April 30, 1993

Dear Madam/Sir:

Enclosed is a copy of the Third Quarterly R&D Status Report produced by the Isis Group under DARPA/ONR contract number N00014-92-J-1866. This report covers the time period between April 1993 and June 1993.

Respectfully yours,

Maureen Robinson
Administrative Aide

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Redesigned Isis and Meta System under Mach

Third Quarterly R & D Status Report
July 1993

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Personnel

- Academic Staff:
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  - Dr. Aleta Ricciardi, Post-doctoral Research Associate
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- Graduate Students:
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The Isis Project Progress

This quarter has seen solid progress toward our major project goals. Horus, the complete redesign of the original ISIS system, is now stable and in use. The design of how to effectively run Horus over high-speed ATM networks and parallel computers such as the Intel Paragon continues, and we have set up a laboratory at the University of California for the continued development of the realtime group programming toolkit Corto [ref 4].

In this quarter, we completed the first non-prototype version of the Lomita monitoring and control language [ref 9]. The lack of such a language has been a major stumbling block in the use of Meta. While the native Meta programming language is efficient, it is almost impossible to use because of its postscript-like syntax. For example, the following is a simple Lomita control rule that has a machine leave one group and join another group when told to do so (by setting a local register). This rule is taken from a Lomita program used to test Meta’s group mechanism:

```
machine[*]
  whenever switch
    do LEAVE machineset[group]
    JOIN machineset[! group]
    group = !group
    switch = FALSE
    PRINT(CTIME(localtime),
      " : switched to machine group ", ! group, ".\n")
    else if STOP do
      STOP = FALSE
      PRINT("Terminated.\n");
```

Here is the same rule, in the “internal” Meta programming language, from which the user is now insulated:

```
RI2 & GUARD "RI0 RI2 & AND localtime & AND TGUARD
"machineset(" RI2 STRING + ")" \ LEAVE "machineset(" +
RI2 NOT STRING + ")" \ JOIN RI2 NOT 'WI2 0 'WI0 localtime
CTIME ": switched to machine group ": RI2 NOT ".\n"
'PRINT ALTERNATE RI7 GUARD 0 'WI7 "Terminated.\n" 'PRINT 'EXIT" + 'LNPL 'EXITO
```
As one would expect, having the ability to now write complex Meta control rules has resulted in the identification of some bugs in Meta. We have been working through these bugs and plan to issue a new (free) university release once the system restabilizes.

We have been very active this quarter in terms of publishing. A book that collects the major ISIS papers is nearing completion. The debate in the academic community continues on the value of virtual synchrony and the underlying order-based communication protocols [refs. 2, 3, 5, 8] versus other methods of programming distributed systems. This debate, in part, has arisen from the success of ISIS in the commercial arena and the creation of various research projects working on ISIS-like systems.

**Transitions**

The external user base for Isis, Horus and Meta continues to grow, including both university and industrial sites. We have recently been talking with a research group in Siemens about the use of Meta and Lomita in an industrial prototype. We have also set up an arrangement for cooperative research with a group in the Software Engineering Institute and with INESC for real-time transports and scheduling support in Corto. Through Isis Distributed Systems Inc, Isis is now installed at hundreds of locations worldwide. A good recent example of an Isis application that also uses Mach is the air traffic control system of a major European government, which has selected Isis on OSF/1 Alpha Workstations from Digital Equipment as the basis for its next generation ATC system effort, with technology deployment to begin in late 1994.
Third Budget Statement

a. ARPA Order Number: 9247
b. Contract Number: N00014-92-J-1866
c. Agent: ONR
d. Contract Title: A Redesigned Isis and Meta System Under Mach
e. Organization: Cornell University
f. PIs: Kenneth P. Birman and Keith Marzullo
g. Actual Start Date: 9/30/92
h. Expected End Date: 12/30/95
i. Expected End Date if Options Exercised: NA
j. Total Price: $3,137,518
k. Spending Authority Provided So Far: $1,281,331
l. Expenditures through 6/93 $710,833
m. Date When These Funds Will Be Fully Expended: 10/31/93
n. Additional Funds Expected Per Contract (by FY): FY94 $928,050
   FY95 $928,137
Publications


  Describes another approach to fault-tolerant services based on message logging protocols. The protocol here, which has been implemented, is both efficient in normal usage and in failure recovery.


  Describes the security architecture designed and built for the Horus system. Addresses several architectural issues about group programming vs. security.


  A formal definition of priority inversion and a set of protocols derived from this definition that completely avoid priority inversion.
