

# Annual Project Summary: 2003 Cooperative Central And Southeast U.S. Seismic Network--CERI

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M. M. Withers  
CERI  
Campus Box 526590  
The University of Memphis  
Memphis, TN 38152-6590  
Ph: 901-678-4940  
Fax: 901-678-4734

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## Summary

This is the annual project summary for USGS Award 01HQAG0010: "*Cooperative Central And Southeast U.S. Seismic Network--CERI*" This agreement covers the CERI component of the CUSSN to perform network operations, and routine data processing, archiving, and dissemination for the purpose of seismic hazards evaluation and scientific studies in the Mid-America region. Collaborating CUSSN institutions include the University of Memphis, St Louis University, Virginia Tech, and the University of South Carolina at Columbia.

## *Routine Operations*

CERI continued with routine operations, maintenance, analysis and participation in the CUSSN. The CERI component of the CUSSN operated 130 permanent seismic stations in FY 2002 (All but 1 are at least 3 component, 13 are broadband, 20 are ANSS urban strongmotion). Telemetry concerns require operation of six data concentrators (or nodes) linked to a central processing facility at CERI. Each node contains about 5 days of continuous revolving buffer and local creation and storage of triggered datasets. All nodes are linked to CERI in continuous near-real-time. Routine operations information and data availability are [online](#).

Subnetwork triggers are analyzed daily at CERI for both the New Madrid and East Tennessee Seismic

Zones (NMSZ and ETSZ respectively). Both paper and digital *helicorder* records are monitored for state of health purposes and missed events. From one to several hours of data are archived for teleseismic events of interest (65 events during the first ten months of 2002). Routine and automated event locations are shared with other networks via *QDDS*. Reviewed parameters are similarly shared and are emailed to [the ma\\_quake](#) listserv (contains 1800 recipients; a 300\% increase over FY2002). By far the most popular tool has been the [recenteqs](#) webpage accounting for more than three quarters of the 5.7 million hits over the past twelve months (approximately equal to the activity level in FY2002). Hypocenters are submitted weekly to the ANSS composite catalog.

A weekly summary of regional and worldwide earthquakes is faxed to approximately 100 recipients in the government and the private sector. While long-distance telephone charges for these faxes was not contained within the budget, the popularity of these reports has precluded other, less costly communications (e.g. internet). Data are also available via a [finger utility](#), and reviewed and automated [earthquake summaries](#) are also available for events within the past six months. Various [catalog searches](#) are also supported. [Psuedo-helicorder images](#) provide a quick review of station operation and events for the previous week.

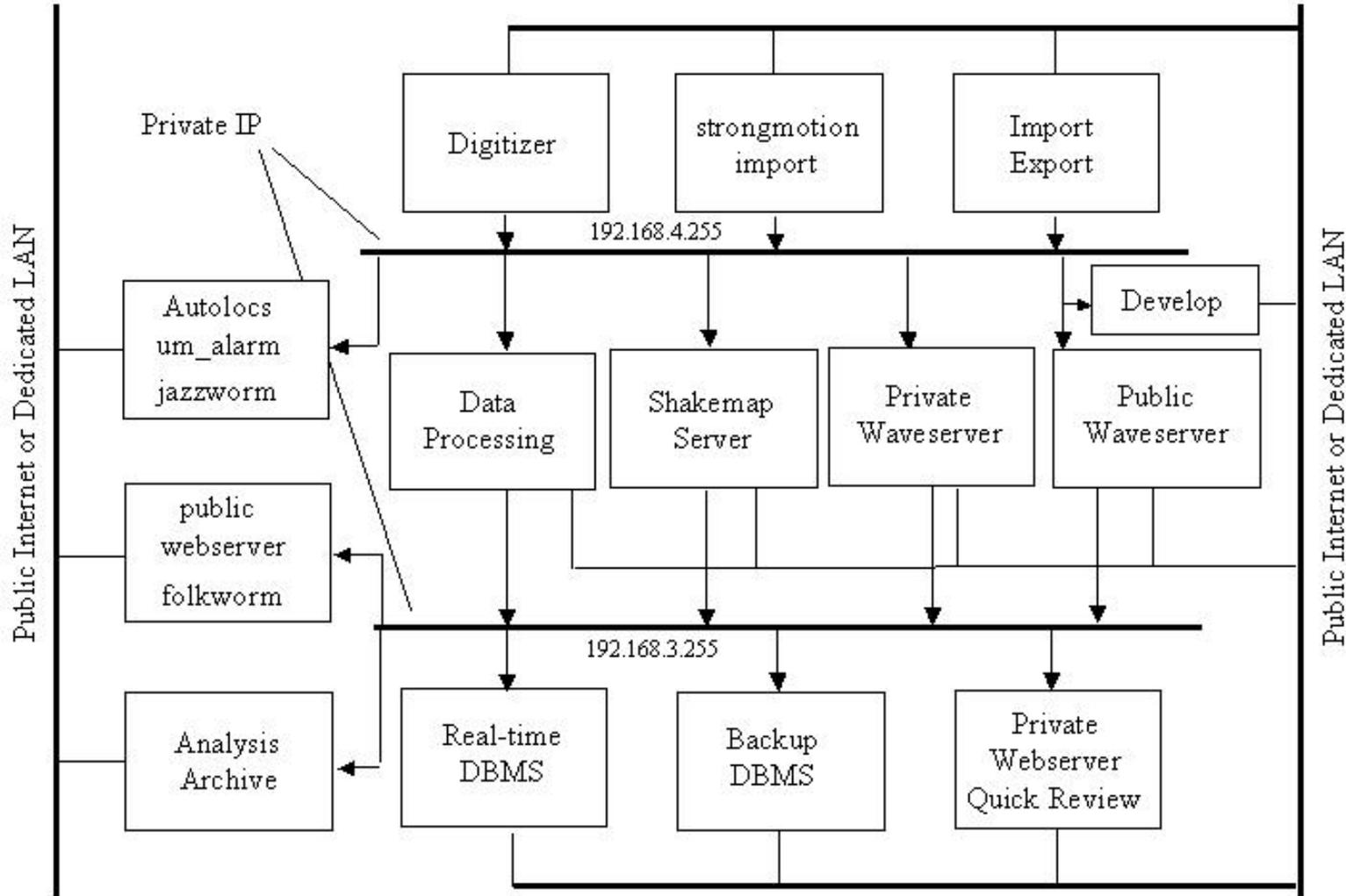
### *Accomplishments*

- Installed broadband station CPCT (Cooper Cave, TN) in the ETSZ
- Installed three ANSS urban strong motion stations in the ETSZ.
- Assisted installation of eight additional ANSS urban strongmotion stations in St Louis and Cape Girardeau.
- Extended 2Mbps spreadspectrum microwave link to node at New Madrid, MO.
- Deployed temporary portable arrays for aftershock monitoring at Fort Payne, AR and Bardwell, KY.
- Continued enhancement of Regional Processing Center (RPC)
- Migrated listserv to more robust system
- acquired hardware necessary to upgrade NMSZ broadband digitizers from 16 to 24 bit
- moved ATHN node to new EMA facility, upgraded telemetry (higher bandwidth, and installed DSL to allow continuous data transfer to Memphis
- Implemented Datascope database hypocenter, parametric, and waveform data

### **Data Acquisition Processing**

Six remote acquisition systems and one local system in Memphis are maintained and provide several levels of redundancy. The remote systems are PC-based *earthworm* using National Instruments 12 bit digitizers. Standard short-to-long-term ratios are employed to store triggered data streams. Additionally, a revolving continuous buffer of about 5 days provides opportunities for post-event archiving. All remote nodes include about 3 days of battery backup. The node at CERI consists of 12 computers housed in earthquake resistant racks within a physically secure, environmentally controlled room with battery and diesel generator backup and 100baseT infrastructure. Each remote node is identically configured and

provides traditional triggered data as well as real-time export of select channels and station triggers. Station triggers are subnetted at the RPC to form subnet triggers and subsequent data files.



### ANSS-MA Regional Processing Center Core Hardware Connectivity

Block Diagram of ANSS-MA Regional Processing Center. Data and products approximately flow from top to bottom and to the left. Communications over private wires is udp/ip and over public wires is tcp/ip.

Components of the above RPC block diagram include:

- Data Acquisition (Dell GX-1):
  - digitize analog shortperiod
- Import (Sun Netra X1):
  - Extract waveforms from ANSS urban strong motion stations
  - Import waveforms from standalone broadbands (e.g. SWET and GNAR)
  - Import waveforms from St Louis Univ.

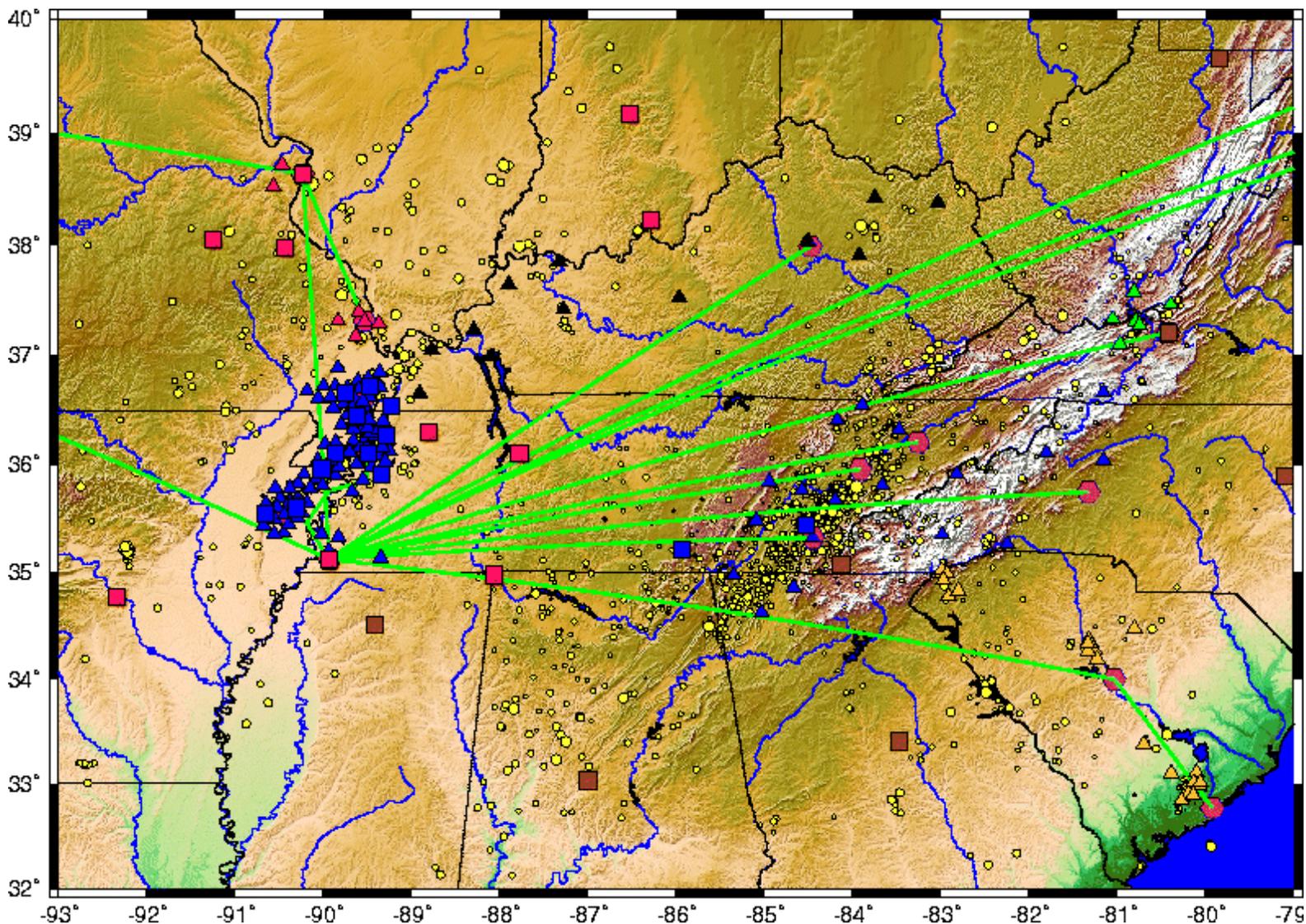
- Import waveforms from UT Knoxville
- Import waveforms from Univ. of Kentucky
- Import waveforms from NEIC
- Import waveforms from Delaware Geological Survey
- Import waveforms from Maryland Geological Survey
- Import waveforms from Lennox, TN node
- Import waveforms from Marked Tree, AR node
- Import waveforms from Hickory, NC node
- Import waveforms from Morristown, TN node
- Import waveforms from Athens, TN node
- Export (Sun Ultra 10):
  - export waveforms to St Louis Univ.
  - export waveforms to NEIC
  - export waveforms to UT Knoxville
  - export waveforms to Virginia Tech
  - export waveforms to Delaware Geological Survey
  - export waveforms to Maryland Geological Survey
- Data Processing (Sun Sunfire 280R):
  - perform station and subnet triggers
  - archive triggered waveforms to disk
  - perform automatic earthquake locations
  - populate dbms (not yet implemented)
  - perform strongmotion functions (not yet implemented)
- Shakemap Server (Sun Sunfire 280R):
  - Currently developmental; not real-time
  - Produce Shakemap
- Private Waveserver (Sun Netra T1 and 3 Storedge S1):
  - approximate seven day revolving disk buffer of all available waveforms with access restricted to RPC
- Public Waveserver (Sun Netra T1 and 3 Storedge S1):
  - approximate seven day revolving disk buffer of all available waveforms with unrestricted access
- Private Webserver (Sun Netra T120):
  - Currently developmental; not real-time
  - Quick Review
  - DBMS interface
- Rapid Notification (Sun Ultra5):
  - page
  - email
  - WWW
  - ASAP (local implementation of CUBE)
- Public Webserver (Sun Ultra5):
  - searchable catalog

- digital helicorder
- recent earthquakes
- qdds interface
- DBMS (Dell PowerEdge 2600):
  - earthworm real-time database
- Analysis (Sun Ultra5):
- Development (Sun Sunblade 1000):

The node at Hickory, TN has been temporarily taken offline. The stations telemetered to this node contain very old hardware and the maintenance burden began to affect progress in other areas. We plan to replace the hardware early in the 2004 calendar year, then bring the node back online.

Network		Sta/Chan		Total
	SP	BB	SM	
CERI	95/370	13/72	22/66	130/508
SLU	6/18	11/75	7/21	24/114
VPI	5/15	0/0	1/3	12/36
USC	16/31	0/0	0/0	16/31
UTK	17/23	0/0	9/45	26/68
Subtotal	139/457	24/147	39/135	202/739
		Imports		
DGS	4/6	0/0	0/0	4/6
MGS	0/0	1/3	0/0	1/3
MVL	0/0	1/3	0/0	1/3
USNSN	0/0	25/75	0/0	25/75
Total	143/463	51/228	39/135	233/826

Regional Data exchange. Data are cooperatively shared throughout the Mid-America region. There are 826 channels available from 233 stations.



Communications between regional data nodes are accomplished primarily through public internet, though dedicated lines are employed in some cases. Cooperating partners include Univ. of Memphis, USGS/USNSN, St Louis Univ., Univ. of South Carolina, Univ. of Kentucky, Virginia Tech, Millersville Univ., Maryland and Delaware Geological Surveys, and UT Knoxville.

## Future Directions

In addition to improvements planned and underway that were previously mentioned, we will begin work on:

- increasing real-time data availability in Memphis for the entire ANSS-MA region,
- continue development of the ANSS Regional Processing Facility standards,
- developing procedures for routine analysis and archiving for the entire ANSS-MA region,
- continuing with new installations to improve coverage particularly in the Southern Appalachian Seismic Zone,
- and continuing to improve ability of analysis and technical staff throughout the region to operate

as a single team.

- implement Shakemap for the upper Mississippi Embayment
- upgrade broadband 16-bit digitizers to DM24 with half duplex telemetry
- upgrade SWET to CMG3T/DM24 (currently CMG3-ESP)
- implement global associator, when available, to perform automatic locations for the entire region
- implement CISN Display clone to replace CUBE based ASAP systems
- complete dbms population with station calibration information for routine IRIS DMC submission, and to facilitate more complete information availability to the ANSS composite catalog
- replace public webserver with larger more appropriate hardware

## Non-Technical Summary

CERI continued with routine operations, maintenance, analysis and participation in the Central and Southeast U.S. Seismic Network (CUSSN), a cooperative effort between CERI, St. Louis Univ., Virginia Tech, Univ. of South Carolina, and the USGS. The CERI component of the CUSSN operated 130 permanent seismic stations in FY 2003. Routine operations information and data availability are [online](#). Data are analyzed daily at CERI for both the New Madrid and East Tennessee Seismic Zones (NMSZ and ETSZ respectively). Both paper and digital *helicopter* records are monitored for state of health purposes and missed events. From one to several hours of data are archived for global events of interest (65 events during the first ten months of 2002). Routine and automated event locations are shared with other networks and reviewed parameters are emailed to [the ma\\_ quake](#) listserv (contains 1800 recipients; a 300% increase over FY2002). By far the most popular tool has been the [recenteqs](#) webpage accounting for more than three quarters of the 5.7 million hits over the past twelve months (approximately equal to the activity level in FY2002). Hypocenters are submitted weekly to the ANSS composite catalog and a summary is faxed to approximately 100 recipients in the government and the private sector. Data are also available via a [finger utility](#), and reviewed and automated [earthquake summaries](#) are also available for events within the past six months. Various [catalog searches](#) are also supported. [Pseudo-helicopter images](#) provide a quick review of station operation and events for the previous week.