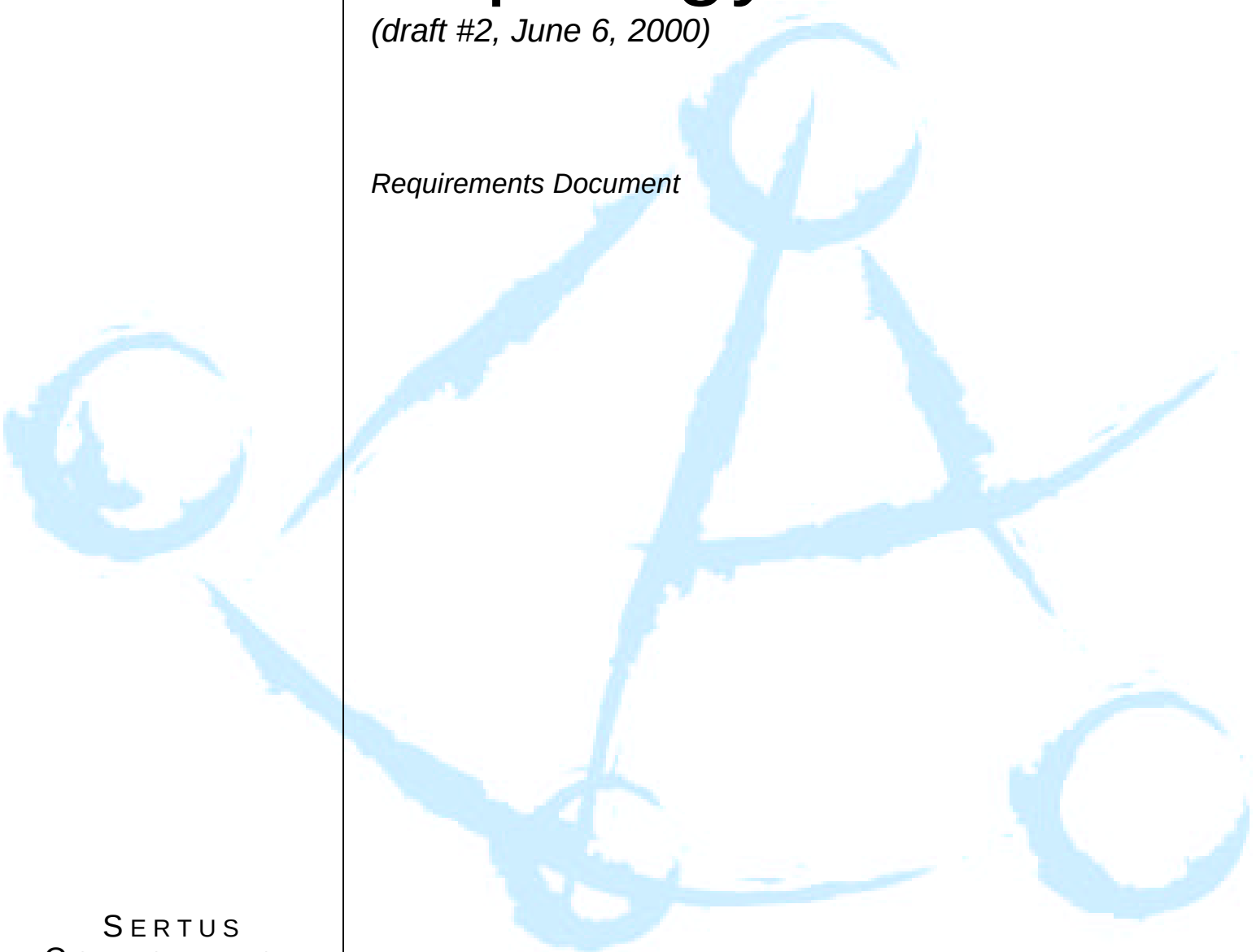
Enterprise Topology

(draft #2, June 6, 2000)

Requirements Document



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Purpose and Scope

The purpose of this document is to provide a high-level perspective of the hardware topology that is required in order to use Sertus' enterprise software.

Basic Concept

The hardware necessary to run Sertus programs will be positioned at sites along a distributed network across the WAN that includes one central corporate site and up to 200 line of business corporate sites.

The hardware topology is a replicated model that is completely symmetrical. In this model, Clear Channel Corporate will have a hierarchy of servers out in the actual markets, as well as others that serve as redundant servers for load balancing, and one large configuration of servers at its own Corporate site. Any combination of servers will work because the software components will be the same wherever the servers are located.

Rationale

There are two particular challenges that have dictated the design decisions for this particular hardware model.

The first challenge is that streaming media stations such as radio, television, and Internet have a myriad of programming rules that dictate how their stations sound, aesthetically. Therefore, their scheduling algorithms are extremely time-complex, and they use a lot of CPU time. If, for example, one doubles the number of radio stations that use a typical scheduling algorithm, it is necessary to employ a server that is up to 16 times more powerful, rather than one that is twice as powerful.

Because of this problem, the costs associated with using one or two large, more expensive servers would be too high. It is far more cost effective and reliable to reduce the load on the servers by distributing many smaller servers over the WAN.

The second reason for recommending the hardware topology described in this document is the reliability of the Corporate WAN. The costs associated with an interruption in scheduling, particularly for high-dollar media advertising spots in large cities, make a distributed client-server system necessary.

Caveats

Running smaller servers over a distributed network has its own set of unique problems. The main caveat is that, since Clear Channel sells multi-market multi-media advertising, it isn't clear where contracts might need to be propagated in order to effectively carry out the business model that the industry is currently using.

If, for example, a particular contract is contained in the SQL server database at one particular site and the contract must be propagated to another site, then the system must have a way to guarantee that the contract numbers and other contract elements are unique.

The way the system is set up, all SQL server entries that are important and that must be propagated over the Internet must use a GUID (global unique identifier), rather than an identity column in the SQL server database. There must be no threat of identity column collisions. In this way, when a person generates a contract, he is guaranteed that a unique identifier will be associated with it.

Information Distribution

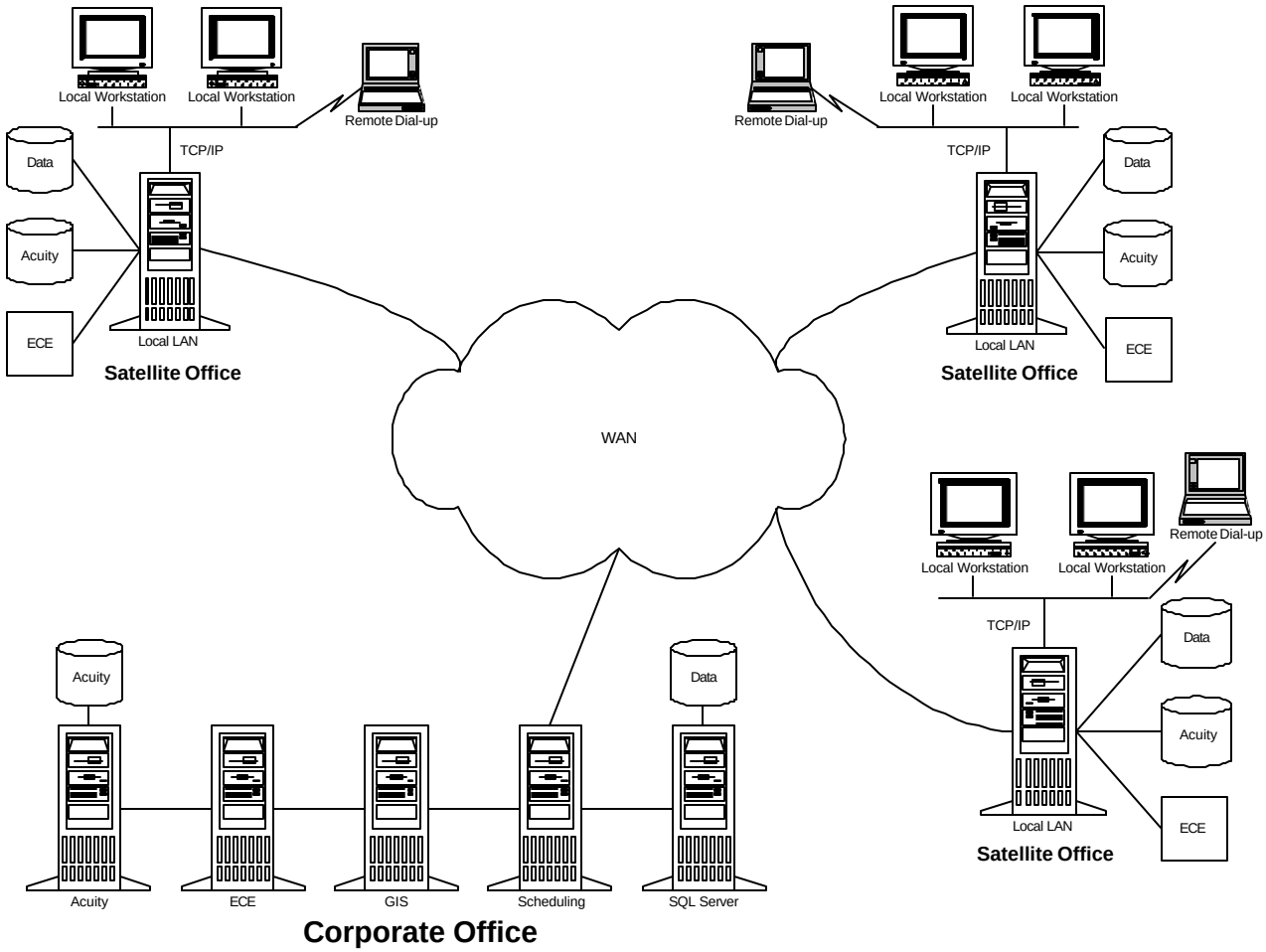
Most of the data storage (about 90 per cent) will be local information. Global information, such as product codes, GLPs, customer numbers, advertiser numbers, etc. that needs to be universal will be set up with GUIDs, and there will be automatic replication across the WAN for any information that needs to be common among the databases.

There are conventional, off-the-shelf methods for replicating information among the SQL servers in the distributed network, enabling all corporate sites to use the same GUIDs associated with universal information. One method is SQL Replication Services; another is LDAP. LDAP already has been proven to work in the distributed model, and it is compatible with the current system.

By replicating the information across the system, we can, for example, guarantee that the product code for a particular product would be the same for all corporate locations without having a central database issuing the unique ID.

System Components

The graphic below illustrates the various hardware components at each site in system and shows how they are distributed over the WAN.



The components in this illustration are described below.

Servers

The reliability and integrity of the servers in the distributed network are very important because the servers do most of the work and perform real-time scheduling. Furthermore, the scheduler will not be running as an event-driven service but will be working in the background, continuously.

The server specifications listed below are for the average satellite office. Offices with greater scheduling demands might want more enhanced features, such as higher processing speeds.

At the Corporate site and at large satellite offices, the servers can be set up so that the Acuity database is on one machine, the scheduler on another, ECE on a third machine, and the SQL server on a fourth machine. This makes the configuration scalable—if performance problems surface, another machine can be added to the system to enhance performance without splitting up the existing configuration.

The servers will have the following system requirements:

- Windows NT 2000® or Windows NT 4.0® operating systems
- NTFS®
- 400 MHz Pentium II processors
- 256 MB of RAM

Note: *Scheduling algorithms perform more efficiently on Windows NT 2000 than on Windows NT 4.0 because of improvements that Microsoft has made in NT 2000's memory allocation schemes. However, Windows NT 4.0 can be substituted for NT 2000, if desired.*

It is recommended that the servers have SCSI 2 Raid 5 hard drives for integrity and reliability.

Client Workstations

Client workstation operating systems are to be Windows 98®, Windows NT 2000 or Windows NT 4.0. These workstations can have processing speeds as low as 233 MHz and RAM as low as 64MB.

The client workstations will run standalone client programs, web based programs, or a hybrid of the two. The Sertus web based programs will be viewed with Internet Explorer®. IE is built directly into the Sertus client programs; therefore, it is not necessary that client workstations be equipped with web browsers when they are put into place.

Remote dial-up access can be configured into the network, if needed. All workstations connected to the servers are TCP/IP based.

SQL Databases

The SQL databases are located at each server. Each SQL database contains several hundred data tables. SQL databases comprise the main part of the back-end service engine, and they keep track of the inventory.

Acuity Databases

The Acuity databases keep track of the financial aspects of the business.

When users access the Acuity databases, they will have the *experience* of accessing AP/AR and General Ledger locally, although this won't actually be the case. Users will have Leasing and Real Estate modules, for example, that tie into the Acuity databases directly through their Sertus software.

Using custom Sertus software interfaces to access the Acuity databases enables users to work with some of the more unique characteristics of the outdoor advertising business, such as leasing real estate.

The Acuity databases reside on each local server at the corresponding satellite offices. This can be accomplished via a separate partition on the server hard drive or some other similar measure.

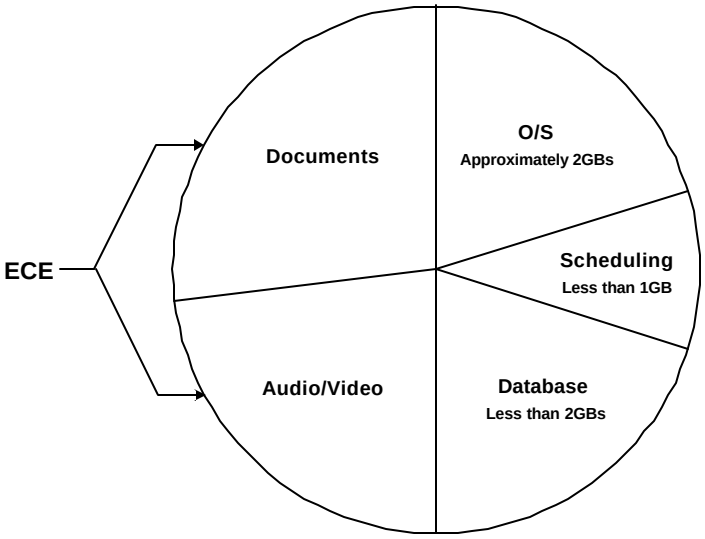
ECE (Enterprise Collaboration Engine)

ECE carries out the media advertising workflow. It coordinates transactions as information flows in and out of the system. XML based documents are used inside the system to execute business rules and further the workflow.

When a proposal is turned in, the information is sent to predetermined decision makers who accept or reject parts of the proposal. When these decision makers accept or reject the information, their responses go to a business logic tree, and the next step in the workflow process is initiated. In this way, documents flow in and out of the ECE as it carries out the workflow over the distributed network in a transparent manner.

Minimum Hard Drive Partitions

At each local server site, multiple hard drives or hard drive partitions are necessary, in order to ensure reliability. The graphic below illustrates how hard drive space should be allocated.



As shown above, the hard drive or hard drives inside the servers at the various locations should be partitioned into at least five sections: the operating system, the scheduling engine, the database, ECE audio/video, and ECE documents.

The database requires less than 2 GB of hard drive space.

The ECE portion of the hard drive takes up nearly half of the allotted space. ECE in itself will need multiple partitions because one section is required for ECE documents and another one for multimedia files (audio/video). Multimedia files occupy a lot of hard disk space—caution should be taken not to partition the hard drive into only one or two large sections in which multimedia files accidentally take up too much space within the same directories as the scheduling engine and database engine. Historically, error correction and monitoring does not prevent problems from occurring in a scenario such as this.

It is recommended that the operating system be partitioned on the C drive of the server, occupying approximately 2 GB, and the other sections be partitioned off on the same drive or on additional drives, depending on the local market size. NTFS formatting should be used for the operating system partition, in order to mitigate security problems.

NT Services and other technologies will be built into the system. These services will enable warning messages to go out over the WAN to specified recipients, in the event that any performance issues surface in any part of the system. For example, if a SQL server's transaction logs start to fill up or if a server begins to run out of hard disk space, the appropriate parties will be notified. These messages will be sent automatically via SMTP mail connectors inside ECE.

Scalability

As mentioned in the section *System Components*, the basic topology for the system is scalable. Servers can be added on at Clear Channel Corporate or at larger satellite offices to handle increasing workloads. Furthermore, the distributed nature of the enterprise enables certain locations to grow without affecting the performance of systems at the other offices. If, for example, Clear Channel doubles in size, it would be necessary to add servers at the Corporate site, but no changes would be necessary at any of the satellite offices.

Backup and Restore

Backup for servers can be handled in any way, as long as the backup process does not interfere with the scheduling engine, which works continuously in the background. If necessary, API calls can be inserted into the scheduling engine that pause scheduling for a short period of time while backup procedures take place.