Distributed Network Intelligence

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Abstract

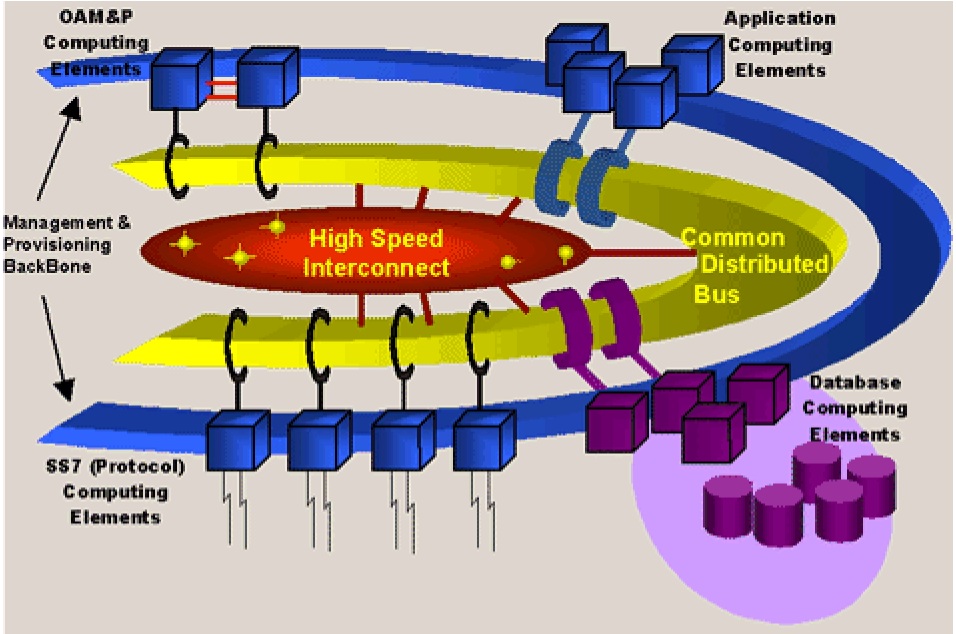
The concept of distributed network intelligence will provide a powerful foundation upon which the next-generation network can be built. It will supplant the intelligent network and computer telephony, and provide the framework upon which information, applications, and the means to bring them together can create services needed and valued by end users, service providers, and network providers. Distribution techniques within holistic systems establish the foreground for architectural implementation in heterogeneous environments for computational, contextual, and cooperative design sets. Intelligence in each of these settings provides the point and multipoint decision-making capabilities for operational evaluation and, quite likely, intelligent modification of the distribution techniques. Combined, the two methods afford today's and tomorrow's telecommunication networks the ability to operate in legacy, heterogeneous, and federated systems proactively.

Introduction

Distributed network intelligence is dependent on the development and deployment of a number of enabling elements that consist of information repositories, applications to manipulate and transform information, and processing platforms -- where applications and information are brought together to interact. Information repositories and processing platforms are connected by the other elements of the access and transmission networks. The successful interconnection and coordination of these various elements depends on the SS7, ATM, H.323, SIP, MGCP, and signaling and data transfer protocols. These protocols are different from each other and reflect the differences of the network.

The distribution of intelligence in a telecommunications network begins as nothing more than segmentation of responsibility (see *Figure 1*). The foundations of that segmentation are established according to the trend of moving telecommunications solutions toward more diverse computing platforms and away from monolithic settings. With movement and diversity comes the ability to integrate new solutions into the overall base system with greater speed and efficiency. Ultimately, the base system transforms to become part of a larger set of integrated components—each with differing levels of responsibility and contribution to the intentions of that evolved solution.

Figure 1. Interconnected Intelligent Networking Responsibilities



Implementing the distribution technique requires several fundamental elements: a high-speed communication interface between participating computing platforms, a negotiated protocol between member services, and a delegation authority for assigning responsibilities to computing platforms based on the makeup of their member services. These and many more decision-making activities continually occur in a capable system that dynamically acts and reacts to both the changing environment and changing needs of the networked solution.

Intelligence in the distributed environment finds its roots in the management of the solution. Cooperative behavior between member sets of the distributed environment lends data to the intelligent patterns. Most of all, the intelligent system grows. It exploits the diversity of the system topology to delegate responsibility to the outer reaches of the system informatively.

Possibilities of a Distributed Network Intelligence

Distribution in the IN affords improvement at all levels of execution, operation, administration, maintenance, and provisioning. The main benefit found with distribution of intelligence is the ability to define systems that meet fluctuating demands logically. A distributed system is one proactively designed for reactive behavior. In the IN, traffic loading is the principle reagent that influences the transitions between system states. Distributing the detection and reaction to state transitions between differing computing systems is an effective means of performing system modification while injecting the least amount of intrusive actions. In a distributed system, intelligent actions perform cures that are not worse than the disease.

At various layers of telecommunication systems, intelligent distribution occurs in several logic points:

- **data/link (switching systems) implementations**—These implementations dynamically allocate links or channels as nodes encapsulating those entities become available. Conversely, they deallocate when the nodes are removed or altered.

- **network implementations**—These implementations perform dynamic routing and congestion algorithms based on behavior characteristics of participating elements. Such implementations route through or around nodes based on their current and predicted performance.

• **transport implementations**—These implementations mediate call flow between the objectives of the nodes to receive the calls and distinguish between node typing so that the appropriate call is enacted on the node that can best facilitate the objectives of the call.

• **session implementations**—These implementations correlate service provisioning to nodes capable of performing the service in question. Again, such implementations use the behavior patterns of the nodes in question combined with their ability to perform the service tasking to establish route paths to service nodes considered to be capable of performing the deployed service.

Network Management

The general theme so far is to allocate to heterogeneous members of one's distributed IN those tasks considered relevant to the capabilities of those members. Configuration in this instance is an intelligent activity that dynamically changes as the nature of both the service requirements and system specifics change. This is intelligent behavior based on intelligent distribution. Perhaps the most commonly addressed distributed intelligent activity, however, runs a course through all of these activities. This is the action of performing network management.

Using the standard means of action/reaction to events within the system, network management works proactively to perform the traditional actions: configuration, event (fault), performance, provisioning, and security management. Each of these actions is triggered by behavior events in each of the participating systems. The network manager in this instance can either be an independent or participatory member of the system. As a result of the distributed nature of the system, the network manager becomes the vehicle for the overall coordination of state between the member elements to be able to define a single system state.

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Article received: 2007-07-01