AT&T

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# AT&T Technical Report

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## Graphical Tools a Snap with OBJECTIVE

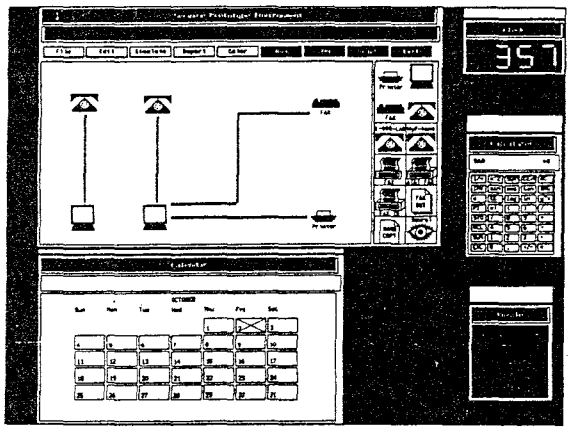
Interactive Graphical User Interfaces (GUIs) have become more important in today's software environment. They enable the user to interact with the underlying software in an intuitive way, thereby increasing the software's usefulness and the user's productivity. Basic GUIs provide buttons and menus through which the user can send commands to the underlying software.

While these features are useful, much more powerful graphical tools exist. Usually they are characterized by the addition of a canvas area that contains graphical representations (such as icons) of concepts that the user can manipulate. Performing an operation on the icon will cause a change in the underlying program data structures or run state. Often a user is able to move, copy, delete or create connections between icons or groups of icons.

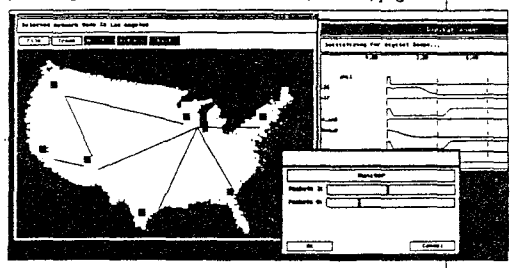
For example, systems engineers might want to design a new telecommunications service by moving around the icons of telephones or fax machines. Network planners might choose to work with switches and trunks. Even software calendars, calculators, clocks and some games fit into this class of graphical tool. With a calendar, each day corresponds to an icon, as does each button on the calculator.

OBJECTIVE (Object-Based Interactive Visual Editing) makes writing any of the above applications (and countless others) unusually

*Please see* OBJECTIVE, *page 2*



**VERSATILE SYSTEM — A computer screen showing a service creation environment (allowing real-time configuration of telecommunications equipment) and some desktop management tools (clock, calculator and calendar), all created using OBJECTIVE graphics.**



**OBJECTIVE CREATIONS — The network management system and simulation waveform display both allow real-time display of information from the underlying systems.**

## Physical-Diversity Algorithms Useful in Network Redesign

With the advent of fiber and its increasing deployment in the network, the risk of losing huge volumes of traffic due to a cable cut has escalated. To help solve this problem, Ramesh Bhandari, MTS at Holmdel, has developed a number of algorithms for engendering physical diversity (node and span disjointness) in networks. One key algorithm finds a pair of the shortest physically diverse paths in the AT&T fiber network. The algorithm is optimal with respect to fiber miles, thus network planners and designers can use it in the redesign of the AT&T fiber network by splitting traffic over two physically diverse paths between a given pair of nodes. Because the algorithm is computationally fast, it can be used for diverse provisioning of business special services in a switched T3-service environment.

"The inbuilt optimality feature should save AT&T money," says Bhandari, who has compared the approach of his algorithm to the commonly used two-step approach of finding the shortest path first, followed by the second shortest path. "The latter approach sometimes erroneously indicates the absence of physically diverse paths when such paths actually exist."

The Network Services Division funded the physical-diversity work, and summer students wrote the computer codes. The list of algorithms, with their C language codes, is:

- shortest K edge/vertex-disjoint paths algorithms (K=2,3),
- shortest pair of physically diverse paths in the AT&T fiber network (with simulation on Sun[1] SPARCstations[2]),
- shortest pair of physically diverse paths for any network topology, and
- a physical-diversity versus dollar-cost algorithm.

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## Operational Profile Speeds Testing And Increases Productivity

Software developers know that system testing occupies a large part of their time and involves substantial costs. System testing is intimately involved in assuring that the reliability of the final software product meets customer expectations.

The operational profile is a new concept that greatly increases testing efficiency. It numerically expresses how customers will use a system. Usage data and discussions with customers lead to determination of the probability of occurrence of each system operation in the field. An operation can be a command, a type of transaction, or an external event that the system must respond to.

Figure 1 shows a typical operational profile. It can involve hundreds of operations, depending on the detail to which a project characterizes system use.

The operational profile plays an essential role in software reliability engineering, a technology that uses quantitative objectives for how frequently software can be allowed to fail to guide software development. Different systems need different balances among the key quality objectives of reliability, delivery date of new features and cost. Reliability depends on how customers will use a system.

"Projects use the operational profile in system testing to achieve an accurate representation of actual use," says John Musa, supervisor, Software Reliability Engineering (SRE) at Murray Hill.

Most systems have operations with unequal use in the field. Driving the test process with the operational profile ensures that the operations with the most use receive the most testing and tend to be tested first. Thus, failures in these frequently occurring operations are found earlier. As a result, reliability improvement proceeds much more rapidly per unit test time than if customer use were not considered.

The international Definity® telecommunications system project, applying the operational profile and

*Please see* PROFILE, *page 2*

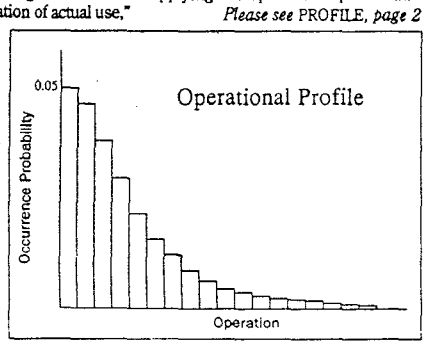



**FIGURE 1**

# Parallel Computing Simpler With Smoke and Memories

Massively parallel processors promise to meet the demand for more computational power. However, for parallel processing to be widely accepted, it must be efficient, applicable to a range of applications, and easy to use. Most commercially available parallel processors, built using off-the-shelf components, fall far short of meeting these requirements.

This led researchers in the Digital Architecture Research Department to create a parallel computing system based on a novel custom processor chip called Smoke. "It is a simple, wide-instruction word, registerless, floating-point architecture with fast context switching for high performance, real-time operation," says Abhaya Asthana, MTS at Murray Hill and co-designer of the Smoke processor with MTS Boyd Mathews.

Architectural simplicity is also the answer to managing two nontrivial tasks in parallel processing: writing efficient parallel programs and debugging them. "The instruction set of the Smoke processor is one of the smallest and most elegant I have seen," explains MTS Paul Krzyzanowski, who wrote the C Compiler for Smoke. "With a typical RISC architecture, one must allocate dozens of registers accessed as autonomous units. In Smoke, the register space is the local memory, thus enabling the full spectrum of addressing modes to be utilized."

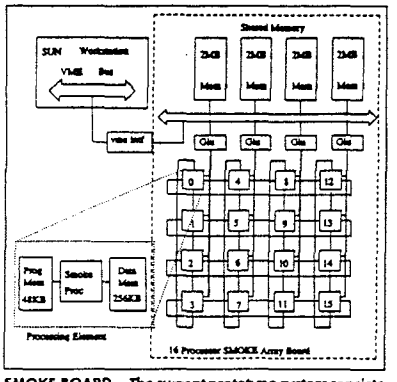
The memory-mapped architecture of Smoke also simplifies the task of debugging complex parallel programs and visualizing results because the host program can reference the local memories directly, and control the processing element's execution at an individual or array level.

A complete system with 16 Smoke processors on a single Sun[1]/VME board has been operational for several months, running applications that include timing simulation, image processing, speech processing and numerical methods. The results show that a 20 MHz Smoke array outperforms a 40 MHz Sun[1] SPARCstation2[2] by factors from 25 to 95 across the range of applications studied.

"Any performance improvement beyond a factor of 16 obviously comes from features inherent in the design of the Smoke processor," says Mathews. "What's really exciting is that this efficiency can be achieved with a simple 80,000-transistor chip, and things will only improve with emerging packaging technologies."

For more information, or to order, contact Abhaya Asthana at **allegra!abhaya** or (908)-582-6687.

1 Trademark of Sun Microsystems, Inc.
2 Trademark of SPARC International, Inc.




**SMOKE BOARD — The current prototype system consists of 16 processing elements, interconnected both as a shared memory and a toroidal-mesh multiprocessor, on a single Sun/VME board.**

## ALGORITHMS

*(continued from page 1)*

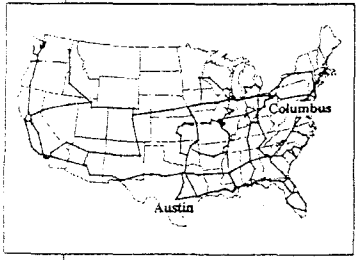
Numerous network design and network performance technicians have already benefited from these tools.

"The physical-diversity algorithms have been very useful in our work," says Jerry Ash, supervisor in the Network Planning Division at Holmdel, whose group is working on the robust design of dynamic networks.

"Internationally, this set of tools can be used to assess and enhance the reliability of foreign PTT networks in need of modernization or expansion," says Bhandari.

For more information, contact Ramesh Bhandari at (908) 949-0693, or **rbh@anchor.ho.att.com.**

1 Trademark of Sun Microsystems, Inc.
2 Trademark of SPARC International, Inc.




**ALGORITHM AT WORK — The shortest (by fiber miles) physically diverse pair of paths between central offices AUSTTXGR and CLMBOH11W03.**

## WHY DON'T WE...?

**...offer a way** for calls that are forwarded from an office phone to a lab phone, which doesn't have a message retrieval system, to return to the office phone's Audix system after a certain number of rings if there is no answer at the lab phone.

**...offer a way** for a custom ISDN phone that displays the expanded number from speed calling or intercom dialing to return to the expanded number after an incoming call, which overwrites the expanded number, is not answered. Currently, the display reverts to the speed code or intercom number.

Doug Maisells, IHP 2F-333, ihlpe!dougm, (708) 979-0948

## I WISH WE'D INVENT...

**...software** to connect my Windows[1] graphical interface to my ISDN phone so I could dial from the PC and keep track of phone calls.

A. P. Corsico, WH 3B-306, **attmail!acorsico,** (201) 386-7784

**...a stand-alone Fax** machine with a serial port. Then you could Fax directly from the PC (as with a Fax modem), Fax normally, or use the Fax machine as a crude scanner for the PC.

Bob Hazy, LC 3W-P10, **attmail!lc15a!rjh,** (908) 580-5433

**...a volume control circuit** for our cordless phones with sufficient range to determine MAX/MIN without having to check the control setting.

**...a cordless phone** with external access to a ringer switch capable of switching an external bell or other alerting device.

D. W. Mumy, Oklahoma City, (405) 491-4806

**...a way to increase the number of telephone numbers you can redial on ISDN phones. Currently, you can redial only the last number by pushing "redial." It would be nice if the user was able to chose any of the last 10 numbers dialed.**

Rex Dailey, IX 1B-267, **ihlpk!jrd,** (708) 979-0355

**...an ISDN card** that plugs into a PC slot to function much the same way as a 730 Multi-tasking terminal IDM card. This ISDN card would work with Windows graphical interface so you could have multiple COM ports instead of having multiple ISDN sets and serial ports.

**...Audix®** telecommunications software to work with Caller ID. When the Audix system is given an external Caller ID number, it would be nice if it recorded the message with the external Caller ID number.

Tony Tontillo, NW 31R13, **ihlpm!agt,** (708) 224-6618

**...an alarm clock** with a snooze feature that has a different tone for the time you want to get up.

Kevin Mysliwiec, **nwscb!krm,** (708) 224-2251

**...ISDN phones** that show the day and clock while you are talking to another person. Now, the number is displayed, making it difficult to know if you've been on the phone too long.

John O'Neil, IH 9G-114, **ihlpb!jfo,** (708) 979-3338

**...a telephone handset** that rests comfortably on a person's shoulder, eliminating the need to scrunch up or buy a separate shoulder rest.

Lisa Weber, IHP 2R-304, **ihlpe!lweber** (708) 713-4782

1 Registered trademark of Microsoft Corp.

If you know of something that might satisfy one of these wishes, contact the person directly. Send "I Wish..." items to **attmail!tlanders.**

## OBJECTIVE

*(continued from page 1)*

easy. It is much more than a GUI builder. With only three lines of text in a file, a complete graphical tool can be described. This tool allows the user to place and interconnect icons on a canvas. Moving, copying, or deleting individual icons or groups of icons is automatic. With no programming, many different types of menus, buttons and dialogue boxes can be specified as well.

"By writing a short C program, a user can associate any attributes with these objects and tie their interaction to any underlying software," says Mike Cantone, MTS at Murray Hill. "The user also has complete control over the appearance of objects."

A powerful interface can often be created in just a few hours. The system does not produce a machine generated program, rather it handles much of the drudgery associated with an interactive interface, such as maintaining linked lists and low-level graphics routines, while retaining complete flexibility for the creator of the interface.

OBJECTIVE has proved to be ideal for several projects. Systems engineers, developers and researchers have benefited from its rapid prototyping capabilities.

Anyone interested in this software can obtain a binary copy and tutorial and reference manuals (including several complete examples) by contacting Cantone at **research!mrc** or (908) 582-4105.

## PROFILE

*(continued from page 1)*

SRE with several other process improvements, realized:

- system-test interval reduced by half,
- a 30-percent reduction in the total development cycle, and
- a factor of 10 reduction in customer-reported problems and in maintenance costs.

Customer satisfaction increased significantly, so that the quality improvement plus a strong sales effort increased sales tenfold.

The technology is easy to learn and apply. Enhancements allow the criticality of the operation, as well as its use, to be considered in prioritizing tests.

The Kelly Education and Training Center offers operational profile technology as part of the Software Reliability Engineering Application course (SN 9110). QUEST provides consulting help. For more information, or to order a paper describing the technology, contact John Musa at **homxc!jmusa** or (908) 582-4993.

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