PROJECT ADMINISTRATION DATA SHEET

Project No. E-20-662
Project Director: Dr. Leroy Z. Emkin
Sponsor: WICAT Systems, Inc.

Type Agreement: Research Project/License Agreement (No. E-20-662)
Award Period: From 9/15/82 To 3/15/84 (Performance) 3/15/84 (Reports)
Sponsor Amount: Total Estimated: $189,000 Funded: $189,000
Cost Sharing Amount: $14,242 (E-20-335) Cost Sharing No:
Title: "Development of the GTICES Basic System (Phase I) and the GTSTRUDL and GTTABLE Subsystems (Phase 2) for the WICAT System 100 and System 150 32-bit supermicro computers"

Sponsor Technical Contact:
Dr. Thomas Sawyer, Vice President
WICAT Systems
P. O. Box 539
1875 South State Street
Orem, Utah 84057
PH: (801) 224-6400

Defense Priority Rating: N/A
Military Security Classification: N/A
(or) Company/Industrial Proprietary:

See Attached N/A Supplemental Information Sheet for Additional Requirements.

Travel: Foreign travel must have prior approval — Contact OCA in each case. Domestic travel requires sponsor approval where total will exceed greater of $500 or 125% of approved proposal budget category.

Equipment: Title vests with

COMMENTS:

COPIES TO:
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Research Property Management Reports Coordinator (OCA)
Accounting GTRI Project File
Procurement/EES Supply Services Library Other
Research Security Services Other

FORM GTRI 6-6-82 REV. 6-83
SPONSORED PROJECT TERMINATION/CLOSEOUT SHEET

Date: 6/19/86

Project No. E-20-662

Includes Subproject No.(s) N/A

Project Director(s) Leroy Emkin

Sponsor WICAT Systems, Inc.

Title "Development of the GTICES Basic System (Phase I) and the GTSTRUDL and GTTABLE Subsystems (Phase 2) for the WICAT System 100 and System 150 32-bit supermicro computers."

Effective Completion Date: 3/15/84 (Performance) (Reports)

Grant/Contract Closeout Actions Remaining:

[ ] None

[ ] Final Invoice or Final Fiscal Report

[ ] Closing Documents

[ ] Final Report of Inventions

[ ] Govt. Property Inventory & Related Certificate

[ ] Classified Material Certificate

[ ] Other

Note: Any documents going to sponsor should go through Legal Dept.

Sponsor has all deliverables.

Continues Project No. Continued by Project No.

COPIES TO:

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R. Embry
LIBRARY DOES NOT HAVE:

First Progress Report
Mr. Gary Bowles
General Manager, WISTRAN
WICAT Systems, Inc.
1875 South State
Orem, Utah 84057

Dear Gary:

SUBJECT: Second progress report of development relating to the Research Project-License Agreement By and Between Georgia Tech Research Institute and WICAT Systems, Inc. dated 1 July 1982.

A copy of the macro task diagram which notes the development milestones is attached hereto as Attachment 1. As was noted in the first progress report dated 8 December 1982, tasks (S)—initial system acceptance, (T)—personnel training on WICAT systems, (P)—detailed planning and design, and (1)—ICETRAN Precompiler coding were well under way. Since the first progress report (i.e., during the past two months), these tasks have been completed. However, neither the next task (2), nor any other task has been completed. Progress towards these next tasks has been seriously impaired due to a severe lack of WICAT hardware systems and WICAT software and documentation availability and reliability.

In particular, there is a dearth of complete, up to date documentation on the software. It has been difficult to obtain software updates, and when received, they often did not have any installation instructions. Frequent hardware failures during or immediately after installation have delayed access to the system and failure of a floppy drive prohibited the installation of software updates.

In general, the software lacks robustness. The system crashes often due to simple programming errors (e.g., wrong number or type of parameters in subroutines), and the only method of debugging is by inserting print statements in programs. However, even using print statements is virtually impossible, since programs often cause the system to crash before the buffered IO catches up (very deceptive in locating where the program caused a crash)!

The program development tools available (editors, backup, archives) appear to be good, but the documentation on the backup and archiver was not received until January, 1983. The language processors leave a lot to be desired. They produce no listings, which, when dealing with tens of thousands of lines of code, presents an extremely difficult problem. The linkage editor documentation hints at adequate abilities, but does not provide enough information to use them. The hardware appears to be sufficient for the implementation, but the software allowing the use of the hardware is in some instances missing. For example, the system has floating point hardware, but the software does not support it.
The parts of the system which are fully documented work well. The editor and the command interpreter program are very well done and provide abilities which ease the task of program development.

Another very major area of difficulty will be providing the limited virtual memory abilities required by GTSTRUDL. The major component to aid in this is a dynamic program loader to be provided by WICAT. This is urgently needed.

The support people at WICAT are very helpful whenever problems arise. They seem to be very willing to try to understand what our needs are and to provide solutions. WICAT has been making use of our feedback in developing extensions to their system. The system initially looked a lot like a souped up micro-computer, but seems to be heading more towards a mini-computer outlook. The target system's small size is deceptive and should be a real turn-on to prospective users when they see what it will be able to do. However, we are only making limited progress due to the severe problems which remain, and which only appear to be solvable by WICAT.

The following provides additional details relating to the problems we are experiencing.

I. Progress Summary

The development progress for software modules within the GTICES/WICAT basic system is far behind schedule at this time. In particular, we are four months into the project and we estimate we are now three months behind schedule. The following items enumerate the principal problem areas which we are experiencing:

1. Hardware reliability and performance.
2. Hardware support.
3. Customer support and software releases.
4. Software engineering environment.

Each of these problem areas are summarized below:
1. Hardware Reliability and Performance.

A. **WICAT System 100**

The System 100 with version 2 of MCS, which was installed in August 1982, was never used for GTICES software development. Aside from WICAT software problems, which will be detailed later, the raw performance of the System 100 was unacceptably slow. According to WICAT, this was primarily due to a poor disk driver design.

The 600 line/minute line printer provided with the System 100 was not completely operational. The parallel interface necessary to drive the printer at the rated speed was not provided. In addition, lower case characters could not be printed until February 3, 1983. This made it impossible to print C listings up until now as the C compiler requires the use of both upper and lower case alphabetic characters.

The System 100 is presently off-line and awaiting shipment back to WICAT. No action has been taken by local customer support to secure the System 100 for shipping although this has been requested by Ga Tech.

In summary, the System 100 did not serve us for software development in any way. Its slow disk performance and lack of an adequate printing device were the chief reasons for this.

B. **WICAT System 150**

The System 150 with MCS version 2 was used as the training device. It provided us with our only hands-on experience with software development under MCS.

System 150 reliability problems centered primarily around the floppy disk drive. After two months of use the floppy disk drive could not read FORTRAN update diskettes provided to us by WICAT customer support. This resulted in mis-matched versions of MCS vis-a-vis FORTRAN. This problem was first reported in November, 1982. A new floppy disk drive was not received until January, 1983.

The 15Mb hard disk in the System 150 is highly sensitive to temperature changes. When the device is warming up or moved from place to place certain files cannot be read. This problem was reported but went undiagnosed until January 1983. It is still not fixed.

The System 150 has not been upgraded as per the research agreement to contain 1.5 megabytes of memory, 30 megabytes of hard disk and floating point hardware. Also, the necessary ROMs to support MCS version 4 have not been shipped to us as of the date of this report.
C. WICAT System 200

The System 200 arrived on December 15, 1982. The system was not fully operational until January 28, 1983. Upon initial installation, the disk contents were corrupted so that it would not boot. In addition, the tape drive was inoperative. Therefore, there was no way to utilize the system.

A new tape drive and controller boards were received by Ga Tech on January 5, 1983. These parts did nothing to correct the problem. On January 7, 1983 a damaged cable connecting the tape drive to the controller board was discovered. A new cable was shipped and the problem was repaired.

MCS version 3 was sent to us on a magnetic tape with the System 200. However, C, FORTRAN and the Assembler were not shipped as promised. Therefore, older versions of the compilers had to be copied from the System 150 to the System 200. This process was lengthy and prone to errors. It is therefore strongly requested the all software updates be sent to Ga Tech together with operating system upgrades on magnetic tapes.

Subsequent to repairing the tape drive cable, the System 200 was operational for five days before the disk crashed over the weekend of January 15, 1983. A new disk drive was shipped, installed and finally operational on January 28, 1983.

2. Hardware Support

Prior to mid December 1982 no local customer support existed.

At present a local third party maintenance organization has been retained by WICAT to provide local support. This third party, Digidyne, has had no exposure to WICAT hardware prior to this agreement. In addition, they have had no formal training on the maintenance and care of WICAT hardware since entering into this agreement.

Digidyne is not to be contacted directly by Ga Tech if a problem with WICAT hardware should arise. Instead we are to call customer support or you to coordinate support. This can only serve to increase response time to critical hardware problems when they arise.

3. Customer Support and Software Releases

Numerous shipping inconsistencies existed between the System 200 packing list and what was actually received. For instance, MCS 3.2 was indicated on the packing list but MCS 3.1.1 was received. The wrong manuals for the Fujitsu disk drive accompanied the shipment.
We have not received hardware upgrades to the System 150. We were lead to believe that other customers had received System 150 upgrages by field engineers.

We feel that we must receive immediate attention when software, hardware and/or documentation updates are made ready for shipping. The policy of "shipping with new machines first" places us in a disadvantaged position.

4. Software Engineering Environment

A. Documentation

Both C and FORTRAN documentation arrived at Ga Tech after the hardware and software. Because of machine and implementation details, these products could not be effectively used without complete documentation. At this time, supplemental manuals are still required for a complete treatment of C and FORTRAN.

Inadequate descriptions of operating system interface mechanisms and run-time library subroutine interfaces still exist. We have asked for, but as yet have not received, documentation covering the calls FORTRAN makes to it's run-time library. Of particular interest are the calls that handle formatted and unformatted READ and WRITE statements. This is urgently needed.

No documentation for the disk drive or tape drive on the System 200 have been provided.

Current language processor documentation is inadequate. The C Programmer Reference Manual we have is for version 1.1, but documentation for version 4.0 is required. The M68000 Assembler Reference Manual we have is for version 1.0. The assembler itself was not provided for the System 200. The assembler Version 2.0, and documentation for that version, must be provided immediately. The WICAT PASCAL language manual is for version 2.2 of Pascal. Although this is not critical, documentation for Pascal version 4.0 should be provided. The FORTRAN 77 (Implementation) Programmer Reference Manual is the August 1982 initial printing, and the FORTRAN 77 (Language/Implementation) Programmer Reference Manual is the July 1982 preliminary draft. It is critical that full documentation for FORTRAN 77 version 4.0 is provided immediately, as well as how Fortran 77 interfaces to C, Assembler and run-time routines. MCS documentation is for Version 3.1 on the System 100 and System 150, but no documentation on MCS for the System 200 has been provided other than the 4.0 release notes. All of this is causing us very major problems.

Current hardware documentation is inadequate for local field service to reference. The documentation for the 474 Fujitsu disk drive which was sent was for the wrong device. Correct documentation for this device should be provided. One copy of the hardware documentation on the CIPHER 9-track tape drive has been provided. We suggest that additional copies of all hardware documentation be sent to the local service personnel so that they may familiarize themselves with the hardware they are expected to service.
B. Software

Several deficiencies in the C and FORTRAN compilers have slowed progress in software development. These are lack of source listings, lack of an interactive debugging facility, and lack of commonly found language extensions.

One of the most time consuming tasks in the development of a large, integrated software package is coding and debugging. This phase has been substantially lengthened by the absence of source listings and interactive debugging aids. Without these two critical aids we estimate that coding and debugging will require three to four times longer to complete!

No postmortem diagnostics are produced when a program crashes. This most basic kind of debugging aid is mandatory if we are to produce a reliable product that can be supported in the field.

Simple, everyday programming mistakes can crash the System 150 and System 200. An example of this is one C program calling another C program with the wrong number of formal parameters. When the call is made, the system crashes without a trace. One week of time was lost tracking down this one problem alone. We feel that we need access to WICAT language processor and systems programming personnel who can support us directly to prevent such needless delays from occurring again.

II. Conclusions

To conclude, the above briefly summarizes some of the problems with hardware and software reliability and performance, hardware support, customer support and software releases, and the software engineering environment which are the critical areas where we feel that major improvements must be made by WICAT in order to insure the timely completion (or even success!) of the GTICES/WICAT development.

Improvements in hardware reliability have been achieved with the System 200. However, during these past four months we have had only the System 150 on which to perform our development. The System 150 was never intended as the main development machine. It was designed to be the target vehicle for the WISTRAN version of GTSTRUDL. It was provided in order to verify that it would be able to execute code developed on the development machine. Because we have not had access to the development machine until January 28, 1983, we strongly feel that acceptance of the System 100 for purposes of initiating the twelve months development schedule was premature. We therefore have established February 1, 1983 as the effective starting date for the twelve month development period.
The following actions from WICAT are immediately required:

1. Faster delivery of hardware and software updates.

2. Better compilers are a necessity if we are to produce reliable software quickly and efficiently. Source listings and debugging aids are the two most critically needed components for a better software engineering environment.

3. Quick and ready access to hardware customer engineers.

4. Parallel interface for the System 200 to the 600 1pm printer.

5. Upgrade to System 150 to include floating point, additional disk drive and mag cartridge devices.

6. Full compliment of MCS 4.0, C, FORTRAN 77 and Pascal documentation. Complete descriptions of commands, language syntax, semantics, implementation details must be included. (See section I.4.A above).

7. Documentation of the interfaces between FORTRAN 77 and C generated code and their respective run-time libraries. We must know, for instance, how many arguments a C program is called with from FORTRAN 77.

8. Documentation for all hardware devices for us and field service personnel.


10. Dynamic loading of program modules into arbitrary locations in user memory. Modules must be capable of containing alias names. Modules must be able to share a global COMMON (FORTRAN 77 sense) area. Weak externals are also highly desirable.

11. Direct access random input/output to disk data sets.

12. Source and object library editors.

13. Software support of hardware floating point hardware on all WICAT Systems.


15. Better communication interface between the System 200 and System 150. We require an X.25 type environment in order to transfer data quickly and accurately.
Without these urgently needed actions, there is a risk of not being able to successfully develop GTICES/GTSTRUDL for WICAT Systems. Our personnel and financial resources are under a great deal of pressure. We estimate that over 25% of project funding has been consumed, but due to WICAT problems, only 7% of progress has been made. We strongly urge a meeting in Orem (the week of 14 February, if possible) to discuss these matters.

Sincerely yours,

David B. Green, III
Manager, GTICES Systems Laboratory

Approval:

Dr. Leroy Z. Emkin, Director
GTICES Systems Laboratory

Attachement (1)

xc: John W. Wilson, Jr., Legal, GTRI
Contracts Manager, OCA

DBG/dg
S - Start (Written acceptance of initial WICAT System 100 by GTRI)

T - Project personnel training on the WICAT System 100/150 computers

P - Detailed planning and design

1 - ICETRAN precompiler coding

2 - Special Loader coding

3 - GTICES Basic System coding

4 - GTCDL Subsystem coding

5 - Miscellaneous System Utilities

6 - GTTABLE Subsystem precompilation and error correction

W - Written acceptance of fully configured WICAT System 100 and fully configured WICAT System 150 by GTRI

7 - GTSTRUDL Subsystem precompilation and error correction

8 - GTTABLE and GTSTRUDL CDL command processing check out

9 - GTTABLE and GTSTRUDL processing check out and debugging

10 - Initial system generated and initial release to selected WICAT customers

11 - GTSTRUDL Basic (automatic mesh generation, frame and finite element static analysis, advanced graphics) completed and general release

12 - GTSTRUDL steel design and dynamic analysis completed and general release

13 - Additional system debugging, fine tuning, and documentation preparation

F - Final check out, follow-up support, and finish

Note: Circled activities represent activity ending dates.
Mr. Gary Bowles  
WISTRAN General Manager  
WICAT Systems, Inc.  
P. O. Box 539  
Orem, Utah  84057

SUBJECT: Third progress report of development relating to the Project/License Agreement By and Between Georgia Tech Research Institute and WICAT Systems, Inc. dated 1 July 1982.

As you know the second progress report submitted two months ago detailed many critical areas where GTRI felt WICAT needed to place further emphasis. In particular, these areas include hardware reliability and performance, hardware support, customer support and software releases and the software engineering environment.

During the succeeding two months the System 200 has shown itself to be a more reliable system than the System 100. Presently, we are not experiencing burdensome down-time due to System 200 hardware failures.

As a consequence of better hardware reliability we have placed little demand on local customer service personnel.

The placement of GTRI on WICAT's prefered customer list has had only marginal effect upon customer support. In particular, the assembler, ASM 1.1 was omitted from a recent complete software set shipment (ASM 2.4.1 was subsequently received), software action report (SAR) forms have never been sent to us as promised, the WS 150 has not been field upgraded to a WS 160 and the delay in the upgrade to UNIX has delayed a visit from Mr. Mark Dye. Mr. Dye's visit is critical to the timely completion of certain basic system design and implementation phases pertaining to demand module loading.

The software engineering environment remains relatively unchanged. During Mr. Michael Week's visit to Georgia Tech we were made aware of certain low-level debugging aids in MCS but these do not obviate the need for symbolic debugging aids. The overall stability of MCS 4.0 has contributed to an improved software engineering environment. Georgia Tech has purchased VAX-11 "C" in order to improve the software development environment. The VAX version provides both testing and symbolic debugging of "C" programs.
Task Summary for March - April 1983

2. Special Loader Coding - Design documents have been passed between GTRI and WICAT which specify what is being done to provide a demand module loading facility for GTICES/WICAT. To date WICAT has evidenced no capability to accomplish the creation of demand loadable modules, however, it is imperative that this task be given highest priority. This task must be completed during the upcoming two month development period.

3. GTICES Basic System Coding -
   
   3a. Array/Memory Management - 50% complete.
   Most of the design and coding for this sub-task is complete. Further coding and final checkout should be completed in the next two months. A simple equation solver using dynamic arrays is presently operational. Further coding is proceeding aggressively.

   3b. Program Management - 10% complete.
   This sub-task has recently gotten underway. It is estimated to be complete in three months.

   3c. Disk Management - 10% complete.
   This sub-task has recently gotten underway. Estimated completion is June 1983.

Other tasks are pending.

Critical Action Items for WICAT

1) Design/implementation and available of the demand module loading capability.

2) UNIX conversion.

3) WS 150 upgrade to WS 160.

4) Description of interface between FORTRAN 77 and run-time formatted and unformatted input-output library.

5) Receipt of SAR forms.
Summary

With anticipated improvements in the software engineering environment afforded GTRI by increased System 200 availability and the introduction of VAX-11 "C", I hope to be back on schedule in three to four months. However, the critical action items for WICAT noted above must be completed now in order for us to proceed in a timely fashion.

Sincerely,

David B. Green III
Manager, GTICES Systems Development

DBG/ji
xc: L. Z. Emkin, Director, GTISL
    Faith Costello, OCA, w/7 copies)
Attachment: Macro Task Diagram
Mr. Glenn Stewart  
WICAT, Inc.  
P.O. Box 539  
1875 South State Street  
Orem, Utah

SUBJECT: Fourth progress report of development relating to the  
Project/License Agreement By and Between Georgia Tech Research  
Institute and WICAT Systems, Inc. dated 1 July 1982.

Dear Mr. Stewart:

This report will highlight the action items outlined in the third  
progress report of April 1983, identify the percentage complete for each  
task remaining in the C and FORTRAN develop areas and state the next  
group of action items for WICAT.

The status of each action item for WICAT, as stated in the third  
progress report is as follows:

1. Design/Implement dynamic module loading. By 1 September GTRI  
had received object code and documentation from WICAT to  
implement dynamic module loading. At this time we are still  
evaluating this submission. WICAT will be advised soon, in a  
separate letter, of the results of our evaluation.

2. UNIX conversion. The System 200 has been successfully con-  
verted to run under the UNIX operating system. The one  
persistent problem related to UNIX is the limited size of the  
system file space. This limitation prevents us from con-  
viently editing and printing large files.  

   The system 150 is still not converted to UNIX.

3. WS 150 upgrade. The add on disk and cartridge unit has been  
received. But, to date, we cannot boot UNIX or MCS. The  
necessary controller ROM's have not been sent to us. Mr.  
Allen Jensen, project leader for C programming has been  
working with WICAT and Digi-Dyne in order to get the WS 150 up  
and running under UNIX. Because of Mr. Jensen's importance to  
the success of the C programming effort I am directing him to  
curtail his involvement with respect to trouble-shooting.
2. The FORTRAN-77 compiler does not compile certain FORTRAN programs which used to compile. The problem with FORTRAN began after the latest changes to LL and the new FORTRAN compiler were installed. It is critical that all available resources be directed towards reinstating FORTRAN, LL and the associated debugging aids to working order. Successfully completion is dependent on this. We cannot afford the slightest slow-down in progress.

3. Completion of hardware/software upgrade to WS 150.

Sincerely yours,

David B. Green, III
Manager
GTICES Systems Laboratory

Approved: Date:

L. Z. Emkin
Director, GTISL

DBG/fs