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IBM's MAGAZINE FOR TECHNICAL COORDINATORS

MARCH/APRIL 1994

Artificial Intelligence in NASA Robots

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The IBM logo is located in the bottom right corner of the cover. It consists of the letters 'IBM' in a bold, sans-serif font, with horizontal stripes through the letters. The background of the cover features a futuristic robot with a metallic, reflective body and a large, spherical head. The robot is holding a red ribbon that is being held by a portrait of Albert Einstein, who is shown from the chest up, wearing a dark suit and a white shirt with a red tie. The portrait is set within a large, oval-shaped mirror or frame. The background is a dark blue space with stars and a bright, glowing nebula or starburst effect. The overall theme is the intersection of technology and human intellect.

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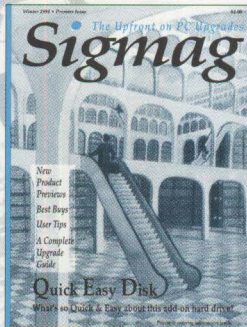
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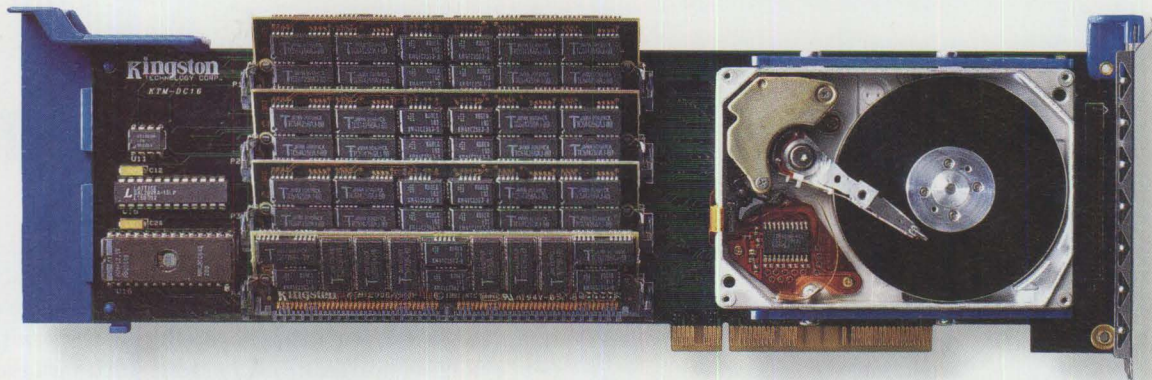


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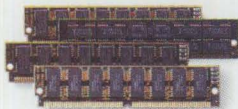
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Opinions: We've All Got 'Em!

A friend of mine recently shared a story with me about a guy who was complaining about an F he got on a paper he had written for a class. The assignment was to write his *opinion* about a certain subject! Huh?

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Webster defines opinion as "A view, judgment, or appraisal formed in the mind about a particular matter." It explains that an opinion is "...a judgment one holds as true. Opinion implies a conclusion thought out yet open to dispute. . ."

And opinions are what we want in *Personal Systems*. Your opinions! We began back in September of last year including a "Point of View" article in every issue. Contributors to this column have all been from the wide world outside of IBM. You know what our opinions are; but we're not afraid to tell you what everyone else thinks, too!

In this issue, Bob Angell, a principal with Applied Information and Management Systems, tells us what he thinks about the database products that are available for OS/2* (see page 16). He points out what's good and what's not so good. We asked him for his opinion and we got it! And, as Webster says, it's "open to dispute. . ."

Now we would like to hear from you. Do you agree with Bob? Do you disagree with him? Whichever, it's your opinion, and we would like to share it with our readers.

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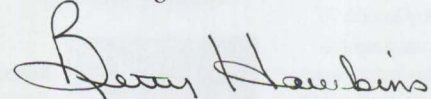
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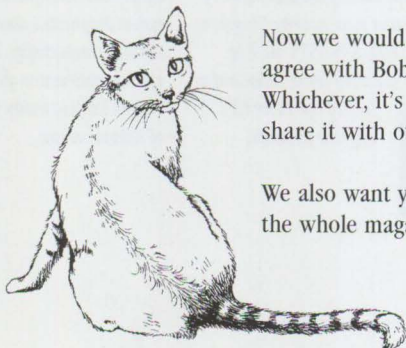
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Betty Hawkins, Editor



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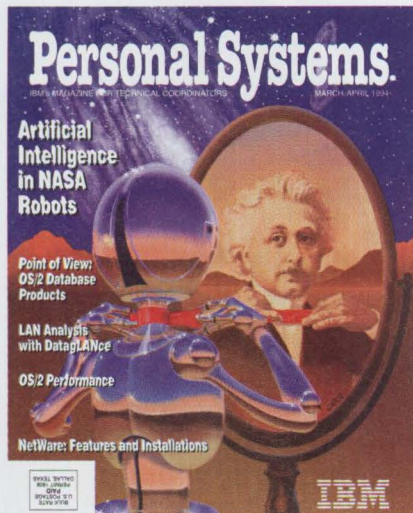
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ABOUT THE COVER

The artist chose an image he felt was a universal symbol of intelligence to reflect the advancements being made in the field of artificial intelligence. Today's computers are rapidly approaching the power and capacity of the human mind. Read about artificial intelligence, speech recognition products, and more in this issue of Personal Systems.

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If I Only Had a Brain

While most OS/2 aficionados are mere earthbound mortals, there are those users who require no food, no water, no sleep, no gravity, and, most importantly, no salary. "SodaPup," an OS/2 2.1-based robot at the National Aeronautics and Space Administration's (NASA) Johnson Space Center in Houston, Texas, is such an animal.

SodaPup is being used to assist robotics researchers at the Robotic Intelligence Section of NASA's Robotic Systems Technology Branch in developing artificial intelligence (AI) concepts for space projects such as Space Station Freedom and the ongoing shuttle missions. The Robotic Intelligence Section is concerned with the intelligent development of robots—how they plan and think, either by themselves or in cooperation with humans, both on the ground and in space.

Engineer/researcher Robert Goode says that his group's decision to provide SodaPup with the intelligence capabilities of OS/2 stemmed from requirements that the robot develop a certain amount of autonomy in its everyday activities. As an example, SodaPup currently navigates the halls of the NASA research facility using its own on-board, feature-based navigational system, which allows it to independently make decisions about where it is and where it needs to go. A motion execution application, in conjunction with a laser-based range finder, controls SodaPup's drive wheels and allows it to maneuver around obstacles in its path.

Yet SodaPup can do more than just find its way around. It has been designed to interact with its researchers through the use of TELRIP, an Ethernet*-based message passing system. If a particular office needs a package picked up, a scientist can send SodaPup a wireless e-mail command and have it come right over. SodaPup is also equipped with an on-board video camera and can process full-motion video

images that can be used for security purposes as well as mapping for the robot's future reference.

But like the Scarecrow from *The Wizard of Oz*, SodaPup needed a brain; otherwise, it would never achieve the level of AI required to increase its autonomy. Though the original prototype of SodaPup ran on a DOS-based platform that allowed it a minimal level of independence, the robot's actions were slow and unresponsive, as DOS limited SodaPup's memory resources and failed to provide the ability to process several tasks at once. In contrast, OS/2 2.1 makes extensive use of memory management and page tuning. This enhancement, along with OS/2 2.1's pre-emptive multitasking capability, played a key role in NASA's decision to use OS/2 2.1 as SodaPup's operating system of choice.

"I've used OS/2 on my PCs since version 1.0," says Goode. "I got started in it

[OS/2] more because of memory management because we do a lot of vision processing, and we were really cramped for memory. OS/2 also gives us the multitasking capabilities that allow SodaPup to run more autonomously."

OS/2 was always used on the remote PC that "talked" to the robot, but it was not until recently that OS/2 2.1 was put on-board SodaPup, when a hardware upgrade saw the installation of a 33 megahertz (MHz) 80486* processor, 16 megabytes (MB) of random access memory (RAM), and a 130 MB hard drive. Though a path planner and an operator interface have always run on-board the robot, motor control and sensor functions have now been placed on it as well, increasing the "self-sufficiency" of the robot's operations. Goode notes that the only work currently done off-board is compute-intensive vision processing and some application development.



Autonomous though it may be, the robot SodaPup remains ultimately under the control of its human master—on Earth and in orbit. Running OS/2's Presentation Manager* on both SodaPup and the NASA researcher's PC provides a graphical "roadmap" of SodaPup's location and destination at all times. Graphical representations of sensor readings, a text-based status/debug message window, and pull-down menus for task selection and control all provide a user-friendly front-end for monitoring the robot's actions.

Goode maintains that the objective of the robotics intelligence research is not to create a "free-thinking" droid like R2D2 in *Star Wars*, but rather to construct a machine that can accomplish relatively mundane tasks without constant human supervision. These tasks could range anywhere from the current pickup and delivery of packages at NASA's Houston complex to the future geological mapping of Mars' surface.

Regarding any necessary customized changes to the operating system, Goode remarks that OS/2 2.1 required very few alterations. "We've probably written nine or ten device drivers over the years [for OS/2], three or four of which we wrote explicitly for OS/2 2.1. Other than that, it's been pretty much off the shelf."

Future plans for NASA's artificial intelligence research will continue to be centered around the "thinking" part of robotics, as Goode puts it. The Robotics Intelligence Section will continue to improve upon SodaPup's artificial "brain," increasing its autonomy and allowing it to take on more responsibilities. Goode says that he believes robots

ThinkPad in the SpacePad

An IBM ThinkPad* 750C found a new home aboard the Space Shuttle Endeavour in a December 1993 mission to repair the Hubble Space Telescope.

The ThinkPad 750C was selected because of NASA's desire to test the capabilities of high performance notebook computers in space. It met or exceeded NASA's requirements for the test computer.

The ThinkPad's main task during the mission was to run a NASA test program to determine if radiation inherent in the space environment causes memory anomalies in the 750C or generates other unexpected problems. As this was the first space flight of a modern notebook computer, NASA had many questions about the ability of advanced

computers to function in low Earth orbit.

In addition to the computer, Endeavour's astronauts carried on-board two ThinkPad 750C 345 MB removable hard disk drives loaded with digital engineering drawings of the Hubble Space Telescope. Astronauts were able to use these drawings for reference as they worked on the telescope.

The shuttle's ThinkPad was a standard 9545-308 model with an extra hard disk drive. The 750C has a 10.4-inch color active matrix display, weighs 6.4 pounds, and includes a built-in Track Point II* pointing device. A type-III PCMCIA card slot is also standard on the ThinkPad 750C. All of these features contributed to NASA's decision to select IBM's ThinkPad for the shuttle test.

will someday assist astronauts with mechanical operations such as handling objects in space shuttle bays during space walks or performing intra-vehicular activities within the multi-national space station.

As NASA researchers continue to ponder and explore visions beyond their wildest imaginings, it seems likely that everyday, prosaic thinking will be increasingly left up to robots like SodaPup. Although SodaPup may not have an enchanting and witty personality like C3P0, and

while it may not have the ability to carry on philosophical conversations about the creation of the universe, what it does have is OS/2 2.1—which ought to tide NASA over at least until the next galaxy.

Todd Watson has worked for IBM since 1991 as the editorial assistant for *AIXtra: IBM's Magazine For AIX Professionals* and will soon complete his master's degree in Mass Media Studies at the University of North Texas at Denton.

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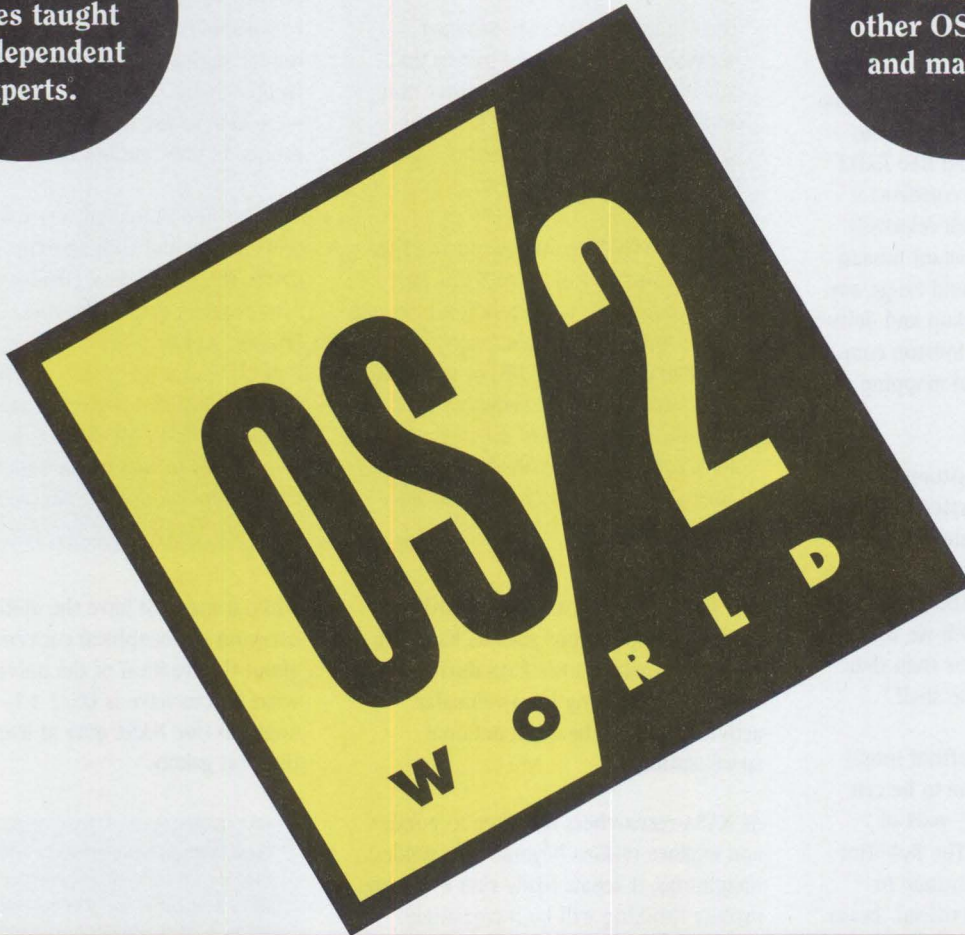
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“Look, Mom! No Hands!” Speech Recognition Products Untie Your Hands

One of the capabilities that helps SodaPup (see “If I Only Had a Brain” in this issue) function more efficiently as he roams the halls of NASA is speech recognition. Imagine a device like SodaPup arriving at your office. You’ve just finished an important report that needs to go out in the next mail run. You hand your package to SodaPup and say, “Take this to the mailroom.” That’s it!

Haven’t you frequently thought how much more work you could get done if you could just “talk” to your computer and applications? Think about the following scenarios.

You’re a lab technician. You don’t even have to lift your head from your microscope examination to key your findings into the record. “Patient Smith, first slide tests negative,” you say to the computer while you proceed to the next slide.

You’re a stock broker. You are watching the Dow Jones reports on the big board, calling a client, and making notes. You turn to your computer with the instructions to “buy 1,500 shares of XYZ corporation at \$1.50,” without having to stop any of your other activities.

Or, you just never learned to type! Now you’re not limited by how fast your fingers can move. The innovation of speech recognition products lets you talk at a 70 to 100 word per minute pace.

You can even use voice commands to perform functions on your OS/2 2.1 Workplace Shell: open folders, start applications, and select options.

It’s been said that one of the easiest things people do is to talk. Now you can use that to your advantage in your business!

How does it work?

Computerized speech recognition systems convert the spoken word into text through a series of complex algorithmic equations that isolate, identify, and interpret the phonemic components of human speech. The text is then displayed on a monitor, delivered to an application such as a word processor, and stored as if it were keyed in. Text that is input by speech takes up no more disk space than keyed-in text.

As you dictate your text into a handheld or headset microphone, the system analyzes it and displays it in a speech window. Users can dictate between 70 to 100 words a minute. And, because properly recognized words are automatically spelled correctly, you don’t even need to check your spelling. Speech recognition

*. . .this technology changes
the way you interact
with . . .computers.*

systems can correctly choose between like-sounding words such as “to,” “two,” and “too” or “our” and “hour.”

The system’s sophisticated adaptive capability “learns” users’ dictation style and accent. It can even allow students whose second language is English to achieve greater levels of speed and spelling accuracy. To learn a user’s voice, the system listens to the user read a short story. Next, it builds a mathematical model unique to the particular user’s voice. The system then interprets all acoustical data through the model. In this way, it handles dialects as well as strong foreign accents.

Its language model understands word patterns and usage. This creates a speech-to-text conversion that is highly accurate.

What is this system?

This is the IBM Personal Dictation System, developed after over 21 years of IBM research. The technology, which originally required mainframe processing power, was first offered in 1992 on a RISC System/6000* platform and is now available on personal computers with Intel 486 and Pentium chips, putting desktop dictation within the reach of millions of users.

The IBM Personal Dictation System provides the most accurate large vocabulary speech recognition capabilities available today. The system features up to a 32,000-word vocabulary and takes dictation at up to 100 words per minute. Ideal for health-care professionals, journalists, attorneys, scientists, and business users, this technology changes the way you interact with and benefit from computers.

Optional medical radiology, emergency medicine, and journalism vocabularies containing large dictionaries of words specific to those disciplines are also available. IBM has optimized the size of each vocabulary for performance and accuracy. This optimization results in a program that can be faster and more accurate than products with a larger vocabulary.

The language models allow users to be immediately productive by providing industry specific terminology and increased accuracy in dictation. The general business language model included with the IBM Personal Dictation System can be used by a wide variety of users who need to create and edit text. Users who would be especially interested are corporate users of e-mail and word

processing systems, executives, students, technical writers, and translators.

Several features are designed to simplify and enhance the system's ease of use. Voice Action Editor enables you to create personal macros. For example, you can program the system to open the calendar and check electronic mail when it hears the words "good morning."

With the Voice Action Editor, you can create short-cuts with nicknames for standard addresses and paragraphs, which are keyed in once and then spoken thereafter. For example, a lawyer dictating a contract may say "standard disclaimer" and the system will automatically include that standard text in the document.

The system also has an "add word" capability; when it hears an unrecognized word, the system stores acoustical data for that word. You can type in the word, link it to the acoustical data, and, from then on, the system will recognize the new word or phrase.

The system learns its users' language patterns. For example, the system, upon hearing a certain set of acoustical data, would normally transcribe "Mr. Wright." But if its user is a romance columnist, the system could be taught to transcribe "Mr. Right" instead. The IBM Personal Dictation System also lets users create speech profiles to format data and interpret commands, such as "new paragraph" or "bold face."

What are some of its uses?

The general business version can help in a number of ways.

- Eliminate or reduce time on proofreading, correcting, typing, and/or waiting for transcription
- Quickly capture information from individuals who have a limited ability or reluctance to use keyboards
- Allow voice control of the OS/2 2.1 Workplace Shell and other application functions

Adding the optional medical vocabularies opens up even wider opportunities.

IBM Personal Dictation System Features and Benefits

| Features | Benefits |
|--|---|
| Voice-to-text capability | Eliminates the need to transcribe business, medical, or technical documents. Permits users who are reluctant or unable to use a keyboard to run business applications. |
| OS/2 Workplace Shell navigation | Allows users to control the U.S. English OS/2 2.1 Workplace Shell and applications by voice. Includes a mechanism that automatically speech-enables the Workplace Shell and any OS/2 applications that rely on the standard Presentation Manager controls. |
| Eyes- and hands-free operation | Allows users to read and describe findings simultaneously. Permits users to dictate while using their hands for other tasks. |
| Large, 32,000-word vocabulary | Helps ensure accurate word capture. Allows you to personalize the system by adding up to 2,000 words to the system vocabulary. |
| Optional industry-specific language models | Lets you customize the system for journalists, emergency medical personnel, and radiologists. |
| Multiple language support | Includes U.S. English in the United States, Canada, and Europe. IBM also intends to provide French, German, Italian, Spanish, and UK English in Europe, the Middle East, and Africa. |
| Application program interfaces (APIs) | Lets developers customize your end-user interface. |
| Speaker enrollment function | Allows the user to create a speaker model of his or her accent and usage patterns by reading a Mark Twain story. The system analyzes the spoken sentences and creates an accurate speaker model of the user's voice. |
| Administrative functions | Allows users to add and delete speaker models. |
| Presentation Manager controls | Allows users to speak the words appearing in the menu bar, as well as in push buttons, check boxes, radio buttons, and list boxes. |
| Dictation | Transfers the spoken text to an application by cut and paste or by keyboard emulation. |
| Voice Action Editor | Allows users to define command macros that perform a sequence of actions with a single voice command. |

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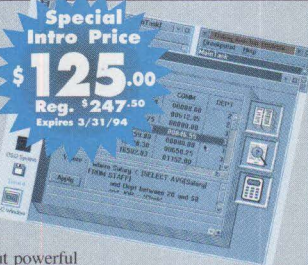
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- Provide documents immediately, eliminating delays caused by transcription and allowing immediate transmission to co-workers
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- Reduce transcription costs

The journalism industry is especially anxious to use speech technology to address the issue of Repetitive Stress Injury (RSI). By using speech to enter text instead of the keyboard, journalists with RSI can be more productive.

Additional speech recognition products are also available from IBM: IBM Speech Server Series and IBM Continuous Speech Series.

IBM Speech Server Series

The IBM Speech Server Series* operates in a client-server environment in which a RISC System/6000 is a requirement for other, co-existing, applications. The recognition engine technology is similar to the Personal Dictation System, with the Speech Server Series technology shared on the server level and the Personal Dictation System technology operating at the workstation level.

The Speech Server Series comes in the following versions:

- IBM AIX Speech Server/6000* base for LAN configuration on the server
- IBM Speech Client/2* for LAN configuration on a PS/2 client
- IBM Speech Client/6000* for LAN configuration on a RISC System/6000 client
- IBM AIX Speech Single User/6000 for stand-alone configuration

IBM Continuous Speech Series

The IBM Continuous Speech Series consists of a Developer's Toolkit to develop speech-enabled applications and a Run-Time System for executing and operating those applications. This product not only enhances the functionality of many of your existing software applications but also enables you to develop new software

applications that keep pace with the needs of today's dynamic markets.

Its features include:

- Continuous speech—you can speak without pausing between words
- Speaker independence—the system requires no training to recognize a voice

By being speaker independent, the Continuous Speech Series is perfect for mall kiosk applications.

Using the speech recognition application programming interface (API), applications can be produced that recognize and process a continuous flow of spoken U.S. English words. These APIs provide data-stream and context control functions that

can give your applications advanced speech recognition capabilities. Plus, they include a unique feature that allows you to construct recognition tasks and word-pair grammars for use at run time.

To learn more about these speech recognition products—and how they can enhance productivity in your organization—contact your IBM marketing representative or call (800) TALK 2 ME (825-5263).

The Road Not Taken: Telecommuting in the '90s

The idea of telecommuting has been bandied about by corporate America for years, but the prevailing notion is that while it's a great idea in theory, nobody is willing to take the necessary actions to put the wheels into motion—off the highways and into the driveways. Well, almost nobody.

In 1990, the United States Congress initiated what may prove to be the cornerstone for the direction telecommuting takes in this country over the next decade. The Federal Clean Air Act, effective November 1992, mandates that by the end of 1996, employers with 100 or more employees in our nation's most polluted cities must reduce employee commuting by 25 percent. This means that large companies having a presence in cities like New York, Los Angeles, and Chicago must take action to curtail employee commuting. Telecommuting appears to be one of the top solutions.

Why telecommuting? First, the technological realities of telecommuting have finally caught up with the fantasies. Recent evolutions in communications technology such as personal computers, modems, fax machines, remote-based LANs, private and commercial electronic networks, and other information-oriented communications tools, now provide reliable, remote connectivity to one's place of work and, for that matter, to the rest of the globe. Aside from the obvious reduction in air pollution and stress caused by commuting, trial

studies have shown concrete proof that telecommuting often results in productivity gains, cost savings, improved morale, and, believe it or not, even more effective workgroup communication.

Nevertheless, employee emphasis on interpersonal discourse and management concerns about employee supervision continue to play a deciding role in American companies' apprehension at implementing telecommuting programs. Overcoming these supervisory and associational fears becomes a primary factor in developing successful telecommuting strategies.

Patricia Mokhtarian, assistant professor of transportation studies at the University of California/Davis, has studied telecommuting extensively. In her article "Defining Telecommuting," she states that understanding and embracing the concept of "remote management" is key to successful telecommuting.

"[Managers wondering] how will I know they're really working?" is undoubtedly the biggest obstacle to the widespread acceptance of telecommuting by employers," says Mokhtarian. "To the extent it can be shown that other, common forms of work have similar remote management requirements, the comfort level with telecommuting may be increased."

A Change in Attitude

Implementing effective telecommuting programs requires an attitudinal change

by both employers and employees. Advocates have positioned the idea of management by objective, or MBO, as being the ideal strategy for managing telecommuting employees. MBO stresses employee productivity, not time spent in the office or employees' acquiescence to workplace guidelines.

No matter the management strategy, Mokhtarian believes that well-planned telecommuting programs stress frequent communication with the *primary* office. She makes this distinction because the term "telecommuting" can be misleading, as it forsakes other remote work types including satellite offices, field work, working while traveling, and long-distance telecommuting.

Mokhtarian is also of the opinion that using "telecommunications" equipment isn't necessarily a prerequisite for implementing a successful telecommuting program. "Requiring telecommunications to take place before calling a particular event 'telecommuting' seems to be unnecessarily restrictive," says Mokhtarian, adding that it eliminates the possibility of a variety of non-telecommunications work tasks that could be done somewhere other than in a primary office. This work could include everything from graphic artists drawing at home on their own drawing tables to editors needing no more resources than a place to sit and read.

According to the New York-based research firm Link Resources, the number of

telecommuters in 1992 was an estimated 6.6 million people, or 5.3 percent of the work force. By 1996, that number is expected to increase to 6.6 percent. As American companies search high and low for ways to reduce labor and office costs yet still increase productivity, it seems that telecommuting would emerge as a viable solution. So why hasn't it?

A study by researchers at the Department of Civil Engineering at the University of Texas at Austin indicates that a variety of issues come into play. For employers, telecommuting often requires a potentially high initial investment and is often viewed with resistance by both management and unions. Performance evaluation and data security also become critical issues when management is considering telecommuting policy.

Employees, on the other hand, face lessened social interaction with co-workers, as well as fears of fewer opportunities for promotion and possibly even lower salaries. Telecommuting can also reduce chances for on-the-job tutelage from senior workers.

Hence the inevitable and fundamental question: Do the benefits of telecommuting outweigh the costs?

According to the UT study, that certainly seems to be the case. Aside from complying with the Clean Air Act regulations established by Congress, it seems likely that most businesses that establish telecommuting programs can benefit both in terms of human resources and cost savings. Well-defined and workable telecommuting plans can enhance a company's image, providing a magnet for potential employees, as well as reduce overhead in the form of decreased office and parking space, less turnover, and better morale among the rank and file.

Employees almost always benefit from telecommuting by spending less time and money on travel. More importantly, they usually feel a reduction in stress and have

fewer distractions during work hours, resulting in productivity gains for the company. Telecommuting can also offer employees more flexibility in meeting family commitments and provide increased opportunities for participating in community activities, which benefits companies, employees, and communities alike.

Action, Not Words

Both studies suggest that the key to realizing a successful telecommuting program, as with any effective business plan, begins with clearly defined objectives that are feasible and beneficial to the company. First and foremost, management must determine the types of jobs most suited to telecommuting in *their particular environment*. For some companies, this could be bookkeepers and writers—for others, designers and managers.

After they've decided upon the positions most appropriate for telecommuting, managers should then identify those individuals who they believe would be both interested in and fitted for work away from a primary office. These individuals probably will have been with the company for at least a year or two and will be quite familiar with company policy and culture. They should be highly motivated, self-starting individuals accustomed to working without a great deal of supervision.

Next, management should establish a gauge for tracking telecommuting employees' performance when working away from the office. This could be anything from a constantly monitored on-line activity report to biweekly meetings with a supervisor—whatever the method, it should be agreed upon by everyone affected. And most employers would be well-advised to research problematic issues such as corporate liability for employees working away from the primary workplace.

And finally, what repeatedly becomes the crux of any telecommuting program: Who's going to pay for it? Though not all telecommuters will need telecommunications

equipment, many will require at least an added phone line; others a personal computer and modem; yet others a fax machine. UT's study indicates that a large percentage of currently non-telecommuting employees they interviewed were willing to incur a small cost in order to obtain equipment for use at home, but only if the cost was insignificant.

The study warns about companies that suggest a pay cut for employees who agree to telecommute—most potential telecommuters interviewed indicated that that would not be a viable option.

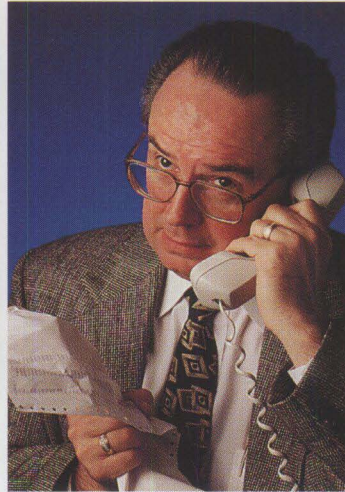
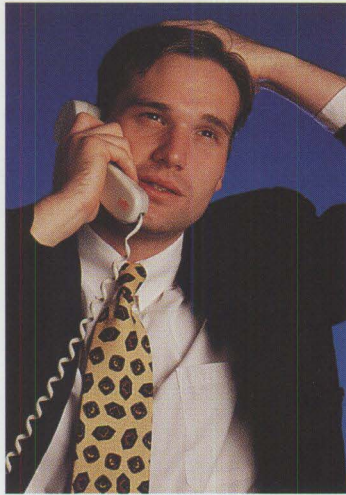
Get Off That Horn!

As air pollution indexes continue to rise alongside the barometer of commuter frustration, and as national disasters such as the recent Los Angeles earthquake help turn common commutes into navigational nightmares, American companies in urban areas that refuse to prepare and institute effective telecommuting policy within the next few years are, down the road, going to find they missed the bus, so to speak.

The American workforce becomes more and more information-based every day. As communications technology continues to evolve in such a way that allows for increased remote work activity, and as employees demand cutting edge work alternatives like flextime and job sharing in order to spend more time with their families, telecommuting is going to dawn on employers as a great way to turn full-time workers, on whom they've spent a lot of time and money training, into just part-time drivers.

Todd Watson has worked for IBM since 1991 as the editorial assistant for *AIXtra: IBM's Magazine For AIX Professionals* and will soon complete his master's degree in Mass Media Studies at the University of North Texas at Denton. He hopes to eventually live and work near the *deserted* freeways of Los Angeles.

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Point of View

Not Just Another Database Article

Before you go ahead and think this is just another database article, think again. This is not an article that describes how databases work, but one that looks at what is available now and could be available for OS/2 2.1.

OS/2 2.1 seems to be doing well as 1994 dawns. I wonder if this year will bring more comprehensive database packages written specifically for OS/2? You mutter to yourself, "I wonder if this bozo has ever heard of DB2/2* [DATABASE 2* OS/2] from IBM?" I know about DB2/2, but I don't think it is quite what is needed. To use it effectively, one must be well versed in structured query language (SQL).

Let's review what has made databases appealing to novices and experts alike. These packages, primarily in the DOS/Windows* environment, have a robust database engine, a good interactive graphical user interface (GUI), excellent reporting and graphing capabilities, and a rich application development language. With these attributes, one can develop a stand-alone, fully abstracted database application within hours.

These databases run very well under OS/2, and there are many who run DOS/Windows databases in this manner daily with great reliability and stability. There are ways to develop the same application using DB2/2, but it takes much

longer and usually requires extensive programming and SQL knowledge.

A database product for OS/2 would not only include all the attributes mentioned above, but would also be object oriented. In addition, this product would include multi-threading for all functions; have a rich graphical user interface, system object model (SOM) hooks, and client/server capabilities; include the robust functions found in DB2/2 today (roll-forward, journaling, etc.); and, most importantly, be easy to use. The pricing for this product would also be competitive with database products from Borland*, Oracle*, Sybase*, and others.

Surprisingly enough, IBM has developed such a package for OS/2, but it is as obscure as an unbroken campaign promise. Personal Application Systems/2 (PAS/2) is a multi-threaded OS/2 application with a rich GUI, SOM, and client/server capabilities; plus, it will read and write DB2/2, dBASE IV*, and other data file formats. PAS/2 also allows you to prepare extensive reports and graphs from your data without knowledge of programming or SQL. However, you cannot develop PAS/2 database applications without its sister product, Builder/2*. With Builder/2 and PAS/2, you can produce fine multi-threaded OS/2 client/server applications without needing to be an SQL expert or a programmer. And, best of all, these two

packages allow you to access all your DB2/2 data.

So, you ask, what am I complaining about? I would like to see these fine tools marketed and priced to reach the masses. Right now PAS/2, Builder/2, and DB2/2 (single-user versions) retail at \$895, \$2,500, and \$425, respectively. Compare this with a retail version of Paradox* for DOS at \$795 that essentially contains all of the above functions but without the object-oriented technology. [Note: Prices as of press time of *Personal Systems*.]

IBM must realize that for these products to become a corporate and small business mainstay, they must be aggressively priced so that everyone has an opportunity to use and introduce them to others. The success of any database product in this area will depend on its widespread acceptability and overwhelming install base.

Bob Angell is a principal with Applied Information and Management Systems in Salt Lake City, Utah, a management consulting firm that specializes in management information systems integration, OS/2 development and integration, total quality improvement engineering, and other related services. He specializes in multiplatform data integration, database design and development, simulation and modeling of complex environments (neural networks), and OS/2 software development.

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- Certified LAN Server Administrator and Engineer (GR28-5113)
- Instructor Professional Certification Program Description (GR28-5260)

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Celebrate the Past on Your Trip Back to the Future!

The Spring 1994 IBM Personal Software Products (PSP) Technical Interchange is heading for the Bay area, and you won't want to miss it!

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This spring's Technical Interchange is tripping the light fantastic at the San Francisco Hilton from April 25 through April 29. It's your chance to step back in time at a '70s flavored conference while learning the very latest, up-to-the-minute OS/2 technologies.

This conference has all the products, strategies, technologies, and demonstrations that an OS/2 professional needs.

Over 100 sessions have been tailored to meet the growing technology-specific needs of the attendees. The show includes even more exhibits and technical sessions; plus, for the first time ever, it includes device driver sessions that were previously only available by attending a separate device driver conference.

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- And much more!

The conference keynote speaker is Lee Reiswig, president of personal software products. Guest speakers include IBM's David Proctor, vice president of personal software products, and John Soyring, director of software development programs. Industry keynote speeches will be given by Charles B. Wang, chairman and CEO of Computer Associates International, Inc., and Donald Haile, general manager of the Networking Software Division.

Conference Opportunities

You'll be able to choose from a wide variety of technically intense activities, and you'll have many opportunities to relax during your week in San Francisco.

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Need to bring something back to the kids and co-workers? The **PSP Store** provides a wide array of merchandise—mouse pads, T-shirts, golf shirts, sweatshirts (you'll need those if you're going out at night in San Francisco), jackets, mugs, caps, watches, and more.

The fun theme of this conference is "flower power." Monday night, throw on your best tie-dyed T-shirt, squeeze into those bellbottoms, and join the crowd for a hip trip to the past at the welcome reception. Prizes will be awarded for the best "retro" threads! This, and several other social opportunities, will ensure you spend the time you need relaxing before beginning the next day of technical sessions.

Register Now!

The early registration fee is \$795.00 before March 21, 1994. After that, the fee is \$895.00. Attendance is limited, and a complete sell-out is expected. Call (800) 872-7109 in the U.S. or (508) 443-4990 outside of the U.S. to register.

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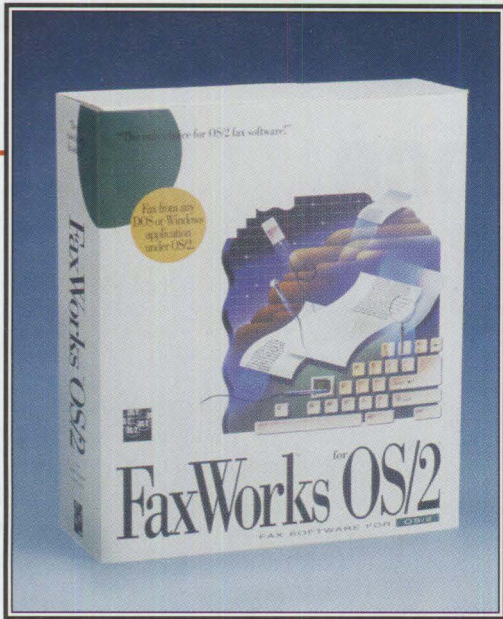
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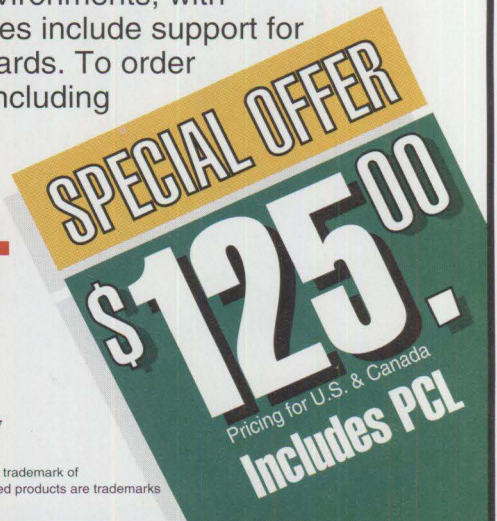
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OS/2 2.1 Performance Tuning Tips—Part II

This is the second article in a two-part series. The first article, which appeared in the November/December 1993 issue, discussed tips and techniques for tuning systems during installation, including file system and partition tuning, general performance enhancements, and swap file tuning. This article includes tips about tuning CONFIG.SYS and AUTOEXEC.BAT files, tuning applications, printing, and communications. It also provides a list of IBM and third-party monitoring tools.

OS/2 has many options and tunable settings. The default settings are designed for the average user; if they do not meet your specific requirements, you can change certain settings and tune your system to increase performance.

Customizing the CONFIG.SYS File

Customizing the OS/2 2.x CONFIG.SYS file improves performance and reduces memory requirements. Unfortunately, experimental changes to the CONFIG.SYS file settings sometimes result in a system that will not boot.

If this happens, use a boot diskette to recover, or better yet, use the new Alt-F1 feature.

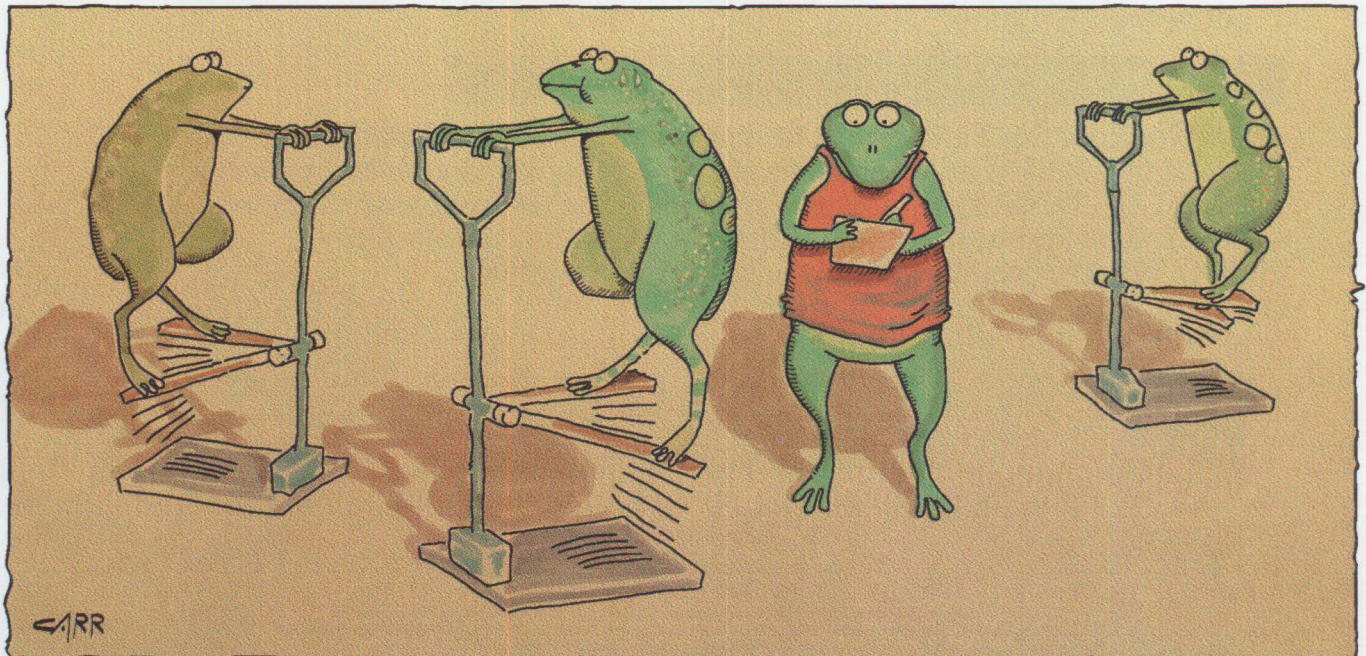
The Alt-F1 feature copies the CONFIG.SYS, OS2SYS.INI, and OS2.INI files from the install directory over the existing files in the root directory. To use this feature, set up the system as you like it—

Workplace Shell included—and shut down the system. On the next boot, copy these files from the root directory to the \OS2\INSTALL directory on the boot partition. Because you will recover to the last saved CONFIG.SYS setup, you can now experiment with little risk.

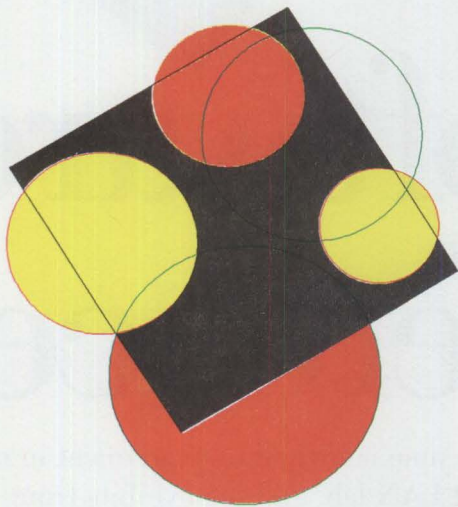
If you do not save your CONFIG.SYS or .INI files to the \OS2\INSTALL directory, the Alt-F1 function will recover the files from the initial installation. You can save time by copying these files to \OS2\INSTALL after making changes you want to keep.

Be careful if you copy a CONFIG.SYS file from a network or other system. Statements from an existing system may not provide optimum performance on your system, because many CONFIG.SYS statements are dynamically set during installation based on the system configuration.

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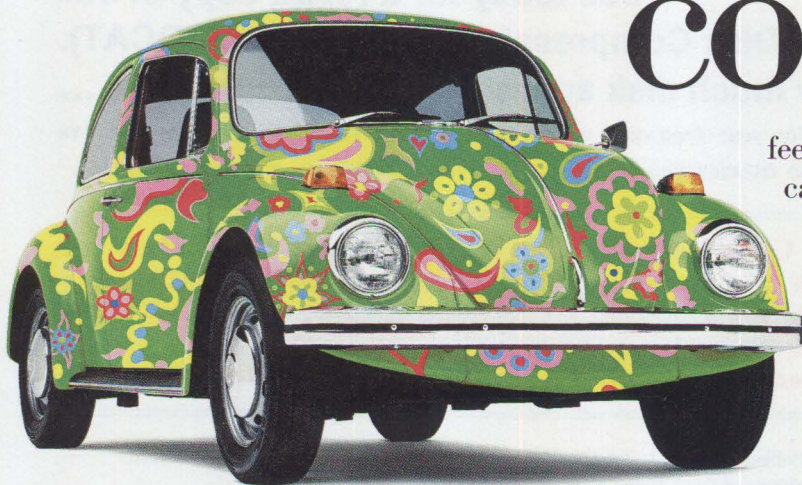
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Tuning Through CONFIG.SYS Statements

Following are descriptions and tuning suggestions for some pertinent OS/2 2.x CONFIG.SYS statements.

PATH= specifies the directories and search sequence to find .EXE, .BAT, .CMD, and .COM files. Tune the path statement for your system by placing the most commonly used directories at the beginning of the path. This improves performance by reducing the number of directories that the system must search to locate a particular file.

LIBPATH= specifies the directories and search sequence to find Dynamic Link Libraries (DLLs), resources, and fonts. Specify the most frequently accessed directories first so the operating system can find these files faster. The A.; at the beginning of the LIBPATH statement tells OS/2 to search the current directory first. This will improve performance when working with applications that keep DLLs, resources, and fonts in the subdirectory from which the system launches the application.

DPATH= specifies the directories and search sequence to find data. List your most frequently accessed directories first so the operating system can find these files faster.

SWAPPATH= specifies the location of the Swap File, the MinFree Value, and the Initial Swap File size. The default location for the Swap File is the \OS2\SYSTEM subdirectory; the MinFree and Initial Swap File size values are in kilobytes. A detailed discussion of how to tune these parameters and their impact on system performance appeared in Part 1 of this article. The following examples show how to change the location and settings of the SWAPPER.DAT file:

- **SWAPPATH=D:\OS2\SYSTEM 2048 4096** creates a SWAPPER.DAT file in the \OS2\SYSTEM subdirectory on the D: partition, with a MinFree Value of 2 MB and an Initial Swap File size of 4 MB.
- **SWAPPATH=E:\ 5120 12288** creates a SWAPPER.DAT file in the root directory on the E: partition, with a MinFree value of 5 MB and an Initial Swap File size of 12 MB.

| Memory Size (MB) | One File System | Two File Systems ¹ |
|------------------|-----------------|-------------------------------|
| 4 | 128 | 128/64 |
| 5 | 128 | 128/64 |
| 6 | 256 | 256/64 |
| 7 | 256 | 256/128 |
| 8 | 512 | 256/256 |
| 9 | 512 | 256/256 |
| 10 to 16 | 1024 | 512/512 |
| 17 to 32 | 2048 | 1024/1024 |

¹The first value is allocated to the file system with the largest total disk space or sum of partitions; the second value is allocated to the other file system.

Figure 1. Disk Cache Defaults

| | | FAT | HPFS |
|-------------------------------|---------|-------------|-------------|
| Cache size | Range | 64 KB–14 MB | 64 KB–2 MB |
| Threshold | Default | 2 KB | 4 KB |
| | Range | 2 KB–64 KB | 2 KB–64 KB |
| Read-Ahead Value ¹ | | 8 KB | 8 KB |
| Cache parameters MaxAge | Default | 5,000 ms | 5,000 ms |
| | Range | Fixed | 1–99,999 ms |
| DiskIdle | Default | 1,000 ms | 1,000 ms |
| | Range | Fixed | 1–99,999 ms |
| BufferIdle | Default | 500 ms | 500 ms |
| | Range | Fixed | 1–99,999 ms |

¹Fixed value that cannot be changed

Figure 2. Cache and Lazy Writing Parameters

DISKCACHE= allocates the memory in kilobytes for the File Allocation Table (FAT) file system's disk cache, enables or disables FAT lazy writing, and sets the threshold in sectors for caching disk reads. Caching speeds up applications that rely on disk I/O by keeping frequently accessed hard-disk data in a cache. Remember that increasing the disk cache also reduces the amount of available memory.

Specify the **LW** parameter for FAT lazy writing. This feature defers data writing to the hard disk so that applications can regain control of the system without having to wait for I/O operations to complete. The default enables lazy writing; disabling lazy writing severely degrades system performance. For example, **DISKCACHE=128,LW** sets the FAT file system cache to 128 KB and enables lazy writing.

The threshold parameter specifies the number of sectors that will be placed into cache for read operations. If the threshold parameter is not specified (as in the previous example), it defaults to a value of 4 (2 KB). The threshold value may not exceed one-quarter of the total cache size. If it does, OS/2 simply ignores the value and uses the default value instead. Any read operation smaller than the threshold is read into the cache first. Subsequent read operations may find the data they need in the cache, thus improving performance.

The statement **DISKCACHE=512,LW,64** sets the FAT file system cache at 512 KB, enables lazy writing, and sets a threshold value of 64, which caches all reads under 32 KB. See Figures 1 and 2 for defaults and ranges.

BUFFERS= provides memory that OS/2 2.x uses to cache FAT directory information, which improves performance. Using **BUFFERS** in OS/2 differs from using them in the DOS environment. A buffer is the size of a FAT sector (512 bytes), so every eight buffers take one page of memory. On larger FAT partitions, you can improve performance by increasing the number of buffers. If you have FAT partitions totaling more than 500 MB, increase **BUFFERS** to 40 or 60. The default buffer value is 30.

IFS= loads the High-Performance File System (HPFS). It also allocates memory (in kilobytes) for the HPFS disk cache (via the **/CACHE** parameter) and sets the threshold (in kilobytes) for caching disk reads (via the **/CRECL** parameter).

Note: If your system has no HPFS partitions defined, disable this statement by adding **REM** to the beginning of the **IFS** line in the **CONFIG.SYS** file.

Lazy writing for HPFS defaults to **ON**, and you must enter a **RUN=CACHE** statement to turn it off. **CACHE** can also be run from a command prompt. Figure 1 shows the default disk cache sizes; Figure 2 shows other cache and lazy write parameters.

The following examples illustrate different ways to set this statement and how each impacts performance.

- **IFS=C:\OS2\HPFS.IFS /CACHE:512 /CRECL:4 /AUTOCHECK:C** is the default statement on 8 MB systems. It sets the HPFS cache to 512 KB and the cache record-length threshold to 4 KB. The **/AUTOCHECK** parameter designates which partitions **CHKDSK** automatically tests when an abnormal exit occurs. In this example, **CHKDSK** is run against the **C:** partition.
- **IFS=C:\OS2\HPFS.IFS /CACHE:2048** sets the HPFS cache to 2 MB and uses the default value of 4 KB for the cache record-length threshold. No partitions are designated for autocheck.
- **IFS=C:\OS2\HPFS.IFS /CACHE:256 /CRECL:16 /AUTOCHECK:DEF** sets the HPFS cache to 256 KB and the cache record-length threshold to 16 KB. It also designates the **D:**, **E:**, and **F:** partitions for autocheck.
- **IFS=C:\OS2\HPFS.IFS /CACHE:64 /CRECL:64 /AUTOCHECK:DEF**

attempts to set both the HPFS cache and the cache record-length threshold to 64 KB. The **CRECL** value is invalid because OS/2 2.1 disk cache thresholds cannot exceed one-quarter of the total cache size. The system overrides the **CRECL** value and uses the HPFS default threshold of 4 KB. It also designates the **D:**, **E:**, and **F:** partitions for autocheck.

If you have large partitions and are running I/O-intensive applications, it is best to set the disk cache and cache threshold higher. If you have a smaller system that is not I/O intensive, minimize the cache and keep the default threshold to save memory. Part 1 of this article contains a detailed discussion of cache sizes, thresholds, and their effect on system performance.

PRIORITY_DISK_IO= specifies disk I/O priority for foreground applications. If

If you have a smaller system . . . minimize the cache and keep the default threshold to save memory.

PRIORITY_DISK_IO=YES is specified in the **CONFIG.SYS** file, an application running in the foreground receives disk I/O priority over background applications, resulting in higher performance. The default value is **YES**. You can set this statement to **NO** when running I/O-intensive applications such as compile in the background and the foreground task is less important. Setting it to **NO** removes the priority boost from the foreground application and improves the background compile performance.

THREADS= specifies the maximum number of threads (dispatchable units of execution) allowed by OS/2 to exist at any one time. OS/2 applications usually have several threads to take advantage of multitasking, whereas DOS and Windows applications usually have only one thread. Other threads are used by the system. The default, 128 or 256 threads (depending on system memory at installation), is acceptable in most environments. Increasing this value consumes additional memory and reducing it below 128 does

not free significant memory. An exception to this rule is a server environment, in which it is preferable to have 256 or 512 threads on the server itself because servers tend to use many threads.

MAXWAIT= sets the amount of time a ready-to-run regular or server thread can wait before the system assigns it a temporary higher priority. The default of three seconds is optimal for most systems. The amount of time to set **MAXWAIT** depends on the number of concurrent applications and the activities they perform.

MEMMAN= specifies memory management control options. When using this statement's **SWAP** option, the system can swap to the Swap File. Even with this recommended setting, there is a risk of overcommitting the memory with the Swap File. Since the **NOSWAP** option prevents swapping, the system must contain physical memory for all memory allocations.

Another option, **PROTECT**, enables certain application programming interfaces (APIs) to allocate and use protected memory.

The **COMMIT** option tells the memory manager to reserve storage in the Swap File if the system allocates memory that exceeds real system memory. Using this option generates very large Swap Files. This option is useful in unattended operating environments, particularly servers. If you specify the **COMMIT** option, you should also increase the Initial Swap File size parameter in the **SWAPPATH=** statement. OS/2 will execute less accounting overhead when the Swap File is less than the original size. The default for **MEMMAN** is **SWAP,PROTECT**.

PRINTMONBUFSIZE= sets parallel-port device-driver character monitor buffer sizes for **LPT1**, **LPT2**, and **LPT3**. To speed up data transfers to devices connected to your system's parallel ports, increase the associated device-driver monitor buffer sizes. For example, **PRINTMONBUFSIZE=2048,134,134** increases the device driver buffer for a device connected to **LPT1** to 2048 bytes. The default is 134,134,134 (bytes).

SET DELDIR= specifies a location for holding deleted files and the total size of files to be retained. This option enables you to retrieve deleted files. The default

has this setting commented-out because backing up each deleted file slows performance.

```
SET DELDIR=C:\DELETE 512;D:
\DELETE 512;
```

means that OS/2 will save files that were erased, deleted, or shredded from the C: partition to a total of 512 KB in the C:\DELETE subdirectory (similarly, files from the D: partition are saved in the D:\DELETE subdirectory). The system uses first in, first out (FIFO) file management. If the last file deleted is larger than 512 KB, then the entire file is saved regardless of its size. In addition, the system does not differentiate between files that a user erases and files that an application erases, such as temporary files.

You will probably want to use this function only when you "clean out" your system. Make sure you specify a large enough size in the statement to save all files until you are finished; then REM out this statement in the CONFIG.SYS file for the next boot.

SET RESTARTOBJECTS= specifies what the Workplace Shell does when the system is rebooted. This line does not appear in the default OS/2 2.x installation, but the system defaults as if it has encountered a SET RESTARTOBJECTS=YES statement. This starts up all objects in the Startup folder and any other objects that were active when the system was last running.

A SET RESTARTOBJECTS=NO statement tells the system not to start anything and provides the fastest boot time. A SET RESTARTOBJECTS=STARTUPFOLDERS ONLY statement tells the system to start up only objects in the Startup folder.

Changing DOS Settings

Virtual device drivers used by DOS sessions are normally loaded into low memory (below 640 KB), yet they occupy little or no memory. These device drivers are required by and are specific to certain applications that run in a DOS session. If you put the commands to load these device drivers or other memory-resident programs in the CONFIG.SYS file, they are loaded into every DOS session. This reduces the amount of available conventional memory for DOS applications.

DOS settings enable you to customize a DOS session. (Settings are properties or

characteristics that tell the operating system how one object differs from others.) Each object has a Notebook or pop-up menu choice for customizing settings.

You can use settings to load the DOS device drivers for DOS applications so that you have the maximum amount of memory available in each DOS session. For example, DEVICEHIGH=[driver-name] loads a specified DOS device driver into an available upper memory block (UMB) for a DOS session. If a UMB is not

available, the device driver loads into low memory (as in a DEVICE= statement). To enable UMBs, include the UMB parameter in the DOS= statement in the CONFIG.SYS file. Although this does not specifically affect performance, IBM recommends loading device drivers this way because it reduces functional overhead.

Tuning OS/2 Applications

Because OS/2 applications are designed to run in the native OS/2 environment and take advantage of OS/2 at the API level,

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they do not need special settings or configurations.

Tuning Windows Applications

All objects—including Program Objects—have settings. Adjusting DOS and WIN-OS/2* settings improves performance. For example, you might customize Program Object settings to tell the operating system how applications should start each time the system opens the Program Object. Or you could open the Mouse Object to customize the mouse for left-hand use.

With OS/2's Enhanced Compatibility mode, many Windows 3.1 Enhanced mode applications can run under OS/2 2.1. This is a mode specific to WIN-OS/2 3.1, not an implementation of Windows 3.1 Enhanced mode. The major benefit of Windows 3.1 Enhanced mode is virtual memory, which OS/2 already has.

As in WIN-OS/2 3.0, a special Virtual DOS Mode (VDM) emulates a DOS Protect Mode Interface (DPMI) server. The WIN-OS/2 3.1 kernel loads into the VDM to directly service requests from Windows applications running in the VDM. To preserve system integrity and avoid running duplicate virtual device drivers, the WIN-OS/2 3.1 Enhanced Compatibility mode does not use the Virtual Device Drivers (VxDs) of the Windows Enhanced mode. As a result, Windows 3.1 applications that do not access the VxDs—such as Mathematica*, OmniPage Professional*, and Vellum*—will run in the WIN-OS/2 3.1 Enhanced Compatibility mode. OS/2 does not currently support VxDs, so applications that require VxDs will not run.

To set up an application to run in the Enhanced Compatibility mode, set the `WIN_RUNMODE` to `3.1 ENHANCED`. in the WIN-OS/2 Settings Notebook for the Application Object. You can also start an Enhanced Compatibility mode session from an OS/2 or DOS command line by entering `WINOS2 /E` or `WINOS2 /3`. For example, to run `hello.exe`, you would enter `WINOS2 /E hello.exe`.

To set up an application to run in Standard mode, set the `WIN_RUNMODE` to `3.1 STANDARD`. (This setting is in the WIN-OS/2 Settings Notebook for the Application Object.)

To determine which mode is enabled in a VDM, use the Help pop-up menu from the Program Manager and select `About...` This displays the About Program Manager box that indicates whether the session is in Standard or Enhanced Compatibility mode. Standard mode provides the best application performance.

Installing a WIN-OS/2 Application

The easiest way to install a WIN-OS/2 application is by migration. Simply select the migration command, and the system will migrate your application, giving it a path and some settings.

To manually install an application on the Workplace Shell, create a Program Object from the Templates folder. Then use the object's Settings Notebook to specify settings for the application. For a single application definition, enter the full path and file name of the application in the Program Object definition. For a multiple application definition, enter the name of the program manager (for example, `MYAPP.EXE`) in the Program Object definition. After doing this, go to the Session Object to specify the session type: WIN-OS/2 Full Screen or WIN-OS/2 Windowed. If you select the WIN-OS/2 Windowed option, then select the Separate option to run the application in a separate VDM. If you do not select this option, it runs by default in a common Windowed session.

Starting DOS and OS/2 Applications from WIN-OS/2

You cannot start non-Windows applications from a VDM running WIN-OS.2 under OS/2 2.0. In OS/2 2.1 you can start DOS and OS/2 applications from a VDM running a WIN-OS/2 Full-Screen or Windowed session.

From a command prompt in a DOS VDM session, you can start an OS/2 application by entering its name as if it were a DOS application. This procedure saves time because you do not have to change sessions to launch applications.

Using Full-Screen Versus Windowed Mode

By default, the WIN-OS/2 icon is set to Full Screen. Because it references * in the program settings, you cannot easily change from Full Screen to Windowed. You can improve performance somewhat by running the application under

WIN-OS/2 in a full screen, or you can run in windowed mode to view multiple sessions simultaneously. A quick way to change between modes is to change the WIN-OS/2 program settings path and file name to `C:\OS2\MDOS\WINOS2\PROGRAM.EXE`, assuming C: is the partition where WIN-OS/2 is installed. This enables you to choose either WIN-OS/2 Full Screen or WIN-OS/2 Windowed to launch your applications.

Loading Applications Faster in the Windowed Environment

Applications can run in common or separate sessions. *Common* windowed sessions share one WIN-OS/2 kernel regardless of the number of applications loaded. *Separate* windowed sessions load a new copy of the WIN-OS/2 kernel each time you start an application. Launching a separate windowed session takes longer because the system must load the WIN-OS/2 kernel as well. To eliminate this delay, load a Windows application in a common session.

Reducing Memory Resource Use

To reduce use of the system memory resource, use a common WIN-OS/2 Windowed session whenever possible. The system will start only one VDM for all the WIN-OS/2 Windowed sessions.

You can also reduce the amount of Expanded Memory (EMS) and Extended Memory (XMS) allocated to your sessions if your applications do not need it. While the session allocates only linear address space, some applications try to touch all memory just to see what is available. This increases the amount of memory needed to run the application and may increase the size of the Swap file. If you are unsure which of your applications use EMS or XMS, reduce the amounts of each from the default 2048 KB to 64 KB. This will provide enough memory for applications that require EMS or XMS support.

Improving Cut-and-Paste Operations

WIN-OS/2 3.1 has new interfaces for specifying the Clipboard and Dynamic Data Exchange (DDE) as either Public or Private. By default, both the Clipboard and DDE for OS/2 and WIN-OS/2 are Public; you can use them to exchange data among programs running in DOS, OS/2, and WIN-OS/2 sessions. If the WIN-OS/2 Clipboard and DDE are set to Private, data exchange

is allowed only among programs running in the same WIN-OS/2 session.

There are two ways to set the operating mode for the Clipboard and DDE. You can select it for all WIN-OS/2 sessions through a new global WIN-OS/2 Setup Object in the Workplace Shell. For local settings that only affect the single VDM session, use the new settings provided in the WIN-OS/2 Settings Notebook page (WIN_CLIPBOARD and WIN_DDE). If the application does not exchange data with a DOS or OS/2 application, set the Clipboard and DDE to Private for better performance.

Changing WIN-OS/2 Settings

You can change the settings for WIN-OS/2 sessions globally by using the WIN-OS/2 Setup icon in the System Setup folder. You can also change settings for specific sessions through the Application Settings Notebook. The WIN-OS/2 Setup settings will not override any custom values set for applications, so it makes changing settings easier when you have multiple applications. There is one new setting for WIN-OS/2 3.1:

WIN_RUNMODE (in WIN-OS/2 3.1) includes two radio buttons for selecting one of two modes: 3.1 Standard (the default) or 3.1 Enhanced Compatibility.

Several other settings affecting WIN-OS/2 session performance are the same as in OS/2 2.0, including the following:

WIN_DDE enables WIN-OS/2 to share DDE information between WIN-OS/2 and OS/2 sessions. For better performance, set WIN_DDE to OFF—but only if you do not plan to share data via DDE between WIN-OS/2 and OS/2 applications. The default is ON.

WIN_CLIPBOARD enables WIN-OS/2 to share Clipboard information between public WIN-OS/2 and OS/2 sessions. For better performance, change the default setting of ON to OFF for private data exchange between WIN-OS/2 applications—but only if you do not plan to share clipboard data between WIN-OS/2 and OS/2 applications.

DOS_BACKGROUND_EXECUTION enables DOS applications to run in the background. ON (the default) means that a Windows application runs when it is in

the background; OFF means that a Windows application suspends when it is in the background. When a Windows application is suspended, it no longer receives interrupts. A polling application running in the background can slow the foreground application. Turn this setting to OFF to gain foreground performance.

INT_DURING_IO enables interrupts to be handled during file reads and writes. It is primarily designed for DOS multimedia applications and should be turned to ON when you run these types of applications. The default is OFF.

DPMI_MEMORY_LIMIT defines the amount of DPMI memory (in megabytes) available to the WIN-OS/2 session. It enables you to specify the amount of DPMI memory for Windows applications on a per-session basis. The default value is 64 MB; the range is from 1 to 512.

You can change all settings before you create the session . . .

Tuning DOS Applications

Non-graphical DOS applications—including file-intensive applications such as FoxPro* 1.0 and word processors such as WordPerfect* 5.1 and Microsoft Word* 5.0—perform well in a windowed session. However, DOS programs performing intensive text or graphics run more slowly in a windowed session than in a full-screen session, primarily because the full-screen session enables the system to write data directly to video memory whereas the windowed session does not.

Multitasking DOS Sessions

With OS/2 2.x, you can run more than one VDM session. OS/2 enables all DOS and OS/2 sessions to timeslice the CPU and other system resources. DOS applications, unlike OS/2 applications, rarely block. They consume CPU timeslices even if they are in the background or appear not to be doing anything useful, such as polling keyboards or other devices. Polling is controlled by the IDLE_SENSITIVITY DOS setting.

Some application vendors recommend that IDLE_SENSITIVITY be set to a high value. Often, these applications contain functions that look like polling to OS/2, and a lower setting on the IDLE_SENSITIVITY causes problems. If your application has functions that appear to hang when the IDLE_SENSITIVITY is set low, increase the IDLE_SENSITIVITY to a value at which the function works correctly.

Another option to increase speed is to set the DOS_BACKGROUND_EXECUTION to OFF. This setting makes the foreground and other OS/2 applications run faster as the background DOS applications stop competing for CPU resources. It also enables you to set the IDLE_SENSITIVITY higher than the default value, improving the performance of the foreground DOS application.

Running Interrupt-Critical DOS Sessions

Some DOS applications require fast and stable hardware interrupt support. For instance, DOS communications programs need a steady flow from COM ports. Because the VDM sessions are virtual, there are some inherent interrupt limitations. For a DOS communications application, the data rate can reach 9600 bps for a single-character buffer COM port. If multiple communications applications are running concurrently, the combined available bandwidth is 9600 bps.

Similarly, DOS multimedia applications require constant timer interrupts. By the nature of the VDM interrupt mechanism, interrupts may be simulated in a clustered fashion rather than at constant time intervals. So if your DOS applications depend on timer interrupts, you may encounter some unpredictable behavior.

Tuning DOS Settings

DOS settings enable you to selectively configure and customize a DOS session to run a particular application. Some DOS applications require certain features; others operate better without these features. You can change all settings before you create the session, and you can even set some settings while an application is running in a session. The Master Help Index icon has detailed information about settings.

Settings affecting DOS applications performance include the following:

IDLE_SENSITIVITY specifies a threshold for judging when an application is considered idle. The value is a percentage of the maximum possible polling rate that the application can perform. If an application polls at a higher rate than this value, it is considered idle.

Idle detection is a "best guess" of what the program is doing. The program may be polling at a very high rate but still be doing useful work between checking. It could be that the application checks at a fairly slow rate but is doing nothing but waiting. The idle sensitivity threshold enables you to adjust the threshold for each application.

If the application seems to be running more slowly than you expected, you can increase the value for the idle sensitivity threshold while running the application, thereby increasing the percentage. Selecting 100 in this field turns off idle detection, and the application can poll as often as necessary without operating system intervention.

Polling applications are detected sooner on fast systems than on slower ones. This means that the value must vary depending on the system's speed—decrease the value on faster systems. For example, assume there is a polling DOS application with IDLE_SENSITIVITY set to 50 on a 33 MHz CPU. OS/2 detects that it is exceeding the threshold and forces it to yield its timeslice. On a 16 MHz system with the same IDLE_SENSITIVITY value, this same application is not detected.

You can usually improve overall system performance by setting the value slightly lower (60 or 65) when you run multiple DOS applications. The default is 75 and the range is from 1 to 100.

IDLE_SECONDS specifies the length of time (in seconds) that the operating system waits before applying idle detection in a DOS session. This setting works with the IDLE_SENSITIVITY setting to help control polling DOS applications. You can increase this value if you have an application that waits for input at a prompt, such as an editor or a desktop publishing application. The default is 0 and the range is from 1 to 60.

DOS_BACKGROUND_EXECUTION enables DOS applications to run in the background. When it is set to ON, the DOS application runs when it is in the background. When it is set to OFF, background applications are suspended, increasing the performance of the foreground application. The default is ON.

INT_DURING_IO enables interrupt handling during file I/O. It is primarily designed for DOS multimedia applications and should be turned to ON when running such applications. If your applications do not require long file read and write operations, leave this setting OFF to conserve memory and system overhead. The default is OFF.

DOS_AUTOEXEC enables you to customize AUTOEXEC.BAT files for each VDM or DOS session. You can customize the VDM AUTOEXEC to help reduce memory usage and optimize functionality. The default is the AUTOEXEC.BAT file in the root directory on the boot device.

Polling applications are detected sooner on fast systems than on slower ones.

VIDEO_RETRACE_EMULATION controls the video retrace frequency. A few DOS applications run more slowly with this set to ON. You can change it to OFF and increase performance, but screen switching is not as reliable. When it is set to OFF, retracing occurs only at the rate specified by the application. The default is ON.

DOS_FILES specifies the maximum number of file handles that can be opened in a VDM. Increasing this value can improve performance for applications that use many files. For example, since dBASE IV requires a DOS_FILES setting of at least 40, setting it higher than necessary will reduce available memory. Refer to your application documentation for the recommended value. The default is 20, and the range is from 20 to 255.

VIDEO_FASTPASTE increases the speed of input from methods other than via the

keyboard. Setting this to ON increases the character speed of cut-and-paste transfers. *Note:* Pasting into a DOS session or application will generally work, yet some applications can fail when using fast pasting because they buffer keystrokes in an internal buffer that can overflow. If you decide to use this option, test your application's ability to work with VIDEO_FASTPASTE before using real data that might get lost. The default is OFF.

DOS_BREAK makes OS/2 check for the Ctrl+Break or Ctrl+C key combinations while an application runs. To quickly interrupt a DOS batch file running in a VDM, this setting should be ON. Unfortunately, DOS applications will not run as fast with it ON. The default is OFF.

VIDEO_ROM_EMULATION controls the emulation of video functions, such as WriteChar, WriteTTY, and full-screen scroll for BIOS Int10 processing. Leave this setting at ON; the emulation enhances performance over most manufacturers' ROM versions of the same functions. Change it to OFF only if your video ROM provides enhancements to these video functions or if your application uses Int10 functions not supported in the emulation. The default is ON.

Tuning Memory

The OS/2 2.x CONFIG.SYS file specifies the operating system configuration and installs device drivers and other memory-resident applications. The OS/2 2.x AUTOEXEC.BAT file is specific to the functioning of the DOS session. To allocate additional memory to applications running in a DOS session, you can move some commands from the CONFIG.SYS file to settings. The following settings can be changed to maximize memory in a DOS setting:

DOS_HIGH determines whether or not DOS is loaded outside the 640 KB low-memory address space. Loading DOS into high memory allows more available memory for application code and data within the 640 KB address space; in fact, some applications must run in low memory. The default is OFF, with DOS loaded into low memory.

HW_ROM_TO_RAM copies the BIOS from ROM to RAM. When this setting is ON, applications can run faster because BIOS

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says
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can't
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good help
these
days?

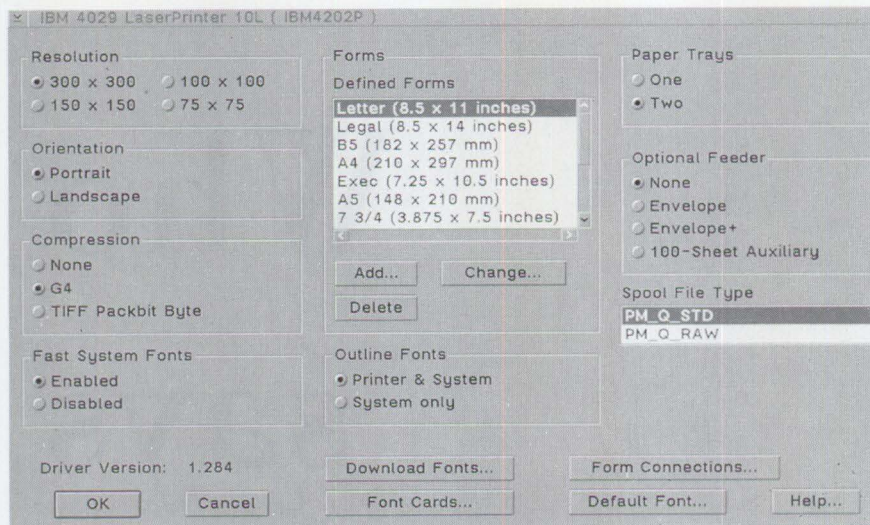


Figure 3. The Print Settings Screen (Screen Shot)

services run slightly faster in RAM than in ROM. This setting may not be compatible with non-IBM hardware. The default is OFF.

VIDEO_ONDEMAND_MEMORY reduces swap space requirements for full-screen VDMs. Turning this setting ON enables a full-screen VDM to run without pre-allocating a virtual video buffer for high-resolution graphics modes. Using this setting does not prevent the graphics application from executing; it simply means that the buffer is not allocated until needed. This can save a substantial amount of memory and swap space. It also enables you to start a program quickly.

Note: If allocating the virtual video buffer fails when the application changes video modes, the session will freeze and you must switch back to the shell to free memory. Unless memory can be freed from another session, you may not be able to get the DOS application running again—a particular concern if the application contains unsaved data. The default is OFF.

Enhancing DPMI Performance

DPMI allows DOS applications to directly access memory greater than 1 MB in Protect Mode.

DPMI_MEMORY_LIMIT enables you to specify the amount of DPMI memory needed for DOS applications on a per-session basis. The field for this setting contains a value (in megabytes) from 0 to 512. You can set the value at 0 if a DOS application does not need DPMI, thus

reducing OS/2's accounting overhead and increasing performance. The default value is 4 MB.

Improving Performance in Applications Using Extended Memory

Two settings affect the performance of DOS applications requiring XMS:

XMS_MEMORY_LIMIT specifies the amount of memory that a DOS application can allocate to XMS. This setting is expressed with a range of 0 to 16384 KB. Specifying a large XMS limit can slow performance. The default value is 2 MB.

XMS_HANDLES specifies the number of XMS Extended Memory Block (EMB) handles. Each XMS EMB uses a handle. XMS requires this because it pre-allocates all the handle spaces to be compatible with XMS specifications. Use this setting only if your application uses many handles.

Reducing this number will reduce memory consumption. If your applications do not require many handles—but you still specify a number that is much more than the default—your system performance will degrade. The default value is 32.

Improving Performance for Applications Using EMS

OS/2 2.x provides full EMS support for DOS applications. Since OS/2 2.x uses virtual memory to emulate the DOS EMS system, some performance degradation occurs when you run a DOS application involving EMS, as opposed to native DOS.

Most overhead is caused by managing large data structures within the virtual memory system. The advantage of using virtual memory to emulate DOS EMS is that it enables large expanded memory to be supported with almost no limitation from physical memory. In some cases, DOS applications can declare more expanded memory than the total size of the physical memory.

EMS_MEMORY_LIMIT defines the amount of EMS available to the DOS session. This value should be 0 if the DOS application does not need EMS. The manual for an application generally states whether the application uses EMS. If you are unsure of your application's requirements, leave this setting at the default.

This setting can limit the amount of EMS an application reserves to prevent an application from allocating more memory than necessary. A limit that is too high (over 16 MB) can slow performance. The default is 2 MB and the range is from 0 to 32768 KB in 16 KB increments.

Improving Printing Performance

You can tune printing performance by changing the printer and job property settings, changing the CONFIG.SYS file, and using the Spooler settings. Some of these changes affect all printing; others affect only certain types of printing. Not all the settings listed in this section are available for all printers, but if available, they do affect the printing performance of your system.

Changing Printer Settings

Every object—including the Print Object—has adjustable settings so you can tune up performance. In OS/2, Job Properties work with the Printer Driver Object's Printer Properties, which are found in the Printer Object Notebook. (Not all settings are supported by all printers.) Printer driver settings include Job Properties such as orientation, fonts, and resolution. Queue Options include printer-specific format and Print While Spooling. Print Options include start and stop times (Figure 3).

The choices for both Job Properties and Printer Properties will be overwritten by applications that permit Job Property specification on a per-job basis. In this

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case, carefully choose the options within your application. The following properties affect performance:

Memory. If you specify the amount of memory available to your printer, the printer driver can determine if it must use compression. Compression reduces the amount of data that has to go to the printer, thereby improving performance.

Resolution. With this option, you can vary the resolution of your graphics printing in dots-per-inch (DPI). The higher the number, the higher quality your output will be. The drawback is that it will also take longer to print. Use a low number for draft output and select the highest number for printing the finished version. A printer's memory size can limit the resolution you can choose.

Compression. This option compresses graphic print data and speeds up most print jobs containing graphics. Two common types of compression are G4 and TIFF Packbit Byte.

- G4 improves printing of graphic data that does not have large numbers of alternating bits, such as large areas filled with solid color. G4 is available on all IBM Model 4029 printers and IBM Model 4019s that support Form Feed Time Out. Model 4019s do not support G4 when printing in landscape mode.
- TIFF improves printing of graphic data that consists primarily of repeating bytes, such as large areas having one type of fill pattern. TIFF compression is available on most printers.

Fast System Fonts. This option is useful for downloading OS/2 system bitmap fonts to your printer's memory. They are copied to your printer as a device bitmap font. The advantage is that a device font uses a smaller spool file and prints faster than a font printed in raster or graphic font form. If your output overlays system fonts with graphics or if print output differs from that on your screen, disable this option.

Printer Patterns. Pattern filling commands are sent directly to the printer, not performed by the operating system. This reduces the spool file size for pages that contain dense graphics and large scaled

text and improves printing speed. Do not use this option if printer output patterns must exactly match those on your screen or if your document contains overlapping shaded or patterned graphics.

HP-GL/2. This option enables HP-GL/2 output that supports many more graphics commands in the printer. It enables faster printing of graphic objects, such as lines and circles, and reduces the spool size to help print more quickly. For faster output, enable Page Protection (this can require more printer memory) on the printer and in the Printer Properties dialog box, and use HP-GL/2.

Large Buffers. Large buffers enable printer drivers to use more OS/2 memory to speed up printing. The system uses around 4 MB for printing, so total system memory should be at least 8 MB. If this option is set to OFF, the system will employ smaller memory requests—around 1 MB—to conserve memory. Do not use this option if you have under 8 MB of system memory.

Print While Spooling. This option enables the printer to start processing the print job before the application has finished sending the entire job to the spool queue. Print jobs formatted in a printer-specific format such as PM_Q_RAW can speed up printing by using this option.

Although this threading increases throughput, it can cause some timeout problems if you are printing large files with images. To solve this problem, disable the Print While Spooling option or increase the timeout value setting in the Port Object. The default is ON.

Start and Stop Time. You can enter a start and a stop time for each Print Object. For example, you can set a job to print between 12:00 P.M. and 12:50 P.M.—while you are at lunch. You can print a low-priority or unusually large job for a specific time, such as 2:30 A.M., when printer traffic is low.

Choosing Fonts that Increase Print Speed

Fonts can be stored in several places: built into the printer, built into a cartridge that is plugged into the printer, or resident on your system and downloaded to the printer as needed.

Using printer-based fonts—either built-in or cartridge—is faster than downloading fonts.

Fonts come in two types: bitmapped and scalable. Each bitmapped font character is stored as a collection of individual pixels, so you need a definition for each point size. Scalable fonts—also known as outline fonts—are stored as algorithms that can generate the font in any size. Unfortunately, this takes time. If you are using one font in just one size for an entire document, the extra time is hardly noticeable. If you are using many different fonts and sizes, however, the extra time can be considerable. You can use any combination of fonts—bitmapped or scalable—stored in the printer, on a cartridge, or on your system. Clearly, you will get the fastest printing with bitmapped fonts stored in the printer and the slowest with scalable fonts stored on your system.

The speed issue aside, there are strong arguments for storing fonts on your computer and for using scalable rather than bitmapped fonts. First, most printers can handle only one or two font cartridges. If you want to add new fonts to your library, you must switch cartridges when you want to use them. It is easier and more efficient to store them on your hard disk where they are all available at the same time.

Second, with scalable fonts, you are guaranteed to have the typeface in any size you will ever need. Scalable fonts also require far less storage space—on disk or in the printer—than a set of bitmapped fonts in a range of sizes.

Printing Through the Spooler

Printing through the Spooler provides the best performance. Settings that can affect printing performance include the following:

OS/2 Spooler. For optimal performance, IBM recommends always keeping the OS/2 Spooler enabled. With the Spooler you can print a job in the background while you continue to use the application, providing flexibility and optimizing your system's print resources. You can now set the Spooler's print priority via the Spooler Object setting.

The OS/2 Spooler can simultaneously support several printers and can be configured so that all the printers share a single

queue. This load balancing, also called *pooling*, is important in server environments and is transparent to the applications.

You can reprioritize jobs while they are waiting in the queue, such as giving an urgent job higher priority than other queued jobs.

Spool Path. For large print jobs, you can assign a different Spooler drive or path that has more space than the install drive. If the print load is heavy, place the spool file on the fastest hard disk. Set the Spooler path in the Spooler Object.

Print Priority. The OS/2 Spooler setting called Print Priority enables you to vary the Spooler's priority from low to high. The default setting balances printing with your desktop and applications. If the applications appear to print slowly, you may want to choose a slightly higher value for faster printing. A higher value, however, can cause your desktop and applications to respond more slowly. In a print environment where there is little on-screen work or where print performance is the highest concern, increase the value. The default is 95 and the range is from 1 to 189. Priority changes become effective when the Spooler Object folder is closed.

Spool File Formats. There are two formats of spool file data: the standard (PM_Q_STD) and the raw (PM_Q_RAW). The standard format is preferred because it consumes much less disk space than the raw format file. In addition, having less data to send across the parallel port saves time in getting the data into the printer's buffer. This especially reduces network traffic when printing across a LAN.

Changing a Print Job's Priority.

Changing a print job's priority will cause it to print before any other queued job. To do this, click on the print job you wish to change. Use the second mouse button to display the context menu, and select Print Next.

To change the print job priority so that a job prints before or after other queued jobs, click on the print job you want to change. Use the second mouse button to display the context menu, open Settings, then change the value in the Priority field. Once a job starts printing, you

cannot change its priority, and the Settings option is unavailable.

Printing from DOS

Although there are no performance-specific tuning options for printing from DOS, here is one thing to check:

The DOS setting called PRINT_TIMEOUT is useful for DOS applications that do not explicitly close their print jobs. The PRINT_TIMEOUT sets the length of time that OS/2 waits before forcing a print job

*If the print load is heavy,
place the spool file on the
fastest hard disk.*

to the printer. A timeout of one or two seconds is sufficient for small print jobs such as copying the screen. When printing large files, formatting documents, or running calculations, you must set the value high enough to enable all print results to reach the Spooler before the time limit expires. If not, results go into two or more spool files instead of one, and the resulting output may be unsatisfactory. The default timeout is 15 seconds.

Printing from WIN-OS/2

For optimal performance of the OS/2 print subsystem, IBM recommends always keeping the OS/2 Spooler enabled. This ensures that printing is performed in a separate thread—even from the WIN-OS/2 environment. The WIN-OS/2 Print Manager should be kept disabled unless you are using a printer attached to a COM port.

The OS/2 Spooler enables multithreading and can deal with large print files, even working within WIN-OS/2. Print jobs sent from any WIN-OS/2 application to a printer attached to a parallel port will not show up in the WIN-OS/2 Print Manager. If you need to view or manipulate these print jobs, use the correct OS/2 Printer Object on the Workplace Desktop.

WIN-OS/2 Ports and Drivers. Where possible, direct output to LPTn.OS2, where *n* is 1, 2, or 3. LPTn refers to the physical printer port and LPTn.OS2 is a

file that WIN-OS/2 intercepts and routes directly to the Spooler. Directing output to LPTn.OS2 will improve performance over the standard LPT port assignments.

Always install equivalent printer queues in the OS/2 Desktop for WIN-OS/2 printers so you can print to them from WIN-OS/2. If you cannot find an equivalent OS/2 printer driver, use the IBMNULL.DRV printer driver found in the OS/2 Printer Object.

WIN-OS/2 COM Attached Printer. If you have a printer attached to a COM port and you want to spool your print jobs, enable the WIN-OS/2 Print Manager. This should be the only reason to use the WIN-OS/2 Print Manager. Remember that print jobs directed to LPTn.OS2 and LPTn will still go through the OS/2 Spooler.

Improving COM Performance

You can improve the performance of communications applications by making changes in the CONFIG.SYS file and DOS_SETTINGS. You must check these settings, because they can affect concurrent applications. In general, the speed of your system will also affect your communications application's ability to achieve high baud rates while multitasking. CPU- and disk-intensive foreground applications and operations will also affect the performance of your communications application when it is running in the background.

The following settings will affect the way communications applications perform:

PRIORITY_DISK_IO. Changing the PRIORITY_DISK_IO to NO in the CONFIG.SYS file will improve the performance of communications applications running in the background that are also performing disk I/O, if the foreground work is also performing disk I/O. See the section on the CONFIG.SYS file for more information.

INT_DURING_IO. When this DOS setting is ON, it enables interrupts to be handled during file reads and writes. This may help the performance of the communications program if it performs disk I/O requiring long read and write operations.

IDLE_SENSITIVITY. This DOS setting, when set to 100, turns idle detection off,

enabling the application to poll without operating system intervention.

HW_ROM_TO_RAM. This DOS setting of ON may speed up DOS communications applications because it enables the operating system to copy the BIOS from ROM to faster RAM.

Using Monitoring Tools

Several available tools are useful in evaluating and tuning the performance of an OS/2 2.x system.

System Performance Monitor/2

(SPM/2)—IBM Corp. SPM/2 2.0 is an integrated package of powerful facilities that enable you to monitor resources such as CPU, RAM, and disk on your local and remote OS/2 2.0 systems. SPM/2's ability to graph this resource information enables you to look at real-time data as well as saved data for any monitored workstation on the LAN. SPM/2 performs the following tasks:

- Collects critical resource utilization data from the CPU, memory, files, swap file, FAT/HPFS cache, physical disk, and printer and communication ports
- Records performance data to disk for processing at a later time
- Collects data from multiple nodes in a single recording session
- Provides a real-time graphical representation of how system resources are being used (CPU, disk, RAM, and swap activity); it also has the ability to play back previously recorded data
- Produces detailed resource utilization reports from recorded data that can be summarized by workstation, application, process, or thread

- Provides in-depth OS/2 2.0 memory analysis information that includes the working set and a view of OS/2 control blocks
- Monitors the remote OS/2 LAN Requester as well as servers

Performance 2.1—Clear and Simple,

Inc. This tool, excellent for novice users, is a simple aid for tuning your system. It provides a way to change the CONFIG.SYS file and remove unnecessary files to free disk space (see related article in the January/February 1994 issue of *Personal Systems*).

Pulse—IBM Corp. Pulse is one of the simplest tools available for monitoring performance. It generates an EKG-like graphic display that shows the level of CPU activity. This tool can be found in the OS/2 Productivity Aids folder.

CPU Monitor—Bonami Software

Corporation. CPU Monitor is a powerful combination of performance and analysis tools for OS/2 users. Using Presentation Manager graphics, CPU Monitor displays real-time information for estimated CPU utilization, OS/2 process relationships, and more. CPU Monitor enables you to dynamically suspend and resume execution for individual threads and helps you detect and stop runaway, invisible, and background programs.

OS/2 Resource Monitor (OSRM2)—

C.O.L. Consulting, Ltd. This integrated group of applications is designed for real-time tracking and performing capacity-planning functions (analysis and modeling) for machine resources, including CPU, disk, memory, and applications.

Bridge/Monitor—Bridge Technology Inc. Bridge/Monitor is an OS/2 performance analysis and reporting tool for large enterprise LANs. It enables you to remotely monitor and manage the performance of a LAN. Bridge/Monitor identifies performance bottlenecks and generates real-time alerts when user-defined thresholds are exceeded. It also features a complete performance database with query capability for reporting, trend analysis, and capacity planning. The product's proprietary communications method enables peer-to-peer services between devices in the network.

Triplecheck—International OS/2

User's Group. This three-in-one monitoring utility includes **SwapMON**, which monitors the size of the swapper file and the free space on the swapper drives and displays the largest contiguous block of memory. **MON** is an idle-time monitor that graphically displays the amount of processor activity over a selectable timespan to monitor background activity. **Clock** displays concurrent date or time in analog or digital format.

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PC File Systems

This article compares and contrasts personal computer file systems, specifically the File Allocation Table (FAT), High-Performance File System (HPFS), and New Technology File System (NTFS).*

When the IBM Personal Computer made its debut in 1981, Disk Operating System (DOS) 1.0 was right at its side. In the ensuing years, DOS has become the most widely used personal computer operating system in the world.

When you install DOS on a new disk drive, you must format that drive to use the FAT file system. Slight modifications and improvements to the FAT system have been made over the years, but the underlying function has remained the same. As hardware disk technology has evolved, so has the need to get greater performance from the software filing systems. This need led to the introduction of HPFS with OS/2 1.2 in 1989 and the more recent introduction of Microsoft Windows NT* and the NT file system.

What is a File System?

A file system is a method for organizing and accessing the data in your computer. Information such as programs and data is organized into files and directories and stored on your hard disk drive. The file system is responsible for placing the data on the disk, remembering its size and location, and retrieving it the next time it is needed. In today's computing environment, it's not enough for the operating system to merely provide access to data—it has to provide that access very quickly and very reliably.

Tony White
IBM Corporation
Roanoke, Texas

Selecting a File System

To know which file system to choose, you must first understand your options. While your hardware might support any of several operating systems, you must consider performance and capability when choosing one over the other.

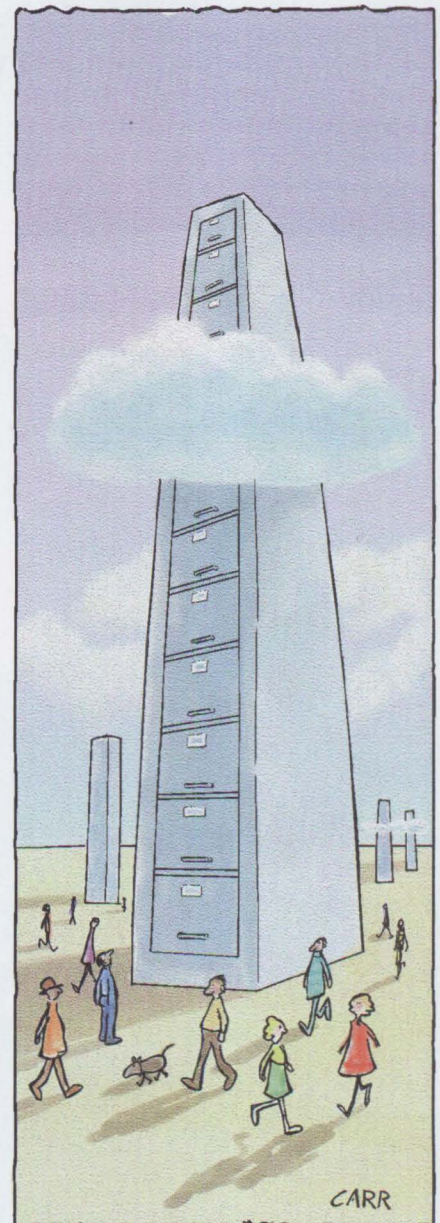
The only file system supported by DOS is the FAT file system. Originally developed for use on diskettes, this file system was updated to work with hard disks as technology improved and disk capacities increased. HPFS and NTFS partitions, and the data on those partitions, are not accessible by a computer with only DOS installed.

OS/2 not only supports the FAT file system, but it also offers an alternate file system called HPFS. The HPFS file system's performance features generally make it a better choice than FAT when used on large hard drives. It also offers a variety of features and functions that aren't available with FAT systems, such as support for long file names, fast data access, and reduced file fragmentation on the disk.

Although HPFS generally performs better than FAT, IBM recognizes that there are still instances where users benefit by using the FAT file system, such as in memory- and disk-constrained environments. With this in mind, IBM improved FAT, calling it SuperFAT. The disk structure of SuperFAT remained

the same as in FAT and was improved by using the same data-caching methods as HPFS. These improvements brought the performance of an OS/2 SuperFAT system close to the performance of HPFS on hard disks smaller than 100 MB.

The recent entry of Windows NT to the operating system market brings personal





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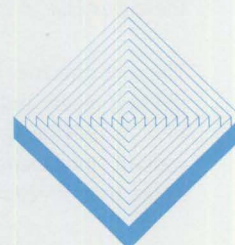
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computer users yet another file system option. Windows NT can recognize data on three file systems: NTFS, HPFS, and FAT. FAT is the default file system with NT, whereas HPFS and NTFS are installable file systems. Choosing NTFS gives you many advantages over FAT on an NT system. You can use long file names, as you can in HPFS. NTFS also supports "hot fixing," as does HPFS. Microsoft claims that additional advantages of NTFS lie in its increased security functions; improved data recovery to disk after a CPU failure, system crash, or I/O error; user-defined file attributes; POSIX support; and the ability to handle extremely large storage media.

DOS and DOS/Windows users have no options for choosing which file system to use. They are forced to use FAT. OS/2 users can choose FAT, HPFS, or both. Windows NT users can choose between FAT, HPFS, NTFS, or any combination of the three. This article addresses SuperFAT, HPFS, and NTFS, because they are the file systems that provide superior performance and future promise.

FAT (SuperFAT) File System

Before getting into the SuperFAT file system, let's first look at its basis, the File Allocation Table (FAT) file system.

The FAT file system manages data on diskettes and hard disks. The first sector (512 bytes) of a FAT-formatted disk contains the *BIOS Parameter Block* (BPB). The information in the BPB includes the number of bytes per sector, sectors per cluster, reserved sectors, number of FAT descriptors, root entries, total sectors, sectors per track, heads, hidden sectors, boot drive, and boot head. (Some of these concepts are explained below.)

Following the BPB is the first *File Allocation Table*. The FAT file system stores data on the disk in individual units called *clusters*, which start at 2 KB in size. The FAT manages all files within these clusters.

The root directory is the next area on the physical media and is managed by the BPB. As previously mentioned, the BPB contains information describing the size of the root directory.

The remainder of the disk consists of all the clusters following the root directory to

the end of the current partition and is used to store user and program files.

Clusters in the FAT file system range in size from 2 KB to 128 KB, depending on the size of your partitions. FAT manages all the clusters on a disk by marking them as free, used, damaged, or as the last cluster of a multi-cluster file (distinguished by an end-of-file mark).

When DOS writes data to the hard drive, it first checks the FAT for the location of an unused cluster, then writes the data to that cluster. It then makes a directory entry, consisting of 32 bytes in the sequence shown in Figure 1.

If the file is large and the data spans multiple clusters, DOS records the location of each additional cluster allocated to that file. DOS stores these locations in the FAT entry for the previous cluster. By doing this, DOS creates a chain of entries that, taken together, map out all the pieces of the file. The last cluster in the chain is marked with the end-of-file mark.

Because of the FAT's structure, large files are usually fragmented on the disk to make the most efficient use of disk space. Because a file's cluster locations are stored in the FAT, DOS doesn't have to access the file to erase it. Instead, DOS merely changes the pointers in the FAT to bypass all the fragments of the file to be erased. This indicates that the space occupied by the erased file is now unused and can be overwritten.

The DOS implementation of the FAT file system does not include *Extended Attributes* (EAs). DOS attribute information describes a file's characteristics and properties such as its size, last modification date, and whether it is to be archived as hidden, read-only, or system.

OS/2 tracks the same attribute data as DOS, but stores additional information about the file in Extended Attributes. EAs provide a means for attaching data that is not part of the normal file-attribute data to a file. EAs may include information such as the file's author name, author's comments, or key phrases that help identify the file. A file's EA data can be up to 64 KB in length and is stored in a single hidden system file named `EA_DATA.SF` in the root directory.

| | |
|---------------------------|---------|
| Filename | 8 bytes |
| Extension | 3 bytes |
| File Attribute | 1 byte |
| Reserved | 8 bytes |
| Extended Attribute Handle | 2 bytes |
| Time of Last Write | 2 bytes |
| Date of Last Write | 2 bytes |
| Starting Cluster | 2 bytes |
| File Size | 4 bytes |

Figure 1. FAT Directory Entry Layout

Improvements in SuperFAT

As previously mentioned, the FAT file system enhancements in OS/2 provide improved performance and function. SuperFAT has these enhancements:

- Disk caching within the file system rather than in the device driver.
- 32-bit memory to improve data transfer speed.
- *Lazy-writing*, a feature that holds disk writes in a buffer and waits until the disk is idle before doing the actual writing from buffer to disk.
- The ability to coordinate disk requests that are accessing contiguous sectors to fill an I/O request. This *command chaining* feature satisfies large numbers of disk requests with one logical disk operation.
- Faster allocation of free space on the logical drive by using a bitmap to track free space on the disk.
- Extended attribute support.

Optimizing a FAT System in OS/2 2.x

To achieve maximum performance for your DOS applications, you may want to take advantage of the advanced file systems now available. Should you stick with the DOS FAT file system, or should you install the HPFS file system in OS/2 and run your DOS applications there?

To help you decide, there are optimization measures that you can use for each of these file systems.

Hardware factors often dictate which file system you should use. If your drive or partition size is less than 80 MB, and if you have less than 6 MB of memory, use FAT rather than HPFS.

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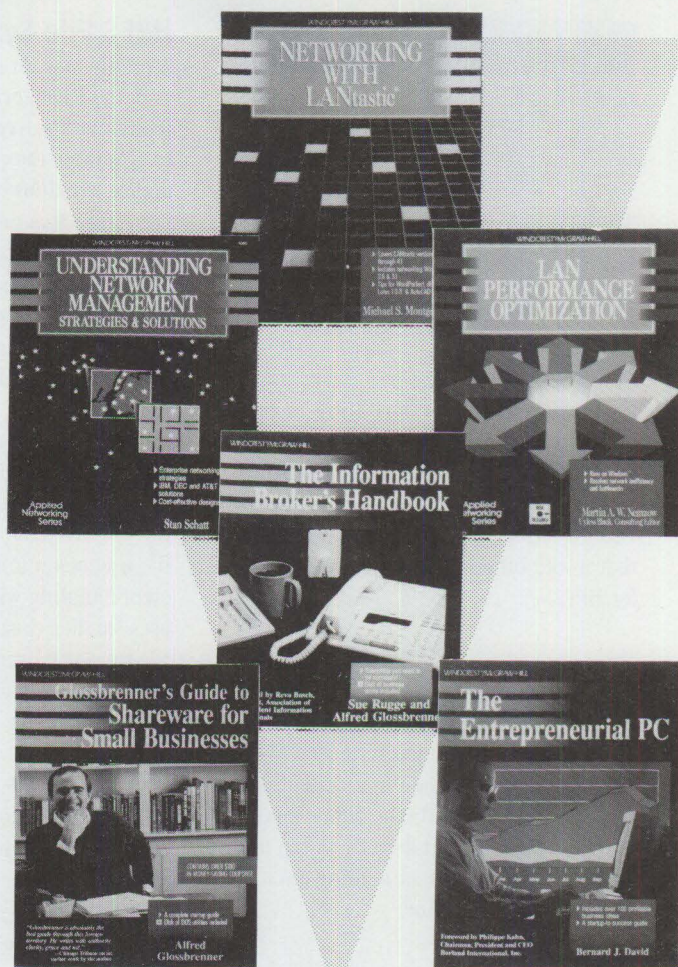
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| Memory | DISKCACHE |
|--------|-----------|
| 8 MB | 1024 |
| 12 MB | 1536 |
| 16 MB | 2048 |

Figure 2. Recommended DISKCACHE Sizes for Different Memory Configurations

If your system doesn't have HPFS installed on any partitions, remove the `HPFS IFS` statement from the `CONFIG.SYS` file. Not loading this driver at boot time frees up 140 KB of memory, plus the cache space that would otherwise have been reserved for HPFS.

The `DISKCACHE` parameter specifies the amount of memory allocated to the FAT file system cache. Using this parameter speeds up disk reads and writes by keeping frequently used data in a cache buffer. When a program needs the data contained in the cache, it is sent directly to the program. This is faster than reading data from the disk each time.

Increasing the `DISKCACHE` size speeds up your system, but it also decreases the amount of available memory. Be careful when changing this parameter, because you may actually degrade overall system performance. Be sure not to enlarge the cache if your system is short on memory. You can realize additional performance by using the lazy-write parameter to specify that the contents of cache memory are to be written to disk only during disk-idle time. The maximum size for the FAT file system cache is 14 MB.

The cache settings in Figure 2, based on the amount of memory installed, should increase your system's performance. We recommend that you perform a benchmark test on both disk I/O and overall system performance before you modify any parameters. Understanding your system's performance before you make any changes will help you recognize whether the changes you make actually increase, or possibly decrease, overall performance. For example, your changes may indeed improve disk I/O performance but could decrease system performance as a whole. This is why conducting the initial benchmark is so important.

HPFS File System

A totally new design from beginning to end, the High-Performance File System (HPFS) introduced in OS/2 1.2 was built to eliminate the restrictions and performance penalties of the DOS FAT file system. HPFS was designed to become the file system that could accommodate future trends in personal computing technology such as larger hard disks, faster processors, networks, and object-oriented applications and operating systems.

HPFS supports long file names (up to 259 characters, including the path), stores extended attributes contiguously (without the `EA_DATA.SF` file used by FAT), resists file fragmentation, improves media error-handling with hot-fix and autocheck, uses smaller cluster size, supports larger file-storage devices, and speeds large disk operation for computers with more than 6 MB of memory.

HPFS Structure

The HPFS volume structure is largely responsible for the superior performance of the HPFS file system compared to that of the FAT file system. HPFS stores its control structures at the center of the disk, starting at sector 0. Locating this frequently accessed data at the disk's center reduces the average amount of time it takes for the disk head to find the data.

Sectors 0 through 15 (8 KB) are called the *BootBlock*. The *BootBlock* contains the volume name, volume ID, BIOS Parameter Block (the BPB described earlier), and the disk Bootstrap program. When the Bootstrap program is accessed at boot time, it locates and then passes control to the operating system initialization files, wherever they reside on the disk. The operating system then completes the boot process on its own.

Sectors 16 and 17 are called the *SuperBlock* and *SpareBlock*, respectively.

The *SuperBlock* contains data that is established at format time and never changes after that. Only `FORMAT` and `CHKDSK` write to the *SuperBlock*. The *SuperBlock* contains pointers to the root directory, free-space bitmaps, bad-block lists, and directory block band. The *SuperBlock* band is the area of the disk where directory information is stored, unlike in FAT, where directories and files share the same space.

The *SpareBlock* contains control data that changes frequently and data that the system uses while running, such as the hot-fix map, pointers to the hot-fix and directory emergency free-block lists, and file-system flags. (Some of these control items are described in the following section, "HPFS Features.")

The rest of the disk is divided into 8 MB bands. Each band has its own *free-space bitmap* that tracks the free space within that band. The bitmap identifies the free sectors within a band, enabling the file system to quickly determine where to place new files.

These bitmaps are located at either the head or tail of a band, such that two adjacent bands have their bitmaps at opposite ends. This layout enables the maximum contiguous free space that can be allocated to a file to be 16 MB (two 8 MB bands aligned back-to-back), as shown in Figure 3. Having up to 16 MB of contiguous storage for a file prevents fragmentation of the file across several sectors of the drive. Preventing fragmentation reduces the disk-head movement when the file is later read or executed.

HPFS places the directory band, which contains directory information, in the middle of the logical drives, instead of scattering it across the drive as in FAT. Since directory information is accessed frequently, locating it centrally allows for speedy performance.

The *F-node* is the fundamental file system object in HPFS. Every file or directory is anchored to an F-node, which stores control and access information about the file or directory such as the extended attributes, access history, file length, and the first 15 characters of its name. The F-node is always stored near the file or directory that it represents, enabling faster retrieval of extended attribute data, which is important when the extended attributes contain valuable information about the file.

Reasonably small files or highly contiguous files can be described completely within a single F-node. HPFS uses a B+ Tree allocation structure to locate files too large or too fragmented for an F-node. Because the B+ Tree can be quickly searched, it provides superior

performance over FAT-linked lists, particularly when searching complex subdirectory structures containing many files, as with file and data servers.

HPFS Features

The principal features of the High-Performance File System include:

- Support for long file names up to 254 characters (259 including the path). File names can include punctuation marks and blank spaces.
- Storage of Extended Attribute data contiguous with the files that the extended attributes represent. This allows for quicker read/write of the files and their extended attributes. The EAs store information such as icons, program settings, and file information. Object-oriented environments that use EAs heavily—such as Lotus Notes or even OS/2—will benefit greatly by having the EA data stored with the files.
- Resistance to file fragmentation due to the file system's banding of the drive.
- Smaller cluster sizes compared to those in FAT. Cluster sizes in FAT systems double every time the partition size doubles. Thus, a 128 MB partition has 2 KB clusters; 256 MB partitions have 4 KB clusters; and so on, up to a 2 GB partition with 32 KB clusters. HPFS partitions always use 512-byte clusters, which waste far less space.
- An enhanced disk read-ahead feature that supports the scatter/gather functions of small computer system interface (SCSI) devices. When installed on SCSI drives, HPFS improves performance by reading data from physically noncontiguous sectors on the drive in a single I/O operation.
- The *hot-fix* procedure, which dynamically identifies and works around bad sectors on the disk. When HPFS detects a bad sector on the disk, it temporarily uses a reserved "hot-fix sector" from the emergency free-block list to store the data that normally would have been written to the bad sector. A message about what has occurred is then sent to the user. The next time `CHKDSK /F` is run, the sector is permanently marked as bad; the data is then copied from the hot-fix sector to a good sector, and the hot-fix sector is made available for re-use.

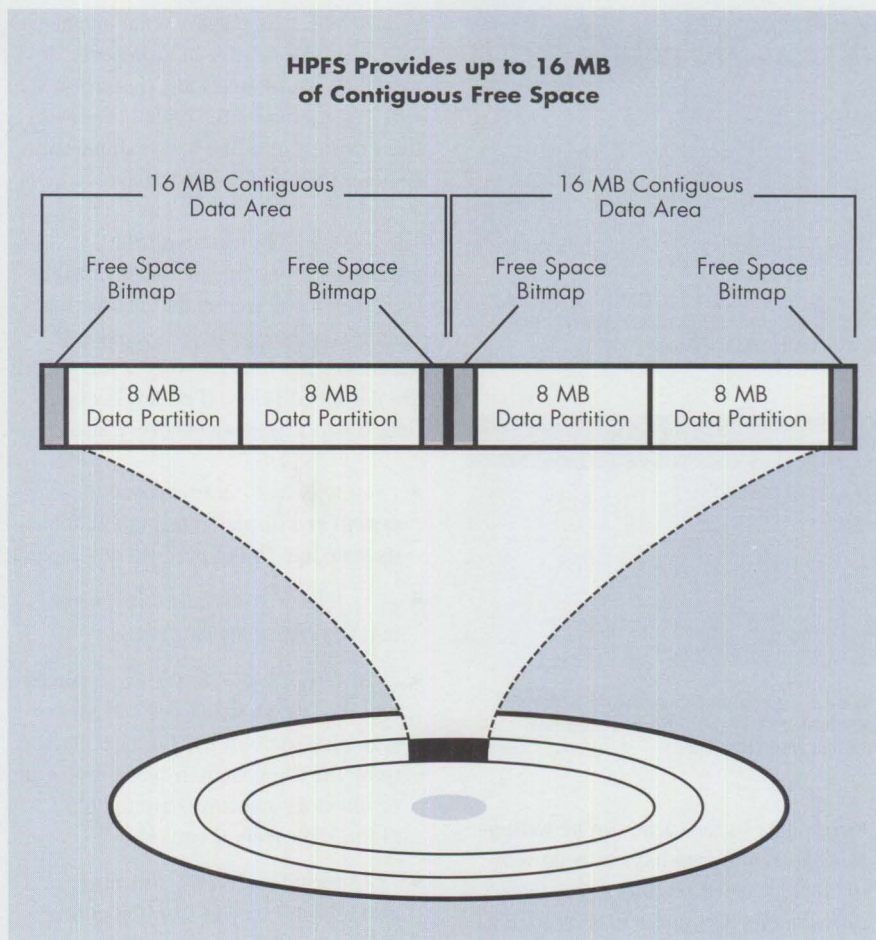


Figure 3. Free-Space Bitmaps

Optimizing an HPFS System

The `CACHE` parameter in the IFS statement of the OS/2 `CONFIG.SYS` file offers the greatest potential for dramatic performance gains when used properly. Functioning much like the `DISKCACHE` parameter discussed in the DOS section above, it sets aside memory for disk caching. You will want to set aside as much memory as possible for caching after analyzing the normal operating requirements for your system.

The recommended cache settings for a system using only HPFS, or using both HPFS and FAT with the HPFS partition handling the I/O-intensive activities, are given in Figure 4.

The recommended cache settings for a system using both HPFS and FAT, with the FAT partition handling the I/O-intensive activities, are shown in Figure 5.

Understanding your computer's working set requirements will help you determine

the optimum cache settings. For example, if your computer has 16 MB of memory and the average working set is 14 MB, you can allocate the remaining 2 MB to cache. The maximum size for the HPFS cache is 2 MB.

Use the `CACHE` command to further maximize performance. The parameters of the `CACHE` command are as follows:

- The `DISKIDLE` parameter specifies the amount of time in milliseconds that the disk controller must be inactive before the cache can start flushing data to disk. The default is 1 second (shown as 1000 ms in the OS/2 online command reference).
- The `MAXAGE` parameter specifies the amount of time before data must be transferred from the cache. (If any data has not been written for this long, it must now be written to disk.) The default is 5 seconds (shown as 5000 ms).
- The `BUFFERIDLE` parameter specifies how long the cache buffer must be idle

| Memory | CACHE |
|--------|-------|
| 8 MB | 1024 |
| 12 MB | 1536 |
| 16 MB | 2048 |

Figure 4. Recommended CACHE Settings, Based on Installed Memory, When HPFS Handles Intensive I/O

| Memory | CACHE |
|--------|-------|
| 8 MB | 512 |
| 12 MB | 768 |
| 16 MB | 1024 |

Figure 5. Recommended CACHE Settings, Based on Installed Memory, When FAT Handles Intensive I/O

before data in the cache can be written to disk. (If any data has not been written for the specified time, it becomes a candidate for writing to disk as soon as the disk is idle.) The default is one-half second (shown as 500 ms).

- The `LAZYWRITE` parameter provides the capability to buffer file writes on their way to the disk and to subsequently perform the actual write at a time when the disk controller is not busy with other disk activity. Since lazy writes are performed during disk-idle time, incoming read and/or write requests need not wait for large write operations to be completed. This optimizes overall system throughput and response time.

On a heavy-use computer system, data could be held for up to 5 seconds or whatever value is assigned to `MAXAGE`; however, if the disk ever becomes idle (as determined by the `DISKIDLE` time), buffers are written to disk until everything that is at least as old as the `BUFFERIDLE` value is written. So, on an idle system, no data sticks around for more than one-half second, or whatever value is assigned to `BUFFERIDLE`.

The `OS/2 CHKDSK` command is an effective tool for analyzing directories and files, determining the file-system type,

volume label, and volume serial number, as well as producing disk status reports. `CHKDSK` can also detect lost clusters on your disk. You then have the option to convert these clusters into files and examine their contents or to simply delete them.

The `CHKDSK` command with the `/F` parameter is perhaps the most valuable `OS/2` tool for detecting and recovering from file and directory errors. The `/F` parameter has four recovery levels, which are described below. If no level is specified, `CHKDSK` assumes recovery level 2.

- `/F:0` tells `CHKDSK` to analyze the file system and display information about its state, but to not perform any repairs.
- `/F:1` tells `CHKDSK` to resolve inconsistent file-system structures.
- `/F:2` tells `CHKDSK` to resolve inconsistent file-system structures and also to scan disk space in use but not referred to by the file system. If recognizable file or directory structures are found, `CHKDSK` recovers them.
- `/F:3` includes all level 2 recovery and also tells `CHKDSK` to scan the entire disk partition for recognizable file system structures.

You cannot use the `/F` parameter if there is any activity on the disk; therefore, the drive to be fixed cannot be the one from which you start the operating system or the one that contains the `CHKDSK` program.

Much more function is available for disk maintenance and data recovery than comes with the `OS/2 CHKDSK` command. Software disk utility packages, such as Norton Utilities, have long been around for `DOS` systems. Countless users have turned to utilities like Norton to save them from catastrophic events such as corrupted files, accidentally deleted files, bad disk sectors, poor system performance, and so on.

Now, `OS/2` users who choose the `HPFS` file system can use GammaTech Utilities* from SoftTouch Systems, Inc. GammaTech offers a comprehensive recovery package for `HPFS` partitions. Its system analysis program identifies characteristics of your system such as bad sectors, disk usage percentages, available memory, free disk space, and volume labels. It has a mass-deletion function that deletes files

based on their specification, file size, or time stamps. It has a sector editor that displays and alters disk sectors in hexadecimal or ASCII. And it has security features that back up `.INI` files and desktop files, monitor boot sectors for viruses, and prevent files from being accessed.

GammaTech Utilities can be operated from the Workplace Shell as a `PM` application. If you can't get to your desktop, many of the GammaTech Utilities can be run from the command line. The list of GammaTech Utilities and where they can be started from appears in Figure 6.

NTFS File System

Windows NT is Microsoft's latest entry in the operating system world. It was developed to exploit the latest advances in computer hardware and software. Windows NT maintains the graphical interface in Windows 3.1 and adds security and networking capabilities.

The major difference between Windows NT and Windows is that Windows NT is an operating system, whereas Windows is not. Windows is a graphical extension of `DOS`, designed to enhance the usability of `DOS` on Intel 80x86-based computers and restricted to using the `DOS FAT` file system. In contrast, Windows NT is a portable, scalable operating system—portable in that it runs on any computer with a 32-bit microprocessor and scalable in that it runs on computers with multiple microprocessors—and it incorporates its own file system, `NTFS`.

Windows NT adapts to existing computing environments because `NTFS` combines the capabilities of the `FAT` and `HPFS` file systems. Windows NT can be installed in a `FAT`, `HPFS`, or `NTFS` partition. The advanced functions in Windows NT can be utilized only when Windows NT is installed in an `NTFS` partition. Windows NT can recognize files in `HPFS` and `FAT` partitions, but `OS/2` and `DOS` cannot recognize files in `NTFS` partitions. However, `NTFS` does allow `DOS` and `OS/2` applications to access files in an `NTFS` partition when the applications are running under Windows NT.

NTFS Features

`NTFS` enhances reliability through its recoverability and hot-fixing features. `NTFS` supports hot-fixing similar to the

hot-fixing in HPFS. Also, NTFS has fault-tolerance features that enable it to fully recover in the event of a system error such as an encounter with a defective sector, a power surge, or disk failure. NTFS maintains a transaction log of all disk activity. If an error occurs during disk access, NTFS uses the information from the transaction log to dynamically restore the disk. The check disk utility does not need to be run unless the recovery fails.

NTFS supports long file names similar to those in HPFS and automatically creates DOS aliases so that files can be shared with DOS users.

The security features in Windows NT and NTFS satisfy the U.S. government's C2 data security specifications. Some security features supported by NTFS include the ability to control unauthorized access to the computer itself, to components of the system such as printers, and to specific files and directories on the hard disk.

NTFS also supports Unicode text. Unicode is a 16-bit, character-encoding format that defines semantics for multiple languages, scripts, and symbols. Programs using Unicode can be enabled with universal data exchange capabilities, which simplify multilingual text processing.

In addition to supporting applications written for Windows 3.1, DOS, and OS/2, NTFS also supports applications that are POSIX (Portable Operating System Interface)-compliant. POSIX is based on the UNIX operating system. A POSIX-compliant application can be moved from one POSIX-compliant operating system to another.

Summary

DOS and its FAT file system—around since 1981—are used in far more personal computers than OS/2's HPFS and Windows NT's NTFS combined. Despite the FAT file system's widespread use and recognition in the marketplace, its performance and function are the lowest of the three file systems outlined in this article. Stick with DOS and the FAT file system if your hardware—mem-

| Utility | Presentation Manager | Command Line |
|--------------------------------|----------------------|--------------|
| Disk Volume Analysis | X | |
| System Information | X | |
| File Undelete | X | X |
| File Attribute Alteration | X | |
| File Deletion | X | |
| Find Files | X | X |
| Find Files on Multiple Volumes | X | |
| HPFS Volume Optimization | X | X |
| Virus Protection | X | |
| Boot Sector Monitoring | X | |
| Boot Sector Backup and Restore | | X |
| .INI File Backup | X | |
| File Locking | X | |
| HPFS File Recovery | | X |
| Enhanced Directory List | | X |
| Recover Damaged Files | | X |
| Mark Bad Sectors | | X |
| Sector Display and Edit | | X |
| Delete Directory Tree | | X |
| Partition Fixup | | X |
| Set Dirty Flag | | X |
| Make Directory Path | | X |
| FAT Directory Sorting | | X |
| Enhanced File Alarm | | X |
| FAT Volume Optimization | | X |

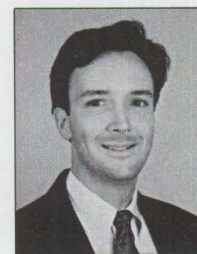
Figure 6. GammaTech Utilities and Where They Can Be Started

ory and disk size—is limiting your options, or if you want to share your files between native DOS (or DOS plus Windows) and either OS/2 or Windows NT.

If your computer has sufficient memory and disk space to run HPFS, you will almost always be better off choosing OS/2 as your operating system. You will be able to use the same applications you were using in your DOS-based system, and you can exploit HPFS's inherent performance and reliability. Your system will perform faster, your data will be kept safer, and you will be able to store and retrieve files using meaningful file names.

NTFS's ability to access FAT and HPFS as well as NTFS partitions, its security

features, and its POSIX compliance give NTFS good potential. Its shortcomings are its expensive hardware requirements and its newness, which causes it to behave unexpectedly at times. As future releases become available and the product matures, it should become a more viable alternative.



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IBM in 1985, he has worked in marketing branch administration, customer engineering, and systems engineering. Tony has a BS in Environmental Science from McNeese State University.

NetWare 4.01 for OS/2: Features and Installation

The "Overview of IBM NetWare 4.01" article in the November/December 1993 issue of Personal Systems covered the features of NetWare 4.01 and briefly talked about NetWare 4.01 for OS/2. This article resumes at that point, discussing in detail the features and benefits of NetWare 4.01 for OS/2, offering some technical insight, and listing the steps involved in installing the product.*

In this article, the stand-alone NetWare 4.01 is referred to as native NetWare 4.01. Native NetWare 4.01 installs onto a computer called a *file server*. Since native NetWare 4.01 is the only software running on that computer, the computer is called a *dedicated* NetWare file server. Here, "dedicated" means that the computer running native NetWare 4.01 is dedicated to doing file-server processes only. A native NetWare 4.01 file server can be configured only as dedicated.

The NetWare 4.01 for OS/2 package, however, provides drivers and programs that let you run both OS/2 2.1 and native NetWare 4.01 on a single computer. Because OS/2 2.1 runs on the same computer as native NetWare 4.01, the computer is called a *non-dedicated* NetWare file server (more specifically, a non-dedicated NetWare 4.01 for OS/2 file server). "Non-dedicat-

ed" means that the computer can do other processes in addition to file-server processes.

Albert Juarez
IBM Corporation
Roanoke, Texas

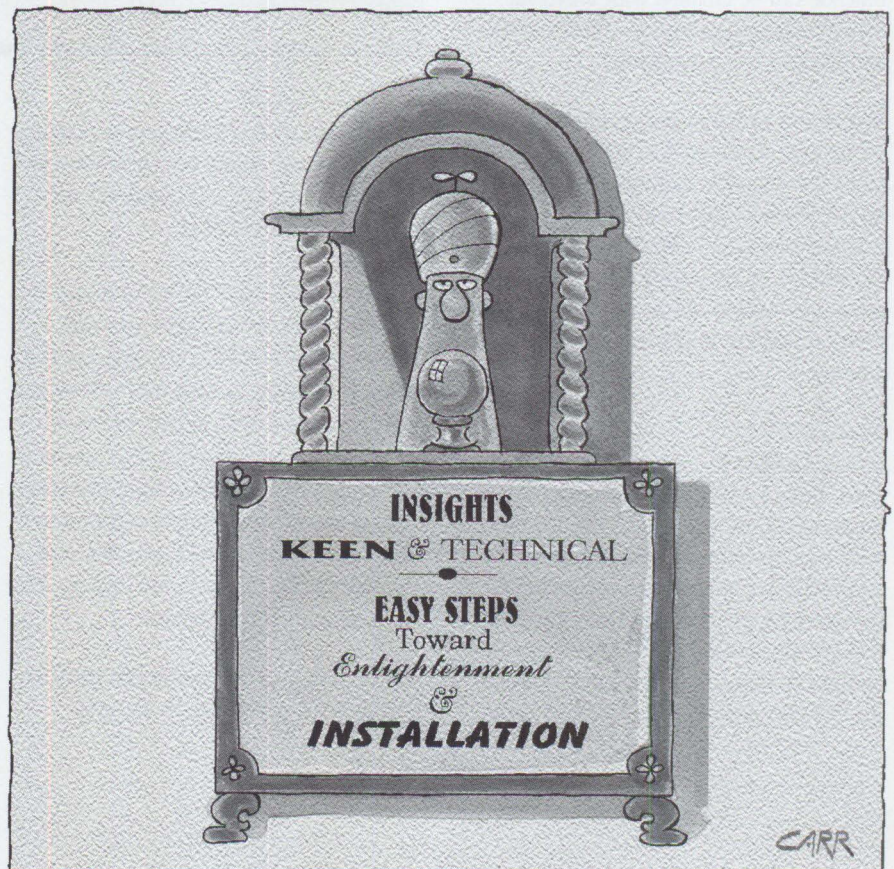
Here is another way to envision this interaction of software components. Think of NetWare 4.01 for OS/2 as an OS/2 session running on an OS/2 computer. OS/2 still functions as it always does (running OS/2, DOS, and Windows applications), but it can now also run the NetWare server software in an OS/2 session. The drivers in the NetWare 4.01 for OS/2 package provide the interface that enables native NetWare 4.01 to operate in non-dedicated mode with OS/2 2.1.

NetWare 4.01 for OS/2 Requirements

The hardware required for installing a NetWare 4.01 for OS/2 file server is the same as for native NetWare 4.01. Your computer should have at least an 80386 processor, preferably an 80486.

You will need the following software to install a NetWare 4.01 for OS/2 file server:

- IBM OS/2 2.1
- Either NetWare Requester for OS/2, version 2.01 (included with NetWare 4.01), or NetWare Client Kit for OS/2, version 2.01



- (Native) NetWare 4.01 (for any number of licenses)
- NetWare 4.01 for OS/2

Accordingly, the total cost of a NetWare 4.01 for OS/2 configuration comprises costs for OS/2 2.1 base, NetWare 4.01 for OS/2, plus the native NetWare 4.01.

NetWare 4.01 for OS/2 Highlights

Following are highlights of NetWare 4.01 for OS/2:

- Since NetWare 4.01 for OS/2 was designed to run with the OS/2 2.1 base system (hereafter called *OS/2 base*), you can install the 4.01 version on computers that also run OS/2 2.1.
- After installing NetWare 4.01 for OS/2, you can continue to run applications that you normally run on your OS/2 base. Version 4.01 for OS/2 leaves the full capability of OS/2 base untouched, simply adding more function.
- You can now configure a NetWare server to be non-dedicated, thus combining OS/2 multitasking, a NetWare Requester workstation, and NetWare file-server capability on a single computer system. Using OS/2 and NetWare Requester for OS/2, you can log in to the NetWare 4.01 for OS/2 file server on the same computer system, as well as log in to other servers.
- NetWare 4.01 for OS/2 has all the security functions of native NetWare 4.01. NetWare 4.01 for OS/2 disk partitions are not readable by OS/2. They are, however, accessible using NetWare Requester for OS/2, on your workstation or other workstations on the LAN.
- Network device interface specification (NDIS)-based programs such as Extended Services for OS/2 or Communications Manager/2* (CM/2*) can coexist with NetWare's Open Datalink Interface (ODI). This coexistence is made possible by using Novell's ODINSUP protocol driver. Figure 1 illustrates how ODINSUP enables NDIS and ODI to coexist.
- You can execute server-based applications at your workstation. Your workstation can log in to a NetWare file server (even a server on the same computer system), download applications from the file server, and execute those applications at your PC workstation.

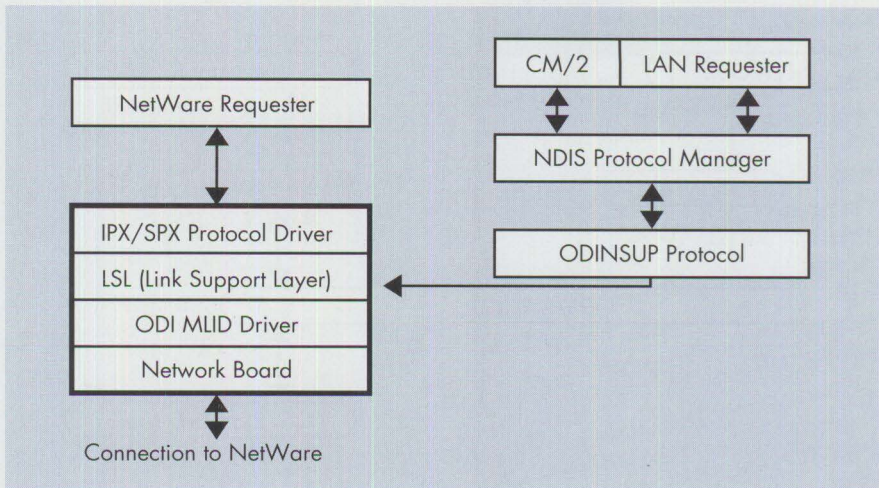


Figure 1. NDIS and ODI Coexistence Using ODINSUP Protocol Driver

- With Dynamic Performance Tuning, you can specify how much processor time you allocate to native NetWare. The remaining time is allocated for OS/2. You can set this performance-tuning parameter through the monitoring utility PMMON.EXE or define it in the NET.CFG file. (You can tune your NetWare server while it is running.)
- With its OS/2 PM-based monitor utility, NetWare 4.01 for OS/2 allows you to see real-time server utilization values, to enable performance tuning, and to disable server alert beeps. For a more complete discussion, see the NetWare Monitor section later in this article.
- You gain the benefit of high performance. Although native NetWare 4.01 shares the processor with OS/2, the NetWare operating system yields about 92 percent of the performance it would have on a dedicated native NetWare 4.01 server. OS/2 takes up the other 8 percent of performance for handling hardware, I/O, and interrupt services. If you are running several OS/2 applications simultaneously, the 92 percent yield may be reduced.

Functionality of NetWare 4.01 for OS/2

Except for the NLM memory protection provided by the DOMAIN.NLM, NetWare 4.01 for OS/2 gives you all the functions of native NetWare 4.01. Figure 2 lists the features of native NetWare 4.01 available in a NetWare 4.01 for OS/2 configuration. For more information about these features of native NetWare 4.01, refer to "Overview of IBM NetWare 4.01" in the November/December 1993 issue of *Personal Systems*.

NetWare Directory Services (NDS)
 New Management Capabilities
 Multiple Language Capability
 Enhanced Security/Auditing
 Routing/WAN Improvements
 Data Compression/Suballocation
 /Data Migration
 CD-ROM/Optical
 Graphical Administrative Tools
 Electronic Online Documentation

Figure 2. Native NetWare 4.01 Features in NetWare 4.01 for OS/2

How NetWare 4.01 for OS/2 Works

NetWare 4.01 for OS/2 is essentially a set of device drivers that allows native NetWare 4.01 to run in parallel with OS/2 base. As is true for OS/2, NetWare 4.01 for OS/2 runs at Ring 0, with a protected block of memory dedicated solely to NetWare.

Figure 3 breaks out the modules in NetWare 4.01 for OS/2 and shows their relationships with each other. There is a total of four modules: a virtual device driver, VNETWARE.SYS; a physical device driver, PNETWARE.SYS; a 32-bit OS/2 application, NWOS2.EXE; and an NLM for sharing disks, DSKSHARE.DSK.

PNETWARE.SYS, an OS/2 physical device driver (PDD), communicates with and controls devices by using OS/2 system calls. This driver is responsible for handling interrupts, memory allocation, and screen notification.

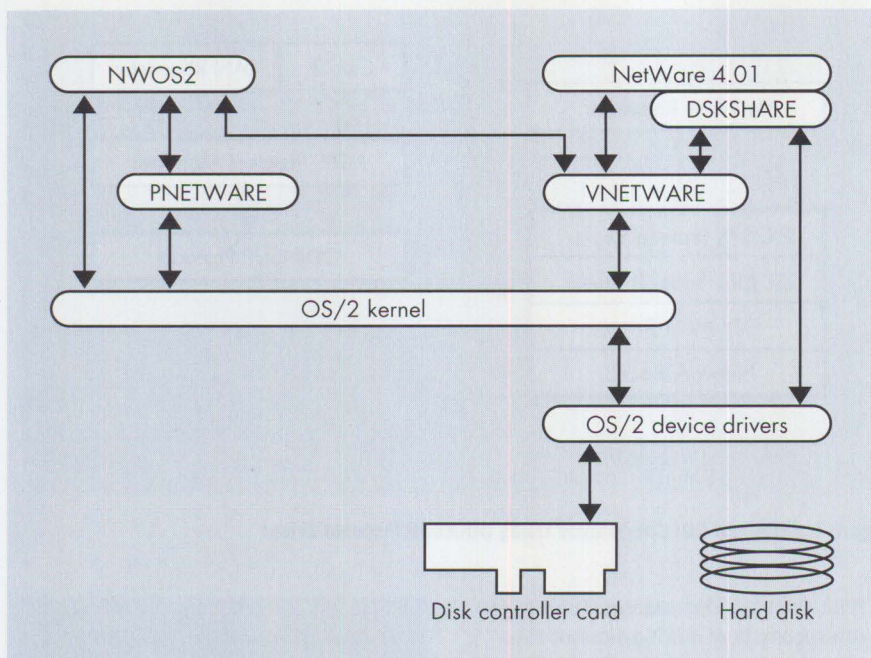


Figure 3. NetWare 4.01 for OS/2 Drivers

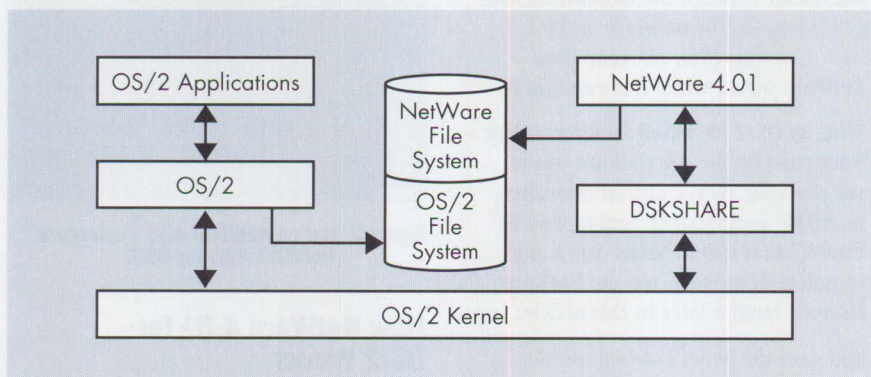


Figure 4. OS/2 and NetWare for OS/2 Disk Sharing

VNETWARE.SYS is an OS/2 virtual device driver (VDD) that operates at Ring 0. It is responsible for controlling the NetWare interface to the server hardware.

PNETWARE.SYS allocates RAM for the NetWare 4.01 for OS/2 server, and the allocated RAM is managed by VNETWARE.SYS. The NET.CFG file defines the RAM to be allocated and managed.

NWOS2.EXE is a 32-bit OS/2 application that calls the OS/2 loader, which then loads the NetWare 4.01 SERVER.EXE program. SERVER.EXE starts the server. NWOS2.EXE—the interface between OS/2 and NetWare 4.01—operates at Ring 3.

Figure 3 also shows the module DSKSHARE.DSK, which is explained in the “Disk Sharing” section below.

Bringing NetWare Up to Date

Novell* originally produced a product called Non-Dedicated NetWare 286, which allowed you to have a DOS-based, non-dedicated NetWare file server. This software is still available today as NetWare 2.2. NetWare 2.2 has only one DOS session and only 640 KB of RAM for DOS applications. Also, since NetWare 2.2 was designed for a 80286* processor, it is not a 32-bit application.

In contrast, a NetWare 4.01 for OS/2 file server opens up the world of OS/2 to you. On a NetWare for OS/2 file server, you can exploit all the capabilities of OS/2 base—multitasking, 32-bit performance, crash protection, execution of your DOS and Windows applications, and many other leading-edge capabilities.

Performance Considerations

When you run a single computer system as both an OS/2 workstation and a NetWare 4.01 for OS/2 file server, you naturally raise questions about performance. You will undoubtedly achieve optimum performance by using a dedicated computer system to run native NetWare 4.01. But, as mentioned above, if your OS/2 workstation is also running NetWare 4.01 for OS/2, you'll find that OS/2 uses only about 8 percent of the computer's resources, leaving 92 percent for native NetWare 4.01 (or less if many other OS/2 applications are running simultaneously).

Some computer systems running both OS/2 and NetWare 4.01 for OS/2 run poorly because they do not have enough memory. To realize decent performance from OS/2, you should have at least 8 MB of RAM on the OS/2 “side” of the computer. If you are running memory-intensive OS/2 applications requiring lots of swapper space, however, you may want to have 16 MB of RAM on the OS/2 side; 16 MB will enhance OS/2 performance because more swapping is done within memory rather than to disk.

On the NetWare 4.01 “side” of the computer, you should have at least 8 MB of RAM. You may need more if you load additional NLMs or if you have a lot of NetWare volume space; the larger your volume space, the more RAM it needs for caching. (To determine the minimum RAM requirement for the NetWare 4.01 side, based on how much NetWare volume space you have and how many NLMs are loaded, see “Overview of IBM NetWare 4.01” in the November/December 1993 issue of *Personal Systems*.)

Disk Sharing

Before you load OS/2 base onto a computer that will also run NetWare 4.01 for OS/2, you should set aside some hard-disk space for a NetWare partition. For a NetWare 4.01 server, you should have at least 50 MB, and preferably 100 MB, of free hard-disk space. While installing NetWare 4.01 for OS/2, you will create a NetWare partition within the free hard-disk space.

The NetWare 4.01 server side shares the same hard disk and controller that OS/2 2.1 base uses. This sharing is made

possible by the DSKSHARE.DSK NLM (see Figure 4).

The DSKSHARE.DSK NLM enables the disk controller and hard disks managed by the OS/2 disk-controller device driver to be shared with the NetWare 4.01 server part of NetWare 4.01 for OS/2. DSKSHARE.DSK takes NetWare 4.01 file system requests and routes them through the OS/2 disk device driver (see Figure 3).

When you install NetWare 4.01 for OS/2, you should load DSKSHARE.DSK in place of a *.DSK disk driver (such as PS2SCSI.DSK) in the file server's STARTUP.NCF file. NetWare 4.01 for OS/2 will then manage the NetWare partition by using DSKSHARE.DSK, and OS/2 will manage the OS/2 file-system partition.

OS/2 and NetWare 4.01 for OS/2 cannot see each other's partitions. The DSKSHARE.DSK NLM prevents OS/2 from reading the NetWare partition on the NetWare 4.01 for OS/2 file server, thus preventing NetWare 4.01 for OS/2 from managing the OS/2 partition and using it as a NetWare server resource. DSKSHARE.DSK was purposely designed this way to enhance security. This is why you must use NetWare Requester for OS/2 to log into and use the NetWare 4.01 for OS/2 file server. If you want to totally isolate both partitions, you can also use one disk drive for the NetWare file system and another drive for the OS/2 file system.

Currently, OS/2 and NetWare on the same computer cannot share an optical CD-ROM drive using DSKSHARE.DSK. In other words, if you start OS/2 and you can access your CD-ROM drive, you cannot also mount that drive as a NetWare volume under NetWare 4.01 for OS/2. The CD-ROM must be dedicated to either NetWare or OS/2. A workaround is to set up a second controller with a CD-ROM, then load the controller's driver through the NetWare file-server side.

LAN Adapter Sharing

A LAN adapter can be shared by the NetWare server side and the OS/2 client side by using the virtual device drivers LANSHARE.SYS (an OS/2 device driver) and LANSHARE.LAN (a NetWare file server LAN adapter NLM). The actual physical driver is loaded on the NetWare server side as a LAN adapter NLM (for example, TOKEN.LAN).

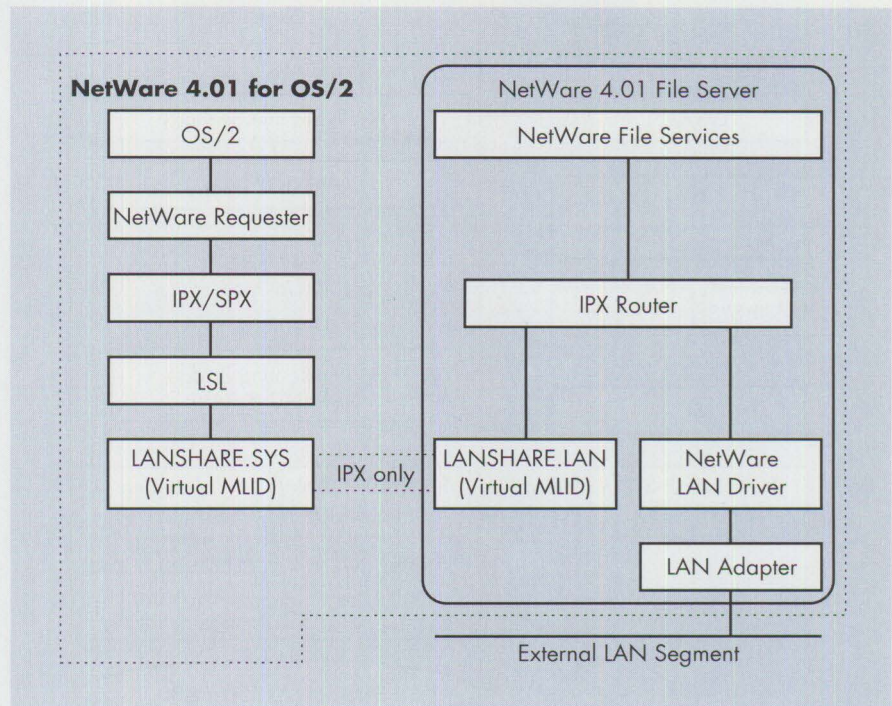


Figure 5. Routing Solution with IPX Only

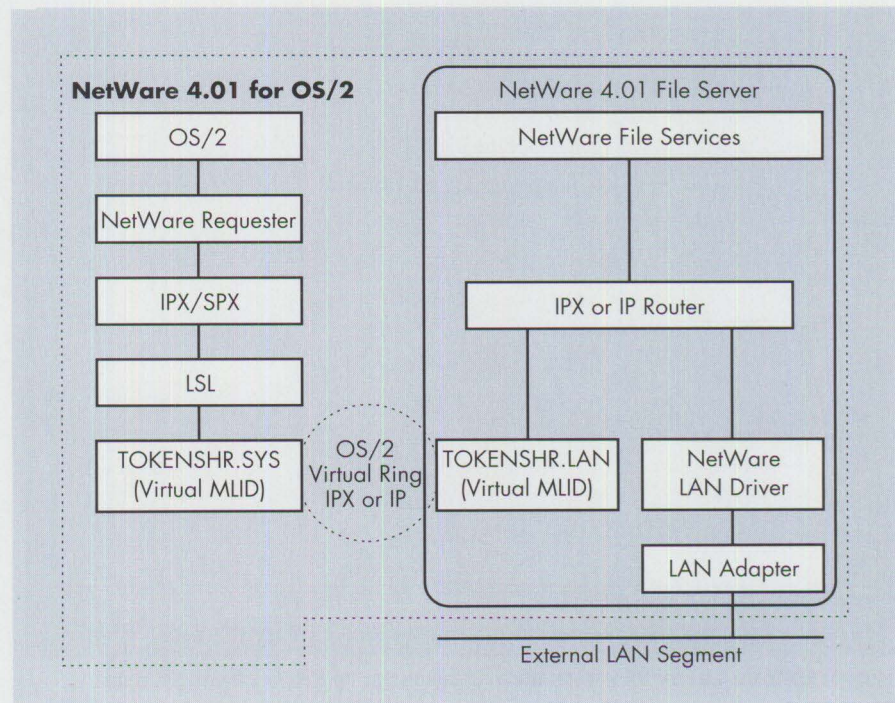


Figure 6. Routing Solution with Token-Ring

The files LANSHARE.SYS, LANSHARE.LAN, TOKENSHR.SYS, TOKENLNK.LAN, TOKENSHR.LAN, and VBRIDGE.LAN are all part of the NetWare 4.01 for OS/2 software package; they do not come with the NetWare 4.01 package.

NetWare 4.01 for OS/2 Routing Configuration Options

You can configure NetWare 4.01 for OS/2 three ways, using various virtual drivers: LANSHARE.LAN, TOKENSHR.LAN, TOKENLNK.LAN, and VBRIDGE.LAN. Which one you use depends on which type of protocol (internet packet exchange

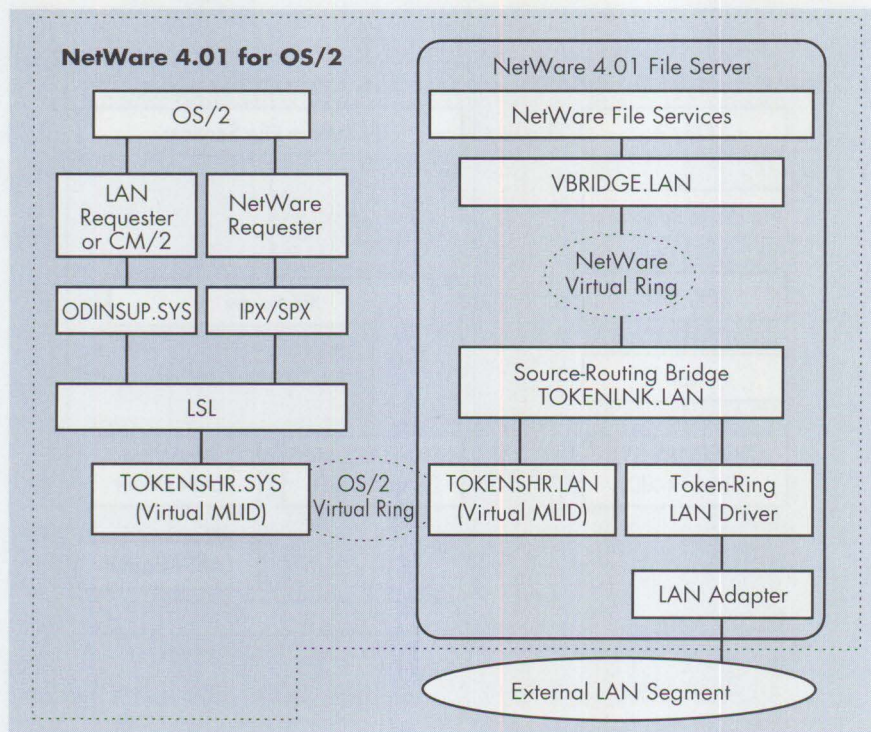


Figure 7. Source-Routing Bridging Solution

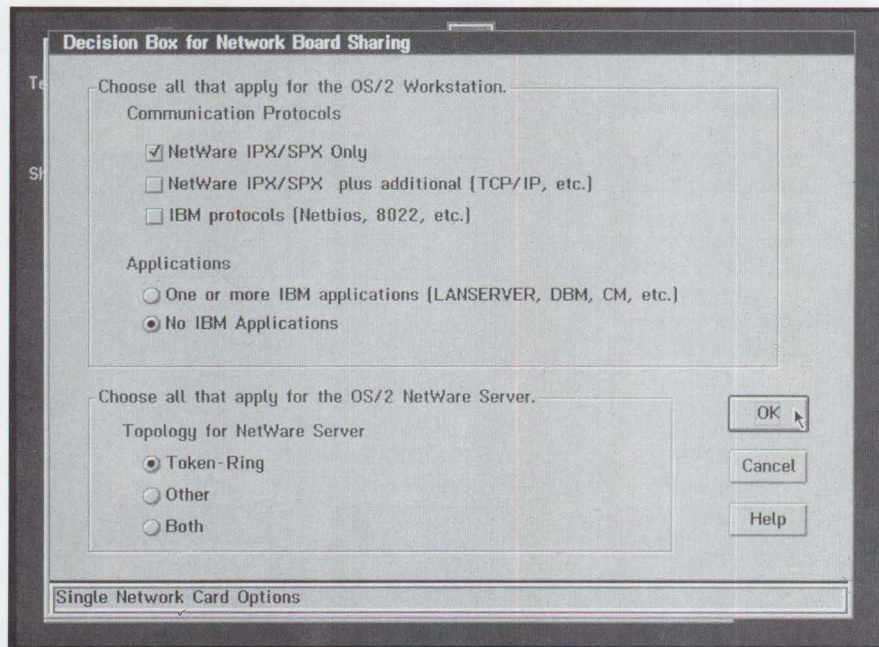


Figure 8. NetWare 4.01 for OS/2 Installation: Decision Box for Network Board Sharing

[IPX] or transmission control protocol/internet protocol [TCP/IP]) you want to route, and whether you want to either bridge SNA traffic or use an SNA-type application.

Routing Solution with IPX Only

Use the IPX routing solution configuration for NetWare 4.01 for OS/2 in normal configurations requiring only IPX traffic, as shown in Figure 5. This configuration uses

LANSHARE.SYS and LANSHARE.LAN virtual Multiple-Link Interface Drivers (MLIDs).

When you initially install NetWare Requester for OS/2 on your workstation, the ODI driver TOKEN.SYS is installed, and your LAN adapter uses the device driver TOKEN.SYS in your OS/2 CONFIG.SYS file. Then, when you proceed with installing NetWare 4.01 for OS/2, and you configure it as a routing

solution with IPX only, the TOKEN.SYS in your OS/2 CONFIG.SYS file is replaced by LANSHARE.SYS. Thereafter, your NetWare Client passes IPX traffic through LANSHARE.SYS and LANSHARE.LAN to the IPX router in the NetWare 4.01 for OS/2 file server. From the IPX router, requests are passed to either the external LAN segment or NetWare File Services.

Routing Solution with Token-Ring

If you plan to share a single network board and to use different protocols such as IPX and TCP/IP with token-ring, then you should configure NetWare 4.01 for OS/2 as a routing solution with token-ring, as shown in Figure 6. This configuration uses the TOKENSHR.SYS and TOKENSHR.LAN virtual MLID drivers. TOKENSHR.SYS, like LANSHARE.SYS above, replaces the ODI LAN adapter device driver (e.g., TOKEN.SYS) in the OS/2 CONFIG.SYS file. The NetWare Client then passes IPX or IP traffic through TOKENSHR.SYS and TOKENSHR.LAN to the IPX/IP router in the NetWare 4.01 for OS/2 file server. The router then passes requests to either the external LAN segment or NetWare File Services.

Source-Routing Bridging Solution

Use the source-routing bridging solution when you want to share a single adapter, and you plan on having 802.2 and NetBIOS communications (IBM applications) with token-ring (see Figure 7). This solution uses TOKENLNK.LAN; when this NLM is loaded, TOKENSHR.LAN and VBRIDGE.LAN are also loaded. The OS/2 client sends information through TOKENSHR.SYS and then to TOKENSHR.LAN. The information or request then goes to the source-routing bridge (TOKENLNK.LAN) and is passed to either the external LAN or to NetWare File Services.

This source-routing bridging solution makes it possible to use both ODI and NDIS drivers on the OS/2 client side. When using NDIS drivers, use the NetWare ODINSUP.SYS driver.

Choosing a Routing Solution

One of the three routing-solution options described above is automatically determined when you install NetWare 4.01 for OS/2. You are asked to make several choices (as shown in Figure 8) such as the type of communication protocol, which applications, and which topology you will

use with the OS/2 NetWare server. Using your responses, the installation program determines the appropriate routing solution for your configuration (see Figure 9).

When you configure NetWare 4.01 for OS/2 to use separate LAN adapters, as opposed to sharing one adapter, use the appropriate drivers for both the OS/2 side and the NetWare side.

Statements in the OS/2 CONFIG.SYS File

Figure 10 shows some of the statements in the OS/2 CONFIG.SYS file when NetWare 4.01 for OS/2 runs on the same computer system. Only the NetWare Requester statements and the NetWare for OS/2 statements are shown.

When you install NetWare Requester for OS/2 as a NetWare client, the ODI LAN device driver TOKEN.SYS is added. When you install NetWare 4.01 for OS/2, the TOKEN.SYS device driver is REMarked out, and a new virtual driver such as LANSHARE.SYS takes its place. This virtual driver communicates with the NetWare for OS/2 file server's virtual driver, LANSHARE.LAN. Also added to CONFIG.SYS are PNETWARE.SYS and VNETWARE.SYS. Figure 11 shows how the NetWare for OS/2 file server and the NetWare Requester for OS/2 interact within NetWare 4.01 for OS/2.

NetWare 4.01 for OS/2 Installation Scenario

We performed the NetWare 4.01 for OS/2 installation scenario described below on an IBM PS/2 Model 85 computer with a 400 MB small computer system interface (SCSI) hard disk, 32 MB of RAM, a token-ring card, and an external CD-ROM drive. The software used was OS/2 2.1 base, NetWare 4.01 for OS/2, native NetWare 4.01, and IBM CD-ROM drivers.

OS/2 2.1 Base Installation

1. Install OS/2 2.1 base on your system. I used a 400 MB SCSI drive, of which 200 MB were allocated to an OS/2 2.1 FAT partition and 200 MB to a NetWare partition.

NetWare Requester for OS/2, V2.01 Installation

2. Install the NetWare Requester for OS/2, version 2.01, using the standard installation procedure. I used the TOKEN.SYS driver for my configuration. ("NetWare Requester for OS/2,

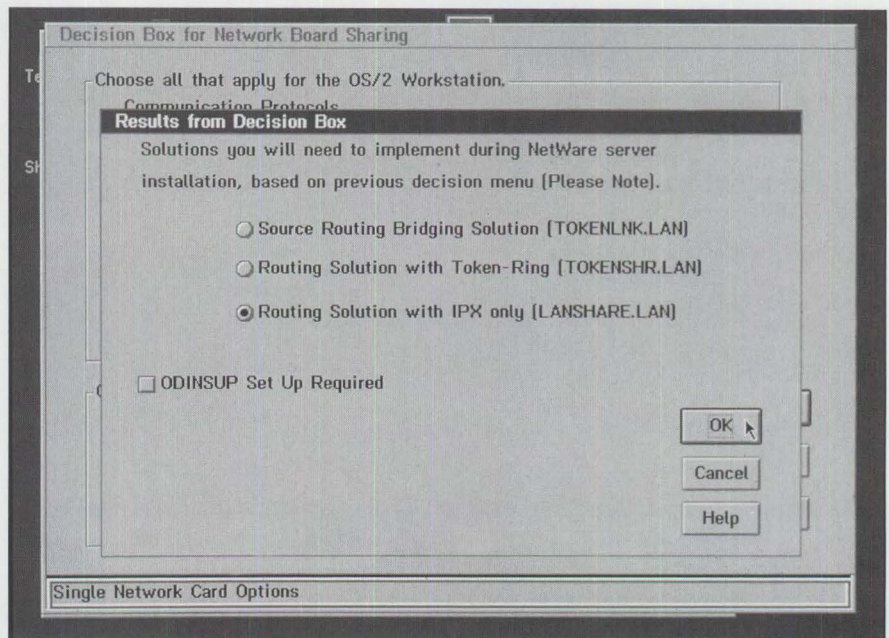


Figure 9. NetWare 4.01 for OS/2 Installation: Results from Decision Box

```

REM -- NetWare Requester statements BEGIN --
SET NWLANGUAGE=ENGLISH
DEVICE=C:\NETWARE\LSL.SYS
RUN=C:\NETWARE\DDAEMON.EXE
REM -- ODI-Driver Files BEGIN --
REM -- DEVICE=C:\NETWARE\ROUTE.SYS
REM -- ODI-Driver Files END --
DEVICE=C:\NETWARE\LANSHARE.SYS
DEVICE=C:\NETWARE\ROUTE.SYS
DEVICE=C:\NETWARE\IPX.SYS
DEVICE=C:\NETWARE\SPX.SYS
RUN=C:\NETWARE\SPDAEMON.EXE
rem DEVICE=C:\NETWARE\NMPPIPE.SYS
rem DEVICE=C:\NETWARE\NPSEVER.SYS
rem RUN=C:\NETWARE\NPDAEMON.EXE
DEVICE=C:\NETWARE\NWREQ.SYS
IFS=C:\NETWARE\NWIFS.IFS
RUN=C:\NETWARE\NWDAEMON.EXE
rem DEVICE=C:\NETWARE\NETBIOS.SYS
rem RUN=C:\NETWARE\NBDAEMON.EXE
DEVICE=C:\NETWARE\VIPX.SYS
DEVICE=C:\NETWARE\VSHELL.SYS GLOBAL
REM -- NetWare Requester statements END --

REM -- NetWare For OS2 statements BEGIN --
DEVICE=C:\NETWARE\PNETWARE.SYS
DEVICE=C:\NETWARE\VNETWARE.SYS
SET NWOS2=C:\NWOS2
REM -- NetWare For OS2 statements END --

```

Figure 10. NetWare Requester and NetWare for OS/2 Statements in the OS/2 CONFIG.SYS File

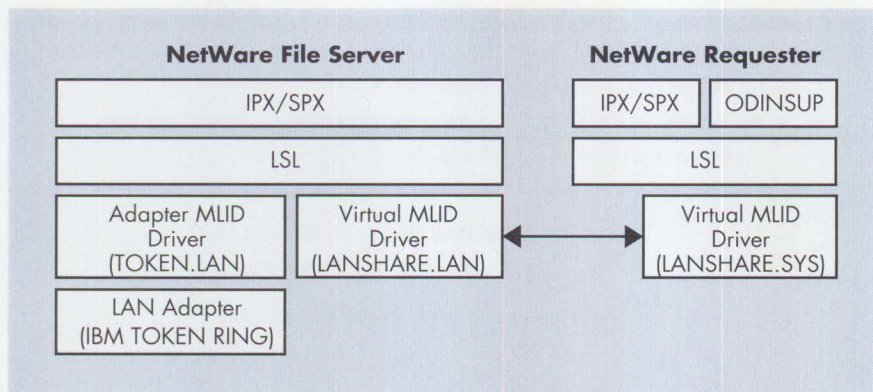


Figure 11. NetWare File Server and NetWare Requester Interaction within NetWare 4.01 for OS/2

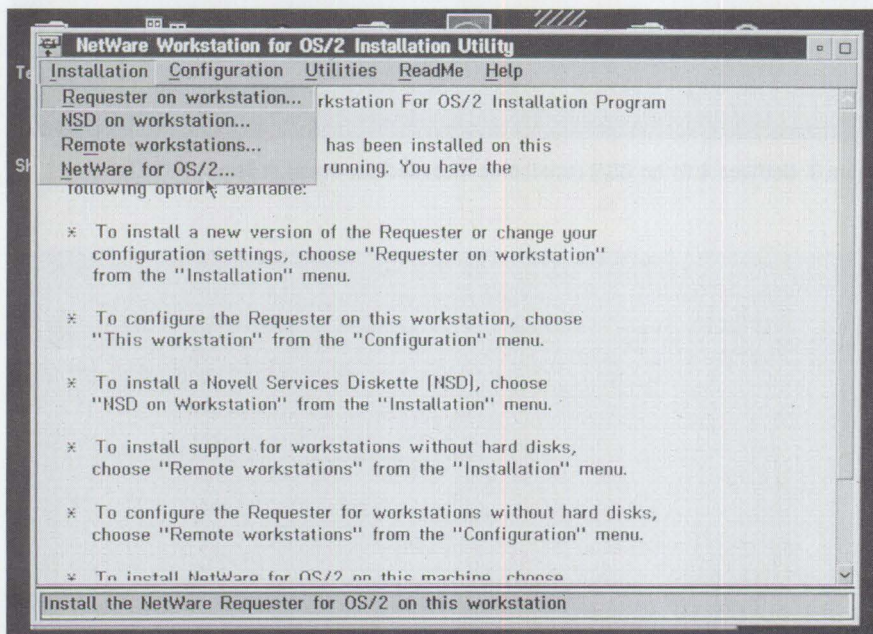


Figure 12. Initial NetWare Requester Installation Screen

V2.01: Features and Installation" in this issue covers installing NetWare Requester.)

3. Install NetWare 4.01 for OS/2 by running `INSTALL.EXE` from the `NWOS2_1` disk. *Note:* you do not need to reboot the computer.
4. Choose "NetWare for OS/2. . ." from the menu bar (see Figure 12). You are asked to confirm the target directory for the OS/2 driver files, `D:\NETWARE`, and the source drive, `A:`. Click on OK to continue.

You are then asked to confirm the target directory for the OS/2 server files, `D:\NWOS2`, and the source drive. Click on OK. You then see a screen that summarizes the target

directories. Click on the Copy box to proceed.

5. A box titled "System Message" appears in the System Message screen. Click on Yes to share your LAN card with OS/2.
6. The next screen you see is "Decision Box for Network Board Sharing" (previously shown in Figure 8). This box determines how your OS/2 `CONFIG.SYS` will be updated. One of two drivers, `LANSHARE.SYS` or `TOKENSHR.SYS`, will be used, depending on which option you choose.

For the Communications Protocols section, keep the default option, NetWare IPX/SPX Only, unless you

plan to use the TCP/IP protocol, or if you have Communications Manager/2 or Extended Services (ES) loaded on the computer system. (For more information about setting up CM/2 and ES coexistence, see "Source-Routing Bridging" on page 21 of the *Installing NetWare for OS/2* manual included with the software.)

For the Topology for NetWare Server section, keep the default option, token-ring, unless you have a different topology for the OS/2 NetWare Server. Click on OK.

7. A box titled "Results from Decision Box" (shown in Figure 9) appears. You need this information when you perform the server part of the installation.

Write down these results, then click on OK. You are asked to save your file as `D:\CONFIG.SYS`. Click on OK. You are then told that the installation process has completed making changes, and you are returned to the first installation screen.

At this point, you have finished the first part of the installation, installing NetWare Requester for OS/2. You can now exit and proceed with installing NetWare 4.x for OS/2, or edit your `NET.CFG` file.

Normally, you will leave `NET.CFG` as is, especially if you choose to share the LAN adapter with both the OS/2 client side and the NetWare server side. Even though you should not alter the contents of the `NET.CFG` file, you should know how to change them if necessary.

Remember that you have been returned to the first screen of the NetWare Workstation for OS/2 Installation Utility. To access the `NET.CFG` editor, click on Configuration in the menu bar, then click on "This workstation..." then choose to edit `NET.CFG`. Figure 13 shows the resulting screen.

Figure 13 shows the window titled "Current `NET.CFG` File Contents," and in it you can see the contents of my `NET.CFG` file. Under the statement "NetWare Requester," I specified "nonded server," which allows the NetWare Requester and NetWare for OS/2 to share the same adapter.

Under the statement "NetWare for OS/2," under "server memory," I entered "16" to tell OS/2 to allocate 16 MB of RAM for NetWare. (The default RAM allocated for NetWare is 6 MB.) During OS/2 startup, the PNETWARE.SYS driver allocates the RAM specified in "server memory 16" to the NetWare 4.01 server side.

After you have made changes to the NET.CFG file, save it and continue.

- Exit the INSTALL program by double-clicking on the upper left corner of the window, then click on the OK button to exit.

Note: be sure to reboot your computer so the changes made to your CONFIG.SYS and NET.CFG files can take effect.

NetWare 4.01 Installation

- Proceed with installing native NetWare 4.01 from the CD-ROM. Insert the NetWare 4.01 CD-ROM into the drive. My CD-ROM drive is drive E:.

From a full or windowed OS/2 session, go to drive E:. There is an INSTALL.COM program in E:\NETWARE.40\ENGLISH. Run INSTALL. You see a screen like the one in Figure 14. From this screen, choose "Install new NetWare v4.x."

- The next screen is titled "Name the new server." In the box titled "Server name:," enter a name for your server (e.g., NW4OS2). If you have several servers in your LAN or WAN, make sure you use a unique name for each.
- The next screen is titled "Assign an internal IPX number to the server." For this screen, you need an internal network number; the number 2CD6A6CE is already entered, because the installation program randomly generates a number for you. You can change it, but make sure you give it a number not already used by another NetWare file server on your network. Press the Enter key to continue.
- The next screen, titled "Copy server boot files to the DOS partition," displays the destination and source paths for the server boot files.
Notice that the source path is D:\NWOS2. Keep the default paths,

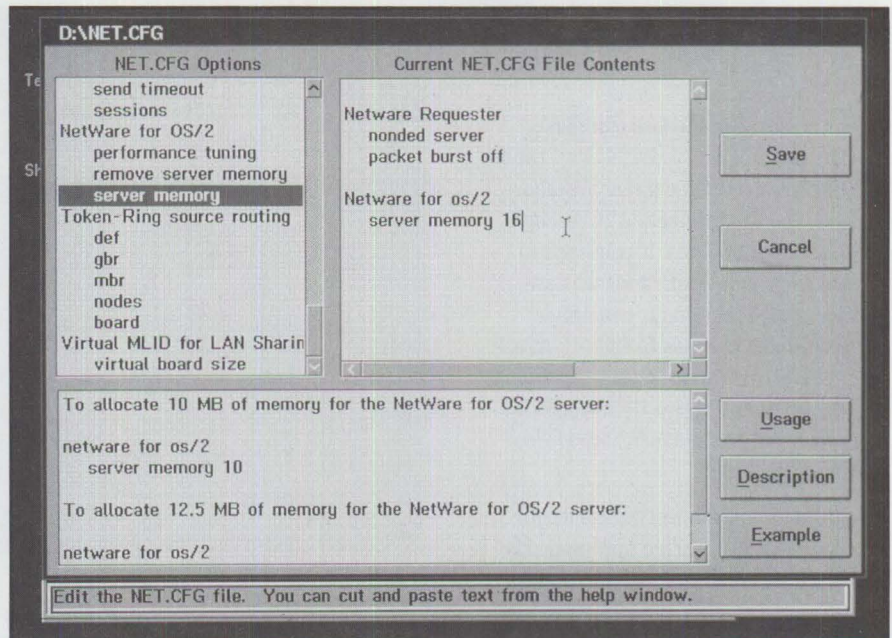


Figure 13. NET.CFG Editing Screen

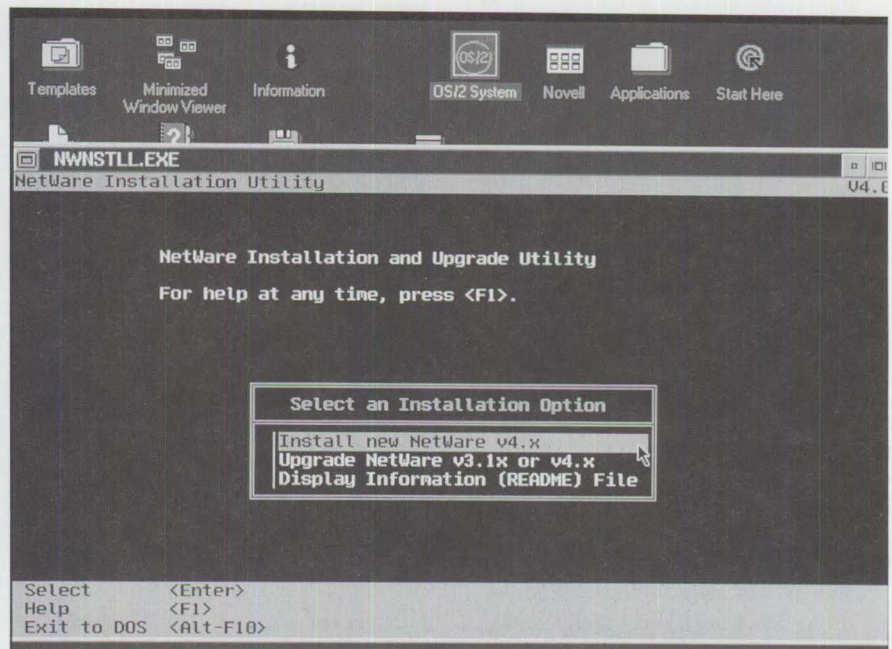


Figure 14. NetWare 4.01 Initial Installation Screen

and press the Enter key to copy the files. You see a screen like the one in Figure 15, which tells you that certain files were already present and were not updated. (These files were copied during the first part of the installation of NetWare 4.01 for OS/2.)

- The next screen does the locale configuration for the server. This screen lets you specify Country Code 001 (United States); Code Page 437 (United States English); and Keyboard

Mapping "None." Keep the defaults unless you need to change them. Press F10 to accept the locale settings.

- In the next screen, titled "Select file name format," choose the recommended option, "DOS file name format." This choice ensures DOS compatibility as well as compatibility with future NetWare releases.

The choice "NetWare filename format" applies when you need non-DOS file-

name formats. Highlight the "DOS file name format" choice, then press Enter to continue.

- In the next screen, you can make changes to your `STARTUP.NCF` file for your server. During a new installation, you do not need to make any changes or updates. If you need to add some line commands or statements, add them now; otherwise, don't make changes to the `STARTUP.NCF` file. In the box titled "Do you want to specify any special startup set commands?," select No, then press Enter.

At this point, the NetWare 4.01 for OS/2 server is started automatically by the installation program, and the NetWare `INSTALL.NLM` is loaded. The rest of the installation will be done by `INSTALL.NLM`.

- The next screen tells you the path from which the files will be copied. At this point, you can press F3 to change the default path (`E:\NETWARE.40\ENGLISH_____`). If you accept the path and press Enter, you are taken to another screen option.

Loading LAN Disk Driver

- The next screen, shown in Figure 16, is titled "Load Disk Driver." Depending on your hardware, choose the proper driver for your hard-disk adapter. In my case, it is the `DSKSHARE.DSK` driver.

If you are using the same controller and hard disk for the NetWare partition and the OS/2 partition, then use `DSKSHARE.DSK`. After selecting it, you get a message indicating that the driver was loaded successfully. Now you are able to enter another disk driver. Continue with the installation.

Creating NetWare Partitions and Volumes

- The screen titled "Create NetWare Disk Partitions" appears. In this screen, you can choose either "automatically" to let the program create the NetWare partition or "manually" to create it yourself.
- The next screen shows your computer system's disk partition table. You should already have a FAT file partition where your OS/2 operating

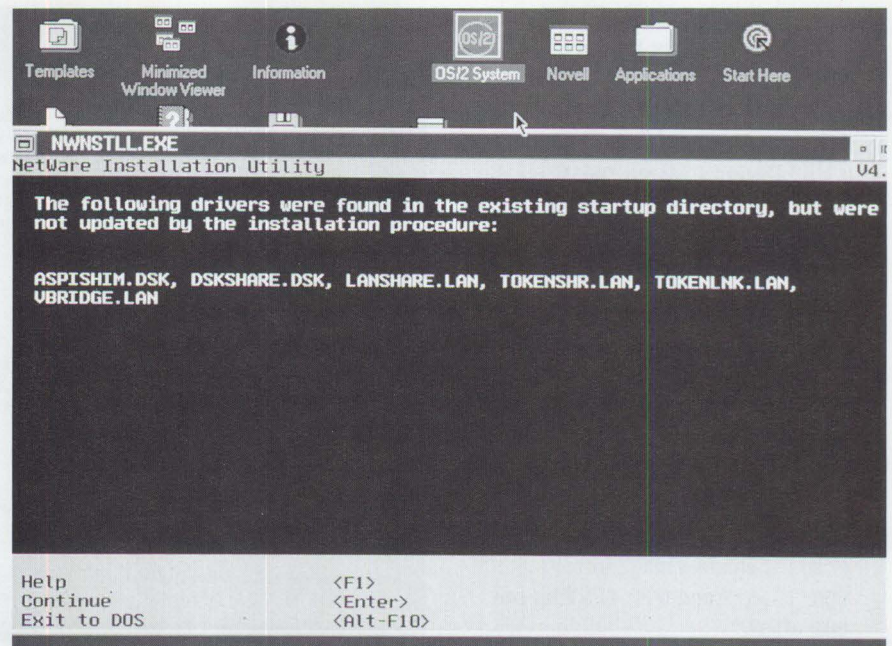


Figure 15. Drivers Currently Found on Server

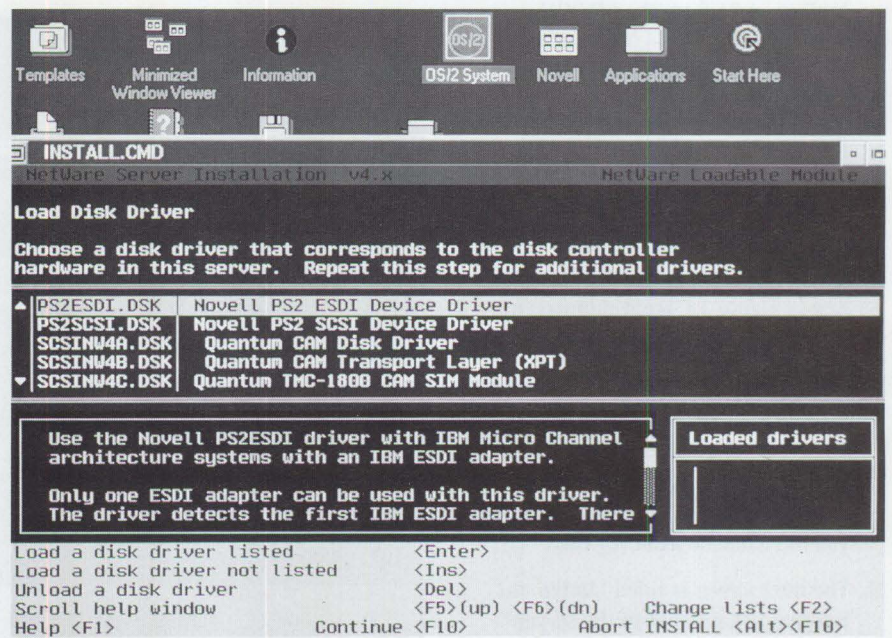


Figure 16. "Load Disk Driver" Installation Screen

system resides plus some free hard-disk space available for your NetWare partition. In this screen, you have several choices: changing the hot fix, creating a NetWare disk partition, or deleting any disk partition. For a new installation, create a partition.

- You see a screen showing you the Partition Type: NetWare Partition; Partition Size, typically the free space available; and Hot Fix information, typically 2 percent of the free

hard-disk space. Press Esc to accept these values.

You are then asked whether you want to create the specified partition. Select Yes and press Enter. You should now see a NetWare partition listed in the NetWare partition table. Press F10 to continue.

- The screen titled "Manage NetWare Volumes" tells you that the available NetWare partition has been used for a SYS volume. (When a partition is

created, it contains no volumes; you have to create a new volume, which defaults to the name SYS.) Press Enter to continue.

You then see a screen showing a table of all the NetWare volumes. At this point, there is only one. Press F10 to save the volume information and continue. You then see a second confirmation. Select Yes and press Enter.

22. Insert the license diskette for native NetWare 4.01 and then press Enter to continue. You will see a confirmation that the license information was installed.

Copying NetWare Files

23. The next screen asks you for the path of the NetWare files that will be copied to the SYS volume. Keep the default path, E:\NETWARE.40\ENGLISH_____. Press Enter to continue.
24. The next screen, titled "Copy NetWare Files," allows you to either select or deselect the following options:
 - NetWare 4.0 DOS Utilities (10,766,210 bytes)
 - NetWare 4.0 OS/2 Utilities (3,382,374 bytes)
 - NetWare 4.0 Windowing Utilities (3,197,269 bytes)
 - Set up a Network Directory for Client Install/Upgrade (17,277,327 bytes)

By default, all are selected. If you have little free hard-disk space, or if you have no need for a specific operating platform, deselect that option. Once you have made your choice(s), press the F10 key. You then see another confirmation request; select Yes to continue.

You now see the files being copied to the SYS volume. A status bar is displayed during the copying, which takes a few minutes to complete. Utilities are copied to the directories LOGIN, PUBLIC, SYSTEM, and MAIL in the SYS volume of the NetWare server. These directories are created by the installation process.

Loading LAN Drivers

25. You see a screen titled "Load LAN Driver."

Note: This is a critical point, because it depends on which driver you selected during the initial NetWare 4.01 for OS/2 installation.

For a normal NetWare 4.01 installation, choose TOKEN.LAN for a token-ring configuration.

If during NetWare 4.01 for OS/2 installation you chose "NetWare for IPX/SPX Only," however, then choose LANSHARE.LAN.

If you initially chose to use different routing protocols (IPX, TCP/IP), then choose TOKENSHR.LAN.

If you have IBM Communications Manager/2, and the LAN adapter is shared by both the server and client parts of the configuration, choose TOKENLNK.LAN. A diagram and a sample OS/2 CONFIG.SYS file can be found in the Routing Configuration Options section above.

For this scenario, choose LANSHARE.LAN. After you highlight it and press Enter, you see a window asking for the IPX Network Address to bind IPX to LANSHARE (frame VIRTUAL_LAN). A random address is displayed (in this case, 8CC6FE1A). Remember that the address must be a unique number. Press Enter to accept it and continue.

26. Now, either load another LAN driver or continue with the installation process. At this point, you should load the TOKEN.LAN driver so that you can communicate beyond your own server with the rest of the LAN.

When you select the TOKEN.LAN driver, you are asked for the slot number, node address, and frame type. You can edit any of these options or accept defaults. If you highlight the frame type and press Enter, you see a table of all available frame types, as well as the logical names for the LAN adapter that you will load. The defaults in my configuration were frame type token-ring and logical name TOKEN_1T_EN-RING (this name must be a unique name). To load the driver and exit this screen, press F10.

27. The next screen prompts you for the IPX network address to bind IPX to TOKEN (frame TOKEN-RING): 1A8D1D60. NOTE: If you are on an

existing LAN and an IPX network address number is already assigned, make sure to enter the correct address, or you will get a router configuration error on the server. Press Enter to continue. Once the TOKEN.LAN driver is loaded, continue with the installation.

Directory Services

28. The installation program examines the network, searching for any available Directory Services trees. If any Directory trees are available, you are given a list to choose from. You are also able to create a new tree; for this example, I created one, named MAPLE. To do this from the list, press the Ins key, enter the name, and press Enter.
29. You are asked for the time zone and given a list of all time zones. For this scenario, choose "United States of America, Central Time." A more detailed screen comes up, which enables you to edit the time-zone abbreviation, offset time from UTC (universal time coordinated), and specify daylight savings time. Typically, you accept the defaults and continue. To save and continue, press the F10 key. You are then prompted again to save the information; press Enter to continue. This information is written to the AUTOEXEC.NCF file found in the SYS:SYSTEM directory of the NetWare file server.
30. The next screen is titled "Specify Context for This Server and Its Objects." Here, you define the company or organization, server context, administrator name, and password. For this scenario, I chose PSTS as the company or organization. As a result, the context defaults to 0=PSTS, and the administrator name defaults to CN=ADMIN.0=PSTS. For the password, choose any password you want. This is your ADMIN password. Press F10 to save and continue. Directory Services then adds your volumes to the directory and gives you a confirmation. Press Enter to continue.
31. You see a screen with a summary of the settings that you entered. The information about NDS is:

Directory Tree name: MAPLE
Directory Context: 0=PSTS
Administrator Name:
CN=ADMIN.0=PSTS

```

set Time Zone = CST6CDT
set Daylight Savings Time Offset - 1:00:00
set Start Of Daylight Savings Time = (APRIL SUNDAY FIRST
    2:00:00 AM)
set End Of Daylight Savings Time = (OCTOBER SUNDAY LAST
    2:00:00 AM)
set Default Time Server Type = SINGLE
set Bindery Context = 0=PSTS
file server name NW40S2
ipx internal net 2CD6A6CE
load LANSHARE slot=0 frame=VIRTUAL_LAN name=LANSHARE_1
bind IPX to LANSHARE_1 net=8CC6FE1A
load TOKEN SLOT=2 FRAME=Token-Ring MSB
    NAME=TOKEN_1T_EN-RING
bind IPX to TOKEN_1T_EN-RING net=9
load route board=2

```

Figure 17. Contents of AUTOEXEC.NCF

```

Create a registration diskette
Upgrade v3.1x Print Services
Configure Communication Protocols
Copy On-Line Documentation from CD-ROM to the Server
Copy Computer-Based Training Files from CD-ROM to the Server (English)
Create Optional Diskettes
Install an Additional Server Language from 4.01 CD-ROM
Install an Additional Server Language
Install NetWare for Macintosh (5-user)
Install NetWare for NFS
Install NetWare for SAA

```

Figure 18. Options in "Other Installation Options" Screen

Note: It is a good idea to record this information and your password for future reference.

Editing STARTUP.NCF and AUTOEXEC.NCF

32. After Directory Services finishes, you see an editing screen for the new STARTUP.NCF file. Notice that the DSKSHARE (which stands for the disk driver DSKSHARE.LAN) is already there. Here is an example of mine:

```
load DSKSHARE slot=0
```

In this editing screen, you can edit, delete, or add commands to STARTUP.NCF. Once your changes are made, press F10 to continue. You are prompted again to save the file.

33. Next, you see the edit screen for the new AUTOEXEC.NCF file. Notice that the information you entered during the installation is now saved in the

new AUTOEXEC.NCF file, shown in Figure 17.

Note that in my AUTOEXEC.NCF file, I used LOAD ROUTE BOARD=2 to load the Source Routing NLM so that I can see beyond the IBM bridges found in my test LAN. The reason for specifying LOAD ROUTE BOARD=2 is this: LANSHARE.LAN, when loaded in the NetWare server, is defined as LOGICAL BOARD 1. When TOKEN.LAN is loaded, it is defined as LOGICAL BOARD 2, and this is why you add BOARD=2 as a parameter to LOAD ROUTE in the AUTOEXEC.NCF. Source Routing will be enabled on BOARD 2.

You must update your AUTOEXEC.NCF file in order to LOAD ROUTE to your token-ring board. Note that in Figure 17, you do not LOAD ROUTE for LANSHARE, but you do LOAD ROUTE for TOKEN.LAN and to BOARD=2.

Press F10 to save. You are asked again whether you want to save the file. Select Yes and press Enter.

34. This step is optional. The screen titled "Other Installation Options" displays the options listed in Figure 18. You can select any number of them (one at a time) or none.

Once completed, press Enter to continue. The NetWare server installation is now complete; you see a box telling you that you have finished. To continue and exit the installation, press Enter. You see the NetWare console screen.

35. In the NetWare console screen, type DOWN and press Enter. This properly shuts down the server.
36. Type EXIT and press Enter to close the session. Look at the Novell folder shown in Figure 19. Notice the two new objects created: NetWare for OS/2 and NetWare Monitor. These two objects are discussed in the next section.
37. Reboot OS/2.
38. In the Novell folder, double-click on the NetWare for OS/2 object to start NetWare 4.01 for OS/2. The NetWare for OS/2 object executes the NWOS2.EXE program, and NWOS2.EXE starts the NetWare 4.01 server part. By default, NWOS2.EXE runs in an OS/2 full-screen session. You can change it to run in an OS/2 window session if you prefer.

This completes the installation steps for NetWare 4.01 for OS/2. You can now log in to the file server.

NetWare Monitor Object

Once the NetWare file server is started, double-click on the NetWare Monitor Object from the Novell folder to see a screen similar to the one in Figure 20. Packaged with NetWare 4.01 for OS/2, the OS/2 NetWare Monitor utility displays information similar to that found in NetWare 4.01's MONITOR.NLM program. PMMON.EXE, the NetWare Monitor found in the D:\NWOS2 directory, is an OS/2 PM application. With OS/2 NetWare Monitor utility, you can view real-time values and tune server performance. Because NetWare 4.01's MONITOR.NLM cannot account for sharing between OS/2 and the

server, you may notice that the server utilization is inaccurate—at times it says 100 percent. Therefore, use PMMON.EXE (the OS/2 NetWare Monitor) instead.

NetWare for OS/2 Object

Located in the D:\NWOS2 directory, NWOS2.EXE is an OS/2 application that starts NetWare 4.01 for OS/2. During installation, the NWOS2.EXE application is placed into the Novell folder as an object. It automatically calls NetWare 4.01 server code. Even though NWOS2.EXE runs in Ring 3, the NetWare 4.01 server code runs in Ring 0 like OS/2 base.

Customer Scenarios for Using NetWare 4.01 for OS/2

The types of configurations that exploit NetWare 4.01 for OS/2 are remote sites such as branch offices. Some branch offices have limited hardware available; in this environment, NetWare 4.01 for OS/2's non-dedicated server configuration is beneficial. Also, any small LAN setup (20 users or less) can exploit NetWare 4.01 for OS/2.

Some education environments have limited budgets, so having a dedicated server computer may not be cost effective; this environment, and similar environments, benefit by having a non-dedicated configuration.



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NetWare products in IBM environments, specializing in NetWare itself, OS/2 base with NetWare, and the coexistence of NetWare, IBM LAN Server, and IBM Communications Manager/2 under OS/2. He has over seven years of experience in the NetWare environment. Albert is a Novell Enterprise CNE, and he has taught Skill Dynamics courses about NetWare. He has an Associate degree in Electronic Engineering Technology from DeVry Institute.



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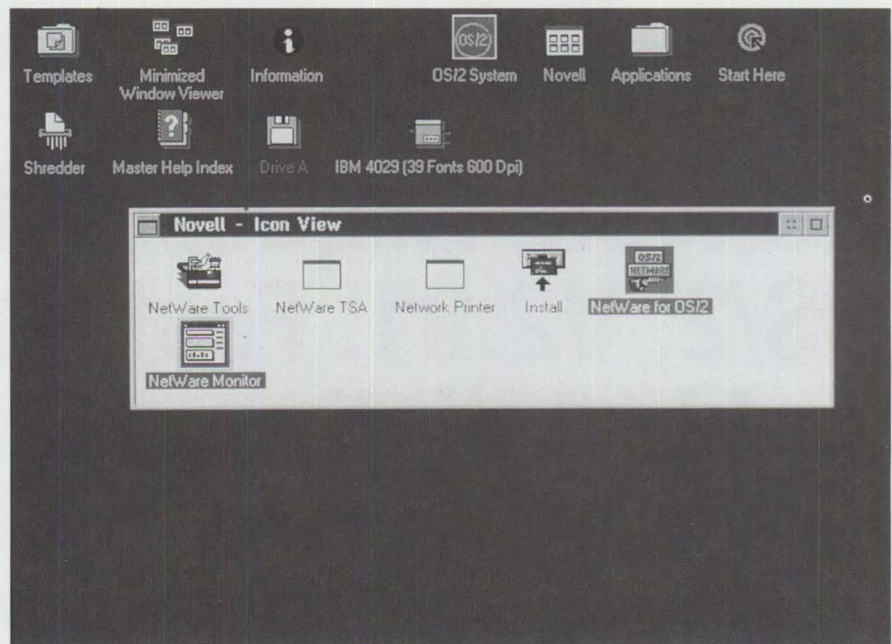


Figure 19. Novell Folder

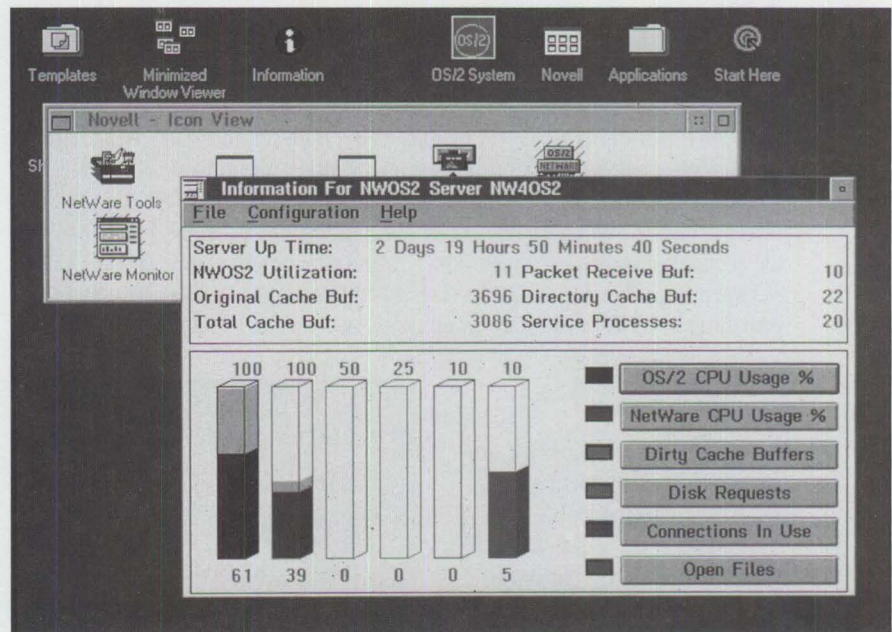


Figure 20. NetWare PM-based Monitor, PMMON.EXE Screen

NetWare Requester for OS/2, V2.01: Features and Installation

This article discusses the NetWare Client (Requester) for OS/2, version 2.01, and gives the steps for installing this software. The article also provides a basic explanation of Novell's Open Datalink Interface (ODI).

NetWare Requester directs network requests from workstations to the network file server. NetWare Requester, a site licensed product, is included in NetWare 4.01 and NetWare 3.12; it can also be purchased separately. (When you buy the NetWare Requester by itself, its product package is titled "NetWare Client Kit for OS/2, v2.01" and it comes with manuals.)

NetWare Requester is based on Novell's Open Datalink Interface (ODI). The ODI interface, shown in Figure 1, provides multiple protocol stack support on a single LAN board using a single LAN driver. NetWare Requester for OS/2 uses internet packet exchange (IPX) as its communications protocol. It can also handle sequenced packet exchange (SPX), NetBIOS emulation, and Named Pipes. NetWare Requester for OS/2 functions in OS/2's multitasking environment, providing a NetWare interface to all OS/2, DOS, and WIN-OS/2 sessions.

VBM and MVDM Sessions

NetWare Requester for OS/2 provides network support to DOS, WIN-OS/2, and native OS/2 sessions with-

in OS/2 2.x, employing two types of device drivers:

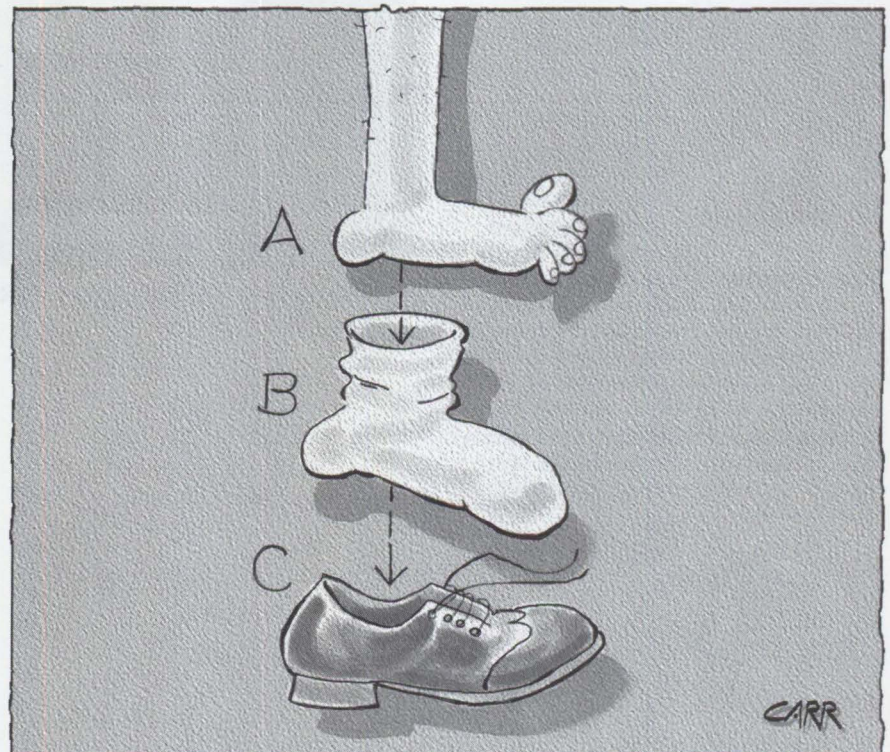
- *Physical device drivers (PDDs).* Using the OS/2 CONFIG.SYS file, you can load a PDD that initializes the LAN adapter. Because hardware is accessible only by the session that loads a physical device driver, the LAN adapter becomes dedicated to OS/2 sessions.

- *Virtual device drivers (VDDs).* VDDs make it possible to share the LAN adapter with both DOS and WIN-OS/2 sessions. The VDD interacts with the PDD.

OS/2 2.1 can run multiple sessions of DOS and Windows applications. The base OS/2 system has two types of DOS sessions: Virtual Boot Machine (VBM) sessions and Multiple Virtual DOS Machine (MVDM) sessions.

VBM sessions can be configured to use a true DOS kernel. MVDM sessions use the OS/2 DOS COMMAND.COM. A WIN-OS/2 session works the same way as an MVDM session.

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The NetWare Requester comes with OS/2 virtual device drivers that allow WIN-OS/2, MVDM, and VBM sessions to access the network. These drivers are VIPX.SYS, DOSVIPX.SYS, VSHLL.SYS, and DOSVSHLL.SYS. They function as follows:

- VIPX.SYS and DOSVIPX.SYS provide IPX/SPX protocol support.
- VSHLL.SYS and DOSVSHLL.SYS provide a NetWare Shell similar to NETX.EXE. VSHLL.SYS is used in global DOS sessions, which are configured during installation of the NetWare Requester for OS/2.

NETX.EXE for VDM sessions can be used in place of VSHLL.SYS. Designed specifically for OS/2 DOS sessions using VIPX.SYS, the virtual IPX OS/2 driver, the NETX.EXE for VDM sessions differs from the NETX.EXE used for regular DOS workstations.

Configuring DOS and WIN-OS/2 Sessions

When installing NetWare Requester for OS/2, you will reach a step that prompts you to provide IPX support for DOS and WIN-OS/2 sessions. This step also gives you three options for how DOS and WIN-OS/2 sessions are configured:

- **Private NetWare Shell Support.** If you choose this option, every DOS and WIN-OS/2 session will have its own login to a NetWare file server; each login will take up one connection to the NetWare file server.

In contrast, all OS/2 sessions on the same workstation share a single login, and thus a single connection, to the NetWare file server. (This is true even if you do not choose Private NetWare Shell Support.)

Private NetWare Shell Support may not be a good idea if you have relatively few available NetWare file server connections. For example, suppose you have a NetWare 3.12, 25-user file server with 20 users. If all 20 users open three DOS sessions and one OS/2 session, then try to have all of these sessions log in to the NetWare file server, your NetWare file server would need a total of 80 user connections at one time; however, it has only 25 simultaneous connections available.

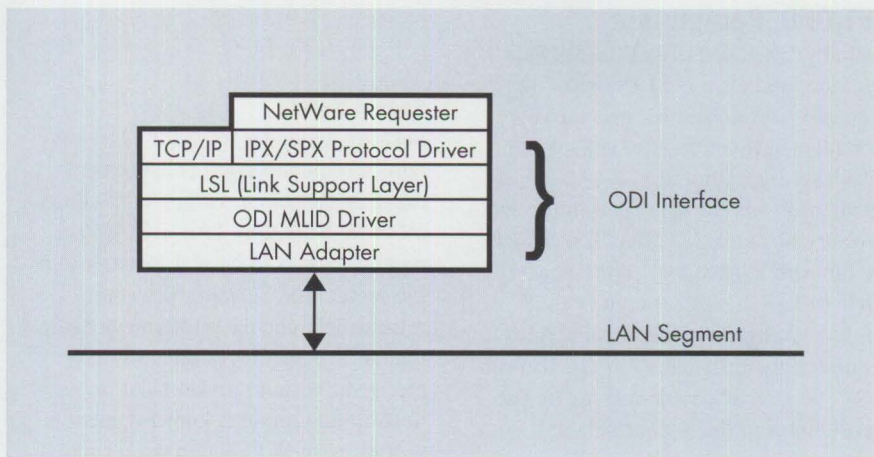


Figure 1. NetWare ODI Interface

```

REM -- NetWare Requester statements BEGIN --SET
NWLANGUAGE=ENGLISH           NetWare national language
                               option
DEVICE=C:\NETWARE\LSL.SYS     Link Support Layer driver
RUN=C:\NETWARE\DDAEMON.EXE    Link support daemon
REM DEVICE=C:\NETWARE\TOKEN.SYS MLID LAN driver
DEVICE=C:\NETWARE\ROUTE.SYS   Source Routing Drive
DEVICE=C:\NETWARE\IPX.SYS     IPX Protocol driver
DEVICE=C:\NETWARE\SPX.SYS     SPX Protocol driver
RUN=C:\NETWARE\SPDAEMON.EXE   SPX protocol daemon
rem DEVICE=C:\NETWARE\NMPPIPE.SYS NetWare Named Pipes driver
rem DEVICE=C:\NETWARE\NPSEVER.SYS Named Pipes Server driver
rem RUN=C:\NETWARE\NPDAEMON.EXE Named Pipes daemon
DEVICE=C:\NETWARE\NWREQ.SYS   NetWare Requester driver
IFS=C:\NETWARE\NWIFS.IFS      NetWare Installable File
                               System
RUN=C:\NETWARE\NWDAEMON.EXE   NetWare daemon
rem DEVICE=C:\NETWARE\NETBIOS.SYS NetWare NetBIOS emulation
rem RUN=C:\NETWARE\NBDAEMON.EXE NetBIOS daemon
DEVICE=C:\NETWARE\VIPX.SYS    Virtual IPX driver
DEVICE=C:\NETWARE\VSHLL.SYS GLOBAL Virtual NetWare Shell
REM -- NetWare Requester statements END --

```

Figure 2. NetWare Requester Statements Added to OS/2 CONFIG.SYS

The Private NetWare Shell Support option is the default.

- **Global NetWare Shell Support.** If you choose this option, all DOS, WIN-OS/2, and OS/2 sessions share a single login to the NetWare server. Your user login is done through an OS/2 session; NetWare resources, such as mappings and print captures, are shared with the other sessions. This option adds the VSHLL.SYS OS/2 drivers to your CONFIG.SYS.

The Global NetWare Shell Support option is typically the one you should choose.

- **No NetWare Shell Support.** This option disables NetWare support for DOS and Windows sessions. This is fine if your applications are not network-aware, but it can be a problem if they are.

NetWare Drivers in the OS/2 CONFIG.SYS

During the NetWare Requester for OS/2 installation, the INSTALL program automatically modifies the OS/2 CONFIG.SYS file. Figure 2 shows the statements added to CONFIG.SYS for NetWare Requester. The INSTALL program also adds P:\OS2;L:\OS2 to the PATH and DPATH statements.

NET.CFG Parameters

Typically, when you install the NetWare Requester and choose a LAN driver, the Requester uses default settings for your LAN adapter. If you need to change the default settings, use the NET.CFG file. By default, this text file is created in the root directory of your OS/2 drive. You can edit the file with a text-based editor, or you can use INSTALL.EXE, found in the \NETWARE directory where the NetWare Requester was installed. (You can also run INSTALL.EXE by double-clicking on the Install object in the NetWare folder.)

Figure 3 lists the available NET.CFG options. For more information about NET.CFG settings, see the *NetWare Requester for OS/2, V2.01, Workstation for OS/2* manual that comes with the product.

Configuring for NetWare 3.1x and NetWare 4.x

Several significant additions have been made to NetWare Requester for OS/2, version 2.01.

Ethernet Frame Type

Unlike earlier versions of the NetWare Requester for OS/2, version 2.01 comes ready to run in a NetWare 4.x network. If you are using Ethernet, you will notice that the frame type is set to Ethernet_802.2 instead of Ethernet_802.3. You can easily change this by adding the following lines to the CONFIG.SYS file:

```
LINK DRIVER NE2000
  FRAME ETHERNET_802.3
```

Note: The second line, a suboption, must be indented at least two columns. NetWare Requester for OS/2 will not recognize the suboption line unless it is indented.

Directory Services

Another significant change in v2.01 is the activation of Directory Services. If you are on a NetWare 3.1x LAN with no NetWare 4.x servers attached and the Requester is installed and running, it takes quite a while to log in. This happens because the NetWare Requester is looking for a NetWare 4.x Directory Tree. To improve the login time, you can disable Directory Services on your workstation by adding the following lines to the NET.CFG file:

```
NETWARE REQUESTER
  DIRECTORY SERVICES OFF
```

Packet Burst

NetWare Requester for OS/2 v2.01 contains a communication enhancement called *packet burst*. Packet burst allows a set of NetWare Core Protocol (NCP) request packets to be sent together to a file server. The NetWare file server returns only one packet acknowledging that all NCP request packets were received. (Without packet burst, a NetWare file server acknowledgment is sent for each NCP request packet sent from a workstation.) Packet burst reduces network traffic, thus improving LAN performance. Packet burst can also be beneficial in a wide area network (WAN).

Packet-burst mode must be present at both the file server and the workstation. If you are using NetWare 4.x, packet burst is enabled by default, but it is used only when the workstation connected to it also has packet-burst mode enabled. If you are using NetWare 3.1x, you will need to load PBURST.NLM (found on CompuServe, in forum NOVFILES, in the file DOSUP9.EXE) to enable packet burst.

Packet burst is active by default in NetWare Requester for OS/2 v2.01. You can disable packet burst by adding the following lines to the NET.CFG file:

```
NETWARE REQUESTER
  PACKET BURST OFF
```

Large Internet Packets

Another function in NetWare Requester for OS/2, v2.01 is *Large Internet Packets* (LIP). In earlier versions of NetWare, if a workstation communicated to a file server through a router, the packet size was negotiated to 576 bytes, causing a performance bottleneck. With LIP, the workstation and server negotiate a larger packet size to go through the router. This eliminates the bottleneck and improves performance. In NetWare Requester for OS/2, v2.01, LIP is active by default, but both the workstation and the file server must have LIP capability. NetWare 4.x has LIP mode enabled by default; NetWare 3.1x needs the PBURST.NLM loaded.

You can disable LIP by adding the following line to the NET.CFG file:

```
NETWARE REQUESTER
  LARGE INTERNET PACKETS OFF
```

NCP Packet Signature

A security enhancement, *NCP Packet Signature*, has been added to the NetWare Requester. NCP Packet Signature protects servers and workstations from packet forgery. Without NCP Packet Signature, a hacker or programmer trying to gain illegal access to the server and all network resources could modify a packet.

To set up the NCP Packet Signature function on the OS/2 workstation, add the following line to the NET.CFG file:

```
NETWARE REQUESTER
  SIGNATURE LEVEL number
```

where number can be 0, 1, 2, or 3, as follows:

| Number | Function |
|--------|--|
| 0 | Client does not sign packets. |
| 1 | Client signs packets only if the server requests it (server option is 2 or higher). This is the default setting. |
| 2 | Client signs packets if the server is capable of signing (server option is 1 or higher). |
| 3 | Client signs packets and requires the server to sign packets (or login will fail). |

Files Found After Loading NetWare Requester

The NetWare Requester install program copies many files into the \NETWARE directory. The files include requester program files, DLL files, network interface drivers, and utility files.

The NetWare utility files are INSTALL.EXE, NWTTOOLS.EXE, NETX.EXE (for MVDM sessions), and TSA_OS2.EXE (NetWare TSA).

The RPRINTER utility in NetWare Requester for OS/2 (Version 2.0 and

| OPTION | FUNCTION |
|--|--|
| DAEMON CONFIGURATION MESSAGE TIMEOUT number | Prevents pop-up and broadcast messages from displaying. |
| DISPLAYHARDERRORS no | Prevents error messages from displaying. |
| LINK DRIVER name DMA [index] channel FRAME name INT [index] irq MEM [index] starting_address size NODE ADDRESS number PORT [index] starting_port number PROTOCOL name id frame SLOT number | Defines the hardware configuration of the driver for the LAN adapter in the workstation. These statements can be used for multiple boards. |
| LINK SUPPORT BUFFERS number [buffer size] | Adjusts the size of the communication buffers used by the Requester. |
| NAMED PIPES CLIENT SESSIONS number SERVER SESSIONS number SERVICE THREADS number | Specifies the maximum number of connections to a workstation and to all Named Pipes servers. |
| NETWARE NETBIOS ABORT TIMEOUT number BROADCAST COUNT number BROADCAST DELAY number COMMANDS number INTERNET number LISTEN TIMEOUT number NAMES number RETRY COUNT number RETRY DELAY number SESSIONS number VERIFY TIMEOUT number | Manages NetBIOS names and sessions and affects the internal memory allocation for NetBIOS. |
| NETWARE REQUESTER CACHE BUFFERS number DIRECTORY SERVICES OFF LARGE INTERNET PACKETS OFF NAME CONTEXT context PACKET BURST OFF PREFERRED SERVER servername PREFERRED TREE treename REQUEST RETRIES number SESSIONS number SIGNATURE LEVEL number | Controls network requests from this workstation to the NetWare server. |
| PROTOCOL ODINSUP BIND driver [number] | Configures network driver interface specification (NDIS) to function through the ODI interface. Applications using NDIS are Communications Manager/2 and OS/2 LAN Requester. |
| PROTOCOL STACK IPX BIND name ROUTER MEM size SOCKETS number | Adjusts parameters for IPX. |
| PROTOCOL STACK SPX ABORT TIMEOUT number LISTEN TIMEOUT number RETRY COUNT number SEND TIMEOUT number SESSIONS number VERIFY TIMEOUT | Adjusts parameters for SPX. |
| PROTOCOL ROUTE SOURCE ROUTE def gbr mbr NODES n BOARD n | Used for source-routing. |

Figure 3. NET.CFG Options

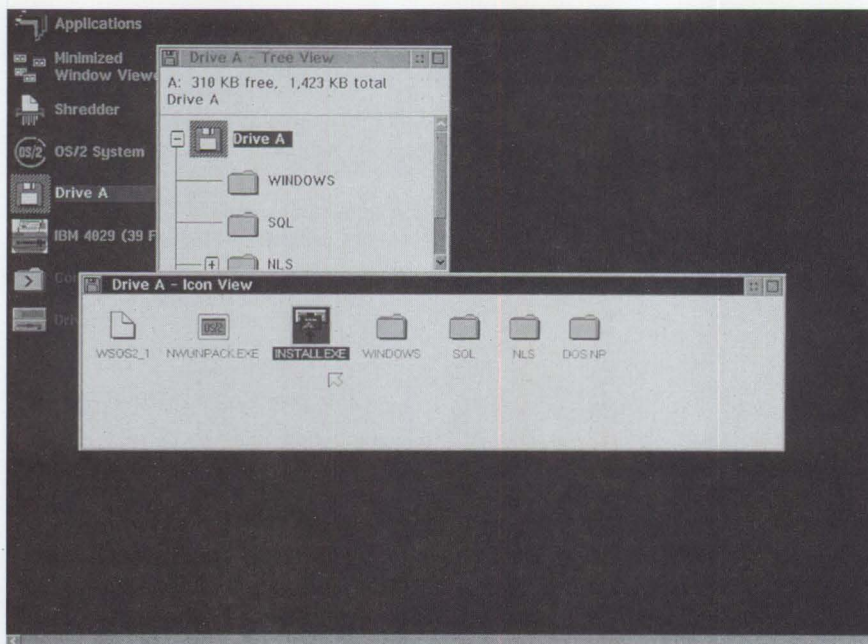


Figure 4. "Drive A - Icon View" Window

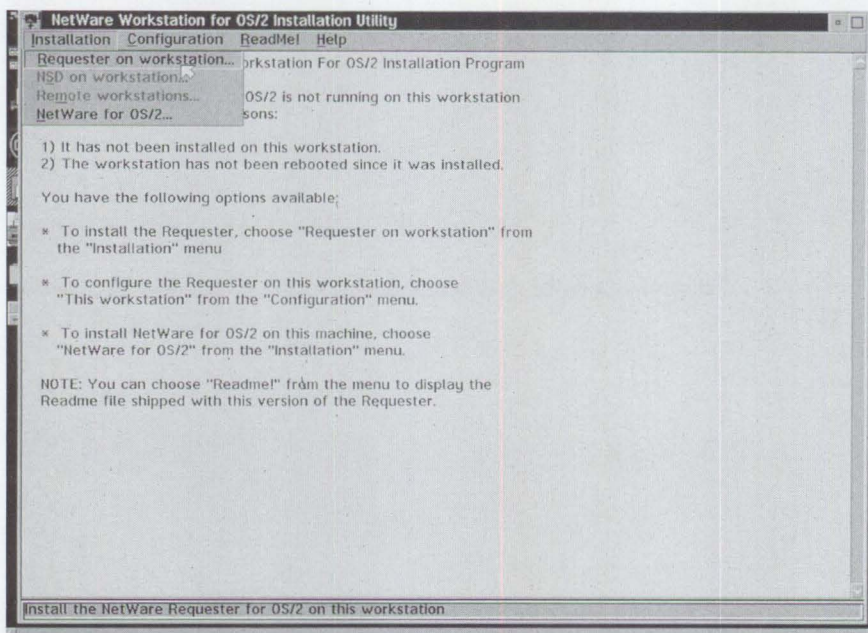


Figure 5. "NetWare Workstation for OS/2 Installation Utility" Window Prior to Installation

earlier) has been replaced with `NPRINTER` in NetWare Requester for OS/2, v2.01. Both do the same thing, but `NPRINTER` also incorporates print services with NetWare Directory Services in NetWare 4.01. `NPRINTER` can also be used with NetWare 3.11 and 3.12.

NetWare Requester for OS/2, (Version 2.0 and earlier) came with `SLIST.EXE`. In v2.01, `SLIST.EXE` is replaced with

`NLIST.EXE`. Both `SLIST.EXE` and `NLIST.EXE` list all of the servers found in a network. However, `NLIST.EXE`, a part of NetWare 4.x, is designed to work with NetWare 4.x's Directory Services. To run `NLIST.EXE`, at a command prompt, type:

```
NLIST SERVER
```

You will find both `NLIST.EXE` and `NPRINTER.EXE` in the file server's OS/2 utilities.

Installation Steps for NetWare Requester

The rest of this article gives steps for installing NetWare Requester for OS/2, v2.01.

Note: The configuration below applies only to computer systems that are not running IBM's Extended Services, IBM Communications Manager/2 (CM/2), or OS/2 LAN Requester, all of which use the NDIS interface. The NDIS interface involves coexistence, which requires Novell's `ODINSUP` driver found in the NetWare Client for OS/2 package. (`ODINSUP` and coexistence will be covered in a subsequent article.)

The computer system used in this setup runs OS/2 2.1 on an IBM PS/2 Model 80 with 16 MB of RAM, an IBM Token-Ring 16/4 Adapter, and a 160 MB hard disk.

Before proceeding, make sure you have the following 3.5-inch or 5.25-inch diskettes from your NetWare Requester for OS/2, v2.01 package:

- WSOS2-1
- WSOS2-2
- WSDRV-1

1. Insert the WSOS2-1 diskette into drive A:
2. Run the OS/2 program `INSTALL.EXE` one of two ways: open an OS/2 session (either a window or full-screen), then type `A:INSTALL.EXE`; or click on the Disk object on the OS/2 desktop, then click on the Install object, as shown in Figure 4.
3. Choose English from the list of five languages options. New to version 2.01, this feature allows you to specify a language for the NetWare Requester installation and help screens.
4. You see the NetWare Workstation for OS/2 Installation Utility window, shown in Figure 5.

Note: If you are using the NetWare Client Kit for OS/2, v2.01 package, skip step 3. The NetWare Requester installation defaults to the English language and takes you directly to step 4.

From the Installation menu option, select "Requester on workstation..." A screen asks for the target directory where you want to copy the NetWare

Requester for OS/2 files. The default drive is the drive where your OS/2 system resides; for this configuration, drive D:. The default path is D:\NETWARE. The screen also shows the source drive (A:) from which the Requester diskettes will be loaded.

Click on the OK button.

5. You now see the "Requester Installation" window shown in Figure 6. This window gives you four options: edit CONFIG.SYS, copy the requester files only, copy the ODI LAN drivers only, or do all of the above. For a first-time installation, select the first option, "Edit CONFIG.SYS and Copy All Files. . ."

Click on the OK button.

6. Select the ODI LAN driver for your LAN adapter from the "Step 1—Choose the ODI LAN Driver" window. Select a driver by clicking on the right, square, down-arrow button of the entry field. You are now prompted to insert the diskette labeled WSDRV_1.

7. Insert the WSDRV_1 diskette, then click on OK. A screen listing the available drivers appears. For this example, click on TOKEN.SYS as shown in Figure 7, then click on Continue (which is behind the drop-down list in Figure 7).

8. The next screen is "Step 2—Choose NetWare Support for DOS and Windows Applications," shown in Figure 8. Here, by default, IPX support for DOS is set to OFF. If you want to use the NetWare network from DOS and WIN-OS/2 sessions, or if you want to log in from OS/2 and provide Global network resources to both DOS and WIN-OS/2 sessions, click ON to set IPX support for DOS to ON. This enables the default NetWare Shell Support options:

- Private NetWare Shell Support
- Global NetWare Shell Support
- No NetWare Shell Support

Choose Global NetWare Shell Support, then click on Continue.

(For more information about IPX support for DOS, refer to chapter 3 of the *NetWare Workstation for OS/2, V2.01, Workstation for OS/2 manual*.)

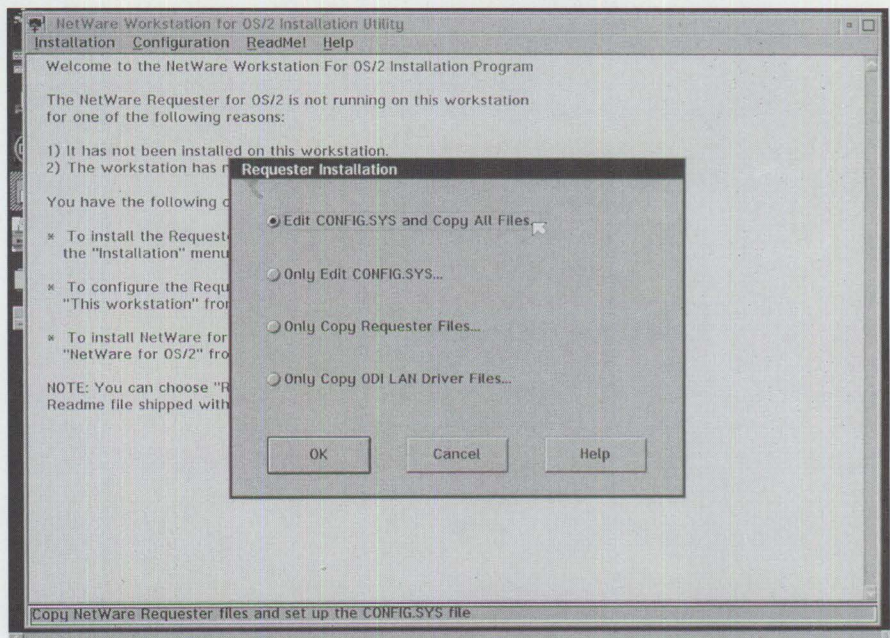


Figure 6. Requester Installation Window

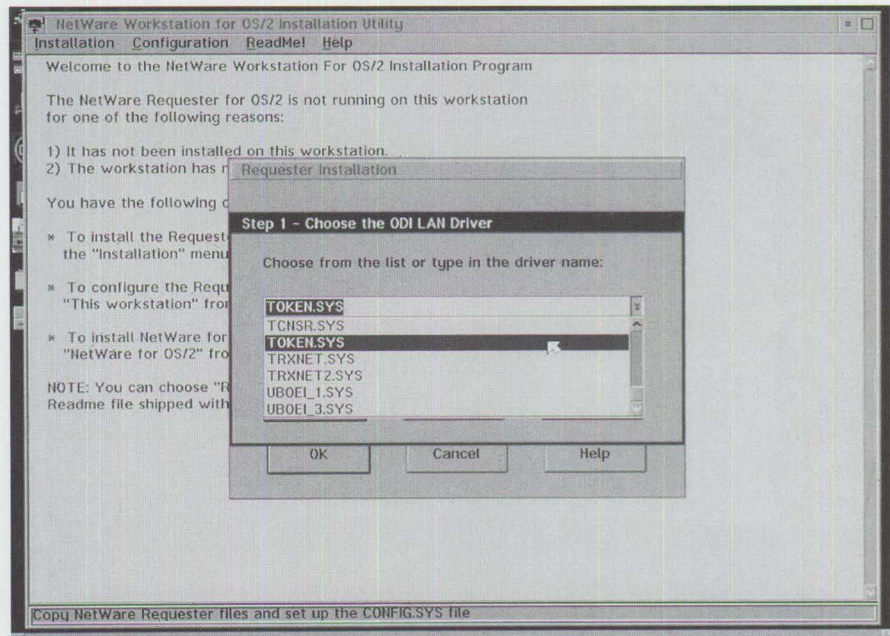


Figure 7. "Choose the ODI LAN Driver" Window

9. The "Step 3—Choose Optional Protocols" window, shown in Figure 9, appears. From here, choose which (or all) of the following drivers to load: the SPX protocol driver, the Novell NetBIOS driver, and/or the Remote Named Pipes driver. The install program adds your selected driver(s) to the CONFIG.SYS file for OS/2. (By default, none is selected.) Each driver is explained below.

SPX Support: Choose this option if you plan to use applications requiring SPX protocol. Some examples include

NPRINT, Named Pipes, or other applications such as NetWare Services Manager for OS/2 and TLI. This option will be the one you will usually choose.

NetBIOS: This is NetWare NetBIOS. Some applications are designed to use NetWare NetBIOS, which can be used with IBM's NetBIOS. For more information, see the *NetWare Requester for OS/2 manual*.

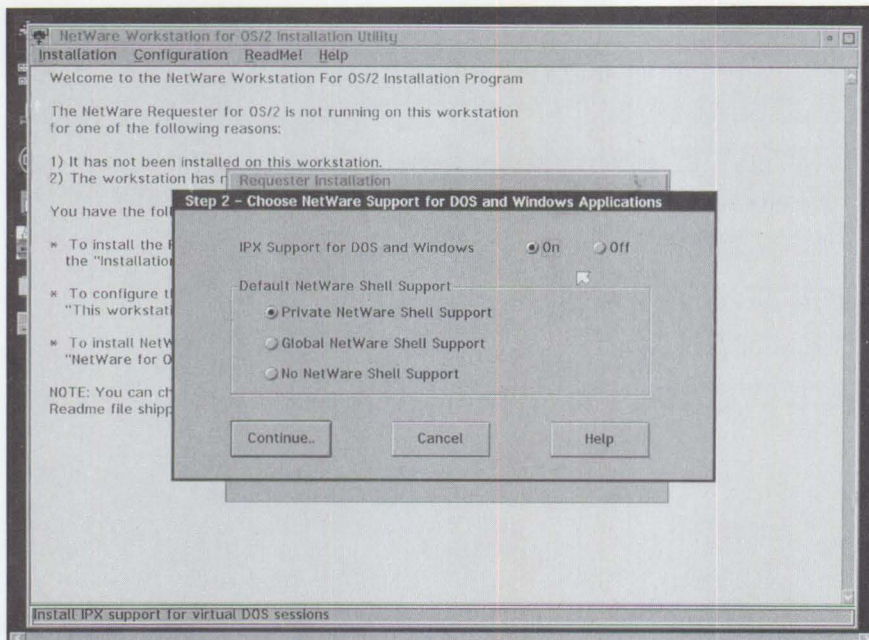


Figure 8. "Choose NetWare Support for DOS and Windows Applications" Window

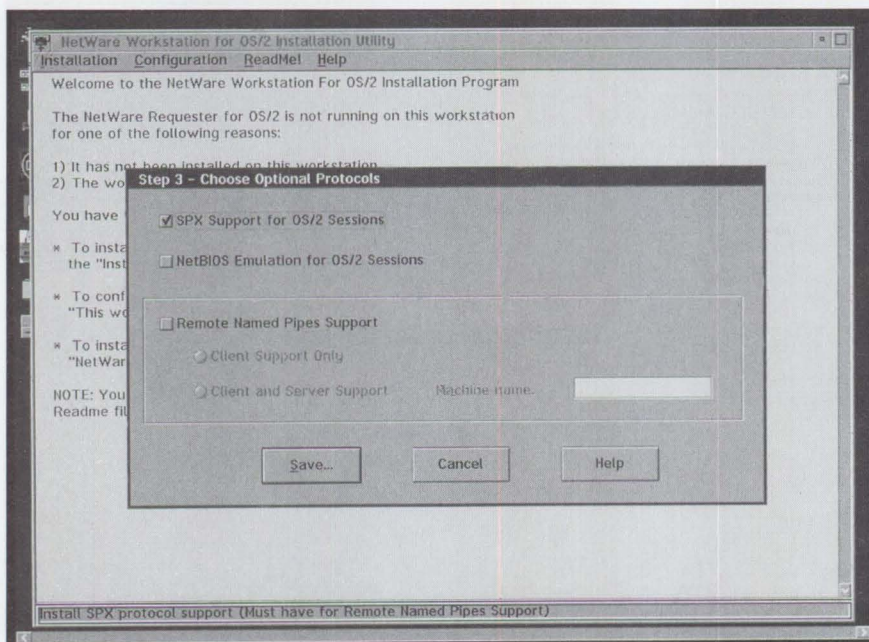


Figure 9. "Choose Optional Protocols" Window

Remote Named Pipes: If you plan to set up this workstation as a Named Pipes server or client, choose this option.

Click on Save to continue. You are then asked to save the changes to CONFIG.SYS. Click on OK to continue.

10. You now see the "Copy ODI LAN Driver Files" window (see Figure 10). The default option copies only the default driver, which in this case is TOKEN.SYS.

To copy all the ODI drivers to your disk in the <drive>\NETWARE directory, click on "Copy all the drivers on the disk." You will usually choose the default option because you don't normally change your LAN adapter board, and you may want to conserve space. You can always go back to your NetWare Requester diskettes to load another driver.

Click on OK to continue. The ODI drivers are then decompressed and

copied to the <drive>\NETWARE directory.

11. The "Copy Requester Files" screen appears showing you where the Requester files will be copied. You should see the entry <drive>\NETWARE. Click on Copy to continue.
12. You are asked to insert the diskette labeled WSOS2_1. Insert it, then click on OK to continue. The bottom grey bar reflects the files that are being copied to the \NETWARE directory. Insert the diskette labeled WSOS2_2 when prompted, then click on OK to continue. You see the rest of the requester files being copied.
13. The Installation screen appears as shown in Figure 11. At this point, you can either close the Installation screen by clicking on the upper left corner of the window, or create or edit the NET.CFG for this workstation by clicking on the Configuration option, then clicking on "This workstation. . . ." In this example, you will create NET.CFG.

Creating NET.CFG is optional; you can create it any time by using this same install program or a text editor. (See the following section for more information about available options.)

If you choose to exit, restart your computer so that the changes made to the OS/2 CONFIG.SYS take effect. Once your computer is restarted, NetWare Requester will start. Make sure that your computer is already physically attached to a LAN and can access a NetWare file server.

Creating a NET.CFG File

To create the optional NET.CFG file, begin by referring to Figure 11.

14. Click "Configuration" in the top menu bar. Then, click on "This workstation . . ." in the pulldown menu. You see the default path for the NET.CFG, which should be the root directory of the OS/2 drive. Leave the default path as is. Click on Edit to continue editing your new NET.CFG. (If you already have a NET.CFG, edit the existing one.)
15. The next screen you see, shown in Figure 12, is split into three parts. The upper left window contains the NET.CFG options. The upper right window is the editing window where

you edit your new (or existing) NET.CFG file. The bottom window is a help window with information about each command, as well as information about cutting and pasting from the help window to the editing window. Some NET.CFG command options in the help window are explained using examples; you can take advantage of these examples by copying a sample NET.CFG command option and pasting it into the NET.CFG file you are editing.

In the NET.CFG file shown in Figure 12, the preferred server is ZR3_S312, the server that the Requester defaults to when the computer is started and the Requester tries to connect.

You are attaching to a NetWare 3.12 file server, which is the reason for the "Directory services off" option explained previously.

Under "Link Support," buffers are set to 14 4210, which are values recommended by Novell. Here, 14 is the number of buffers (instead of the default 20), and 4210 is the number of bytes in each buffer (instead of the default 1514).

The rationale for these numbers is this: You are using an IBM Token-Ring 16/4 Adapter running at 16 Mbps, so you set your server to recognize 4 KB packets. To enable your workstation to send and receive 4 KB packets, you need to set the buffers option to the values 14 and 4210 because the Requester cannot allocate more than 64 KB (65,536 bytes) of memory for communication buffers. Also, header information occupies 5210 bytes. The 14 buffers, multiplied by 4210 bytes per buffer, plus 5210 bytes for header information, equals 64,150 bytes.

Ensure that your token-ring board is configured for 16 KB of RAM. On IBM PS/2 systems, use the Reference program to make this change.

Once you have made all necessary changes, click on Save. A message confirms that you have finished configuring NetWare Requester for OS/2.

Exiting Installation and Rebooting

16. To exit the installation application, double-click on the upper left corner of the window.

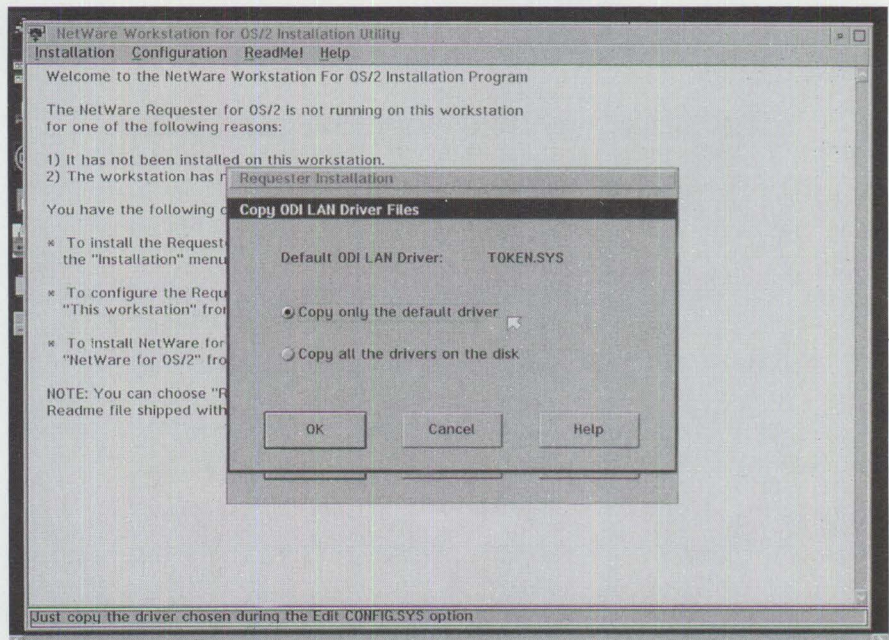


Figure 10. "Copy ODI LAN Driver Files" Window

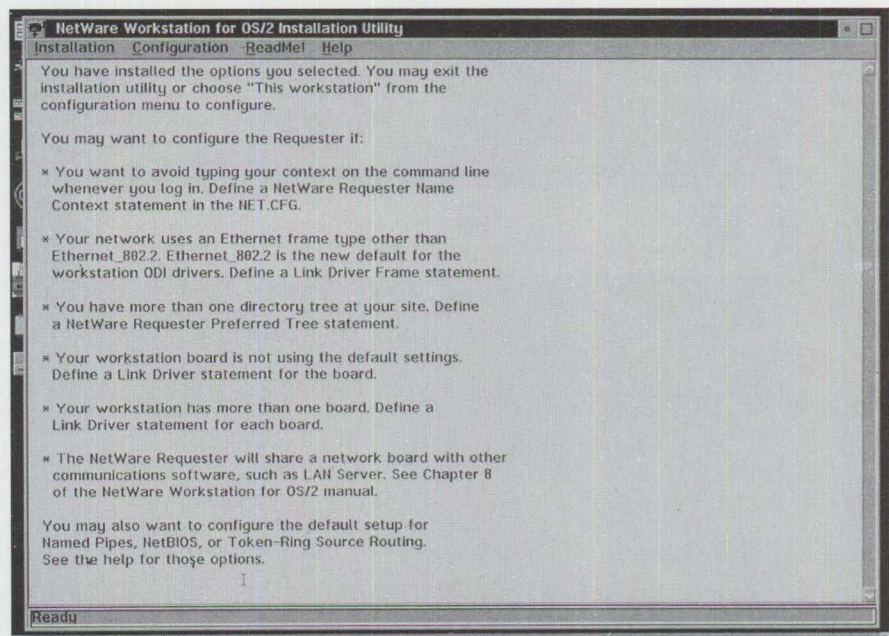


Figure 11. Installation Screen

A new Novell folder appears on the OS/2 desktop (see Figure 13). The Novell - Icon View shows the objects it contains. The Novell folder and its objects were created by the NetWare Requester for OS/2 installation program.

17. Close the Drive A-Icon View and Drive A - Tree View windows. Remove the diskette from drive A:, then shut down your OS/2 system and reboot so that the NetWare Requester can start.

Perusing the NetWare Requester Drive

After OS/2 has restarted, you should be able to go to drive L:, which is automatically assigned by the Requester as the <server>\SYS:LOGIN directory. Your CONFIG.SYS now has a path to it, L:\OS2.

18. Go to the L: drive and issue a DIR command. You will see an \OS2 subdirectory. (If you have a NetWare 3.11, 3.12, or 4.01 server, and you specified to load the OS/2 utilities during OS/2

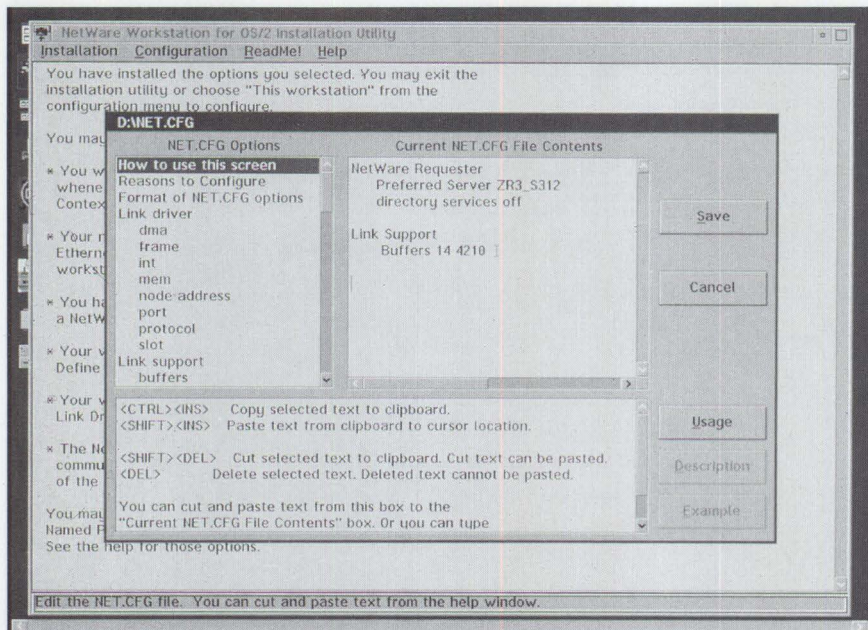


Figure 12. Editing NET.CFG

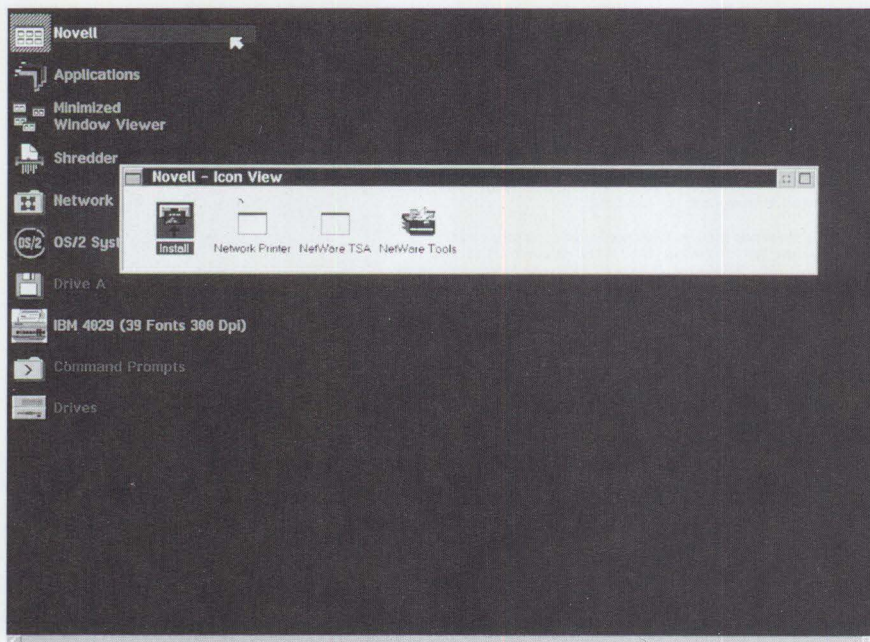


Figure 13. Novell - Icon View

installation, the \OS2 subdirectory was created.) Since the \OS2 subdirectory is in the path, you should be able to run ATTACH.EXE, LOGIN.EXE, MAP.EXE, or SLIST.EXE (NLIST.EXE in NetWare 4.01) no matter which drive, directory, or subdirectory you are in.

- Execute the LOGIN.EXE program to log in to your NetWare file server. Because you defined your server as ZR3_S312 in NET.CFG, you just type

LOGIN <username> from an OS/2 session prompt.

You have now installed NetWareRequester for OS/2, v2.01.

The Novell Folder

NetWare Requester created the Novell folder during the installation. The objects within the Novell folder, shown in Figure 13, are:

Install: The same install program as the one on diskette.

Network Printer: The NPRINT.EXE in NetWare 4.01 and RPRINT.EXE in NetWare 3.1x. Both of these files are in the PUBLIC directory in your file server.

NetWare Target Service Agent (TSA): Part of Novell's Storage Management System (SMS) used for remote backups.

NetWare Tools (NWTOOLS): Similar to SESSION.EXE, the NetWare DOS-based menu utility found in NetWare 3.11. An ideal utility for managing your workstation, NWTOOLS enables you to see and change all of your current drive mappings. It lists all of your printer ports including which NetWare queues they are captured to, and allows you to end capture or to capture to a new queue. You can set up your mappings and capturing, then save them to a file with an .NWS extension.

Once your NetWare file-server drive mappings and NetWare print-queue capturing is saved to a file such as PERSONAL.NWS, you can invoke your configuration by typing the following command at an OS/2 command prompt:

```
NWTOOLS PERSONAL.NWS
```

Or, you can invoke your configuration by loading the PERSONAL.NWS through the NWTOOLS menu. NWTOOLS also lists the servers to which you are connected. Use NWTOOLS.EXE if you need to connect to a server and you want a list of all available servers or if you are attaching to a NetWare 4.01 network Directory Tree and would like to see a specific Directory Services Tree list, as shown in Figure 14.

Quirks and Missing Functions in NetWare Requester

WIN-OS/2 Sessions: After the NetWare Requester is installed and you go into a WIN-OS/2 session, you may experience errors such as:

- General Protection Fault in NETWORK.DRV
- Sys3176, Sys3171, and Sys3175 errors in WIN-OS/2
- IGNORE_RETRY message returned from FILE-RUN-BROWSE
- General Protection Fault in NWIPXSPX.DLL
- Incorrect drive list in File Manager

- LAN Server drives not listed in the File Manager list in WIN-OS/2

A fix for these problems is available on CompuServe, in forum NOVFILES, in file R201FX.EXE.

DOS Sessions: When running a DOS session with NETWARE_RESOURCES set to GLOBAL, you may get a Trap D or Sys3176 message if the application is using Queue Management Services (which enables an application to print directly to a NetWare queue). Use R201FX files to correct this problem.

NetWare Requester for OS/2, v2.01 does not come with the remote boot function. No RIPL files are present.

Directory Services in NetWare Requester for OS/2, v2.01 is available only in OS/2 sessions.

When you install the ODINSUP driver for NDIS support through the NetWare ODI interface, the PROTOCOL.INI file for NDIS is not automatically modified. You must manually change the PROTOCOL.INI. (More about using ODINSUP with the NetWare Requester and coexistence will be covered in a subsequent article.)



Albert Juarez is a member of the Workgroup LAN Systems Support and Services Group in IBM's Personal Systems Competency Center (PSCC) in Roanoke, Texas.

Albert's mission is to

support Novell NetWare products in IBM environments, specializing in NetWare itself, OS/2 base with NetWare, and the coexistence of NetWare, IBM LAN Server, and IBM Communications Manager/2 under OS/2. He has over seven years of experience in the NetWare environment. Albert is a Novell Enterprise CNE, and he has taught Skill Dynamics courses about NetWare. He has an Associate degree in Electronic Engineering Technology from DeVry Institute.



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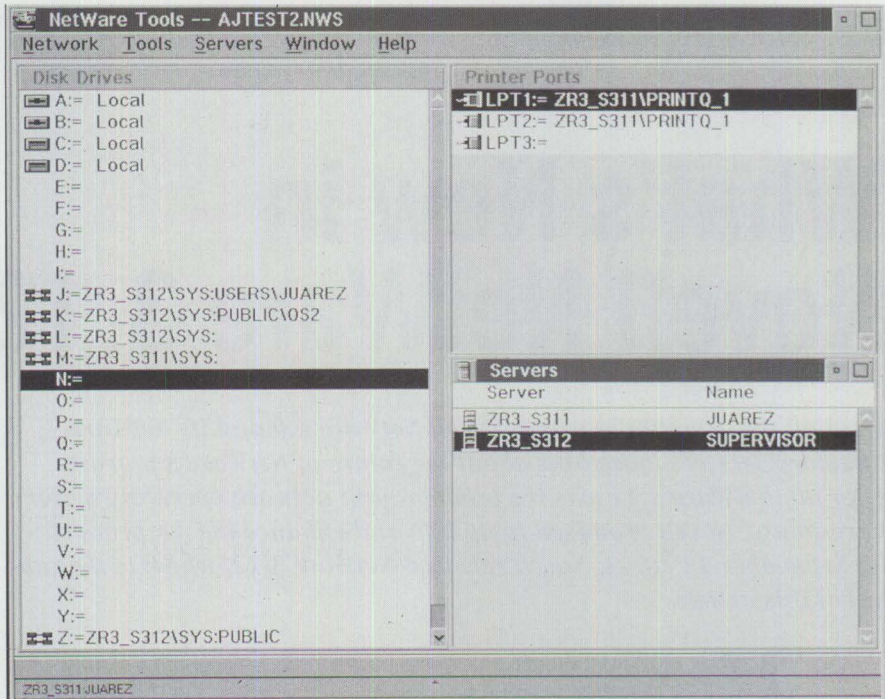


Figure 14. NWTOOLS.EXE Window

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What's New in Novell NetWare 3.12?

Amid all the attention given to Novell NetWare 4.0 and its NetWare Directory Services, questions about the future of NetWare 3.x arose. After all, NetWare 3.11 was the predominant network operating system. In response, Novell promised to update and enhance the 3.x product. On September 13, 1993, Novell released NetWare 3.12, which is the subject of this article.

How did Novell enhance NetWare 3.x when they released NetWare 3.12? They introduced several new and updated features, and they brought some technologies across from their larger system, NetWare 4.01. Highlights of the new features in NetWare 3.12 follow.

NetWare for Macintosh Is Included

To support Macintosh* workgroups within NetWare 3.12 environments, NetWare 3.12 includes a five-user NetWare for Macintosh 3.12 license at no additional cost. (Previously, it was sold separately.) Although Macintosh connectivity is not new to NetWare, NetWare for Macintosh 3.12 is a new version.

NetWare for Macintosh 3.12 comes with a new set of Macintosh-based utilities that allow system administrators to perform most network administration functions from the

Macintosh. Users needing more than five Macintosh connec-

Steven H. Bumgarner
IBM Corporation
Roanoke, Texas

tions can purchase an optional 200-user version of NetWare for Macintosh.

Basic MHS Is Included

NetWare 3.12 includes Basic Message Handling Service (MHS), a NetWare loadable module (NLM)-based NetWare MHS engine. Although MHS is not new to NetWare, this is the first time MHS support has been bundled with the network operating system.

Basic MHS locally delivers MHS messages for applications such as electronic mail, fax services, forms processing, and workflow automation among the users on a single NetWare server. When messaging needs grow beyond the capabilities of a single server or when users need messaging connectivity to other MHS servers or non-MHS environments (such as simple mail transfer protocol [SMTP], systems network architecture distribution services [SNADS], and X.400), they can upgrade Basic MHS to NetWare Global MHS.

FirstMail E-Mail Is Included

Basic MHS is accompanied by a starter e-mail application, FirstMail*, which gives



DOS and Macintosh users immediate access to the messaging services. OS/2 and UNIX users are not included, although OS/2 users can take advantage of the built-in virtual DOS support in OS/2. Basic MHS and FirstMail provide basic messaging functions on a single-server system and work best with 25 or fewer users.

A New Version of NetWare Btrieve Is Included

Btrieve* 6.1 is Novell's industry-standard, key-indexed record manager. Btrieve 6.1 offers significant performance improvements over previous versions, due to its new file format and improved caching algorithms. Another new feature is online file backup, which enables backups to be done while files are in use. Also, concurrent transactions that permit one or more applications to run multiple transactions simultaneously for the same file are now possible.

CD-ROM Installation Option

Anyone who has previously spent hours shuffling diskettes to install a NetWare file server will appreciate the speed and simplicity of CD-ROM installation with NetWare 3.12.

In addition, NetWare 3.12 supports CD-ROM drives and can mount CDs as NetWare volumes, so that once the installation is complete, the CD still has a useful purpose. Here are two good uses of the NetWare 3.12 CD after installation:

- In a multi-server network, you might not have a CD-ROM drive for every file server. You could move the CD-ROM and its small computer system interface (SCSI) controller from server to server, or you could mount the NetWare 3.12 installation CD on your first server, making the CD-ROM accessible as a network drive.

NetWare 3.12 can optionally install from a network drive. You can even install multiple file servers simultaneously across the network. If you choose this method of installation, remember that each server requires its own unique license disk, which comes in the NetWare 3.12 package.

- The CD-ROM installation option also includes a complete set of documentation in Novell's new ElectroText*

electronic format. Therefore, you can mount the CD as a volume and allow users to access the electronic documentation without using an enormous amount of hard-disk space.

First implemented in NetWare 4.0, all of these CD-ROM features are new to the NetWare 3.x environment in version 3.12.

New Universal NetWare Client

NetWare 3.12 users are offered a choice of implementing either the new Virtual Loadable Module (VLM) DOS Requester architecture or an updated version of the NETX DOS Shell and Open Datalink Interface (ODI) client architecture. All VLM, NETX, and ODI client drivers are included.

First introduced in NetWare 4.0, VLMs standardize the client software across DOS and Microsoft Windows desktops, providing support for enhanced client services in NetWare 3.12 and NetWare 4.01

*NetWare 3.12 supports
CD-ROM drives and can
mount CDs as
NetWare volumes. . .*

environments. VLM technology also moves more functions to high memory, thus increasing the conventional memory available for application support.

The NetWare 3.x shell, NETX, works as a front end for DOS, intercepting user and application requests before they reach DOS. NETX determines whether to handle the request and redirect it to a network server or to pass it to DOS. With its backward compatibility, NETX supports applications that may not have been tested for compatibility with the new VLM client architecture.

The ODI Client provides flexibility by supporting multiple transport protocols using a single network board. Since the ODI drivers are modular in design, you can easily update them. You can also make changes to the transport protocols without rebooting the workstation.

NetWare 3.12 also includes the latest OS/2 Requester 2.01 plus improved support for the extended file attributes of OS/2.

You can implement the new VLMs, the latest NETX, ODI client drivers, and OS/2 Requester 2.01 in your existing NetWare 3.11 servers.

All of these software products are available from NetWare, Novell's electronic bulletin board service. For more information about NetWare subscriptions, contact CompuServe* at (800) 848-8199 within the USA; outside the USA, call (614) 457-0802.

Other Improvements in NetWare 3.12

NetWare 3.12 inherits all the previous features and capabilities built into NetWare 3.11, including compatibility with existing NLMs from both Novell and third parties. Migration from NetWare 3.11 to NetWare 3.12 is seamless—NetWare 3.11 NLMs written using Novell's published application program interfaces (APIs) will run on NetWare 3.12.

NetWare 3.12 has been updated with Novell and third-party LAN and disk drivers. All LAN and disk drivers previously included in NetWare 3.11 or available from NetWare have been updated to their latest versions and included in NetWare 3.12. In addition, more than 50 new third-party device drivers are included.

In NetWare 3.12, Novell has changed the default frame type for Ethernet networks from Ethernet 802.3 Raw Frame to the IEEE* Ethernet 802.2 Frame. This means your users may not be able to access your new server after installation. You will need to change either the workstations to IEEE 802.2 or your new server to 802.3 Raw.

I recommend that you update your existing servers and workstations to IEEE 802.2. By making this change, you will use an industry-standard frame type, support multiple protocols with a single frame type, improve reliability, and increase performance of internet packet exchange (IPX) packets when bridging LAN segments.

NetWare 3.12 also incorporates all the previously available performance enhancements, updates, and new utilities.

Since the initial release of NetWare 3.11, a number of performance improvements, notably support for packet burst and large internet packets, have been added to the product. Such enhancements had previously been available via NetWare or through Novell's After-Market Products group. NetWare 3.12 includes all these enhancements, in addition to a number of updated utilities, plus support for CD-ROM volumes.

System and License Requirements

NetWare 3.12 requires at least 6 MB of RAM and 15 MB of hard-disk space. If you decide to implement the electronic documentation without mounting the CD-ROM, you will need an additional 25 MB of hard-disk space. This makes the CD-ROM even more valuable. Hard-copy manuals are available from Novell resellers for an additional charge.

NetWare 3.12 is available in 5-, 10-, 25-, 50-, 100-, and 250-user configurations from Novell resellers (there is no longer a 20-user version as with NetWare 3.11).

NetWare 3.12 Attracts 2.x Users

NetWare 3.12 gives NetWare 2.x users who have been waiting to upgrade to NetWare 3.x the incentive to do so now, by offering new features and advanced network services not currently available in the NetWare 2.x environment.

NetWare 3.12 is a good candidate for new customers who are looking for a powerful network operating system but who do not require the expanded enterprise and management features of NetWare 4.01. Even if you just need an additional server, NetWare 3.12 will fit nicely into your existing array of NetWare 3.11 servers.

In NetWare 3.12, Novell has implemented some technologies that were developed for NetWare 4.0. However, NetWare 3.12 does not include disk compression and suballocation blocks, which are features of NetWare 4.01. All told, in NetWare 3.12, Novell added functionality, increased performance, enhanced ease of use, and maintained compatibility with NetWare 3.11—without increasing the price.



Steven H. Bumgarner is an Advisory Marketing Support Representative and Enterprise CNE in IBM's Workgroup LAN Systems Support and Services organization in Roanoke, Texas. He provides technical support and consulting services for NetWare from IBM products. Steven has worked with and taught classes on Novell products for seven years and has been involved with local area networks at IBM since he was hired in 1979.



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LAN Analysis Using IBM's Data g LANce Network Analyzer

Far from being just troubleshooting devices, network analyzers provide invaluable information for getting the most out of your network while avoiding trouble. With a top-of-the-line network analyzer, you can perform an amazing number of networking functions without investing in the skills of a network analyst.

This article highlights ways to use the IBM Data g LANce Network Analyzer for Ethernet and Token-Ring to bridge the gap between you and your network by locating network hot spots, monitoring performance, isolating problems, and preparing for the future.*

When local area networks (LANs) run smoothly, we usually take them for granted, but when things go wrong—help! An increasing percentage of our work depends on LANs; if they stop working, so do we. That is why it is very important to invest time up front to understand and record how your network functions when things are running smoothly. Then you will be better prepared to avert problems or, if necessary, react when disaster strikes.

Baselining

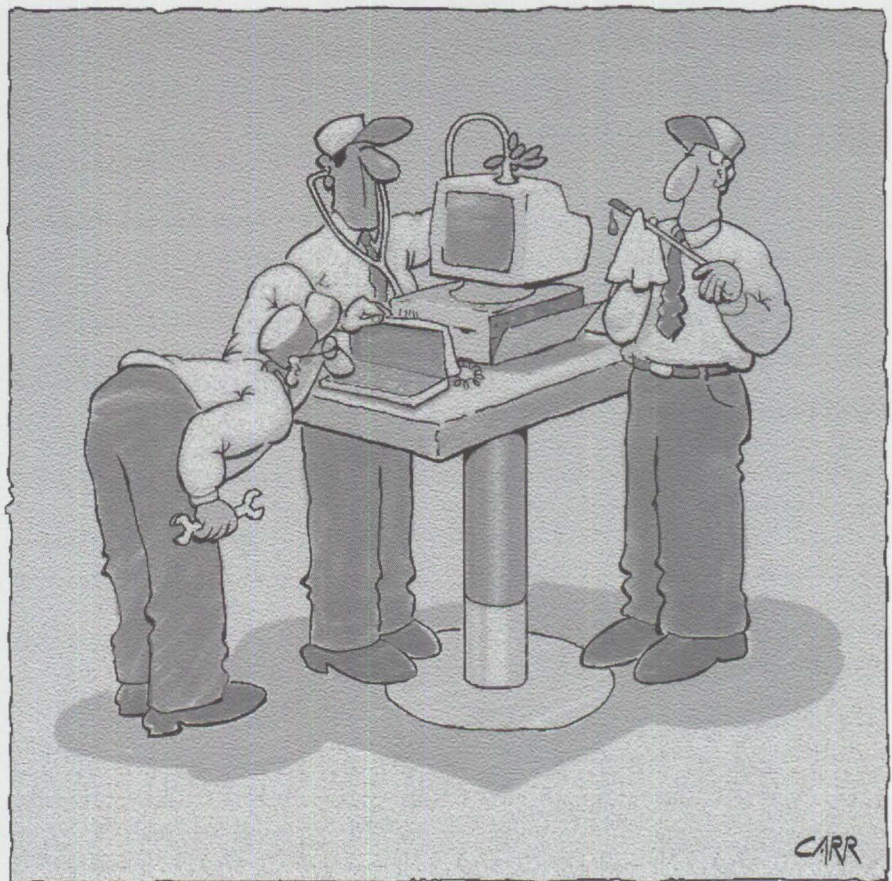
Baseline is a sports term that lately has been used in discussions about quality. Its traditional meaning is simple: a baseline represents a boundary within which the game is played. In the world of quality, it refers to

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North Carolina

measuring what is happening now, so you can measure how well you improve over time. In other words, a baseline simply serves as a point of reference against which you can make future measurements. With networks, baselining makes a record of what is normal, so when things go wrong, you can locate the problem just by looking for differences. The analogy of a car's dashboard can help explain.

The dashboard of a car contains a number of status indicators—speed, temperature, oil pressure, mileage, fuel levels, and battery charge. Similarly, network analyzers keep track of key performance and status conditions. The following conditions can prove invaluable in baselining:

- *Utilization*: the fraction of the total network capacity being used.
- *Frame Rate*: the number of messages per second appearing on the network.
- *Error Rate*: the number of garbled messages (or messages reporting errors) per unit of time detected on the network.



```

Sample Interval   : 5 minutes
Start Recording At: 7:00 AM on the desired day
Samples to Record : 288 (one day)
File Name        : BASELINE
File Format       : Text with delimited fields

```

```

Selected statistics for recording
All Frames       : Frame, Byte, Utilization,
                  and All error types
Broadcast Frame: Frame

```

Figure 1. History Statistics

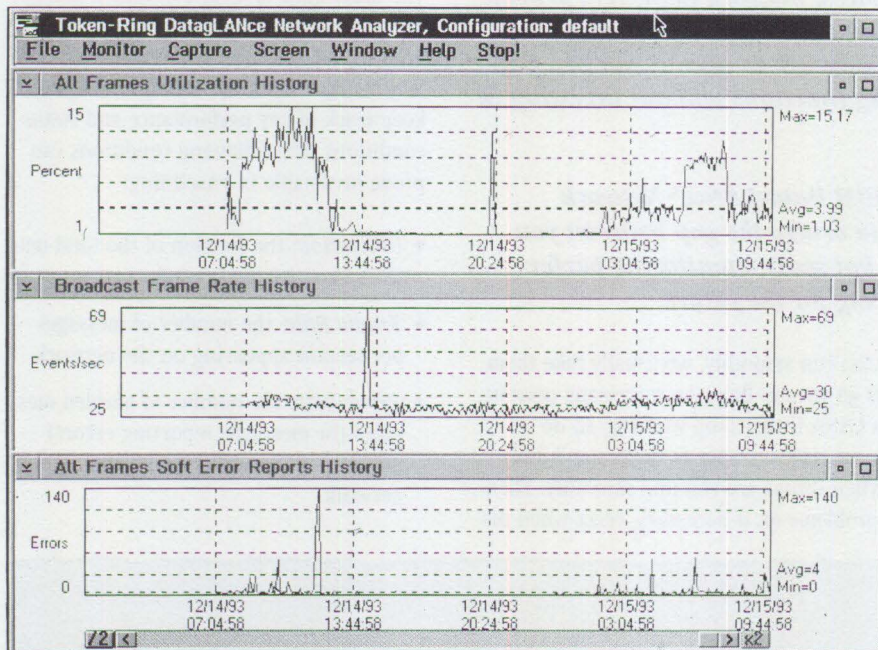


Figure 2. DatagLANce History Graphs

- **Broadcast Frame Rate:** the number of special messages per second that are addressed (using Group Address FFFFFFFF) to each member of the network.

The first step in establishing a baseline is collecting all this information. Simply connect your network analyzer to the LAN you want to measure, and set it up to monitor performance. Pick a full 24-hour day when you expect network loading and errors to be typical of normal operation. Armed with this data, you can answer these questions:

- What is the average value we can expect to see for each of these statistics?
- When are these values highest?
- When are they lowest?

By combining a familiar graphical user interface with pre-defined functions, impressive underlying power, and accuracy, the IBM DatagLANce Network Analyzer makes this baselining job easy. So grab your DatagLANce tool, and let's get started!

First, launch an Ethernet or token-ring DatagLANce session appropriate to your network's type. To launch the session, click on the Default Configuration icon in the "DatagLANce Network Analyzer - Icon View" window for your network type, either Ethernet or token-ring. The default configuration contains pre-defined settings useful to the baselining process.

Next, from the Monitor menu (located on the second line of the screen in the main menu bar), select History Statistics, then fill in the parameters shown in Figure 1.

Now, return to the main screen and select Go! from the main menu bar. DatagLANce will automatically collect the selected data over the time interval you specified.

Once you have completed this simple step, you can breathe more easily. If disaster strikes, you now have a reference.

Figure 2 shows an example of DatagLANce history graphs.

Besides its value in damage control, this baseline information can serve as a basis for performing the following functions:

- **Network Planning.** Subsequent history recordings that indicate usage growth could point the way to orderly network expansion.
- **Broadcast Control.** Sometimes broadcast frames can tie up a network. LANs improperly linked can experience an out-of-control condition called *broadcast storms*. If you see a drop in network performance and an increase in broadcast traffic, make sure your LAN bridges are properly configured.
- **Error Monitoring.** If you see a jump in error rates, check your connections, hubs, and individual adapters. Errors degrade performance because bad messages must be retransmitted, thus multiplying the amount of traffic on the network. By noting when the error rate rises, you have a clue for isolating the problem.
- **Alarm tuning.** Once you know the bounds of your network performance, you can instruct your DatagLANce analyzer to alert you when network performance deviates from those limits. You will be notified when high utilization or broadcast storms occur.
- **Scheduling.** Knowing when low usage occurs can help you get the most from your network while affecting users the least. Schedule your daily high-traffic maintenance operations during low usage periods. Also, back up your server during network lulls.

Finding Most-Used Protocols and Primary Users

Just as baselining performance statistics painlessly brings you a wealth of general information about your network, the DatagLANce Traffic Analysis option

automatically gathers the specifics about the sources contributing to these statistics.

The performance baseline will indicate a particular time of day when the frame rate reaches a maximum. By monitoring traffic during this peak time, you can home in on the sources of that traffic.

This time, from the *DatagLANce* Monitor menu, select Traffic Statistics Options and enter the information shown in Figure 3.

Once you return to the main menu and select Go!, the analyzer is primed to capture traffic data during the peak period you specified. You can dynamically view the data being gathered by selecting Traffic Statistics from the Window item in the main menu. Figure 4 contains an example, taken from our network, of traffic statistics sorted by protocol usage.

Until you use something, you may not really appreciate its elegance. That is how the subtle power of the *DatagLANce* Traffic Analysis display works. You can display a wide range of statistical data. Then you have many choices for sorting, based on any one of the data items. You can move instantly from top talkers to top listeners, to top error sources, and more.

By selecting the Traffic Statistics Display option Traffic from Both and the Sort Option Frames, you will see the relative activity of all stations on the LAN. The traffic window can display local low-level Data Link Control (DLC) addresses, network addresses, and symbolic names for each station pair. It can also display the protocols used by each user pair. This arrangement immediately answers two important questions:

- Which user pairs are most active?
- Which protocols are they using?

Now, let's find the top talkers and top listeners on the LAN. To do this, return to the Traffic Statistics Options menu, and change from Protocol Matrix to Single Station. The Single Station option accumulates statistics for traffic to and from each station, rather than between station pairs. Now, by displaying Traffic from Station and Traffic to Station, you can see top talkers and top listeners respectively. You can then change your selection to sort on Errors to pinpoint any problem areas.

| | | |
|--------------------|---|-------------------------|
| Traffic Statistics | : | Enable |
| Table Entries | : | 2043 |
| Start | : | Time peak period begins |
| Stop | : | Time peak period ends |
| Process Priority | : | Time Critical |
| Analysis Type | : | Protocol Matrix |

Figure 3. Traffic Statistics Options

| Major Prot | Minor Prot | Station | Partner | Frames | Bytes |
|------------|------------|-------------------|-------------------|--------|-------|
| TCPIP | UDP | 9.67.195.15 | 9.67.195.43 | 17618 | 47921 |
| TCPIP | TCP | 9.67.192.81 | 9.67.193.36 | 7596 | 17379 |
| TCPIP | DNS | 9.67.194.20 | 9.67.1.5 | 6380 | 7368 |
| TCPIP | TCP | 9.67.194.24 | 9.67.194.30 | 4764 | 18017 |
| TCPIP | UDP | 9.67.195.41 | 9.67.195.15 | 4248 | 20344 |
| NETB | NETB | 40:00:7D:43:FF:82 | NetBIOS | 3884 | 9339 |
| NETB | NETB | 40:00:7D:43:FF:76 | NetBIOS | 3803 | 3230 |
| TCPIP | UDP | 9.67.195.43 | 9.67.195.15 | 3593 | 6519 |
| TCPIP | DNS | 9.67.194.24 | 9.67.1.5 | 3341 | 3800 |
| NETB | NETB | 40:00:7D:43:FD:7E | NetBIOS | 3056 | 2531 |
| TCPIP | TCP | 9.67.192.87 | 9.67.192.71 | 2869 | 8109 |
| TCPIP | UDP | 9.67.195.15 | 9.67.195.41 | 2591 | 38091 |
| NETB | NETB | 40:00:7D:43:FE:6F | NetBIOS | 2349 | 2021 |
| NETB | NETB | 10:00:5A:EA:B4:F8 | NetBIOS | 2319 | 1838 |
| TCPIP | DNS | 9.67.194.18 | 9.67.192.3 | 2080 | 2391 |
| TCPIP | DNS | 9.67.193.177 | 9.67.192.3 | 2011 | 2331 |
| NETB | NETB | 40:00:7D:43:FE:80 | NetBIOS | 1900 | 1578 |
| NETB | NETB | 40:00:7D:43:F8:A9 | NetBIOS | 1827 | 1518 |
| DLC | BPDO | 10:00:5A:4D:40:C2 | 80.01.43.00.00.00 | 1825 | 1329 |
| NETB | NETB | 40:00:7D:43:F8:E2 | NetBIOS | 1818 | 1544 |
| TCPIP | UDP | 9.67.195.15 | 9.67.195.43 | 1802 | 23684 |
| NETB | NETB | 40:00:7D:43:F8:AE | NetBIOS | 1800 | 1717 |
| TCPIP | UDP | 9.67.195.41 | 9.67.195.15 | 1793 | 3421 |
| TCPIP | UDP | 9.67.192.87 | 9.67.194.156 | 1773 | 6734 |
| TCPIP | DNS | 9.67.194.62 | 9.67.192.3 | 1653 | 1954 |
| NETB | SMB | 40:00:7D:43:FF:A4 | NetBIOS | 1619 | 3287 |
| TCPIP | TCP | 9.67.195.13 | 9.67.8.109 | 1620 | 9669 |

Figure 4: Protocol Matrix Traffic

Next, take the list of most active protocols and insert them into the real-time graphical display section of the analyzer to observe their relative usage over time. The easiest way to do this is to load the Protocol Suite Distribution *DatagLANce* configuration, found in the File menu accessed from the main menu bar. Then, just modify the monitored protocol suites to include the ones you found most active.

You can even use this configuration to display protocol usage within a protocol suite—such as transmission control protocol/internet protocol (TCP/IP), which is used by File Transfer Protocol (FTP), Telnet, and other network applications, or user datagram protocol/internet protocol (UDP/IP), which is used by Network File Server (NFS) and other network applications—to determine the percentage of all traffic represented by these protocols. The resulting display distributes selected protocol suites in bar chart form, as shown in Figure 5.

With this expanded arsenal of information, you can now tackle these problems:

- **Resource Utilization.** How well are shared resources used? If a server resides on one LAN, but most usage comes from another, maybe the server should be moved. If a shared device on one LAN shows low usage, but one of the same type has high demand on another, consider moving the most active users of the device to the LAN with greater capacity.
- **Network Tuning.** By knowing which protocols appear on your network, you can investigate whether undesirable traffic exists and take action to eliminate it. For example, some protocols create a lot of broadcast traffic to locate network resources. By identifying these protocols, you can identify the need for bridge filters or routers to minimize the impact on other LAN segments.

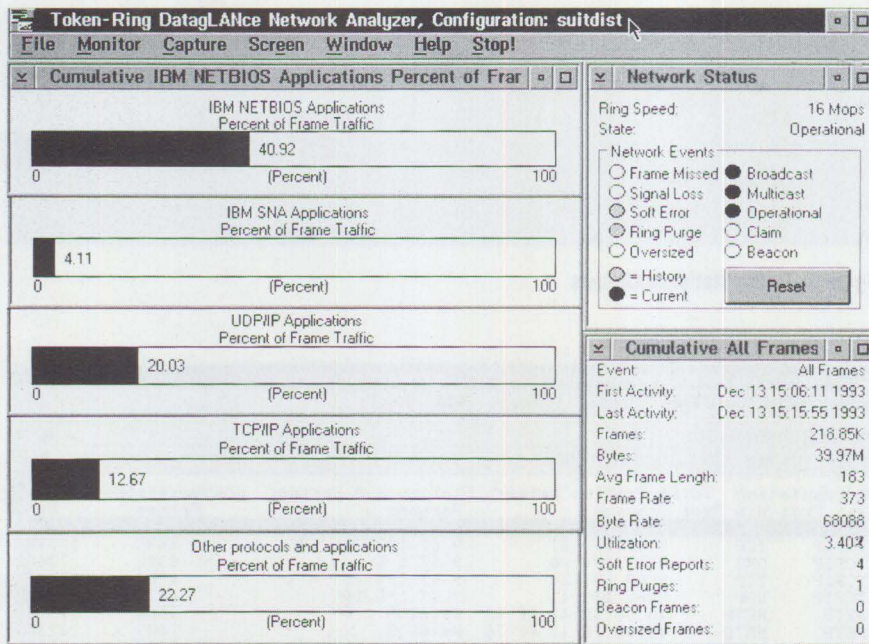


Figure 5. Protocol Suite Distribution

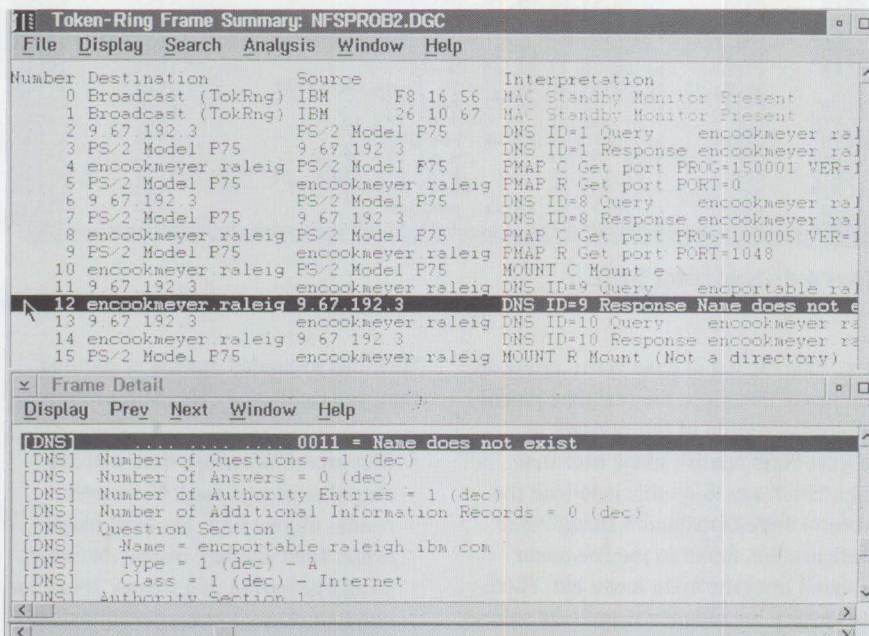


Figure 6. Frame Detail Protocol View

- **Error Isolation.** From the error traffic display, read the addresses of the stations that are reporting and receiving most of the errors. Based on the physical locations of these devices, start troubleshooting to isolate the problems to faulty cables, adapters, connection devices, or other physical or software-based problems. Use the divide-and-conquer approach to remove offending members.

Troubleshooting Using Protocol Analysis

We began our journey into LAN analysis at a high level, identifying network performance based on the sum of all traffic. We then proceeded to isolate performance data based on specific stations and protocols. In this final phase, we leave the world of performance measures to tiptoe around the vast sea associated with network messages. While the knowledge level required to navigate in this world is

significant, the DatagLANce analyzer gives enough help to enable most of us to get our feet wet.

If you have trouble connecting to a file server, if you experience sluggish network response time, or if you are plagued by lost sessions between your workstation and the host computer, look to your protocol analyzer to help you understand why. Powerful functions integrated into the DatagLANce Network Analyzer can capture specific communication among selected devices and store it for analysis. In addition, the time of capture can be set to wait for specific events or error conditions that supply fully decoded views of what happened before, during, and after things went wrong.

A Real-Life Example

To better understand the value of limited protocol analysis, consider this real-life example. Recently, we needed to configure a PS/2 Model 95 as an NFS server and a PS/2 Model P75 as a client. Using the IBM TCP/IP for OS/2 software, we installed and configured NFS and TCP/IP on both machines, obtained an authorized network address for the P75, and configured TCP/IP accordingly.

Next, we tried to “mount” a disk drive from the network to give the P75 local access to it. This attempt failed. We rechecked the NFS software installation, verified proper usage of the mount command, and tried again. No luck. It was time to call in the big guns—after all, we designed the DatagLANce tool!

After setting up DatagLANce to capture frames to and from the P75’s physical adapter address (10:00:5A:26:10:67), we examined the result. It showed that the P75 had requested the IP network address for encookmeyer.raleigh.ibm.com (which resides on the Model 95) from the domain name server identified by IP address 9.67.192.3. That server responded with the requested IP address. However, when the P75 attempted to perform the mount function, the new NFS server (the Model 95) responded with an error.

To get more information about what was happening in the Model 95, we launched a second capture, this time including its physical adapter address (10:00:5A:f8:16:56) as well. The result of this capture appears in Figure 6.

In Figure 6, frame 12 shows the NFS server asking the domain name server for the IP network address of `encportable.raleigh.ibm.com`, which resides on the P75. The domain name server then responds, in frame 13, that the name does not exist. Since the NFS server could not validate the IP address of the P75, the NFS server disallowed the P75's request to mount a disk drive. Investigation verified that the domain name server had not yet been updated with the authorized network address for the P75. As soon as the network administrator updated the domain name server with the new address, the problem was fixed.

Although many networking problems need much greater analysis and knowledge to resolve, there still exists a whole class of problems, like the one just described, that only need a closer look at communication among the network members experiencing problems. By determining the stations involved and setting up

the *DatagLANce* Network Analyzer to reveal their interaction, you can isolate, and maybe solve, many similar problems.

Keeping the Pulse of Your Network

Today's network analyzer can make an important contribution to the daily health of your LAN. With its graphical user interface, flexibility, accuracy, and power, the *DatagLANce* Network Analyzer for Ethernet and Token-Ring brings a unique combination of function within the grasp of users whose networking skills vary widely. By applying these functions to your LAN, you can keep up with the pulse of your network, solve problems, optimize performance, and intelligently plan for the future.

For more information on *DatagLANce* products, please call our *DatagLANce* hotline at (919) 254-1264 or fax your request to (919) 254-0984.



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Little Solutions

NetWare Remote Management Facility for OS/2

While browsing through my NetWare 4.01 and NetWare 3.12 file servers, I noticed that there was no OS/2 Presentation Manager (PM)-based version of the DOS utility `RCONSOLE.EXE`. After doing a bit of searching, I located a NetWare file that does the same thing as `RCONSOLE.EXE`; that is, it lets you see the file server's console screen at a workstation and enter commands from that workstation.

A compressed file called `OS2UTI.EXE` resides on CompuServe, in NOVLIB forum, Library 6 (NetWare Utilities). This file contains OS/2 utilities for all versions of OS/2 Requester. It also fixes the problem in which a user cannot log in to a network between 12 noon and 1 p.m.

In `OS2UTI.EXE`, there is a utility called `REMOCON.EXE`, which is the OS/2 PM version of the DOS `RCONSOLE.EXE` NetWare utility. Normally, to see the console, you have to go to the file server and look at its monitor. `REMOCON` provides the same remote workstation capability for OS/2 servers that `RCONSOLE.EXE` provides for DOS servers.

Figure 1 shows a NetWare file server's console screen using `REMOCON.EXE` in an OS/2 PM session.

The initial screen (Figure 2) lets you see a list of servers to which you can connect.

Once you select a file server, the `REMOCON` utility asks you for a password. After you enter your password, `REMOCON` completes the connection, then shows you the screen that is currently on the server console. In the upper menu bar, under Options, `REMOCON` offers these options: Change Screen, Directory Scan, Turn Sound On/Off, and Exit. Change Screen is equivalent to the `Alt + Esc` hot key used in the file server's console screen. This function allows you to switch between NetWare loadable module (NLM) screens such as

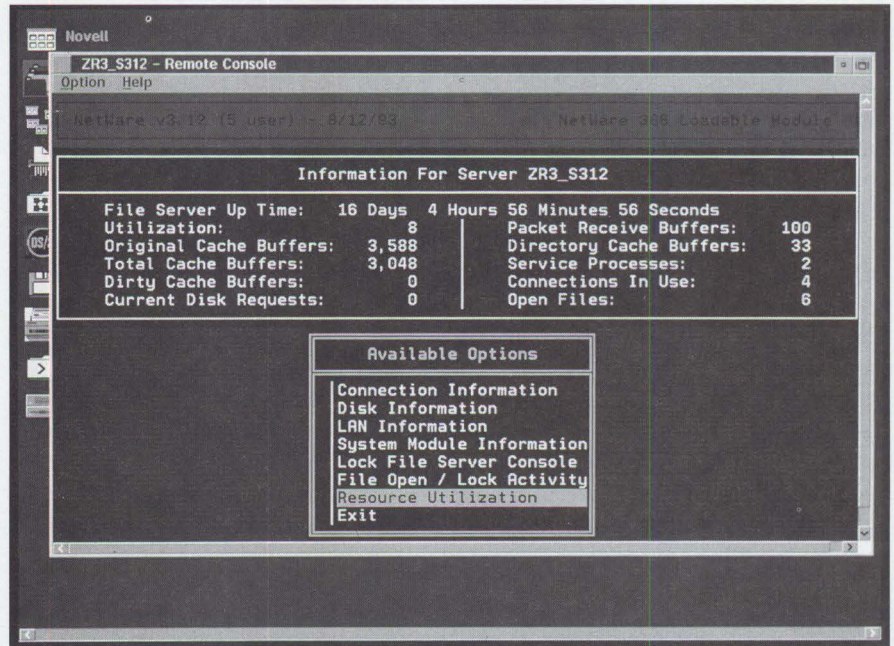


Figure 1. OS/2 Remote Console Utility as an OS/2 PM Screen

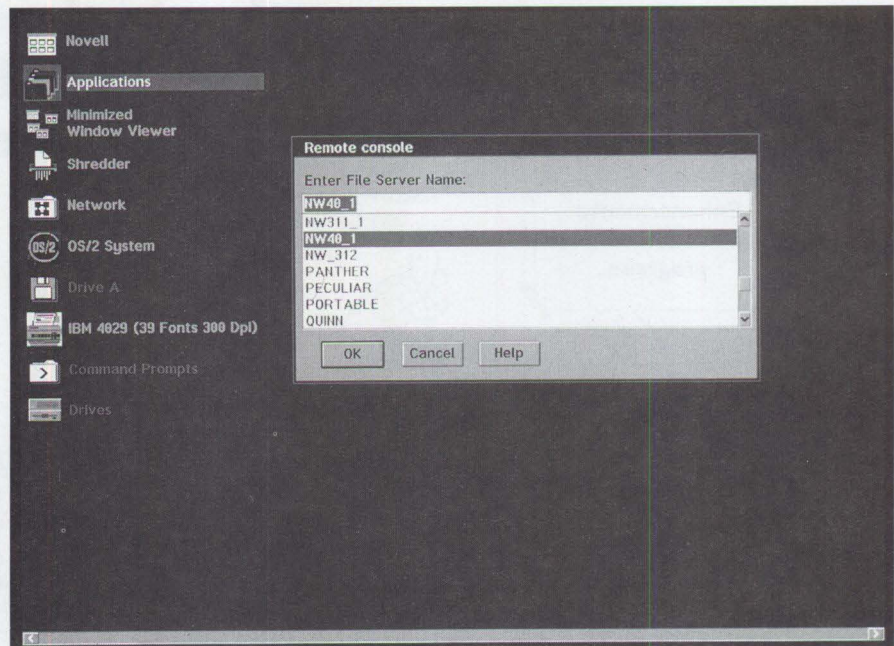


Figure 2. Initial Screen for Remote Console Utility

monitor and the console prompt screen. Directory Scan lets you scan all NetWare volumes and directories, plus the file server's local drive.

You can also use the `+` and `-` keys on the numeric keypad to switch back and forth between console screens. Doing this is equivalent to using the `Alt + Esc` keys.

REMOCON.EXE communicates with the NetWare servers using the standard Remote Management Facility (RMF) NLMs included with NetWare 3.11, 3.12, 4.0, and 4.01. The NLMs are REMOTE.NLM (the NetWare Remote Console, where the remote password is established) and RSPX.NLM (remote SPX driver).

— Albert Juarez, IBM Personal Systems Competency Center, Roanoke TX

NetWare Requester for OS/2 2.01 Utilities Missing After Installation

You may have noticed that the files MAP, LOGIN, CX, NPRINT, and NLIST are missing from your C:\NETWARE directory after you install NetWare Requester for OS/2 2.01. This occurs only if you create the NetWare Requester for OS/2 2.01 diskettes from the NetWare 4.01 CD-ROM. The solution is to copy these files manually from the SYS:PUBLIC\OS2 subdirectory. If you purchased the NetWare Client Kit for OS/2 2.01 and installed from it, you will have these files.

— Albert Juarez, IBM Personal Systems Competency Center, Roanoke TX

Don't Lose Your Customized Desktop

Don't lose your customized desktop! Back up your INI files automatically every time you boot your OS/2 system!

We recommend that you keep copies of the three latest versions of your OS2.INI and OS2SYS.INI files. The Workplace Shell uses these files to store your customized desktop. If these files become corrupted, you'll lose all the changes you made to the desktop. Keeping backup copies of these files ensures that you can restore the latest version of your desktop should the INI files become corrupted.

How can your INI files become corrupted? One of the most common ways is when you fail to shut down your system in an orderly way. OS/2 needs to update these files before the power is turned off. Without an orderly shutdown, these files are not updated. Power surges, hardware problems, and improper INI updates by applications or by OS/2 can also damage your INI files.

Back Up Your INI Files

There are several ways to back up and restore these INI files to avoid losing your customized desktop. The example below explains how to back up the OS2.INI and the OS2SYS.INI files at boot time by calling a batch program from the CONFIG.SYS to execute before the Workplace Shell is initialized. The three most current versions of these INI files are kept in a directory structure that you create.

Before you execute this batch file for the first time, you must create the directory structure needed to store the backed up files. To do this, issue the following commands from the root directory of the OS/2 boot drive:

```
MD BACKUP
CD BACKUP
MD BACKUP1 BACKUP2 BACKUP3
```

The batch file in Figure 3, SYSBACK.CMD, illustrates how you can use the directory structure above to keep the three most current versions of your OS2.INI and your OS2SYS.INI files.

To call SYSBACK.CMD from your CONFIG.SYS, add the following statement to your CONFIG.SYS:

```
CALL=C:\OS2\CMD.EXE /C
C:\SYSBACK.CMD
```

SYSBACK.CMD copies the three most current versions of the OS2.INI and OS2SYS.INI files to the BACKUP subdirectory and into the appropriately numbered directory. If your INI files do become corrupted, then you need to restore the INI files that are in the BACKUP\BACKUP2 subdirectory. Do not restore the files that are in the BACKUP\BACKUP1 subdirectory because the INI files in BACKUP1 are the ones that were corrupted, then backed up when you booted your system. The uncorrupted INI files will be in the BACKUP2 subdirectory.

It's very important to have three copies of the INI files, because if you reboot your system a second time, the corrupted INI files are copied from BACKUP1 to BACKUP2, and the INI files in the BACKUP2 subdirectory become unusable.

With OS/2 2.1, the INI files are no longer locked and can be copied while OS/2 is running, plus the batch file, SYSBACK.CMD, can be executed from your STARTUP.CMD file rather than from your CONFIG.SYS. With OS/2 2.0, however, the INI files are locked and you must execute SYSBACK.CMD from the CONFIG.SYS.

Note: SYSBACK.CMD can also be used to back up other files such as CONFIG.SYS, AUTOEXEC.BAT, STARTUP.CMD, IBMLAN.INI, NET.ACC, Communications Manager configuration files, etc.

```
REM *****
REM *****          SYSBACK.CMD          *****
REM *****          Backup INI Files          *****
REM *****
REM Set bootdrive equal to the drive that OS/2 is installed
set bootdrive=c:
REM Copy old files to next backup subdirectory
REM to make room for the current copies
xcopy %bootdrive%\backup\backup2\*. * %bootdrive%\backup\backup3
xcopy %bootdrive%\backup\backup1\*. * %bootdrive%\backup\backup2
REM Back up current INI files to BACKUP/BACKUP1 subdirectory
xcopy %bootdrive%\OS2\OS2.INI %bootdrive%\backup\backup1
xcopy %bootdrive%\OS2\OS2SYS.INI %bootdrive%\backup\backup1
```

Figure 3. SYSBACK.CMD Batch File

Restore Your INI Files

If you lose your customized desktop, you must restore the backed up INI files. You cannot replace the INI files once the Workplace Shell has come up and the INI files have been initialized, because the files are in use by the operating system and cannot be written over or deleted. You will, therefore, have to restore these INI files using one of the following methods:

- Boot from diskette or to another operating system on your system if you have Boot Manager installed. Once you have booted your system, copy the OS2.INI and OS2SYS.INI files from your BACKUP2 subdirectory to the OS2 subdirectory. Reboot your system to restore your desktop.
- Rename the INI files to something like OS21.INI and OS2SYS1.INI, then copy the INI files from the BACKUP2 subdirectory into the OS2 subdirectory. Edit the SET USER_INI= and SET SYSTEM_INI= statements in your CONFIG.SYS to point to the new INI files. Reboot your system to restore your desktop.
- Embed the following statement in your CONFIG.SYS to bring up an OS/2 full screen prompt before your desktop is initialized:

```
call=c:\OS2\CMD.EXE
```

Once this statement is in your CONFIG.SYS and you reboot your system, an OS/2 full screen prompt will become active before the INI files are initialized. Since the INI files have not been initialized and are not yet in use by the operating system, you can copy the backed up INI files to the OS2 subdirectory. Once the INI files have been copied, type EXIT and press Enter. Your system will continue the boot process to a restored desktop. After OS/2 is booted, edit the CONFIG.SYS and remove the above statement so you will not have to manually exit the OS/2 full screen during each boot.

- Copy the OS2.INI and OS2SYS.INI files from the BACKUP\BACKUP2 subdirectory into the OS2\INSTALL subdirectory. Once you have copied these files, reboot your system. When you see the OS/2 logo screen with a black background, press Alt+F1. Hold the keys

down until you hear a rapid succession of beeps. This renames the OS2.INI and OS2SYS.INI files in the OS2 subdirectory and copies the files from the OS2\INSTALL subdirectory to the OS2 subdirectory, where they are used when the Workplace Shell is initialized.

Note that these are not the only files that are renamed and replaced by files in the OS2\INSTALL subdirectory when you use the Alt+F1 method. The CONFIG.SYS file is renamed and replaced by the CONFIG.SYS file in the OS2\INSTALL subdirectory. If you have not replaced the CONFIG.SYS in the OS2\INSTALL subdirectory with a current one like you did with the OS2.INI and OS2SYS.INI files, you will get a CONFIG.SYS that does not reflect the changes you made since you installed your system. The STARTUP.CMD file is also renamed when using this method. A STARTUP file is not installed with OS/2; therefore, there is not one to copy over from the OS2\INSTALL subdirectory. The current STARTUP file is renamed but not replaced.

Keeping a current backup of your OS2.INI and OS2SYS.INI can save your customized desktop if your INI files become corrupted. If these files become corrupted, without a backup, the Workplace Shell will not have the information that it needs to reconstruct your customized desktop. Save your customized desktop as well as your time and energy—back up your INI files!

—Tyra Steil, IBM's Personal Systems Competency Center, Roanoke, Texas

Where to Find OS/2 NetWare Utilities for Your NetWare File Server

The OS/2 NetWare Utilities do not ship with NetWare Client Kit for OS/2 2.01. You can find these utilities on CompuServe, in NOVLIB forum, Library 6 (NetWare Utilities). Look for files UT10S2.EXE and UT20S2.EXE. These files contain the utilities that were shipped with the NetWare Client Kit for OS/2 2.0. These utilities work with the NetWare Client Kit version 2.0 and above. Once the NetWare Utilities are installed on a NetWare file server, they can be found in the SYS:SYSTEM\OS2,

SYS:LOGIN\OS2, and SYS:PUBLIC\OS2 directories.

If you have NetWare 3.11, you already have the OS/2 NetWare Utilities 1.3 for your file server. Even though they are not the most current, they still work.

If you have NetWare 3.12, the OS/2 NetWare Utilities are automatically copied from the NetWare 3.12 CD-ROM to your NetWare file server.

If you have NetWare 4.0 or 4.01, you have the option of copying the OS/2 NetWare Utilities to your NetWare file server.

Keep in mind that, in the NetWare Client Kit for OS/2 2.01, RPRINTER.EXE is replaced with NPRINTER.EXE, and SLIST.EXE is replaced with NLIST.EXE. Also, Directory Services Support has been added.

If you are running OS/2 2.1, we recommend that you use the NetWare Requester for OS/2 v2.01.

UT10S2.EXE

UT10S2.EXE is a self-extracting file. From it, a directory called \OS2PUB is extracted. This directory contains files to be copied into the SYS:PUBLIC\OS2 directory on your file server.

Create a directory on your hard disk that has the same name as the self-extracting file: \UT10S2. This directory is temporary and is used for extraction of the files in UT10S2.EXE. The files you extract will occupy over 1.6 MB.

Figure 4 lists the files in UT10S2.EXE.

Use the following steps to install the utilities found in the UT10S2.EXE file:

1. Log in to a NetWare server as supervisor or supervisor-equivalent.
2. Change to the \PUBLIC directory.
3. Type MD\OS2 to create an \OS2 subdirectory in the public directory.
4. Copy the files from the \OS2PUB subdirectory into \PUBLIC\OS2.

UT20S2.EXE

Directories called \OS2LOG, \OS2PUB1, and \OS2SYS are extracted from the

```

\
  UT10S2.TXT (README
    file)
\OS2PUB
  ALLOW.EXE
  ATTACH.EXE
  CAPTURE.EXE
  CAPTURE.MSG
  CASTOFF.EXE
  CASTON.EXE
  CHKDIR.EXE
  CHKVOL.EXE
  DSPSPACE.EXE
  DSPSPACE.HLP
  ENDCAP.EXE
  FILER.EXE
  FILER.HLP
  FLAG.EXE
  FLAGDIR.EXE
  GRANT.EXE
  LISTDIR.EXE
  LOGIN.EXE
  LOGOUT.EXE
  MAKEUSER.EXE
  MAKEUSER.HLP
  MAP.EXE
  NCOPY.EXE
  NDIR.EXE
  NPRINT.EXE
  NVER.EXE
  REMOVE.EXE
  REVOKE.EXE
  RIGHTS.EXE
  TLIST.EXE
  USERDEF.EXE
  USERDEF.HLP
  USERLIST.EXE
  VERSION.EXE
  VOLINFO.EXE
  VOLINFO.HLP
  WHOAMI.EXE

```

Figure 4. Files Contained in UT10S2.EXE

UT20S2.EXE. These directories contain files to be copied into the SYS:LOGIN \OS2, SYS:PUBLIC\OS2, and SYS:SYSTEM\OS2 directories, respectively, on your file server.

As with UT10S2 above, you can create a directory on your hard disk that has the same name as the self-extracting file: \UT20S2. This temporary directory is used for extracting files in UT20S2.EXE. Figure 5 lists the files in UT20S2.EXE.

Use the following steps to install the utilities found in the UT20S2.EXE file:

1. Log in to a NetWare server as supervisor or supervisor-equivalent.
2. Change to the \SYSTEM directory.
3. Type MD\OS2 to create an \OS2 subdirectory in the \SYSTEM directory.
4. Copy the files from the \OS2SYS subdirectory into \SYSTEM\OS2.

```

\
  UT20S2.TXT (README
    file)
\OS2LOG
  ATTACH.EXE
  LOGIN.EXE
  MAP.EXE
  SLIST.EXE
\OS2PUB1
  PCONSOLE.EXE
  PCONSOLE.HLP
  PRINTCON.EXE
  PRINTCON.HLP
  PRINTDEF.EXE
  PRINTDEF.HLP
  PSC.EXE
  PURGE.EXE
  SALVAGE.EXE
  SALVAGE.HLP
  SEND.EXE
  SETPASS.EXE
  SETTTS.EXE
  SLIST.EXE
  SYS$ERR.DAT
  SYS$HELP.DAT
  SYS$MESSG.DAT
  SYSCON.EXE
  SYSCON.HLP
  SYSTIME.EXE
\OS2SYS
  ATOTAL.EXE
  BINDFIX.EXE
  BINDREST.EXE
  PAUDIT.EXE
  SECURITY.EXE

```

Figure 5. Files Contained in UT20S2.EXE

5. Change to the \PUBLIC directory.
6. Type MD\OS2 to create an \OS2 subdirectory in the \PUBLIC directory.
7. Copy the files from the \OS2PUB1 subdirectory into \PUBLIC\OS2.

8. Change to the \LOGIN directory.

9. Type MD\OS2 to create an \OS2 subdirectory in the \LOGIN directory.

10. Copy the files from the \OS2LOG subdirectory into \LOGIN\OS2.

An update for these utilities, called OS2UTI.EXE, is also found on CompuServe, in NOVLIB forum, Library 6 (NetWare Utilities).

— Albert Juarez, IBM Personal Systems Competency Center, Roanoke TX

Redefining the Mouse Drive in OS/2 for Windows

If your DOS-based mouse doesn't work after you install OS/2 for Windows, you simply need to select the OS/2 mouse device driver.

1. Open the OS/2 System folder, choose System Setup, then Selected Installation.
2. Click on Mouse, then click on OK to display a screen of available mouse options.
3. Select the one appropriate for your hardware, then click OK and Install.
4. Reboot your system.

OS/2 2.1: Add Program Objects to Your Pop-Up Menus by Dragging and Dropping Icons

Enhancements to OS/2 2.1 allow you to add program objects to a pop-up menu by dragging and dropping the program object icons onto the menu page in the Settings notebook. The following example shows how to add an OS/2 window to your desktop pop-up menu.

1. Using the right mouse button, open the desktop's Settings notebook by clicking on a blank spot on the desktop.
2. On the pop-up menu, select the boxed arrow next to Open.
3. Click on Settings.
4. When the Settings notebook opens, click on Menu.
5. Drag the OS/2 Window icon onto the list box under Action on the Menu. (Note: The OS/2 Window icon is in the Command Prompts folder, which is inside the OS/2 System folder.)

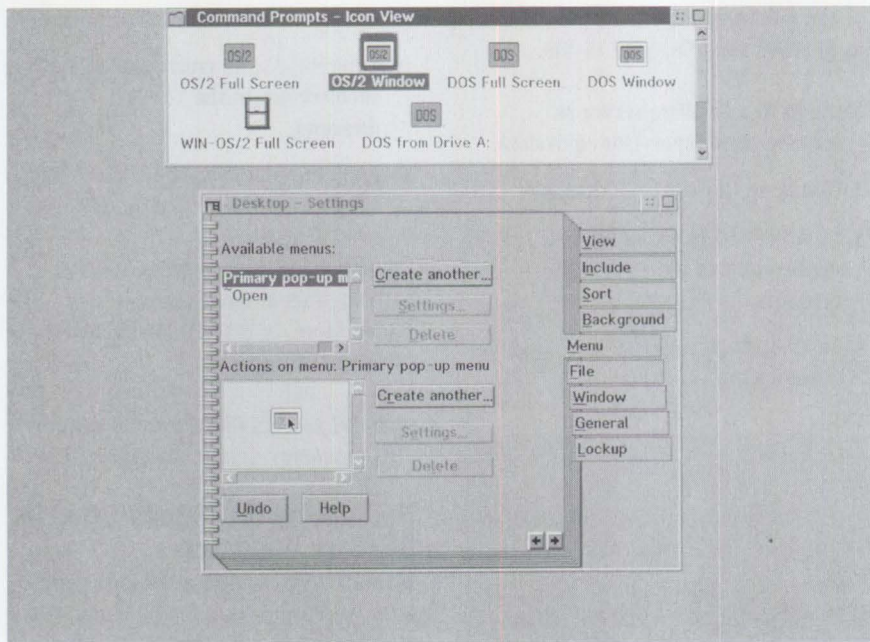


Figure 6. OS/2 Window Icon in Settings Folder

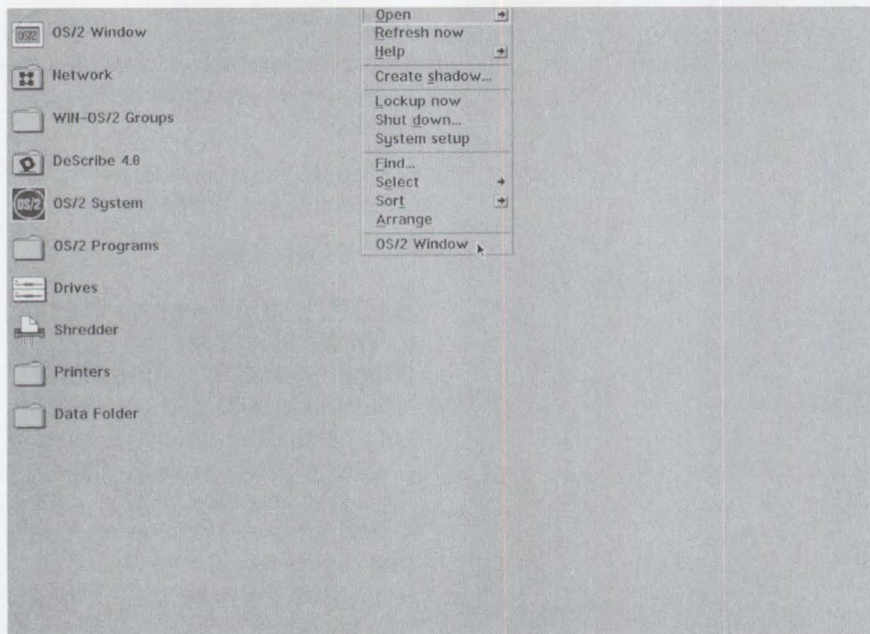


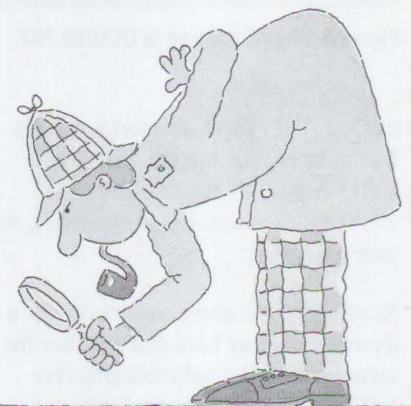
Figure 7. Desktop Pop-Up Menu with OS/2 Window Item

To drag the OS/2 Window icon onto the list box, click on the icon with the right mouse button, holding it down while dragging the icon onto the list box. Then release the mouse button. The OS/2 Window icon now appears in the list box (Figure 6).

After adding the OS/2 Window to the Menu page, you can select it from the desktop's pop-up menu by clicking on the desktop with the right mouse button and selecting OS/2 Window (Figure 7).

You can use this method to add other program objects to the pop-up menus on folders and other objects. This enhancement to OS/2 2.1 makes using the desktop pop-up menus much easier.

—Tyra Steil, IBM's Personal Systems Competency Center, Roanoke, Texas



We invite you to share your "little solutions" in this column. Send them to us in care of the editor.

Questions and Answers

NetWare

We have an application that needs to use software interrupt 5Ch for NetBIOS in a WIN-OS/2 session. The application is in production under DOS using the NetWare NetBIOS emulator. Does the OS/2 NetWare NetBIOS emulator also make the 5Ch interrupt available in a WIN-OS/2 session? If not, would the native OS/2 NetBIOS code (from Network Transport Services/2 or NTS/2) present the 5Ch interrupt in WIN-OS/2 sessions?

The answer to both of your questions is yes. There are two ways to enable NetWare NetBIOS support in WIN-OS/2 and one way to enable "native" NetBIOS support in WIN-OS/2. Since interrupt 5Ch is part of NetBIOS' definition, all of the above methods support it.

Figures B-17 and B-18 on pages B-18 and B-19 of the *NetWare Requester for OS/2 2.0* manual (GG24-3891) show how this is accomplished.

If you do not need IBM NetBIOS, put the following statements in your CONFIG.SYS:

```
DEVICE=C:\IBMCOM\PROTOCOL
\LA NVDD.OS2
DEVICE=C:\IBMCOM\PROTOCOL
\LA NPDD.OS2
DEVICE=C:\IBMCOM\PROTOCOL
\NETBIOS.OS2
DEVICE=C:\NETWARE
\NETBIOS.SYS
RUN=C:\NETWARE\NBDAEMON.EXE
```

If you need IBM NetBIOS, put only the following statement in your CONFIG.SYS:

```
C:\IBMCOM\PROTOCOL\NETBEUI.OS2
```

You must also add statements to your PROTOCOL.INI file. Pages 7-9 of the

NetWare Requester for OS/2 2.0 manual show the exact syntax of the statements. The syntax in this section tells NETBIOS.OS2 which network to send requests.

NetBIOS statements are optional in the NET.CFG if you want to use the defaults. NetBIOS parameters begin on page A-442 of the Requester manual.

Note that the method shown on page B-18 is the easiest to configure. It only requires that you load NETBIOS.EXE in the DOS session and have IPX (internet packet exchange) support for the session; however, the above method will work.

I am trying to update the NetWare Requester files that are on the server, e.g., LOGIN.EXE from the 2.0 version to the 2.01 version. The old requester let me install to the workstation or to the server. That is no longer a choice with the new requester. As a result, files in C:\NETWARE are different from those on the server under SYS:\LOGIN and SYS:\PUBLIC. In addition, MAP.EXE and LOGIN.EXE differ.

How do I update/upgrade the NetWare Requester and other associated files on the server to be the same as those on a 2.01 requester workstation?

No update to the server's software is required. While the new requester does come with newer versions of the utilities, these newer versions are for use on 4.0 servers. While the newer utilities will work on 3.11 servers, you should not install them on 3.11 servers. You should continue to use the ones you have. You do not need to worry that the files in C:\NETWARE are different from those on the server.

Another reason that the new requester does not have the option to install files to

the server is that a 4.0 server comes with the latest OS/2 utilities. These files are installed during server installation.

I am logged into NetWare 3.11 Server 1 and then I attach to NetWare 3.11 Server 2 to map drives on Server 2. Am I using two licenses here, since I am attached to two servers, or just one, since I am logged on to only one server? If Server 2 is a 20-user license version of the software, will the 21st concurrent user be physically blocked from attaching to Server 2?

In a wide area networking scenario, where many people may be accessing many servers across the enterprise, does Novell or IBM sell enterprise or site licenses for NetWare?

If you LOGIN to SERVER1 and ATTACH to SERVER2, you will be using a user connection on both servers (using two licenses). This is because LOGIN and ATTACH are basically the same thing, except that LOGIN runs the LOGIN SCRIPTS for that server while ATTACH does not.

If a user tries to LOGIN or ATTACH to a server with no user connections available, that user will receive a message that no connections are available and will not be able to access the server.

NetWare server operating systems are sold by user version licenses only. They do not come by site or enterprise licenses.

I am installing a NetWare 3.11 Ethernet network. About 85% of my machines are IBM PCs; the rest are Macintoshes. Will I have to install an AppleTalk* network with its cabling separate from my Ethernet? Is there a way to connect Macs to an Ethernet?

There are at least two ways to connect Macs to an Ethernet. AppleTalk-to-Ethernet

routers are available. With EtherTalk, Macs can be attached directly on the Ethernet. Contact Apple* or your Apple dealer for more information.

Which option you choose depends on cost and performance requirements. Putting the Macs directly on the Ethernet would probably offer the best performance; however, you would need an Ethernet adapter for every Mac. Other methods of attachment are available.

We would like to boot a remote, diskless workstation off of a single 1.44 MB diskette, using DOS applications from a NetWare 3.11 server. Two DOS applications on the RIPLed machine must be able to multitask. If LAN Server is introduced to this scenario, could the RIPLed OS/2 machine with one diskette boot off LAN Server and launch two DOS applications off the NetWare server?

To RIPL off LAN Server means to RIPL either OS/2 LAN Requester or DOS LAN Requester. Both OS/2 and DOS LAN Requesters use the NetBIOS protocol while NetWare uses the IPX protocol; therefore, a machine booted from an OS/2 LAN Server could not run applications from a NetWare server. This would require OS/2 LAN Server to RIPL a machine that uses the IPX protocol (e.g., a NetWare requester). LAN Server does not support the RIPLing of a NetWare requester.

I am running OS/2 2.1, and I have just installed NetWare Requester for OS/2 2.01. When I run a WIN-OS/2 session, then run File Manager, all drives slow down. (I do not have all of these drives mapped.) This feature worked correctly in the old version of the NetWare Requester NSD202. Now, when I click on one of the phantom drives, WIN-OS/2 responds with Drive ? does not exist. What is the problem?

It sounds as if you are using a global WIN-OS/2 session. When a session is set to global with the new requester, all of the drives available to OS/2 are passed to WIN-OS/2, regardless of whether they have been previously mapped. If you set NETWARE_RESOURCES to private for the session, then you will only see previously mapped drives. A global session must have

access to all drives so that any drives mapped in OS/2 are available to that session.

What you are seeing is really a reflection of how DOS sessions work in OS/2 (WIN-OS/2 is basically just another virtual DOS machine). It is not a defect in the Requester.

I have purchased two LANStreamer* (token-ring) adapters. When using two adapters, how are they defined to NetWare 3.11? Are two CONFIG.SYS files required? How do I bind them?

The NetWare driver for the LANStreamer adapter is IBMTRDBO.LAN. It's on the diskette that comes with the adapter.

To load and bind both adapters, all you need to know is which slots the adapters are in. You will load the driver twice—once for each adapter—and specify the slot number when it is loaded.

The following example assumes that LAN Streamer will be in slots 2 and 3, the adapter in slot 2 will be on IPX network A2, and the adapter in slot 3 will be on IPX network A3:

```
LOAD IBMTRDBO slot=2 name=
streamer_2
BIND IPX to streamer_2
net=A2
LOAD IBMTRDBO slot=3 name=
streamer_3
BIND IPX TO streamer_3
net=A3
```

Put these statements in the AUTOEXEC.NCF so they are executed every time the server is started.

With the new NetWare Requester 2.01, we have an OS/2 dialog box that pops up at reboot and prompts to LOGIN. The LOGIN works but no LOGIN scripts execute; it seems more like an ATTACH than a LOGIN. How can I keep the dialog box from appearing?

There are two ways to disable this OS/2 2.1 feature:

1. Edit the CONFIG.SYS and remove CONNECTIONS from the SET AUTOSTART= line.

2. Have the user log out before shutting down the workstation. However, this does require user intervention before every shutdown.

This dialog box appears because by default, OS/2 2.1 tries to restart any network connections that were active when the system was shut down. This dialog box performs only an ATTACH to the server. It cannot execute the user's LOGIN script.

Are the new LANStreamer MC32 adapters (token-ring) compatible with NetWare for SAA* 1.3? I would like to use two of them, one for SAA and one for IPX. Is this supported?

The new LANStreamer adapter should be compatible with NetWare for SAA 1.3.

What is the difference between PS2OPT and PS2SCSI? Which is the latest and greatest? Which should I be using on my PS/2* Model 95?

PS2OPT was originally released for PS/2s with embedded SCSI controllers, while PS2SCSI was for all other PS/2s. Recently they were combined into one driver. First it was named PS2SCSI. Now the combined driver is called PS2OPT. This only applies to NetWare 3.11 servers. NetWare 4.0 comes with a new version of PS2SCSI for all PS/2s.

The latest version of PS2OPT is 3.20, dated February 4, 1993. Its file size is 33,087 bytes.

Since the Model 95 uses a regular SCSI controller, it will work with the PS2SCSI that comes with NetWare 3.11; however, if you want to use the latest PS2OPT, it will certainly work.

I am trying to load NetWare 2.2 as a non-dedicated server on a Compaq* 486/25 machine with 8 MB of RAM and a 120 MB hard drive on an Ethernet (10Base-T) LAN. I installed a DOS partition and NetWare partition without any problems, but after I copied Windows from the other requester to the 2.2 server, I have problems.

If I don't load HIMEM.SYS and SMARTDRV.SYS, NetWare 2.2 comes up

| | Workstation Connections | Named Pipes Connections |
|---------|---|--|
| Command | CLIENT SESSIONS number | SERVER SESSIONS number |
| Usage | Replace number with a number from 3 to 128 | Replace number with a number greater than 2. Novell's Named Pipes support is designed to handle more than 1,000 server sessions; however, because of OS/2 requirements, the practical upper limit is much lower (around 400). |
| Default | 16 sessions You need at least one client session for each connection from an OS/2 application to a Named Pipes server. The default of 16 sessions is usually adequate, unless the application uses many Named Pipes. | 32 sessions You must have at least as many SPX (sequential packet exchange) sessions as you have Named Pipes server sessions (see Protocol Stack SPX on page A-32 of <i>NetWare Requester for OS/2 2.0</i>). If you specify fewer SPX sessions than Named Pipes server sessions, the requester will treat the SPX session number as the maximum number of Named Pipes server sessions. |
| Example | To allow each client 30 sessions: NAMED PIPES CLIENT SESSIONS 30 | To allow each server 300 sessions: NAMED PIPES SERVER SESSIONS 300 |

Figure 1. Workstation and Named Pipes Connections

OK; however, when I load HIMEM.SYS and SMARTDRV.SYS through the CONFIG.SYS file, the NetWare 2.2 system gives me the following error:

Insufficient memory, needs at least 1024K extended memory.

How can I run Windows applications in extended mode and NetWare 2.2 at the same time?

Memory managers do not work with the non-dedicated NetWare 2.2 server. Since the 2.2 server performs all memory management functions, it must access all memory in the machine. The HIMEM.SYS driver will "hide" the extended memory from the server, preventing the memory from being loaded.

A non-dedicated NetWare 2.2 server gives you a primitive DOS session equivalent to an 8088 with 640 KB of RAM. You will not be able to run Windows in it, nor will you be able to use any extended memory. You will only be able to run software that uses conventional memory.

I have two servers: one has 20-user NetWare installed, and the other doesn't have any NetWare installed. I have two licenses of NetWare: one

20-user and one 100-user version. I would like to get the 100-user version on Server A, which currently has the 20-user version. I will then install the 20-user version on Server B.

Can I copy the files from the NetWare 100-user SYSTEM-1 diskette to Server A? What is the easiest way to get the 100-user version on top of the 20-user version?

For NetWare 3.11, the number of connections is set inside of SERVER.EXE. To change Server A to a 100-user version, simply copy SERVER.EXE from the SYSTEM-1 diskette to the DOS partition of Server A. Then install Server B using the SYSTEM-1 diskette from the 20-user copy of NetWare.

If you have NetWare 4.0, use the install program to install the new license diskette. Then install Server B using the 20-user license diskette.

I have OS/2 2.0, NetWare Requester 2.0, and Extended Services 2.0. How do I increase the number of Named Pipes on my OS/2 2.0 workstation?

The number of Named Pipes sessions is configured in the NET.CFG file of the

OS/2 workstation. These parameters are documented on page A-54 of the *Novell NetWare Requester for OS/2 2.0* manual (GG24-3891). Two parameters determine the number of Named Pipes sessions: the first is for Named Pipes client sessions and the second is for Named Pipes server sessions.

Figure 1 specifies the maximum number of connections a workstation can establish with all Named Pipes servers plus the maximum number of connections a Named Pipes server can support with all Named Pipes clients at any one time.

Putting the two above examples together, you would put the following section in your NET.CFG (if the workstation is a Named Pipes server and client):

```
NAMED PIPES
CLIENT SESSIONS 30
SERVER SESSIONS 300
```

You must make sure that the NET.CFG ends with a blank line so it will be parsed correctly.

Corrective Service Information

Figure 1 shows maintenance release levels for the listed products. This information is effective as of January 19, 1994. To order all service packages—except for the OS/2 2.0 and OS/2 2.0 Toolkit ServicePaks*—call IBM Software Solution Services at (800) 992-4777. For the OS/2 2.0 ServicePak (XR06100) or the IBM Developer's Toolkit for OS/2 2.0 ServicePak (XR06110) on diskettes or CD-ROM, call (800) 494-3044. Most OS/2 service packages are also available electronically from the following sources:

- **OS/2 Bulletin Board Service (BBS):** Once connected, select Option 2. (Corrective services are also listed under the General category on the IBMLink BBS.) To subscribe to the OS/2 BBS, call (800) 547-1283.
- **IBM Personal Computer Company (PCC) BBS:** Call (919) 517-0001. Service packages are located in Directory 4.
- **CompuServe:** Download service packages from the IBM OS2 FORUM library (GO IBMSERV).
- **Internet:** Do an anonymous FTP from software.watson.ibm.com. Service packages are located in the /PUB/OS2 directory.

Selective Service for DB2/2 and DDCS/2

The Database Services components for DATABASE 2 OS/2 (DB2/2) and Distributed Database Connection Services/2 (DDCS/2) have been packaged as "SelectPaks" to meet customer demand. You wanted us to selectively package the pieces of Database Manager corrective service diskettes (CSDs). They are now available on

CompuServe, Internet, OS/2 BBS, and PC Company BBS with the following names (or some derivative to meet naming schemes of the BBS). All supported languages are available.

- WRx7015 Database Manager DB2/2 1.0 Engine SelectPak
- WRx7016 Database Manager DDCS/2 2.0 SelectPak

Service for Extended Services 1.0 Database Services

The WRx6035 ServicePak for the Database Services portion of Extended Services 1.0 is cumulative and replaces WR06001, WR06002, WR06003, WR06004, WR06014, and WR06015 SelectPaks.

For Japan and Taiwan, WRx6036 provides the same service as WRx6035 and picks up AT bus support.

Service for Communications Manager

The Communications Manager* component of Extended Services 1.0 currently has SelectPak WR06116 on multiple bulletin boards. WR06116 includes a virtual device driver providing emulator high level language application programming interface (EHLAPI) support to Windows applications in OS/2 2.0. The package is called EHLLSP016 (sometimes EHLLSP16) on various BBSs.

WRx6025 has been added as a ServicePak to service ES 1.0 Communications.

Service for SPM/2

WR06075 provides service for System Performance Monitor/2 (SPM/2). Its fixes

plus new enhancements are now available as a ServicePak for electronic and diskette orders. The U.S. version will service all countries.

Service for LAN Server 3.0

Three SelectPaks are available for LAN Server 3.0 (LS 3.0):

- IPx7001 provides service for LS 3.0 Server, Requester, Remote Initial Program Load (RIPL), User Profile Manager (UPM), and Fault Tolerance.
- IPx7003 provides service for LAN Server 3.0 DOS LAN Requester and is available electronically from the OS/2 BBS, CompuServe, Internet, and the PC Company BBS.
- IP07005 provides some High-Performance File System (HPFS) fixes plus additional fixes for the LAN NetView* product. This SelectPak is for users who are not now using LAN NetView.

ConveniencePak for LAN NetView

IP07006 is for LAN NetView users. It contains everything in IP07005 plus some additional fixes required for OS/2 2.0, OS/2 2.1, LS 3.0, and DB2/2. To get the ConveniencePak, call (800) 992-4777.

Service for NTS/2 and LAPS

WRx7020 replaces WR07008 and provides a service refresh for Network Transport Services/2 (NTS/2) for LAN Server 3.0 and LAN Adapter and Protocol Support (LAPS).

—Arnie Johnson, IBM Corporation,
Austin, Texas

| Product/Component | Release | CSD Level | PTF Number | Change Date | Comments |
|---|---------|-----------|------------|-------------|--|
| OS/2 Standard Edition | 1.3 | XR05150 | XR05150 | 2-10-93 | |
| OS/2 Extended Edition Operating System Presentation Manager REXX User Profile Management Communications Manager Database Manager LAN Requester LAN Server | 1.3 | WR05200 | WR05200 | 5-12-93 | WR05200 replaces WR05050, which can no longer be ordered on diskette. |
| OS/2 | 2.0 | XR06100 | XR06100 | 9-1-93 | XR06100 replaces XR06055. |
| OS/2 Toolkit | 2.0 | XR06110 | XR06110 | 9-1-93 | |
| | 1.3 | XR05053 | XR05053 | 3-23-92 | |
| OS/2 LAN Server/Requester ServicePak Service/Requester Fault Tolerance User Profile Management (UPM) | 2.0 | IP06030 | IP06030 | 4-25-93 | |
| | 3.0 | IP07001 | IP20086 | 10-7-93 | |
| LAN Server/DOS LAN Requester SelectPak | 3.0 | IP07003 | IP07003 | 7-28-93 | Diskettes not available. Download from one of the BBSs. |
| LAN Server HPFS | 3.0 | IP07005 | IP07005 | 11-2-93 | IP07005 requires IP07001 be applied to system. IP07005 is not for LAN NetView users. Diskettes not available. Download from one of the BBSs. |
| LAN NetView Prerequisite | 1.0 | IP07006 | IP07006 | 11-8-93 | IP07006 is a prerequisite before applying LAN NetView. It contains IP07005 plus fixes for OS/2 2.x and DB2/2. Requires WR07010 applied with DB2/2 and XR06100 applied with OS/2 2.0. Diskettes not available. Download from one of the BBSs. |
| OS/2 Network Transport Services/2 SelectPak | 1.0 | WR07020 | WR07020 | 10-11-93 | Diskettes not available. Download from one of the BBSs. |
| OS/2 LAN Adapter and Protocol Support SelectPak | 2.0 | WR07020 | WR07020 | 10-11-93 | Diskettes not available. Download from one of the BBSs. |
| OS/2 Extended Services Database Manager ServicePak | 1.0 | WR06035 | WR06035 | 11-18-93 | Supersedes WR06001, WR06002, WR06003, WR06004, WR06014, and WR06015. |
| Database Manager DB2/2 | 1.0 | WR07015 | WR07015 | 1-19-94 | Supersedes WR07010 and WR07012. Diskettes not available. Download from one of the BBSs. |
| DDCS/2 | 2.0 | WR07016 | WR07016 | 1-19-94 | |
| Extended Services Communication Manager ServicePak 3270, 5250 Emulation CM SNA | 1.0 | WR06025 | WR06025 | 11-29-93 | |

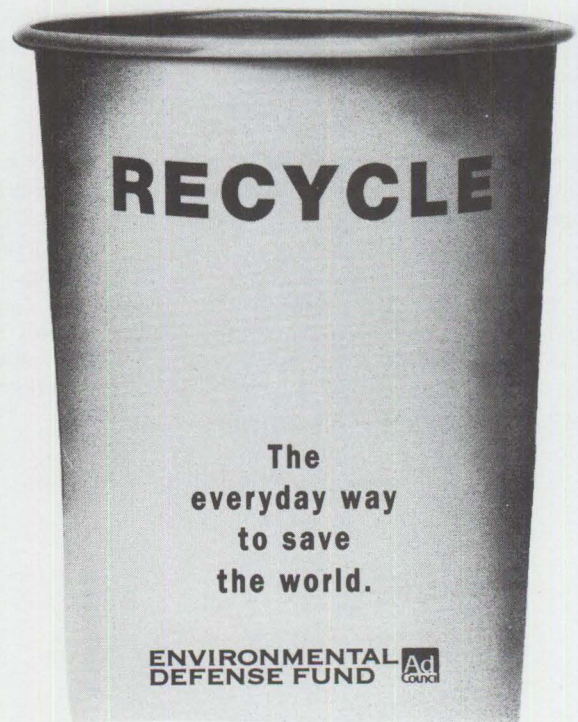
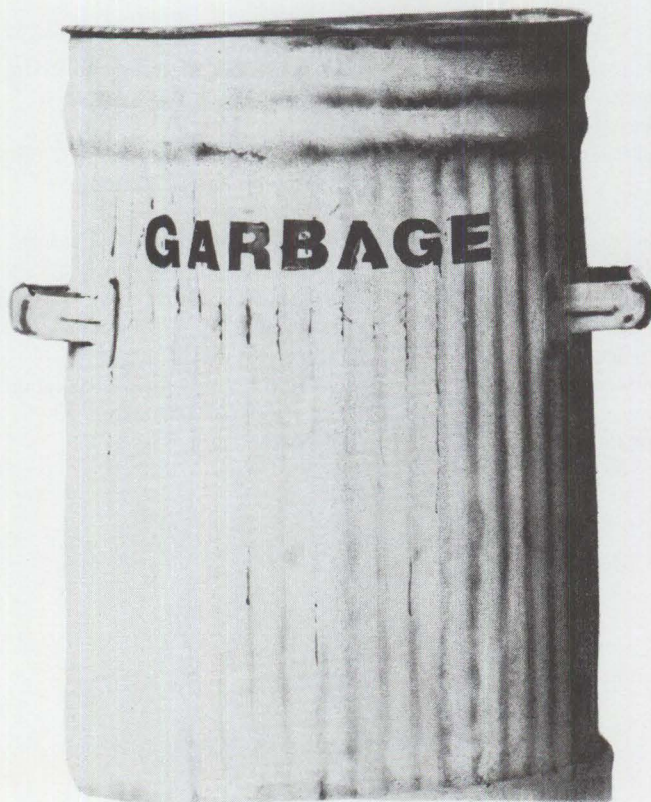
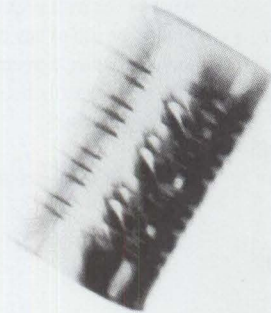
Figure 1. Maintenance Release Levels

| Product/Component | Release | CSD Level | PTF Number | Change Date | Comments |
|--|-----------|-----------|------------|-------------|-----------------------------|
| System Performance Monitor (SPM/2) Service Pak | 2.0 | WR06075 | WR06075 | 12/10/93 | |
| Communications Manager/2 Version 1.01 ServicePak | 1.00 | WR06050 | WR06050 | 6-11-93 | Available only on diskette. |
| DOS | 4.0, 4.01 | UR35284 | UR35284 | 9-26-91 | |
| | 5.0 | UR37387 | UR37387 | 9-22-92 | |
| PC/3270 | 1.01 | 2012 | IP00832 | 11-21-91 | |
| PC/3270 (DOS) | 2.0 | 3005 | IP00874 | 3-29-93 | |
| | 3.0 | 7002 | IP20006 | 9-27-93 | |
| PC/3270 (Windows) | 2.0 | 4002 | IP00841 | 4-17-92 | |
| | 3.0 | 6004 | IP20014 | 10-22-93 | |
| PC/3270 Emulation, Entry | 1.22 | 2201 | UR29500 | 3-16-90 | |
| | 2.0 | N/A | N/A | N/A | |
| PC LAN Program | 1.33 | 3301 | IP00249 | 5-15-90 | |
| | 1.34 | | IP00755 | 6-26-91 | |
| C Set/2 Compiler | 1.0 | CS00050 | XR06150 | 6-29-93 | |
| C Set C++ Compiler | 2.0/2.01 | CTC0002 | XR06102 | 12-15-93 | |
| Workstation Program (WSP) | 1.12 | | UR23217 | 1-14-89 | |
| TCP/IP for OS/2 Base Kit | 2.0 | UN50382 | UN50382 | 12-31-93 | |
| TCP/IP for OS/2 Applications | 2.0 | UN52840 | UN52840 | 12-31-93 | |
| TCP/IP for OS/2 DOS Box Kit | 2.0 | UN50383 | UN50383 | 12-31-93 | |
| TCP/IP for OS/2 Extended Networking | 2.0 | UN52906 | UN52906 | 12-31-93 | |
| TCP/IP for OS/2 Programmer's Toolkit | 2.0 | UN54155 | UN54155 | 12-31-93 | |
| TCP/IP for OS/2 Domain Name Server | 2.0 | UN54143 | UN54143 | 12-31-93 | |
| TCP/IP for OS/2 Network File System | 2.0 | UN52386 | UN52386 | 12-31-93 | |
| TCP/IP for OS/2 X-Windows Server | 2.0 | UN52841 | UN52841 | 12-31-93 | |
| TCP/IP for OS/2 X-Windows Client | 2.0 | UN52842 | UN52842 | 12-31-93 | |

Figure 1. Maintenance Release Levels (Continued)



**Recycling
is easy. You've
almost been doing
it for years.**



Recycling.
It's one of the
easiest
ways you personally can help
save our world.
Recycling will not only
help keep
us from being buried
in our own trash,
it saves natural resources and reduces
pollution. If you'd
like to know
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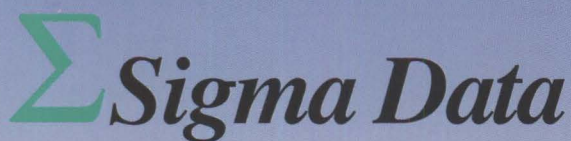
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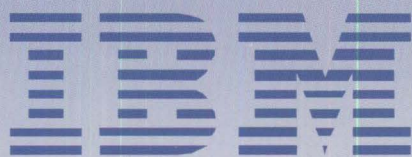
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Even a free memory manager may not be a bargain—especially if it can't give you all the memory you need.

Introducing QEMM 7 The Memory Manager Worth Paying For

The newest version of QEMM, version 7, pioneers new ways of using the critical area between 640K and 1024K. It optimizes this area, taking into account the many drivers that need more memory at start-up than when running; instantly calculating millions of possible memory configurations to find still more memory for your applications, TSRs and utilities to use.

Instant Riches

What does more memory mean in a practical sense? Simply that your DOS and MS Windows programs run faster, smoother and more reliably. It means you can continue to add valuable utilities, drivers, TSRs and new capabilities to your PC. Whether it's workhorse drivers like LAN utilities and fax drivers; productivity-enhancers like disk caches and disk compressors; or fun and exciting capabilities like sound boards, CD ROM drivers, graphics tablets, etc. The better your memory is managed, the more versatility and flexibility your PC will have. QEMM 7 lets you have it all without fear of 'out of memory' messages or crashes.



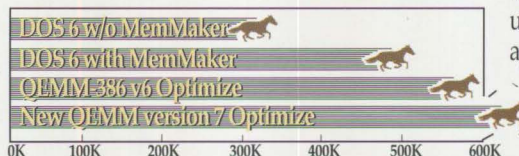
DOS 6 Giveth; DOS 6 Taketh Away

The best feature of new DOS 6 is the stable of utilities it includes. Trouble is, they all eat up memory. DoubleSpace file compression needs 43K, Vsafe anti-virus needs 745K, Smartdrv disk cache needs 28K and even Undelete takes 10-14K as a resident program. Using MemMaker, you could easily lose—not gain—available 'conventional' memory in DOS 6.

New QEMM 7 takes the best of the new



How to Look a Gift Horse in the Mouth



We tested DOS 6 with and without MemMaker and with QEMM 6 and our new QEMM 7 runs away from all of them. See details of test conditions listed below.

DOS 6 features into account, finding ways to cut memory demands for these utilities by up to 80%, ensuring that the all-important memory below 640K is free for your programs. And QEMM 7's seemingly small feature of supporting DOS 6's

multiple configurations gives you the flexibility and ease of setup that you expect. (MemMaker doesn't work well with this important DOS 6 feature.)

Page Frame: the Key to Your Future

There's been a lot of jealous talk about our patent-pending Stealth technology. Nobody else can duplicate its 48-115K gains.

The key to Stealth is its use of a 64K reserved area above 640K called the page frame. Besides being used by Stealth, the page frame lets Lotus 1-2-3 r2.x run larger spreadsheets and WordPerfect 5.x larger documents. It's also used by DESQview for multitasking, Novell NetWare, IBM LAN Server and DECnet for reducing the network driver memory footprint, plus games for fast action. You sacrifice all this when other memory managers turn off the page frame.

Stealth saves you room to set up your PC with a mouse, CD ROM, sound board, a network such as Novell NetWare, create 8-24K of extra memory for optimal MS Windows performance, use all of DOS 6's memory-hungry utilities and still have more than 630K to run applications smoothly and safely.

Put Your Money on a Winner—QEMM 7

The new and ever more exciting capabilities coming to your PC will all compete for memory with your favorite applications, TSRs and drivers. And that makes QEMM 7 the most vital utility you can own.

Our seventh-generation memory manager is a thoroughbred that helps you get the most out of your PC today and tomorrow.



Prior versions of QEMM won just about every competition in sight, as well as remaining the #1 best-selling memory manager 5 years straight.

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How we got the chart numbers CPU—486/33 ALR Power/business VEISA machine equipped with 16 megs of RAM and running MS-DOS 6. Comparisons were done using the following memory managers: QEMM 7, QEMM 6.02, MS-DOS 6 MemMaker. In addition to the driver (or drivers) required by each memory manager, the following drivers, DOS resources and programs were loaded for all comparisons: in the CONFIG.SYS file: SETVER.EXE, DOS-HIGH, FILES=20, BUFFERS=10, STACKS=0,0, MVSOUND.SYS, SNDBK12.SYS, SLCD.SYS, DOS SHELL—statement, in the AUTOEXEC.BAT file: VSAFE, MSCDEX, UNDELETE, LSL.COM, NE2000.COM, IPXODI.COM, NETX OR EMSNETX, MOUSE.COM, SMARTDRV.COM, PRISCCAP.COM. ©1993 Quarterdeck Office Systems. Trademarks are property of their respective owners.

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