ISDN—A new high performance platform for distributed computer systems

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INTRODUCTION

ISDN provides distributed computer system designers new opportunities for improvement in the performance, flexibility, and cost of complex distributed applications.

This presentation will provide an overview of ISDN constructs and performance capabilities that open up these opportunities. A hypothetical real-time, distributed financial management system is described, providing as a paradigm to illuminate use and benefits of these new features.

Some of the ISDN features in this presentation are based on ISDN network attributes that are not presently available. The purpose here is to graphically illustrate distributed application possibilities from both presently defined and anticipated new service offerings expected from ISDN.

NEW DISTRIBUTED SYSTEM OPPORTUNITIES

When viewed from the perspective of higher layer networking software, and the distributed applications that this software supports, these new ISDN features represent an improved transport network “platform” for the designer. Benefits from these improved transport network capabilities, that will result from ISDNs, can be passed up through the higher layer software to aid implementation of more sophisticated and responsive distributed applications.

These improvements can be identified as benefits of:

1. more flexible and responsive system designs
2. higher performance (Error rate, throughput, delay)
3. improved network management and control
4. reduced network management artifacts imposed on information bandwidths
5. lower total system cost

The focus of the presentation is on a dynamic, interactive, distributed application. It illustrates that new and anticipated ISDN capabilities can support distributed applications with a more flexible, reliable, and responsive set of services.

A DISTRIBUTED FINANCIAL MANAGEMENT APPLICATION

A multi-node network model is assumed. Distributed throughout these nodes are mainframes, minicomputers, databases, PBXs, LANs, workstations, and personal computers. Voice is also integrated into the same system.

What will be illustrated is how a distributed application, overlaid on these disjoint heterogeneous resources, can be efficiently implemented through new ISDN services and features, and achieve a higher performance, more flexible, economical implementation than through present-day networking methodologies.

This hypothetical distributed financial application provides its users with real-time, dynamically updated graphics-based presentations. These presentations aid complex, real-time, financial decisions. Information from geographically distributed databases is required. These databases are updated in real-time from “sensors” that continuously acquire various financial and event data. Also, the databases are updated periodically from batch runs by the company’s mainframes, and aperiodically from manual workstation inputs that result from user-initiated actions. Automatically generated system requests, triggered by adaptively determined conditions from sensor, processor and database sources, result in additional information transfer between the system databases.

The notion behind this real-time financial management system is that many decisions for transactions of financial instruments rely on multiple data sources. These data are changing constantly. Further, some of these decisions rely on human input from one or several “experts,” but it is indeterminate when this will occur, which particular experts will be “asked” for input, and what queries must be made of these experts. AI-based applications software adaptively establishes these queries, based on real-time data from the multiple remote data and event information sources of the system. Finally, manual input of certain data is also required aperiodically from financial professionals. The interfaces that provide the end users the input/output they need to make these real-time
financial transaction decisions are high-performance graphics workstations and personal computers.

The scenario then, is a setting of several locations, physically separated across distances ranging from the next desk, to next room, to near-by buildings, to locations separated over wide geographical distances. The system is highly adaptive, and both transaction- and stream-oriented in its connection requirements. A priori determination of connection attributes (e.g., throughput) cannot be made. Therefore, bandwidths and type of channel are selected adaptively, on a call-by-call basis, as determined by the application state at the time of connection. This has the benefit of closely tailoring the transmission resources of each individual physical and logical call to what is actually needed, greatly reducing networking costs.

**DYNAMIC SELECTION OR TRANSPORT RESOURCES**

The system described will provide a wide spectrum of voice and data link capabilities between these different locations, will dynamically select the type and quantity of bandwidth needed, and will adaptively change distributed network management algorithms and resources as a function of system traffic loads and network faults.

Multiple logical channels, of dynamically adaptable bandwidths, are available from each PC, workstation, mini-computer, database, PBX, and LAN. A given session will involve multiple logical connections, established to different end-points from the origination end-point. This assumes a workstation that provides multitasking capabilities. These logical channels will be established and disconnected independently from each other and will select varying bandwidths on a call-by-call basis. The attributes of each connection are selected based on the type of transaction, and its performance needs, that must be supported by the specific applications process it is interconnecting.

**USER-TO-USER INFORMATION**

Database, and other processing element queries, can result in unnecessary commitment of resources due to unavailable processes, for example, or data that has not been updated since the last query. Accordingly, this hypothetical distributed system makes extensive use of a new feature of ISDNs: The User-to-User Information (UUI) field in the call establishment and disconnection primitives.

This construct allows a process to conduct a quick, low overhead status query or control input to the remote process without proceeding with the resource commitments of a complete connection. It is felt that in a large distributed system, this mechanism alone can provide for substantial reductions in unnecessary resource commitments.

Also, information received back from the remote end in this UUI field, during transmission of call establishment primitives, could help determine the exact level of connection and processing resources that should be committed to the association.

**IMPROVED NETWORK MANAGEMENT RESOURCES**

ISDN offers a high-performance signaling channel separate from the information bandwidth. This signaling channel is available at all end points and nodes interconnected with ISDN services. The presentation will illustrate some advanced network management uses of this new signaling capability.

The original purpose of the new signaling channel, as defined by telephone administrations, was for the establishment, addressing, control, and disconnection of voice and data calls. By expanding on the definition of "control" to include management of an end users network, overlaid across the ISDN facilities, improvements in performance and efficiency of customer networks are possible.

For example, a customer's private packet network, implemented on top of the public ISDNs, could use the D-channel's UUI facilities for short, low-cost status and control updates between packet nodes. This could be used, for instance, to dynamically update flow control and congestion algorithms, and buffer resources, based on knowledge of network loads and faults.

The notion is that network signaling systems are separate resources to those used for information transmission and switching. This offers benefits in areas of functionality, reliability, and efficiency. Network management communications to the end user's system could make effective use of this resource.

**SECURITY SUPPORT**

Use of the D-channel facilities for passing encryption keys, separate from the information channel, can provide a much more robust security strategy. These keys could be passed around the network dynamically, making a network security compromise extremely difficult. The presentation will discuss some applications in this area.