installation, and site support for 5 years from the date of the agreement. The second mechanism is through MOU's with distribution partners who directly handle the installation and support for the site. Distributors decide on their financial support model and are responsible for handling support for all of their SOS sites. Since March of 2020, all installations are now handled through the latter method using our distribution partners worldwide. Support to user sites consists of:

- On-line and over-the-phone support to SOS and SOSx installation sites worldwide
- Assistance with:
    - software upgrades to the systems,
    - data delivery issues,
    - systems operations
    - advice on hardware and software upgrades and issues.
- 2nd Tier support for distributors unable to resolve software related issues

There is no formal support for the SOSx Mobile application. Support is typically handled by the community. This activity can be expanded in the future

B. Data management, distribution, and catalog

The SOS Data Catalog consists of 550 data sets, of which 43 are real-time. SOS datasets are used widely by most known spherical display systems, many semi-spherical displays, flat panel systems, and planetarium systems (e.g., Pufferfish, Omni Globe, DigiGlobe). NOAA's SOS provides content to users from many sources beyond GSL.

Some key data providers include NOAA/NESDIS, NASA, USGS, universities, and the museums that have SOS. Historically, everything that has gone into the SOS Data Catalog has been vetted by the SOS team with assistance from subject matter experts. Moving forward, the operations/development team will continue this effort and ensure datasets are scientifically correct, are functional and understandable, and that real-time datasets are consistently delivered.

The SOS Data Catalog requires the following activities:

- Manage real-time data ingest from various data sources
- Manage real-time data processing creation and blending of products

- Manage data delivery services to external partners via FTP and HTTPS protocols
- Manage intake of new datasets to SOS Data Catalog
- Manage SOS Explorer datasets and tours hosted on AWS Cloud Services and Vimeo.

C. SOS website and social media presence

The SOS program has a very popular web and social media presence, with hundreds of thousands of facebook followers, and thousands of website views per week. The SOS website allows for an interactive virtual globe display of SOS datasets for any interested user via the Internet as well as a playlist builder for presenters. The SOS website contains manuals, user guides, and how-to videos for managing local SOS installations. The website hosts educational content that assists educators in using the data catalog

Activities include:

- Manage, update, and maintain SOS website (includes hosting website content)
- Manage and maintain the SOS social media presence

D. Software maintenance

Periodic software maintenance is required to fix issues reported by users, or improve the code, its capabilities, or performance related faults. Software maintenance is needed to keep the software functioning, easier to maintain, and to preserve its capability over time. Software maintenance activities of the SOS program include the following:

- Maintenance and bug fixes of the SOS applications:
    - SOS, SOSx, and SOSx Mobile software
    - SOS Remote iPad App
    - Visual Playlist Editor
    - SOS Kiosk
    - Localization across applications (i.e., support for non English languages and other changes necessary for use of software in non U.S. locations)
- Maintenance necessary to keep up with hardware, software, and OS updates.
- Maintenance of Code Protection hardware and software using Wibu CodeMeter and encrypting software (may not be needed depending on future software model)

E. Software development of feature enhancements

Development of new software features and capabilities for the SOS program are required to keep the program relevant, enhance the user experience, and to continue to maximize the ability of the system to support education goals of users. Feature development and enhancements are guided by two efforts, (1) the operations/development team will stay abreast of the availability of new technology opportunities, innovative visualization techniques, and new kinds of scientific education content, and (2) feedback from

SOS sites through workshops and other discussions about what features would further help their technical and educational use of SOS.

Activities include:

- Development of new features and capabilities as advised by collaboration and feedback from User Network
- Development of tools and capabilities to better communicate the environmental impacts associated with the datasets.
- Improve user experience and interaction with SOS programs and applications through user research activities coordinated with SOS User Network
- Delivery of new features and software releases to end users.

F. Education and content curation

The SOS program has a strong tie to both formal K-12 education and informal education of the general public. The SOS program has developed content to assist installations in their education and outreach efforts. This includes several efforts to make SOS and SOSx more accessible to formal education through the creation of lesson plans and phenomena-based learning modules that teachers can use in association with a visit to a local SOS institution. These efforts provide valuable opportunities to link NOAA science and observations to environmental impacts, and provide tools for formal and informal education about NOAA missions and activities. Part of this effort includes the curation of new content expanding the capability and communication themes around the SOS program. Activities required as part of this effort include:

- Working with User Network and other education grant opportunities to assist teams conducting education research on data visualization using SOS products.
- Expand lesson repository for both SOS and SOSx applications
- Work with Subject Matter Experts to develop new content and stories around existing content for distribution through the SOS program.
- Curation of content for the SOS program from NOAA, SOS sites, and other interested parties.
- Sustain existing methods of allowing users to discover what others are doing and share what they are doing in education (e.g., Ed forums and SOS User workshops)

G. Agreement and distributor management

Through MOU's between NOAA and distributors, the SOS program authorizes distributors to install and maintain SOS on behalf of NOAA. MOU's are typically 5-year agreements and are with both domestic and international/foreign parties. As of the date of this document, NOAA GSL has active agreements with 7 distributors. Agreement management requires the following activities:

- Manage, maintain, establish new, and renew MOU agreements with distributors as necessary.
- Train distributors annually on new features and capabilities of the SOS program.

- Track new distributor installations, collecting reimbursable money, and distributing software keys required to run SOS System software as necessary.
- Pass along inquiries for new installations to active distributors.
- Ensure distributors maintain quality of SOS installations and upkeep of software and support to their sites.

H. Project Management

Project Management oversees the entire SOS program. From managing staff associated with the program, setting development priorities, leading collaborations, and ensuring research to operations transition occurs. Project management activities include the following:

- Team personnel oversight
- Prioritization and direction of program
- Promote the program within and outside of NOAA.
- Develop collaborations with other similar entities.
- Lead SOS Users Collaborative Network
- Manage collaboration with OAR/GSL.
- Ensure research to operations transitions occur.
- Travel approval (for CI employees) and support

I. IT support

To support the data management, processing, and delivery, the SOS program maintains a number of systems and/or Virtual Machines (VMs). System administration is necessary to support the underlying network and systems needed for the SOS program. IT support activities include the following:

- Manage underlying network infrastructure
- Maintain OS through patching and rebuilding of systems as necessary

(note -- this activity currently leverages existing staff shared with other projects across GSL)

J. Program Administration and Physical Support

Administrative staff are needed to help with day-to-day needs of the program, assisting staff with clerical and administrative needs. Administrative staff will support the following activities:

- Support staff on purchasing needs, and other related program activities
- Support property management
- Support and manage office space and phone numbers

(note -- this activity currently leverages existing staff shared with other projects across GSL)

3.4   Research Activities

Post Transition Responsible Organization: NOAA/GSL

A. Visualization, Information System, & Data Delivery Research

Since the inception of the SOS project, GSL and its predecessors have made and continue to make significant technological advances in visualization, information system, and data-delivery capabilities to support communication, understanding of science, education, and outreach activities. Research activities include the development of new technology, software, and software methods, to not only improve the usefulness, performance, and quality of the SOS experience, but also improve the efficacy of the SOS dataset library. Research ensures the SOS program stays current with the latest in visualization technology, data delivery, human/computer interactions, and user experience demands. Each of these areas has potential applications across NOAA and could take years of work or technology growth before they are ready for prime-time. Research enables the team to investigate these technologies in a low-risk environment for an audience that can tolerate risk without threat to the operational aspects of the program.

Activities include:

- Foundational Research into new technologies, user experience designs, human/computer interaction towards advancements in visualization, information systems, and data-delivery capabilities.
- Application of research towards advancements in visualization, information systems, and data-delivery capabilities.
- Delivery of new capabilities to operations/development team for refinement into operational capability
- Regular interaction with the SOS operations/development team to ensure user feedback is provided to the research team.
- Attend SOS User Network Workshops to understand how the field is evolving.

4.   Transition Activities

Transition activities will be tracked and reported into NRDD.

4.1   Transition of responsible party of existing SOS distributor MOU's to NOAA/OEd

This activity will create new or modify existing distributor MOU agreements to change the responsible party from GSL to NOAA/OEd engaging NOAA Technology Partnerships Office as necessary to assist with new agreements.

4.2   Transition of responsible party of existing SOS Site Support MOU's to NOAA/OEd

This activity will amend existing SOS and SOSx Site Support MOU agreements modifying the responsible party from GSL to NOAA/OEd.

4.3   Re-align Cooperative Institute staff for SOS Operational and Development under NOAA/OEd

Staff will remain with existing Cooperative Institutions and within the NOAA DSRC facility, but realign under NOAA/OEd. Part of this activity includes the need to identify office space or create an agreement with GSL to remain in current offices.

    a. Establish Funding Mechanism and Requirements between OEd to GSL

        For OEd-associated staff, funding will consist of two phases. In year 1, (2022), pending availability of funds, OEd will fund all OEd SOS program staff through GSL. In the following year (2023), the CI grants will be expanded to allow OEd to directly fund CI staff on the SOS program. OEd will directly fund OEd SOS program staff through this new agreement. OEd will continue to fund GSL SOS Program staff directly through GSL.

    b. Establish Agreement to Rent Office Space in DSRC for OEd CI Staff

        OEd associated staff will remain in the DSRC. This activity is to establish an agreement with GSL to procure and fund office space within DSRC for OEd associated staff.

4.4   Transition of Data Management, Ingest, Processing, and Delivery Software (i.e. Data Catalog) to NOAA/OEd

        This activity will also transition in phases over two years. In year one (2022), subject to the availability of funds, OEd will pay OAR/GSL overhead to cover the historic support OAR has provided for hosting the data catalog while the operations/development team identifies and implements a new mechanism to host these processes outside GSL. In year two (2023), OEd will have transitioned hosting the data catalog outside of OAR. Two options will be explored, they are:

        Option 1 - Cloud Based Data System

        SOS staff will migrate data management, ingest, processing, and delivery software to use cloud services. As part of this activity, NOAA/OEd will contract cloud services necessary for transition.

        Option 2 - On-Premises Data System

        SOS staff will migrate data management, ingest, processing, and delivery software to an operational data facility under NOAA/OEd management. SOS staff will identify hardware needs, and as needed NOAA/OEd will acquire necessary hardware.

4.5   Transition of SOS website to NOAA/OEd

Move content and hosting of SOS website to NOAA/OEd hosted system or cloud services. The current site uses 11ty (https://www.11ty.dev/)

4.6   Develop Joint Software Development Process to Support Operations, Development, and Research Activities.

GSL and NOAA/OEd will develop a process to support joint software development across Operations, Development, and Research activities related to the SOS program, including continual transition of new capabilities. This will include communication between research and operations, how to manage the codebase allowing bug fixes, implementation, and tracking research activities and to create software releases to the operational side for delivery to distributors and end users.

5.   Milestones and deliverables

Activity	Completion Date
5.1 Existing distributorship MOU's are reassigned to NOAA/OEd (4.1)	October 2021
5.2 Existing Site Support MOU's are reassigned to NOAA/OEd (4.2)	October 2021
5.3 Joint Software Development plan between GSL and NOAA/OEd is established (4.6)	October 2021
5.4 Cooperative Institute for SOS operational and development activities is re-aligned under NOAA/OEd -- Establish Funding Mechanism and Requirements between OEd to GSL (4.3a)	October 2021
5.5 SOS website migrated to NOAA/OEd (4.5)	March 2022
5.6 Cooperative Institute for SOS operational and development activities is re-aligned under NOAA/OEd -- Establish Agreement to Rent Office Space in DSRC for OEd CI Staff (4.3b)	July 2022
5.7 Data management, ingest, processing, and delivery software (i.e. Data Catalog) migrated to NOAA/OEd (4.4)	June 2022

6.   Acceptance Criteria for Transition

The following acceptance criteria will be used to evaluate when the transition is complete:

- OEd is the responsible organization for all SOS and SOSx MOU agreements with the distributors
- OEd is the responsible organization for all existing SOS and SOSx Site MOU agreements for support
- OEd performs all end-user facing activities including but not limited to:
  - Provide support and troubleshooting for SOS and SOSx Sites installed by NOAA
  - SOS, SOSx, and SOSx Mobile software maintenance, releases, and updates.
  - Data Catalog hosting, maintenance, and updates
  - SOS Website hosting, maintenance, and updates
- OEd directly supports SOS staff performing operational and development activities

7.   Roles and Responsibilities

OEd and GSL will continue to collaborate to ensure information is shared between the operations/development and research efforts. GSL will have a reduced role in the SOS program moving forward and the focus of the effort will be on research that may benefit the SOS program. OEd will take over as the primary manager of the overall SOS effort including operations and development. Subject to availability of funds, OEd will support the project through BOPs to OAR/GSL (in FY22) and through NOAA's existing and newly established cooperative agreements with NOAA CIs. OEd will also provide the management oversight of the funding provided to the cooperative institutes.

7.1   NOAA/OEd role

- Education and Funding Activities
  - Seek and receive funding for the SOS Program.
  - Distribute funds to LOs supporting effort.
  - Continue to advocate for the program within NOAA.
  - Coordinate SOS program with GSL to achieve common goals.
  - Maintain connection to informal learning community
  - Continue to support the SOS users network and education programs.
- Manage operational aspects of SOS program
  - Manage operational data flow, process incoming data, deliver to SOS sites (i.e., Data Catalog)
  - Support SOS sites and SOS User Network (Help Desk, Bug Fixes, Minor Enhancements)
  - Maintain and deliver software releases and updates to SOS sites.
  - Establish and manage MOUs with distributors
  - Maintain and update SOS website
  - Provide training to distributors on conducting SOS site installation and customer instruction on operating SOS and custom content
- Manage development aspects of SOS Program
  - Implement new features and capabilities for SOS, SOSx, SOSx Mobile based on user

needs

- ○ Gather end-user feedback and requirements through the User network workshops and other meetings.
- ○ Implement necessary maintenance and improvements as hardware and OS evolve
- ○ Maintain and manage SOS, SOSx, SOSx Mobile code base.
- ○ Evaluate, test, approve, adapt, and incorporate research software and datasets contributed by the GSL research team for use in production systems (i.e., Research to Operations transfers)
- ● Support and manage OEd staff through the Cooperative Institutes

7.2   NOAA/GSL

- ● Research Activities
  - ○ Foundational and applied research on visualizations and related technologies that support SOS programs and GSL's visualization goals.
  - ○ Research on applications, technologies, and tools enhancing understanding of complex scientific phenomena and education capabilities.
  - ○ Coordinate with Office of Ed on requirements and priorities for future software functionality and technology advances
  - ○ Contribute features and enhancements to shared code base managed by OEd
  - ○ Transition new technologies to Operations.
- ● Facilities and Staffing
  - ○ Manage and maintain SOS in DHPT installed at GSL, including hardware, software, and network support.
  - ○ Allow operations, research, and development staff to continue to use SOS in GSL as an experimental platform to test new capabilities and features.
  - ○ Develop an agreement with NOAA/OEd for space within DSRC for co-located staff, including support for hardware, networking, and administrative support.
  - ○ Support and manage GSL research staff through Cooperative Institutes.

8.   Budget Overview

8.1   Pre-Covid Cost of Current System

Funded through reimbursables from GSL distributor MOU agreements, GSL site installations, and GSL base allocation.

Organization	Staffing	Total Costs
Cooperative Institute (CIs)	5.8	$1,336,689
Federal	1.3	$360,000

Total Program Costs	**7.1 FTE**	**$1,696,689**

8.2 Cost of transition

The transition cost provided in this section is subject to availability of funds.

FY22 Budget Estimate

Managing Organization	**Staffing**	**Total Costs**
NOAA/OEd (CIs)	4.3 FTE	$834,000
NOAA/OEd Hardware/Admin/Misc*		$73,000
GSL (OEd funded CIs/Fed)	1.5 FTE	$393,000
GSL (CIs/Fed in kind)	1.0 FTE	$250,000
Total Program Costs	**6.8 FTE**	**$1,550,000 (including $250K in-kind)**

*Identification of, or purchase of new hardware or cloud services to support SOS website, Data Delivery, and software releases needed $73 K.

Reduction in staff is because a full time web developer is no longer needed, as migration will be complete at the end of FY21.

9.   Risks and Mitigation

9.1 Funding Stability

Previously the program was majority funded with external revenue from SOS installations and software support services fees. Based on the recommendation of DUS Ben Friedman, NOAA is seeking to provide funding to support the program long-term. However, at this time, a definitive funding mechanism is not in place. OEd and NOAA Leadership were successful in having a new budget request included in the FY22 President's Budget. Funding through the direct bill process is also being pursued as a back-up option to appropriation funding. A decision will be made about the direct bill by September 1, 2021.

9.2 Existing staff may not agree to transition

Existing staff are aware of upcoming potential changes, however may not agree to transition with the program to NOAA/OEd. In the event this happens, new hires would be required and can be trained by remaining staff.

9.3   IT Support for data catalog and other server needs

IT support for staff offices is not at the level it is for line offices, especially for supporting data services. It is possible that OEd may not be able to be the long-term host for the data catalog and other similar needs due to insufficient IT infrastructure and support. This issue will be examined during FY22 and if needed, other line offices will be approached to serve as hosts.

9.4   On-going technical support for SOS and SOSx sites

With the adoption of a new model whereby all SOS and SOSx installations will be handled by distributors, it is not clear how technical support will be provided once the site-based agreements with the distributors expire. Historically NOAA has provided in-kind support to nearly all users. We will need to assess if the operations/development team can continue to provide this support (from a workload perspective) and if so, what ramifications there may be for distributors.

10.   Period of Agreement and Modification/Termination

This agreement will become effective when signed by all parties. The agreement may be amended at any time by mutual consent of the parties. The parties will review this agreement at least once every two years to determine whether it should be revised, renewed or canceled.

Any party may terminate this agreement by providing 180 days written notice to the other party. All commitments described in this agreement are subject to the availability of funds.