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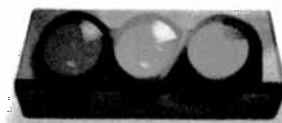
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CIRCLE 51 ON INFORMATION CARD

MAPPING

The Mapmaker's Medium

Optical disk technology holds its own in mapping and GIS applications

By Michael L. Sena

Maps take up a lot of space. In fact, the maps stored by county, state, and federal governmental agencies, highway, airport, and port authorities, utility companies, map publishers, and engineering firms could fill all of the buildings in a large city with paper, plastic, and film.

Traditionally, to reduce the amount of space required to store maps, mapping professionals transferred their maps to microfilm. As technology progressed, they con-

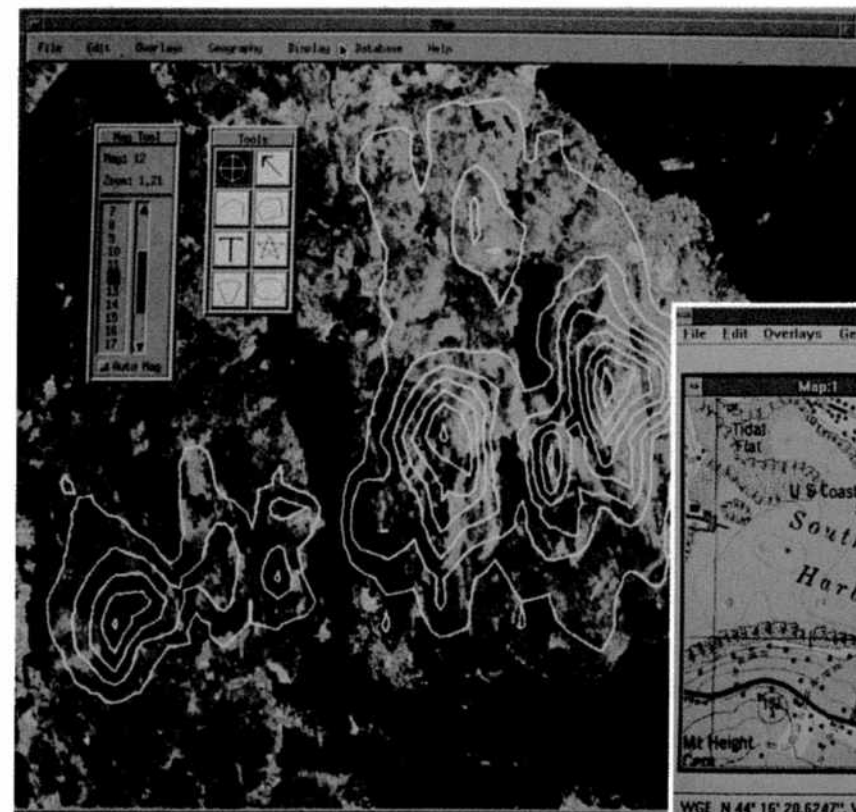
verted them into digital form.

But as federal agencies, map database producers, and municipal and county governments continue to create more detailed and extensive geographic databases—and as more applications are built around this data—those in the industry are finding that maps are just as space-hungry in digital form as they were in paper form: Digital maps may occupy less floor area, but they can eat up miles of backup tape and consume huge blocks of storage space on hard disks.

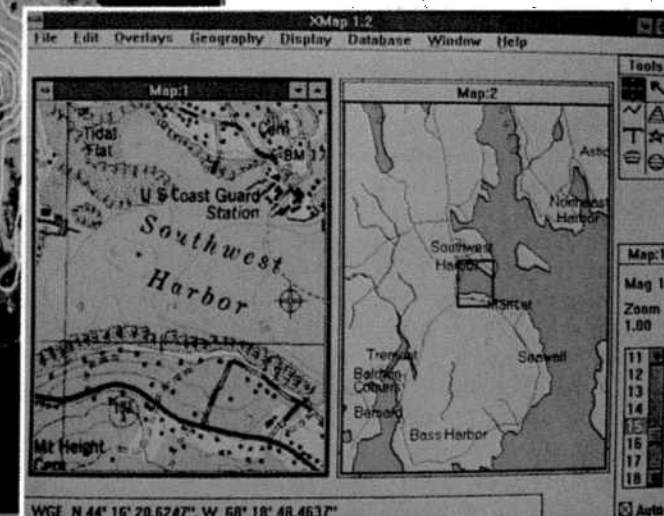
Several recent mapping projects exemplify this dilemma:

- Experts estimate that the Bureau of the Census pre-census TIGER (Topologically Integrated Geographic Encoding and Referencing) database for the US will require 19 gigabytes of storage space (about 6M per county and 400M per state). The final database, due for release in 1991, will require even more space.

- The US Defense Mapping Agency's Digital Chart of the World (DCW)—which involves the conversion of the DMA's 270 Operational Navigational Chart series into a 1:1 million scale digital base map of the entire planet—will re-



The distribution medium of choice: Delorme Mapping Systems is making available on CD-ROM more than 50,000 US Geological Survey 7½-minute topographical maps of specific regions in the United States. Called Quads USA, the maps are available for less than \$995 per CD-ROM.



sult in 12.5 gigabytes of data.

• A scene of Landsat Thematic Mapper data—with 30-by-30-meter pixels and seven spectral bands covering about 38,000 square kilometers—requires almost 300M of storage space. Actually, three to four times this amount may be needed for multi-temporal spectral data with overlay features.

Primary producers of geographic data—agencies such as the Bureau of the Census and the DMA—and geographic data integrators—companies such as Navigation Technologies (Sunnyvale, CA), Delorme Mapping Systems (Freeport, ME), Etak (Menlo Park, CA), and Geographic Data Technology (Lyne, NH), which combine data from many sources and add value to the data by improving accuracy, detail, and coverage and by formatting the data for resale to the public—require massive amounts of storage space to create and maintain their databases.

The major difficulty for both of these groups, however, has been to duplicate and distribute their databases to end users. Both user groups need an efficient and cost-effective means to convert their base maps and associated data into a widely used and generally accepted format.

One way they are accomplishing this is through optical disk technology. Optical disks fall under three categories: Compact Disk-Read Only Memory (CD-ROM), Write Once, Read Many (WORM), and erasable optical (for more information, see "Data Deluge," August issue).

Each of these technologies offers distinct advantages. For instance, a CD-ROM, which consists of a master from which multiple copies can be created, can't be written to or erased by users. Also, it's non-magnetic, so data can't accidentally be erased. Erasable optical disks, on the other hand, can be written to and erased. And with WORM, users can write to the disk until it's full; thus, WORM is an ideal medium for archiving.

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But the major advantage of optical disks is the huge amount of data they can store: CD-ROMs can hold up to 600M of data, while WORM disks and erasable optical disks can store between 250M and 2.5 gigabytes or more of data.

Geodesk, one of the first CD-ROM-based mapping systems for PCs, was introduced in 1986 by Geovision (Norcross, GA), a firm that converts public-domain geographic data into a non-proprietary format so that the data can be read by any Geographic Information System (GIS) or CAD program. Geodesk is delivered on CD-



Database sales are the primary business focus of Etak Inc. One Etak database, used by PARS Travel Information Systems, an airline reservation service, consists of EtakMaps stored on CD-ROM and Etak MapAccess software. A travel agent using the system can display a map of the area a traveller wishes to visit and print a map directly from the stored data.

ROM and uses a CD-ROM drive for storing the company's Geodisk US Atlas, a reformatted and ready-to-use US Geological Survey Digital Line Graph file. Geovision's Windows/On the World desktop mapping software is part of Geodesk and is used for accessing and working with the data.

Because it is durable, non-magnetic, and small (making it easy to drop in the mail), CD-ROM is an ideal medium for distribution of

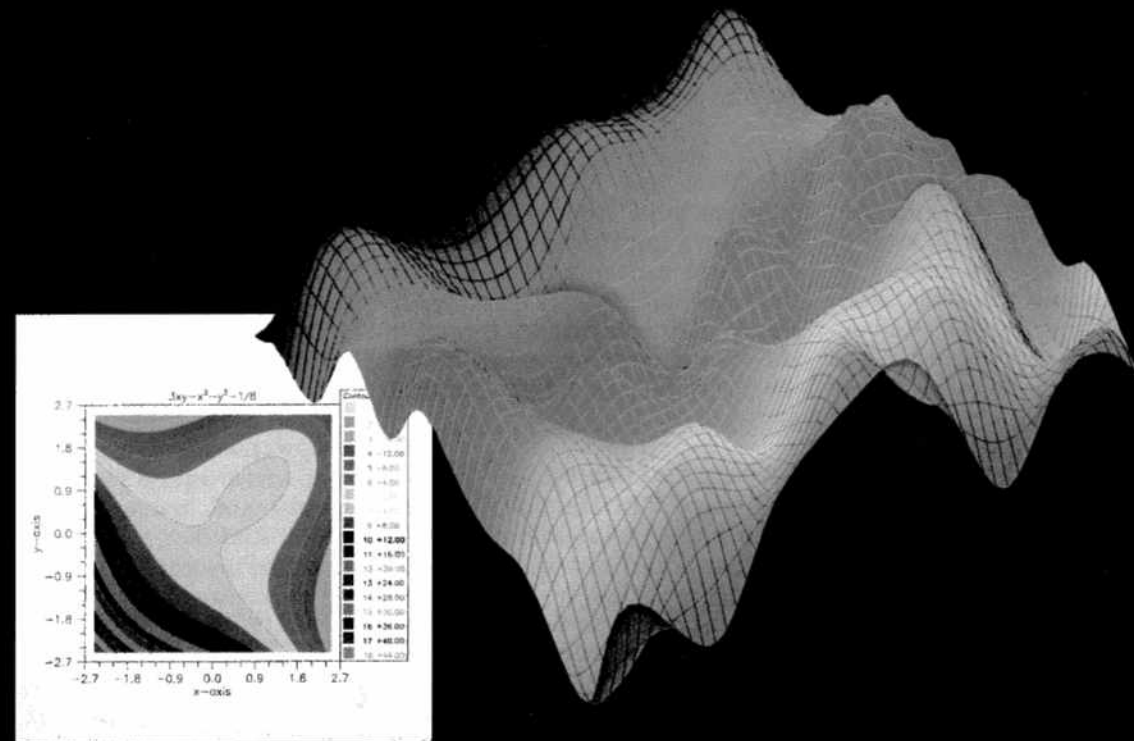
data. Large geographic databases can be made available to anyone with a PC and a CD-ROM drive.

In fact, the DMA is making CD-ROM the primary distribution medium for its Digital Chart of the World so the data will be accessible to the broadest audience of potential users. And Geovision will be working with the DCW project's prime contractor, ESRI (Redlands, CA), to develop software for accessing the data from CD-ROM media on PCs. A library of 25 disks will contain coastlines, rivers, administrative boundaries, major transportation networks, and geographic names. The data will be topologically structured and assigned attributes to allow users to perform GIS processing. The DMA also expects the DCW data to be suitable for cartographic production.

The Bureau of the Census TIGER/Line files are also available on CD-ROM; a total of 30 650M disks were needed to store the nation's pre-census data. The Census Bureau made lower price a major incentive for buyers of the TIGER files to choose CD-ROM over tape format: In nine-track tape format, a data set for the US costs about \$90,000, while at \$250 per CD-ROM, a buyer can have the same data for less than \$10,000. By lowering the price of the files, the Census Bureau saves money in data reproduction and distribution costs, and users save money on acquisition costs.

Delorme Mapping Systems is another pioneer in the use of optical disk technology for mapping. In 1986, Delorme introduced the Delorme World Atlas, a CD-ROM-based digital map of the world. Currently, Delorme is scanning the US Geological Survey's 7½-minute quadrangle maps of the US—a total of over 50,000 maps. With Delorme's data compression technology, a single topographical map fits on a 1.2M floppy disk, but one CD-ROM will hold up to 500 maps. The color maps can be displayed on a Unix workstation running X Windows, or on a DOS-

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CIRCLE 52 ON INFORMATION CARD

based PC running MS Windows using Delorme's XMap software.

Another emerging application for CD-ROM, and a variation called CD-I (Compact Disk-Interactive), is in-vehicle navigation, routing, and information. German electronics giant Bosch Blaupunkt has begun to manufacture an in-vehicle navigation system originally designed by Etak. The original Etak system, called the Navigator, stored geographic data on a series of cassette tapes (a total of six cassette tapes were needed for the San Francisco Bay area alone). Naturally, this proved cumbersome, for when a driver using the Navigator passed from one cassette tape zone to another, he or she had to change the tape.

On Bosch Blaupunkt's redesigned CD-ROM system, called the TravelPilot, the US fits on five disks, with plenty of room on each disk for travel-related information or even a car's owner's manual.

While Etak initially created its geographic database for use with

Contributing editor Michael L. Sena is president of Matrix Consultants (Boston).

MAPPING

the Navigator, database sales are its primary business focus today. For example, PARS Travel Information Systems, an airline reservation service jointly owned by Delta, Northwest Airlines, and TWA, uses EtakMaps stored on CD-ROM and Etak MapAccess software in its Integrated Reservations Imaging System (IRIS). One CD-ROM contains all major US metropolitan areas. A travel agent using IRIS can display a map of the area a traveller wishes to visit and print a map directly from the stored data.

Helping End Users

While CD-ROMs distribute and store large geographic databases, other optical disk technologies are solving technical and data management problems for the end users of geographic data.

For example, erasable optical disks are ideal for users who analyze Landsat and SPOT images, as

satellite images can require a few hundred megabytes or more of storage space. A further difficulty for image analysts is that many of their applications, such as identifying and quantifying land use and land cover changes over time, generate equally large intermediate files before the final image is created. Thus, access to at least 600M of on-line data storage is a must for efficient operation. Erasable optical disks are ideal, as they can be assigned a logical address like a fixed disk, and intermediate files can be temporarily stored.

Indeed, optical disks and the software being written to access the data stored on them are helping to take digital geographic data out of the cartographic labs and map archives and place it into the hands—and computers—of eager users. And now that Sony has introduced to the Japanese market its palm-sized Data Diskman EB CD-ROM reader, which looks like a mini laptop computer, it won't be long before the "shirt-pocket digital street atlas of the world" becomes a reality. *CGW*

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