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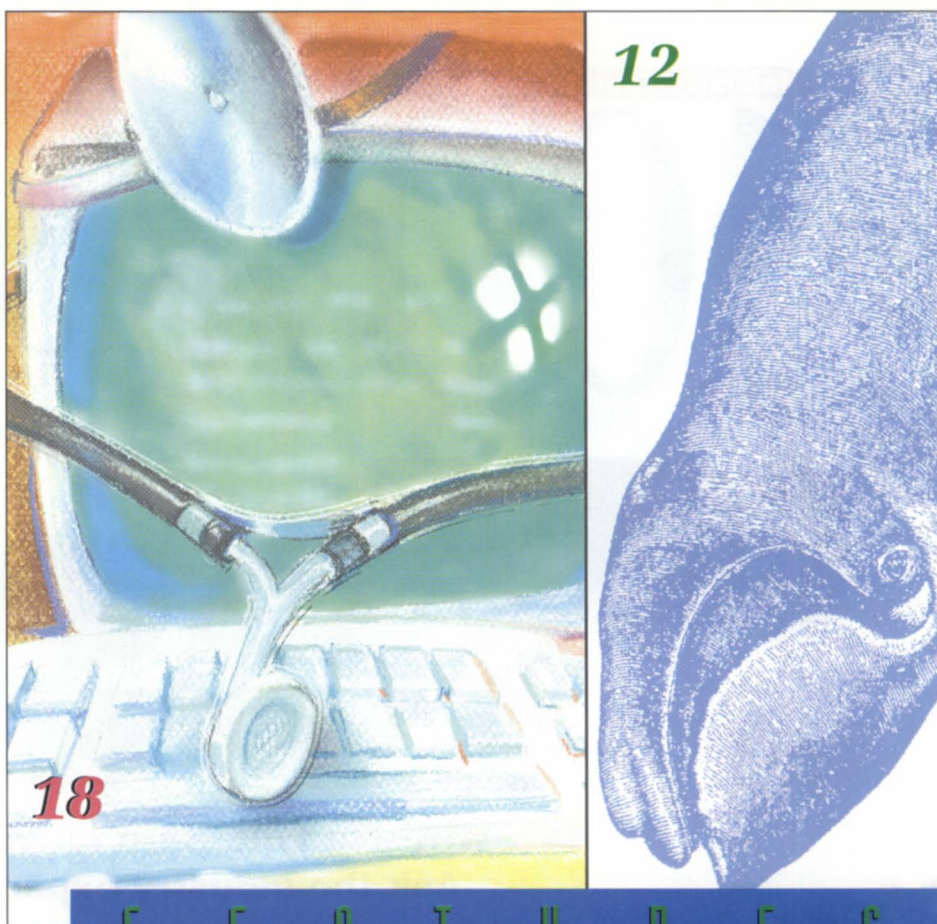


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Cover art by Daniel Rodriguez

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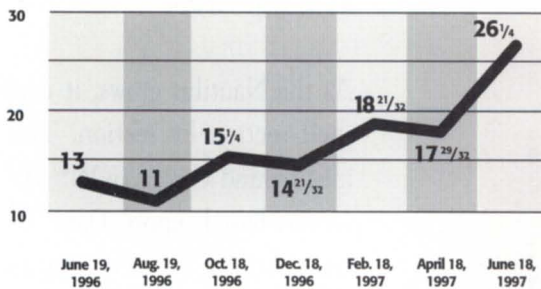
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Vital Signs Show Viability

ComputerWorld

DOUBLE TIME

Data General's stock has been slowly and dramatically rising



ComputerWorld's June 23 issue highlighted DG's remarkable stock rise over the last year, as shown above. Fueling that rise, they claim, has been the seven consecutive quarters of increased earnings and market acceptance of the company's Pentium-based Aviiion server and Clariion storage lines. One analyst who was interviewed, Pater Labe, said that DG's strengths are its reputation, installed base and "excellent products technically."

NADGUG, too, is posting gains as we head into the Conference. A year ago this month there was much trepidation about NADGUG's future. A restructured conference format had concerned both members and supporters, and, frankly, NADGUG was in a fiscal hole. Conference '97 attendees will be treated to the Treasurer's report and new budget which will show that NADGUG is now "in full recovery!" NADGUG is in the black and heading into the next year with high hopes and solid plans for continuing to meet users' needs.

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DG Showcases Healthy Future

Industry greets Data General's new product launch with enthusiasm.

by Shannon McIntire, DGFocus staff

On June 10, Data General and Clariion held a major international press conference to unveil the new Aviion 20000 server and Clariion FC5000 disk array. The event was a resounding success. "It was standing room only here in Westboro," said Gordon Haff, Product Manager for Enterprise Servers, Data General. "The announcement was also simulcast via satellite to London and that [event] was packed as well."

DG's announcement has generated excitement in the industry. ComputerWorld recently ran an article saying that "Wall Street's opinion of Data General Corp. has been as upbeat as the company's stock." Data General's stock has been slowly rising over the last year and these new products look to help continue that trend.

The Aviion AV 20000 server uses Non-Uniform Memory Access, or NUMA, architecture which extends traditional multi-processing systems to very large-scale systems. Haff remarked that the AV 20000 gives DG "a new high end for the Aviion product line. Obviously, our Intel servers have been very well received in the market and have allowed us to grow the Aviion business over the last few quarters. . . . With the AV 20000, we can extend the Aviion product line upwards, which allows us to enter new markets, such as large scale data warehousing."

The AV 20000 offers an alternative to building a large SMP system piece by piece. "In the past," Haff said, "if you wanted a large scale system, you had to do everything yourself from the ground up. This is a very expensive and time consuming proposition." The AV 20000 makes that unnecessary at an affordable cost.

For established DG users, the new server offers a significant performance boost. "With the AV 20000," Haff said, "we now have an Intel system that provides a very strong upgrade path where you can more than quadruple your performance in the Intel product space.

"I'm very excited about this system," Haff continued. "I think it allows us to move forward in the Intel line into larger scale servers. It provides a strong upgrade path for existing customers in OLTP and other applications. And it lets us enter some interesting new server areas." The system has a very competitive entry point price, so even someone who does not need a big, high end system now can buy at the entry point confident of having a strong growth path when they need it.

Also at the June 10 press conference, Clariion, a DG company, announced a new series of storage solutions using advanced fibre channel technology. Clariion unveiled its strategy for delivering the next generation of high performance, highly available RAID storage for open systems. The strategy is based on a flexible new architecture called Multidimensional Storage Architecture, or MSA, and the new FC5000 Series disk array family which incorporates advanced fibre channel technology. Also introduced was a fibre channel upgrade path for the Series 3000 family.

According to Joel Reich, Manager of Product Marketing for Fibre Channel Products, Clariion, "The reason the FC5000 Series is unique is that it is comprised of different building blocks and components that allow you to match a storage system's configuration with the application requirement. Most other storage systems are unitary storage devices. In other words, one big box with a fixed relationship between the number of disk drives and the amount of processing power in the storage system." This type of architecture limits the deployment of storage in a given application environment. With a modular system like the FC5000, a user can match the application profile with the storage system instead.

For users with the Series 3000 disk array, now there is an easy upgrade path to fibre channel. Reich said, "If you have Series 3000 SCSI products, there is a very simple three board upgrade that you can do." It takes little over an hour and does not affect data on the array. △

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SAFETY IN NUMBERS: DG LAUNCHES SECURELINE

Data General has aligned with several leading providers of security software to provide Secureline, the strongest Internet/Intranet security offering in the industry.

With their new Secureline family of products, Data General addresses the growing problem of Internet security. "As more and more organizations use the Internet to transact business, security has become the major concern, and that concern is well justified," said Bill Wilson, senior vice president of Marketing for Data General.

Research has shown that computer break-ins are on the increase. A recent study by the Computer Security Institute found that almost 50 percent of their respondents' computer sites had been attacked during the past year.

"A security breach can result in stolen confidential information, corrupt data, shut down computer networks and damage an organization's image. The ultimate cost can be a company's livelihood itself," said Wilson. "Secureline is the industry's most comprehensive Internet/Intranet security offering."

DG has teamed up with the likes of BDM International and Microsoft to provide a total security package. "Our Secureline family combines the best security products with our powerful Avion server and Clariion storage platform and complements that with a solid service program that includes analysis, planning, implementation and testing," said Wilson.

"No other company in the computer industry can match this total solution."

Data General's Secureline family of solutions will include software from BDM International, CyberGuard, Microsoft and Raptor Systems. BDM provides Cybershield, the industry's most secure computing platform. Secureline also includes the CyberGuard Firewall, which uses a B1 level trusted operating system to provide an integrated enterprise-wide security solution. Raptor Systems contributes the Raptor Eagle family, which addresses the five domains of network security, and The Wall, an affordable applications level firewall designed for small to medium sized businesses. Microsoft Proxy Server, a secure Internet gateway which allows multiple users in organizations to access and share Internet applications, supports a wide range of applications such as RealAudio and VDOLive.

JADCO, one of Australia's leading Commerce Service Providers, has chosen Data General's Secureline family. "With Secureline, we get the security capabilities, the platforms, and the expertise we need to handle all of our security requirements," said Jacob Van der Eyk, JADCO general manager. "Our customers require bulletproof security for their electronic commerce services. We chose the Cybershield solution because it offers the highest level of security available." The Secureline offers both consumers and businesses the key to successful electronic commerce. △

DG Sets Sail with Oracle's Flagship

Data General will add Oracle8, Oracle's next-generation database for network computing, to its suite of supported Oracle products. Data General's family of Aviion servers, including the recently announced AV 20000, provide a highly scaleable, highly available, and cost-effective platform for the latest version of Oracle's flagship product.

Oracle8, the database for networking computing, manages large amounts of information securely, reliably and economically over computer networks. Oracle8 is a versatile information platform that enables high-speed transactions, better business decisions, and sophisticated object-relational applications. Built on a foundation of proven technology, Oracle8 is designed to lower an organization's computing costs, manage all types of data, and deliver faster information access to all kinds of users.

DG resells and supports the full suite of Oracle products on Aviion servers running either Microsoft Windows NT Server or DG/UX operating systems. Oracle8 will enable DG to not only meet the growing database needs of existing customers, but also pursue highly scaleable data warehousing applications in targeted industries such as retail, telecommunications, healthcare, energy, and financial services. △

—●● DG Hits NT Benchmark Record ●●—

Data General announced a record-breaking benchmark performance for SAP's R/3 Sales and Distribution standard application running on Data General's Aviion AV6600 and AV3600 servers. A total of 1300 R/3 benchmark users were simultaneously supported in a benchmark test performed in Walldorf, Germany. The average dialog response time was 1.76 seconds.

"The results of this benchmark further exemplify the ability of Data General hardware platforms based on the Intel architecture and the Windows NT operating system to accommodate enterprises with very large R/3 user populations," said Jose Leruth, Director of the SAP Alliance for Data General.

The client/server configuration used by DG included an AV6600 as the database server, 14 AV3600 as R/3 application servers, and two Clariion disk arrays with the database. △

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Ron Skates Puts DG on Track to Healthy Recovery

Industry Week

The cover story for Industry Week's May 19 issue featured DG's Ron Skates as it chronicled the amazing rebound DG has experienced over the past year.

From the mid-1980's to the mid-1990's Data General had fallen on hard times and Skates was placed at the helm in 1989 after three years of red ink. Despite the red ink, Skates held firm to his view that the company could be remade from within. His goal, the article states, "was to recharge the company with new product lines, new people, and a new sense of corporate will." Recharging has certainly happened. From a 1995 fiscal-year loss of \$46.7 million, DG has posted 1996 earnings of \$28.1 million.

The turnaround was not easy. In 1990, his first full year as CEO, Skates presided over the layoffs of 3,000 people in four months. Over time, the workforce was slashed by nearly three-fourths, from 17,700 to 4,950 today. He also ended the manufacture of components

that could be made by others. John Gavin Jr., DG's vice president and controller commented that, "The benefit of open systems was the commoditization of a lot of components, which allowed us to downsize the company." DG was freed to concentrate on designing computers.

Despite posting losses in nine of ten years, Data General was always able to maintain steady revenues. The steady cash flow allowed DG to continue to fund necessary research and development. "The central thing that kept this company alive," Skates commented, "is the technology."

The story of Clariion is illustrative. When DG was demonstrating a new Aviion line, a securities analyst noticed DG's backup data-storage device and told them, "That product's better than your computer." Heeding that comment, Skates decided to push the company into data storage—despite internal concern that it might hurt their Aviion business. It has become a very successful OEM business with revenues comprising 27% of the company's total.

While new products seemed to bode well for the company's renaissance, other obstacles to a healthy recovery surfaced. Sales of the Eclipse minicomputer line plummeted dramatically in the face of the PC-network computing explosion and the Aviion line was slow to gain market share. Then, adding to their difficulties, Motorola decided not to invest further in the 88000 microprocessor, which was the foundation of their Aviion line.

A key decision was made: to go with the Intel-based chip. The decision to go with Intel was in July 1995 and within two months DG reported its first profitable quarter.

Other new products continue to emerge— "The cost-cutting is over. The mentality here is one of revenue growth," claimed Gavin. △

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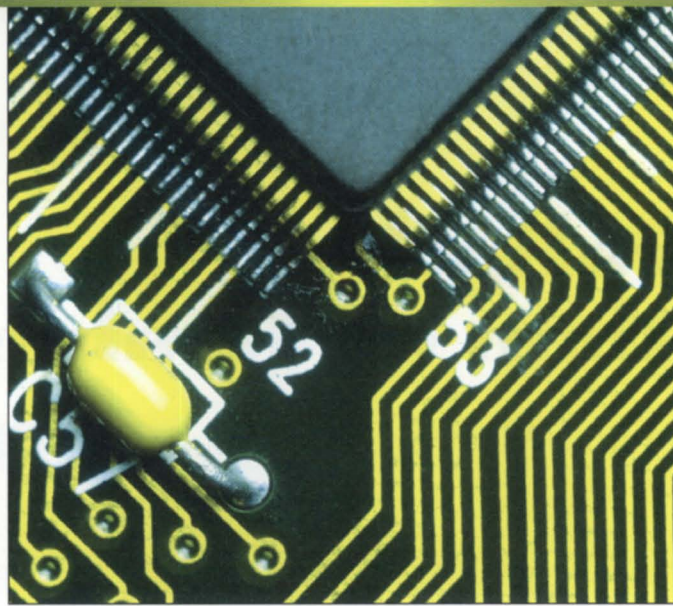
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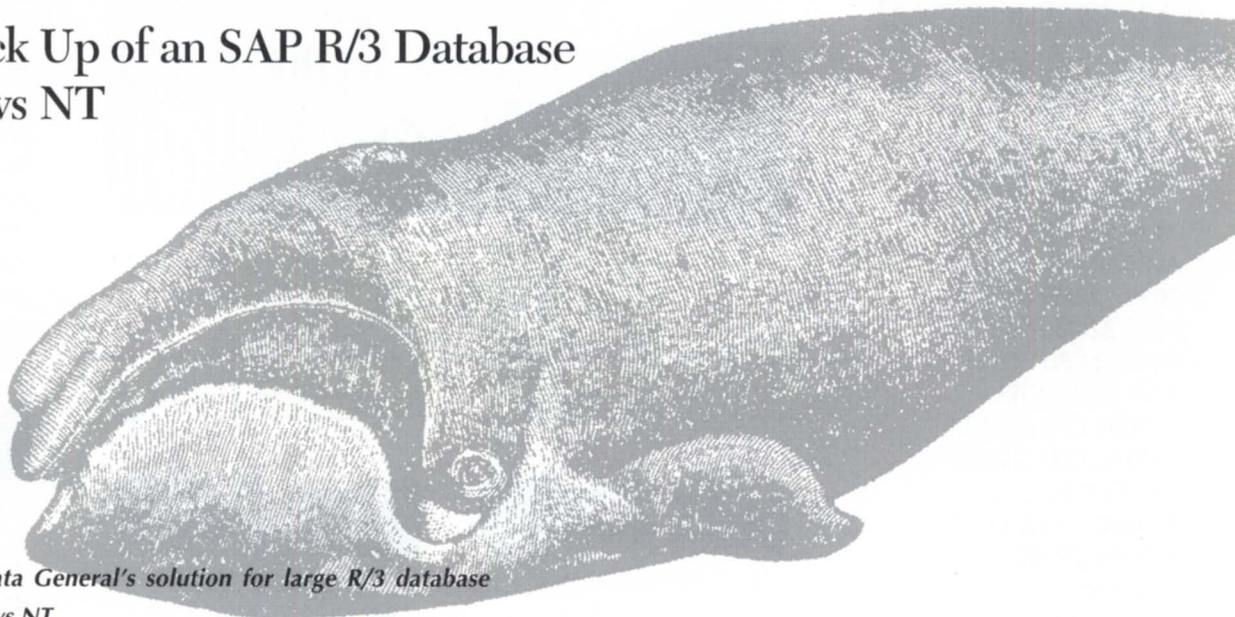
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DG's TeraBack: A Leviathan of Terabits

Online Back Up of an SAP R/3 Database on Windows NT



Jones highlights Data General's solution for large R/3 database backups on Windows NT.

by Dr. Katherine Jones, Special to DGFocus

Reliable backup and restoration of corporate R/3 data is critical in the data management schema of all R/3 users today. Information must be reliably and systematically backed up to safe media, and the integrity of the data must be maintained during the process of backup, the storage of the media, and the act of restoration. And because of the nature of the data in an R/3 database, its importance to the corporation is paramount.

But there is another goal: safe and systematic backup which does not hurt the production environment. Corporations simply can no longer afford to have their R/3 systems unavailable for hours at a time while backup processes are being run. With multi-national corporations using R/3 around the clock, access at all hours may well be required. There is no longer the nighttime "shift" in which production hosts are taken off-line and backed up, denying access to users. In a word, there is "no time for downtime."

Data General's solution to the problem is unique:

- A high level of RAID-protected data integrity on a tape array.
- Economical, high performing servers created just for backup with a minimum effect on a 7x24 operating environment.
- Back up for a terabyte of data for the price of a deskside server.

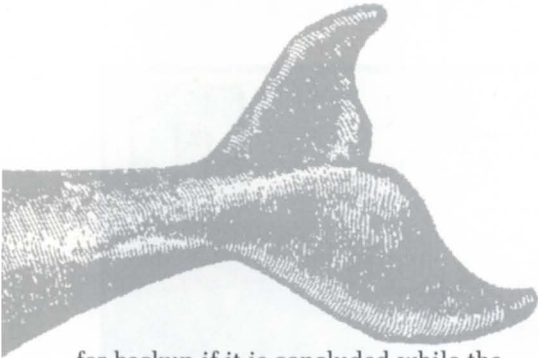
- A consistent, well-marked growth path for increasing R/3 users and their growing database.

The Role of Backup

The reasons for backups are often overlooked. Administrators back up corporate data as a safeguard against catastrophic failure in the computing environment. In cases where mechanical failures, espionage, acts of violence, or natural disasters like flood or fire may occur, the backed up information must restore vast amounts of data, and restore it in exactly the same manner as it existed on the original database. In addition, the factors of human and procedural error can make the need for backup more frequent and even more difficult to explain to your end users.

Rather like an insurance policy, a sound backup strategy for R/3 protects against events which one hopes will never occur. Yet, like that policy, it is essential to the well-being of the corporation and the computing enterprise that the strategy is sound, is tested, and makes sense for the business itself. Higher frequency backup without production impact, together with effective recovery, is key to maintaining satisfaction in the R/3 user community.

In backups, there are multiple factors to be considered. First, the value of the data to the corporation and the subsequent need for high availability in the backup process. Second, the time which a corporation can allow



for backup if it is concluded while the servers are off-line. And finally, the cost of the backup solution.

One of the biggest problems facing system and network administrators in the Windows NT environment is how to back up a large database without disrupting production. Traditionally, in order to back up a database, users and the administrators of a system have to stop using the database and the applications that it serves. Small databases can sometimes be backed up at night, but that is less viable in those businesses that have round-the-clock production environments like many R/3 sites. For such businesses, taking the database server off-line for backups is either not an option or too costly.

The Data General backup solution for a large R/3 on Windows NT implementation includes a configuration with Aviion servers running Windows NT Server for the R/3 environment; a SAP-approved database; Clariion fault tolerant disk arrays; the DLTArray, a high performing, highly reliable tape array; and TeraBack, a server engineered explicitly for those customers with very large databases and very small windows of off-line time in which to conduct backup.

TeraBack to the rescue

TeraBack is a hardware and software solution designed to provide over a terabyte a day of backed up data without impacting R/3 production systems. Based on Data General's Aviion Intel-based architecture and

Microsoft's Windows NT Server, TeraBack provides a solution to the loss of production time associated with database backups. TeraBack is a dedicated backup and restoration server which system and network administrators can add to an existing production database environment at a very economical price.

TeraBack provides many benefits in the R/3 environment. Administrators can back up the R/3 database

“In a word, there is ‘no time for downtime.’ ”

without interfering with company production because R/3 users continue using the database during the backup. Moreover, TeraBack integrates with any industry-standard backup tool and R/3 users experience no significant performance degradation. Using TeraBack can decrease the time the production system is affected by the backup process from hours to minutes. In terms of price/performance, TeraBack is extremely cost effective. Fortunately, TeraBack Management tools make it easy to use and easy to manage and it provides rapid backup when used in conjunction with Data General's DLTArrays. For DG systems, TeraBack can enhance backup in any Windows NT environment using Clariion fault tolerant disk arrays.

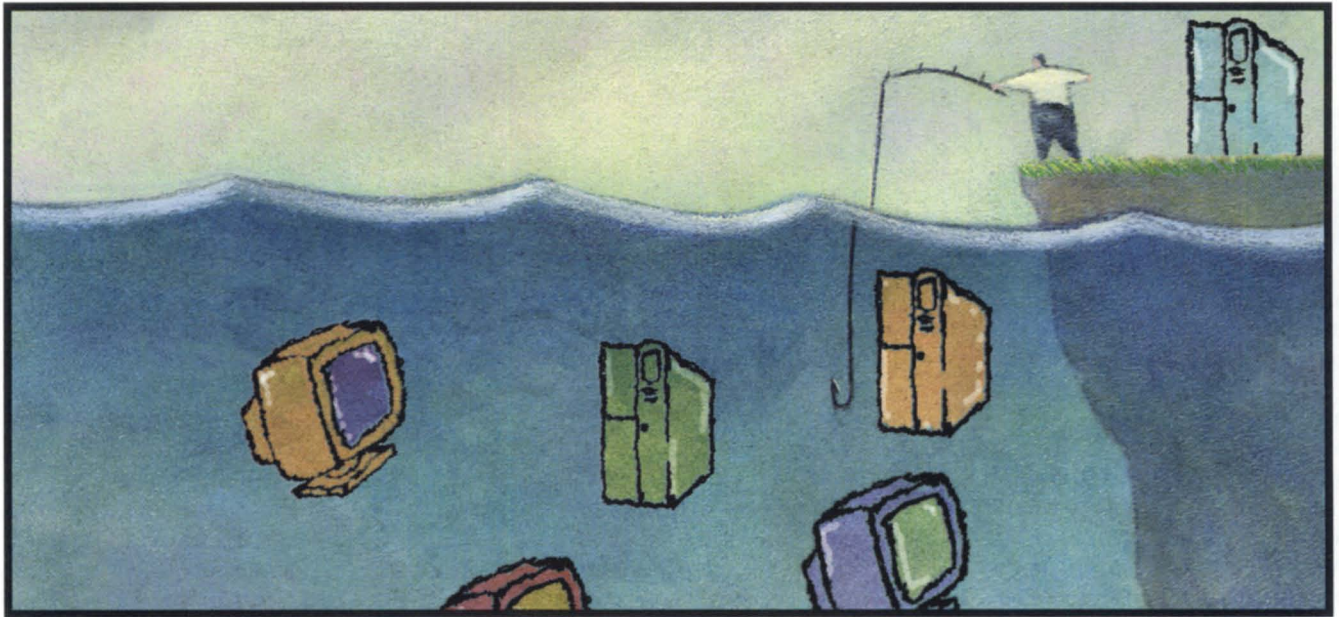
The DLTArray for R/3

The Data General Digital Linear Tape Array (DLTArray) and TeraBack working in concert can provide the safest, most reliable backup available with the least effect on the operating environment for the lowest cost. The R/3 databases and archive logs are backed up to Data General's DLTArray. The DLTArray protects investments through its expandability, accommodating growth through both the addition of disks and through its daisy chaining capabilities. After backup, it can create multiple copies of tapes for provision to disaster recovery sites, vaulting, and data restoration at production sites.

The DLTArray 4000 series complements both the Aviion family of servers and the TeraBack backup server by providing high availability, high performance, and high capacity along with a reliable tape storage subsystem. Data General is the first computer manufacturer to provide DLTArray technology to its R/3 customers. The array supports RAID level-1 “mirroring” and level-3 “data striping” concepts. Higher performance is achieved in the data striping mode (RAID level-3) of operation, in which striping data across two or four drives results in two to four times the data transfer rate of a single drive. Higher data availability is achieved by use of a parity drive. The presence of a drive holding parity information allows for continuous operation in the event of one

Continued on page 16

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tape drive failure.

The performance and capacity matches the needs of mid-to-large R/3 database environments as well as other applications that have the requirement for a high performance tape subsystem. With four DLTArrays, for example, a 100GB R/3 Oracle database can be backed within an hour, depending on the server configuration. The DLTArray looks and acts like a single DLT 4000 tape drive, but actually utilizes up to five DLT tape drives that function collectively as a single high performance and high capacity tape drive. To all standard host utilities, this subsystem func-

tions like a single DLT drive.

In the event of a failed tape media or drive, the array will continue to function, giving users full access to data, including the portion residing on the defective media or drive. This continuous operation feature will allow users to complete a backup or restore operation should a drive or tape fail or even be missing. Further high availability features include the N + 1 cooling and the optional N + 1 power supply. The array is supported by Microsoft's Windows NT. There is a Graphical User Interface (GUI) to configure and monitor status of the array for NT.

TeraBacks for R/3

The TeraBack Pentium Pro-based Aviiion system is an addition to the R/3 production environment. This low-cost, high performing dedicated server is connected to the Clariion mass storage sub-system and one or more DLTArrays. TeraBack provides an automatic way to get the R/3 system to the backup state.

When the backup starts, the system is quiesced, a checkpoint is taken, and Data General's Copy-On-Write (COW) capability is initiated. At that point no new transactions can enter the database and all those in process continue until they are finished. The backup server will start a static I/O driver which will copy all the pages and another COW I/O driver copies the "before" images of the pages which are written. The two combined images provide a transaction consistent view of the state of the database. TeraBack then reloads the data with a proper merge of the two copies to provide a transaction consistent reload. TeraBack backup servers can be daisy-chained to scale the system. Likewise, Clariion disk arrays can be daisy-chained and backed up by one TeraBack.

Anticipating the Variables

Backing up data concerns many aspects of computing technology, hardware and software. The elements which affect the speed of both the backup and the recovery processes include the computer itself, the operating system, the peripheral transmission devices, data transmission means, the database, the software products used for backup, the characteristics of the tape arrays, and the R/3 database itself.

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Under "normal working conditions" the following capacity and rate are likely to pertain:

| # of DLTArrays | GB Backed up per Hour |
|----------------|-----------------------|
| 1 | 28.7 G |
| 2 | 56.6 GB |
| 3 | 80.8 GB |
| 4 | 105 GB |

Thus, the use of the DLTArray will provide reliable backup for R/3 with linear scalability, depending on the number of arrays used. The backup scales over progressively more DLTArrays; one can add more DL-

TArrays or multiply the GB/hour to determine the time required for an off-line backup. The considerations here are those of timeliness versus cost. The DLTArray is the only array which can provide RAID striping for very reliable backup and is very competitively priced, making it the most cost effective solution in a very large site or for a very large database.

When TeraBack quiesces the R/3 database, two factors can affect the total time the backup will take: the length of time it takes for the running transactions to be complete and the length of time which has elapsed since the previous checkpoint. Because all changes

since the last checkpoint are in memory, and if a long time has elapsed such that there is a lot of working data in memory, flushing that data out may take time.

"Time" in the context of TeraBack is relative—TeraBack can copy a very large database to its local memory in the amazingly short time of 30 seconds to a maximum of a few minutes. Thus at a very low price point, TeraBack technology can revolutionize the impact of off-line backup on systems which need to run R/3 7x24.

Rapidity of backup to tape is in part determined by the number of DLT devices to which the back-

Continued on page 33

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Vital Signs:

DG's Healthcare Division

Behind DG's largest marketplace.

by Liz Syer, Data General Healthcare Marketing Division

Data General first became involved in the healthcare industry in the late '60s during the company's early days. Since then, healthcare has grown into Data General's largest vertical market. In fact, DG is one of the only computer companies to have a dedicated healthcare sales and marketing force today.

At DG, the Worldwide Healthcare Division represents 30 percent of the company's revenues with over 1,250 healthcare customers around the world. The question is, what makes DG's Worldwide Healthcare Division so robust and effective? According to Robert Iacono, Director of U.S. Sales, Worldwide Healthcare Division, success comes from a DG tradition of excellence with a blend of individuals possessing unique expertise in the industry.

"About as long as Data General's been in business, we have been affiliated with some of the premier hospital information systems vendors such as HBO & Company, CompuCare, Meditech, and Health Data Sciences," Iacono says. "These companies initially were attracted by DG's small and relatively inexpensive computers, but soon discovered that their software applications performed exceedingly

well on our platforms and technologies." DG's charter for the healthcare industry—to deliver the technology and services that enhance the competitive advantages of healthcare organizations—became clear and meaningful to these companies as well.

In the years since DG entered the market, healthcare has changed dramatically, evolving into a huge, dynamic industry. "The economics of the healthcare industry are no longer the same as they were even five years ago," Iacono observes. "The industry is consolidating. Large companies are forming and their needs are changing significantly." That's a primary reason why DG formed the Worldwide Healthcare Division—headed by Mike Worhach—as a separate, dedicated area to keep pace with this rapidly expanding and ever-changing market.

DG initially started selling information to hospitals (more acute care focused), but today, healthcare extends far beyond ill people in hospital beds—physician offices, health insurance administrators, managed care facilities, nursing homes and home health agencies are all a part of healthcare. Having already established a strong presence in hospitals, the Worldwide Healthcare Division expanded beyond acute care to proactively meet the demands created by



a changing industry. DG has developed relationships with vendors whose target is various agencies of healthcare, and there are plans to move into more new areas with vendor partners. As healthcare needs become greater, for instance, enterprise applications are necessary, and vendors such as PeopleSoft and SAP develop healthcare interests that were previously not there.

Prescription for Success

DG has long been an innovator in healthcare information systems. As a leader in introducing new technology to the healthcare industry, the company continues to expand its technology offerings to healthcare organizations throughout the world. It is part of the philosophy of doing business for the Worldwide Healthcare Division to

work closely with select business partners and support them with DG technology. According to Iacono, DG assigns channel managers and account executives to the software partner accounts who are directly responsible for that relationship. "They help the partners port their applications to DG platforms, whether it's Unix or NT," Iacono says. "The channel managers and

account executives work with them to provide expertise for quickly resolving technical issues." Given this strategy, DG can either sell with the software partners or support the sales process with DG's direct sales organization. "We have dedicated systems engineers who work with clients and business partners to maximize performance on our systems," he explains. An example

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of this type of partnership is described in the sidebar on page 20.

The Worldwide Healthcare Division also leverages DG's systems integration packages to provide additional value for partners and customers. Partners who do not handle enterprise-wide installations can take advantage of DG's Network Services to implement their network environment, such as NT. This ensures proper performance of their specific application on the platform. These value-added services create a more robust and attractive package for the partner's customers (see *DGFocus* June 1997 for more about DG Network Services).

Imaging and security are among the other value-added services provided by DG. Healthcare imaging includes archiving, storing, and reading medical images and records, as well as business office imaging. DG's Electronic Medical Record solution provides cost-effective imaging and document management software. Because this is highly desirable for many healthcare partners, DG's solutions make it easier to sell technology.

A major issue for all healthcare technology today is security on Internet/Intranet systems because of the ability to and convenience of accessing information. There is, however, a technology mandate for privacy and confidentiality because of the personal nature of one's medical records. That's why DG offers Cybershield, the secure Internet server. Cybershield is implemented in the software based on the DG/UX B2 Security Option. No other computer vendor offers a B2 security Internet/Intranet server. By leveraging DG's Internet expertise, healthcare organizations can gain ready access to the Internet for business use, for publication of information, and to establish an immediate Internet presence (For more on Cybershield, see the April 1997 *DGFocus*).

These value-added services strengthen DG's relationship with customers and partners. "Our goal is to technologically stay ahead of our partners," Iacono says. Many of those

partners are extremely specialized, such as CSC Healthcare Systems and CareWare Systems, that focus mainly on physician groups, while BancTec and HST focus primarily on the insurance claims administration branch of the industry. At DG, almost every aspect of healthcare has a partner to support it.

Giving a Good Diagnosis

"The healthcare industry, from an information technology budget perspective, has experienced phenomenal growth over the last couple of years," Iacono remarks. "With more than 20 percent market share in the acute care marketplace in the U.S. and Canada, DG's Worldwide Healthcare Division is poised to grow as the industry grows."

As for the future of this market, Iacono says that currently there is a huge expense in infrastructure that should continue as the industry seeks to integrate, affiliate, and consolidate. Traditionally, once hospitals implement their financial information systems, the focus becomes more oriented to the clinical information systems side (automated systems to support clinical diagnosis and treatment). Because the push is toward measuring clinical outcomes and managing a population's health, data warehousing is coming to the forefront to provide better information more quickly to clinicians that enable them to make evidence-based decisions for their patients.

Another area experiencing growth is in imaging services—from a records perspective as well as from the office and radiological perspectives. Rather than using film images and paper files, digital image files drive huge amounts of magnetic and optical storage. Iacono predicts larger investments will be made to this technology by physician practices as the technology becomes more prevalent, automated, and reliable in the eyes of physicians.

Why the City of Chicago Public Health Chose Data General

Working with an outdated information system is never any fun, but until recently the problems facing the City of Chicago Department of Public Health were especially frustrating. Employees were forced to fill out forms over and over again, patient scheduling was complex, case management had become increasingly difficult, and paperwork piled up to unmanageable levels.

The challenge was to find a computer system that would integrate Public Health's entire clinical, case management, and billing functions. The department administrators realized that clinic supervisors needed to access information quickly to assess patient needs more precisely and provide improved service. An accurate, consistent method for patient service scheduling had to be implemented because patient check-in was taking far too long. Additionally, redundancy and excess paperwork needed to be reduced. Users had been dealing with a system in which each program required a different form.

"We wanted suppliers with the flexibility and willingness to work with us, not just hand us some off-the-shelf package. We needed software tailored for our needs," said Patrick Lehnihan, Deputy Commissioner of Public Health. "Both companies were a good fit for us—Global Health with their services and software, and Data General for their equipment and performance." The city decided to turn to Data General and Global Health Systems for a solution. Global Health Systems provided an integrated public health information system running on a DG Aviiion AV 9500 computer with a Clariion disk array for continuous access.

Competitive evaluation showed that Data General provided the City of Chicago with the best overall system solution. With its symmetric multiprocessing architecture, the Data General Aviiion system scales better than other systems, so the department could grow as fast as business needs dictate, with no changes to application software.

The Global Health Information System now builds a single automated patient record that shares data across all programs, following patients as they visit multiple facilities at different locations. This efficient scheme facilitates treatment and gives workers accurate, timely records to track patients, monitor their progress, and provide case managers with appropriate reports.

Clearly the success of DG's Worldwide Healthcare Division comes from its ability to pay close attention to the market, meet its needs, and grow with the market. Iacono says, "DG has a unique ability to proactively respond to the marketplace, develop leading-edge technology, and wrap solutions and partners around it who are

major forces in the marketplace. We see our customers as valuable partners and the real key to our success." Δ

Liz Syer works for Data General's Healthcare Marketing Division. She can be reached at lsyer@hcdiv.us.dg.com. Contributing research: Shannon McIntire, DGFocus staff.

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◆ Windows Book Lets in Light

Windows Annoyances, a new book from O'Reilly & Associates, is packed with proven tips, tricks and workarounds for annoyed Windows users. It shows readers how to customize every aspect of the Windows 95/NT system, giving them more control over their Windows environment. Written for intermediate and advanced users of Windows 95 and NT 4.0, *Windows Annoyances* gives users a chance to take full advantage of the powerful new features in these operating systems. Contact: Sara Winge, 707-829-0515.

◆ Security for Web Surfers

Also from O'Reilly comes the new book *Web Security and Commerce* which takes a look at the real risks and security threats facing people and organizations who have come to rely on the World Wide Web. Entertaining as well as illuminating, it looks behind the headlines at the technologies, risks and benefits of doing business on the web. Contact: Sara Winge, 707-829-0515.

◆ Sharp's New Digital Camera

Sharp Electronics had come out with its first digital camera, the VE-LC1. It features a unique 270 degree rotating lens that enables the user to be in the picture simultaneously with other subjects and a 2.5 inch TFT color LCD screen that offers outstanding clarity while allowing users to see their subject while recording or during playback. The VE-LC1 includes Sharp's image transfer software which makes true seamless editing of images possible, ensuring that users can take advantage of the professional tools of photography. For instance, users can perform tasks such as retouching and enlarging. A multi-screen mode enables the user to see up to 16 "thumbnail" images onscreen at once for easy viewing and selection. Contact: Sharp Electronics, 1-800-BE-SHARP.

◆ Eagle Wins Boss Award

Eagle Software Inc. received the Best of Show Select Award from *BackOffice Magazine* at DECUS '97 in Cincinnati for Cabinet Converter, its premier migration tool. Ten awards were issued for products that proved to provide innovative solutions in the Windows NT environment. Andy Kratzer accepted the award for Eagle.

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Synching Shipments:

The Ins and Outs of ATM

Is the rival to the Ethernet right for you?

by Peter Macaulay, Senior Consultant, Data General Network Services

What is ATM? Well, let's just say this article is not the place to find out about communicating with bank teller machines! Perhaps you have heard that ATM is a hot new network technology which promises to work miracles on the LAN at your workplace. Or perhaps you heard it being attacked as something which would never replace a faster Ethernet and wondered what stirred up such passionate opposition. This article is an introduction to the subject. As such it begins in a fairly non-technical manner, but then unfortunately it has to get deeper into the network-communications technology to describe ATM properly. It eases back to more understandable description towards the end.

The full name of this network protocol is Asynchronous Transfer Mode. Why is it called Asynchronous? This is not the old PC COM-port RS232 asynchronous that you know and love, with start and stop bits for each character. In fact, bit detection is, for most media, quite tightly tied to a fixed speed clock; so it is synchronous, in the same sense that X.25 and Frame Relay are synchronous. The name was given because telephone companies, who contributed heavily to the ATM protocol design, were accustomed to time-division multiplexing of digital voice (and later data) in fixed channels. Their data always occupied a particular timeslot or group of bits relative to the clock and framing of the digital trunk lines—synchronized, in their terms. Since this new standard was for chunks of data which could arrive anywhere in the bit stream, the telephone companies, or TelCos, deemed it asynchronous.

In the original proposals for these protocols, ATM was known as one of the class of Cell Relay protocols. There are still some (not ATM-standard) Cell Relay implementations around. You may run across them, or hear them compared to ATM.

But why does ATM exist? And why were TelCos involved in what is frequently seen as a LAN protocol?

The original digital telephone system trunks allocated a fixed bandwidth to each current user for the time of the call. When the usage time scale is measured in minutes (or tens of seconds), it is true that the bandwidth required for speech is fairly constant. But if you go to a finer time scale, say tenths of seconds, voice becomes more "bursty," and there are moments of silence. Then when you get to compressed voice (vowel sounds = moments of constant frequency, and so compress to very small pieces of data) at the microsecond resolution of high speed digital trunks, there are then a lot of gaps in the data flow. A fixed constant bandwidth allocation be-

comes very wasteful. By fitting the bursts into small cells, and multiplexing them, you could squeeze more users onto the existing scarce resource (high speed digital trunk lines) and make more revenue without much capital spending. So, ATM was a way for TelCos to provide more service and make more profits without replacing trunk lines.

In addition, it soon becomes obvious that when you get to high-speed communication and very fine time scales, say the multi-megabit rates of T3 or SONET/SDH trunks, then not only voice, but compressed video and computer LAN data also look very bursty and fit nicely in clusters of small cells. So,

if this principle suits all of these types of communication, and becomes a widely available standard on many connectivity media, you can see that people might get very interested in using it. The following quote is from the ATM Forum public presentations, though to be fair, they have a vested interest in ATM :

"ATM has grown out of the need for a worldwide standard to allow interoperability of information, regardless of the 'end-system' or type of information. With ATM, the goal is one international standard. There is an unprecedented level of acceptance throughout the industry of both the technology and the standardization process. With ATM, we are seeing an 'emerging technology' being driven by international consensus, not by a single vendor's

"ATM was a way for TelCos to provide more service and make more profits without replacing trunk lines."

view or strategy. Historically, there have been separate methods used for the transmission of information among users on a Local Area Network (LAN), versus 'users' on the Wide Area Network (WAN). This situation has added to the complexity of networking as user's needs for connectivity expand from the LAN to metropolitan, national, and finally world wide connectivity. ATM is a method of communication which can be used as the basis for both LAN and WAN technologies. Over time, as ATM continues to be deployed, the line between local and wide networks will blur to form a seamless network based on one standard—ATM. Today, in most instances, separate networks are used to carry voice, data and video information—mostly because these traffic types have different characteristics. With ATM, separate networks will not be required. ATM is the only standards based technology which has been designed from the beginning to accommodate the simultaneous transmission of data, voice and video."

Reality Versus Hype

The promise sounds good, but how real is all this today? Actually, the phone companies have something like it already for voice. You probably have seen the advertisements for real ATM devices for LANs in computer magazines. And video? Well, if you were in Europe and watched last year's Atlanta Olympics on TV, the EBU (European Broadcasting Union) TV feed was actually digital video carried by Broadband ATM over Deutsche Telekom satellites. Broadband ATM was also used for some US and Canadian TV feeds.

For the EBU, it had to be digital video format because of the differing TV standards around Europe, and ATM so that they would get a smooth flow of video images. You may also have been able to watch the effects of ATM cell drop and video resync live and in real-time, as well.

“ATM has been designed from the beginning to accommodate the simultaneous transmission of data, voice and video.”

ATM and You

This technology is great for phone companies and TV networks, but what does this leading edge stuff offer to the home, or office, or workstation? The need for more network bandwidth is changing like system memory once did. You may remember when a few

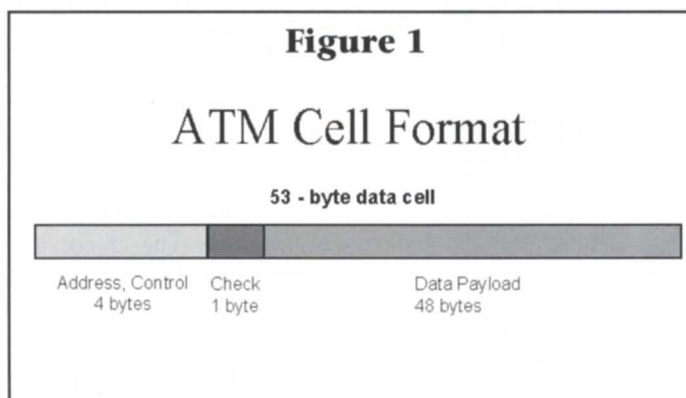
about eight times more memory than the corporate mainframe used to have, and that's just to play the latest games. Network bandwidth is going the same way now. Corporate financial people are working with multi-megabyte spreadsheets. Engineering and manufacturing drawings are all electronic. What used to be circulated memos now overflow your E-mail wastebasket, and the corporate Intranet is distributing graphic images down to the lowest-level clerical staff. All of these applications take network bandwidth and the number of network users is increasing. Everywhere you have a terminal, a drawing board, or a typewriter, you will need a network-connected PC (or something similar) sometime in the near future. With network bandwidth demands getting so high, some form of switched bandwidth segments and a high-speed backbone becomes essential. Just look at the growth of Ethernet switch sales.

That alone doesn't force you into using ATM. If you're going to change to some switched backbone, it makes sense to go to a form of network which is physical-medium independent, which will mix across different types and speeds of physical links without a lot of extra conversion and re-addressing, and which can also handle different types of information media. That way when changes and additions come in the future, you don't have the

trouble and expense of re-doing the whole network. You only have the trouble and expense of adding or modifying the new part. ATM is the only technology which provides this flexibility and convenience.

How's It Work?

So far the description of ATM has been promises and vague details. To see how those promises are really achieved, and to see if there are drawbacks to ATM, we have to get a little

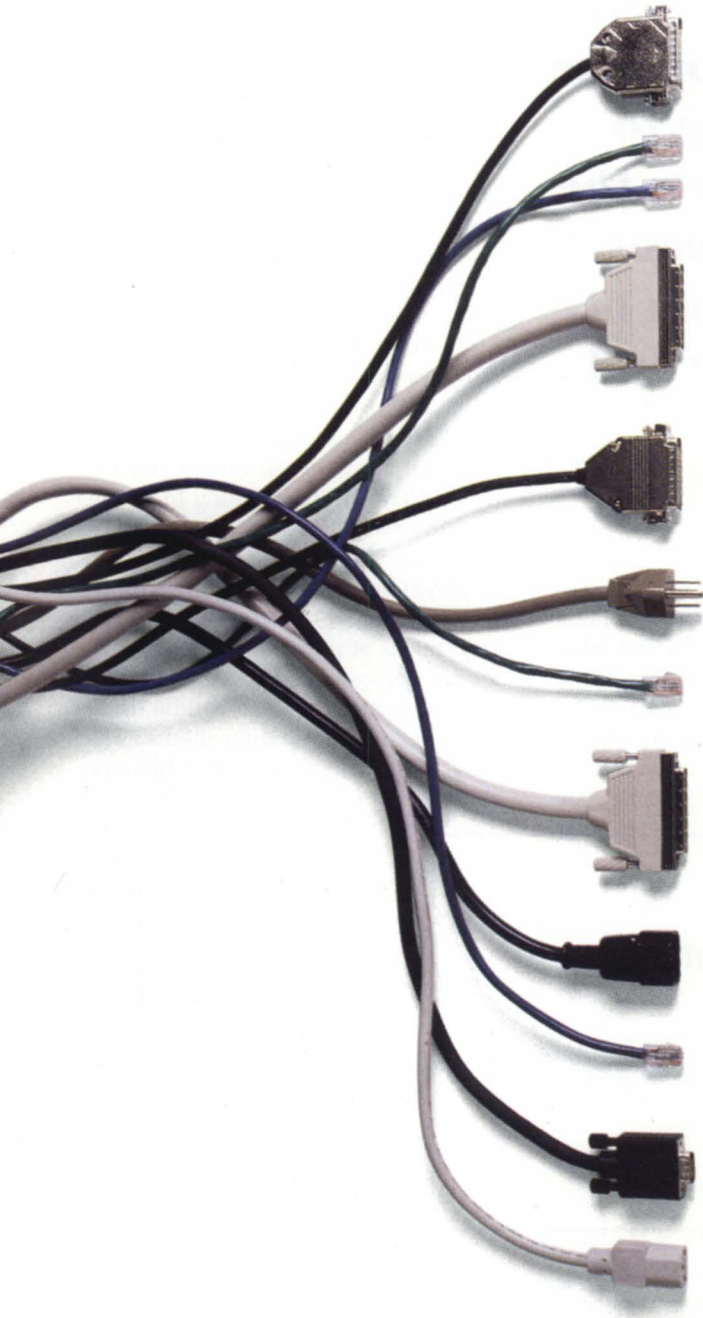


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deeper into the technical details. In using ATM, information is segmented into fixed length cells, transported to, and re-assembled at the destination. Being fixed length allows the information to be transported in a predictable manner. This predictability accommodates different traffic types on the same network. Each cell can be separately addressed, switched, and routed. Let's take a look at this basic unit, the cell.

A cell is fifty-three bytes—an odd, not-a-power-of-two, size for digital data. Why is that? Because it was designed by a committee, and of course they had to make compromises. A small cell, say 32 bytes, gives a more even flow for voice and video but has more overhead per unit of data. A larger cell, say 64 bytes, is better for data that

“A cell is fifty-three bytes—an odd, not-a-power-of-two, size for digital data. Why is that? Because it was designed by a committee, and of course they had to make compromises.”

comes in discrete chunks (like data frames on a LAN) but using larger cells could cause gaps in voice or jitter in video. The committee split the difference and decided on 48 bytes of user data per cell. Then they added a four byte header for the network to handle addressing and control, and one byte of checksum to make 53. The checksum covers only the header, not the user data. Cynical readers may consider that this lack of respect for the user's data integrity was typical of TelCo influence on the committee, but there was a genuine technical reason. The presence of a cell can be detected by calculating the checksum over the previous four bytes (or 64 bits, for some media types) received. If it matches, you've got a cell, and you are holding the address and control infor-

mation, so you can immediately begin switching it. This is pretty efficient.

Also, with this detection method there is no framing, sync characters, preamble, waiting for the token, or other overheads you have for other communication methods. This lack of prerequisites is part of what permits ATM to be adapted to so many physical carrier methods.

While it is nice to keep the overhead as low as four bytes for address and control, this leads to another question about addressing. You've all heard how the world is running out of IP addresses, and IP uses four bytes just for address alone, never mind control, and IP addressed objects are just a subset of the things which ATM promises to connect. Well, the header of the ATM cell does not contain the

full end-point address which the IP header has; it only holds temporary path and channel information. In order to start an ATM session, you must first “place a call” (using a standard CCITT protocol) to a 20-byte end address. This “call first” allows you to use a small header to get to a big end address. Also, during the calling phase you can establish what quality or “class of service” you want from the ATM network: guaranteed bandwidth, data integrity, and so on. This “class of service” is not a measure of better or worse quality; it is more a choice of characteristics to suit the type of data you are transferring on this call. For example, for a voice call you might allow cells to be dropped in order to preserve even flow of voice across a congested line, since your ear



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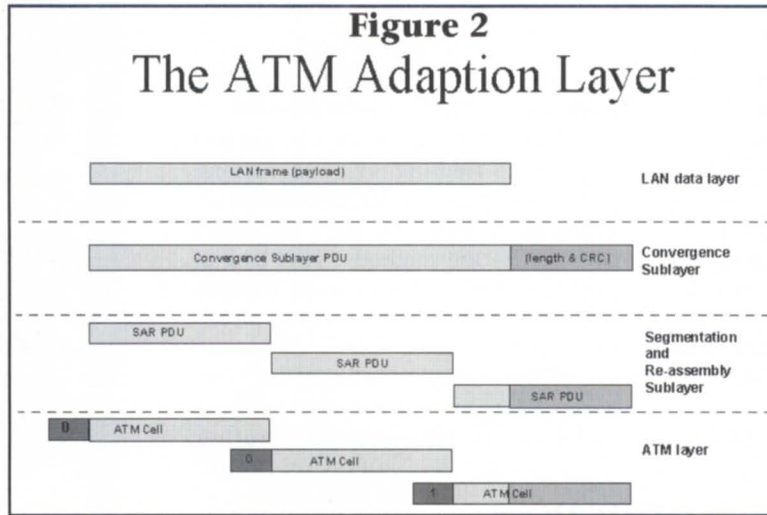
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corrects for milliseconds of dropout. But for a data call, you might want to have data slightly delayed rather than any cell dropped under congested conditions, since total data integrity is worth a few milliseconds wait. The fact that ATM is a "virtual circuit" protocol permits these negotiations on call setup so that prioritization, for example, is not an overhead on each packet as it is with some other protocols. It also permits faster switching using fewer resources. However, it does mean that each communication session is a connection between two endpoints, the called and calling parties, and this is very important when using ATM with LAN protocols, since many LAN

protocols use broadcast rather than one-to-one communications.

rently available or widely used? All the TelCo digital transmission line formats have standard ways of "packing"



ATM cells into their physical frames. So T1 (1.5 Mbps), T3 (45 Mbps), E1 (2 Mbps), etc., are all available. The same goes for all the TelCo-provided fiber types: Sonet and the rest of the Synchronous Data Hierarchy (SDH), and local campus and metropolitan net implementations of them. So both devices, and in some areas public services, are available. If a switched service is not available you can still "rent" dedicated phone lines and run ATM over

Which Transmission Medium?

Now I said earlier you could use any transmission media to carry ATM. But what transmission media are cur-

public bandwidth.

For LANs, the most popular implementations use multimode fiber (the same stuff you would use to carry 10baseFL Ethernet), modulated with OC-3c at 155 Mbps. You can also use Cat 5 copper cable with STS-3 NRZ coding to give 155 Mbps. Since these are standard cable types, you may have an ATM-ready wiring infrastructure today.

There is a standard for 100Mb fiber with a similar modulation to FDDI, but it is almost never seen in current implementations. There is also a standard which uses ATM over Cat 3 cabling at 25 Mbps, with compatible switching devices. This is popular in places where there were Token Ring networks which became overloaded, since 25 Mbps switched Full-duplex performance beats 16 Mbps simplex and wait-for-token every time, and you don't have to replace any cabling. Since most Unix shops didn't have TKR or Cat 3 cable, you only tend to see this form of ATM in ex-IBM environments.

The Adaptation Layer

Previous sections covered the cells and getting them across the network—but how about getting my valuable data into the cells? This philosophy of "one size fits all" really means that nobody fits exactly, and everyone has to be cut



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to fit the size. The process of doing that is contained in what is called the "ATM Adaptation Layer" or AAL. There were originally five types of AAL defined by the committees. Later they found that some were essentially the same, and others needed re-defining. You will mostly see AAL-5 used for computer networks.

There are two parts to the Adaptation Layer. One takes your user data—say, an Ethernet MAC layer frame—and adds some bytes for data identification and integrity checking. This is called the Convergence Sublayer or CS. The other sublayer (the SAR) chops the product of the CS into ATM cells, adds whatever is needed to know which are last (or first) in a set, and sends them across the network. On the other side of the net, this sublayer gathers all the cells together, passes them to the CS which can then identify and verify this unit of data, removes the CS specific bytes and sends it on its way—say, as a frame on an Ethernet. So the name SAR stands for "Segmentation And Reassembly."

Of course, once having been split and celled, the cells may be multiplexed with others on the same carrier network. That's part of the point of using ATM.

LANE and Other Confusing Acronyms

LAN Emulation (LANE): Once upon a time there were people inventing separate adaptation layers (or adaptation layer procedures) for each LAN protocol. This was known as "Stack Attack" and was considered a Bad Thing, since it would make for complex ATM devices and incompatible proprietary implementations. Many argued that since all these protocols co-existed on a LAN, they could, or should, be made to coexist on an ATM network if that net emulated a LAN. The problem with LAN Emulation is that first you

need an ATM address to MAC layer mapping. Second, most LAN protocols are reliant on Broadcast, which was not a function of ATM or any other "Virtual Circuit" protocol. These problems have been solved in the LANE standards, though they involved inventing a copy-and-repeat and a one-way party call function in switches to cope with the broadcast issue. Big growth has come in ATM use only since LANE (or, MPOA—multi-protocol over ATM) standards were finalized.


User Network Interface (UNI): This is the interface specification for the device which places or receives the calls, and their subsequent streams of

cells, but does not route or switch the packets for others. The ability to implement certain revisions of LANE depends on you having the appropriate revision of the UNI standard.


Net-Net Interface (NNI): Specification for call control and routing between switches on public networks which process and route calls for others. There are still some arguments among telephone companies about how each one implements this, so I wouldn't think about trying to place any international ATM calls just now. However, some form of NNI is needed in order to make LANE work. The ATM standards committees have settled on an extension of UNI called "PNNI." You got it—Private Net to Net Interface!

Edge Device: There has to be some device which takes the thing you want transferred, digitizes and packages it, and places or accepts the UNI call and sends or receives the cells. This is the device where ATM starts (or ends). These are referred to as "edge devices." Up to them there is ATM, and beyond them there is Something Else. They could be a telephone PBX with a special card, a video CODEC with an ATM interface, or an Ethernet switch with an ATM uplink.

"This philisophy of 'one size fits all' really means that nobody fits exactly, and everyone has to be cut to fit the size."





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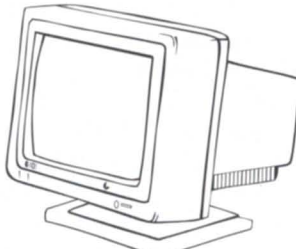
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Real Life Performance

How does all this really work? Is it a valid network backbone for your circumstances? With all the complications listed above, is the performance good enough? How does it compare with 100Mb Ethernet on a LAN?

Easiest first—using ATM has no different “feel.” Part of the attraction of ATM is that you are still using the same devices and interfaces, up to the “edge device.” Although there are direct ATM interface cards available for servers running NT or Unix, most of the application programs you use still communicate through LAN protocols and drivers, and so if you installed an ATM card in your server, it would likely be running LANE. An application which made use of ATM directly would be much more powerful, but the package software vendors haven’t made that investment yet.

Would it suit your circumstances? If you have to mix various media over the same cabling system (data and voice and video) and can’t maintain a separate cabling system for each format, then you will have to plan on going to ATM. For example, hospital network systems often circulate diagnostic images and data, and need video-conferences with medical specialists, all to the same locations within the hospital. Many are going to ATM based networks. Similar requirements show up in magazine publishing and production. Those needs may be lurking in your workplace, and you may not have heard about them because the people with the needs don’t know there’s a possible answer in the computer network technology.

Even if your environment is “all data” instead of mixed-media, the ability to prioritize traffic segments between different portions of your network without going to a proprietary priority scheme may make ATM attractive. Another attraction may be the seamless LAN-WAN integration; you don’t need a router at the points where you change media, just a different interface card in the ATM switch. But for an “all data” network without these needs, it will come down to performance, and this does not have such a simple answer.

In fact, overall performance is a trickier issue. If you transport moving video, or voice, it is sensitive to variations in the rate or flow on arrival (jerky movement, stuttered voice). Any network which allows big packets—Ethernet for example—will always have unpredictable variable latency. So, though its performance for data may be good enough in aggregate bandwidth to support video, the performance of the video result may not be acceptable. For switched data only, the actual switching process is faster and simpler in an ATM switch than in an Ethernet switch, since the virtual circuit call presets a portion of the switching decision in ATM, though at a price in extra time at call-setup. For similar physical media, such as multi-mode fiber, ATM is faster—155 Mbps in place of 100 Mbps Ethernet. And though the Gigabit Ethernet standard is coming (although it appears to have some distance limitations), ATM already has standards for, and been tested with, OC-12 at 622 Mbps.

But that’s not the whole performance story. If you consider the whole path, including the edge devices, then ATM has the AAL-SAR overhead, and an Ethernet switch doesn’t. Admittedly this overhead assures ATM a more fairly-allocated access to the media, which Ethernet doesn’t; one large Ethernet frame can block many small ones. But SAR affects performance, and if you just measure what one user sees for end-to-end data rate you may see this effect. Because the whole AAL process (CS and SAR) happens on a per-frame basis, if you test with the maximum number of minimum-length frames (as many Ethernet tests do) you may end up testing the edge-device’s computational ability rather than the network speed. This, and short tests where the ATM call setup was a much higher proportion of the total communication, have led to a few published results where it has been claimed that for data-only, ATM is slower than comparable switched Ethernet. But those results are valid only for the test circumstances and the devices. Newer models of edge devices are faster. But, if your network will be computer-

data only for the foreseeable future, there is some argument for not incorporating ATM.

However, the ATM overall performance appears to be better, or at least as good as, switched Ethernet on equivalent data-only networks. The areas where ATM may be slower are also “compute dependent” areas, and will become faster with enhanced equipment in future. But the mixed- and multi- media capabilities of ATM are proving a strong attraction for many sites. Also, since ATM is independent, you can adapt to it without changing communication protocols even as the physical-carrier medium, such as faster microwave or new fiber technologies, become available. ATM provides a flexibility and scalability that other networking methods lack.

Learning More

Today there are many ATM devices on the market, with more coming all the time: switches, routers, video codecs, multiplexors. There are an increasing number of sites where ATM switches are used for the network backbone. The public TelCo offerings so far have been all PVC’s—a sort-of super Frame Relay service. Switched (UNI) access has not been made available.

If you need more information, there are a number of books out there, the standards are available, and manufacturers are supplying information as well as products. But books change, standards evolve, and more manufacturers get into the business. The web sites <http://cellrelay.indiana.edu/cell-relay/> and <http://www.atmforum.com/> are both good places to start your search. Δ

Peter Macaulay worked for Data General for 14 years before he left in 1987 to design and implement network solutions. His projects included destination-sensitive encryption for transporting secure data over public networks. He rejoined DG in 1994 as a Senior Consultant in Network Services. He can be contacted at 508-898-6887 or peter_macaulay@DGC.ceo.dg.com.

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Continued from page 17

up is taking place. Multiple DLTArrays decrease the time which needs to be allotted to backup and increases the amount of data which can be backed up with TeraBack in a given period of time. For example, TeraBack, working in conjunction with four DLTArrays, has backed up more than 100 GB of R/3 data in an Oracle database in one hour using Computer Associates' Cheyenne ARCserve backup software. The use of the DLTArray provides significant reliability enhancements to backed-up data integrity.

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software, the database recovery features recover the database. Restoration can also be initiated on the Aviiion database server in addition to the TeraBack. There are several variables which affect the rate at which the data is restored. One factor affecting performance is the degree of parallelization of the data on multiple disks. Another is the number of DLTArrays used, as the linear scalability evident in backing up data is apparent in restoring it. Still another consideration is the RAID level chosen for the DLTArray for the protection of the R/3 data.

For example, with one DLTArray at RAID 1, 10 GB an hour is restored in an hour, using only 5% of the 4 processor TeraBack's resources. Using RAID 3, 6.2 GB can be restored in an hour. Under normal working conditions using RAID 1, the following figures apply:

| Restored Data/Hour | Array Number |
|--------------------|--------------|
| 10 GB/Hour | 1 DLTArray |
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| 30 GB/Hour | 3 DLTArrays |
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Rates of restoration are independent of database type or size.

Growth Path

The DLTArray provides a consistent growth path for R/3 environments, allowing easy expansion with minimum change. As the volume of data grows or as the desire for more rapid backup to tape occurs, additional DLT Arrays may be daisy-chained

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Katherine Jones is Manager of ERP Strategic Alliances at Data General. She is widely published and a frequent speaker on the use of technology to improve business.

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Contact: Vicky Allen

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Hardware: All DG, UNIX-based or INTEL **Operating System:** DG/UX, all UNIX, NT **Language/Database:** MF COBOL, CQCS, SQL Server, C, C++, others

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