

MCEER RESEARCH TASK STATEMENT

Thrust Area: Networking

Budget:

Yr 9 Assigned

Project Number: 9.5.1

Task Title: Integrated Networking Infrastructure Based on Grid Computing

Investigator/

Institution:

A. M. Reinhorn*, University at Buffalo (UB) / J. Hanley (UB)

G. Dargush / Mark Green (UB-CCR)

T. O'Rourke / Art Lembo (Cornell)

R. Eguchi (ImageCat)

M. Grigoriu (Cornell) / Filiatrault (UB)

M. Shinozuka (UCI)

**indicates task leader*

Statement of Project Goals: *(Conceptually describe what the work is intended to accomplish, in 100 words or less. Do not provide detailed description here.)*

The objective of this task is to continue develop the networking infrastructure for sharing newly developed products of research and disseminate them through educational programs. While this is a continuation of the original objectives of the program, in Year 9 a new development will start based on new developments in the GRID computing, primarily based on the availability of NEESgrid infrastructure, an open architecture, missing currently the computing simulation infrastructure, which can be offered by MCEER through this Task: The objective is to implement the developments of MCEER's integrated multi-hazard risk reduction decision tools in a grid environment which simulates the Center System diagram (see below).

The infrastructure includes software for communication, integration and linking distributed software and databases produced by the research tasks. Moreover the development includes distribution of information via web-based operations to engineering community, to research community, to educational programs at MCEER institutions and its minority based universities. Work in this task includes a functional integration of the information collected to develop an integrated platform.

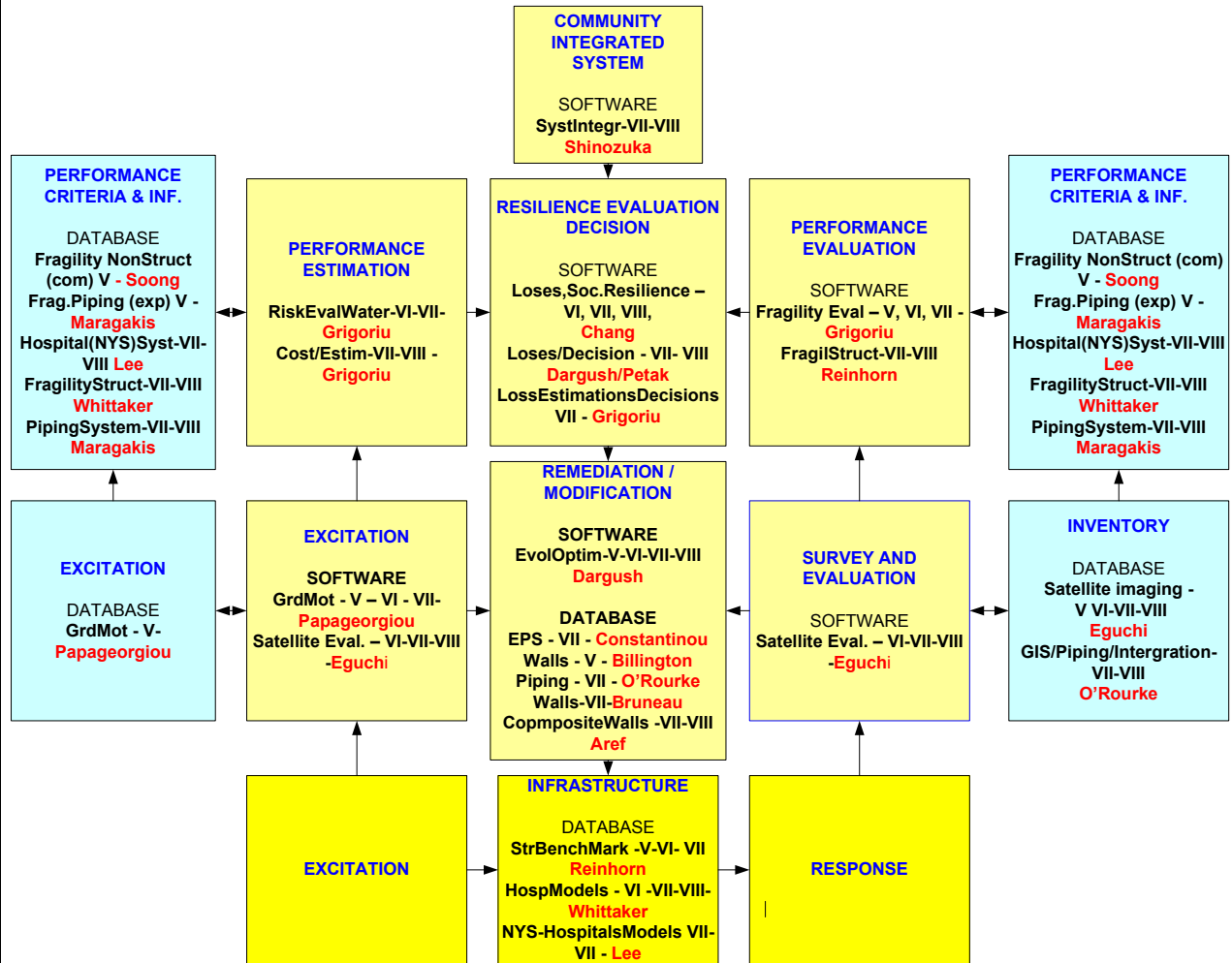
Year 9 will focus on development of a prototype example linking several products resulting from research tasks, ground motion generation, network layout (GIS) and damage survey (Satellite), resilience evaluation, decision support, response modification, integration done within a GRID computational system.

Problem Description and Research Approach of Proposed Work for Year 9: *(Detailed description of research to be conducted and methodology to be used.)*

Following the developments in previous years, the Networking Program is focusing on organizing a distributed infrastructure of access to products created in the main research tasks. The infrastructure has grown by adding individually developed software products and databases, mostly prepared for the evaluation of structures and lifelines and for surveying damage. While the products available in the network are those, which became available in the previous research tasks, those products do not cover the overall center-wide mission as reflected in the system diagram.

The Networking Program identified products developed in the research tasks, products missing in the “overall system platform” see diagram below, and planned networking sub-tasks, which can complement and complete the platform.

The networked products cover evaluation procedures and databases, which are stored at institutions, which developed them and procedure to access and use them. The access currently is only individual and is based on a series of web-access procedures developed as templates, - or example programs –, which facilitate use by researchers, industry partners and other users.



This task will develop (i) an example of integration of several products resulting from research tasks, i.e. ground motion generation, network layout (GIS) and damage survey (Satellite), resilience evaluation, decision support, response modification with the cooperation of the suggested investigators; (ii) the integration will be done for pairs of procedures and databases at one time, building API (Application Interfaces) based on grid computing principles which allow operating the procedures at the location where was generated and where is continuously maintained (similar with the “teleoperations” of equipment in NEES environment); (iii) the grid operations will be developed to use either generic grid or NEESgrid which will provide the access through multiple links and computer systems operating the procedures. Mr. Jason Haley and Mr. Mark Green working with the task leader in the networking efforts will verse the grid computing planning component of this task. In preparation for this integration task a one day meeting will be organized to identify the most appropriate demonstration example

to be developed; A second one day meeting will be organized for evaluation of connectivity and possible integration of multiple procedures.

Moreover this networking program will facilitates use of the center information by students and researchers for education purposes through web-based distribution. Webcast seminars and other lectures, video-teleconferences and other virtual meetings will be further developed and supported with infrastructure developed in house using low budget communication systems through web and point-to-point connections.

The program in cooperation with the Education Program will also provide support infrastructure for the multidisciplinary seminar, which covers the integrated engineering and social science aspects. The Networking Program will provide the infrastructure for development of such seminar without displacing the speakers and the audience.

Assessment of State-of-the-Art: *(Describe other relevant work being conducted within and outside of MCEER, and how this project is different.)*

The work done in this program is generic and although elements of simulations are being developed in NEESgrid (such as the OpenSEES platform developed by PEER Center)- through its CHEF and GLOBUS components - the suggested task would provide a much broader content to the decision making capabilities (as characteristic to MCEER) spanning from engineering – (technical) to socio-political (organizational). The proposed task will utilize grid computing capabilities (knowledge available in the IT community) which can be easily integrated in the NEESgrid. Use of NEESgrid will facilitate and save some parts of the generic developments related to authorizations and access.

Progress to date: *(If applicable, a short description of achievements in previous years. Clearly distinguish progress achieved in the past year, i.e., accomplishments from April 1, 2004, to March 31, 2005.)*

To date all products available from the research tasks were integrated in the access platform. This is (i) Girgoriu's decision support; (ii) Dargush's initial version of evolutionary design method; (iii) Eguchi's databases and satellite data collection and display. Other products are currently in integration process: S. Chang procedures, Whittaker database, Filiatault ground motions, Shinozuka's resilience platform. Preparations were made for self preparation of information in from of Templates and training sessions are carried out for other center investigators.

Role of Proposed Task in Support of Strategic Plan: *(Describe how the effort will make a unique, useable contribution to the MCEER strategic plan.)*

This task is intended to provide the tools for evaluation of resilience, assist in decision making for mitigation of risk prior to the event and for response and recovery after an extreme event. This task intends to develop the link between the individual developments prepared by most of the investigators and provide a unique platform for access and process information required during the decision process. If successful this task will provide one of the most prominent products created collectively by MCEER investigators.

Task Integration: *(Describe how the work performed interfaces with other tasks and researchers funded by MCEER.)*

This task is an integration task of products developed by the co-investigators: A. M. Reinhorn*, University at Buffalo (UB) / J. Hanley (UB) in charge with the development of integration tools and support of educational activities of MCEER and in support of SLC.; G. Dargush / Mark Green (UB-CCR) who developed the evaluation tools and first steps in grid

computing; T. O'Rourke / Art Lembo (Cornell) who developed the GIS databases of soil characteristics, damage in structures and lifelines information who will be supporting web based integration and remote applications through API's; R. Eguchi (ImageCat) who developed the damage detection techniques using satellite databases and visualization techniques, who will attempt to integrate this work with GIS databases and the decision tools by Grigoriu; M. Grigoriu (Cornell) / Filiatrault (UB) who developed techniques for decisions of modifications structures, who will be contributing to the ground motion integration (with A. Filiatrault), with analysis programs; M. Shinozuka (UCI) who developed a stand alone resilience evaluation for electrical and transportation network who will provide the prototype links for the procedures used in his development. The integration will require coordination done in this task through two suggested meeting days and through multi-participant VTC-MCU available at MCEER – Buffalo.

Possible Technical Challenges:

This task has many technical challenges primarily related to integration of various procedures and databases which do not have common formats, and common data information. This along with the grid processing provide obstacles that can be overcome in the multi steps suggested in this task (such as linking two procedures at one time) to be able to build the demonstration example.

Anticipated Outcomes and deliverables:

(Also indicate those of particular benefit to IAB members and other end users.)

- 1) This networking should be able to provide a platform for decision making not a fragmented series of procedures.
- 2) The result of Year 9 task will provide the basic grid links connecting damage detection from satellite imagery with a basic decision tool.
- 3) An example of integration of procedures that will lay the base for the completion of this vision in Year 10.

Potential end-users beyond academic community: *(IAB members and others.)*

- 1) The integrated decision tools should be useful in post earthquake reconnaissance and decision support for response

Educational outcomes and deliverables, and intended audience:

This task will also provide the services for the development of the distributed seminar course and some of the materials for evaluations and decision support.

Project Schedule and Expected Milestones for the Project: *(Milestones and estimated time of achievement; e.g., Fall, Spring, Summer.)*

- 1) A working group meeting will be organized upon the award of this task. Observers will also be invited from groups outside the program. The meeting will result in planning of an example which will be developed by this Task during Year 9 (i.e. an electrical network, hospital structure, etc)

- 2) An example of first procedure linking database with decision procedure will be completed in six months from start.
- 3) Two more integration procedures will be completed at end of third quarter.
- 4) A prototype platform will be completed at end of the investigation (end of fourth quarter)

Team Members: *(If known, provide names of team members associated with project including project leader, other faculty and their departments, undergraduate students, graduate students, postdoctoral students, industrial participants.)*

Current team will include A.M.Reinhorn at task leader, Mr Jason Hanley (two months on leave from NEES), two grad students with CS background (to be hired from a pool of 20 interviewed recently), Mark Green from UB CCR and Art Lembo from Cornell University (times to be negotiated depending on the example decision); All other investigators will be participating upon necessary activities and will be supported from this global task

Possible Direction of Work in Subsequent Years:

This is the first step in developing the MCEER platform to be implemented and perhaps shared by the community after graduation though users fees if personnel and maintenance will be necessary.

Multi-Hazard Statement:

a) *(Conceptually describe in 200 words or less how some of the work you are conducting as part of your MCEER Year 9 research task can be exported/applied to other natural or man-made hazards including multi-hazard research.)*

As most of the work from MCEER is versatile, and the concept of resilience is much broader than the seismic hazard, the platform suggested here should provide the base for the decision tools and information collection procedures applicable to potential disasters. Some of the procedures already proved that are applicable to various disasters, such as flood, hurricanes, man made disasters (WTC) etc. The platform will integrate the procedure and will provide the capabilities to address other types of hazard information. The platform's architecture will be expanded to include hazard information from various available sources and an initial implementation will be started – with an example. At this stage it is envisioned that the platform will provide the base of integrating high performance computing reduced to the access level of engineers use. The design of this platform will address user accessibility, user functionality at the same time with the use of the fastest network speeds provided through TerraGrid (10 – 40 GB/sec). Such speeds will be available to many institutions for commercial use in the next three years. University at Buffalo will have such services available at end of this calendar year

b) *If you are seeking supplemental multi-hazard funding, describe the multi-hazard milestones that you plan to complete as part of your Year 9 research.*

The platform development will be tested for windstorms applied to evaluating damage and developing decision support tools integrated with it.