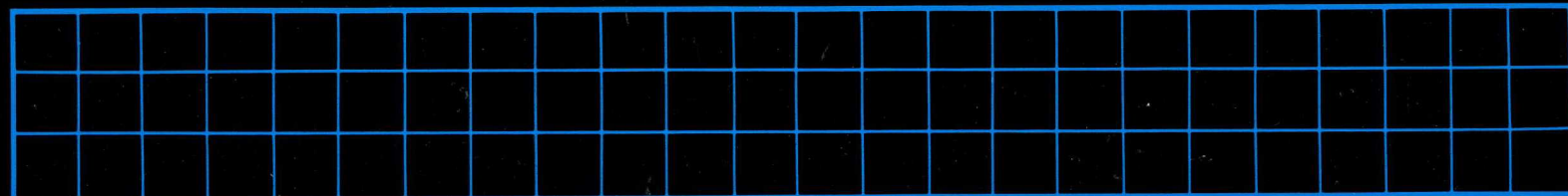


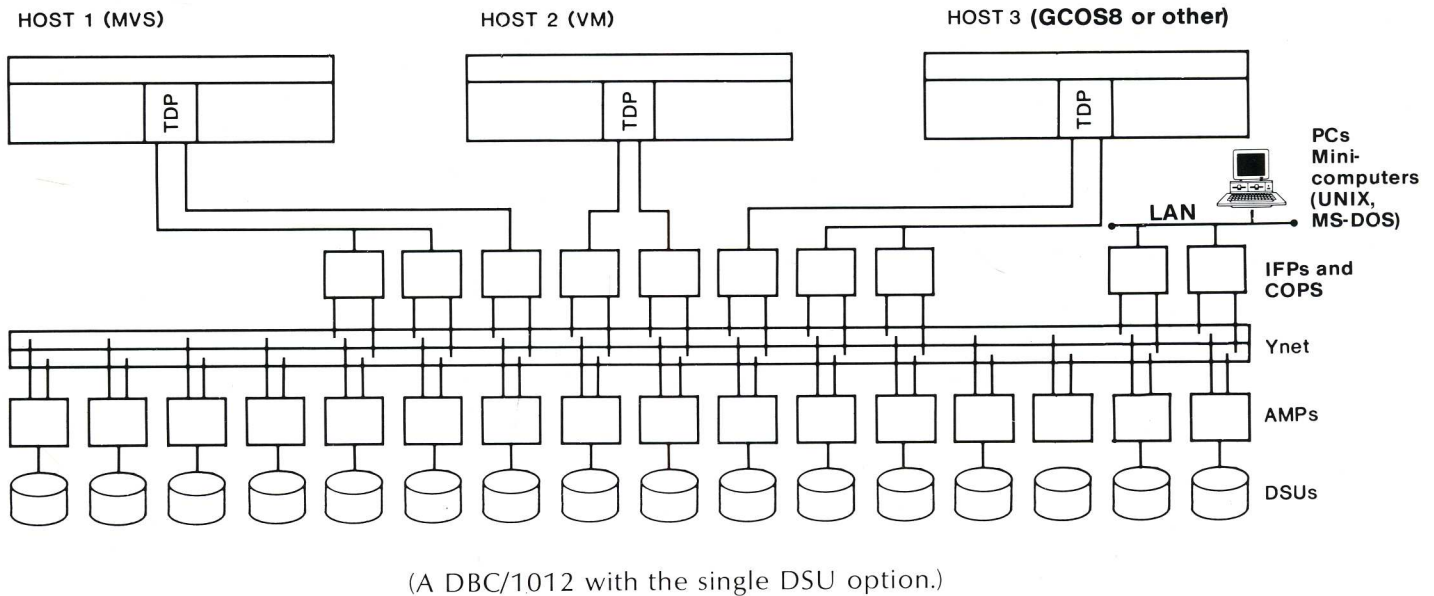
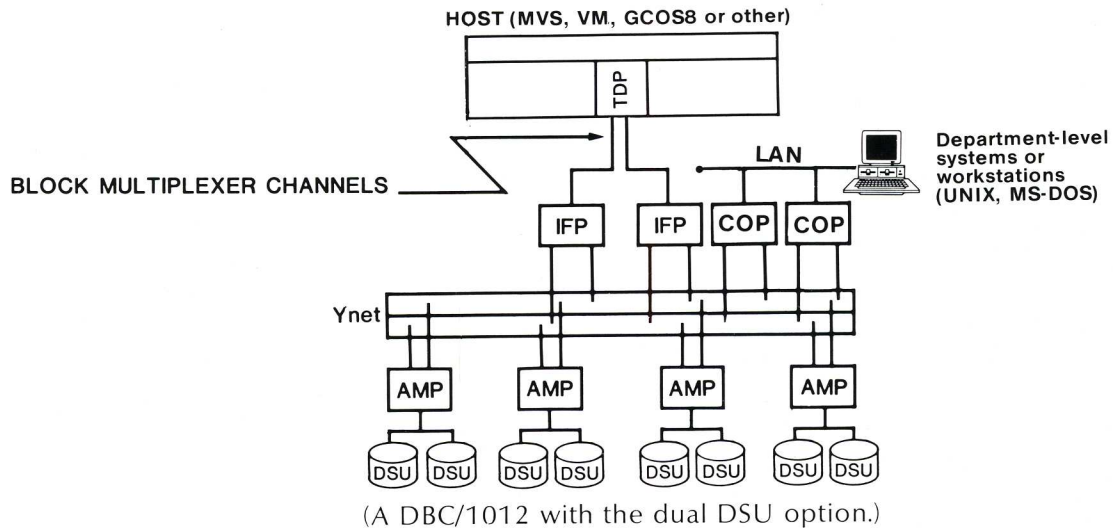
DBC/1012
Data Base Computer System
Introduction



THE DBC/1012 DATA BASE COMPUTER SYSTEM

The DBC/1012™ utilizes a parallel processing architecture comprised of Interface Processors (IFPs), Communication Processors (COPs), Access Module Processors (AMPs), and high-speed Winchester-type Disk Storage Units (DSUs). The proprietary Ynet™ coordinates the activities of these components to insure that the sum of their processing power is realized as one work force. Rows of each relational table are evenly distributed over the available DSUs. The system's superior performance is achieved by all AMPs working as a "team" with their portions of the data.

A DBC/1012 may be configured with as few as 3 and as many as 1024 processors. Each AMP may have one or two DSUs.

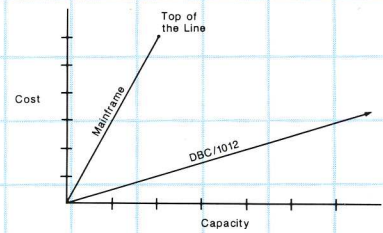


Software for both the DBC/1012 and each supported host/workstation environment is also included in the system. Each host or workstation runs a Teradata Director Program (TDP) that manages the traffic to and from the DBC/1012. Additional interfaces are available for CICS, TSO, CMS, PL/1, and COBOL.

THE TERADATA ADVANTAGE

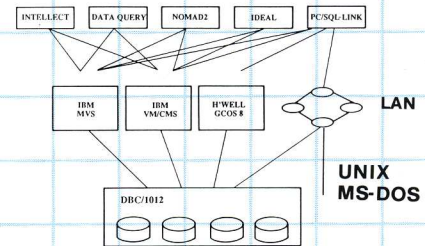
PRICE & PERFORMANCE

The DBC/1012 Data Base Computer System achieves the same performance as a mainframe for approximately 1/4th the cost. Moreover, it achieves performance levels exceeding the most powerful mainframes. This is accomplished through the use of microprocessor subsystems and parallel processing.



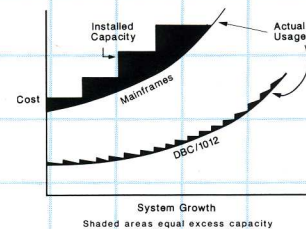
CONNECTIVITY & SHAREABILITY

Teradata's open systems architecture strategy, called a "shared information architecture," incorporates information delivery tools, a variety of processing environments, and the DBC/1012 as a shared relational data base management system. The DBC/1012 can be connected to multiple host mainframes at the same time. Each host may run a different operating system (MVS, VM, GCOS8, UNIX). This sharing of data by multiple hosts eliminates the need for costly data duplication while solving the associated problem of concurrent data access.



MODULARITY

With the DBC/1012, capacity may be added in low cost increments. There is no need to acquire excess capacity. Thus, the need to spend today's dollars for tomorrow's needs is greatly reduced. This advantage is particularly important when usage is growing rapidly or usage growth is hard to predict.



RELIABILITY

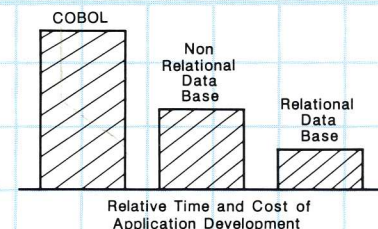
The DBC/1012 is fault-tolerant. It has fully redundant circuitry and software, as well as a "fallback" data protection option. Data availability exists even if disks or processors fail. What's more, all recovery is automatic — there is no requirement for operator intervention.

Fail-Safe Operation

- Fault Tolerant Architecture
- Automatic Recovery
- Data Availability

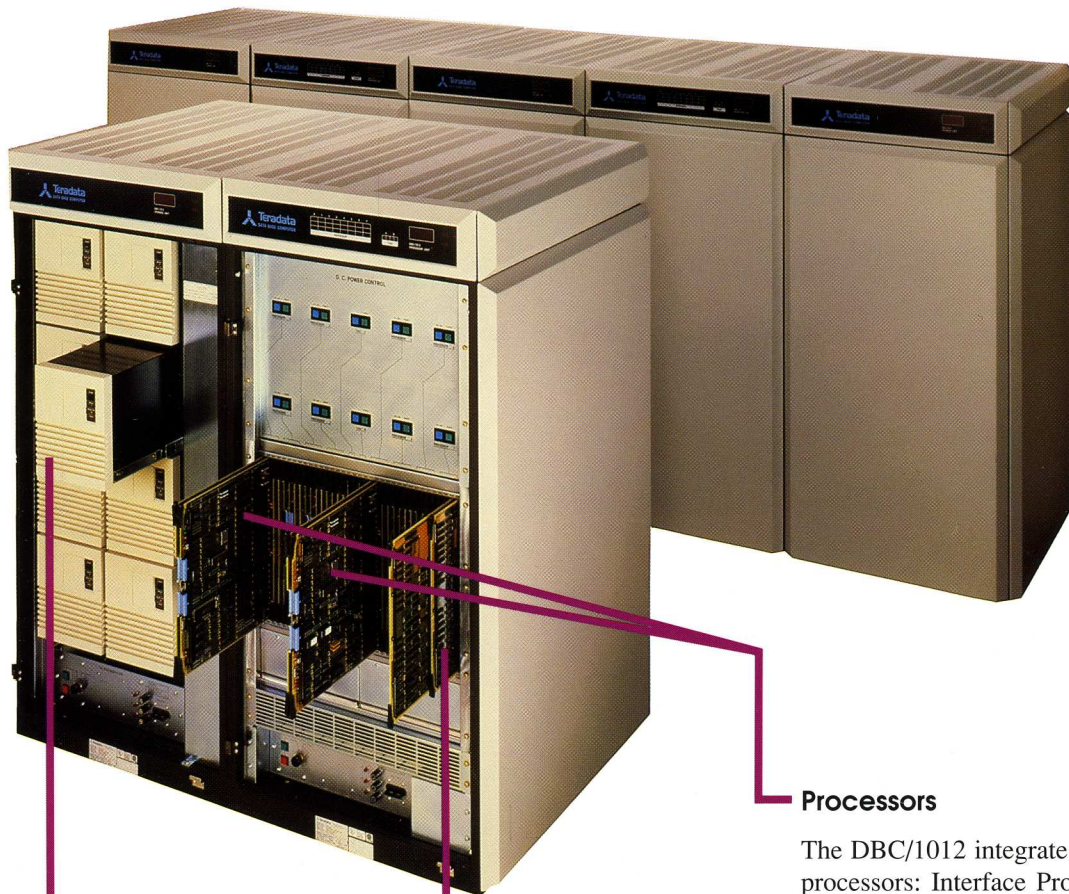
RELATIONAL PRODUCTIVITY

The DBC/1012 employs the relational model data base management system. Through a data access language called DBC/SQL, end-users and programmers can enjoy the same easy-to-use data base system. The result is typically better than a two-fold improvement in productivity.



DBC/1012 Data Base Computer System

The DBC/1012 is a high performance, fault-tolerant computer system optimized for relational database management. This microprocessor-based system is expandable in small modules of processing and storage capacity. The minimum configuration includes a processor subsystem and a storage subsystem, providing up to 24 MIPS (millions of instructions per second) of processing capacity and up to 19 gigabytes of storage capacity, depending on options. The system can be expanded to more than 3 BIPS (billions of instructions per second) and nearly 5 terabytes of data storage, all operating as a single system with a single image.



Disk Storage

The system incorporates high-speed disk storage units (DSUs) which can be configured to provide nearly 5,000 gigabytes of database storage.

Ynet™

The Ynet high-speed intelligent interconnect is the heart of the system's proprietary parallel processing architecture. It is designed to harness the power of 3 to 1,024 processors.

Processors

The DBC/1012 integrates three types of processors: Interface Processors (IFPs), Access Module Processors (AMPs), and Communications Processors (COPs). The IFP provides connection to mainframe hosts; the AMP manipulates the database, accesses DSUs and prepares the data results; the COP provides connection to a local area network, enabling user access from minicomputers, workstations and personal computers.

Relational Answers to Complex Questions



Substance Research

Applying an iterative process, identify a unique set of chemical substances that possess specific characteristics which can be applied to new pharmaceutical chemicals.



Advertising Return

Which products advertised this week exceeded their weekly sales average by more than 10% in the targeted regions?



Passenger Load Factors

What is the potential impact of the mileage bonus program on full-revenue seats for transoceanic routes during the holiday season?



Premium Prospects

How many \$70,000 households write more than 25 checks per month, maintain an average balance of more than \$3,000 and have a credit card account?

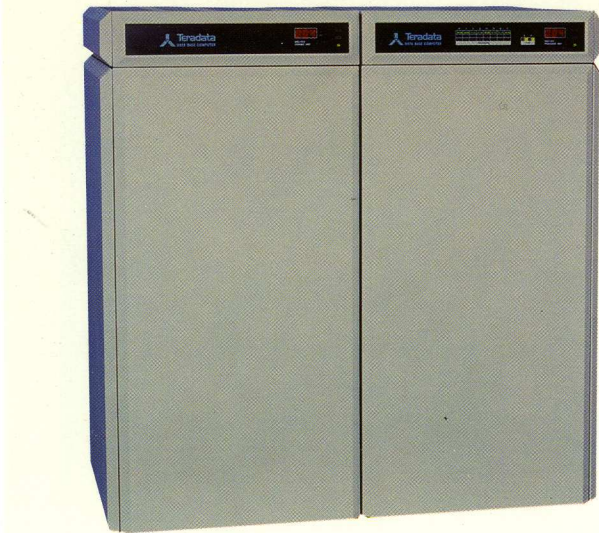


Service Availability

What percentage of the communications network has been out-of-service for more than one minute during the last two-hour period?

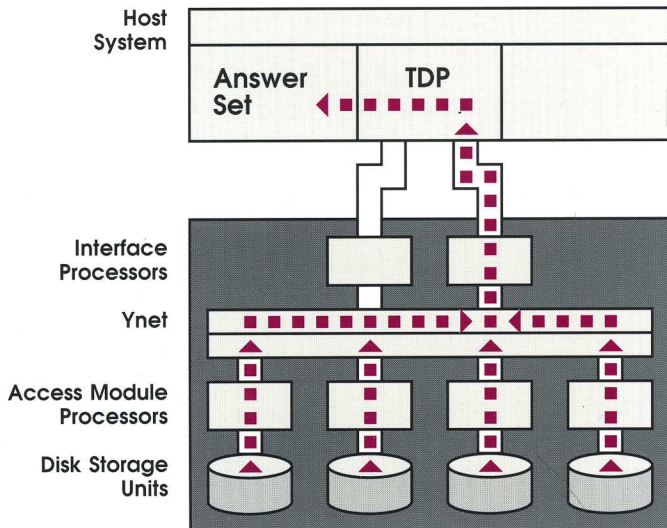
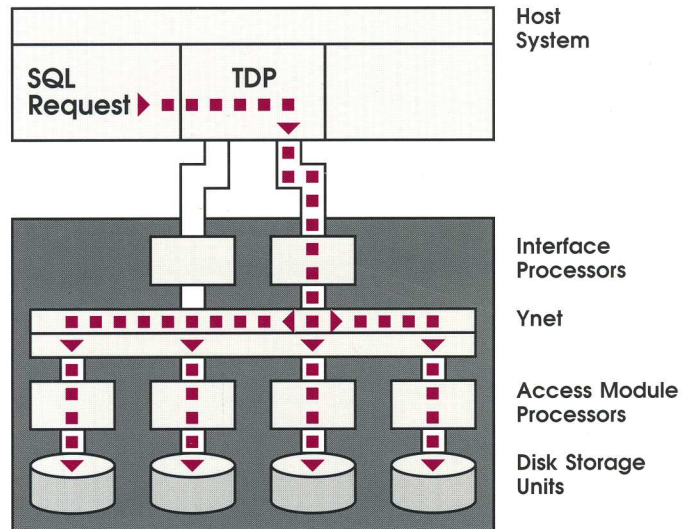
The DBC/1012 Data Base Computer

Flow of an Information Request



1. The user's SQL is captured by the Teradata Director Program (TDP) and promptly dispatched to the DBC/1012 where it is received by an Interface Processor (IFP) and translated into relational database worksteps.

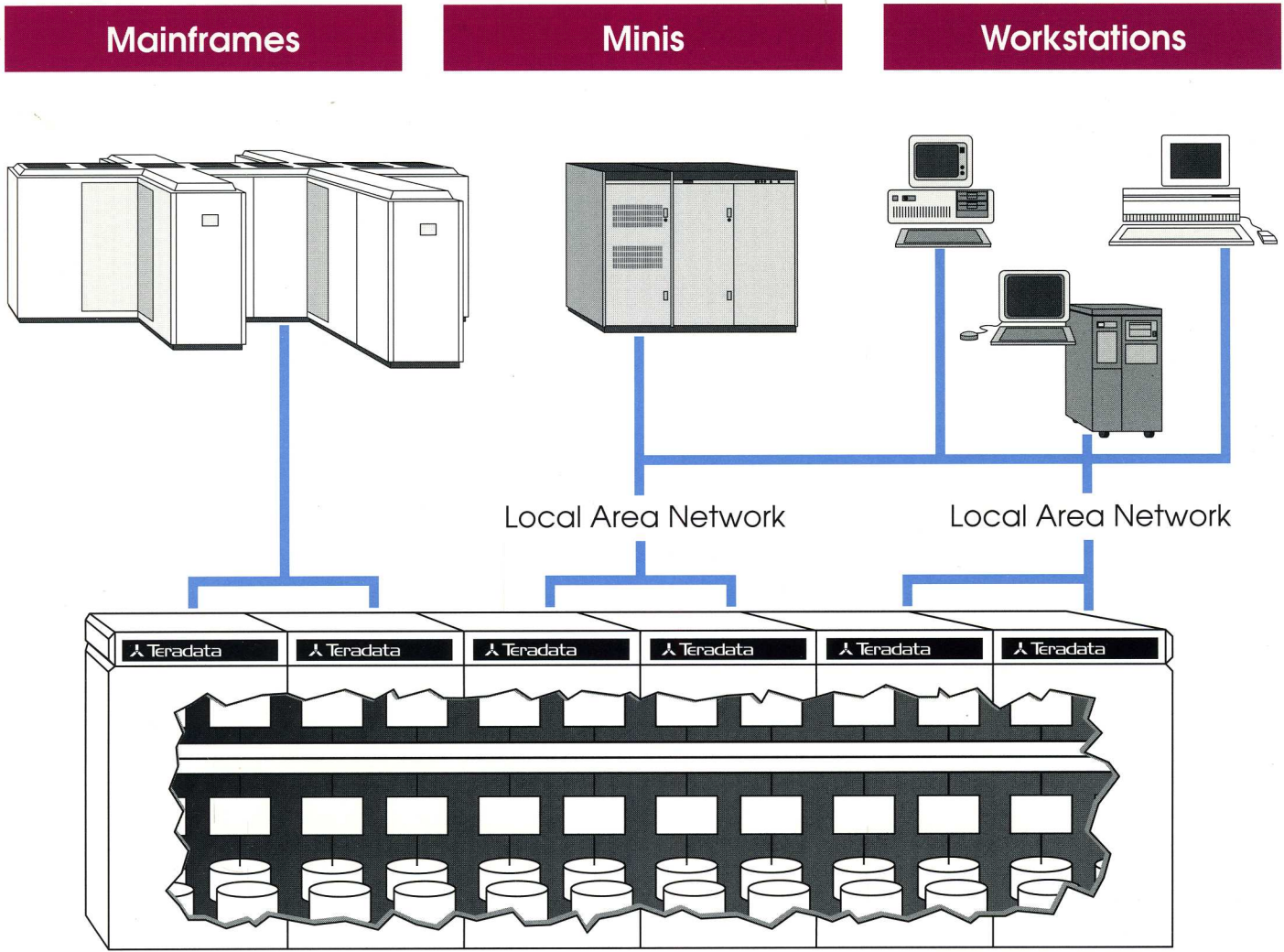
2. The Ynet broadcasts the request's worksteps to the Access Module Processors (AMPs). Each AMP processes the workstep with its associated Disk Storage Units (DSUs). AMPs work independently, but at the same time on the same request – in parallel.



3. Since the rows of all database tables are distributed evenly across the DSUs, all AMPs work with an equivalent portion of the database. Working in parallel, each AMP selects the rows within its DSUs that qualify for the request and posts the necessary columns (fields) to the Ynet.

4. The Ynet performs a hardware sort/merge, collating each AMP's response set into one master answer set. The sort sequence is determined by the Order clause of the original SQL request. The answer set (file) is then sent back to the host by an IFP and posted to the requesting user's application area.

Multi-Platform Connectivity



The DBC/1012 can service multiple host mainframes, minicomputers, workstations and personal computers simultaneously. This enables a shared database environment that simplifies the complexities of data management. It reduces the need for redundant data storage and its associated cost, while ensuring greater data integrity.

Supported Systems:

IBM (MVS, VM, TPF)
UNISYS (OS1100)
Amdahl (UTS)
Siemens (BS2000)

DEC (VAX/VMS)
AT&T (3B2/UNIX)

MS-DOS
Metaphor
Sun Microsystems (UNIX)

 **Teradata**

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"The DBC/1012 takes existing microcomputer and disk technologies and marries them with the Ynet to produce a system that is greater than the sum of its parts."

—Dr. Philip M. Neches
Chief Scientist

The Teradata DBC/1012™ is the first complete data base computing system. It is wholly original in concept and execution, yet its basic subsystems are built from proven industry-standard components. Reliable, high-speed Winchester-type disks are the storage media. Microcomputers supply the processing power. Combined with the Teradata patented Ynet™ technology, these elements produce a totally integrated system solution for data base management.

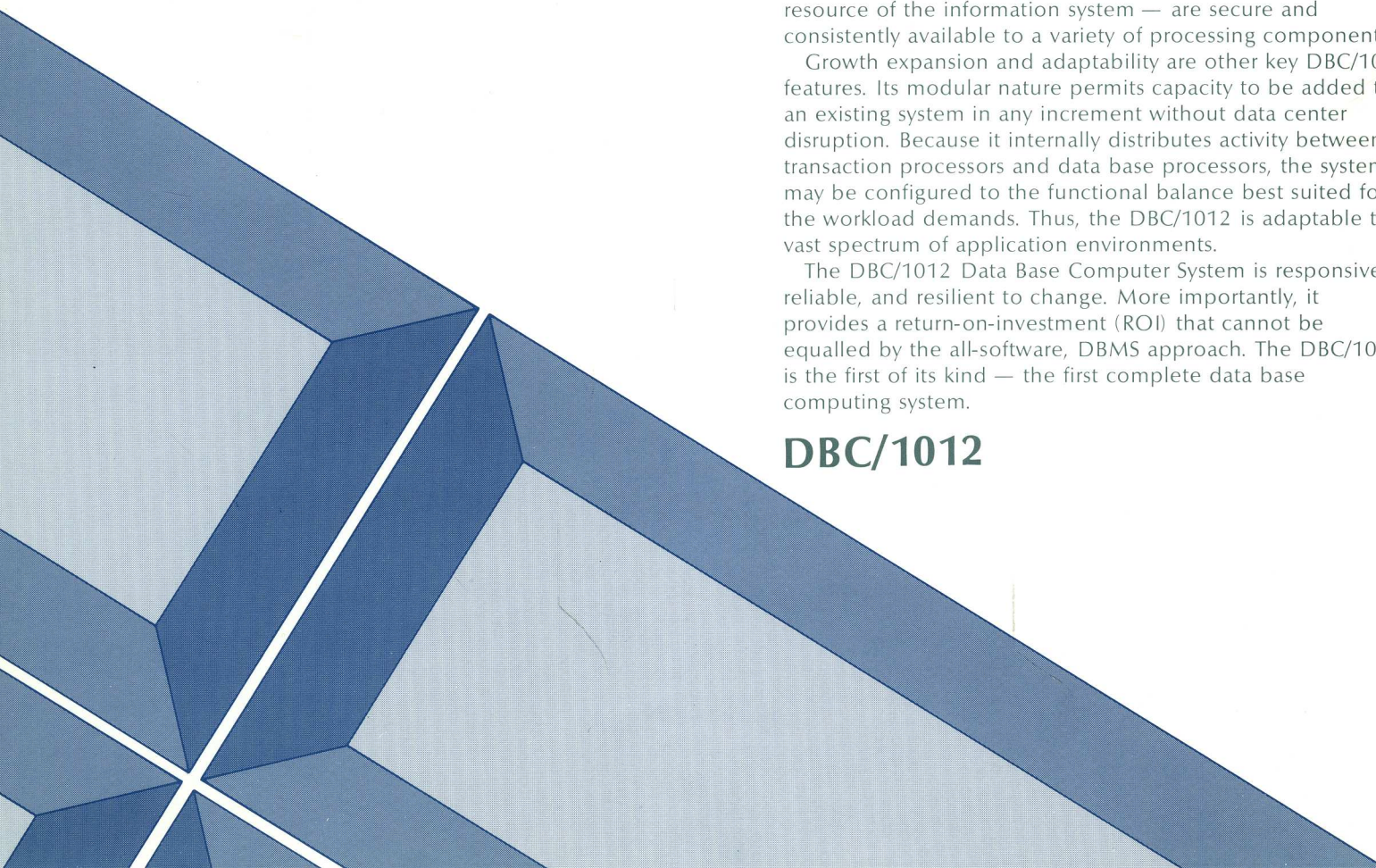
This unique architecture of hardware, firmware and software permits the DBC/1012 to exploit the full functionality of the relational model for data management. By leveraging multiple microprocessor subsystems to the problem, the DBC/1012 achieves the performance levels required to support concurrent end-users and production systems activity.

But, performance is only one of the outstanding advantages of the DBC/1012 Data Base Computer System. It is also shareable by multiple mainframe computers, department-level systems or workstations running the same, or different operating systems. This capability reduces the need for replicated storage structures and multiple data base management systems. Additionally, the fault tolerant nature of the DBC/1012 and its automatic recovery features provide a reliable, fail-safe environment. Thus, data — the main resource of the information system — are secure and consistently available to a variety of processing components.

Growth expansion and adaptability are other key DBC/1012 features. Its modular nature permits capacity to be added to an existing system in any increment without data center disruption. Because it internally distributes activity between transaction processors and data base processors, the system may be configured to the functional balance best suited for the workload demands. Thus, the DBC/1012 is adaptable to a vast spectrum of application environments.

The DBC/1012 Data Base Computer System is responsive, reliable, and resilient to change. More importantly, it provides a return-on-investment (ROI) that cannot be equalled by the all-software, DBMS approach. The DBC/1012 is the first of its kind — the first complete data base computing system.

DBC/1012



Parallel Processing Breaks the DBMS Bottleneck

The DBC/1012 employs a parallel processing approach that is not found in traditional data base management system implementations. Instead of servicing the data management workload serially, as in a uniprocessor mainframe environment, the DBC/1012 distributes the activity to many processors that collectively work as a team (in parallel). The processing burden imposed by any given request is subdivided into smaller tasks which are distributed among multiple processors.

In the DBC/1012, multiple microprocessor subsystems with data base management software work against their individual disk storage units which contain appropriate portions of the overall data store. All processors respond to a globally broadcast problem and then proceed, asynchronously, to process their individual portions of the data base. The aggregate of the computational power derived from all processors is applied to the problem and the sum of the I/O rates of each disk unit is similarly realized. The more processors and disks, the faster the response.

Thus, the processing bottleneck that is so frequently encountered by the monolithic mainframe data base system is eliminated. The DBC/1012 represents a new standard for throughput and response time.

The Relational Model and DBC/SQL

The DBC/1012 Data Base Computer System implements the relational model for data base management — an approach that is generally recognized as having superior characteristics in the areas of data handling and ease of use. However, until now, all relational systems contained trade-offs between functionality and performance that compromised the advantages of the model. The DBC/1012 is the first system, combining hardware and software, to fully exploit the richness of the relational model.

DBC/SQL is the user's window to the system. It is a non-procedural data language that may be used effectively by programmers and non-data processing professionals alike. Compatible with the emerging industry-standard SQL (Structured Query Language), DBC/SQL is composed of simple English-like commands that allow the user to state *what* data is needed, without having to specify *how* to get it.

A System of Subsystems

The DBC/1012 is a complete system solution for relational data base management. Its modular structure is a system of subsystems. It synergistically combines host or workstation interface software, Interface Processors (IFPs), Communication Processors (COPs), Access Module Processors (AMPs), Disk Storage Units (DSUs), a system console and the Ynet interconnect logic — the enabler for parallel processing.

Host Interface Software

As Figures 1 and 2 indicate, the DBC/1012 communicates with a mainframe via one or more block multiplexer channels, or departmental systems and workstations via a local area network (LAN). Inside the host, the Teradata Director Program (TDP) operates in its own address space or virtual machine. It manages the channel activity while servicing request/ response traffic from other address spaces.

TDP is re-entrant and therefore capable of directing multiple sessions of activity concurrently.

When the DBC/1012 is shared by multiple hosts, as shown in Figure 3, each host machine runs its own TDP. Other host software packages are supplied by Teradata. Each insulates the user from low-level interactions by automatically managing the Call-Level Interface to the TDP. These useful tools include:

- ITEQ (Interactive TERadata Query) — permits interactive terminal users to establish a direct DBC/SQL dialogue with the DBC/1012. ITEQ is an application program that runs within MVS/TSO and VM/CMS.
- BTEQ (Batch TERadata Query) — an easy to use facility with report formatting functions used to submit scripts of DBC/SQL statements, as well as export data from the DBC/1012 to host data sets.
- COBOL and PL/1 Preprocessors — programmer aids that permit DBC/SQL statements to be embedded in source code. They may be used for batch programs or on-line applications running under IBM's Customer Information Control System (CICS).
- Data Base Administration Utilities — a full set of powerful tools for dumping, restoring and bulk-loading data bases.
- Coordinated Products — Popular software developed by other companies: e.g., NOMAD2, a 4th generation language system for end users, and IDEAL, a high-level application development tool, and many other packages.

Interface Processors

Interface Processors (IFPs) manage the dialogue between users on a mainframe and the other subsystems of the DBC/1012. Each IFP incorporates a channel adapter, a CPU and two high-speed Ynet interfaces.

DBC/SQL statements are received by an IFP. Its software then translates the requests, dispatches appropriate work-steps and routes data responses back to their requestors.

A minimum of two IFPs per host is required for fail-safe operation. However, more may be added as required (as in Figure 3) depending on the number of hosts to be serviced and their respective traffic volumes.

Access Module Processors

Access Module Processors (AMPs) perform the data base manipulation activities.

Each AMP is responsible for one or two DSUs as shown in Figures 1 and 2, respectively. The AMP software executes data base manipulation work steps, accesses the disk(s) as appropriate and prepares the resulting data.

Data records (or, more properly, rows of a relational table) are distributed evenly across all DSUs in the system. In the configuration illustrated by Figure 1, each AMP/DSU would maintain approximately one-fourth of each relational table in the data base. In Figure 3, where there are sixteen AMP/DSUs, each would maintain a sixteenth, etc.

When a relational request is received that requires the manipulation of multiple rows, each AMP fields the request and works asynchronously upon its portion of the data base. All AMPs work concurrently on the same problem in parallel.

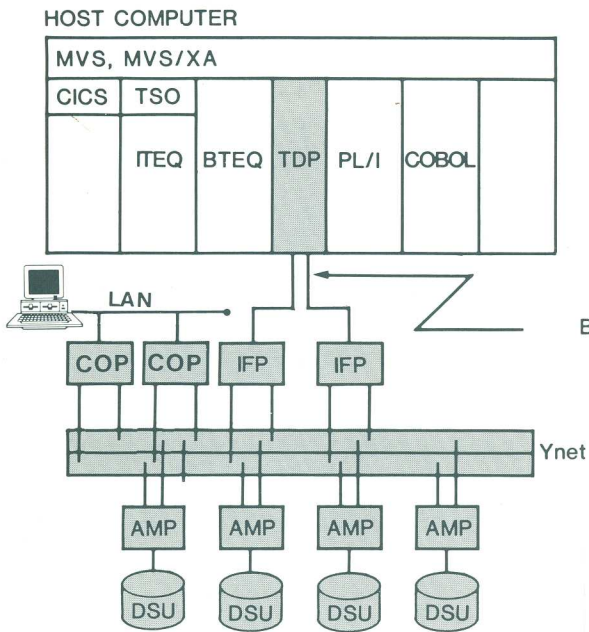


Figure 1

BLOCK MULTIPLEXER CHANNELS

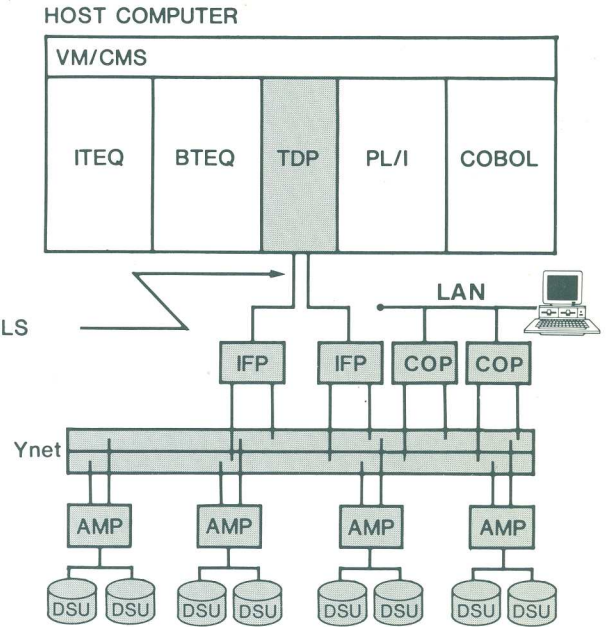


Figure 2

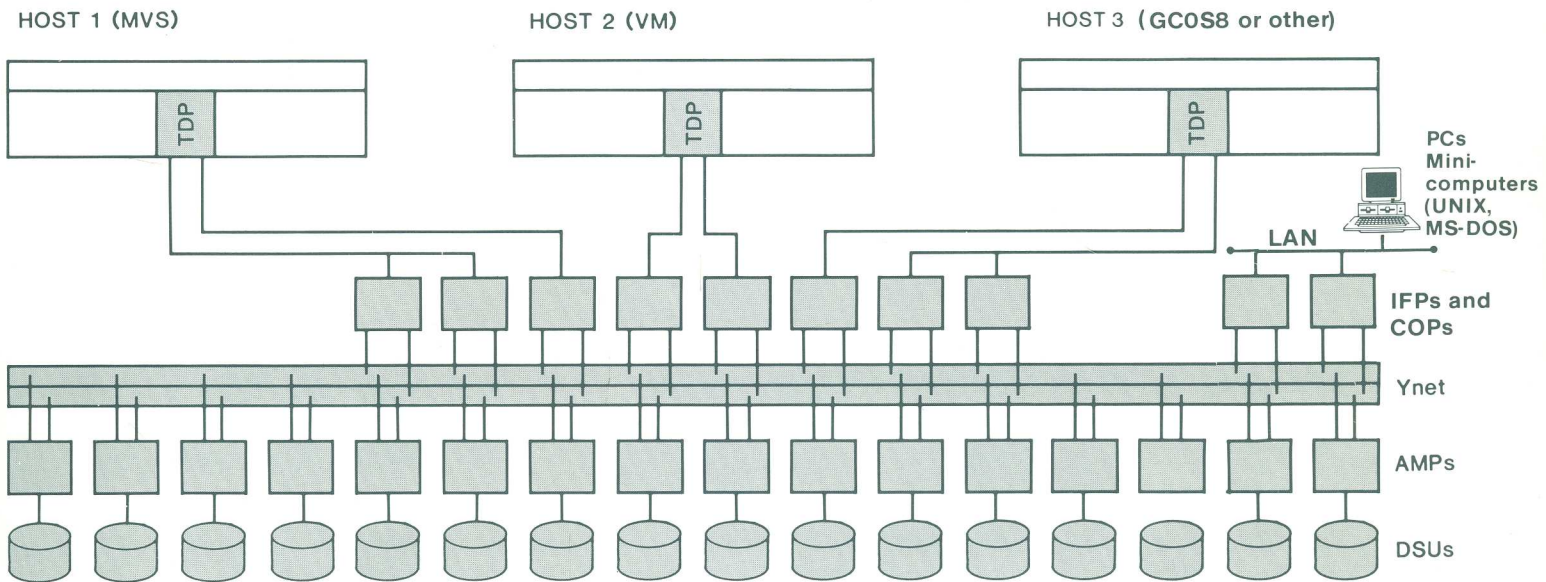


Figure 3

Communication Processors

Communication Processors (COPs) manage the dialogue between users on a department-level (mini) computer or workstation (PC) and the other subsystems of the DBC/1012. Each COP incorporates a local area network (LAN) adapter, a CPU, and two high-speed Ynet interfaces. DBC/SQL statements are received by a COP. The software then translates the request, dispatches appropriate work steps and routes data responses back to the requestors.

A minimum of one COP per department-level processor or workstation is required for operation. More may be added as required depending on the number of hosts to be serviced and their respective traffic volumes.

Disk Storage Units

High-speed, large volume Winchester-type DSUs are used in the DBC/1012. The storage area of each disk is formatted to accommodate system work areas for such tasks as sorting and spooling, prime storage for relational data, and optional fallback areas where critical data may be intentionally duplicated.

Fallback Option

When FALLBACK is specified, a copy of the prime data of each DSU is distributed evenly across other DSUs. Should a DSU fail, the DBC/1012 automatically directs requests for its data to the other supporting drives, which team together to substitute for the failed unit until it has been repaired. At that time, the DBC/1012 automatically re-establishes the primary copy of the data using the fallback copy, including any changes that may have been made to that data while the DSU was down. Data remains consistent and available.

The Ynet

The patented Ynet is the heart of the DBC/1012 and the enabling technology for true parallel processing. In contrast to ordinary bus structures, the Ynet is an active array of high speed logic.

A DBC/1012 system contains two fully redundant Ynets, so that the failure of one does not prevent the system from operating normally. All processors (IFPs, COPs and AMPs) interconnect to both Ynets.

As a tree-structured network of packet-sorting elements, the Ynet performs three functions. It broadcasts work messages from the IFPs or COPs to the AMPs, manages AMP to AMP communications and then merges data results from AMPs back to IFPs or COPs.

With the Ynet, the power of many microprocessors operating in parallel can be harnessed and logically treated as a single, much larger processor. The Ynet is capable of interconnecting up to 1024 processors.

System Flow

The services of the DBC/1012 may be exercised by both interactive and batch environments running within the host computer or workstation. In either case, requests for data are expressed with DBC/SQL statements. Teradata's host interface software transfers a DBC/SQL request from the user to the TDP, and then transmits over a block multiplexer channel to an IFP. Similarly, a COP accepts requests from the user program in a minicomputer or a PC workstation.

It is important to note that the DBC/SQL requests which are sent to the DBC/1012 are in source language format. *No language processing occurs in the host.*

IFPs or COPs receive incoming DBC/SQL requests and parse (translate) them. Using the active DBC/1012 Data Dictionary/Directory, the IFP or COP determines the validity of each request and whether the originating user or program is authorized to perform the operation. The IFP or COP determines the work steps necessary to service the request and then dispatches these instructions over the Ynet to one or more AMPs — depending on whether the request is for a single row or for a number of rows.

AMPs accept the work steps transmitted by an IFP or COP and perform the indicated functions. They manage the retrieval of data as well as all changes made to that data. Inter-AMP communication is invoked for numerous operations such as the relational join and concurrency control.

AMPs prepare data results for the Ynet. If the request included sequence ordering, each AMP will sort its results accordingly. Once all AMPs are ready, the Ynet merges (collates) the results back to the dispatching IFP or COP.

Completed data responses are sent back to the host under the IFP's or COP's supervision. A small set of responses can be managed in one transmission. Larger response sets are spooled and sent a block at a time.

TDP coordinates the DBC/1012 response flow and directs the data results back to the requesting user. Teradata-supplied software, such as ITEQ, BTEQ, and language preprocessors, assure that enough buffer space is available to efficiently receive the returned data.

System Modularity

The DBC/1012 Data Base Computer System is modular. The customer may configure as many IFP, COP and AMP subsystems as required in order to process the workload within a desired level of performance.

DBC/1012 configurations are determined from two categories of requirements: the volume of the request traffic and the characteristics of the data base. If one IFP or COP is capable of supporting n requests per second, and the workload is $6n$, then six IFPs or COPs are needed.

The number of IFPs is also influenced by the number of host computers that will share the DBC/1012 data resource. In Figure 3, three hosts are shown with the IFPs required to service their unique request volumes.

The number of COPs required is influenced by the number of department-level systems or PCs required to support the application, the number of local area networks which are to be attached to the DBC, and the data or traffic volume across those LANs. In Figure 3, two COPs are shown as sufficient to handle the expected load from the workstations or department-level machines attached to them.

The size of the overall data bases (including FALLBACK and work areas) as well as the scope of the data manipulation requirements determine the number of AMPs and DSUs.

The two IFP, four AMP systems indicated in Figures 1 and 2 are modest configurations. The DBC/1012 shown in Figure 3 is a more powerful configuration capable of servicing a larger workload.

Capacity Growth in Easy Steps

The DBC/1012 accommodates capacity growth in manageable, incremental steps. There is no need to install "excess" processing or storage capacity. The user may add-on any increment of IFPs, COPs, AMPs or DSUs as may be required at the time. A system may be expanded to a maximum of 1024 processors.

As the system grows and new processors are added, there is no need to unload the data base, then reload after the additional equipment is installed. When a system is expanded to add AMPs and DSUs, an internal DBC/1012 utility automatically redistributes the data (including FALLBACK) to populate the new processors. This minimizes the costly operational disruption normally encountered when adding disk storage capacity to an existing system.

System for All Users

The DBC/1012 supports access from both end-users as well as on-line and batch programs. End-users can retrieve data through ITEQ, BTEQ, or coordinated products, while batch or on-line programs access data using embedded DBC/SQL statements. This is the first system where both groups of users are able to work effectively with the same relational data.

System Performance

The response times that can be achieved with the DBC/1012 are outstanding. Simple requests can be satisfied as quickly as with conventional systems, while complex requests run 4 to 100 times faster than conventional systems, depending on the number of processors in the configuration. By distributing the workload over parallel processors, the DBC/1012 avoids the performance bottleneck that is common in a mainframe CPU.

DBC/1012 Hardware Specifications

The DBC/1012 components are housed in handsome faceted cabinetry. Two subsystem cabinets exist: one for processors and the other for disk storage units. Both require the same floor space and are distinguished from the exterior by their display panels.

Dimensions (Single Cabinet)

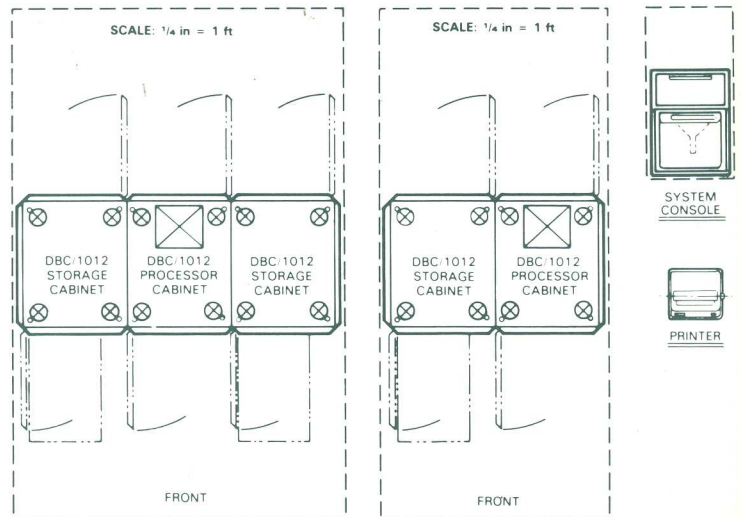
Width 74 cm (28")
Depth 91 cm (36")
Height 152 cm (60")

Subsystem cabinets are grouped by twos or threes: a processor cabinet plus one or two storage cabinets. A system console and printer are provided as part of each DBC/1012 system.

A processor subsystem cabinet accommodates up to eight processors (AMPs, IFPs and COPs) plus dual (redundant) Ynet interconnection. A storage subsystem cabinet can house from four to eight DSUs, depending on the disk option selected.

Processor Modules

The IFP, COP and AMP microprocessor subsystems are each composed of two high speed state machines for interfacing with the two Ynets, and three microprocessors; a Central Processing Unit (CPU), a Numerical Processing Unit (NPU) and an I/O Processor. All of these processing components share a common memory resource.



Each processor module requires four Printed Wire Board Assemblies (PWBA's); two for the Ynet interfaces, a memory board, and a processor board. The COP also requires an adapter board for the local area network.

Power Requirements

A DBC/1012 cabinet group requires one branch circuit providing 208V, 30A, three-phase, five-wire, wye-connected power. Power distribution is determined by the system hardware configuration. Each cabinet group requires an AC power receptacle and branch circuit.

Air Conditioning Requirements

The DBC/1012 subsystems are cooled by fans that draw air in through the bottom of the cabinet and circulate it out through the top. The number of subsystems in the configuration determine the amount of heat produced. A fully loaded processor cabinet emits approximately 8400 BTU/hour. A full storage cabinet is rated at 8090 BTU/hour.

For further information regarding the architecture of the DBC/1012 and site planning details, please refer to the following Teradata publications: C02-0001 DBC/1012 Data Base Computer Concepts and Facilities, C07-0001 DBC/1012 Data Base Computer Planning Guide.

THE RESULT: DATA BASE COMPUTING

The DBC/1012 is a complete system offering the full functionality and productivity of the relational model. In servicing the needs of programmers and information users, the DBC/1012 offers:

- Superior responsiveness and throughput due to its parallel processing architecture.
- Consistent data availability through fault-tolerant redundancy.
- The ability for multiple users and multiple hosts to share a common data resource.
- Modular sizing to accommodate the workload of today's requirements as well as the unknown of tomorrow.

These benefits combined with the price/performance ratio define the new generation of data management: data base computing — enabled by the Ynet, delivered by Teradata.

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"We call the Ynet "the Enabler" because it is the mechanism that allows us to fully exploit parallel processing and make cost effective relational data base computing possible."

—Dr. Jack E. Shemer
Chairman of the Board

The Ynet™ is a Teradata® patented invention. It is a breakthrough in multiprocessor system organization. As "the Enabler," it harnesses the power of up to 1024 microprocessors operating in parallel to provide information faster, more easily, and in a more cost efficient manner than ever before.

The Ynet is a redundant array of active logic. This logic provides selection and sorting functions for the Data Base Computer System. Requests for information that come from Communication or Interface Processors are broadcast to the correct Access Module Processors via the Ynet. The resulting information is then merged by the Ynet and delivered back to the user.

This ability to interconnect many processors solves the long-standing problem of building large parallel processing systems. The Ynet allows processors to operate autonomously, without contention for centralized control. Thus, as new processors are added, a linear improvement in performance and throughput is realized. And, because of the Ynet's redundancy, system availability is exceptional.

The Ynet is the heart of the DBC/1012® architecture. No other architecture available today can provide — on such a large scale — the cost-effective processing power that is harnessed by the Ynet. Since relational data base computing is inherently a parallel process, the DBC/1012 makes the relational model more efficient and therefore more practical and accessible.

Ynet



The name Ynet is derived from the schematic representation of the basic interconnect subsystem, a network of high-speed circuits that resemble upside-down Ys arranged in a tree structure. The upside-down letter Y, highlighted in Figure 1, is also symbolized in the Teradata logo.

A DBC/1012 system includes two independent, fully redundant Ynets. Each Ynet is an intelligent network that interconnects all Interface Processors (IFPs), Communication Processors (COPs), and Access Module Processors (AMPs). The Ynet performs — in high-speed hardware — many of the complex tasks associated with multiprocessor system management.

As fully independent networks, each Ynet has physically separate circuits with separate power supplies. Each processor is connected to each Ynet. This redundancy, combined with integrated recovery logic, insures high availability of the system. In normal operation the two networks share the traffic load. However, if one network malfunctions, the other Ynet performs all necessary system activities.

The basic Ynet configuration or node module, depicted in Figure 1, consists of seven nodes connected to the Ynet interfaces of eight processors. This figure shows only one of the dual Ynets. In reality, each processor is connected to the other Ynet as well.

The Ynet operates in the DBC/1012 as a switching mechanism passing messages from Interface and Communication Processors to Access Module Processors and back. Simply explained, work steps from an IFP or COP travel up the node module hierarchy and then down, directed toward a single AMP (as in a prime key request) or fanning out to a number of AMPs (as in a request for multiple rows). Contention logic (for sorting) is applied in the upward path. In the downward path, the nodes operate in simple broadcast mode. Since all nodes operate from a common clock, all communication within the Ynet is synchronous.

Because of the Ynet design, the DBC/1012 is easily and dynamically expanded with the addition of subsequent node

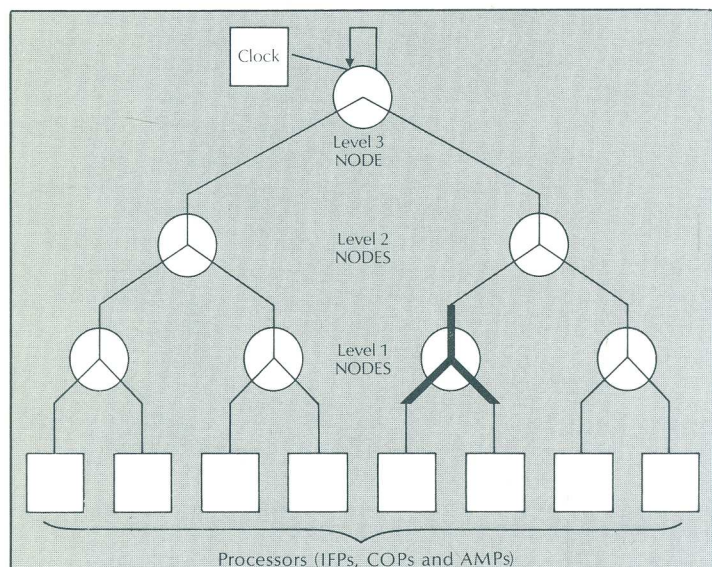


Figure 1: Basic Ynet Configuration

modules. It allows the interconnection of as many as 1024 processors in excess of 1000 MIPS of processing power. Figure 2 shows node expansion modules connecting eight 8-processor cabinets into a 64-processor configuration. In this diagram, both Ynets are shown in concurrent operation. With the addition of only two more node expansion levels, the full 1024 processor system can be configured.

And, as the DBC/1012 expands, performance grows linearly with its number of processor modules. For instance, if the configuration doubles in size, performance is twice as good — therefore, the larger it grows, the faster it goes — an important benefit for relational data base processing. The result is rapid responses even to complex queries.

Storage capacity grows linearly as well. The user is no longer concerned with physical distribution. To accommodate growth, the Ynet permits the automatic restructuring of the data. It gives the DBC/1012 the capability to manage over 1 trillion (10^{12}) bytes of information. This fact led us to our name — Tera, the scientific prefix for "trillion" — hence Teradata.

The Ynet is truly a remarkable achievement. It was an innovative outgrowth of the Teradata engineering organization. The DBC/1012 is the first application of this concept.

Like most really significant ideas, the Ynet is very simple. The astonishing thing is how it solves the complex problems of parallel processing. It is an elegant answer for the first data base computing system — a system that delivers superior cost performance, processing efficiencies, modular growth and great expansion capabilities — the Teradata DBC/1012.

The Ynet is truly a remarkable engineering achievement. A simple "Y" circuit with active logic to solve the complex problems associated with parallel processing. It is "the Enabler" that makes data base computing possible.

A typical 8-processor system. Note that two Ynets operate concurrently.

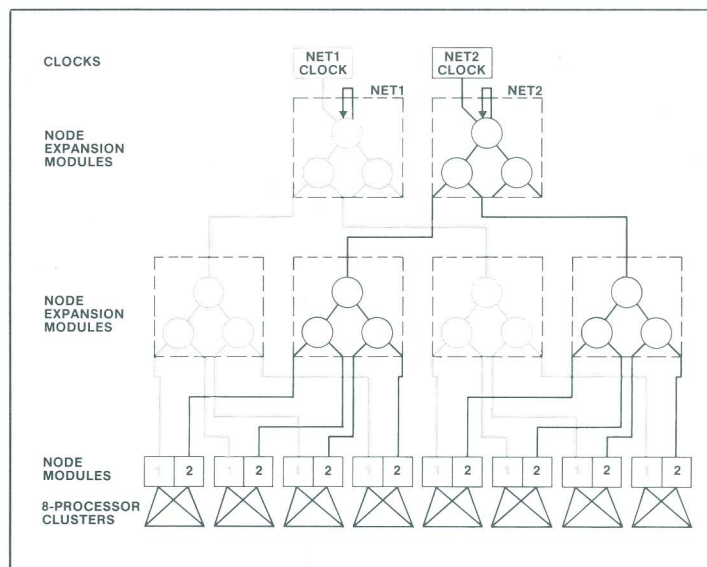


Figure 2: Multi-Level Network Configuration



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"Why is DBC/SQL easy to use? Because the user only needs to tell the DBC/1012 what data he wants — not how to get it. That's up to the DBC/1012."

— Dr. Philip M. Neches
Chief Scientist

The product of any data base system is information. However, the demands of today's business climate have surpassed the ability of traditional systems to deliver that product. The result is costly development and unmet backlogs.

To be productive, information must be quickly delivered to the people who need it, when they need it, and in a form that they can use. Moreover, information should be obtained with the least amount of effort: ask a question, receive a reply.

The relational model data base approach answers many of these problems. Yet, all-software implementations of the relational model lack the performance and reliability to support a meaningful community of data base users. In recognition of this deficiency, a leading mainframe vendor cites the need for "significantly more systems resource — both machine cycles and memory."

The Teradata distinctive solution enriches the relational model with special purpose, high-performance hardware, and DBC/SQL — a unified, multi-purpose data base language that satisfies the needs of both programming professionals and direct end-users. DBC/SQL is Teradata's implementation of the emerging industry-standard SQL data base language. Simple English-like statements evoke rapid response, and information is delivered easily and quickly.

All functions of the DBC/1012™ — data definition, data manipulation, query, and report writing — are handled by DBC/SQL commands. Statements may be issued directly by interactive terminal users or they may be embedded within application programs.

This powerful, easy-to-learn language allows a broad community to access and manipulate the data base. End-users without programming skills can master the system within a short period of time. Programmers and analysts can develop applications much quicker than before. Finally, with the DBC/1012 there is one language that meets the needs of information users and production systems, without compromises that favor one use or the other.

DBC/SQL provides full availability of the relational model for data base management — an approach that both simplifies and expedites the processing of information. The relational model is a more productive tool than the systems of the past. Now DBC/SQL and the DBC/1012 deliver the winning combination — the productivity benefits of the relational approach with levels of cost/performance and reliability unmatched by prior systems.

DBC/SQL

The Relational Approach

The key benefits of the relational model data base approach come from its simplicity. Data are seen in tables — the way most people work with related pieces of information every day. This familiar view of data permits programmers and end-users alike to easily understand and use the data base.

The DBC/SQL language allows the user to retrieve and manipulate tabular data in a non-procedural fashion — that is, without iterative loop processing and step-by-step navigation. With DBC/SQL, the user states *what* is needed, but not *how* to get it. Thus, an entire table or data base may be handled with a single statement, rather than numerous lines of procedural programming code.

Tables: The Basic Data Structure

Figure 1 depicts two relational tables. Each table (relation) has a name: Employee and Department. Each vertical column has a name. The horizontal rows are the entries or instances of the relation. All rows have the same data format. The intersection of a column and a row is called a field.

All data in a table can be modified. Rows may be added or deleted and individual fields may be changed. Similarly, entire columns may be altered, deleted or added to an existing table. The user has total control of the data.

| EMPLOYEE | | | | |
|----------|------------|--------|------------|-----------|
| EmpNo | Name | DeptNo | Position | Salary |
| 10001 | Peterson J | 100 | Bookkeeper | 25,000.00 |
| 10002 | Moffit H | 100 | Recruiter | 35,000.00 |
| 10003 | Smith T | 500 | Engineer | 42,000.00 |
| 10004 | Jones M | 100 | Vice Pres | 50,000.00 |
| 10005 | Kemper R | 600 | Assembler | 29,000.00 |
| 10006 | Marston A | 500 | Secretary | 22,000.00 |
| 10007 | Reed C | 500 | Technician | 30,000.00 |
| 10008 | Watson L | 500 | Vice Pres | 56,000.00 |
| 10009 | Regan R | 600 | Manager | 44,000.00 |
| 10010 | Carter J | 500 | Engineer | 44,000.00 |
| 10011 | Greene W | 100 | Payroll Ck | 32,500.00 |
| 10012 | Russell S | 300 | President | 65,000.00 |
| 10013 | Newman P | 600 | Test Tech | 28,600.00 |

| DEPARTMENT | | |
|------------|----------------|-----|
| DeptNo | DeptName | Loc |
| 100 | Administration | NYC |
| 300 | Exec Office | NYC |
| 500 | Engineering | ATL |
| 600 | Manufacturing | CHI |

Figure 1

Relational Operations

It is easy to access relational tables. The operations of the relational model can deal with an entire table, portions of a table or multiple tables.

The following DBC/SQL statement will deliver the entire sample employee table — that is, all rows and columns:

```
SELECT *
FROM Employee;
```

Often, users will only need to access some of the columns and/or rows. The relational operations "select" and "project" do this.

The DBC/SQL "project" operation restricts the columns returned. For example, the statement shown below narrows the return of employee data from five columns to two — employee name and position:

```
SELECT Name,Position
FROM Employee;
```

The "select" operation restricts the rows returned. As the following DBC/SQL statement illustrates, the WHERE clause is used to specify row selection:

```
SELECT *
FROM Employee
WHERE DeptNo=500;
```

The "select" and "project" operations may be used together, as well, as in this example:

```
SELECT Name,Position
FROM Employee
WHERE DeptNo=500;
```

A third relational operator, called the "join", combines data from two or more tables. The following example uses the tables from Figure 1:

```
SELECT Name,Employee.DeptNo,Loc
FROM Employee,Department
WHERE Employee.DeptNo=Department.DeptNo;
```

This example combines the name and department number from the employee table with the location from the department table. The value of the department number is common to both tables and is the "link" used to "join" the tables.

Ordering

DBC/SQL provides the ability to present information in any order desired. The relational model can order returned information in two ways: horizontally (by column) and vertically (by row). For instance, the DBC/SQL statement below asks for data in a different column order than exists on the employee table:

```
SELECT DeptNo,Name,Salary
FROM Employee;
```

The ORDER BY clause controls vertical (row) sequencing. For instance:

```
SELECT DeptNo,Name,Salary
FROM Employee
ORDER BY DeptNo;
```

Any field or combination of fields may be stipulated in the ORDER BY clause. Thus, the user could have this return in department number, name or salary order. The next example results in a major sort by department number, and a minor sort by salary:

```
SELECT DeptNo,Name,Salary
FROM Employee
ORDER BY DeptNo,Salary;
```


Data Maintenance Functions

The DBC/SQL language may also be used to CREATE tables and maintain them. New rows are added to a table with the INSERT statement. Existing rows can be modified by using the UPDATE command or eliminated with the DELETE command.

Using the UPDATE as an example, the following statements illustrate how a DBC/SQL command can be used to maintain either a single row or a selection of multiple rows:

```
UPDATE Employee SET Position='Accountant'
WHERE EmpNo=10001;
```

```
UPDATE Employee SET Salary=Salary * 1.1
WHERE DeptNo=500;
```

Views

A view is an "apparent" table derived from one or more "real" tables. The view allows data to be tailored to users' perceptions and needs without redesigning the data base. For instance, assume that a group of users require a view of the sample tables in Figure 1. They commonly need to know the employee name, department name and location. They do not need to know the position or salary. The following statement prepares an appropriate view:

```
CREATE VIEW Directory (Name,DeptName,Loc)
AS SELECT Name,DeptName,Loc
FROM Employee,Department
WHERE Employee.DeptNo=Department.DeptNo;
```

Users of this view may deal with the Directory view as if it was a real table with three columns — Name,DeptName and Loc:

```
SELECT Name
FROM Directory
WHERE Loc='NYC';
```

Views simplify formulating requests and function as a data security mechanism by precisely limiting access to information to that which is required.

ITEQ — Interactive Use of DBC/SQL

DBC/SQL statements may be embedded in application programs or issued to the DBC/1012 interactively through the ITEQ (Interactive T_Eradata Q_Uery) facility.

ITEQ provides functions for controlling terminal operations during a dialogue with the DBC/1012. DBC/SQL statements may be directly entered, edited and executed. The user may format outputs, compose reports, and create macros.

ITEQ, together with DBC/SQL, presents a powerful set of report writer features. Data can be formatted for terminal display and prepared for printing. Formatting can:

- Center information
- Show summary information (for example, totals and subtotals by groups)
- Specify a report title, which automatically appears centered at the top of each display or printed page along with the current date and page number
- Change column headings and column summary titles
- Specify the format for numeric fields (for example, suppression of leading zeros, number of decimal places to appear)
- Establish printer page size (width and length)
- Cause a report file to be created and sent to a printer

Screen A shows a typical ITEQ display result. The screen shows the results from the DBC/1012 at the top and the user's request at the bottom. If the user wishes to further format the data for a report, the input statement may be edited using ITEQ and resubmitted to the DBC/1012. For example, by adding a WITH clause to the SELECT statement, the user can produce subtotals for each department. Screen B shows the modified input statement and the resulting response.

ITEQ automatically uses names from the DBC/1012 Data Dictionary/Directory for column headings. However, the user may change these names. The example in Screen C shows how DeptNo can be changed to DeptNumber and SUM Salary to Dept TOTAL to customize a report.

RETRIEVE COMPLETED. 9 RECORDS FOUND. 3 COLUMNS RETURNED.
MAXIMUM LINE WIDTH IS 32 CHARACTERS.

| DeptNo | Name | Salary |
|--------|------------|-----------|
| 100 | Greene W | 32,500.00 |
| 100 | Jones M | 50,000.00 |
| 100 | Moffit H | 35,000.00 |
| 100 | Peterson J | 25,000.00 |
| 500 | Carter J | 44,000.00 |
| 500 | Marston A | 22,000.00 |
| 500 | Reed C | 30,000.00 |
| 500 | Smith T | 42,000.00 |
| 500 | Watson L | 56,000.00 |

```
= => SELECT DeptNo, Name, Salary FROM Employee
WHERE DeptNo IN (100, 500)
ORDER BY DeptNo, Name;
```

Screen A

RETRIEVE COMPLETED. 9 RECORDS FOUND. 3 COLUMNS RETURNED.
MAXIMUM LINE WIDTH IS 32 CHARACTERS.

| DeptNo | Name | Salary |
|--------|------------|------------|
| 100 | Greene W | 32,500.00 |
| 100 | Jones M | 50,000.00 |
| 100 | Moffit H | 35,000.00 |
| 100 | Peterson J | 25,000.00 |
| | SUM Salary | 142,500.00 |
| 500 | Carter J | 44,000.00 |
| 500 | Marston A | 22,000.00 |
| 500 | Reed C | 30,000.00 |
| 500 | Smith T | 42,000.00 |
| 500 | Watson L | 56,000.00 |
| | SUM Salary | 194,000.00 |

```
= => SELECT DeptNo, Name, Salary FROM Employee
WHERE DeptNo IN (100, 500)
WITH SUM (Salary) BY DeptNo
ORDER BY DeptNo, Name;
```

Screen B

RETRIEVE COMPLETED. 9 RECORDS FOUND. 3 COLUMNS RETURNED.
MAXIMUM LINE WIDTH IS 32 CHARACTERS.

| Dept Number | Name | Salary |
|-------------|------------|------------|
| 100 | Greene W | 32,500.00 |
| 100 | Jones M | 50,000.00 |
| 100 | Moffit H | 35,000.00 |
| 100 | Peterson J | 25,000.00 |
| | Dept TOTAL | 142,500.00 |
| 500 | Carter J | 44,000.00 |
| 500 | Marston A | 22,000.00 |
| 500 | Reed C | 30,000.00 |
| 500 | Smith T | 42,000.00 |
| 500 | Watson L | 56,000.00 |
| | Dept TOTAL | 194,000.00 |

```
= => SELECT DeptNo ('TITLE 'Dept//Number'), Name, Salary
FROM Employee
WHERE DeptNo IN (100, 500)
WITH SUM (Salary) ('TITLE 'Dept TOTAL') BY DeptNo
ORDER BY DeptNo, Name;
```

Screen C

BTEQ — Batch Use of DBC/SQL

DBC/SQL statements may also be issued to the DBC/1012 as a batch job through the facility called BTEQ (Batch Teradata Query).

BTEQ also provides the user with a powerful set of report writer features. Data can be formatted for printing or exported to a host data set for further processing.

The following example shows how BTEQ can be used to generate a report:

```
●SET FORMAT ON
●SET RTITLE 'Departmentalized Salary Report'

SELECT DeptNo (TITLE 'Dept//Number'),Name,Salary
FROM Employee
WHERE DeptNo IN (100,500)
WITH SUM (Salary) (TITLE 'Dept TOTAL')BY DeptNo
ORDER BY DeptNo,Name;
```

RETRIEVE COMPLETED.9 RECORDS FOUND.3 COLUMNS RETURNED.
MAXIMUM LINE WIDTH IS 32 CHARACTERS.

Page 1

9/15/85 Departmentalized Salary Report

| Dept Number | Name | Salary |
|----------------|------------|------------|
| 100 | Greene W | 32,500.00 |
| 100 | Jones M | 50,000.00 |
| 100 | Moffit H | 35,000.00 |
| 100 | Peterson J | 25,000.00 |
| | Dept TOTAL | 142,500.00 |
| 500 | Carter J | 44,000.00 |
| 500 | Marston A | 22,000.00 |
| 500 | Reed C | 30,000.00 |
| 500 | Smith T | 42,000.00 |
| 500 | Watson L | 56,000.00 |
| | Dept TOTAL | 194,000.00 |

Macros

Macros save time by simplifying a complex entry and reducing errors in keying. A macro is a set of DBC/SQL statements, stored on the DBC/1012 with a macro name, that the system will execute as a single transaction. A simple EXECUTE followed by the macro name will cause the stored DBC/SQL statements to be processed.

Application Program Interface

DBC/SQL statements may also be issued from within an application program. Any programming language with a CALL facility can direct DBC/SQL commands to the DBC/1012 through the Teradata Call-Level Interface (CLI). This interchange is similar to the CALL structures of traditional data base systems.

Teradata offers preprocessors for COBOL and PL/1 which simplify the coding tasks by allowing the programmer to use high level DBC/SQL statements intermixed with COBOL or PL/1 statements. The Teradata COBOL and PL/1 Preprocessors run in the host computer as a batch job. Before a source program is compiled, the preprocessor scans the program for embedded DBC/SQL statements identified by a prefix delimiter, normally a ? character. The preprocessor adds appropriate expansions and CALLS that handle the actual program interface, and thus relieve the programmer of dealing with the low level details of the interface.

The sample COBOL code shown below illustrates how easily a DBC/SQL statement may be used. This structured code receives an input department number, retrieves the salary statistics for the department from the DBC/1012, and then places the results into an appropriate COBOL work area. Error control is provided by the Preprocessor ONERROR facility.

```
035300*****
035400 2210-REPORT-DEPARTMENT SECTION.
035450
035500 MOVE 'DEPARTMENT SALARY STATS' TO REPORT-TITLE.
035560 MOVE ZERO TO PAGE-NUMBER.
035700
035800 ?SELECT DEPARTMENT.DEPTNO, DEPTNAME,
035900 ? AVG(SALARY), MIN(SALARY), MAX(SALARY)
036000 ? FROM DEPARTMENT, EMPLOYEE
036100 ? INTO DEPT-SAL-STATISTICS
036200 ? WHERE DEPARTMENT.DEPTNO=EMPLOYEE.DEPTNO
036300 ? AND DEPARTMENT.DEPTNO=:DEPT-VALUE-INPUT ;
036400
036500 ?ONERROR (NO-SUCH-DEPT,2210-DEPT-ERROR,
036600 ? OTHERWISE,SNAP) ;
036700
036800 PERFORM 3920-WRITE-PRINTER.
036900 GOTO 2210-EXIT.
037000
037100 2210-DEPT-ERROR.
037250
037300 MOVE 'INVALID DEPARTMENT NUMBER' TO ERROR-MESSAGE.
037460 PERFORM 3210-PRINT-ERROR.
037500
037600 2210-EXIT.
037700 EXIT.
```

Controlling Data Access

The ability to control access to sensitive data is an important DBC/SQL strength. Specific access privileges are GRANTED to each user of the system — depending on the data needed by and authorized for that individual. Typically, the granting of privileges is managed by the Data Base Administrator or by his or her delegate — that is, an individual who has been granted the right to GRANT. Thus data remains secure, in a controlled and manageable system.

Data Dictionary/Directory

DBC/1012 software automatically maintains an active Data Dictionary/Directory. This facility catalogs all CREATED tables, views and macros as well as users of the system and their access rights. All modifications to such entries are automatically recorded. Numerous usage statistics are also dynamically stored in the dictionary during system operation.

Because the Data Dictionary/Directory is a relational data base on the system, the customer can access its contents using DBC/SQL. Users can create tailored reports on data structures, user rights, and statistics for chargeback purposes.

For further information regarding DBC/SQL, ITEQ and BTEQ, please refer to the Teradata documents CO3-0001 DBC/1012 Data Base Computer Reference Manual and CO9-0001 DBC/1012 Data Base Computer User's Guide. Should detail be needed for the Call-Level Interface (CLI), please request C12-0001 DBC/1012 Data Base Computer Host Interface Manual.

Coordinated Products

Users of the DBC/1012 also need information delivery tools to enhance the usage of the stored data. Interfaces are available to software such as: NOMAD2 and FOCUS, 4th generation languages, IDEAL, a high-level application development tool, and PC/SQL-link, a SQL-based program supporting PC-to-mainframe interaction.

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"At Teradata, our last customer is more important than the next."

— Kenneth W. Simonds
President

Teradata is a company dedicated to a new spirit of support for its customers. It is committed to providing a level of trust and understanding for customer needs — not just hardware and a manual but a support system that meets these needs every step of the way.

Teradata fulfills this commitment to support with a team of customer oriented professionals as well as accurate up-to-date documentation and education. Service begins in the field with veteran sales representatives, system engineers, and customer engineers. These individuals are in turn supported by active headquarters-based facilities; a National Service Center, documentation, and education departments.

Sensitivity to customer needs and preferences is the key theme. Teradata has been, and will continue to be, a company that listens and responds to its customers. Therefore, it will maintain the highest level of customer support — from the initial sale to installation, to user orientation and training, to software and hardware service. At Teradata, we believe that the customer's success with the DBC/1012™ Data Base Computer System will be mutually beneficial.

Teradata Field Support

Teradata provides its clients with five levels of direct support: the sales representative, the system engineer, the customer engineer, the National Service Center and customer education. These multiple levels ensure a quality service structure dedicated to meet every need, anticipated or unanticipated, from corporate, regional and field locations.

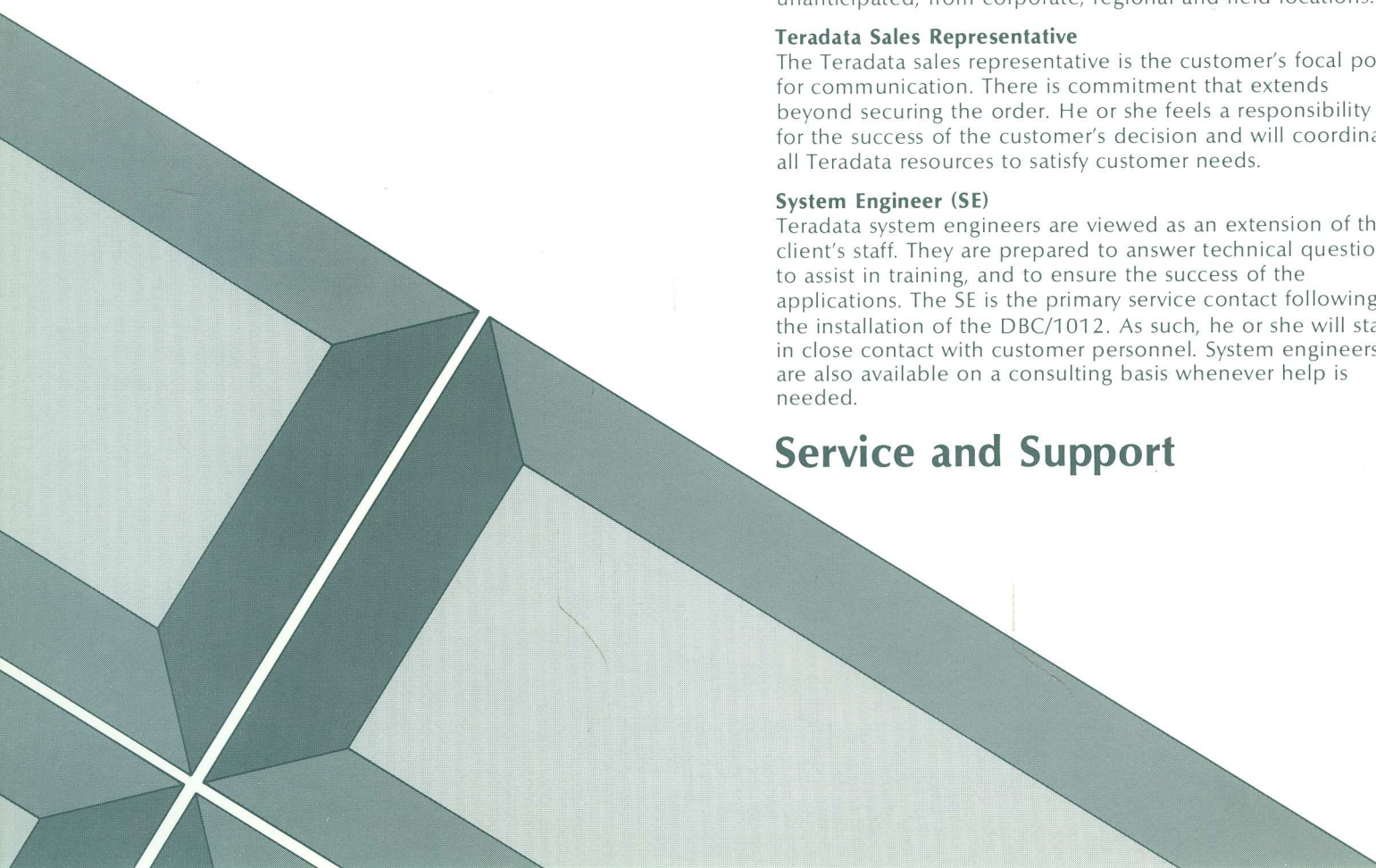
Teradata Sales Representative

The Teradata sales representative is the customer's focal point for communication. There is commitment that extends beyond securing the order. He or she feels a responsibility for the success of the customer's decision and will coordinate all Teradata resources to satisfy customer needs.

System Engineer (SE)

Teradata system engineers are viewed as an extension of the client's staff. They are prepared to answer technical questions, to assist in training, and to ensure the success of the applications. The SE is the primary service contact following the installation of the DBC/1012. As such, he or she will stay in close contact with customer personnel. System engineers are also available on a consulting basis whenever help is needed.

Service and Support



Customer Engineer (CE)

Teradata's commitment to service includes customer engineers trained to work with the customer from the initial site survey through equipment installation, upgrades, and repair. Backed by an extensive local spares inventory and in-depth systems software knowledge, these engineers are equipped to repair all possible system failures on the spot.

National Service Center (NSC)

Backing up the field organization is a trained corporate staff of National Service Center personnel. This staff includes senior system engineers and customer engineers with in-depth knowledge of the DBC/1012. The NSC is responsible for all reported problems and tracks each case to its conclusion.

To provide troubleshooting advice, staff members have access to a customer data base where the history of previous problems and solutions can help in current problem diagnosis. In addition, the system developers are available should a question arise that needs their expertise.

Customer Documentation

The DBC/1012 Data Base Computer System is a powerful information management tool. In order to derive the maximum benefit from the system, its use must be quickly assimilated into the organization. Documentation is needed at several levels, from systems professionals to the end-users. Teradata provides the following set of manuals and guides.

DBC/1012 Data Base Computer Concepts and Facilities CO2-0001

This manual presents a general overview of the DBC/1012 Data Base Computer System.

DBC/1012 Data Base Computer Reference Manual CO3-0001

This reference manual contains comprehensive descriptions of the major Teradata software: DBC/SQL, ITEQ, BTEQ, the COBOL and PL/1 Preprocessors, and the Data Dictionary/Directory (DDD).

DBC/1012 Data Base Computer Reference Card CO4-0001

This card summarizes the syntax of DBC/SQL statements; ITEQ and BTEQ commands; COBOL and PL/1 Preprocessor statements; DDD view formats; and Call-Level Interface entry points.

DBC/1012 Data Base Computer Planning Guide CO7-0001

This planning guide contains information required to prepare a customer site for installation of a DBC/1012. It includes a summary of physical planning issues, DBC/1012 hardware specifications, a physical planning template, and a summary of host system software installation procedures.

DBC/1012 Data Base Computer User's Guide CO9-0001

This guide describes how to communicate with the DBC/1012 in order to work with data stored on the Data Base Computer System.

DBC/1012 Data Base Computer System Manual C10-0001

This manual describes the administration of the DBC/1012 and summarizes the procedures and utilities that support its maintenance. It also provides guidelines for designing efficient relational data bases.

DBC/1012 Data Base Computer Utilities Reference Manual C11-0001

This manual presents the utilities that are used to load, dump, and restore data, initialize and configure a DBC/1012 system, and perform system maintenance.

DBC/1012 Data Base Computer Host Interface Manual C12-0001

This manual describes the host interface software that provides communication between host-resident user applications and the DBC/1012 Data Base Computer System.

DBC/1012 Data Base Computer CICS Interface Manual C12-0002

The CICS interface manual is written for programmers who access the resources of the DBC/1012 system through CICS.

DBC/1012 Data Base Computer MVS/VM Host Software Manual C13-0001

This manual describes the host-resident software components supplied by Teradata, SVC mode and cross-memory services mode under MVS, and corresponding operation under VM.

DBC/1012 Data Base Computer Operator's Guide C15-0001

The guide presents features of the DBC/1012 and its console, as well as their operating procedures, programs, and status indicators.

DBC/1012 ITEQ Keypad Template C99-0002

The template, which fits over the terminal keyboard's PF-key keypad, shows the assignment of PF keys to ITEQ commands.

Education

Teradata offers a complete educational program to acquaint customers with the DBC/1012 and its use. Classes offer labs, lectures, and workbook exercises with strong emphasis on student participation. Programs can be tailored to a client's needs and can be conducted either at Teradata education centers or at the client's site. A class schedule is available upon request.

DBC/1012 Data Base Computer Concepts CU 100

CU 100 provides an overview of the hardware and software subsystems of the DBC/1012 System. Duration: 1 day.

DBC/1012 Operations CU 120

CU 120 provides the customer data center personnel (operators and supervisors) with information necessary in the day-to-day operation of the DBC/1012 system. Duration: 1 day.

System Administration CU 210

CU 210 teaches students how to handle system administration, configuration issues, and software maintenance procedures. Prerequisite: CU 100. Duration: 2-3 days.

DBC/1012 Language: DBC/SQL/ITEQ/BTEQ CU 220

CU 220 enables the student to become proficient in DBC/SQL, ITEQ and BTEQ through hands-on experience in the lab. Prerequisite: CU 100. Duration: 2-3 days.

Data Base Design CU 215

CU 215 presents performance considerations when designing a relational data base for the DBC/1012. Prerequisite: CU 100. Duration: 2-3 days.



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