Building the National Virtual Collaboratory for Earthquake Engineering Research

NEESgrid

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NEESgrid Early Adoption and Implementation Plan

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1 Introduction

1.1 About This Document

This document lays out a roadmap for the planned development and early adoption phase of the NEESgrid project. It covers the period from April 1 to October 1, 2002. The results of these efforts will be the deployment of an early NEESgrid infrastructure with limited functionalities, with a view to demonstrate an initial set of capabilities.

There are three important entities involved in the development of the NEESgrid during this phase, namely:

- The early (technology) adoption (EA) sites,

- The shadow sites, and

- The system integration (SI) team.

This document details the responsibilities and activities of each of these entities. It provides information about the generic experiments being undertaken at each site, specifies the hardware and software requirements for conducting these experiments, and details the tasks to be performed by each of these entities. It also gives a schedule for the development and deployment of NEESgrid services and capabilities.

This document is an evolutionary one; we expect changes and will adapt task items as warranted based on lessons learned during our software development and deployment process.

For more information about the NEESgrid project in general, see www.neesgrid.org.

1.2 Early Adoption and the Spiral Development Model

We have chosen the spiral model for the development and deployment of software for the NEESgrid. Loosely speaking, the spiral model means a sequence of iterations of deployment, testing, and refinement of a system.

The SI team has developed a two level-approach for developing and implementing a grid for the NEES community. A small subset of the NEES equipment sites has been chosen to assist in the early development of the system.

The plan is to develop, reasonably quickly (on the order of months), an initial implementation of grid software for NEES with limited features and capabilities. These packages are to be installed at a small number of the NEES equipment sites called Early Adopters (EAs), followed by tests of the SI system via representative experiments.

Based on the lessons learned in this initial step, a new iteration of software, documents, software, and hardware installation and testing procedures will be developed and tested. Each iteration of the system will further flush out and address the problems that arise, provide bug fixes, add new features and capabilities etc. The final result is a robust system for production use by the earthquake engineering community.

In summary, the Early Adoption process is being used to drive an initial set of NEESgrid capability demonstrations in the next six months. After this time frame, the SI team will

continue to work with all of the equipment sites to install NEESgrid software and continue to add refinements and new features throughout the length of the project.

1.3 Early Adopter Sites

The SI team intends to develop initial NEESgrid capabilities at the following Early Adopter institutions:

- Oregon State University (Tsunami Wave Tank)

- Rensselaer Polytechnic Institute (Centrifuge)

- University of Nevada, Reno (Shake Table)

Early Adopter sites have been selected based upon:

- Representative technology (wave tank, shake table, centrifuge, reaction wall etc.);

- Readiness of the NEES equipment in the time frame of the early adopter program;

- Availability of EE staff and personnel to design appropriate experiments (with increasing complexity) with the SI Team to test and shake out the grid software; and

- Availability of software resources (people and equipment) to work with the SI team to develop (parts) of the NEESgrid software system and to install, test, and provide insightful feedback. Coupled with rapid turnaround times that are required during this phase of operations.

1.4 Shadow Sites

The EA plan is also being used as a mechanism allowing all other NEES equipment sites to participate in the development of the NEESgrid. Those sites that are not designated as an EA site can participate as Shadow Sites (SS) by shadowing the EA sites with similar NEES equipment. These Shadow Sites are integral to the EA process. Scientists at these sites are experienced and knowledgeable in the earthquake engineering field, and thus can:

- Help design the experiments to be run,

- Determine the important data to be captured via the data models,

- Act as remote users of the NEES collaboratory,

- Test out the NEESgrid capabilities as they are developed,

- Help flush out bugs, and

- Provide suggestions for improvements to software, data models, collaboration tools, tele-operation tools of the NEESgrid etc.

In addition, input from these shadow sites will also be **actively and continuously solicited** towards the development of data schemas, capability requirements, etc., so as to best serve the NEES community as a whole. The shadow sites could be involved in the early adoption process by interacting with their colleagues at the Early Adopter sites.

Researchers interested in participating in the EA process would also interact with the EA sites as appropriate.

1.5 Related Documents

For more information, you may wish to see the NEESgrid System Architecture document, which is available in draft form at www.neesgrid.org/NSFreview.

1.6 Acronyms

The development of NEESgrid is an AIA (acronym-intensive activity); the following NEESgrid acronyms are used throughout this document.

- ACL: access control list

- API: application programming interface

- DAQ: data acquisition

- EA: Early Adopter site

- EE: earthquake engineering

- IOPS: instrument operations

- NDDP: NEES Data Discovery Protocol

- NEESpop: NEESgrid Point-Of-Presence server

- NMHP: NEES Metadata Harvesting Protocol

- NMI: National Middleware Initiative

- NTOP: NEESgrid Teleoperations Protocol server

- SA: System Architecture

- SI: System Integration team.

- SS: Shadow Site

- VI: LabView Virtual Instrument

2   Software Components for the NEESgrid

1. The majority of NEESgrid software will be standard components based on the NSF Middleware Initiative (NMI) and NEESgrid components produced by the SI team. Both of these components are completely independent of the mechanisms used for site-specific data acquisition or instrument operations. In other words, sites would use the same NEESgrid software components for data discovery, data movement, scheduling of resources etc., regardless of which site-specific software packages used locally for data acquisition (DAQ) and instrument operations (IOPS)

2. The equipment sites will be responsible for the acquisition of the hardware and software, and for specifying the procedures required for data acquisition and for instrument operations. As described below, this does not require a large effort.

3. For data acquisition, the sites will be responsible for moving data from the data acquisition system onto local data storage in one of a set of NEESgrid recommended data formats.

    Local data storage will either consist of disk(s) added to the NEESPOP, or another independent machine dedicated (or partially dedicated) to data storage, as decided by the site. In order to be accessible to NEESgrid, this local storage must be accessible to the NEESPOP. This can be accomplished either by making the storage locally accessible to the NEESPOP (through a protocol such as NFS) or by adding grid software to the dedicated data storage machine. Required grid packages include GridFTP (for enabling data movement), the new NEESgrid developed metadata discovery server, and an RLS server (for replica services). The SI team will develop and provide these grid packages along with instructions on their installation and operation. Local storage requirements will vary according to the volume of data produced by sensors. Sensor and human-generated metadata will require ordinary amounts of storage, and standard multi-gigabyte hard drives and backup facilities will be sufficient. Video, however, is much more storage intensive and will require an amount of local storage in the .5-1TB range, typically implemented as a RAID array. Local backup for such high-throughput data, if desired, will need to be based on tape, DVD-R, or similar high-capacity medium.

    In addition to providing local storage, the site will be responsible for translating data from existing formats into NEESgrid recommended formats. The SI will provide comprehensive specifications for the recommended formats as well as reference translation codes for a set of example cases of existing formats (e.g. tab-delimited columnar ASCII).

4. Remote viewing of streaming data from NEES equipment is handled by the "NEESgrid TeleOperations Protocol Server" (NTOP server). Some of the tele-operations functionality can be implemented independently of the local DAQ/IOPS server; however, some of that functionality (such as setting up connections for data streams, translating control commands, and detecting when

an experiment trial is finished) depends on the particular DAQ/IOPS server software. The Data Acquisition and Control-dependent functionality is handled by an NTOP server driver (a small set of functions with a clearly-defined API), which communicates with software on the data acquisition and control system. The SI will provide:

- An NTOP server that includes a reference driver that will support LabVIEW;

- A version of the "glue" software necessary on a LabVIEW DAQ/IOPS system to communicate with that reference driver; and

- Detailed documentation on how to write drivers and DAQ/IOPS glue software for other DAQ/IOPS systems.

Most sites can simply make use of the reference driver. Sites that cannot use the reference driver and glue software are responsible for developing their own software.

Similarly, researchers who wish to use streaming data in their applications or to have their applications send control requests to remote equipment sites must make sure that their applications can communicate using the NTOP protocol. Strategies that they can use to accomplish this include:

- Modifying their individual applications;

- For applications that run a framework using a public driver interface, writing (or acquiring) an NTOP driver for that framework. In this case, a driver would need to be written for each framework, but the individual applications in that framework would not need to be modified;

- Providing external filter programs that translate between NTOP and other data formats / protocols

To support these strategies, the SI will provide an API (and reference library) to translate between the NTOP protocol and programming language constructs.

5. In addition, the SI team will develop an initial reference implementation for testing purposes and will provide LabView implementations of #3 and #4 above.

While some amount of software development is required at each of the equipment site, the effort is actually quite small. A rough estimate would be about 6 weeks of development time from a software developer or a graduate student in computer science.

3   Hardware Components at the Equipment Site

There are three sets of hardware components at each NEES Equipment Site.

1. The NEESPOP component: a Linux box, as explained in section 7.1 of this document;

2. A video services component (cameras, internet appliances, and a Linux box), as explained in section 7.5 of this document and in the tele-presence white paper; and

3. A data acquisition and local storage services component, as explained in the next section.

4   LabVIEW^{TM} for Data Acquisition and Control

The SI team has chosen LabVIEW, a popular data acquisition and control software developed and sold by National Instruments, for development purposes. Note that the SI team is not mandating the use of LabVIEW for NEESgrid. We realize that some sites may choose alternative commercial products or develop their own customized software solutions for their DAQ/IOPS applications. However, in order for the SI team to quickly setup a NEESgrid system that provides rudimentary NEESgrid functionality and that can be used for testing purposes during the EA phase, the SI team has determined that LabVIEW represents a commercial software solution for data acquisition and control which has the widest acceptance amongst the NEES equipment sites.

The SI team will develop, document, and provide representative examples that implement data acquisition and storage using LabVIEW and provide example LabView Virtual Instruments (VI's) which can in turn interoperate with NEESgrid protocols and therefore make them available to the Equipment Sites. Equipment sites will be able to use these examples as models to implement the necessary changes to their site-specific software.

Table 1: Summarizes contact with NEES Sites by SI Team as of March 5th, 2002

Equipment Site	VTC (completed)	Site Visit by SI team (completed)	POC	Has the site provided an experimental plan
Reno	Nov '01	Dec '01	Prof.. Gokhan Pekcan	Yes, Appendix 1
RPI	Nov '01	Feb '02	Prof.. Mourad Zeghal	Yes, Appendix 2
Oregon State	Oct '01	Jan '02	Prof. Solomon Yim	Yes, Appendix 3
UC Berkeley	Jan '02	Jan '02	Dr. Silvia Mazzoni	No
Buffalo	Dec '01	Feb '02	Dr. Kurt Winter	Not requested by SI
UC Davis	Not yet	Not yet		Not requested by SI
Minnesota	Not yet	Not yet		Not requested by SI
Colorado	Not yet	Not yet		Not requested by SI
Texas	Not yet	Not yet		Not requested by SI
UCLA	Jan '02 (ISI)	Not yet	Prof. Daniel Whang	Not requested by SI
UCSD (not a NEES site)	None	Jan '02	Prof. Lelli Hose	Not requested by SI

5   Scenario: the Early Adopter Experiment

This section describes the generic scenario of the experiment that all EA sites will participate in, along with the components from the System Architecture document that will be exercised during each step. Please see also Section 7 of the System Architecture document describing various scenarios.

5.1   Breakdown of the Experiment

5.1.1   Preparation for the Experiment

Investigator(s) at remote sites (such as interested shadow sites or other EE sites) use NEESgrid collaboration tools and environments to plan an experiment (tsunami, shake table or centrifuge) in coordination with the equipment specialists at a particular NEES (Early Adopter) equipment site. An experiment usually consists of a series of "tests" (or "trials" or "runs"), each with slightly different experimental settings.

The investigator(s), remote collaborators, and site manager(s) discuss the particular test performed in the experiment. These discussions could include details about the parameters used, test specifications (e.g. stress form and magnitude for a shake table), results and data that are of interest, when and how to proceed with the experiment, and how to conclude the experiment. In addition, they participants will come to an agreement on what experimental data is to be observed in near real-time (both experimental data and near real-time video streams of data) and what experimental data needs to be recorded (along with the associated metadata, to be able to later interpret the recorded values). Researchers and site equipment managers also negotiate acceptable experiment parameters settings for this run.

The collaboration tool WorkTools supports discussion amongst sites as well as with the SI team via custom web pages, archived mailing lists, and notification services. The parties come to agreement on the parameters of each experimental run.

The investigator and equipment operators use electronic lab notebooks and other metadata authoring tools to generate metadata on experimental design, sensor configuration, actuator calibration, etc. This information is stored in local storage, and the investigator optionally uses data and metadata "publishing" procedures (section 5.2.3 of the System Architecture document) to also publish this information into the centralized **NEES data repository** for access by remote collaborators. Note that these procedures will have limited functionality (simple prototype data models and schemas) during the EA phase (April – October 2002). **Security services** (Section 5.1 of the SA document) describes how users are authenticated and provides some authorization procedures enabling them to participate in the experiment.   Administrators of the centralized data repository will establish authorization procedures. Authorization for adding, retrieving, and modifying data for an experiment in the repository will be controlled by investigators, subject to NEES-wide security policies.   During the EA phase, there are no plans to integrate grid services with the collaboration tools; thus, no grid-based authentication or authorization will be supported during the EA phase for the collaboration tools.
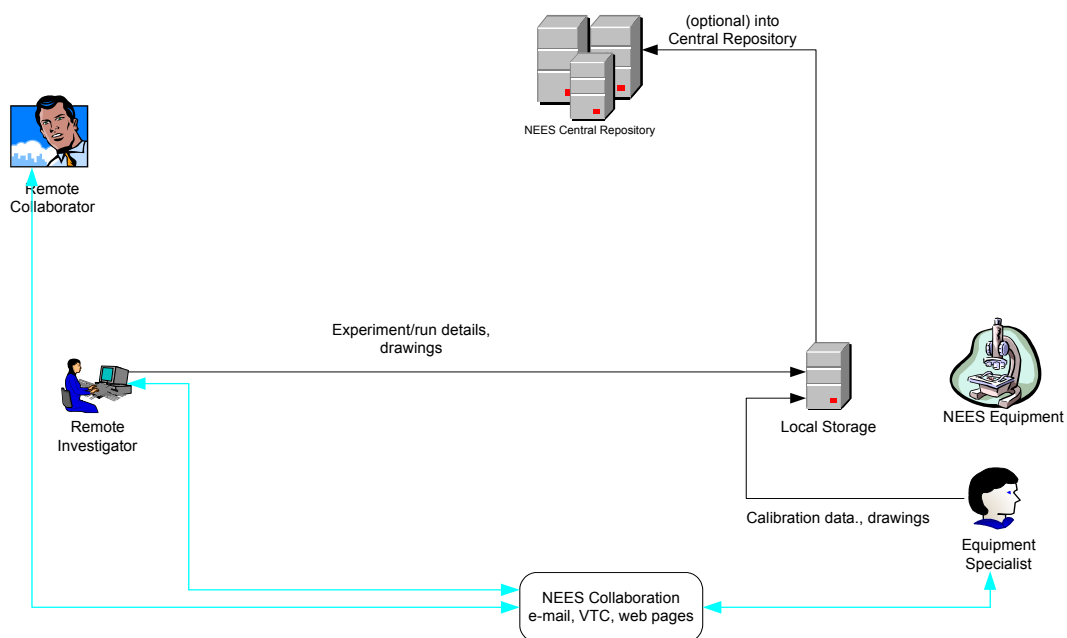
Figure 1: NEES Components and services required for the experiment preparation phase.

5.1.1.1   NEES Components and Tasks Required for this Preparation Phase

- Collaboration Tool WookTools deployed at a central site and accessed via web browsers. (POC: Joseph Hardin)

- Initial design and implementation of the data schema to capture relevant experimental information (POC: Joe Futrelle)

- Initial implementation of the metadata harvesting protocol. (Joe Futrelle)

- Establishment of a centralized data repository (with GSI). (POC: Joe Futrelle and Doru Marcusiu)

- Authorization of users at the central data repository. (POC: Joe Futrelle and Doru Marcusiu)

5.1.2   Experiment Run in Progress

The on-site equipment specialists initiate a test of the experiment. Raw data from the NEES equipment is collected on the instrument itself or onto a local storage device. At (or before) this time, calibration data and meta-data information will be stored on the site local storage. Video is collected onto the local storage through the video services box. Investigators will have access to this collected data in its entirety at the conclusion of the run as described in section below.

However, investigators can monitor some subset of the sensor data (in near real time) using the NTOP protocol and services (provided by the NEESPOP) while the experiment run is in progress. This includes experimental data acquired from the NEES equipment,

along with some metadata information. A subset of streaming near-live video (**tele-observation services**) from video cameras trained on appropriate experimental via the video server. Investigators thus have the capability to view the experiment in progress, view data as it streams, use a visualization tool, or feed the data into numeric simulation programs as necessary.
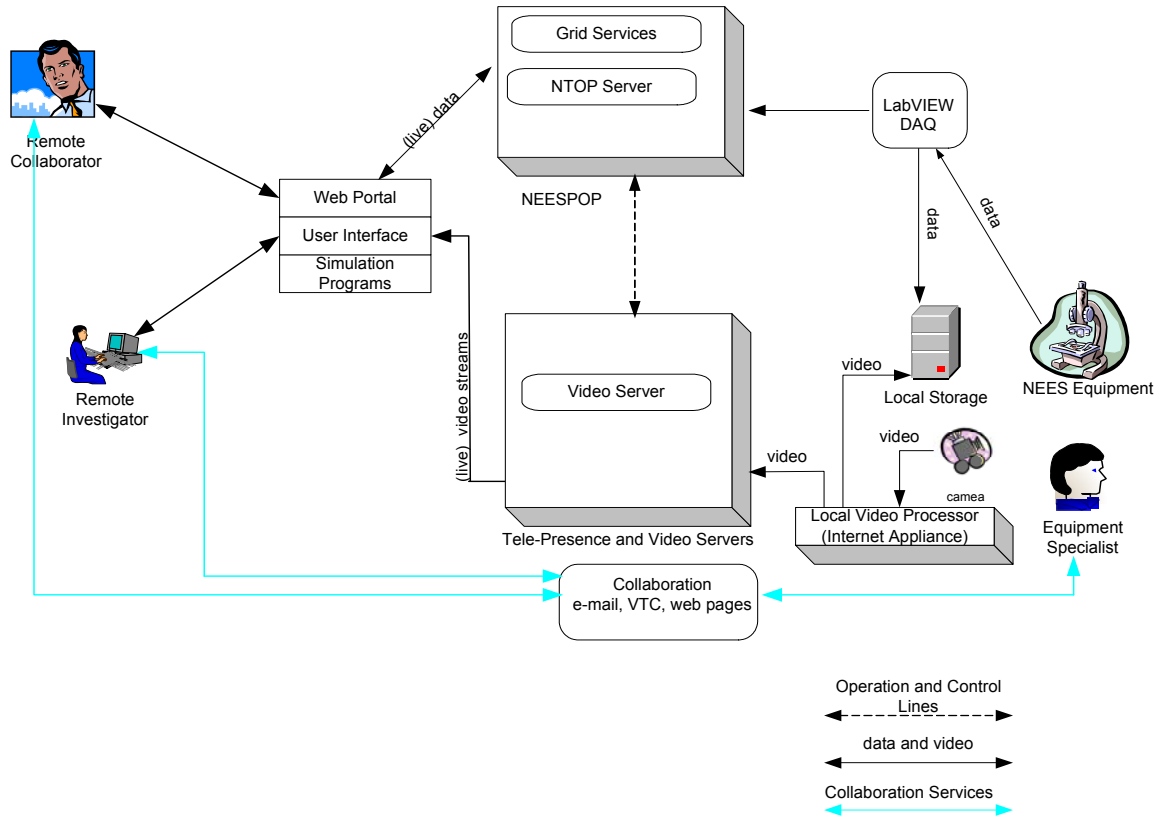
Figure 2: NEES Components and tasks exercised during an experimental test, including live monitoring of data and video.

5.1.2.1 NEES components and tasks required for the run/ monitoring phase

- Configuration and Integration of NEESpop. Equipment Site Responsibility. (POC: Doru Marcusiu)

- NEESpop user accounts created. (POC: Doru Marcusiu)

- User X509 certificates requested and granted. (POC: Doru Marcusiu)

- Initial specification of a subset of the NTOP protocol dealing with streaming sensor data. Equipment control will not be addressed during this phase. (POC: Laura Pearlman, Paul Hubbard, Nestor Zaluzec)

- Initial implementation of an NTOP server. (POC: Laura Pearlman, Paul Hubbard, Nestor Zaluzec)

- Initial implementation of a reference NTOP server driver and glue software for use on LabVIEW^{TM} machine. (POC: Laura Pearlman, Paul Hubbard and Nestor Zaluzec)

- Installation, configuration and integration of video server, cameras and internet appliances. Equipment Site Responsibility. (POC: Nestor Zaluzec)

- Initial implementation of the video services protocol. (POC: Nestor Zaluzec)

- Identification of a streaming data client for use during the EA phase.

- Integration of the streaming data client with NTOP. (POC: Paul Hubbard)

- Identification of a streaming video client (or clients) for use during the EA phase. (POC: Nestor Zaluzec)

- Integration of the streaming video client(s) with the NEES video protocol(s). (POC: Nestor Zaluzec)

5.1.3 Conclusion of the Test

The SI team will provide a reference implementation of **Data Acquisition Services** (section 5.4.1 System Architecture document) based on the LabVIEW Virtual Instrument. If the Early Adopter site does not use LabVIEW Virtual Instrument as a DAQ, it is responsible for making the experimental data available in this format.

At the conclusion of the test, the equipment site is responsible for copying or moving the raw data from the NEES instrument DAQ system, along with calibration data from the control system, onto local data storage. Video data from the Internet Appliance or the video camera will also have moved onto the local data storage. The local storage service (operated and maintained by the NEES Equipment site) should be accessible to the NEESPOP using a local access mechanism. Recommended local access mechanisms are NFS, AFS, FTP, and scp.

GridFTP is used to copy (or move) the experimental data from the site local data storage into the central **NEES data repository** as described in section 7.2 of this document. This can either be done automatically by the central repository on a periodic basis, or can be "pushed" to the repository immediately by an investigator. All experimental data will now be accessible from the central NEES data repository by the investigators and other authorized users, using the NEES Data Discovery Protocol and GridFTP.

Investigators and collaborators can now download the entire dataset to their local machines and visualize the data using the synchronized Data/Video viewer provided by the University of Michigan or other local tools such as MatLab. Participants collaborate with the on-site scientists, technologists, and operators to understand and interpret the collected information.
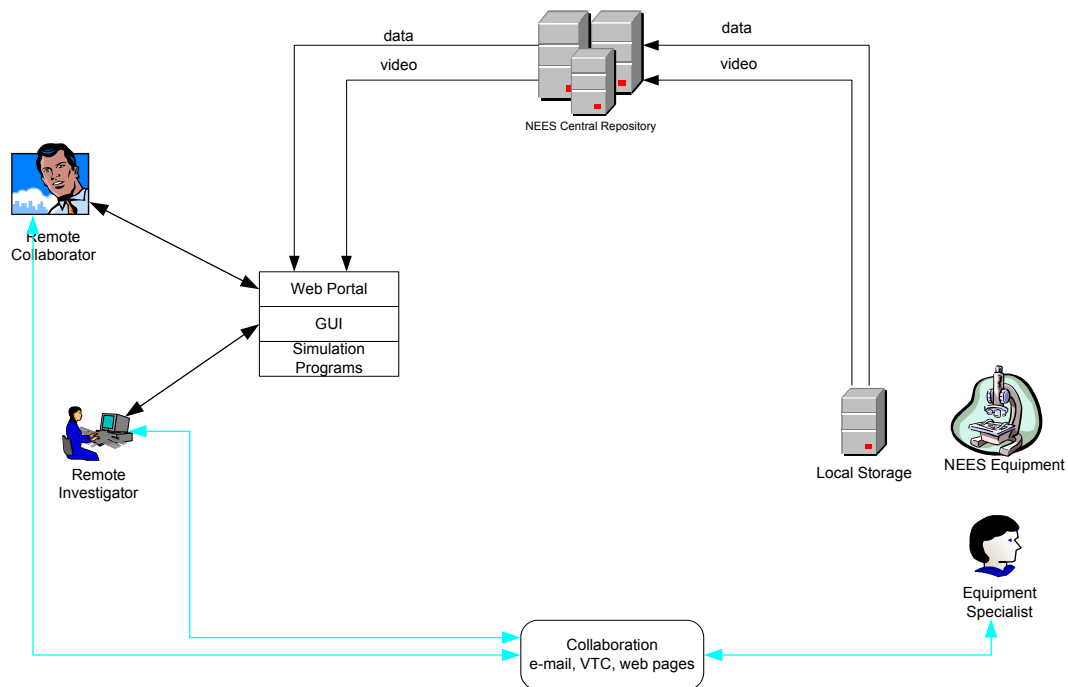
Figure 3: NEES components and services exercised at the conclusion of an experiment test.

5.1.3.1   NEES Components and tasks required at the conclusion of the test

- Reference DAQ implementation based on the LabVIEW Virtual Instrument. (POC: Paul Hubbard)

- Initial implementation of the metadata harvesting protocol (NMHP). (POC: Joe Futrelle)

- Identify local storage at EA site. Equipment Site responsibility. (POC: Joe Futrelle and Doru Marcusiu)

- Software/procedures to move experimental data from DAQ to local storage (e.g. NFS mounting, GridFTP etc.) Equipment Site responsibility. (POC: Joe Futrelle and Doru Marcusiu)

- Software/procedures to move all data (experimental and video) from local storage to centralized data repository. (POC: Joe Futrelle)

- Tools to visualize/analyze the data using browsers and simulation tools including the Data-Video Viewer from University of Michigan. (POC: Joseph Hardin)

5.1.4 Collaboration, follow-up test

Based on the conclusions drawn from the previous step (as facilitated by the use of collaboration tools), the investigators, collaborators and site equipment specialists decide on the parameters for the next test of the experiment, and then repeat the steps from section 5.1 above.

Alternately, they can decide to modify the experiment, design a new follow-on experiment, or conclude the experiment if the goals have been met.

5.1.4.1 *NEES components and tasks required for collaboration/follow-up run*

- All tasks in this section can be accomplished via the tasks listed in the above sections.

6 Global Timelines

❑ Development of architecture document — Feb 15th, 2002

❑ Visiting potential EA sites — Feb 28th, 2002

❑ Announcing EA sites — Feb 28th, 2002

❑ Assisting equipment sites with NEESpop
  specifications — Feb 28th, 2002

❑ Finalizing EA plans — Mar 31st, 2002

❑ Development of EA implementation plan
  (This document) — April 1st, 2002

❑ Communicating and firming up
  EA experimental plans with individual EAs — April 15th, 2002

❑ Tracking release of NMI — May 7th, 2002

❑ Release of strawman data models
  and recommended data formats — April 15th, 2002

❑ Installation of NEESpop at ISI, ANL,
  NCSA (Grid software) — May 1st, 2002

❑ Installation of mock ES at ANL for DAQ
  (LabVIEW for DAQ, Matlab under WIN, Mac) — May 15th, 2002

❑ Installation of mock ES at ISI for DAQ
  (LabVIEW for DAQ, Matlab under Linux)
  (Matlab under Linux/Win/MacOS) — May 25th, 2002

❑ Development of prototype NTOP protocols, data
  acquisition and data services and schemas

❑ Initiate installation of NEESpop at EA Sites — Jun 1st, 2002
  (dependent on sites having equipment by this time)

❑ Development of NMMP and NDDP based
  software (initial implementation) — Jul 1st, 2002

❑ Initiate Experiments phase 1 at EA — Jul 15th, 2002

❑ Conclude experimental phases 1 — Oct 15st, 2002

❑ Contact with all ESs via VTC and site visits — Continuous

7 Responsibilities within the SI Team

7.1 Deployment Services (lead: Randy Butler)

7.1.1 NEESpop Hardware Specifications

The NEESpop Hardware Specification document addresses hardware requirements for the NEESpop. The document also contains information about software, vendors, and networks.

7.1.2 Installation and testing of Packages

A testbed of several NEESpop machines has been established at NCSA. We are using these hosts to install targeted software and to make available a test environment for other NEESgrid SI developers.

Packaging techniques for deploying NEESgrid software are currently under development.

The NEESPOPs testbed at NCSA will be used to test the installation of the NEESgrid software in preparation for installation on NEESPOP machines at EA sites.

7.1.3 NEESpop Software Specifications

7.1.3.1 Components and Timelines

All NEESgrid software will be deployed on the SI testbed machines as it becomes available. It is anticipated that all the software will be available to be deployed at the EA sites by the first week of June.

7.1.3.2 Grid Services

- GRAM
- MDS2.1
- GridFTP
- GSI-Open-SSH
- Condor-G client tools

7.1.3.3 Support Software

- Httpd
- Tomcat
- JDK 1.3 or 1.4
- NTP
- Globus Java Cog
- NWS

7.1.3.4   Client Tools

NMHP protocol 1.0 alpha will be delivered and NMHP server 1.0 alpha will be deployed on NEESPOP by the end of June 2002, along with the following:

- NEES recommended data and metadata formats 0.5 alpha

- NEES Data Translation Toolkit (for translating limited kinds of data into recommended data and metadata formats) 0.5 alpha

7.1.4   Distribution of Software

The deployment team will be responsible for software distributions and their deployment. Software will be deployed remotely from NCSA to the EA NEESpop machines.

7.1.5   Bug Fixes

NEESgrid software bugs should be reported via email sent to the list "neesgrid-bugs@neesgrid.org". Eventually, a bug tracking system will be incorporated to track, record, and handle bug reporting information.

7.1.6   Frequency of Updates

The initial set of NEESgrid software will be distributed and deployed using NMI release I tools and packages. Future releases will be either synchronized with NMI releases, made as new functionality is introduced, or made as new software components and capabilities are introduced.

7.1.7   Testing of software

All essential Grid services and site NEESpop status will be tested remotely and displayed on a web page hosted on the NEESgrid website.

7.1.8   Information Services

The NEESgrid Virtual Organizational (VO) Index server will be hosted by NCSA. All NEESpop resource information servers will register with the VO server. The VO server will represent information about all NEESgrid resources as reported by the site resource information servers.

7.1.9   CA Services

The Alliance Certificate Authority (CA) will be entrusted with the task of issuing all NEESgrid certificates, using the NCSA certificate request and retrieval tools.

7.1.10 Account Management

Local accounts on the NEESpop machines will be created using Alliance account management infrastructure mechanisms. All users requiring NEESpop will make requests to the Alliance using the existing allocations request process. This process will result in the system configuration of the site NEESpop machine to provide the user access.

7.1.11 Packaging Software

One of the packaging goals for NEESgrid software is to provide a consistent mechanism for packaging and deploying the software. The Grid infrastructure software will consist of NMI core packages with additional NEES-specific packages packaged using GPT. While initial deployment of other NEESgrid software will probably not use GPT, every effort will be made to distribute future releases packaged with GPT.

7.1.12 Support and Communications

Support and communications between the EA sites and the SI team will be done via email lists and video teleconference (VTC) calls. Appropriate email lists will be established as new communities identify a need. VTC calls addressing specific issues can be arranged so that all interested parties can participate. The collaboration suite of tools for the EA period will be WorkTools. We plan to use the WorkTools mail list capability to have an archive of the e-mail, notification of announcements, threaded discussions, a resource area for documents, and other features.

7.2 Data Representation and Access (Lead: Joe Futrelle)

7.2.1 Software Development

The NEES Metadata Harvesting Protocol (NMHP) will be a lightweight protocol for transferring structured metadata. It will use GridFTP as its underlying transport mechanism, and will add functionality for transferring groups of metadata records, including:

- Flow control

- Grouping by date range

- Updates

- Push/pull modes (peer-to-peer)

The functionality of NMHP will closely resemble the Open Archives Initiative Protocol for Metadata Harvesting, but will have a superset of its features, notably Grid-based authentication and access control. An NMHP peer will be installed on the NEESpop at EA sites, and a corresponding peer will be deployed simultaneously at the central repository. The SI will oversee the configuration of NMHP at the EA sites.

The NEES Data Discovery Protocol (NDDP) will be a client-server protocol for performing queries against the metadata in the NEES repository. The NDDP server software will be developed and deployed at NCSA by the SI. A web interface (initially in a bare-bones implementation) will be deployed at NCSA on the same time frame.

In order to test these two protocols, EA sites must provide data and metadata formatted according to the NEES data and metadata format and place it in local storage accessible to the NEESPOP. Data formats and simple tools for generating data in those formats will be made accessible as the NMHP and NDDP tools are deployed.

The data and metadata models and formats will be capable of representing:

- Sensor data

- Metadata about the

    o Sensors

    o Experiment, including

        ▪ Experimental design

        ▪ Specimen design and characteristics

        ▪ "Human sensor" metadata

        ▪ Annotations

- Video

- Supporting documentation

These models, during the EA program, will provide limited metadata, since the full metadata specification is a large undertaking that is going on in parallel with the EA effort.

For more information, see the NEESgrid data repository page at http://www.neesgrid.org/repository/.

The strawman data/metadata model, released on 4 April 2002, is currently in version 1.1. This set of classes is designed to describe NEES-related entities such as investigators, experiments, and equipment. It also contains a number of abstract classes supporting these higher-level descriptions; attributes such as location; and entities such as quantities, identifiers, coordinate systems, and versions. For the specification, see http://www.neesgrid.org/repository/metadata/1.1/.

In order for shadow sites to participate in the development and testing of the data components, they can provide data in the recommended data and/or metadata formats. They can either make this data available to the repository by installing NMHP and GridFTP on their storage, or they can manually transfer their data to an EA site's storage.

7.2.2 Central Repository Issues:

The central repository will be deployed in its initial form by the first week of July. Repository services (data access, metadata harvesting, and data discovery) and their respective protocols (GridFTP/RLS, NMHP, NDDP) will be developed by the SI and deployed on NCSA's large-scale data systems, and an appropriate amount of disk space (initially on the order of 1TB) on those systems will be allocated to NEES data. The initial implementation of the repository will provide a subset of its eventual functionality sufficient to support EA experiments.

7.3 LabVIEW DAQ (Lead: Nestor Zaluzec)

This effort will proceed as follows:

- Installation of LabVIEW DAQ under Windows and Linux at ANL, ISI

- Development of a reference implementation of LabVIEW data acquisition system

- Conversion of data acquired into NEES recommended data formats (data software ready July frame).

7.4 Data Movement (Lead: Joe Futrelle)

Data will move from local storage to the central repository in two ways. Metadata will be harvested using NMHP. "Bulk" data (i.e., sensor data) will be transferred to the central repository using GridFTP. Both protocols will work either in "push" or "pull" mode, so that sites can decide when and how their data is transferred to the repository. For both kinds of data, transferring it to the repository will not remove it from local storage but rather will copy it. Sites will be able to implement their own policies with respect to archiving, deleting, or copying local data. A "delete after transfer" option will be provided as a convenience.

With regard to authorization, both the NEESpop and the central repository will be authorized to transfer data and protocol requests in either direction. This special level of authorization does not mean, however, that the *users* of these systems will be able to access the data without authorization. The repository and local storage system will enforce access control to data by non-local users. Access to data on the NEESpop, as well as on the local storage, will be controlled locally by the sites.

Local authorization policy and implementation is the responsibility of the sites; by the same token, authorization to physically access equipment is the responsibility of sites. With respect to authorization for reading and writing to the repository and for access to data once it is in the repository, the authorization strategy is two-pronged:

- Each data object (such as a metadata record, a video file, or set of DAQ channels) and/or collection of data objects will have access control lists (ACL's) associated with it, under the control of the producer of the data file (i.e. an investigator or group of collaborators).

- The NEESpop will have an identity as a user, so its ability to read and write particular data objects can be controlled by data producers with ACL's.

Once a data object is in the repository, users and groups can be authorized to read and write it, subject to consortium policy. These policies could certainly allow that the data producer can modify ACL's as they see fit.

ACL's will be able to control the following kinds of access:

- Read;

- Write;

- Search (i.e. a user might be authorized to see that a data object matches a search query, but not actually read the data set);

- List contents of a directory, folder, or collection;

- Add a new version; and

- Modify Access Control Lists (ACLs). An ACL is a data structure associated with a resource (e.g. file) describing which actions are permitted for which users or groups.

7.5 Streaming Data Issues (Lead: Nestor Zaluzec)

Using the Telepresence system discussed in the next section, data will be streamed from an EA site to remote collaborators. The collaborators will view streamed data in a browser window on their desktop systems after having been granted access by the NEESpop. From within the browser window the remote client will be able to select authorized subsets of the experimental data being generated at the EA site.

7.6 Tele-presence Observation and Operation (Lead: Nestor Zaluzec)

During the EA phase of the NEESgrid project, the Telepresence system will concentrate upon the implementation of the passive mode of operation. In this mode, the Telepresence system will initially provide a ubiquitous thin-client WWW-based environment to a NEES Equipment Site, accessible to any remote users authorized by the NEESpop using the CA. Collectively, the system will consist of a user interface, as well as hardware and software facilitating the linking of a remote workstation to an authorized resource. There will be no attempt to facilitate active (control) mode during the EA phase.

7.6.1   Tele-presence Functionality:

The following functionality will be provided by the reference implementation of the Tele-presence architecture.

- Virtual experimental windows that can be configured remotely to permit viewing of user-selected sensor data-streams in near real-time from a Labview ™ system;

- Remote viewing of lab space and physical experiment by remote tele-robotic video cameras having ZPT (zoom-pan-tilt) capabilities;

- Remote viewing using fixed video cameras that are positioned by a local collaborator for site-specific observations;

- Remote audio connection to the lab space to monitor the sounds of the experiment;

- An electronic notebook for documenting and sharing experimental data integrated into grid services; and

- Remote viewing of high-resolution, non-video static images uploaded to the notebook by a user.

In order to achieve this functionality at all NEESgrid sites, an initial architecture consisting of both hardware and software components must be established. Just as the SI has selected LabView as a representative DAQ system, a similar selection of hardware and software has been documented for a number of the Tele-Presence related components.

7.6.2   Tele-presence Hardware Specifications

The hardware architecture for the Tele-Presence Video System is documented in the white paper (TPMOverview20020306.pdf). The basic system consists of:

- A Grid-enabled Linux server: which communicates to the NEES POP, remote clients and experimental resources using the appropriate protocols;

- Internet-aware video appliances;

- Internet-aware audio appliances;

- Connections to audio and video sources;

- Video and audio data streams from I/O devices;

- Connections to LabView™ data acquisition and control system(s); and

- Data streams to/from a LabView™ DAQ and control system(s).

A prototype of this set up is currently operating with limited functionality at ANL.

7.6.3 Hardware /Software Installation:

Individual EA sites wishing to participate in telepresence testing will procure the commodity hardware and software, based upon the specifications and their individual site requirements. Commodity hardware has been specified that requires minimal customization. Installation procedures and simple on-line tools will be developed by the telepresence team and distributed as needed to the EA sites to permit configuration of the various internet appliances and software. These will eventually be "packaged" for the Deployment Services Team.

The following software packages are the minimally required subset on the TVS.

- Red Hat Linux 7.2 patched to the appropriate level;

- Apache WWW server (with and without SSL);

- Perl, Java, SSH, GridFTP/RLS, NMHP, NDDP; and

- Broadware IMS Video Server (commodity software for Linux).

7.6.4 Software Development Tasks:

The specification of NTOP and the development of implementations of this protocol will be carried out in parallel with deployment of the conventional telepresence services.

Modifications to the e-notebook will be implemented in order to integrate it into Grid services and to make it possible to use this user interface for metadata creation. Data files created by the notebook will be presented to NMHP for processing.

The NTOP Data Server will be written in Java for the telepresence Linux box.

7.6.5 Time Lines for Tele-Presence Services

Reference implementation of streaming A/V at ANL	May 1st
Reference implementation of LabView in NTOP at ANL	May 1st
Gridification of e-notebook	June 1st
Reference TPS available for installation at EA site	July 1st
NTOP specifications completed	Aug. 1st
NTOP implementation in LabView	Oct. 1st

7.7 Collaboration Services and Issues (Lead: Joseph Hardin)

7.7.1 EA Phase Collaboration

The collaboration system provided for the EA phase will be the prototype WorkTools system. This collaboration environment is already in use by some of the SI teams working on NEESgrid development. Information about WorkTools can be found at http://worktools.si.umich.edu. For a tour of WorkTool's capabilities, see http://worktools.si.umich.edu/wt-tour/. A description of the services provided by Worktools can be found at https://coursetools.ummu.umich.edu/umwt/help.nsf/ .

As part of the EA preparation, a worksite will be setup for each EA site, and an additional "global" worksite will be set up for all EA sites to use. Users from each EA site will be registered to allow entry into their site as well as the global worksite. WorkTools will be hosted by the University of Michigan for the EA period; this can be extended if need be.

Every WorkTools worksite starts with a login page. An EA site may choose to present publicly available information here. The site may also list documents to be downloaded by the general public. Only participants of the team can log in and access private materials beyond this page. Materials are designated *private* or *public* when they are uploaded into the worksite's resources area.

After successfully logging in, participants arrive at the EA sites worksite home. The worksite home includes recent announcements, selected resources the organizers choose to highlight, and a navigation bar to access materials and communications functionality.

The functionality provided by WorkTools, all through a web browser, is:

- Group Repository, (Files, URLs, documents);
- Mail list and email archiving, including search capability on the archives;
- Threaded discussion groups;
- Announcements, notifications;
- Calendar, in calendar format or as lists;
- Chat;
- Remote Slide presentation;
- Login; and

- Other features (see below).

7.7.2 Access Privileges

There are two levels of worksite access: organizer and participant. There is no limit to the number of organizers or participants who have access to a particular worksite. Organizers can add or delete participants at will, and can allow a participant to have organizer status.

7.7.3 Worksite Administration

Organizers use the **administration** area (available only to them) to make features like the schedule, chat, and threaded discussion available. They also determine the level of web-email integration. For example, participants can be automatically notified via email when a new discussion item is posted at the worksite. No knowledge of HTML is necessary to set up and administer a WorkTools site. Organizers can tailor the worksite to their particular sites needs and preferences.

7.7.4 Simple Participation

Participants can post **announcements**, and schedule items, tasks, and resources by typing directly into web forms. No knowledge of HTML is necessary. Plaintext postings are simple to create, modify, and delete if necessary. URLs typed into these documents are automatically "hot," and the author can easily link to other materials available in the worksite resources area.

The worksite **schedule** can be displayed as a list or in calendar form. Schedule items often include upcoming meeting agendas, past meeting minutes, project benchmarks and action deadlines. If the worksite organizers wish, an email message can be automatically sent to each participant every time a schedule item is posted or revised. The schedule is one-way EA sites can use in planning experiment tests.

7.7.5 Sharing Materials

The **resource** area is where worksite participants store materials in the form of plaintext, uploaded files, or web links. Resources are usually arranged into cascading folders. There is currently no limit to the number of resources that can be posted in a worksite. One copy of a document can be placed in the resources for everyone to view rather than emailing each participant a separate copy (attachment).

7.7.6 Online Conversations

The **discussions** area is the place to engage participants in on-line conversations that might have otherwise happened via email. Like email, worksite discussions are asynchronous. Unlike email used outside of WorkTools, worksite discussions are automatically archived and always available for review by all participants. Attachments reside at the worksite instead of in email inboxes and personal hard drives.

An EA site may choose to allow use of the **chat** feature to facilitate online conversations among participants. Transcripts of worksite chat sessions are available for later review.

7.7.7 Remote Presentation – Slide tool

Slide presentations can be conducted remotely for any number of participants who may be online and participating from various locations. Slides are presented using the **presentation** tool. To give a slide show, the presenter uploads a PowerPoint slide set. It is available immediately to the slide show viewers as a full screen image, with slide advancement controls. The chat tool is also integrated with the presentation tool, and can be used simultaneously, if desired.

7.7.8 Video and Data Browser

The Video/Data Browser and the use of WorkTools are deliverables for the EA phase. The data browser will be available as a prototype for EA, operating outside of the WorkTools environment. For EA, there will be only two kinds of data plots: a property over time and a property over a property. More features will be added after the EA phase, depending on user requests and priorities. For video, only one or two video formats will be supported.

The data viewer depends on the metadata and repository specification. For EA, these models will be limited (see Section **Error! Reference source not found.**), and the Video/Data Browser will accept data formatted in the recommended format as of EA.

7.8 Support, EA Communications, Coordination (Sridhar, Ian, Carl)

These tasks will proceed as follows:

- Announce EA list;

- Weekly Meeting within SI team to track progress;

- Weekly meeting with all EA sites (sharing of issues and problems) our software and components are very similar at all sites, so everyone can benefit from a common discussion;

- Develop progress markers;

- Track progress on all fronts; and

- Establish POCs within the SI team for the EA sites, at least two (one from NCSA and one from the development team).

7.9 Documentation

Documentation will be web-based HTML format and available on the NEESgrid web site. The following is a list of documentation that will be provided:

- NEESgrid Site System Administration Guide

- Toolset, as appropriate

8 Milestones for First Phase of EA Experiments

- Establishment of NEESpop at ANL, ISI, NCSA
- Establishment of Video services at ANL and ISI
- Establishment and testing of NEESpop at ES
- Installing GridFTP on local storage at ES and ANL, ISI, NCSA
- Installation and testing of NMHP, NDDP data software at ISI, ANL, NCSA
- Installation and testing of NMHP, NDDP data software at ES
- Installation of video services software at ISI, ANL
- Installation of video services software at ES
- Demonstrating data acquisition ES
- Demonstrating Telepresence at ES

9 Work Plan and Milestones, in breakdown by Month

9.1.1 April:

Deployment Group:

- NEESpop testbed at SI sites established for testing and development
- Development of NEESgrid specific packages

Data Acquisition

Data Model Software Services

  Strawman data models and scenarios released

Data Movement:

Central Repository

  Allocation of disk space

  Installation of GridFTP and RLS

Video Services

Collaboration Tools
  First prototype of Chef (based on http)

Coordination Communications

NEES Site Reno

NEES Site RPI

NEES Site Oregon State

9.1.2 May

Deployment Group:

- Develop GPT Beta version of NEESgrid Grid Services Distribution
- Test installation process of beta version of NEESgrid Grid Services Distribution
- Development of prototype examples site resource objects for NEESgrid information services

Data Acquisition

  Strawman data models and scenarios revised based on EA feedback, submitted to data and MD task force

Data Model Software Services

  Data Translation Toolkit v0.5 alpha

Data Movement:

Central Repository

Video Services

Collaboration Tools

Coordination Communications

NEES Site Reno

NEES Site RPI

NEES Site Oregon State

9.1.3 June

Deployment Group:

- Install NEESgrid Grid Services Distribution on site NEESPOPs

- Test grid services on site NEESPOPs

Data Acquisition

      Sspread sheet MD templates added to Data Translation Toolkit

      Columnar ASCII translation code added to Data Translation Toolkit

Data Model Software Services

      NMHP procotol 1.0 alpha specification

      NMHP client and server 1.0 pre-alpha experimental prototypes

      NDDP protocol 1.0 alpha specification

      NDDP client and server 1.0 pre-alpha experimental

Data Movement:

Central RepositoryVideo Services

Collaboration Tools

      Port Video viewer to CHEF

Coordination/Communications

NEES Site Reno

NEES Site RPI

NEES Site Oregon State

9.1.4 July

Deployment Group:

Data Acquisition

Data Model Software Services

      NMHP client and server 1.0 alpha

      NDDP client and server 1.0 alpha

Data Movement:

Central Repository

      NMHP client and server 1.0 alpha deployed at repository

      NDDP client and server 1.0 alpha deployed at repository

Video Services

Collaboration Tools

      Migration to NMMP and NDDP

Coordination Communications

NEES Site Reno

NEES Site RPI

NEES Site Oregon State

9.1.5 August

Deployment Group:

Data Acquisition

Data Model Software Services

Data Movement:

      Demonstration of transfer of data to repository

Central Repository

      Demonstration of data discovery

Video Services

Collaboration Tools

Coordination Communications

NEES Site Reno

NEES Site RPI

NEES Site Oregon State

9.1.6 September

Deployment Group:

Data Acquisition

Data Model Software Services

Initiate revision of data software to accommodate recommendations of data/MD task force

Data Movement:

Central Repository

Video Services

Collaboration Tools

Trouble shooting, user feedback, adding user requests, migration to GridFTP

Coordination Communications

NEES Site Reno

NEES Site RPI

NEES Site Oregon State

10 Proposed EA site: University of Nevada, Reno

NEES Equipment: Shake Tables

POC: Prof. Gokhan Peckan peckan@unr.edu

Plan**:** The experiments proposed for the EA system include several shake table runs at various stages and capacities. Develop test specimen(s), perform necessary setup, installation and run tests on the shake tables.

NEESpop activities will include**:**

Data acquisition, archiving, and making it retrievable;

Teleobservation

Description of a Generic Test Specimen

Test specimen(s) should represent a realistic structural system that both the scientific community and public are familiar with. Examples of such systems that LSSL can offer are:

a) Three-story, small-scale 'shear' building,

b) Typical section of a bridge hinge restrainer sub-system on elastomeric bearings,

c) Scaled models of various reinforced concrete bridge piers.

d) Scaled model of slab-on-steel girder bridge (requires two or three shake tables)

The above list is given in the order of ease of setup and instrumentation. Following table summarizes estimates of time required to setup including placement of the specimen on the shake table, instrumentation, tuning, and minimum number of instruments/channels to realistically capture response characteristics.

Test Specimen	Time Required to Setup	Number of Instruments	Dates	Experiment Phase
a	2 days	7	May – July 2002	1
b	7 days	12	June – July 2002	1
c	7 days	40	June – August 2002	2
d	21 days	60	June – August 2002	3

Phase 0: Set up an initial NEESpop box. Install grid software packages and test it out components and a whole.   Test network connectivity to outside world, test data control, and access from outside. Perform other set up tests as appropriate.

Test interface from NEES equipment to NEESpop.

Experiment Phase 1:

Develop specimen, set up shake table appropriately. Set up and acquire data (*data acquisition*) from experiment with 7 instruments and make data available via rudimentary data models and access methods.

Prerequisites on SI side: Prototype data models and schema to capture and present data

Experiment Phase 2:

Develop specimen, set up shake table appropriately. Set up and acquire data (*data acquisition*) from experiment with 40 instruments and make data available via rudimentary data models and access methods.

Develop and enable rudimentary tele-observations. Single or multiple video streams to remote sites.

Prerequisite on SI side: Prototype teleobservation mechanisms in place. Handling of multiple video streams, storage (with appropriate meta data), and retrieval (using GridFTP).

Experiment Phase 3:

Develop specimen, set up shake table appropriately. Set up and acquire data (*data acquisition*) from experiment with 60 instruments and make data available via rudimentary data models and access methods.

Continue development and enable rudimentary tele-observations. Single or multiple video streams to remote sites.

Store video data using rudimentary data models and make these available for post experiment analysis.

11 Proposed EA site: Rensselaer Polytechnic Institute

NEES Equipment: Centrifuge

POC: Prof. Mourad Zeghal zeghal@rpi.edu

Plan**:** The experiments proposed for the EA system include several runs of the centrifuge at various stages and capacities. Develop test specimen(s), perform necessary setup, installation and run tests.

NEESpop activities would include**:**

- Data acquisition, archiving and making it retrievable; also, near real-time sharing of EXCEL files as well as plots of data values;
- teleobservation: three video streams to be generated; and
- telecontrol (very limited).

Experiment Phase 0: Set up an initial NEESpop box. Install grid software packages and test it out components and a whole. Test network connectivity to outside world, test data control, and access from outside. Perform other set up tests as appropriate.

Test interface from NEES equipment to NEESpop.

Setup on centrifuge by installing and testing 32 DA channels (PXI & SCXI units) from National Instruments. Preliminary implementation of LabView from NI.

Experiment Phase 1:

Data Acquisition: Acquire data, store and make it available in near real time. Make plots of processed data available at the conclusion of the experiments.

Prerequisites on SI side: Prototype data models and schema to capture and present data

Experiment Phase 2:

Setup and run centrifuge collect data from 128 channels in Labview,

Data Acquisition: Same as phase 1, with additional channels of data

Telepresence: Set up and operate three video streams to monitor the centrifuge, model and to communicate with the onsite centrifuge operator. Make these three streams available to remote participants.

Prerequisite on SI side: Prototype teleobservation mechanisms in place. Handling of multiple video streams, storage (with appropriate meta data), and retrieval (using GridFTP).

Experiment Phase 3:

Setup and run centrifuge; collect data from 196 channels in Labview,

Data Acquisition: Same as phase 1, with additional channels of data

Telepresence: Same as in phase 2, but with the ability to digitize video streams and make these available to remote users.

Telecontrol: Limited remote teleoperations. Can send messages to the centrifuge operator and she/he can perform actual operation.

Prerequisite on SI side: Development and implementation of prototype telecontrol protocols.

12 Proposed EA site: Oregon State University

NEES Equipment: Wave Tank

POC: Prof. Solomon Yim Solomon.yim@orst.edu

Plan**:** The experiments proposed for the EA system include several runs of the wave tank to generate tsunami run-up experiment of moderate scale to demonstrate a range of instrument and data acquisition capabilities.

NEESpop activities will include**:**

- data acquisition, archiving and making it retrievable, searchable interfaces
- teleobservation: (two video streams to be generated) one underwater and one on surface. Audio data will also be collected and stored
- simulation studies compared with experimental findings make this a useful exercise

Phase 0:

Set up an initial NEESpop. Install grid software packages and test it out components and a whole.   Test network connectivity to outside world, test data control, and access from outside. Perform other set up tests as appropriate. The wave tank is already set up in a model-of-opportunity and will only require minimal modifications.

Experiment Phase 1:

Data from 12 sensors, two cameras (one underwater and the other on the surface) coupled with a microphone (audio data) will be stored temporarily on a file server at the Wave Research Laboratory, and then uploaded via existing gigabit Ethernet to larger fileserver, to be made available for downloading.

Prerequisites on SI side: implementation of basic data models and schemas to present data for sharing amongst scientists. Prototype teleobservation mechanisms in place. Handling of multiple video streams, storage (with appropriate meta data), and retrieval (using GridFTP).

Experiment Phase 2:

Interfaces will be developed by Oregon State to enable browsing of results from multiple past experiments.

Experiment Phase 3:

Simulation studies and results will be included in the data that is disseminated. Predictions of wave profile and wave induced velocity from deterministic algorithms that use water depth and generator displacement.

Appendix 1

Outline of Experimental Program for NEES-POP Development at the University of Nevada, Reno (UNR) – Large-Scale Structures Laboratory (LSSL)

Prof. Gokhan Pekcan (Nov 2001)

Objective

The objectives include development and refinement of the NEESGrid software (NEES POP) that is expected to enable teleparticipation (i.e. teleobservation and teleoperation) as part of the NEES project, demonstration of utility and generation of excitement in the earthquake engineering community at large in a timely and efficient way.

This exercise involves a number of shake table runs at various stages and capacities. For this purpose, one or more test specimens and necessary setup, installation and shake table time will be required.

Description of a Generic Test Specimen

Test specimen(s) should represent a realistic structural system that both the scientific community and public are familiar with. Examples of such systems that LSSL can offer are:

a) Three-story, small-scale 'shear' building,

b) Typical section of a bridge hinge restrainer sub-system on elastomeric bearings,

c) Scaled models of various reinforced concrete bridge piers.

d) Scaled model of slab-on-steel girder bridge (requires two or three shake tables)

The above list is given in the order of ease of setup and instrumentation. Following table summarizes estimates of time required to setup including placement of the specimen on the shake table, instrumentation, tuning, and minimum number of instruments/channels to realistically capture response characteristics.

Test Specimen	Time Required to Setup	Number of Instruments
a	2 days	7
b	7 days	12
c	7 days	40
d	21 days	60

It is noted here that option d) is not feasible until after the installation and acceptance of the third shake table, i.e. mid-July 2002.

Experimental Procedure

Stages III and IV as described above under the heading *Shake Table Experiments, Instrumentation and Data Acquisition/Storage*

Timelines

It is expected that before the construction commences on or about April 1, 2002, one of the two existing uniaxial shake tables will be available for short periods of time during January-March, 2002 time frame. But this shake table will be required and used for ongoing research projects as well. Therefore, it is suggested that test specimen a) be used as the test bed for the initial and follow-up phases of NEEGrid/POP development, because it will require the minimum time to setup and run.

It is anticipated that at least one of the three shake tables will be operational during the upgrade and construction of the shake tables during the April-July, 2002 time frame. It may be possible to use test specimens described in either b) or c) during this period if necessary.

Once the construction is completed and three biaxial shake tables are available in mid-July, 2002, it will be possible to setup test specimen d) over two or three shake tables for demonstration purposes to a broader [interested] community.

Once research on this specimen is complete (late summer), the three tables will probably be reconfigured for single table operation to address the backlog of work expected to accumulate over the summer months. Nevertheless, it is envisaged that one of the three tables will be available for NEES-POP development using one of the specimens a, b or c, listed above.

Appendix 2

Rensselaer Polytechnic Institute (RPI's) Centrifuge

Data Acquisition and Local Network Implementation Schedule Dr. Tarek Abdoun, Dr. Christophe Dupre, Prof. Mourad Zeghal (Nov 2001)

Local network:

According to our NEES project schedule, we are currently working on building the gigabit local network at the RPI centrifuge facility. The RPI centrifuge local network will be installed in three phases according to the following schedule:

Phase 1:   i) High speed connection (uplink)
           ii) Cisco Gigabit/FastEthernet switches   January 31, 2002
           iii) Computer Rack
           iv) Inter-room cabling

Phase 2:   i) Cisco PIX Fire wall
           ii) 50-60 Gigabyte file server   March 31, 2002
           iii) Tape Backup system

Phase 3:   i) Increase file server capacity   During the Fall of
              (if needed)   2001 (2002?)

Data Acquisition (DA):

As part of the NEES project we are planning to replace the current DA system (32 DA channels & DOS based software) by a CDAN (Centrifuge Data Acquisition Network, see Figure 1). CDAN and the high speed RPI network connection will make it possible to share experimental data and other information in near real time between the research staff at the RPI centrifuge and outside parties. CDAN will include 128 to 196 DA channels and Lab View. The current DA system will be maintained during the deployment of CDAN according to the following schedule:

Phase 1:   i) Cisco wireless network
              between the centrifuge machine
              and the control room
           ii) Installing and testing 32 DA   March 31, 2002

channels (PXI & SCXI units)

from Nation Instrum ents (NI)

iii) Preliminary implementation

of Lab View from NI

Phase 2:   i) Increasing the DA channels

to 128

ii) Advance implementation of Lab   June 30, 2002

View

iii) Add ability to digitize NTSC

video feed

Phase 3:   i) Increasing the DA channels

to 196

ii) Full implementation of Lab   During the Fall of

View   2002

iii) Install High Speed camera

and image processing software

Successful implementation of the local network and CDAN according to the time frame presented above as well as the installation and debugging the POP during the Spring of 2002 would allow us conduct a demo test for the NEES group some time during the summer of 2002. The demo test might include the following:

1) Outside user teleparticipation via NEESgrid high speed connection (three video streams are needed to monitor the centrifuge, model and to communicate with the centrifuge operator onsite)

2) Outside user limited teleoperation of the shaker (for safety reasons he can select the shaker excitation signal but before actually sending the signal it has to be approved by the centrifuge operator onsite)

3) Outside user would have immediate access to the excel files of the recorded data

4) Outside user would have immediate access to plots of processed data (similar to the plots we sent to you on 11/21/2001)

5) Outside user would have immediate access to results and plots of advanced analyses such as System Identification and Visualization (This really depend on the computational capabilities and software packages made available to us by the NEESgrid)

If we run into problems during the implementation of the CDAN system and we couldn't finish in the time frame presented earlier, we can only have items (i) to (iii) available for the demo test. This is our preliminary thought of what could be done for the demo test based on the limited information of the POP capability and we certainly appreciate any

additional ideas from your group. We expect this to change and improve as the project progresses.
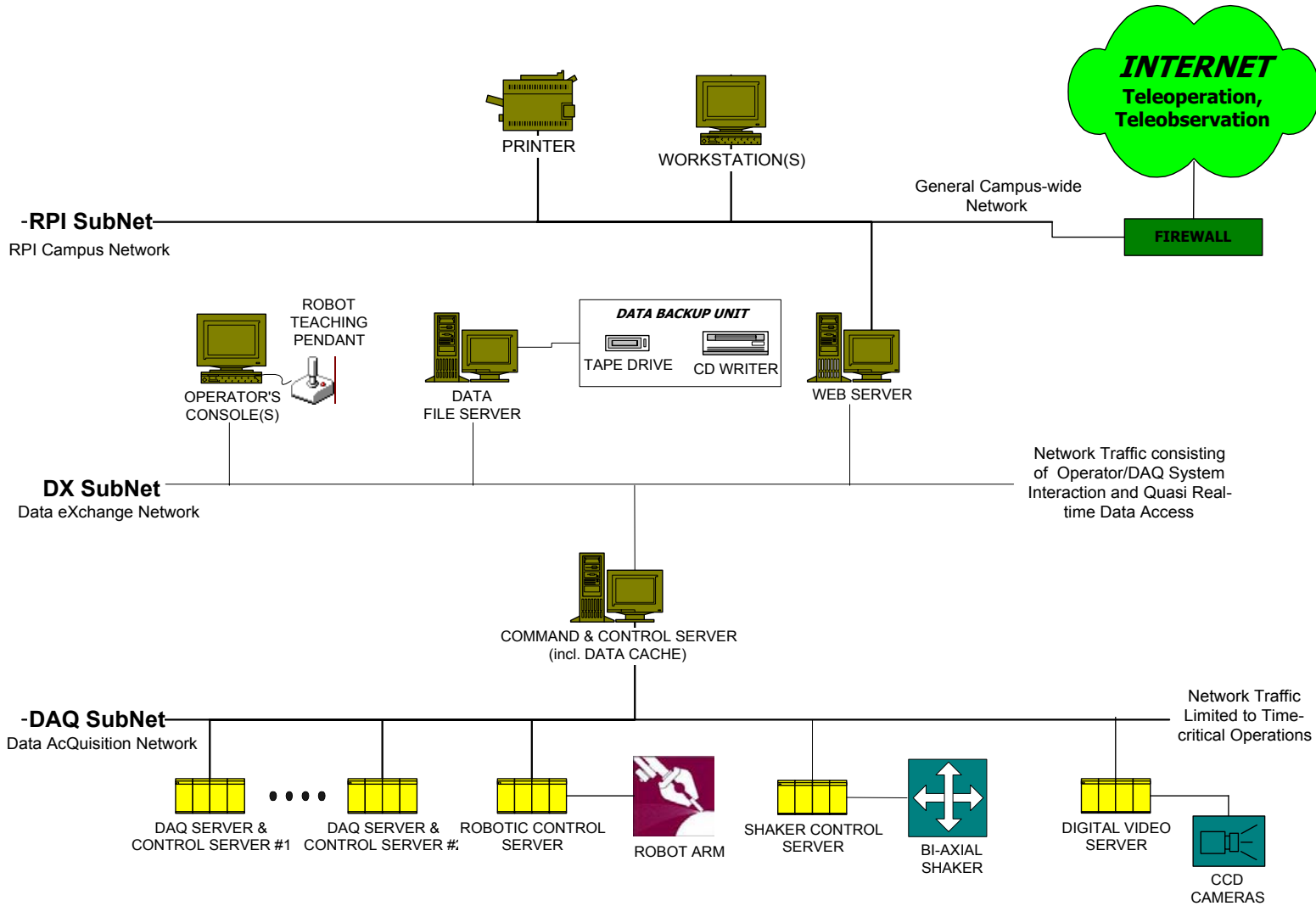

Figure 1: Topology of proposed RPI Centrifuge Data Acquisition Network (CDAN)

Appendix 3

EARLY ADOPTER EXPERIMENT

TSUNAMI WAVE BASIN

OREGON STATE UNIVERSITY

From Prof. Charles Sollitt (Nov, 2001)

Oregon State University proposes to model a tsunami runup experiment of moderate scale to demonstrate a range of instrument and data acquisition capabilities. The experiment will be undertaken in our directional wave basin, which measures 26.5 m (87 ft) long, 18.3 m (60 ft) wide and 1.5 m (5 ft) deep. Our 30-segment directional wave generator will be used at full stroke, 0.91 m (3 ft) and maximum velocity, 1.02 m/sec (3.33 ft/sec) to produce a tsunami wave height of approximately 18 cm (7 in) in a water depth of 1.0 m (3.28 ft). The wave crest line will be directed parallel to the face of the wave generator and incident upon a model of a half-section of a jetty or peninsula of regular geometry. The jetty model is constructed along one wall of the basin with the basin wall forming the centerline of the model. The effect of the wall is simply to provide a line of symmetry, yielding the equivalent test of a full width jetty located down the centerline of the basin. The headland of the jetty is conical in shape, one-quarter cone, and is armored with uniformly placed concrete armor units to prevent destabilization of the permeable core material (3/4-2 in gravel). The slopes of the cone headland and sides of the jetty are 2:1, horizontal to vertical. This is a model-of-opportunity that is currently in place in the basin and will require minimal modification for the proposed tests.

A suite of twelve sensor-based measurements is proposed along with one surface and one underwater video camera. The sensor-based measurements will include four electro-resistive wave gauges, which will monitor the water surface elevation in front of the wave generator and at three locations near the toe of the jetty head. Three electro-resistive runup gauges will monitor the water excursion up the conical jetty head at orientations of 0, 45 and 90 degrees relative to initial direction of wave propagation. A three axis current sonic current meter will measure mutually orthogonal tsunami induced water velocities in front of the wave board. Also, a two-axis load cell will support an isolated armor unit in the vicinity of the jetty to examine tsunami induced forces on the armor unit. Two additional channels of data will be monitored: the input displacement signal to the wave generator and one wave board displacement response. Finally, a digital surface video camera and an analog underwater video camera, the latter run through a frame grabber, will be recorded. The surface video will pan the test area and the underwater video will be focused up the conical slope. The microphone output of the surface video will also be recorded to complement the test experience.

The sensor-based data will be sampled at 30-100 hertz. The video images will be sampled at 30 hertz or more. These sampling rate ranges are appropriate for resolving the observed phenomena. The image density for both cameras is 380K pixels. The analog camera has an NTSC resolution of 460 lines with 400 vertical columns. Higher rates can be sampled to test the throughput of the system. The duration of the proposed experiment

will be 256 seconds or less. Experiments can be repeated approximately every thirty minutes; a stilling period of approximately one-half hour will be required to establish acceptable low background currents in the basin.

Data collected from the experiment, including sensor output and video as well as descriptive metadata, will be stored temporarily on a file server at the O. H. Hinsdale Wave Research Laboratory (WRL), and then uploaded via our gigabit Ethernet link to a larger fileserver at the Northwest Alliance for Computer Science and Engineering (NACSE) and made available for downloading via a web-based interface. The interface will allow experimenters to search, mainly via drop-down lists of metadata entries for specific experiments and categories of data. In the initial early adopter experiment, the search capability will be largely for demonstration purposes, since the number of experiments in the data will be small, possibly one. However, we will develop an interface that is intended to be scalable to large numbers of experiments and associated data files.

In generating metadata, we distinguish between identifying metadata and descriptive metadata. Identifying metadata include data such as the date and location of the experiment, and keywords indicating the type of experiment, effects being examined, wave types involved, etc., i.e., those metadata which an experimenter could use to find a particular experiment in a database of experiments. Descriptive metadata are used to describe the particular experiment, and may include lists of sensor types and locations, calibration information for test equipment, etc.

At a minimum, descriptive metadata for the experiment should include the following for each sensor: identifying name, sensed property, serial number, x-y-z location relative to basin corner (using a Cartesian coordinate system, first quadrant), calibration in engineering units per volt, date and time of calibration. A total station survey of the model surface should be recorded and referenced to the same basin corner used to locate the instruments. The video cameras should be similarly identified and located with the x-y-z coordinates of the initial image center also noted. Some fiducial reference points should be visible in each video frame and the location noted in the metadata.

Simulations will be straightforward predictions of the wave profile and wave-induced velocity from deterministic algorithms that use the water depth and generator displacement as independent variables. Least squares error analysis relative to the measured profile and velocity will provide a rational basis for evaluating the simulation and modifying subsequent tests.