INFORMATION SHARING ON A MASSIVE SCALE

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ABSTRACT

Information sharing is of critical importance to soldiers in the field. Enemy movements, squad movements, asset allocation, updated orders and missions, and current status are just some of the types of information required to be transferred between soldiers on the field and the commanders in the theater of operation. However, while it is important that information is properly sent and guaranteed to be received, it is also of extreme importance that too much information is not sent over the network, causing information overload and bandwidth problems. This situation becomes even more critical as robotic systems are used for the Future Combat System. Cybernet Systems Corporation, a small research and development company located in Ann Arbor, Michigan, has developed a massive multi-agent network information sharing system for message and information passing, called OpenSkies. Cybernet is currently working with CECOM (at Fort Monmouth) to use OpenSkies for communications to provide a nearly autonomous control methodology for telemaintenance of robotic platforms. Furthermore, OpenSkies will improve the responsiveness of the Objective Force Warrior by increasing the amount of information that can be shared, as well as increasing the capabilities for remote distance training and learning.

1. INTRODUCTION

Cybernet has developed a patent pending, distributed network server technology for the real-time data transfer of dynamic simulation and communication network content. The OpenSkies Real Time Intelligent Routing technology provides a low cost, high performance solution that is easy to implement into simulations and communication systems. Supporting this networking technology is a full open source simulation engine with network chat, terrain management, dynamics, and realistic rendering that is integrated fully with the OpenSkies communications model.

OpenSkies networking technology has also been implemented in the commercial market for Massive Multi-Player Gaming (>50,000 simultaneously players in applications that require first-person-shooter levels of performance). The network router/server technology, which is the basis of OpenSkies, is more broadly applicable to any dynamically changing, many-to-many communications applications.

2. COMMUNICATION TRAFFIC

The majority of communication traffic is composed of one-to-one or one-to-many interactions (See Figure 1). However, the growth of the communication needs for troops, especially the FCS (as well as online gaming business and chat rooms), has shown that there is an increasing demand for a more interactive experience on the Internet. This demand for interactivity has already grown to the point where the national networks are no longer able to handle the traffic and users are staying away due to poor performance. Handling the demand for an interactive Internet requires novel approaches to increase performance and provide a better quality of service to the end users.

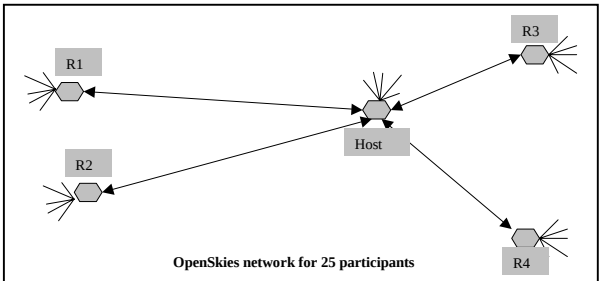

Figure 1: Network Configuration

3. ROUTING TECHNOLOGY

Cybernet's OpenSkies Real Time Intelligent Routing Technology meets this need. The technology provides a solution for increased performance where there are many-to-many interactions in real-time. Cybernet is focused on bringing this technology to the battlespace environment. By providing intelligent routing capabilities that service non-cacheable requests across the Internet, we can provide a faster and better quality of service to the end user in many-to-many interactions.

Cybernet's technology takes the concept of caching to the next level. While caching distributes content across

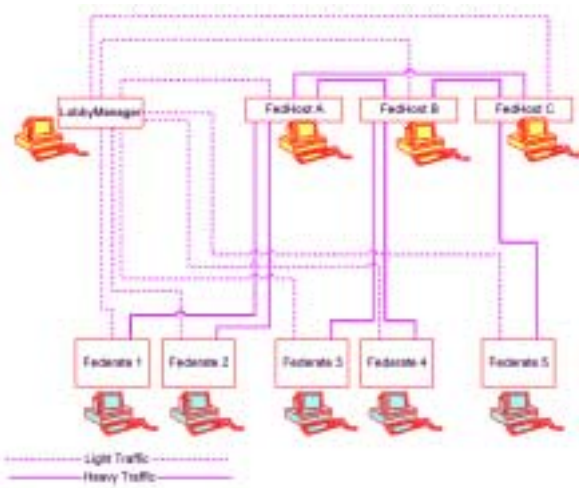

Figure 2: OpenSkies Network Topology

the Internet to reduce load on a web server, intelligent routing technology reduces the redundancy of real-time requests across the backbone by putting application-specific information in the router.

The OpenSkies Real Time Intelligent Routing technology uses a software-based system running across a distributed server network. The clients (called *federates)* connect to one of the distributed servers (called *FedHosts*). These FedHosts then act as traffic cops, acting in concert to route the data where it needs to go (Figure 2).

With culling properly implemented, each FedHost is primarily busy servicing its assigned clients so the number of clients that can be handled by the system scales linearly with the number of supporting FedHosts. Developers are able to implement their own culling modules, which can take advantage of the attributes of a specific application and its requirements. Some examples are culling by radio frequency, culling by viewing angle, culling by distance, and culling by rank or security clearance. Since the developer is able to code his/her culling module using standard C++, the rules can be arbitrarily simple or complex.

Linear scaling is the key to managing network bandwidth. As clients are added, more distributed servers (FedHosts) can be added to the network. Ultimately, the connection backbone will saturate, but saturation can be avoided by partitioning the backbone connectivity so each segment has the bandwidth to support its connected client load.

Intelligent routing is made possible by the use of culling rules that control data flow through the network backbone. Culling rules simply eliminate transmission of data that the client does not necessarily need, resulting in a significant reduction in required bandwidth. Interactive TV is an example of where data culling is effective. Interactive TV systems provide the ability to watch a sporting event from multiple cameras. Typically, each of these video streams are placed on the network in parallel, and the user chooses which stream to watch at the client end of the connection. Our culling technology determines which streams the user is actually watching, restricting the unwatched video streams nearest the source and routing only the desired video streams for delivery to the client. In an example where there are 10 different camera angles and the user is only watching one, we can reduce the bandwidth load by 90%. OpenSkies also reduces the bandwidth from the client by performing the required routing on external servers. A client who is currently visible from 20 other clients need only send one update rather than being burdened by having to send 20 of them. This is especially important for those players with slower Internet connections.

4. CONCLUSIONS

The OpenSkies communication technology is critical for situations where large amounts of data needs to be sent in a secure manner while ensuring that only the information required (and no more) is received by the desired groups. Therefore, OpenSkies can be used by small groups of soldiers all the way up to commanders who are operating and controlling an entire theater of war. As just one example, OpenSkies could be the method for handling and distributing all Uninhabited Air/Ground/Sea Vehicles, and displaying such information on a 3D VR battlefield map. Such specific and detailed control of information transfer will allow commanders and soldiers to be far more effective, increasing the versatility of the troops.

OpenSkies is also an economically feasible platform because the hardware requirements scale linearly with the number of agents. OpenSkies also works on any Windows or Linux platforms. OpenSkies is currently being adapted for use by the Army (CECOM) for robotic telemaintenance, as well as by the Air Force for satellite control and training (Wright-Patterson AFB). Furthermore, this technology has been adapted for use by the massive multiplayer online gaming community. Our first licensee is Tesseraction Games, and their game, called Enigma Rising Tide, is scheduled to be released in the third quarter of 2002. Enigma is expected to handle 140,000 simultaneous players, demonstrating the full scaling capabilities of the OpenSkies system. The real world testing of OpenSkies in the computer gaming market will ensure that we have produced a better product for the Army.