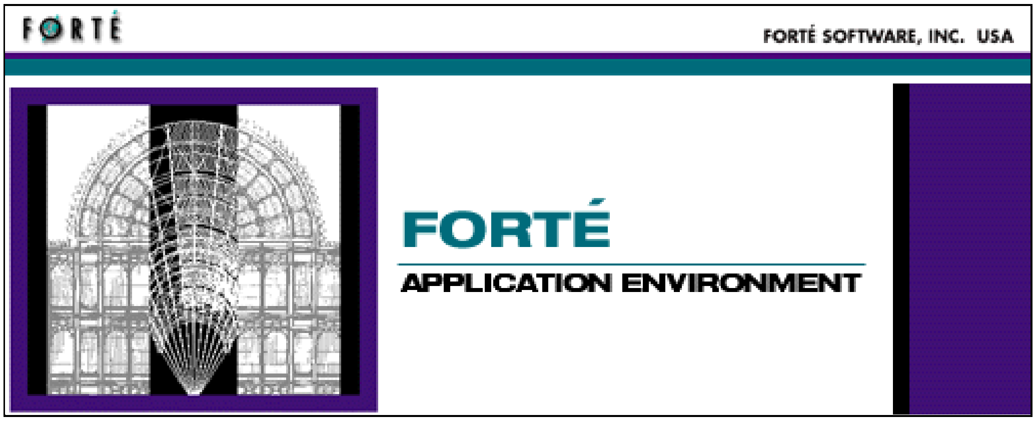

(Introductory material for presentation on 04/11/97)

Preface

The Forte Application Environment is an integrated set of object-oriented tools for building, deploying and managing high-end client/server applications. With Forte, organizations create custom applications for up to thousands of on-line users. To build an application, Forte developers define business functionality at a high level, as if it were to run on a single machine. Forte then automates the process of deploying the application into a specific client/server environment with its own combination of Graphical User Interfaces (GUIs), operating systems, Relational Databases Management Systems (RDBMSs), and networks.

In the process, Forte breaks apart or partitions the application into client components that run on the desktop and a set of server components, each of which can be reused by multiple applications. After initial deployment, an organization can change its deployment environment (e.g., add new servers with different operating systems) and Forte will redeploy the application for the new environment without requiring any programming changes. This greatly simplifies application maintenance. During deployment, Forte also provides a set of services to increase reliability and performance, while also providing for the management of the distributed application.

Introduction

A very dynamic business environment, coupled with rapidly evolving information technologies, is giving rise to a new generation of enterprise-wide applications. These high-end applications are part of a paradigm shift in how computing is applied to business problems. Instead of requiring a mainframe, these new mission-critical applications are being developed and deployed in complex client/server environments.

At the same time, these applications typically support new levels of functionality. For example, to improve its competitive position, an organization may build an advanced customer information system that enables its service representatives to review outstanding bills, analyze buying trends, offer special promotions, place orders, check inventory, and schedule deliveries--all during one phone call (Figure 1).

These increasing complexities, in both computing environments and application functionality, have created the need for a new generation of application development tools. Forte meets this need.

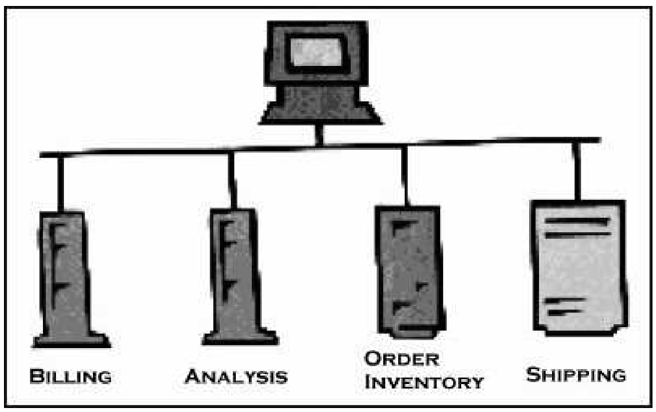

Figure 1. A customer service application may interface with multiple subsystems.

Forte is an advanced application development environment for high-end client/server applications. With Forte, organizations can build applications that meet current business needs and easily evolve them as new requirements emerge.

For development, Forte provides a complete set of object-oriented tools including a graphical user interface (GUI) designer, an object-oriented 4GL (fourth generation language), a comprehensive set of class libraries, and a repository to support team development. Forte is tightly integrated with the leading relational database management systems (RDBMSs) and can interface with external systems such as legacy applications and electronic data feeds.

For deployment, Forte generates an application optimized for the target deployment environment. Forte includes robust distributed execution capabilities and a set of application management tools. Forte supports enterprise-wide applications for up to hundreds or thousands of on-line users with high levels of reliability, performance, and manageability.

Environment Independence

Today's computing environments are more complex than the host-based systems of the past. In addition, change is constant. Forte's breakthrough technologies help organizations take full advantage of this new world of computing.

Application Partitioning

With Forte's high-level tools, developers build a logical application that is independent of the underlying physical environment. Developers build an application as if it were to run entirely on a single machine. Then, Forte automatically splits apart (partitions) the application to run across the clients and servers that comprise the deployment environment (Figure 2). Forte also enables developers to easily modify the partitioning scheme.

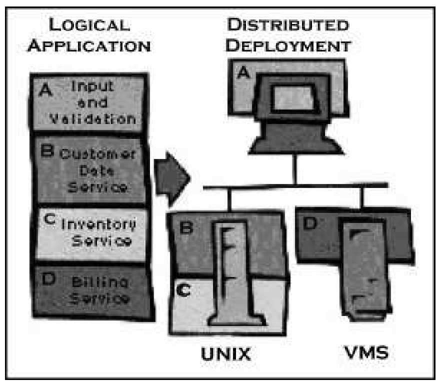

Figure 2. After development, an application is partitioned into components that run on separate machines.

Application partitioning offers extensive advantages:

- Development Productivity.

Forte allows developers to work at a high level of abstraction. Developers can concentrate on the business functionality of the application while Forte handles the low-level technical issues of how to split up the application among multiple computers and how to support specific operating systems, GUIs, RDBMSs, and networks. This significantly shortens the development of high-end client/server applications.

- Flexibility.

By separating development from deployment, Forte allows organizations to easily evolve their computing environments. They have the freedom to add new hardware and software from multiple vendors, thereby benefiting from change instead of being challenged by it.

- Increased Performance.

Correctly partitioning an application can substantially increase performance. For example, if an application analyzes hundreds of stocks to determine the best fit for a customer's portfolio, Forte will place the analysis on the server to save the network overhead of moving all data to the client. By reducing network traffic, Forte applications run faster and scale up.

- Control.

Partitioning also improves control of applications since business rules can be enforced centrally on a server, rather than residing on every user's desktop computer. This allows organizations to update business rules in one place, simplifying change management and ensuring consistency.

Portability

Forte provides transparent portability across the most common client/server platforms for both development and deployment. Each developer can choose among Windows, Macintosh and Motif desktops. Forte masks the differences while preserving the native look and feel of each environment. Any set of supported platforms can be used for deployment. For example, applications developed with Sybase on UNIX can be deployed with Oracle on VMS. It makes no difference with Forte. Organizations have the freedom to alter their technical infrastructure while preserving their investments in developed applications.

Server/Hosts	Desktop GUIs	RDBMSs
Data General AViiON	Macintosh	DB2/6000
Digital Alpha Open VMS	Motif	Informix
UNIX	Windows	MS SQL Server
Digital VAX Open VMS		ODBC
HP 9000		Oracle
IBM RS/6000		Rdb
Sequent Symmetry		Sybase
Sun SPARC		
Windows NT		

Advanced Application Functionality

Due to rapidly evolving business requirements and competitive pressures, computer applications are becoming more powerful and cross-departmental in nature. To support these requirements, Forte simplifies the development and deployment of more complex computer applications.

Shared Application Services

With Forte, developers build a high-end application as a collection of application components. These components can include client functionality such as data presentation and other desktop processing. They can also include shared application services which provide high-level business functions such as a billing service, a repair scheduling service or an inventory service. Shared services are built along with desktop functionality using the same set of tools in a unified development environment. When the application is partitioned, Forte installs each shared service on a multi-user computer where it is accessed simultaneously by many users. There is no need for each user to have his own copy of the service.

Shared application services form the basis for a three tier application architecture where clients request actions from application services that, in turn, access one or more of the underlying data sources (Figure 3). Each tier (clients, application services, data sources) can be developed and maintained independent of each other.

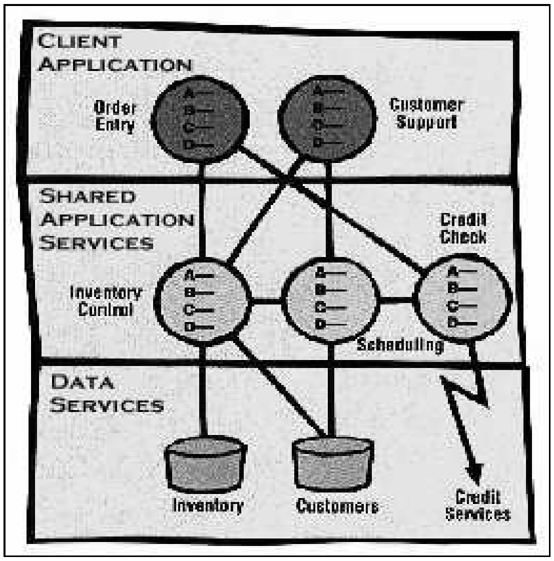

Figure 3. With a three tier application model, client applications access application services that, in turn, access the underlying data sources.

Shared application services provide several advantages:

- Productivity.

Developers build complex applications more quickly by breaking the application into a set of services, each of which can be individually developed. The same Forte development language is used to create both client functionality and shared services. Shared services can be reused by different applications.

- Maintainability.

Shared services allow organizations to respond more quickly to change. Any application service can be modified independently, enabling organizations to more easily implement application updates.

- Consistency.

Shared services also provide a powerful mechanism for ensuring consistency by providing the same view of the business to multiple applications. This allows business units to make decisions with up-to-date information on the recent activities of other business functions.

Business Events

Business events automate the notification of significant business occurrences so that appropriate actions can be taken immediately by users and/or application services. For example, in a customer support application, service reps can be notified of critical calls, even if they are busy at the time. In financial services, a trader can be notified when the price of a bond hits a new high. In manufacturing, if a machine fails, shipping schedules can be automatically adjusted and repair people can be immediately redeployed.

Forte supports business events with several key technologies. Forte detects events, whether they originate on a user's desktop or in an application service. Forte then sends notification to all the application components that have expressed interest in that event. Each Forte application component can process the arrival of an event, even if it is working on another application task at the time. These capabilities apply to events that flow from clients to servers, from servers to servers, and from servers back to clients (Figure 4).

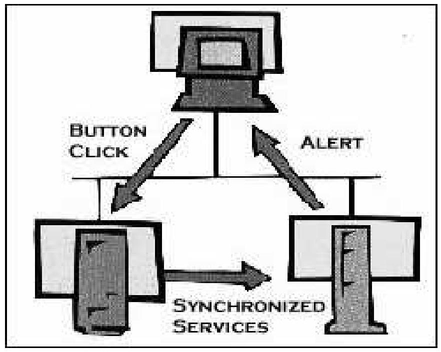

Figure 4. Business events can signal any application component when a significant occurrence happens in any other part of the system.

Business events help organizations in two important ways:

- Responsiveness.

The immediate notification of an event allows business units to resolve problems in the shortest amount of time or take advantage of new opportunities as they arise.

- Operational Efficiency.

As organizations collect more operational data in an effort to reflect the state of the business in real-time, they must find ways to analyze and use that data in a cost efficient manner. With business events, they can automate the appropriate processing of incoming data, rather than perform costly analysis after the fact.

Open Integration

With Forte, developers pursue an evolutionary approach of adding new functionality within the existing technical infrastructure. New applications leverage previous investments by integrating data, existing applications and other services.

- Desktop Integration.

Forte users leverage work in other desktop applications by using OLE or Apple Events to both import and export information. For example, users can enter data in a Forte application and have it automatically update a desktop spreadsheet or document. And vice versa.

- External System Integration.

In addition to providing tight integration with the leading RDBMSs, Forte facilitates integration with other non-Forte components. A general purpose wrappering facility can encapsulate external services, such as a real-time feed or an existing application, and treat it as a Forte component. Forte also offers an integration option via DCE, CORBA or Encina whereby external clients and servers can interoperate with Forte services. This capability allows organizations to build upon their previous investments.

- Mainframe Integration.

Forte supports several options for integrating with mainframes. For read-only data access, Forte applications can use database gateway products that provide direct access to mainframe data. For processing transactions against mainframe data, Forte supports the Netwise product which provides integration at the application level, thereby leveraging the business rules included in the mainframe application. Forte's wrappering mechanism can also be used to integrate with the mainframe.

International Support

End users can interact with a Forte application in their native language, whether it is a single-byte language such as French or a multi-byte language such as Kanji.

- Localization.

Forte applications can adopt the local alphabet or character set with the appropriate collating sequence and the appropriate formats for such things as currency, date/time, and the use of commas (or periods) in long numbers. All items appearing on the user's screen, including any system generated messages, appear in the local language of the user.

- Multi-Lingual Support.

A Forte applications can support many users, each working in a different language. When users log on to the system, they specify their language of choice. The Forte application manages the inter-dependencies among users, while displaying all information on the user's screen in the language of choice. This capability enhances business productivity in multi-lingual countries such as Switzerland and Belgium.

Mission Critical Support

As organizations support their mission-critical business functions in client/server environments, they must achieve appropriate levels of reliability, performance and manageability. Unlike mainframe architectures, client/server systems depend heavily on networks and multiple processing nodes. Since client/server systems introduce new complexities, they must also introduce new strategies for supporting mission-critical applications.

Reliability

Forte incorporates several strategies to enhance the reliability of high-end applications.

- Protection Against Component Failure.

As environments become more distributed, the probability of any node or network failure increases. With Forte, critical application services can be replicated, and Forte will automatically redirect service requests to the backup copy whenever the primary one is unavailable (Figure 5). This strategy significantly increases application availability.

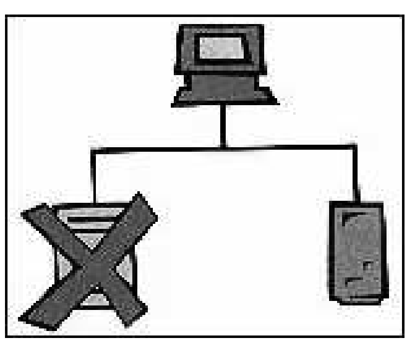

Figure 5. To increase availability, Forte supports replication and automatic failover of critical application services.

• Transaction Support.
Since many applications update the state of the business, it is important to ensure the integrity of each update. To accomplish this, Forte incorporates transaction support within the application itself. For example, a user may traverse a series of screens in the process of defining updates to a RDBMS. If the network goes down, Forte will reset the application, including the user's screen, while the RDBMS restores the data. By automating the restoration of the application, Forte simplifies the work of developers and ensures the reliability of the application.

• Component Consistency Check.
For high-end client/server systems to work correctly, all distributed components must be consistent with one another. If, for example, an old version of an application service is mistakenly loaded, an organization's current business rules may not be enforced. To avoid this problem, Forte automatically verifies that the version of each component is compatible with the others.

Performance

Forte provides numerous strategies to ensure optimal performance and scaleability:

• Load Balancing.
Forte application services can be replicated to accommodate greater processing loads. For example, an application service may calculate pricing for various product configurations. As usage grows, Forte can place replicated copies of the service on different computers, and route requests in a balanced manner among these computers. This strategy enables applications to scale as new users are added.

• Reduced Network Traffic.
Forte's adjustable partitioning provides a powerful performance tuning mechanism for dealing with network bottlenecks. By moving application functionality from one node to another, network traffic can be dramatically reduced, thereby improving performance.

• Parallel Processing.
Any Forte component can communicate with several other components at the same time (Figure 6). For example, a client can request information simultaneously from a database server and an independent image server. There is no need to wait for one request to complete before the second one begins. This can significantly improve end user response time.

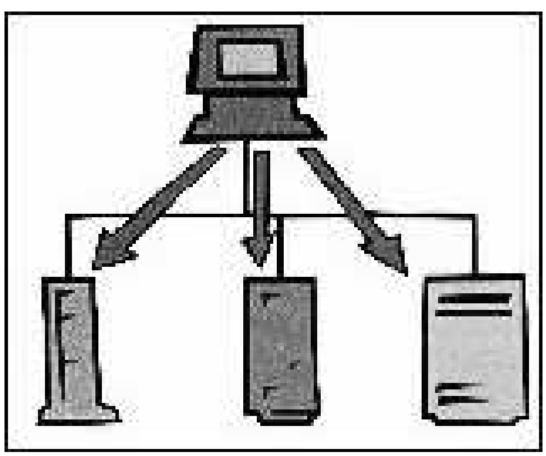

Figure 6. A Forte application can communicate with several servers at the same time.

- Code Generation.

Forte 4GL code for all shared application services is converted into 3GL and compiled for optimal performance. This enables many users to simultaneously access any application service without incurring the performance penalty of interpreted execution.

Manageability

The distribution of application functionality introduces new complexities for application management. To simplify these complexities, Forte includes a set of tools for managing the deployed application.

- Performance Monitoring.

Forte provides a performance monitor that tracks the message and event traffic among application partitions to identify performance bottlenecks.

- Repartitioning.

Forte allows for easy repartitioning of the application to optimize the use of computing resources. The tool displays a map of the physical environment and includes a drag-and-drop user interface for moving an application component from one node to another. Forte then generates a new version of the application. This ease of regeneration greatly simplifies the process of making changes to applications as the configuration evolves.

- Application Management.

Forte simplifies the job of operations personnel in controlling a complex distributed application environment. From a single interface, an application administrator can:

  - start and stop Forte partitions
  - view the specific properties of each node
  - view the message traffic among partitions
  - monitor CPU and memory utilization

Forte Product Structure

In order to meet the requirements of building and deploying enterprise-wide client/server applications, Forte provides a comprehensive set of product capabilities. Forte is comprised of an application development environment, a system generation environment, and a comprehensive distributed execution environment (Figure 7).

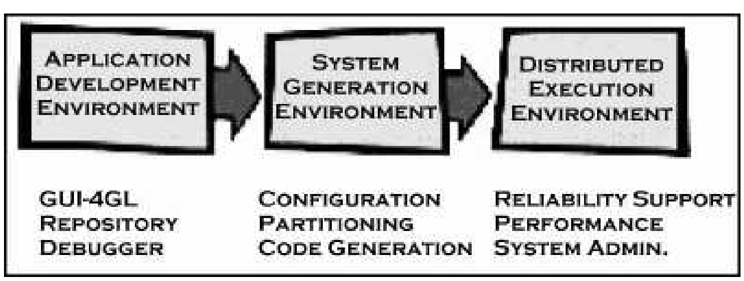

Figure 7. Forte supports the development, generation, and execution of high-end client/server applications

Application Development

Forte includes an object-oriented development environment where programmers build an application as a collection of high-level business service objects. For example, one service object may handle shipping requests while another generates purchase orders. Development tools include a GUI designer, an object-oriented 4GL, a source level debugger, a rich set of class libraries, and a class browser. To further simplify the development process, Forte Express uses business and application models to generate the GUI and RDBMS access components for three tier applications. With Forte, developers build both client and server components of the application with the same toolset. Forte supports an iterative style of development where applications are quickly tested and debugged without time consuming compiling and linking. Code management for development teams is provided by the Forte development repository.

System Generation

With Forte, developers specify one or more target deployment environments in the Forte repository. Environment specifications include different types of GUIs, server machines, RDBMSs, and networks. The Forte system uses the target environment specification to create a default partitioning scheme that maps an application's functionality into the target deployment environment. Forte automatically moves server partitions to their deployment machines.

Distributed Execution

The Forte runtime system supports the partitioned application. It manages the communications among application partitions for high performance. It implements the reliability strategies of partition failover, transactions, and version checking. It provides integration with OLE, DCE, object brokers, RPCs, TP monitors, and wrappered external services. It also includes the Forte performance monitor and application management interface.

Forte is an ideal choice for organizations that are developing a new generation of enterprise-wide applications. With Forte, organizations can turn the business challenges of the 1990s into strategic opportunities.