Erik Stevenson

From:	Christian Wildfeuer
To:	doschamp
Cc:	bradc; bradsi; ilamgrs; imm; ioem
Subject:	further ms-dos 6.2 launch documents
Date:	Monday, October 25, 1993 6:05PM

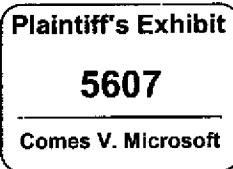to help you pitch the product, are attached:

- the presentation bradc gave at the ESM in Paris (which was rated the highest of all presentations there): ESM106.PPT
- the latest reviewer guide, also comparing with the competition: REVGDE5A.DOC (this doc is also on \\pyrex\public\dosmktg\msdos6\msdos62\elguide2.doc)
- a specific doc comparing us with Novell DOS 7: NOVDOS7D.DOC

Intl LA Managers, pls distribute to your sales forces. thx!

<<File Attachment: NOVDOS7D.DOC>> <<File Attachment: ESM106.PPT>> <<File Attachment: REVGDE5A.DOC>>

MS-DOS vs DR-DOS Comparative Review

Table of Contents

A Comparison of MS-DOS 6.2 and DR-DOS 7

Overview
This document provides a comparison of MS-DOS 6.2 and DR-DOS 7. Because DR-DOS 7 is not yet a shipping product, information on DR-DOS 7 in this document is based on reviews published in trade publications, public Novell documents and conversations with Novell personnel. However, the final product could differ significantly from what we present in this comparative review. The information included in this document is accurate to the best of our knowledge at the time it was prepared.

Based on what we have been able to learn coupled with recent Novell announcements, DR-DOS 7 combines Novell's desktop operating system, DR-DOS, and an upgrade to their peer networking product, Netware Lite 1.1 which Novell renamed Personal Netware.[1] Because of the lack of integration in DR-DOS 7 between their desktop operating system and their peer network, the most accurate and easiest way to view the product is to break it into the DR-DOS and NetWare Lite components. The balance of this comparative review will analyze the strengths and weaknesses of these components relative to the comparable MS offerings; namely, MS-DOS 6.2 and Windows for Workgroups (WFWG) 3.11. Hopefully this stand-alone approach will help to highlight the key features and distinctions of these competitive operating system and peer networking products.

Executive Summary
Key advantages of MS-DOS 6.2 and Windows for Workgroups over DR-DOS 7 and Netware Lite include:
- More compatibility
  - MS-DOS standard ensures broad industry support and lower support costs
  - ISVs and PC OEMs test and develop applications with MS-DOS
  - Clear future migration path for users
- More safety
  - New data protection technology makes DoubleSpace safer than DR-DOS' solution
  - Features like ScanDisk and DoubleGuard provide an extra layer of protection for data
- More conventional memory for MS-DOS applications
  - MemMaker optimizes *all* TSRs and device drivers to maximize conventional memory
- More tightly integrated with Windows
  - Optimized to run with Windows and Windows for Workgroups 3.11
- More compelling benefits for peer and large corporate networking users
  - MS-DOS is a universal client and all networking products including Netware and Netware Lite/Personal Netware run successfully on MS-DOS
  - Windows for Workgroups includes broad connectivity support for multiple networks while Netware Lite client is designed for Netware family.
  - Windows for Workgroups 32-bit architecture improves performance significantly while requiring only 4K of conventional memory
  - Extension of Windows family ensures compatibility with Windows applications

Operating System Comparison: MS-DOS 6.2 vs. DR-DOS 7

Compatibility

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[1] The product offers only two real areas of integration: installation and security. As a separate product, users can run Netware Lite runs successfully on both MS-DOS and DR-DOS.

3

During the evaluation of a new operating system, customers must weigh one very important criteria against the benefits of the features and technology offered by a new product: compatibility. Microsoft's fundamental belief with MS-DOS is that *if it's not completely compatible, it's not MS-DOS*. We learned from MS-DOS 4 that when compatibility becomes an issue, users were dissatisfied. Thus, our vision for MS-DOS 5 and 6 focused on delivering a solid product to PC OEMs and users that offers compelling features without sacrificing compatibility.

We achieved our vision of delivering compelling products that preserved compatibility by testing extensively with key ISVs, PC OEMs and end-users and taking extreme care when we modified the MS-DOS kernel. In addition, hundreds of books and videos as well as thousands of trained professionals all leveraged the MS-DOS infrastructure to provide customers with information to help minimize support costs. Our customer satisfaction data showed over 90% satisfaction with MS-DOS 6 and our product support data indicated that MS-DOS 6 received fewer support calls than any of Microsoft's top 10 products. In extremely rare cases, though, users did experience serious problems. We took this very seriously and responded with MS-DOS 6.2 which provides users with even greater protection for their data.

In contrast, Novell's approach with DR-DOS does not appear to have achieved complete compatibility. A consequence of this is that DR-DOS has a history of compatibility problems. DR-DOS 6 suffered from compatibility problems as evidenced by at least 6 patches shipped for the product. This presents a significant problem for users because too many operating system updates becomes very expensive to administer on desktop PCs. Novell has already confirmed that DR-DOS 7's multitasking feature is incompatible with Windows in Enhanced mode. PC Week also reported that DR-DOS 7 is likely to break third-party memory managers. In addition, Novell recently indicated that DR-DOS 7 is also incompatible with Windows for Workgroups 3.11 even after Novell received its first beta of Windows for Workgroups earlier this year. This is a major concern since approximately 30% of all new PCs shipped in the next 12 months will ship with this new version of Windows for Workgroups. The history of these incompatibilities also suggests why DR-DOS has not gained a significant presence in either the retail, VAR and PC OEM channels. Although DR-DOS 7 is a significant improvement over DR-DOS 6 in terms of features and technical advancements, it continues to lack broad industry support. We believe users will be concerned about the problems described above.

Summary of Strengths and Weaknesses

Key points about MS-DOS 6.2:
- Pros
  - Very broad PC industry support
  - Extensive testing effort by Microsoft, ISVs and PC OEMs ensures compatibility
  - Industry standard operating system reduces training and support costs
  - Optimized to run with Windows and Windows for Workgroups
  - ScanDisk provides an integrated disk analysis and repair tool.
  - New DoubleGuard technology provides additional layer of protection for DoubleSpaced drives.
  - MemMaker memory optimizer enables users to easily get more memory for their MS-DOS-based applications.
  - SmartDrive caches CD-ROM drives providing significant performance benefit (15% or greater depending on application and function performed).

- Cons
  - Multitasking for MS-DOS-based applications available only with Microsoft Windows.
  - Support for protected mode drivers available only with Microsoft Windows.

Key points about DR-DOS 7:

- Pros
  - DPMS (DOS Protect Mode Services) versions of several drivers (disk cache, CD-ROM extension, disk compression and multitasking drivers) enable protected mode execution and help to maximize conventional memory for both MS-DOS and DR-DOS users.
  - Multitasking enables running of multiple MS-DOS applications.
  - User-level security model provides protection for customers' systems.

- Cons
  - Acknowledged incompatibilities discussed above.
  - Less third-party testing and support. This could present a significant support problem for customers.
  - DPMS API lacks industry support. No memory optimizer available with the product.
  - Multitasking is incompatible with Microsoft Windows in 386 enhanced mode and most third-party memory managers.
  - No clear future migration path for customers.

Major Features Review

Disk compression
In DR-DOS 7, Novell has chosen to replace the SuperStor disk compression in DR-DOS 6 with Stacker. This was probably a good decision on Novell's part given SuperStor's consistent portrayal as a second-tier compression product by independent reviewers. However, it presents DR-DOS 6 users with possible migration issues and forces them to learn a new compression technology. A consequence of this learning is higher training and support costs. In addition, it's unclear how well integrated compression is with the operating system. To be fair, Stacker and DoubleSpace share many of the same features; including uninstall and automounting. Although Stacker supports compressed floppies on any PC and password protection, the checksumming and surface scan don't provide the same degree of safety offered by DoubleSpace's DoubleGuard and ScanDisk.

Memory Management
DOS Protected Mode Services (DPMS) enables users to run drivers and TSRs in protected mode. Novell has provided DPMS drivers for several though not all of the utilities in DR-DOS 7. This technology is beneficial because it provides users with more conventional memory. However, it seems that it's three years late. Currently, DPMI is the standard. The VxD protect mode driver model in Windows supports this standard and is the basis for a new, more powerful protect-mode standard. The VxD model is a core part of Windows and Windows for Workgroups and will be supported in future Windows releases as well. To date, there are *over 300* independent hardware vendors which have developed VxDs for Windows. These may not work with DR-DOS 7. DPMS requires developers to write programs that support the DPMS API before users can take advantage of its benefits. Its not clear why developers would do this in light of the DPMI standard and the VxD protected mode driver model supported by Windows.

DR-DOS 7 doesn't include any memory optimization program like MS-DOS 6.2's MemMaker. While DPMS provides support for only a handful of device drivers, users can get more conventional memory by using either MemMaker or third party memory managers to optimize *all* TSRs and device drivers. This means that DR-DOS 7 users must purchase a third-party memory manager to get the same amount of conventional memory. Ironically, these memory managers are apparently not compatible with the new multitasking feature discussed below. Microsoft's MemMaker provides easy and safe memory optimization for all users while allowing the flexibility for advanced users to customize their systems. MemMaker is generally regarded as providing comparable memory optimization with better ease of use and safety than the third-party memory manager utilities available.

Multitasking

On the surface, the multitasking feature in DR-DOS 7 appears to be a technological gain. However, today users have an easy way to multitask applications: there is Windows or a product called Desqview. Nonetheless, multitasking in DR-DOS 7 raises serious compatibility issues. While it does allow multitasking of MS-DOS-based applications, Novell acknowledged that their multitasking is incompatible with Windows in 386 Enhanced mode. In addition, PC Week reports that multitasking will probably break third party memory managers.

Disk Analysis and Repair Tool

MS-DOS 6.2 includes a new disk analysis and repair tool called ScanDisk. ScanDisk diagnoses and repairs errors on both DoubleSpace and uncompressed drives. Its features include:
- Crosslink and lost cluster detection and resolution.
- Repair of damaged certain damaged portions of Compressed Volume Files and recovery of data.
- Hard disk surface analysis and marking of bad sectors while "hotfixing" the disk by moving data from the bad sector to a good sector.
- Ability to undo any changes made to the hard disk.

DR-DOS 7's Stacker disk compression comes with a limited surface scan for Stacked drives only. It doesn't have a utility with the breadth of diagnostic and repair features available with ScanDisk.

Other Features

Novell, following the MS-DOS lead, has added two new utilities in DR-DOS 7: Backup and Anti-Virus.
- **Backup:** Novell has licensed Fifth Generation Systems' Fastback Express, a subset of their Fastback Plus product, for DR-DOS 7. Micorsoft has licensed Microsoft Backup in MS-DOS 6.2 from Symantec (Norton Backup). Norton Backup has received numerous awards for its backup technology and ease of use. Microsoft Backup leverages these strengths. Norton's Backup also received higher marks for ease of use compared to Fifth Generation's Backup. MS-DOS 6.2 provide MS-DOS- and Windows-based versions of Backup. Though Microsoft Backup doesn't include support for tape drives, users receive these drivers when they purchase tape drives.

- **Anti-virus:** Novell has also licensed the anti-virus utility, Search and Destroy from Fifth Generation Systems for DR-DOS 7. Microsoft licensed Microsoft Anti-virus from Central Point Software, a leader in anti-virus technology. Software Digest Ratings Report picked Central Point's Anti-virus as one of its recommendations while citing Fifth Generation's Anti-Virus for focusing on the hard disk and not catching floppy disk viruses. MS-DOS 6.2 includes both MS-DOS and Windows versions of anti-virus

Other utilities included in both MS-DOS 6.2 and DR-DOS 7 are:
- Undelete - MS-DOS 6.2 has both DOS- and Windows-based versions. DR-DOS 7 includes a DOS version but uncertain about a Windows version.

- Disk cache - SmartDrive, the disk cache in MS-DOS 6.2 also caches CD-ROM drives; DR-DOS 7 has a DPMS disk cache.

- Disk defragmenter

- CD-ROM extentions - DR-DOS 7 offers a clone of Microsoft CD-ROM extensions and include DPMS support.

In general, utilities included in DR-DOS 7 are different from those in MS-DOS 6.2. Users will need to learn and support non-standard technologies when adding DR-DOS to their MS-DOS-based computing environments.

Networking Comparison: Windows for Workgroups 3.11 vs. Netware Lite

A True Universal Client

In this part of the review, we discuss the importance of MS-DOS and Windows in the networking environment. Although MS-DOS doesn't bundle networking, it nonetheless serves as the universal client for the hundreds of networking products available all over the world. As network vendors evolved their solutions for both large and small environments, they all have one common thread: they run successfully on MS-DOS. With MS-DOS as the universal client, this allows users to keep their systems open and makes it easy to grow existing networks as the need arises. Networking vendors also benefit because they can easily leverage the MS-DOS infrastructure and test their products extensively thus ensuring compatibility with applications and hardware.

Today the focus on developing new user interfaces, and hardware and software technologies is in a Windows environment. Now that Windows is the standard in a protect-mode environment, it is quickly assuming the role of the universal client for networking products as well. This means that our Windows family needs to operate seamlessly with other vendors' networks. Thus we've improved Windows for Workgroups to operate seamlessly with products like Novell's Netware by providing a 32-bit IPX/SPX compatible protocol and included support for the TCP/IP protocol standard to ensure broad connectivity support for other vendors' networks like DEC PATHWORKS, Banyan VINES, and LAN Server. In addition, as part of the Windows family, Windows for Workgroups leverages the Windows architecture. This means that users can install and use Windows for Workgroups easily. Recognizing the importance of Windows, it's essential that users understand which real-mode operating system is optimized to run with Windows. An operating system that isn't tightly integrated with Windows might prevent users from benefitting from new technologies in networking or workgroup applications like Microsoft Mail or Lotus Notes. The tight integration also ensures a smooth migration path for future releases of Windows. With Novell's acknowledgement that Netware Lite is incompatible with Windows for Workgroups or that certain features in DR-DOS 7 are incompatible with Windows, it appears once again that Novell is not ensuring complete compatibility for both MS-DOS and Windows users.

Summary of Strengths and Weaknesses

Key points about Windows for Workgroups 3.11:
- Pros
  - Easy to install and use since it builds on Windows 3.1
  - Broad connectivity support for other vendors' networks
  - 32-bit disk access and file system drivers which means performance gains of up to 150%
  - Seamless interoperability with Windows NT for enterprise networking
  - Concurrent access to multiple servers including Novell Netware
  - Low conventional memory requirement: 4K
  - Mobile features: Built-in fax capabilities to send/receive files and messages that can be edited and remote access services
  - 32-bit networking architecture ensures greater reliability
  - Workgroup applications included: Microsoft Mail and Schedule+
  - Availability of workgroup add-on for MS-DOS to allow 8088/286 PCs to share resources and function as servers

- Cons
  - Simpler, less granular security model
  - Limited network management tools but focus on centralized control of peer services

Key points about Netware Lite:
- Pros

- > Single client allows users to connect to Netware Lite, Netware 2.x, 3.x or 4.x servers
- > Some management of servers/workgroups including user-level security
- > Announced support for cross-platform connectivity with OS/2, Macintosh and UNIX operating systems
- > Peer-peer network add-on for low end 8088 PCs to share resources

- • Cons
  - > Novell acknowledged incompatibility with Windows for Workgroups 3.11
  - > Lack of support for broad network connectivity
  - > Substantial conventional memory requirement
  - > Real-mode drivers in Netware Lite impact performance significantly compared to Windows for Workgroups
  - > Scalability - no more than 50 users per workgroup and users may not simultaneously access resources in 2 or more different workgroups
  - > Installation is more difficult than Windows for Workgroups
  - > Limited mobile computing features

Major Features Review

Peer Networking Services

Windows for Workgroups 3.11 leverages the Windows architecture while providing users with powerful, easy to use features. For example, the 32-bit architecture of Windows for Workgroups provides tight integration of networking into the operating system thus improving performance and reliability. This architecture will be the basis for developing network support in future versions of Windows. In addition to the 32-bit architecture, we've improved support for NetWare which allows Windows for Workgroups to operate seamlessly with Netware. Windows for Workgroups also offers broad connectivity support for other networks such as LAN Server, Banyan VINES, DEC PATHWORKS and all other networks supported in Windows 3.1. This broad support for industry-standard protocols and server systems keeps networked PCs open in mixed-vendor enterprise environments that typify many corporate information systems. Finally, Windows for Workgroups provides additional support for networked Windows applications through mechanisms like Network DDE to facilitate file and printer sharing.

Network administrators can control peer sharing of resources by selected workstations, specify password settings for enhanced network security and use the powerful domain security controls in Windows NT. Administrators can set policy for entire groups of machines by a editing a single security-settings file or they may choose to provide individual settings for each machine. This allows administrators greater control over security and file and print sharing across the network.

In comparison, Netware Lite offers users some interesting benefits. The single client makes it easier for customers to access the family of Netware servers. The product's user-level security and network management tools leverage Netware's offerings in these two areas so this comes as no surprise that Netware Lite incorporates similar functionality.

However, a significant cause for concern is Novell's acknowledgement that Netware Lite is incomaptible with Windows for Workgroups 3.11. As mentioned earlier, over the next 12 months approximately 30% of all new PCs will ship with Windows for Workgroups. In addition to the potential incompatibilities, users must contend with the product's lack of support for other vendors' networks. The Netware Lite client is designed for the Netware family of servers. These problems have the potential to increase support costs substantially for network administrators. It appears that network administrators will assume greater responsibility with Netware Lite without a significant payback.

Faster Performance & Improved Reliability

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Windows for Workgroups 32-bit architecture ensures greater reliability and significant performance improvements in a protect mode environment. For example, hard disk access can be improved by up to 150% with 32-bit disk and file system drivers that benefit network, standalone and remote PC users. In addition, network access is up to 100% faster because of the new 32-bit NDIS 3.0 network-card drivers in Windows for Workgroups 3.11.

For Netware Lite, the drivers are real-mode drivers and include support for DPMS. While this may free conventional memory for users, there is a cost associated with this implementation. A consequence is slower performance since the drivers are 16-bit rather than 32-bit. A second effect is that vendors today support a more powerful protect mode standard: the Windows VxD model Thus users face the possibility that these drivers may not work with Windows.

Scalability
Netware Lite uses the same workgroup architecture supported in Netware. This means that up to 50 users can be assigned to a workgroup. This limitation poses problems for administrators as they must now incur additional support costs by maintaining multiple workgroups when their networks increase beyond 50 users. Windows for Workgroups does not limit the number of users in a workgroup thus providing users the flexibility to grow their network as needed without incurring significant incremental support costs.

Installation
Netware Lite is more complicated to set-up and configure as a peer-peer network than Windows for Workgroups. The reason is that Netware Lite lacks a common user interface with NetWare 3.x and Netware 4.x. This requirement creates yet one more support burden for administrators and can affect users' productivity.

In contrast, Windows for Workgroups is an extension of the Windows family so current Windows users can install and use this product almost immediately. For example, the product includes a new toolbar in the Windows File Manager and Print Manager for performing common tasks such as accessing network drives and shared resources.

Mobile Computing
For standalone and mobile users computing from home or other remote locations, Windows for Workgroups offers a complete remote access solution. The Remote Access Services client built into Windows for Workgroups allows users to remotely access resources on Windows NT or Windows NT Advanced Server-based networks. By the end of the year we will offer a point-point server that allows mobile users to dial into another Windows for Workgroups machine and access its hard disk. Finally, Windows for Workgroups includes the Microsoft at Work fax software, the *first* PC-based implementation of the Microsoft at Work technology, which allows users to send and receive fax messages and fax files that can be edited from one Windows for Workgroups-based machine to another.

As of the time of this document, it's unclear how Novell is supporting users that must access their PCs remotely. In addition, from the public information available on Netware Lite, there is no discussion of a product strategy to address mobile computing needs.

Summary
When evaluating operating systems, MS-DOS 6.2 provides some significant advantages over DR-DOS 7: it is compatible with applications and existing hardware, has broad industry support and offers better compression and memory management solutions. With MS-DOS 6.2, we've evolved compression to make it the safest compression available today. In addition, ISVs are committed to develop and support new technology like integrated compression in their products. Several product which include support include: Norton Utilities 7.0, PC Tools by Central Point Software, Netroom by Helix Software, and QEMM by Quarterdeck. Finally, by adopting the MS-DOS standard, users can also leverage the huge MS-DOS

infrastructure through books, videos and thousands of trained personnel thus helping to minimize support costs. Although DR-DOS 7 appears to offer to some interesting features, users face significant tradeoffs when adopting an operating system which hasn't delivered complete compatibility and lacks broad industry support.

For networking users, MS-DOS and Windows are the universal clients for all networking products. Netware Lite, on the other hand, is a Netware client. With millions of Netware users running successfully with both MS-DOS and Windows today, it's unclear why a user finds a compelling reason to switch operating systems. Rather these customers need solutions which offer compelling benefits to their network solutions. With its 32-bit network architecture, extension of the Windows family and broad connectivity support, Windows for Workgroups offers both standalone and network customers Windows compatibility, speed and broad connectivity as well as the opportunity to leverage the Windows infrastructure in a networking environment.

Table A. Operating System Features

The following table summarizes the key features of MS-DOS 6.2, DR-DOS 7 and PC DOS 6.1:

Key Features	MS-DOS 6.2	DR-DOS 7	IBM PC DOS 6.1
Compression			
Integrated compression	Yes	Yes, but different format than MS-DOS 6.2.	Uncertain - not shipping at time of this document.
Checksum verification	DoubleGuard continuous checksumming protects against corrupted data being written to disk	Calculates checksum after data written to disk. Does not protect against corrupted data being written to disk	
Auto Uncompress	Yes	Yes	
Handles loss of power during compression	Automatically restarts after power loss	Requires complete decompression after power loss and then recompression	
Automatic mounting of compressed drives	Yes	Yes	
Surface scan disk before compression	Yes	Yes - limited functionality and works only on compressed drives	
Conversion utility	Converts Stacker drives	Converts DoubleSpace drives	
Windows permanent swap file support	Automatic relocation of swap file to host drive	Automatic relocation of swap file to host drive	
Windows utility	Yes	Yes	
Defragmenter	Yes	Yes	
Memory Management			
Easy to use memory optimizer	Yes	No	Yes, but different format than MS-DOS 6.2.
Protect mode support	Support for protect mode drivers available with Windows	DPMS	No
Optimizes upper memory for Windows users	Yes	No	No
Automatic recovery of up to 200K of upper memory	Yes	No	No
Handles loss of power during optimization	Automatically restarts after power loss	No	No
Improved utility to view upper memory	Yes	No	No

Table A. Operating System Features (continued)

Data Protection	MS-DOS 6.2	DR-DOS 7	IBM PC DOS 6.1
Disk analysis and repair tool	Yes. ScanDisk diagnoses and repairs variety of problems on both DoubleSpace and uncompressed drives.	No	No
Backup for MS-DOS and Windows	Yes	Yes but different format than MS-DOS 6.2.	Yes but different format than MS-DOS 6.2.
Undelete for MS-DOS and Windows	Yes	Yes	Yes but different format than MS-DOS 6.2.
Anti-Virus for MS-DOS and Windows	Yes	Yes but different signature format than MS-DOS 6.2.	Yes but different format than MS-DOS 6.2.
Other Features			
Disk cache protects data and includes support for CD-ROM drives	Yes - Smartdrive protects data by writing it to disk before exiting to C: prompt and caches CD-ROM drives.	No	No
Improved utilities to help troubleshoot PC	Yes - Clean Start and Interactive Start make it easy to troubleshoot PCs	No	No
Support for multiple configurations	Yes - MultiBoot option allows for multiple configs	Yes but different format than MS-DOS 6.2.	No
Multitasking	Support available in Windows to multitask MS-DOS applications	Yes, but feature is incompatible with Windows in enhanced mode.	No

Table B. Networking Features

The following table summarizes the key features of Windows for Workgroups 3.11 and Netware Lite:

Key Features	Windows for Workgroups 3.11	Netware Lite
Support for peer networking	Yes	Yes
32-bit network architecture	Yes - ensures greater reliability and improved performance.	No - Network drivers are real-mode drivers which execute in protect mode via DPMS
32-bit disk access and file system drivers	Yes - improves hard disk access by up to 150%	No
Broad support for other vendors' networks (ie. Banyan Vines, DEC PATHWORKS, etc.)	Yes - allows users to connect to multiple networks at the same time	Single client connects to Netware family of servers only
Scalable	Yes - no limit to number of users in a workgroup nor limitations on sharing resources in multiple workgroups	Limited scalability. Workgroup architecture allows a max of 50 users per workgroup and doesn't allow users to share resources in 2 or more different workgroups
Conventional memory required	Very low: 4K	Substantial
Installation	Extension of Windows family means installation is quick and easy.	More difficult than Windows for Workgroups because of lack of common user interface between Netware Lite, Netware 3.x and 4.x.
Security	Simpler, less granular security model	Includes user-level security model supported in Netware
Network management tools	Focus on centralized control of peer services	Some management of servers/workgroups
Support for 8088/286 PCs	Separate workgroup add-on available to allow MS-DOS-based PCs to share resources and function as network servers	Support available for low end PCs to share resources
Mobile computing support	Yes - includes built-in fax capabilities to send/receive files and messages that can be edited. Also includes services to access PCs remotely.	Unknown at the time this document was published.

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13

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Reviewer's Guide

Evaluating Microsoft® MS-DOS® 6.2

October 1993

Why MS-DOS 6.2?

MS-DOS 6 was announced on March 31, 1993. By all measures it has been an extremely successful product. More than 5 million MS-DOS 6 Upgrades and an estimated 10 million OEM systems with MS-DOS 6 have been shipped since the announcement. So why are we releasing MS-DOS 6.2 in a relatively short period of time following the announcement of MS-DOS 6?

There are really two reasons for MS-DOS 6.2. First, we felt the need to address the controversy surrounding MS-DOS 6 and, specifically, DoubleSpace integrated disk compression head-on. Second, customers have given us great feedback on ways to enhance DoubleSpace, improve performance and make MS-DOS easier to use. Our goal with MS-DOS 6.2 is to achieve as close to 100 percent customer satisfaction as possible.

We have called it MS-DOS 6.2 because we believe the features it offers over MS-DOS 6 justify a ".2" designation and we wanted to avoid confusion with PC-DOS 6.1. The day PC-DOS 6.1 was announced customers started calling us with questions about it thinking we had released "MS-DOS 6.1." We will discuss the MS-DOS 6 2 enhancements later in this document, but first, we want to share with you what we have learned about compression and further explain our vision behind MS-DOS 6.2.

What We Learned About Compression

Customers told us they wanted disk compression "built in" as part of MS-DOS. So we focused on integrating DoubleSpace disk compression in MS-DOS 6 and highlighted it as the key feature. This decision turned out well: our market research indicated that DoubleSpace was the primary reason people purchased the product, and that customer satisfaction for both Doublespace and MS-DOS 6 ranks among the industry leaders.

Over the course of millions of DoubleSpace installations, we learned a great deal. Distilling down reams of data and conversations with tens of thousands of customers that call our product support lines, the key facts are:

- MS-DOS 6 received fewer calls per unit than any of Microsoft's top 10 products
- An extremely small, but clearly important, number of DoubleSpace users have had data corruption problems
- We have found no major bugs to fix which would explain any of these serious problems
- There are external conditions that explain most, but not all, of these serious problems; by "external conditions" we mean conditions outside DoubleSpace's control like defective hardware or errant software
- Many customers have not reached the same level of comfort or expertise with disk compression as part of MS-DOS as they have established with the FAT file system and MS-DOS in general over the years

The fact that *any* customer has had data corruption problems, regardless of the reason, is a very serious concern for us. The external conditions that can cause corruption on a DoubleSpace drive are rare and quite difficult to reproduce; otherwise, they would have surfaced during the extensive beta test process that included over 10,000 customer sites. DoubleSpace in MS-DOS 6 already handles certain external conditions, such as the loss of power in the middle of compressing a drive, but not other less frequent conditions. For example, most often DoubleSpace can manage a slightly malfunctioning hard disk, but given a specific set of conditions, any disk defect can cause severe corruption.

MS-DOS 6.2 Vision

Whether or not they are aware of the "controversy" about DoubleSpace (though in particular if they were), customers appreciate additional safety features. Therefore, the overriding objective of MS-DOS 6.2 is to provide new data protection technology without lessening the functionality provided by MS-DOS 6. Our approach for providing added data protection is to address both errant hardware and software on people's systems. We want to help any way we possibly can because when the extremely rare problems do surface, it does not matter to the customer who is responsible. By way of analogy, MS-DOS 6 provided a driver's side air bag and anti-lock brakes to help make compression safer and easier. MS-DOS 6.2 extends this

protection by providing a passenger-side airbag. We hope this new technology will not only provide extra protection for our customers' data, but also increase customer's comfort when using disk compression.

With this new technology in MS-DOS 6.2, we think we have significantly raised the bar for data compression protection standards. But there is an important caveat· Notwithstanding our enhancements in MS-DOS 6.2, we cannot guard against everything. Given an installed base of over 100 million systems and the peripheral devices, drivers and applications used in connection with these systems, the combinations for testing are innumerable. Consequently, we encourage customers to regularly use the backup and anti-virus tools included in MS-DOS or utilities similar to these provided by third-party vendors.

In addition to new data protection technology, we have added some new features based on feedback we have received from customers. We have elaborated on these items in the next section.

Enhancements in MS-DOS 6.2

The following summarizes the key enhancements in MS-DOS 6.2.

ScanDisk - Disk scanning and repair tool
ScanDisk diagnoses and repairs errors on both DoubleSpace and uncompressed drives. Intended as a replacement for both CHKDSK and DoubleSpace /CHKDSK, its features include:

- *Automatic crosslink resolution.* CHKDSK detects but does not repair crosslinks. ScanDisk does both by automatically resolving crosslinks. ScanDisk also detects and resolves crosslinked clusters within a compressed volume file (CVF). Also, like CHKDSK, ScanDisk detects and fixes lost clusters.
- *Repair of damaged CVFs.* Using a number of different checks, ScanDisk can regenerate and repair certain damaged portions of a CVF, and recover all data in many cases.
- *Surface analysis.* ScanDisk will scan an entire disk, and if it encounters any unreliable sectors, mark them as bad and "hotfix" the disk by moving data from the bad sector to a good sector.
- *Undo.* ScanDisk lets the user save a record of any changes ScanDisk makes to a floppy disk, and can subsequently undo any changes it makes to the hard disk.

Other DoubleSpace protection enhancements
DoubleSpace in MS-DOS 6.2 includes important new technology designed to protect user data:

- *DoubleGuard.* Data corruption can result if an errant program or TSR corrupts the in-memory buffers used by DoubleSpace to hold its critical data structures. To protect against this possibility, DoubleSpace now incorporates technology known as DoubleGuard that calculates a checksum every time it modifies its buffers, and then verifies the checksum before writing the buffers to disk. If the verification fails, DoubleGuard pops up an error message and halts the system to limit any corruption that may occur. In addition, DoubleGuard periodically verifies that DoubleSpace's own in-memory code has not been corrupted. DoubleGuard penalizes performance about 2 percent, and can be turned off by the user. For technical details on DoubleGuard, please refer to Appendix I.
- *ScanDisk on installation.* Corruption can occur on both uncompressed and compressed drives if disk data structures are written onto an unmarked bad sector. To avoid the possibility of writing its data structures onto unmarked bad sectors during installation, the DoubleSpace install program now executes Scandisk to check for errors and do a surface scan of the entire disk before compressing or uncompressing it. If DoubleSpace finds any unreliable sectors, it recommends the user use ScanDisk to repair the disk and then re-run DoubleSpace.

Other DoubleSpace enhancements
We made a number of other enhancements to DoubleSpace in response to common customer requests:

- *Uncompress.* DoubleSpace now provides an option that lets users easily uncompress a DoubleSpace drive (assuming they have enough disk space). After uncompressing the last DoubleSpace drive on the user's system, DoubleSpace will be uninstalled from memory.
- *Smaller memory footprint.* Part of DoubleSpace now resides in the HMA, and its footprint has shrunk from 43K to 34K with automounting off, and to 39K with automounting on.

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- *Automounting.* Compressed floppy disks and other compressed removable media now mount automatically under MS-DOS and Windows. Automounting increases DoubleSpace's resident size by 4K, but can be turned off by the user.
- *Error message improvements.* We have replaced cryptic error messages such as "Error 105" and "The CVF is damaged" with clear messages that tell the user what corrective steps to take.

SmartDrive
The enhancements to SmartDrive are:
- *CD-ROM caching.* SmartDrive now caches CD-ROM drives with performance comparable to or better than other CD-ROM cache products available.
- *Write-caching disabled by default.* A new switch, /X, disables write-caching on all drives and Setup now installs SmartDrive by default with write-caching disabled. If the Upgrade is installed on a system that already has write-behind caching on it will leave it on.
- *Flush to disk before returning to the C: prompt.* If write-caching is enabled, SmartDrive flushes its cache to the disk after all commands before returning the user to the C: prompt. Flushing to disk can be disabled for faster batch file performance, if desired.

System Startup
New system startup features include:
- *Interactive execution of AUTOEXEC.BAT.* Interactive start, F8, now lets users selectively execute commands in AUTOEXEC.BAT as well as CONFIG.SYS.
- *Interactive batch file execution.* As a by-product of the above feature, users can now execute batch files interactively by typing "COMMAND /Y FOO.BAT" at the C: prompt.
- *Clean start without DoubleSpace.* The Ctrl-F5 combination lets users clean boot without loading DoubleSpace, which may be necessary for certain troubleshooting procedures.

Other utility enhancements
Enhancements include:
- *Commas.* DIR, MEM, CHKDSK and FORMAT now display all numbers greater than one-thousand with commas, as in

> 57 file(s)   1,081,654 bytes
> 43,753,472 bytes free

- *No-swap DISKCOPY.* By using the hard disk as scratch space, DISKCOPY now makes floppy-to-floppy copies without requiring multiple disk swaps.
- *Copy Overwrite protection.* Before copying one file over another with the same name, MOVE, COPY and XCOPY now all warn the user first. This behavior is disabled during batch file processing to maximize compatibility with existing batch files.
- *Higher capacity DEFRAG.* By using XMS, DEFRAG can now defragment disks with approximately twice as many files as previously. The limit is approximately 20,000 files, but can be higher or lower depending on disk configuration.

Finally, we have removed DOSSHELL from MS-DOS 6.2, and placed it on the MS-DOS 6.2 Supplemental Disk. We chose to move DOSSHELL as its usage among MS-DOS 6 users is nearly zero because of the explosion in Windows adoption. It also keeps the MS-DOS cost-of-goods down, which helps us continue to extend very attractive pricing for 6.2 customers.

How to Compare MS-DOS 6.2

Users have a choice among real mode, desktop operating systems. In comparing MS-DOS to the other choices, there are a number of overarching user concerns one should consider.

Compatibility is of utmost importance

As productivity tools, PCs are only as useful as the applications they reliably run. If an operating system prevents users from getting their work done by not completely supporting their applications or performing unpredictably, then they will be dissatisfied regardless of how many new, interesting features it contains. Therefore the MS-DOS team takes the extra time and work to conduct large beta tests and why other software vendors use MS-DOS as their testing platform. Compatibility testing should be a key element in evaluating any operating system.

Feature quality, not just quantity

Traditional product evaluations have essentially been feature counts. Unfortunately this approach ignores quality of implementation and the relative importance of the features to users. The developers on the MS-DOS team have always spent their time getting a few features right as opposed to developing many semi-functional features. For example, much time was spent getting Setup and MemMaker to work seamlessly on systems running Stacker or Superstor, and yet this work appeared in very few feature checkbox charts.

Our customer research validated our choice to focus narrowly: If a user had anything less than a positive experience with any one of the key components in MS-DOS 6 - specifically: kernel compatibility, Setup, DoubleSpace, MemMaker/EMM386 or SmartDrive - they were dissatisfied with the entire product. Therefore product evaluations should consider the quality and completeness of feature implementation, not just the quantity of new features.

Benefits should be seamless

A body of knowledge - user experience, books, in-house help desks, and so on - accumulates over time on how to use and manage the operating system. The more an operating system requires users to change their behavior, the more negatively it is viewed as yet another product to be learned and supported.

That is why the MS-DOS team invested so much time ensuring that features such as DoubleSpace, DoubleGuard and MemMaker are easy to install and provide meaningful benefits that do not require users to change how they interact with the operating system. Users look disapprovingly at differences unless there are extremely compelling reasons to justify them. Therefore evaluations should consider the relearning costs associated with the benefits promised by a new operating system.

Beyond MS-DOS 6.2 - The Future of MS-DOS

Concurrent with the development of MS-DOS 6.2, a leap-frog team is working on the version of MS-DOS beyond MS-DOS 6.2. Although the next version of Windows, code-named "Chicago," will not require MS-DOS, we will release a standalone version of MS-DOS because people work differently, and some prefer a non-graphical operating system.

This future version of MS-DOS will be based on Chicago technology, and will release at approximately the same time. Like Chicago and Windows 3.1 today, it will include key features such as the ability to multi-task MS-DOS-based applications as well as support for high-performance device drivers that run in protect mode and have no conventional memory footprint. The consistency in the device driver model between Chicago and MS-DOS will lead to a huge selection of robust drivers and thus make it easier for customers to add peripheral devices.

In addition, like all major releases of MS-DOS in recent memory, this version will be compatible with existing applications and device drivers, and will not provide any new sets of APIs to support new classes of MS-DOS-based applications.

Appendix I: Technical Details

DoubleGuard

The stability of MS-DOS depends on system extension programs being well-behaved. Since any program can write to RAM occupied by the MS-DOS kernel or its related components, a misbehaved program can cause instability, a system crash or data loss. Consequently, the MS-DOS 6.2 version of DBLSPACE.BIN incorporates a technology known as DoubleGuard, and its function is to monitor DBLSPACE.BIN's own memory to detect and prevent improper writes, or 'trashing,' by other programs.

DoubleGuard uses checksumming to detect trashing, and its particular checksumming technique is a variation on the TCP/IP 16-bit one's-complement checksumming. DoubleGuard checksums DBLSPACE.BIN as follows:

Main code block
At the time of DBLSPACE.BIN's final placement in memory (which typically happens when the line DEVICE=DBLSPACE.SYS /LOAD is encountered in CONFIG.SYS), DoubleGuard checksums the bulk of DBLSPACE.BIN's code. It then periodically rescans this code in DBLSPACE.BIN to ensure that the checksum has not changed.

MDFAT and BitFAT
When reading a compressed drive, DBLSPACE.BIN reads portions of these two internal Compressed Volume Files (CVF) structures into its own in-memory buffers, and when writing it modifies them and then writes them back to the disk. DoubleGuard checksums these buffers continuously as the MDFAT and BitFAT are critical data structures. It checksums the buffers immediately after any read of a compressed drive, adjusts the checksums when the buffers are modified, and then verifies the checksums before any write back to the disk. In addition, DoubleGuard verifies the checksums before using any information in the buffers if a certain amount of time has passed since their last usage.

File Fragment List
Another critical DoubleSpace data structure, the File Fragment List, is used to track the location of the CVF on the host drive. It is calculated when a CVF is mounted, and if corrupted data can be written to the wrong cluster on the host drive and result in severe data loss. Consequently, the File Fragment List is checksummed when a CVF is mounted, and the checksum is verified before each use of the list.

If any checksum fails to verify, DBLSPACE.BIN halts the system immediately since data loss could be imminent. It displays a message on the screen containing a brief description of the problem, and an error code pinpointing which of the four memory areas outlined above was corrupted. The error code is designed to help Microsoft Product Support Services determine which program caused the corruption. At this point the system can only be restarted by turning it off and then on, and our purpose in forcing the user to restart from scratch is to prevent the corruption in RAM from being propagated onto the disk.

ScanDisk

ScanDisk, the new disk scanning and repair tool in MS-DOS 6.2, can detect and correct the following types of errors:

Logical errors
The two most common logical errors found on both uncompressed and DoubleSpace drives are lost clusters and crosslinked files. Lost clusters are pieces of files or directories that have no names attached to them because of data loss elsewhere on the drive or incomplete file deletion. ScanDisk can find lost directories and reattach them - often recovering entire trees of lost data - and can

reattach remaining lost clusters as files or free the space they are using. "Crosslink" is the term used when more than one file occupies a single cluster on a drive. Consequently, if you change one file, the other file changes as well. Instead of using the traditional means of resolving a crosslink by truncating or deleting one or both files, ScanDisk uses an innovative method and resolves them by dividing the crosslinked clusters and giving each file its own separate copy of the shared data.

DoubleSpace-specific errors

ScanDisk also has a substantial amount of intelligence dedicated to repairing errors specific to DoubleSpace drives. It can detect and repair a wide range of errors in a CVF that would otherwise result in wasted storage space or data loss. Also, ScanDisk operates equally well on mounted and unmounted CVFs; if DoubleSpace cannot mount a CVF because it is damaged, ScanDisk can reconstruct or repair every area of the CVF that is needed to make it mountable and error-free.

Physical errors

ScanDisk checks for physical damage by surface scanning a drive. During a surface scan, each area of the drive is tested to ensure it can be read from and written to properly. If an area of the drive fails, ScanDisk relocates the file or directory using the damaged area, and then marks the area to prevent its use in the future.

ScanDisk requires 350K free conventional memory to operate and makes use of additional free memory to increase the speed of its analysis.

System protection in MS-DOS 6.2

A great deal of effort was invested in 6.2 to protect the user from a range of problems that may arise on their system. As examples, MS-DOS 6.2 protects against:
- Loss of power during
  - √ installation.
  - √ compression of a disk.
  - √ uncompression of a disk.
  - √ resizing a compressed drive.
  - √ defragmentation.
  - √ running of MemMaker.
- Usage of older, incompatible versions of various caching software and disk partitioning software such as Disk Manager and Speedstor.
- Compression of a disk with bad hard disk sectors.
- Trashing of DoubleSpace's code and in-memory buffers by another program.
- A driver or TSR hanging the system while running MemMaker .

It is important to note, however, that MS-DOS 6.2 does not protect against everything. As examples, MS-DOS 6 2 does not protect against:
- Random or sporadic physical hard disk failure
- Random scribbling on the hard disk by errant programs or improper user changes to the hard disk using a disk editor tool.
- Bad memory not caught by the CPU (as a parity error), BIOS POST (Power-On Self Test) routines or HIMEM's new memory test.
- Faulty upper memory blocks, such as those created by improper usage of EMM386's I= parameter.
- Powering off the computer before returning to the C prompt while using SmartDrive's write-behind caching. Note that write-behind caching is no longer installed by default.

Appendix II:
A Compression Comparison - DoubleSpace and Stacker 3.1

This document provides information to help users answer a basic question: Given that DoubleSpace comes as part of the operating system, is Stacker worth the time and expense?

Safety
Safety is the critical measure of a compression product. In terms of real-world testing, as measured by installed-base size, both products are well-seasoned. DoubleSpace has about 4 million users; Stacker software has about 1 million by our best estimate. The following table indicates where the products stand concerning the other relevant safety features.

Safety Features	MS-DOS 6.2	MS-DOS 6	Stacker 3.1
Integrated compression	Yes	Yes	Yes, using MS-DOS 6 integration technology
Handles loss of power during compression	Automatically restarts after power loss	Automatically restarts after power loss	Requires complete decompression after power loss and then recompression
Checksumming	DoubleGuard continuous checksumming protects against data corrupted in memory being written to disk .	None	Does not protect against data corrupted in memory being written to disk. Calculates checksum after writing to disk.
Auto Uncompress	Yes	No	Yes
Surface scans disk before compression	Yes	No	Yes
Repair tool	SCANDISK	CHKDSK	CHECK
Scan & Repair compressed drive	Yes	Partial	Yes
Scan & repair host drive	Yes	No	No
Resolve crosslinked files	Yes	No	No
Repair unmountable drives	Yes	No	No

Performance & Compression Ratios
Press reviews indicate that DoubleSpace and Stacker are equivalent performers. In their September 14, 1993 review on DOIS utilities, PC Magazine's benchmark found Stacker about 2% faster than DoubleSpace. Like performance, DoubleSpace and Stacker compress data about equally well. On a representative mix of data, Stacker's overall compression may be about 4% higher.

Other features	MS-DOS 6.2	MS-DOS 6	Stacker 3.1
Default memory usage	39K	43K	47K
Min. memory usage	34K	43K	39K
Automounting	Yes	No	Yes
Supports compressed floppies on any PC	No	No	Yes
Windows utility	Yes	Yes	Yes
Defragmenter	Yes	Yes	Yes
Drive letter control	Yes	Yes	No
Recompress utility	No	No	Yes
Conversion utility	Yes- from Stacker	Yes- from Stacker	Yes- from DoubleSpace

Appendix III: Compatibility Testing

Compatibility Testing - In General

This document outlines a series of tests that we run as part of internal testing efforts. They are tests designed to uncover problems and test an operating system's ability to handle error conditions and complicating factors. Consequently, they are more effective at finding problems than, for example, simply booting Windows or WordPerfect on a system to ensure that they run.

The only way to truly test MS-DOS compatibility effectively is through a large, diverse beta program. Basic applications testing in a lab is a first pass, but unless such testing were done on a wide range of hardware and software configurations, it is unlikely it would uncover significant incompatibilities in a released operating system product.

In the absence of a beta test, it may be possible to simulate compatibility testing through the testing of common boundary cases and error conditions, and introducing common complicating factors to see how the operating system handles them. The tests below are intended to investigate such boundary conditions. If the operating system causes or fails to prevent data loss, or leaves the user's system unbootable, this would be considered a serious incompatibility. Loss of functionality in either the operating system or an application would also be considered an incompatibility.

Setup Tests
- Setup over a system running compression: DoubleSpace, Stacker 3.0 and 3.1, SuperStor Pro
- Setup an operating system other than DR DOS over a DR DOS system with password protection or delete-tracking enabled
- Setup on a compressed system that has an estimated compression ration of 1.6 or higher and reports just enough free space to fit the operating system
- Setup DR DOS 7 over a compressed DR DOS 6 system. Test several common conditions: (1) A memory manager is loaded before the compression driver SSTOR.SYS in DCONFIG.SYS, and so is loaded from the host drive before the drive swap takes place, (2) A storage device driver (such as a Bernoulli driver or Hardcard driver) is loaded before SSTOR.SYS.
- Setup DR DOS 7 over an MS-DOS 6 system (compressed or not) that: (1) has had MemMaker run on it; (2) has multi-config menus; (3) loads resident programs such as doskey, undelete, vsafe or interlnk

Multitasking compatibility and error-handling

The following tests are designed to check multitasking error handling and applications compatibility in DR DOS 7, and should all be run with its native memory manager loaded as well as third-party memory managers such QEMM, Netroom or 386Max:

To check if the timer is being virtualized properly
- Run a game that reprograms the timer, such as Lemmings or Falcon. Switch out. Switch back
- Run two games that reprogram the timer, like those above, at the same time and switch between them
- Run one of the above games in one session. In another session, run a program known to behave erratically if the timer has been improperly virtualized, such as MS Word or Works for DOS. Switch between them, performing edit tasks in the second session.

To check if the ports are being virtualized properly
- Run two comm apps and download data in both sessions. Check that the data as downloaded correctly in each session.
- Run a comm app and download data in one session. In another session, run a disk-intensive application such as a database or a compiler. Verify data integrity in each session.

To check if the floppy controller is being virtualized properly
- Run a backup application to floppy using its fastest DMA setting in one session. In another session, run a disk-intensive application
- Run a backup application to floppy in one session. In another session, write to the same floppy drive
- Install an application from floppy in one session. In another session, write to the same floppy drive
- XCOPY to a floppy in one session. Switch to another session. Remove the floppy disk

General error-handling
- Install an application from floppy that creates a new directory as part of installation in one session. In another session, copy a series of files to that directory
- Connect to the net and start XCOPYing large amounts of data in one session. In another session, do the same. Let both session continue until disk-full. Should test on both a compressed and uncompressed system. On the compressed system, should test with typical, highly compressible and incompressible data.
- Same test as above, except in one session XCOPY data from another PC using DR's FILELINK utility instead of over the network

Applications compatibility
- Run an application and open some files in one session. In another session, run a disk maintenance utility, such as DR's DISKOPT defragmenter, NU's Speedisk or NDD, or PC Tools' Diskfix.
- Run a disk maintenance utility in one session. In another session run a disk-intensive application or another disk maintenance utility. If the application refuses to run in a multitasked environment, note the steps necessary to return to a non-multitasked environment in order to run the application.
- Run an application that reprograms the screen fonts, such as PC Tools or Norton Backup in one session. Switch away. Switch back.
- Repeat the same test as above with Autocad
- How does one run Windows? Does DR DOS's multitasking have to be disabled?
- Install each of the three major memory managers: QEMM, 386Max, Netroom. Run their optimizers while multitasking is active.

DPMS
Each of these tests should be run with DR DOS 7's DPMS drivers loaded (at minimum, Stacker and Netware). In addition, the tests should be run bare and with other memory managers installed and optimized: DR's EMM386.SYS, QEMM, 386Max and Netroom with Cloaking on and off.
- Run a series of VCPI and DPMI apps: Autocad 386, Lotus123 3.x, Fox Pro (DOS version), Paradox (DOS version), Borland C++
- Run Windows. Under Windows, run a series of Windows apps, DOS apps, and DOS-extended VCPI and DPMI apps
- Run an app that requires a DPMI server: Visual C++, for example

Compression testing
These tests would apply to any operating system that provides compression.

General robustness and disk full
- Create a bogus UMB by improperly mapping over memory using I= such that the system does not hang on startup and you can load programs into the UMB. Load the compression driver into the UMB. Do various disk operations to trigger the memory conflict. Load driver into stretched UMB, start windows
- Fill a drive. Fragment it severely. Copy on a series of small, highly compressible files. After copying, confirm that the files are intact.
- Load Delete Sentry from MS-DOS 6 or a similar TSR from NU or PC Tools. Create situations where Sentry is force to purge when copying a file and when growing a file (to what is presumably a nearly full drive). Also, create situations such that Sentry is forced to purge its "deleted" files when copying a file and growing a file yet the command still cannot complete for lack of space (for example, delete highly compressible files, and then copy a large uncompressible file).

- Under Windows, connect to the net and begin XCOPYing large amounts of data in a background MS-DOS session. In another background session, do the same. Let both sessions continue until disk-full. Should test with typical data, highly compressible data, and uncompressible data.

Compression setup testing
- Fill an uncompressed drive with 16:1 files, and leave several MB free. Run the compression setup.
- Repeat the same test as above, except initially fill the disk with ZIP files
- test damaged disks (e.g., cross-links, lots of lost clusters)
- Cut the power during -
     Free Space check on host
     Scanfix check of drive
     Compressing files (i.e. copying files from the host to the CVF)
     Preparing to spawn Defrag
     Defragging CVF

Uncompress testing
Attempt to uncompress a compressed drive:
- Full of 16:1 files
- Full of ZIP files
- With Delete Sentry and other or other similar TSRs loaded on the system and files ready to be purged on the compressed drive
- With Delete Sentry and other or other similar TSRs loaded on the system and files ready to be purged on the host
- That has too much data to uncompress. In this scenario the user should get a message telling them to delete N bytes in order to proceed. Delete N-1 bytes and attempt to uncompress. Delete N bytes and attempt to uncompress.
- That is heavily fragmented
- In a low memory condition (less than 400K free after loading CONFIG.SYS only)·
- Where data on the compressed drive would fit if host had cluster size < = 8K, but host has clusters > = 16K
- With a huge number of empty subdirectories
- Filled with very large files (at least 20MB)
- With hidden/system files near the end of the CVF, like those created by Norton's IMAGE or PCTools Mirror
- With duplicate filenames in the root directories of both the CVF and the host
- With a subdirectory in one of the root of the CVF has the same name as a file in the root of the host
- That is empty
- That has lost clusters, crosslinked files or bad sectors

Also, test uncompress of
- Multiple CVF's on multiple hard drives
- Single CVF on a single host drive
- Multiple CVF's on a single host drives
- Multiple CVF's on multiple host drives for both CIP & CFS

Also, while uncompressing, cut the power during
- Free Space check on host
- Scanfix check of drive
- Copying of files from the CVF to the host
- Preparing to spawn Defrag
- Defragging CVF

Memory management testing

These tests would apply to any operating system that provides upper memory management. The first three tests would only apply to those operating systems that also provide an automatic optimizer.

- Optimize a system with Stacker 2.0, 3.0 or SuperStor Pro installed
- Optimize a system already running another memory manager such as QEMM, 386Max or Netroom
- Interrupt the optimization process in the middle by turning off the power or rebooting the system. Note the recovery process
- Test programs that loadhigh automatically when DOS UMBs are present, such as Mirror from PC Tools or Smartcan from NU, or programs that can detect DOS UMBs, such as Manifest, to ensure that all operating systems provide standard DOS UMBs via the documented Int 21h, function 5802h and 5803h APIs

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