Engagement and Performance Operations Center (EPOC)

(Formerly known as ReSEC)
NSF Award #1826994
Year 2 Quarter 2 Report
1 July 2019 through 30 Sept 2019
PIs: Jennifer Schopf (IU), Jason Zurawski (LBNL), Dave Jent (IU)

Summary

The goal of the EPOC project is to provide researchers and network engineers with a holistic set of tools and services needed to debug performance issues and enable reliable and robust data transfers. It supports five main activities: Roadside Assistance and Consulting, Application Deep Dives, Network Analysis using NetSage, the provision of Managed Services, and Training. In Year 2 Quarter 2, highlights include the publication of the Deep Dive report for Arcadia University, eleven invited presentations, and consultations with members of each of our Regional Networking Partners.

1. EPOC Overview

The Engagement and Performance Operations Center (EPOC) is a production platform for operations, applied training, monitoring, and research and education support. EPOC is a collaborative focal point for operational expertise and analysis and is jointly led by Indiana University (IU) and the Energy Sciences Network (ESnet). EPOC provides researchers and network engineers with a holistic set of tools and services needed to debug performance issues and enable reliable and robust data transfers. By considering the full end-to-end data movement pipeline, EPOC is uniquely able to support collaborative science, allowing researchers to make the most effective use of shared data, computing, and storage resources to accelerate the discovery process.

EPOC supports five main activities:
- Roadside Assistance and Consulting via a coordinated Operations Center to resolve network performance problems with end-to-end data transfers reactively;
- Application Deep Dives to work more closely with application communities to proactively understand full workflows for diverse research teams in order to evaluate bottlenecks and potential capacity issues;
- Network Analysis enabled by the NetSage monitoring suite to proactively discover and resolve performance issues;
- Provision of Managed Services via support through the IU GlobalNOC and our Regional Network Partners;

● Training to ensure effective use of network tools and science support.

This report details the staffing, collaboration, and focused work in each of the five activities in Year 2 Quarter 2.

2. Staffing and Internal Coordination

At the end of Quarter 1, funded project staff consisted of:
- Jennifer Schopf, IU, PI - overall project director
- Hans Addleman, IU, Roadside Assistance and Consulting Lead
- Dan Doyle, IU, system architect - measurement and monitoring
- Heather Hubbard, IU, project coordinator
- Ed Moynihan, IU, Science engagement support
- Doug Southworth, IU, Partner coordination and deep dives

At IU, Dave Jent is a co-PI, but due to his position at IU is unable to formally charge the project. During the quarter, Scott Chevalier joined the project to help with science engagement and training.

At LBNL, the process for Zurawski to formally charge for his time was finally completed. In addition, LBL added an additional staff member to contribute .1FTE on a monthly basis: George Robb. George will contribute to the Managed Services efforts.

At the end of Quarter 2, funded project staff included:
- Jennifer Schopf, IU, PI - overall project director, Measurement and monitoring co-Lead
- Jason Zurawski, LBNL, co-PI, Deep Dives and Managed Services Lead
- Hans Addleman, IU, Roadside Assistance and Consulting Lead
- Scott Chevalier, IU, perfSONAR support and Managed Services
- Dan Doyle, IU, system architect - Measurement and monitoring co-Lead
- Heather Hubbard, IU, project coordinator
- Ed Moynihan, IU, Science engagement support
- George Robb, LBNL, Managed services support
- Doug Southworth, IU, Partner coordination and deep dive support

The EPOC staff coordinate internally via four primary mechanisms:
- Synchronous and asynchronous communication via an email mailing list and Slack workspace;
- Project management via shared Trello (digital KanBan board) to track ongoing projects, requests, and record outcomes;
- Weekly project management calls to update the Trello infrastructure and triage new requests; and
- Twice yearly All Hands Meetings for face-to-face discussion on important strategic topics.

EPOC internal partners meet twice a year at Face-to-Face All Hands Meetings to discuss strategic goals, address more complicated topics that cannot be addressed in a phone call, and to plan for the upcoming 12 months. The second EPOC All Hands Meeting was held on August 27-28, 2019, in Bloomington, IN. Topics discussed in detail included evaluation of internal roadmap for the remainder of 2019 and 2020, communication strategies, meeting participation and priorities for travel, updates to Managed Services, and strategic goals for Project Year 2 and Year3. EPOC anticipates holding another all hands meeting in February or March, 2020.

3. Collaboration and Travel

EPOC staff participated in various meetings to support ongoing deployment, collaboration, and training. Note that several of these were funded by other sources but relevant to EPOC. The travel for Year 2 Quarter 2 included:

- Zurawski and Schopf attended the NOAA N-Wave Technical Workshop in Boulder, CO, on July 9-11, 2019, https://noc.nwave.noaa.gov/nwave/public/events.html. Both gave talks related to EPOC initiatives and assisted a running panel featuring NOAA site coordinators.
- Moynihan attended the Earth Science Information Partners (ESIP) Summer Meeting in Tacoma, WA, on July 16-19, 2019, https://2019esipsummermeeting.sched.com/info. He presented a poster on science engagement and efforts to support US researchers collaborating internationally. He spoke with scientists from NASA, NOAA, and other science agencies and institutions about their networking requirements and their data transfer needs.
- Zurawski attended the Spring 2019 ESnet Site Coordinators Meeting (ESCC), in Berkeley, CA, on July 16-18, 2019. He gave a talk on EPOC and participated in a roundtable discussion on science engagement.
- Zurawski attended the Training Workshop for Network Engineers and Educators on Tools and Protocols for High-Speed Networks and Cybersecurity in Columbia, SC, on July 22-23, 2019, http://ce.sc.edu/cyberinfra/workshop.html. He gave multiple talks on EPOC technologies and initiatives.
- Zurawski attended PEARC19 in Chicago, IL, on July 29-August 2, 2019, https://www.pearc19.pearc.org/. He gave a training workshop on EPOC Deep Dives and also participated on a panel regarding NSF centers in cyberinfrastrucure.
- Zurawski attended the Navajo Tech University Technical Meeting (NTUStar) in Tempe, AZ, on July 31-August 1, 2019, https://sites.google.com/navajotech.edu/navajotech-cc/ntustar-technical-meeting. He gave multiple talks on EPOC technologies and initiatives.
- Moynihan attended the Large Synoptic Survey Telescope (LSST) Global Networking Workshop and the TICAL meeting in Cancun, Mexico, on September 2-5, 2019, http://tical2019.redclara.net. During this meeting there was discussion of how to support the LSST application as it transferred its data from South America to the archive at NCSA, and from there on to partner sites in the US and Europe.

- All members of EPOC attended the EPOC All Hands Meeting, in Bloomington, IN, on August 27-28, 2019. This event was used for planning for the next twelve months of the project.
- Zurawski attended a side meeting at the Texas Advanced Computing Center (TACC) in Austin, TX, on September 9-10, 2019, to discuss security related initiatives for EPOC.
- Zurawski attended the Southern Crossroads (SoX) Member Meeting in Atlanta, GA, on September 11-12, 2019, http://www.sox.net/events/fall2019/. He gave a talk on EPOC and participated in a roundtable discussion on science engagement.
- Schopf and Zurawski attended the CC*PI/National Research Platform/Quilt meeting in Minneapolis, Minnesota on September 22-26, 2019, https://www.thequilt.net/public-event/2019-nsf-nrp-and-the-quilt-workshops-and-meetings/. Zurawski ran a workshop on large scale data movement. Schopf ran a panel on science engagement and gave a lightning talk on the results of the EPOC Deep Dives to date. They also participated in the "Speed Learning" session, discussing ways for CI and IT staff to interact with researchers. Side meetings were held with many partners, including all of the Regional Networking Partners and most of the Infrastructure Partners.
- Moynihan attended the eScience and Science Gateways co-located meetings in San Diego, CA, on September 23-27, 2019, https://escience2019.sdsc.edu/. He presented a poster on science engagement and on our efforts to support US researchers. He also met with Science Gateways staff to discuss a potential MoU.

4. Presentations and Publications

1. Zurawski, J., Schopf, J.M., Addleman, H., and Southworth, D. *Arcadia University Bioinformatics Application Deep Dive*. Lawrence Berkeley National Laboratory Technical UCPMS report number 2568399, July 2019. Available online at: https://escholarship.org/uc/item/1196z33x.
2. Zurawski, J., "Demystifying the Science Requirements Review Process for Network Design and Use", Invited Talk, NOAA N-WAVE Technical Workshop, Boulder, CO, July 9, 2019.
3. Schopf, J.M., "Engagement and Performance Operations Center (EPOC) and NetSage", Invited Talk, NOAA N-WAVE Technical Workshop, Boulder, CO, July 10, 2019.
4. Zurawski, J., "Engagement Performance and Operations Center (EPOC) Overview", Invited Talk, Spring 2019 ESnet Site Coordinators Meeting (ESCC), Berkeley, CA, July 17, 2019.
5. Zurawski, J., "Cyberinfrastructure for Big Science Flows: Science DMZs", "End devices in Science DMZs: DTNs", and "Monitoring end-to-end systems: perfSONAR", Invited Talks, Training Workshop for Network Engineers and Educators on Tools and Protocols for High-Speed Networks and Cybersecurity, Columbia, SC, July 22-23, 2019.
6. Zurawski, J., "Demystifying the Science Requirements Review Process for Network Design and Use", Invited Talk, PEARC19, Chicago, IL, July 29, 2019.
7. Zurawski, J. & Schopf, J.M., "The Engagement and Performance Operations Center", Invited panel presentation, PEARC19, Chicago, IL, July 30, 2019.

8. Zurawski, J., "Best practice: Active Measurement, perfSONAR & Maddash", "ScienceDMZ overview Components: DTNs, intrusion detection (BRO)", and "Engagement and Performance Operations Center (EPOC)", Invited Talks, NTUStar Workshop, Tempe, AZ, July 31-August 1, 2019.
9. Zurawski, J., "Engagement Performance and Operations Center (EPOC) Overview, Invited Talk, SOX Member Meeting, Atlanta, GA, September 11-12, 2019.
10. Moynihan, E., "The Engagement and Performance Operations Center (EPOC)", invited poster presentation, eScience workshop, San Diego, CA, September 23-27, 2019. Available online at: https://drive.google.com/drive/folders/1XDEHbva_IDqQsEDmZ1fmn4m9cXoPOIXZ
11. Zurawski, J., "2019 Data Mobility Workshop", Invited Workshop, CC* PI Meeting/Quilt/NRP, Minneapolis, MN, September 23, 2019. Information available online at: http://fasterdata.es.net/performance-testing/2019-2020-data-mobility-workshop-and-exhibition/
12. Schopf, J.M., "How Regional Partnerships with National Performance Engineering and Outreach Initiatives are Enabling Science", Invited Panel, CC* PI Meeting/Quilt/NRP, Minneapolis, MN, September 24, 2019. Available online at: https://drive.google.com/drive/folders/1k0hlquL2ezWIODqb8x_Xf86b0dgNSGnn
13. Schopf, J., "EPOC Deep Dive Lessons Learned", Lightning Talk, CC* PI Meeting/Quilt/NRP, Minneapolis, MN, September 26, 2019. Available online at: https://drive.google.com/drive/folders/1G33qAqsX3odYgZohG2PUMI3eHIUOlED_

Throughout the report, we reference these documents and talks by the number listed here.

5. Project Coordination

EPOC has three types of partners: *Regional Networking Partners*, who are deploying the infrastructure EPOC supports and use their members for outreach for EPOC, *Infrastructure Partners*, who are themselves collaborations that support a variety of cyberinfrastructure (CI) services, and *Science Community Partners*, each of which represent a community of scientists.

5.A Regional Networking Partners

EPOC is partnered with the six regional network operators.
- **iLight** is the regional network for Indiana. EPOC staff met with ilight at the CC* PI meeting. A Deep Dive was held with Purdue University in May, 2019, and the report is expected to be available shortly. The iLight NetSage flow data deployment, http://ilight.netsage.global, was updated with the latest NetSage release. We also assisted iLight member Indiana University via a consultation this quarter.
- **Front Range GigaPop (FRGP)** is the regional collaboration of networks that cover the western states, including Colorado, Wyoming, Arizona, Idaho, Utah, and New Mexico. EPOC staff met with members of FRGP at the CC* meeting, at the NWAVE meeting. This quarter, we moved forward with the NetSage Tstat deployment at the NCAR Wyoming Data Center and began conversations for a NetSage flow data deployment for

all of FRGP. We continued discussions with the FRGP partners at Tribal College regarding the small perfSONAR testpoints we had shipped them in Project Year 1, in support of their initial MaDDash set up, online at http://ps00-ntu-cp-ccstar.itth.navajotech.edu/maddash-webui/index.cgi?dashboard=Dashboard%201. FRGP is in discussions with EPOC staff to see if it would make sense to work with the Tribal Colleges for a wider perfSONAR Managed Service deployment. We assisted NOAA in a consultation and are working with NCAR on a Roadside Assistance case.

- **The Lonestar Education and Research Network (LEARN)** is the regional network for Texas. We met with LEARN members at the CC* meeting and at TACC this quarter. We held a Deep Dive in May with LEARN member Trinity, with a report expected as soon as feedback is given. This meeting also resulted in a consultation session with Trinity, and EPOC also supported LEARN partners Texas A&M University (TAMU) and Prairie View A&M University (PVAMU) with consultations. Another Deep Dive is being planned with LEARN partner Baylor for December 2019. LEARN has stated an interest in deploying NetSage, but the timing has not yet been agreed on, although there is a NetSage Tstat deployment for the TACC data archives. LEARN continues to be interested (pending funding) in the Managed Services aspects of EPOC.

- **The Ohio Academic Resources Network (OARnet)** is the regional network for Ohio. The CEO for OARnet stepped down this quarter, and a new CEO has not yet been named, so most plans with OARnet are on hold until this position is filled. We met with several other OARnet staff members at the CC* PI meeting. EPOC staff led a Deep Dive at the University of Cincinnati in April, and are waiting on feedback to make the report public. We assisted OARnet members University of Cincinnati, Ohio State University, and Kent State University with consultations this quarter.

- **The Great Plains Network (GPN)** is the regional network that serves North Dakota, South Dakota, Nebraska, Iowa, Minnesota, Kansas, Missouri, and Arkansas. GPN was the first EPOC partner to have a NetSage SNMP deployment, and we continue conversations with them about next steps. GPN member KanRen is interested in a Managed Service deployment, and that conversation will continue next quarter. We led a Deep Dive training session at the GPN All Hands Meeting in May, and will have a draft report shortly. We continued work with GPN member Iowa State University for a Roadside Assistance case.

- **The Keystone Initiative for Network Based Education and Research (KINBER)** is the regional network for Pennsylvania. We led a Deep Dive at Arcadia University jointly with KINBER, and released that report in July [1]. One outcome of the Deep Dive is the possibility of deploying a perfSONAR Managed Service at Acadia, which will continue to be discussed in the next quarter. KINBER management have received agreement from their members to deploy a NetSage flow data deployment, and work will start on this in Quarter 3. KINBER members Arcadia and Duquesne worked with EPOC on consultations.

5.B Infrastructure Partners

EPOC's Infrastructure Partners are used to leverage different kinds of support offered by each group to expand the set of services available to the broader community. The current set of Infrastructure Partner organizations includes:

- **The Campus Research Computing Consortium (CaRCC)** is a consortium of over 30 campuses that facilitates access to cyberinfrastructure. Schopf is the main contact for this group. Conversations with CaRCC team members took place at the CC* PI meeting in September to ensure coordination between the groups.
- **Trusted CI: The NSF Cybersecurity Center of Excellence** supports cybersecurity for NSF funded projects. Addleman is the main contact for Trusted CI. Zurawski and Von Welch, the Trusted CI lead, spoke on a panel titled "Community Engagement at Scale: NSF Centers of Expertise" at PEARC19 [7].
- **Internet2** supports solving common technology challenges for their over 200 educational, research, and community members. Schopf is the main contact for this organization, and she met with Internet2 staff members at the CC* PI meeting. We have been accepted to present a session for the Internet2 Technical Exchange to take place in December with a focus on Roadside Assistance. We have also had accepted a submission for a BoF session on mid-level BGP administration to help address the routing issues that are now commonly being seen in NetSage.
- **The Quilt** provides a central organization for networks to share the best practices to support end user science. Zurawski is the primary contact for the Quilt, and has regular meetings. Aurawski served on the advisory committee for the Fall Quilt Members meeting, and with Schopf presented or moderated several sessions:
    - The Data Mobility Workshop and Exhibition [11]
    - A Session of "Speed Learning": "Starting a Conversation with the Scientific Community and Strategies to Increasing Adoption & Awareness"
    - A Panel entitled: "How Regional Partnerships with National Performance Engineering and Outreach Initiatives are Enabling Science" [12]
    - A lightning talk on EPOC's Deep Dives [13]

  A face-to-face meeting with Quilt leadership also took place where plans for the February Quilt Members Meeting were made, including a request for Deep Dive training. We also plan to host our next Regional Networking Partners meeting at the February Quilt Members Meeting.
- **The Science Gateway Community Institute (SGCI)** provides best practice recommendations and support for scientists building and using data portals. Moynihan is the contact for this group and presented a poster on EPOC [9] at their meeting in September. We are working with SGCI to create a formal partnership MoU that will outline our future collaboration.
- **The Extreme Science and Engineering Discovery Environment (XSEDE)** supports a single virtual system and CI expertise through the Campus Champions. Schopf is the primary contact for this group and plans to meet with members of the XSEDE leadership team at SC'19. Schopf also met with several members of the Campus Champions team at the CC* PI meeting to ensure coordination, especially for Roadside Assistance cases.

5.C Science Community Partners

EPOC Science Community Partners each consist of a collaboration of scientists, enabling us to scale our reach to larger community groups. The partners include:

- **The Earth Science Information Partners (ESIP)** is a consortium of over 180 members that provides a forum for the Earth science data and technology community. Moynihan is the primary contact point for this collaboration, and presented a poster [10] on EPOC at their Summer Meeting in July. We are looking into the feasibility of doing an EPOC deep dive workshop at a future ESIP meeting.
- **The World Climate Research Programme's International Climate Network Working Group (ICNWG)** supports thousands of scientists through using the Earth System Grid Federation's (EGSF) globally distributed climate data repository sites. Zurawski and Eli Dart, LBNL/ESnet, share the contact point for this group. There has been no significant activity for this group during the quarter.
- **The IU Grand Challenge Precision Health Initiative** works with a broad set of precision health applications. Schopf is the primary contact for this team, and is working with the IU Research Technologies team to reestablish contact.
- **The University of Hawai'i System Astronomy Community** supports 15 facilities with hundreds of researchers and experiments every year. Southworth is the primary contact for this group, as they have also been collaborating with the IRNC NetSage team and support a NetSage Tstat deployment. They contributed data to the NetSage Science Registry to get better coverage for astronomy applications.
- **The Midwest Big Data Hub (MBDH)** supports the use of data for a variety of applications and end users across twelve states. Southworth is the primary contact for this group and will be attending their All Hands Meeting in October to present a poster on EPOC.
- **The Open Storage Network (OSN)** will support dozens of applications across a broad set of application domains. Southworth is the primary contact for this group. This relatively new group has made progress recent progress getting organized and EPOC staff plan to attend their October All Hands Meeting in Austin, TX.

5.D External Partners

In addition to the partners that were named in the proposal, the EPOC team is coordinating with a number of additional groups.

The "Toward the National Research Platform" (TNRP) project (NSF #1826967), led by Larry Smarr and Tom Defanti, is tasked by NSF to stay in coordination with EPOC as both teams support the other CC* awardees. Schopf is the primary contact point, and current coordination is primarily taking place during the bi-weekly PRP/I2 Engagement calls, or when we jointly attend meetings, such as the CC* PI meeting where conversations took place. Smarr also participated in Schopf's panel on engaging with the NPEO awardees [11].

The EPOC External Advisory Board (EAB) members were given pointers to various EPOC materials online for their review. We plan to hold a first (virtual) EAB meeting in Quarter 3 to offer feedback on key project goals, including:

- Reporting: How to make quarterly NSF reports more useful
- Roadside Assistance: State of tickets and possible improvements to the process going forward.
- Deep Dives: List of completed events and review of published material.

Other items will be reviewed in future meetings.

EPOC is working with the CI Engineering Community (https://www.es.net/science-engagement/ci-engineering-brownbag-series/) to catalog the presented webinars from the Brownbag series held from 2017 to present. Currently 57 webinars have been uploaded to the EPOC YouTube channel, and available online at: https://www.youtube.com/channel/UChIaulc1bccif1Dz4cfZl0w.

6. RoadSide Assistance and Consulting

A key aspect of the EPOC project is the operations center and process pipeline for immediate help, referred to as Roadside Assistance and Consulting. The Roadside Assistance and Consulting approach helps collaborators when data sharing failures occur, since these almost always involve multiple domains and organizations. More information about the Roadside Assistance and Consulting process is available at: https://epoc.global/wp-content/uploads/2019/04/Roadside-Assistance-Description.pdf. Hans Addleman is the lead for this activity.

6.A Roadside Assistance Cases

In Year 2 Quarter 2, we had one ongoing Roadside Assistance case:

- **Iowa-NCAR:** A climate researcher at Iowa State University contacted us with poor performance when transferring real-time earth observation data files from an NCAR archive to Iowa State. In the past, the performance averaged approximately 1Gbps. Because of the real-time nature of the data, transfers on the order of 80Mbps were needed to keep up with the data flow, and at the time of contact the performance was only 32Mbps. The performance had been intermittently degraded at times over the last 2 years, but recently had become much worse. The researcher was using the NCAR Unidata Local Data Manager (LDM) to move the data, but replicated this behavior using FTP and HTTP. We have engaged engineers at Iowa State campus, engineers with the Great Plains Network (who support Iowa), and additional upstream providers, including NCAR, to work towards diagnosing this issue. Iowa State has now deployed three additional perfSONAR nodes in different parts of their network to help diagnose the issue. To date, changes have been made to the building, campus, building, and wide area networks to address issues that have been found as part of this work.

6.B Consultation Cases

In Year 2 Quarter 2, we had seven completed and twelve ongoing consultations. The primary topics were Science DMZ architectures, data transfer strategies, and routing issues.

Completed consultations included:
- **Colorado School of Mines (Mines):** EPOC staff members provided advice on perfSONAR, ScienceDMZ, firewall architecture, and switch buffers.
- **American Museum of Natural History (AMNH-1):** EPOC and ESnet staff discussed ScienceDMZ architecture and firewall configurations with AMNH Engineers. The final resolution was that their performance issues were caused by an egress filter.
- **University of Cincinnati (UC):** EPOC worked with UC engineers to define use cases and recommendations for file transfer nodes with help from Indiana University Research Technologies staff.
- **Indiana University-NOAA (IU-NOAA):** When the NetSage NOAA Tstat server was set up to collect statistics from a NOAA archive, an ongoing jumbo frame issue was discovered as part f the data flow between NOAA in Boulder and Indiana University. IU campus networks were contacted and several errors were corrected, with the penultimate one being an MTU mismatch within the campus network.
- **Arcadia:** After the Deep Dive, KINBER staff, on behalf of Arcadia University, contacted EPOC and ESnet staff to better understand possible choices in border routers. EPOC staff offered suggestions for a requirement evaluation to enable KINBER and Arcadia to make this selection.
- **Trinity:** In a followup to the Trinity Deep Dive, the IT team and a local researcher contacted EPOC for assistance on network-attached storage devices. Two solutions were proposed: one that was scalable for long term use but more expensive, and the second which was less expensive but unlikely to scale past the initial needs. The university will make a choice based on the available funding and prepare for submission of a CC* proposal.
- **South African National Research Network (SANReN):** A network engineer from SANReN contacted ESnet and EPOC staff with questions about asymmetric performance behavior across a switch, and how best to configure a DTN. Configuration suggestions were offered and the problem was resolved.

Ongoing Consultations include:
- **Pacific Northwest National Laboratory (PNNL):** The ESnet Science Engagement Team and EPOC were consulted on ways to create a Deep Dive process for use at a National Lab Campus. Materials were provided, and we are waiting to hear if additional assistance will be needed in terms of planning or execution.
- **Washington State University (WSU):** EPOC staff have been discussing perfSONAR best practices, achievable real world bandwidth results, and expectation level setting with WSU engineers. This has not progressed due to needed staff members being away for summer.

- **University of California Merced (UCM):** A professor who recently moved from the University of Massachusetts Amherst to Merced has a large amount of CAT Scan data for bats that needs to get moved from her old university to her new lab. EPOC is working with engineers at both universities to evaluate issues in the path.
- **Duquesne University (Duq):** EPOC is providing advice and feedback on a new ScienceDMZ architecture at Duquesne. A meeting was held at PEARC and additional requirements were discussed, followed by a call in September where the ScienceDMZ design was gone over and there was additional discussion regarding lab testing, vendor selection, and buffers.
- **Texas A&M University (TAMU):** EPOC staff were contacted by engineers at TAMU to help them understand why traffic between TAMU and University of Nebraska Lincoln (UNL) was asymmetric. Transfers from UNL to TAMU are correctly routed over the Internet2 backbone, but in reverse it appeared to be taking a commodity path. EPOC staff have pulled in engineers from LEARN to assist.
- **University of Wisconsin-Michigan State University (UW-MSU):** Users moving data from University of Wisconsin in Madison, WI, to Michigan State University in East Lansing, MI, are seeing poor performance. EPOC has started a dialog between engineers at both universities. Initial investigation has revealed some odd routes between the two sites.
- **Ohio Supercomputing Center (OSC):** OSC stood up a new perfSONAR node in August and requested that they be added to the Large Facilities ESnet perfSONAR dashboard. A number of routing anomalies and MTU issues are keeping performance low. EPOC staff engaged engineers from perfSONAR, ESnet, and OARnet to resolve these issues.
- **American Museum of Natural History (AMNH):** EPOC staff were contacted about problems with perfSONAR tests between AMNH and NyserNet. Consultation is ongoing.
- **TAMU-PVAMU (T-P)**: EPOC staff followed up with PVAMU after an initial engagement in mid 2019. PVAMU requested a followup call to discuss Science DMZ network designs, and also questions about perfSONAR, Science DMZ switch selection, and the Zeek intrusion detection system. After the call, PVAMU was provided with documentation and will receive a followup in January, 2020.
- **University of North Carolina Greensboro (UNCG):** As part of their Science DMZ redesign, engineers contacted EPOC staff for feedback on their designs and options for both the DMZ and a possible DTN deployment. Initial discussions also explored options with intrusion detection systems. This is ongoing.
- **University of Michigan (UM):** EPOC staff were contacted by a researcher at University of Michigan to discuss their NetBasilisk security project to better understand any data transfer implications. EPOC staff brought in experts from Trusted CI to assist with the evaluation, and we will check back in January to address any additional information needed.
- **Kent State University (KSU)** - Engineers from Kent State reached out to EPOC staff for feedback on their draft plans on their upcoming network redesign (including equipment options) and performance issues with their current DTN. A discussion followed that

included examining possible issues with buffering and better understanding their use cases. They may be interested in borrowing the EPOC Viavi Network Testing Device.

6.C Metrics

Table 1: Metrics for Roadside Assistance and Consultation activities.

Case Identifier	EPOC Partner	Type	Start Date	End Date	Area of request	Science Domain	Asked by: Eng, Scientist, other	Primarily R(ch), E(du), O(ther)	Size: S, M, L
Iowa-NCAR	GPN	RA	6/21/19	ongoing	File Transfer	Geo	Sci	E	L
Mines	FRGP	Cons	10/3/18	7/23/19	Architecture	Infra	End	E	M
AMNH-1	-	Cons	2/5/19	7/9/19	ScienceDMZ	Infra	Eng	O	-
PNNL	-	Cons	2/19/19	ongoing	Deep Dive	Infra	Eng	R	S
WSU	-	Cons	3/6/19	ongoing	perfSONAR	Infra	Eng	E	L
UCM-2	-	Cons	4/17/19	ongoing	Perf	Geo	Eng	E	L
Duq	KINBER	Cons	5/10/19	ongoing	ScienceDMZ	Infra	Eng	E	S
UC	OARnet	Cons	5/31/19	8/7/19	File Transfer	Infra	Eng	E	L
IU-NOAA	iLight/FRGP	Cons	6/14/19	9/11/19	Perf	Infra	Eng	E	L
TAMU	LEARN	Cons	6/14/19	ongoing	Routing	Infra	Eng	E	L
UW-MSU	-	Cons	6/18/19	ongoing	Routing	Bio	Eng	E	L
Arcadia	KINBER	Cons	7/3/19	7/12/19	Arch	Infra	Eng	E	S
SANReN	-	Cons	7/3/19	8/13/19	DTN	Infra	Eng	O	-
Trinity	LEARN	Cons	7/12/19	8/28/19	DTN	Infra	Eng	E	S
OSU	OARNET	Cons	8/21/19	ongoing	PS	Infra	Eng	E	L
AMNH-2	-	Cons	9/18/19	Ongoing	PS	Infra	Eng	O	-
T-P	LEARN	Cons	9/24/19	ongoing	DMZ, PS	Infra	Eng	E	M
UNCG	-	Cons	9/24/19	ongoing	DMZ	Infra	Eng	E	S
UM	-	Cons	9/24/19	ongoing	Evaluation	CS Rsch	Sci	R	L
KSU	OARNET	Cons	9/24/19	ongoing	Arch, DTN	Infra	Eng	R	S

7. Deep Dives

Deep Dives aim to understand the full science pipeline for research teams and suggest alternative approaches for the scientists, local IT support, and national networking partners as relevant to achieve the long term research goals via workflow analysis, storage and computational tuning, and identification of network bottlenecks. We have adapted the ESNet facilities approach for work with individual science groups, which is documented at: https://epoc.global/wp-content/uploads/2019/04/Application-Deep-Dive-Description-1.pdf. Jason Zurawski is the lead for this area.

7.A In Progress Application Deep Dives

EPOC staff completed the interviews for six Application Deep Dives in Quarter 1, and continue to refine the final reports in Quarter 2. We note that some of these events were primarily meant as training exercises to demonstrate the Deep Dive technique to an audience, while others, which we refer to as *Campus-Wide Deep Dives,* were localized for specific campuses to work directly with their researchers, often to give feedback to higher administrators about general CI needs. This set of Deep Dives includes:

- **KINBER and Arcadia University**: KINBER requested a Deep Dive training event for their annual meeting, using an example from Arcadia University related to bioinformatics research. During the session, the research team highlighted the ongoing challenges that they have supporting a class that involves accessing data from a remote data source and using remote Galaxy compute resources. The lack of available local compute and storage resources meant that they could not fully demonstrate modern research techniques with students. Several updates to the campus cyberinfrastructure were identified, including a DMZ that is supported by recent NSF funding. The final report was published in July, 2019 [1]. A consultation resulted from this Deep Dive.
- **OARnet and University of Cincinnati:** OARnet, with member institution University of Cincinnati (UC), requested an on-site Campus-Wide Deep Dive at UC to focus on several campus science drivers. EPOC staff traveled to Cincinnati, OH, in April and worked with researchers from high energy physics, medicine and bioinformatics, mathematics, aerospace, and criminal justice. The final report has been returned to the University for clarification, and once that has been received it will be published.
- **GPN and Kansas State University:** The Great Plains Network requested an EPOC Deep Dive training event, to take place their annual meeting, using an example from Kansas State agronomy. The driving factor behind the research was the likely upcoming food scarcity due to changing climate. The team was measuring a broad set of environmental variables for actual crops and then working with a variety of researchers who build models to estimate likely outcomes. Identified pain points included challenges with storage and changing file formats, which made sharing the data more challenging. The final report is being drafted, and is expected next quarter.

- **LEARN and Trinity University:** LEARN, with member institution Trinity University, requested a Campus-Wide Deep Dive to focuses on several campus science drivers, including geology, classical studies, archaeology, computer science, biology, physics, and neuroscience, to assiste with planning for an upcoming grant submission. They found that almost all of the researchers had strong storage requirements that were not being met with existing technology and that computation resources were currently sufficient but would require growth in the coming years. The final report has been returned to the University for clarification, and once that has been received it will be published. A consultation resulted from this Deep Dive.
- **Purdue University:** Purdue University requested a Campus-Wide Deep Dive training event, focusing on two emerging use cases from the college of agriculture involving high-performance computing resources on campus. One goal of this review was to walk through the Deep Dive process with the research and IT staff so that university staff could repeat the approach with other researchers independently. We found that the strongest concern was that the research storage support was lacking for the two profled groups. Purdue research computing has the technology and support staff to supply the researchers needs, however the gap that was identified was in working with the researchers so they could better understand the time/technology investment would be worth the time away from their core research. The final report is being drafted.
- **University of Wisconsin:** The University of Wisconsin requested a Campus-Wide Deep Dive to assist campus leadership in understanding upcoming CI needs by researchers in high energy physics, space sciences (including support for several NASA and NOAA missions), polar studies (including the IceCube project), bioinformatics, and high throughput computing. The findings of this report are still being drafted, but focus on the need for upgraded science DMZ networking, research support for computing and storage, and a more frequent review of science drivers campus-wide.
- **PEARC 2019:** EPOC performed a Deep Dive training event at PEARC 2019 in Chicago, Illinois on July 29, 2019 [6]. EPOC profiled the work completed at Purdue University as the research profile by discussing bioinformatics. No additional report will be generated.

7.B Planned Application Deep Dives

Deep Dive planning typically takes a series of meetings and conversations over several months with the target institutional leadership and research community. After the event, the EPOC team, joint with the participants, produces a report of the events that can be used by the campus and/or regional network to influence future directions of technology support. We have begun planning four additional Deep Dives to take place in Year 2:
- **Arizona State University / Sun Corridor Network**: In August, 2019, Arizona State University reached out to EPOC to host a potential Deep Dive of campus and regional requirements to take place during February, 2020. Discussions are ongoing.
- **Oregon State University:** In April, 2019, members of Oregon State University contacted EPOC staff about a possible EPOC Deep Dive to profile their campus research and the regional network for the state, LinkOregon. Dates and focus areas are being discussed, and is likely to occur during Summer 2020.

- **LEARN and Baylor University:** In June, EPOC began a conversation with Baylor University about a possible campus-wide Deep Dive to be jointly run with the LEARN regional network. Dates and focus areas are being discussed, but it is expected to occur in December, 2019.
- **Quilt**: In September, Quilt management approached us about hosting a Deep Dive Training session at the February 2020 meeting. Planning will start in Quarter 3.

7.C Metrics

Table 2: Metrics for Deep Dive activities.

Meet Date	Appl name	Public/ Private	Audience	Offer or Request	Head Count	Issues Identified	Complete Date
4/3/19	Arcadia University Bioinformatics	Pub	KINBER staff & members	Req	9	Storage, computation, training	Q2
4/26/19	University of Cincinnati - 6 Use cases	Priv	University of Cincinnati faculty & staff, OARnet staff	Req	28	Storage, computation, local networking, data privacy	Expected Q3
5/21/19	KSU Agronomy Research	Pub	GPN staff, GPN AHM attendees, KSU faculty & staff	Req	36	Connectivity, workflow assistance	Expected Q3
5/29/19	Trinity University - 5 Use cases	Priv	Trinity University faculty & staff, LEARN staff	Req	16	Storage, local networking, computation	Expected Q3
5/31/19	Purdue University- 2 Use cases	Pub	Purdue University faculty & staff	Req	39	Storage, workflow assistance	Expected Q3
6/17-19/19	University of Wisconsin- 10 Use cases	Priv	University of Wisconsin faculty & staff	Req	24	Storage, workflow assistance, performance problems	Expected Q4
7/29/19	PEARC	Pub	PEARC19 Attendees	Off	15	Training exercise	No report

8. NetSage Deployments and Analysis

Understanding application performance and network measurement are two sides to a single coin - one doesn't make sense without the other. The EPOC project uses the NetSage tool (http://www.netsage.global) to collect and evaluate common network measurement data. The initial NetSage software was developed and deployed on the NSF-funded international networks. It was meant to work with sparse, international circuits, and for end users primarily consisting of circuit owners and operators. EPOC has expanded the use of this software to work with more densely defined networks and to support additional analysis and visualizations. Jennifer Schopf and Dan Doyle jointly lead this activity.

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8.A Current Status

Different components of NetSage can be deployed in different ways, depending on the requirements of the customer. The status of the current deployments for NetSage network-related dashboards for the EPOC partners includes:

- **Great Plains Network:** The NetSage SNMP dashboard for the GPN associated circuits (http://gpn.netsage.global) was initially deployed in October, 2018, and remains stable and supported. Discussions are ongoing to extend the deployment to include flow data collection, although this will likely not move forward until later in the year due to GPN's preference that a containerized approach be used for the data gathering.
- **iLight/Indiana GigaPop:** Flow data collection for the five Indiana GigaPop routers began in mid-April, 2019, and a dashboard was presented to iLight members at their All Hands Meeting in May. This is now publicly available at http://ilight.netsage.global.
- **KINBER:** KINBER management has said they are interested in a NetSage deployment for their network at this time. We met at the CC* PI meeting and will be moving forward with this as soon as an engineer is put in touch with the EPOC development team.
- **LEARN:** At their All Hands Meeting, LEARN staff expressed an interest in moving forward to deploy NetSage for the state of Texas network. Follow-up conversations will continue at SC19.
- **FRGP**: We have a call scheduled with the FRGP technical advisory board in early October, 2019, to discuss options in deploying NetSage across the region.

The Archive site deployment is funded by the NSF IRNC NetSage project, but is also being used by the various EPOC partners. NetSage uses a software package called Tstat to collect flow data as well as retransmits from the archives. The deployments include:

- **TACC/LEARN:** The Tstat software was updated this quarter, and TACC deployed the new version. This work is stable.
- **University of Hawai'i Astronomy:** A temporary installation of Tstat for the Astronomy archives was replaced with a permanent solution this quarter and the data is now being fed to the various flow dashboards.
- **NOAA/FRGP:** NOAA deployed the Tstat software to the head node of a backup archive at NOAA Boulder, and that data is now being fed to the appropriate dashboards. Discussions are ongoing to extend this deployment to additional science archives.
- **NCAR/FRGP:** NCAR deployed Tstat at their site in Wyoming in July.
- **National Energy Research Scientific Computing Center (NERSC):** NERSC was the first deployment for IRNC NetSage and the Tstat software. This archive is widely used internationally and domestically for energy science related data sets.

8.B Metrics

Table 3: Metrics for NetSage activities.

Where Regional	What	Date Live	Data Type	# Monitored Devices	# Unique End Points for Flow
GPN	SNMP Dashboard	10/18	SNMP	2 routers	N/A
iLight	Flow Dashboard	4/19	Flow	5 routers	7,981
TACC (LEARN)	Archive Dashboard	1/19	Tstat	4 head nodes	132
UHawaii Astro	Archive Dashboard	5/19	Tstat	1 DTN	334
NOAA (FRGP)	Archive Dashboard	5/19	Tstat	1 head node	38
NCAR (FRGP)	Archive Dashboard	7/19	Tstat	1 DTN	1,233
NERSC	Archive Dashboard	3/18	Tstat	11 head nodes	178

9. Managed Services (aka "In a Box")

EPOC is tasked with developing a set of service definitions for common R&E infrastructure components that could be run by a third party as a Managed Service. The goal of these definitions is to provide guidance for our Regional Networking Partners to implement, maintain, and operate (potentially for a fee) the service as a benefit for downstream connectors. In doing so, the costs associated with design, specification, and installation can be ameliorated for a larger population than would otherwise have access to this technology due to the burdens of entry which may include not having knowledgeable staff or enough compelling use cases to invest time and money. EPOC is targeting five use examples of Managed Services:

1. *perfSONAR*: a widely-deployed test and measurement infrastructure that is used by science networks and facilities around the world to monitor and ensure network performance.
2. **NetSage:** a measurement and monitoring service that is being deployed as part of EPOC in domestic settings.
3. *Science DMZ*: Dedicated network infrastructure specifically configured for the security and performance implications required for scientific use cases.
4. *Data Transfer Hardware & Software*: PC-based Linux servers built with high-quality components and configured specifically for wide area data transfers along with software layers that can facilitate easier forms of data sharing
5. *Network Testset*: Specialized hardware used to provision and validate network infrastructure.

Jason Zurawski is the lead for this area.

Activities in Quarter 2 were sporadic for the Managed Services area, in part due to our regional partners waiting to hear back about potential funding to help support this effort and difficulties allocating staff time to work on this project. Conversations are continuing with:

- **KINBER - perfSONAR:** KINBER is exploring deploying perfSONAR as a service with partner institution Arcadia University. KINBER, Arcadia, and EPOC began discussions

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on this matter in September, 2019, with a target of a call to discuss implementation in early 2020.

- **LEARN - perfSONAR, Data Transfer, DMZ:** LEARN and EPOC had discussions about operating a combination of services, namely providing Science DMZ, perfSONAR, and data transfer, to a selection of small colleges and universities. LEARN has received notification that they will receive NSF funding to facilitate the hardware purchase and has agreed to work with EPOC to implement this service.
- **OARnet - Data Transfer:** OARnet and EPOC had discussions about operating data transfer as a service to several pilot sites that lack the capability to do so currently. OARnet did not receive NSF funding to facilitate the hardware purchase, thus has requested that work on this be put on hold for the time being.
- **GPN member KanREN - Data Transfer:** KanREN has interest in deploying a network of data transfer hardware capabilities around the state for use by member institutions. Initial conversations discussed the feasibility and scalability aspects of this work. KanREN did not receive NSF funding to facilitate the hardware purchase, thus has requested that work on this be put on hold for the time being.
- **FRGP and Tribal Colleges - perfSONAR:** Last project year, EPOC sent six small nodes to be used for a perfSONAR deployment for the Tribal Colleges who are in a joint project with FRGP, which are now part of a MaDDash available online at http://ps00-ntu-cp-ccstar.itth.navajotech.edu/maddash-webui/index.cgi?dashboard=Dashboard%201. EPOC has been asked to assist with a training activity, but it is possible that a more effective approach would be to work with FRGP to run the perfSONAR nodes as a Managed Service deployment on behalf of the Tribal Colleges, especially as the deployment expands. This is a topic of ongoing discussion.
- **OARnet and Kent State University - Network TestSet:** Kent State has expressed an interest in using the network testset as part of their network upgrade. This is being tracked as part of the consultation case with them.

A key deliverable in Year 2 for the Managed Services activity will be the publication of a set of whitepapers that detail the concepts of operating a Managed Service. It is anticipated that EPOC will release documents for each of the five services about how they will be supported by EPOC and their partners.

10. Training

EPOC continues the successful training that ESnet and IU lead as part of the Operating Innovative Networks (OIN) program. This includes training for network engineers to be coordinated with existing cyberinfrastructure support teams. While training programs like OIN emphasized the design and deployment of technology, we have pivoted to train staff on the use of these tools and the improvement of scientific use of networks through them. In addition to training on tools such as perfSONAR, we offer training for network engineers on interacting with their researchers through teaching them how to perform Application Deep Dives. All EPOC

training materials are available online, including lecture materials, exercises, and recorded sessions when possible.

During Quarter 2, EPOC staff were involved in the following training events:

- **Training Workshop for Network Engineers and Educators on Tools and Protocols for High-Speed Networks and Cybersecurity,** Columbia, SC, July 23-24, 2019. Training Workshop with University of South Carolina and other invited attendees. This event was attended by 33 participants, and featured presentations on Science DMZ, DTNs, perfSONAR, and engagement strategies.
- **PEARC Deep Dive Training**: Chicago, IL, July 29, 2019: This event was attended by 15 participants and featured education in the process to conduct a Deep Dive within a campus environment. Purdue University assisted as the use case that was profiled.
- **NTUstar Technical Workshop, Tempe AZ**, July 31-August 1, 2019. Technical Talk (ScienceDMZ concepts) and EPOC Overview with FRGP and Tribal College staff. This event was attended by 45 participants and featured presentations on Science DMZ, DTNs, perfSONAR, and engagement strategies.
- **2019 Data Mobility Workshop**, part of the CC* PI Meeting/Quilt/NRP, Minneapolis, MN, September 23, 2019. Technical talks on Science DMZ, DTNs, perfSONAR, and data movement. This event was attended by 50 participants, and featured presentations on Science DMZ, DTNs, perfSONAR, and engagement strategies.

We are currently planning a Deep Dive training event to take place at the February Quilt Members meeting.

11. Data Privacy and Security

No PII is shared in the Roadside Assistance or Consultation summaries or reports, which are made public. There may be PII, for example IP addresses, in other documents in a Roadside Assistance Case Folder, but this information is locked down and access is controlled and only shared with specific staff working on a particular issue.

NetSage does not collect PII. The IRNC NetSage privacy docs were updated for EPOC and are available online at https://epoc.global/wp-content/uploads/2019/02/EPOC-Data-Privacy-Policy-21919.pdf.

Basic security measures are being maintained and there were no security incidents to report for this quarter.

12. Reporting Against Deliverables

Table 4: Current progres on Deliverables.

	Deliverables	Status
RA	ROADSIDE ASSISTANCE	
RA.1	Adaptation of IN@IU, ESnet science engagement, and IRNC NOC PET process with expanded focus	Completed Year 1
RA.2	Advertising roadside assistance and consulting	Ongoing
RA 3	Assist with ongoing RAs - Partners	Ongoing
RA 3.1	iLight RA	Ongoing
RA 3.1.1	Consultation - IUB jumbo frame issue with NOAA	Started Y2Q1, Completed Y2Q2
RA 3.2	FRGP RA	Ongoing
RA 3.2.1	Consultation - Colorado School of Mines	Started Year 1, Completed Y2Q2
RA 3.2.2 (NEW)	Consultation - Gonzalez Tribal Colleges	Completed Year 1
RA 3.3	LEARN RA	Ongoing
RA 3.3.1	Consultation - TAMU routing	Started Y2Q1, ongoing
RA 3.3.2 (NEW)	Consultation- Trinity DTN	Started Y2Q2
RA 3.3.3 (NEW)	Consultation- LEARN DMZ, PS	Started Y2Q2
RA 3.4	OARNET RA	Ongoing
RA 3.4.1	Consultation - UC DTN	Started Y2Q1, Completed Y2Q2
RA 3.4.2 (NEW)	Consultation- OARNET DTN	Started Y2Q2
RA 3.4.3 (NEW)	Consultation- OARNET Arch and DTN	Started Y2Q2
RA 3.5	GPN RA	Ongoing
RA 3.5.1	RA Iowa State-NCAR Geoscience	Started Y2Q1, Ongoing
RA 3.6	KINBER RA	Ongoing
RA 3.6.1	Consultation - F&M switches	Started and completed Y2Q1
RA 3.6.2	Consultation - Duquesne DMZ	Started Y2Q1, Ongoing
RA 3.6.3 (NEW)	Consultation- Arcadia - switches	Started Y2Q2, Completed Y2Q2
RA 3.7	ESIP RA	Ongoing
RA 3.8	ICNWG RA	Ongoing
RA 3.9	IU GC RA	Ongoing
RA 3.10	U Hawaii RA	Ongoing
RA 3.10.1	PANStarrs	Completed Y1; 3x improvement

RA 3.11	MWBDH RA	Ongoing
RA 3.12	OSN RA	Ongoing
RA 4	Other RA	Ongoing
RA 4.1	LHC Pakistan	Completed Year 1; 10x improvement
RA 4.2	Washington State Pullman	Started Year 1, Ongoing
RA 4.3	Consultation - American Museum Natural History	Started Year 1, Completed Y2Q2
RA 4.4	Consultation- University Florida	Completed Year 1
RA 4.5	Consultation - Compute Canada	Completed Year 1
RA 4.6	Consultation - New York University School of Medicine	Completed Year 1
RA 4.7	Consultation- LSU Health training information	Started and completed Y2Q1
RA 4.8	Consultation- PNNL Deep Dive process	Started Y2Q1, ongoing
RA 4.9	U Wisconsin Madison - Michigan State data transfer issue	Started Y2Q1, ongoing
RA 4.10	Consultation - LSU Health Deep Dive Templates	Started and completed Y2Q1
RA 4.11	Consultation- Vanderbilt PS	Started and completed Y2Q1
RA 4.12	Consultation-U Wisconsin Madison - dark fiber for seismic	Started and completed Y2Q1
RA 4.13	UC Merced - Amherst data transfer issue	Started Y2Q1, ongoing
RA 4.14	Consultation - UC Merced NASA data transfer	Started and completed Y2Q1
RA 4.15 (NEW)	Consultation- SANRen	Started Y2Q2
RA 4.16 (NEW)	Consultation- AMNH- PS with NyserNet	Started Y2Q2
RA 4.17 (NEW)	Consultation- UNCG- DMZ	Started Y2Q2
RA 4.18 (NEW)	Consultation- U Michigan - evaluation	Started Y2Q2
DD	DEEP DIVE	
DD.1	Adaptation of ESnet facility deep dive process for use with applications	Completed Year 1
DD.2	Over project period, at least 2 deep dives per regional partner	Ongoing
DD.2.1	iLight Deep Dives	Ongoing
DD 2.1.1	Purdue University	Event Y2Q1, report pending
DD.2.2	FRGP Deep Dives	Ongoing
DD 2.2.1	NOAA and NASA Deep Dive (with Training)	Completed Y1
DD 2.3	LEARN Deep Dives	Ongoing
DD 2.3.1	Trinity University	Event Y2Q1, report pending

DD 2.3.2	Baylor	Planned Dec'19
DD 2.4	OARNET Deep Dives	Ongoing
DD 2.4.1	University of Cincinnati	Event Y2Q1, report pending
DD 2.5	GPN Deep Dives	Ongoing
DD 2.5.1	Training - KSU Agronomy	Event Y2Q1, report pending
DD 2.6	KINBER Deep Dives	Ongoing
DD.2.6.1	Arcadia Bioinformatics (with training)	Event Y2Q1, report completed Y2Q2
DD 2.7	ESIP DD	Ongoing
DD 2.8	ICNWG DD	Ongoing
DD 2.9	IU GC RDD	Ongoing
DD 2.10	U Hawaii DD	Ongoing
DD 2.11	MWBDH DD	Ongoing
DD 2.12	OSN DD	Ongoing
DD.3	Other Deep Dives	Ongoing
DD.3.1	QUILT/University Maryland (with Training)	Completed Y1
DD.3.2	University of Wisconsin	Event Y2Q1, report pending
DD 3.3	PEARC'19	Completed (no report)
DD 3.4	Oregon State Univ	Planned Year 2
DD 3.5	Quilt Training	Planned Y2Q4
NS	NETSAGE	NOTE: Renumbering took place in Y2Q2
NS.1	NetSage prototypes for regional partners	Ongoing
NS1.1	NetSage for iLight	Ongoing
NS 1.1.1	SNMP for iLight	May not be needed
NS 1.1.2	Flow for iLight	Completed Y2Q1
NS 1.2	NetSage for FRGP	Discussion Year 2
NS 1.2.1	SNMP for FRGP	Discussion Year 2
NS 1.2.2	Flow for FRGP	Expected Y2Q34
NS 1.2.3	Tstat for NOAA	Completed Y2Q1
NS 1.2.4	Tstat for NCAR	Expected to be deployed in Year 2
NS 1.3	NetSage for LEARN	Ongoing
NS 1.3.1	SNMP for LEARN	Discussion Year 2
NS 1.3.2	Flow for LEARN	Discussion Year 2

NS 1.3.3	Tstat on TACC archives	Completed Year 1
NS 1.4	NetSage for OARNET	Ongoing
NS 1.4.1	SNMP for OARNET	Discussion Year 2
NS 1.4.2	Flow for OARNET	Discussion Year 2
NS 1.5	NetSage for GPN	Ongoing
NS 1.5.1	SNMP for GPN	Completed Year 1
NS 1.5.2	Flow for GPN	Planned for Year 2
NS 1.6	NetSage for KINBER	Ongoing
NS 1.6.1	SNMP for KINBER	Discussion Year 2
NS 1.6.2	Flow for KINBER	Discussion Year 2
NS 2	NetSage deployments related to other partners	Ongoing
NS 2.1	University Hawaii	Ongoing
NS 2.1.1	Tstat on Astronomy Archive	Completed Y2Q1
NS 3	Adaptation of NetSage analysis for network disturbance detection	Planned for Year 2
MS	MANAGED SERVICE	
MS 1	Define perfSONAR Managed Service (PS MS)	Started Year 1, Ongoing
MS2	PS MS deployments	Ongoing
MS 2.1	iLight PS MS	TBD
MS 2.2	FRGP PS MS	TBD
MS 2.2.1	PS MS for Tribal Colleges	Under discussion - planned for Year 2
MS 2.3	LEARN PS MS	Underway Y2
MS 2.4	OARNET PS MS	TBD
MS 2.5	GPN PS MS	TBD
MS 2.6	KINBER PS MS	Started Year 1, Ongoing
MS 2.6.1	KINBER and Franklin Marshal PS MS	Under discussion - planned for Year 2
MS3	Define Data Transfer Managed Service (DT MS)	Planned for Year 2
MS4	Pilot DT MS	TBD
MS 4.1	iLight DT MS	TBD
MS 4.2	FRGP DT MS	TBD
MS 4.3	LEARN DT MS	Underway Year 2
MS 4.4	OARNET DT MS	Onhold Year2

MS 4.5	GPN DT MS	Onhold Year2
MS 4.5.1	GPN and KanRen DT MS	Onhold Year2
MS 4.6	KINBER DT MS	TBD
MS 5	Define DMZ Managed Service (DMZ MS)	Planned for Year 2
MS 6	Pilot DMZ MS	TBD
MS 6.1	iLight DMZ MS	TBD
MS 6.2	FRGP DMZ MS	TBD
MS 6.3	LEARN DMZ MS	LEARN seeking funding and interested in discussion in Year 2
MS 6,4	OARNET DMZ MS	TBD
MS 6.5	GPN DMZ MS	TBD
MS 6.6	KINBER DMZ MS	TBD
MS 7	Testset Loaning	Ongoing
T	TRAINING	
T 1	Set up public site for training materials	Completed Year 1
T 2	Technical training	Ongoing
T 2.1	perfSONAR	SOX PS training Completed Y1
T 2.2	perfSONAR, DMZ	GPN LCI training completed Y2Q1
T2.3	perfSONAR, DMZ, DTN, Security	LEARN training completed Y2Q1
T 2.4	perfSONAR, DMZ, DTN, Security	NTU Star Y2Q2
T 2.5	PS, DMZ, DTN, Engagement	S. Carolina, completed Y2Q2
T 3	Engagement training	Ongoing
T3.1	Deep Dive Training 1	NOAA training completed Year 1
T 3.2	DD Training 2	QUILT training completed Year 1
T 3.3	DD Training 3	KINBER training completed Y2Q1
T 3.4	DD Training 4	GPN training completed Y2Q1
T 3.5 (NEW)	DD Training 5	PEARC training completed Y2Q2
T 3.6 (NEW)	DD Training 6	QUILT planned Y2Q4
T 3.7	DD Training 7	TBD Year 3
T 3.8	DD Training 8	TBD Year 3
T 4	Other training	TBD as requested by community
T 4.1	Finding Researchers	iLight - completed Y2Q1
T 4.2 (NEW)	Data Mobility Expo	Completed Y2Q2

13. Financials

Item	Univ	Jul-19	Aug-19	Sep-19	TOTAL
STAFF COSTS (INCLUDING BENEFITS, F&A)					
Schopf, Jennifer-PI	IU	6,013	6,013	6,013	**18,039**
Addleman, Hans	IU	4,062	10,154	10,154	**24,370**
Chevalier, Scott	IU	0	1,783	1,783	**3,566**
Southworth, Doug	IU	3,248	3,248	3,248	**9,744**
Moynihan, Ed	IU	1,893	1,893	1,893	**5,679**
Hubbard, Heather	IU	1,561	1,647	1,595	**4,803**
Doyle, Dan	IU	2,315	2,315	2,315	**6,945**
IU Dev Team	IU	7,254	7,351	7,254	**21,859**
Zurawski, Jason	LBNL	8,563	7,455	6,713	**22,731**
Robb, George	LBNL			2,606	**2,606**
TOTAL STAFFING		**34,910**	**41,859**	**43,575**	**120,344**
Travel and Other Costs (including overhead)					
Travel - Schopf - Quilt Minn Sept'19	IU	591			**591**
Travel - Addleman - Purdue DD Apr'19	IU	372			**372**
Travel - Zurawski - UWisc DD Jun'19	LBNL	1,751			**1,751**
Travel - Zurawski - LEARN Jun'19	LBNL	1,484			**1,484**
Travel - Chevalier - Purdue DD Apr'19	IU	132			**132**
Travel - Southworth - Purdue DD Apr'19	IU	332			**332**
Travel - Schopf - GPN KC May'19	IU	1,632			**1,632**
Travel - Addleman - OARNet May'19	IU	953			**953**
Travel - Chevalier - LCI OK May'19	IU	643			**643**
Travel - Addleman - UWisc DD Jun'19	IU	2,279			**2,279**
Travel - Schopf - WestNet SLC May'19	IU	2,651			**2,651**
Travel - Schopf - TNC Estonia Jun'19	IU	6,791			**6,791**
Travel - Zurawski - NWave Boulder Jul'19	LBNL		1,915		**1,915**
Travel - Zurawski - CyberTraining SC Jul'19	LBNL		1,219		**1,219**
Travel - Zurawski - PEARC & NTU/FRGP Training MN/AZ Sep'19	LBNL		2,707		**2,707**
Travel - Zurawski - TACC TX Sep'19	LBNL			2,334	**2,334**
Travel - Moynihan ESIP WA Jul'19	IU		4,497	79	**4,576**
AHM Aug'19	IU			347	**347**
Travel - Addleman LEARN TX Jun'19	IU			1,419	**1,419**
TOTAL TRAVEL		**19,610**	**10,338**	**4,179**	**34,127**
TOTAL EXPENDITURES		**54,520**	**52,197**	**47,827**	**154,544**
PARTICIPANT SUPPORT					
AHM Aug/19	IU			73	**73**
TOTAL PARTICIPANT SUPPORT		**0**	**0**	**73**	**73**