ROADMAP TO THE SRS COMPUTING ARCHITECTURE

by

Johnson, A.

Westinghouse Savannah River Company
Savannah River Site
Aiken, South Carolina 29808

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Roadmap to the SRS Computing Architecture (U)

Information
Resource
Management

Westinghouse Savannah River Company
Savannah River Site
Aiken, SC 29808

Prepared for the U. S. Department of Energy Under Contract No. DE-AC09-89SR18035

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Publication Date: July 5, 1994

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I. Introduction

This document outlines the major steps that must be taken by the Savannah River Site (SRS) to migrate the SRS information technology (IT) environment to the new architecture described in the *Savannah River Site Computing Architecture*. This document proposes an IT environment that is

... standards-based, data-driven, and workstation-oriented, with larger systems being utilized for the delivery of needed information to users in a client-server relationship.

Achieving this vision will require many substantial changes in the computing applications, systems, and supporting infrastructure at the site. This document consists of a set of roadmaps which provide explanations of the necessary changes for IT at the site and describes the milestones that must be completed to finish the migration.

The roadmaps provided here group the necessary changes by the following technologies:

Advanced Networks (Networks)—The upgrade of the site data network, SRSnet, to one that is robust and reliable enough to support the architecture's requirements.

Networked Systems (Netsys)—Steps to upgrade the site's personal computers (workstations) and supporting networked services infrastructure to the capabilities required by future site systems and applications.

Information Warehouse (IW)—Steps to establish a managed information environment where data specific to the management of an enterprise is extracted from the data collections or operational environment and migrated to an integrated reporting environment that is specifically tuned to query and end-user access.

Client/Server (C/S)—Steps to develop applications based on the client/server model. An application is said to be a C/S application when one computer, usually on a desktop, performs some of the functions of an application and requests services of other computers across a computer network to provide the remainder of the application function.

Multimedia (MMedia)—Steps to develop applications based on multimedia data types. Multimedia is a collection of technologies that combines the formats of text, voice, video, audio, image, and animation for delivery to workstations, specialized platforms, or existing standard audio visual equipment.

Electronic Office (Office)—Steps to develop an environment in which common office functions, which depend on manual and paper-oriented processes today, are performed using computers and communications networks.

Object Oriented Technology (Object)—Steps to convert the site application acquisition, development, and support environment to one based on the concepts of object-oriented programming (OOP).

For each technology area, the document outlines the goals envisioned for the technology (that is, the Destination), the current state of the site with respect to the technology (Starting Point), and a set of milestones grouped as follows:

1. **Infrastructure Milestones**—Milestones pertaining to the site computing infrastructure which must be resolved to adopt the technology.
2. **Administrative Milestones**—Milestones pertaining to organizational and management issues which must be resolved to adopt the technology.
3. **Cultural Milestones**—Milestones that pertain to the site culture which must be resolved to adopt the technology.
4. **Process Milestones**—Milestones that pertain to work flow that must be resolved to adopt the technology.
5. **Technology Milestones**—Milestones that pertain to the technology itself that must be resolved to adopt the technology.
6. **Miscellaneous Milestones**—Additional milestones not covered by any other issue area that must be resolved to adopt the technology.

Note that neither the roadmaps nor the milestones are necessarily sequential in nature. It is not only possible but desirable to pursue as many of them in parallel as possible. It is equally important to realize that no document of this type can ever be complete or up-to-date. The destination is, by definition, a moving target and can never be completely defined. Similarly, the starting point is also moving as the site itself adopts new technologies and capabilities, and drops or modifies old ones. Moreover, the technology itself is constantly evolving a new set of opportunities for migration. In view of this situation, a document of this kind represents a snapshot of a point in time.

II. Advanced Networks Roadmap

Introduction and Destination

Ideally, a computer network should provide transparent and unrestricted data transport services to its attached computer systems, the applications that run on these systems, and the personnel that use the applications. That is, if a user or application requires access to data or computational services that are available on one part of the network, the network has the capability to provide access to this data or service without (significant) delay and without placing undue navigation or access requirements on the user. This capability is desired regardless of the distances or the amount of data involved, and (again ideally) the user of such a facility should not be required to be aware of the network's existence and certainly not aware of the details of the network topology.

Figure 1 below illustrates this facility. The user at network location A uses an application that executes at location B and accesses data from location C. The network is drawn as an oval, but in reality, the network topology will be complex and relatively arbitrary.

Figure 1: Typical network of today.

If the network is to be transparent in this case, then the network must possess the following attributes:

- **The network must be reliable.**

If the network is not reliable, then it is certainly not transparent to the user. Reliability is a relative concept and also involves tradeoffs with cost of implementation and flexibility. Network reliability is created either by improving the reliability of the individual components of the network or by

building in redundancy in the manner in which the individual components (communications lines and the processors used to direct traffic over the communications lines) are implemented.

■ The network must be robust.

A robust network has the capacity to serve all its users without failure and without significant (that is, users are aware of) delay. For example, if an application requires a million characters of data to be transferred between locations and the slowest connection link in the path between the two locations supports only 1,000 characters per second, then in the best case, the user of the application will be aware of 1,000 seconds of delay. If other network systems are also attempting to utilize this same link at the same time, then the delay will be much longer.

Robustness is, of course, also a relative term. What we called robust yesterday is painfully slow today. Nevertheless, a robust network must have the capability to support all users and application requirements without introducing significant delay.

■ There must be network-wide user authentication.

The user is required to authenticate him- or herself only once (that is, supply a user identification and confidential password) at the network level. The user must not be required to authenticate at every node on the network which supplies the user data or services. With network-wide authentication, the user authenticates to a security authentication server once, and this device communicates authentication information when required by service nodes.

The network of the future is expected to be based on the following key technologies:

■ Switched Ethernet Hubs

Traditional Ethernet hubs provide Ethernet local area network (LAN) segments based on unshielded twisted pairs (UTP) of wire (that is, telephone wire) connected from the users' workstations to the hub in a star configuration. Every user connected to the hub shared a single Ethernet. With switched Ethernet hubs (SEH), each user is given a dedicated Ethernet port at 10 million bits per second (mbps). Traffic from this user is directed to a single destination port on the hub. In this way, high bandwidth communications between two hub-connected computers do not impact the other nodes on the hub. Indeed, many simultaneous file transfers can take place within the hub with the aggregate data transfer rate far in excess of Ethernet's 10 mbps.

As described, SEH provide an ideal workgroup network environment for peer-to-peer applications. However, since many network applications are not peer-to-peer but rather many-to-one (for example client/server applications, file servers, and communications servers such as network routers), SEH needs to provide the capability to link the hub users with network servers at higher speeds. This capability prevents a bottle neck at the server. Fiber Distributed Data Interface (FDDI) and Asynchronous Transfer Mode (ATM) technologies will be used to join the SEH to these servers.

■ Fiber Distributed Data Interface

FDDI is a 100 mbps LAN technology based on fiber optic technology. It is now well accepted as a standard LAN. FDDI adapters are available for all common workstations, host computers, and communications servers. FDDI technology is suitable for both work group LANs and network trunks. Because it is a shared medium type of LAN, data rates available to individual users will always be less than 100 mbps (and often much less). For this reason, FDDI is expected to be phased out in favor of ATM (described below) over time. However, FDDI is now a mature standard that promises near-term expansion over Ethernet data capabilities, while ATM is not yet mature.

■ Asynchronous Transfer Mode LANs and WANs

ATM, also called cell relay, is an emerging communications technology that promises to revolutionize the way data networks are built. ATM is based on the ability to break all communications (voice, video, data) into small (53 byte) packets called cells. An ATM network consists of relay nodes that can switch incoming cells to the appropriate outgoing communications line. These devices are characterized by high capacity (millions of cells per second) and low latency (very little delay in a cell going through the device). Combined with fiber optics communications technology that permits high data rates at long distances, this technology blurs the distinction between local area networks and wide area networks. Indeed, with a fully implemented ATM network, data traffic could theoretically flow between any two SRS locations at the same high speeds, regardless of locations or distances involved. ATM devices used to support high performance local area networks are called ATM hubs. ATM switches are used to build wide area ATM networks. ATM will be implemented at various data rates from 55 mbps to over a gigabit (a billion bits) per second.

■ Network Management

There are now standards for network device management (Simple Network Management Program, Common Management Information Protocol) that are the key components required to build an effective network management system (NMS). In such a system, each network component (workstations, servers, hosts, routers, bridges, hubs, etc.) would report routinely and on demand to a network management station its current operational status and would also allow configuration and operational changes to be set in the network devices from a single station.

■ Network Authentication

A network supporting network-wide user authentication requires a common protocol for user authentication that is supported by the operating system and appropriate applications software on all platforms (user workstations, host computers, and servers) attached to the network. For example, the personal computer terminal emulation and data access software must support a common network authentication protocol, as must the security portions of the operating systems for the IBM hosts, the VAX hosts, the UNIX hosts (including the Cray), and the network file and print servers. Fortunately, there is such a protocol that appears to be gaining acceptance across these platforms, the Distributed Computing Environment (DCE) Security Services protocol. This protocol, an outgrowth of the MIT

Kerberos protocol, provides for network security servers. Users authenticate themselves at the security servers via the exchange of user ID and password. If a user needs access to a network service or data, the security server provides an authenticated permission to the host system.

■ Wireless LAN Extensions

The capability to extend the LAN with wireless technology is needed to provide cost effective network connections in those situations where rewiring a facility is cost prohibitive or restricted for other reasons. Wireless technology also supports the concept of mobile computing, that is, the ability to utilize a workstation from anywhere on the site, in the local area, or even in the world to connect to services and data sources provided by SRSnet. The technology is available now; implementations will depend on the ability to resolve security and frequency management issues.

Figure 2 shows how a network utilizing these technologies could look. Note that the slowest link between any two personal computers in this figure is a dedicated 10 mbps.

Figure 2: The network of the future.

Starting Point

The Savannah River Site's primary data communications network is called SRSnet. SRSnet is comprised of facility or area Ethernet LANs interconnected by digital telephone circuits (T1) or by the site broadband (CCTV) system. Additionally, two Fiber Distributed Data Interface (FDDI) high performance local area networks have been established as part of SRSnet, one as a trunk facility joining together Ethernet segments and one as a high speed LAN for Central Computer Facility (CCF) system access. Figure 3 shows an overview of the SRSnet.

Figure 3: SRSnet overview.

All new Ethernet installations are being installed using the 10BaseT standard for Ethernet. This provides for Ethernet LANs over data grade unshielded twisted pairs (UTP). The site standard for UTP, locally called "universal wiring," consists of multiple UTP data ports per work location. The UTP wiring is terminated in a 10BaseT communications hub located in an equipment room. The 10BaseT hubs are attached to SRSnet, often using fiber optics cables between buildings in a given area or facility. All new on- and offsite buildings are being universally wired as a routine part of building construction. Additionally, universal wiring and 10BaseT connectivity are being retrofitted to existing site buildings on network upgrade projects.

Most multi-user systems (typically VAX, UNIX, and IBM hosts) attach to the LAN at Ethernet speeds (10 million bits per second), though the Cray and the IBM Central Computer Facility attach to the LAN at FDDI speeds (100 million bits per second). However, a majority of the site's personal computer systems attach to the LAN via slow speed devices called terminal servers.

These permit LAN access at speeds up to 19,200 bits per second. Most of the existing onsite building wiring is based on old technology and will support only these slower data rates.

One IRM project, WISDOM, has been encouraging attachment of personal computers directly to the LAN at Ethernet data rates. Under current WISDOM implementations, some 100-200 workstations share a common Ethernet. Although each of the workstations has the capability to generate 1 to 5 million bits per second (mbps) on the LAN, in practice, LAN utilization rates have remained below capacity as the host-based applications commonly used today generate relatively low amounts of data traffic. Thus, the use of WISDOM in a facility requires the facility to be universally wired.

There are no current installations of wireless LANs at the site.

The site network can be judged according to the three criteria used to evaluate the required network of the future:

- The network must be reliable.

Today, the LAN portions of the SRSnet are reasonably reliable. However, there is little redundancy built into the system, and key components can and do occasionally fail. The major threat to reliability is the lack of good proactive network management tools to detect component failure and limit resulting downtime.

The Wide Area Network (WAN) components of SRSnet, the digital and analog communications facilities leased from Southern Bell to link onsite areas and WSRC offsite facilities together are not as reliable as the LAN components. This is especially true of the site broadband (CCTV) system used to support TNX and D areas.

- The network must be robust.

SRSnet, consisting mainly of 10 million bits of information per second LANs and 1.5 mbps WAN links, is robust enough for host-based (terminal-oriented) applications, since these types of applications sustain only small data transfer requirements.

The typical LAN user segment today is shared media Ethernet so that every user on that segment (typically 100 to 200 directly attached workstations) shares equally in its use. A single pair of personal computers today can utilize up to 50% of an Ethernet's capability in a file transfer. As applications such as multi-media documents, computer based-training, and client/server database queries are developed, the network workstations will utilize this capability to saturate the network to the point that network reliability is endangered.

Just as the LAN links of today are inadequate for the demands of tomorrow, the WAN links are also too slow for demands that will be placed on it. Ideally, the network should present the appearance to application developers and users of a utility that works equally well across all locations. Today, care must be exercised in the design and use of network-intensive applications that cross wide area boundaries.

- There must be network-wide user authentication.

There is no network-wide authentication system in use at SRS today. Though computer ID format has been standardized across site systems,

each system maintains its own list of user IDs and associated passwords and requires the user to authenticate (that is, log in) himself or herself for service.

Networks Infrastructure Milestones

The following infrastructure milestones must be resolved to adopt the technology. Each is described in more detail in the following sections.

Networks.I.1	Install the Replacement Telephone System
Networks.I.2	Complete Intra-area Cabling
Networks.I.3	Complete Site Universal Wiring
Networks.I.4	Complete Building LANs
Networks.I.5	Install Ethernet/FDDI Network Trunks
Networks.I.6	Install Switched Ethernet Hubs
Networks.I.7	Install ATM Network Trunks
Networks.I.8	Install ATM Workgroup Networks
Networks.I.9	Complete Network Management System
Networks.I.10	Initiate Network Authentication Service
Networks.I.11	Install Wireless LANs as Extension to SRSnet
Networks.I.12	Complete Analysis of Network, Telephone, and Dedicated Fiber Usage Requirements
Networks.I.13	Provide Access Between SRSnet and Offsite Locations

Networks.I.1 Install the Replacement Telephone System

Responsible Organization

IRM

Sponsoring Organization

WSRC

Initiation Date

1Q/94

Status

Project started

Anticipated Duration

24 months

Resources Considerations

RTS implementation resource requirements have been identified and allocated.

Discussion

The Replacement Telephone System (RTS) is installed with supporting inter- and intra- area fiber optic cabling. Inter-area fiber (single mode) will connect all site areas together. Implementers of SRSnet can utilize this fiber either directly (via data network interfaces to FDDI or ATM technologies) or indirectly (via the use of high speed [T3 at 45 mbps] telephone circuits). Intra-area fiber (multimode) can be utilized for Ethernet, FDDI, and ATM connections within the area.

Action Items

- 1) Have vendor install RTS, including supporting inter-area and intra-area fiber cables.
- 2) Choose interface technology between RTS and LAN is chosen.
- 3) Add interfaces between RTS and LAN to provide improved inter-area data transport.

Dependencies

None

Benefits

The RTS provides fiber optic cables connecting all site areas and various facilities within each area. Various LAN and WAN technologies can utilize this fiber at speeds of up to hundreds of megabits per second today, and billions of bits per second in the future. This milestone enables the completion of the intra-area cabling, universal wiring, and current and future network trunks, as well as ATM workgroups.

Networks.I.2 Complete Inter-area Cabling

Responsible Organization

IRM

Sponsoring Organization

WSRC

Recommended Initiation Date

1Q/94

Status

Under way with several separate initiatives

Anticipated Duration

24 months

Resource Considerations

Most new intra-area cabling will consist of fiber provided by Replacement Telephone System (RTS). Additional funding requirements expected to be minimal.

Discussion

Installation of fiber optic or coax cable that connects each facility (building or trailer) in a given SRS area or WSRC offsite location will be part of the RTS. Additional funding will be required for special connection requirements.

Action Items

- 1) Identify intra-area cabling requirements.
- 2) Reconcile requirements with RTS activities.
- 3) Initiate additional cabling projects and complete them where needed.

Dependencies

Networks.I.1	Install the Replacement Telephone System
Networks.A.1	Set Site Direction, Funding, and Priority

Benefits

This milestone provides the prerequisite inter-area cable plant upon which all SRS area LANs will be constructed. Fiber optic cabling provides great growth potential. Current implementation at 10 mbps will be upgraded to much faster data rates (on the existing cables) in the future. This milestone enables the milestones concerning installation of current and future network trunks (Ethernet, FDDI, and ATM).

Networks.I.3 Complete Site Universal Wiring

Responsible Organization

IRM

Sponsoring Organization

IRM

Initiation Date

1Q/94

Status

All major offsite locations were wired as part of facility preparation. Wiring projects for several onsite buildings have been completed or are in progress. The degree of installation of this wiring is inconsistent across the site.

Anticipated Duration

24 months

Resource Considerations

A universal wiring drop costs on average from \$250 (new buildings) to \$800 (old buildings). Currently, wiring is two-thirds complete. The Replacement Telephone System (RTS) project will support most of the effort to complete the wiring as part of WSRC's contract with the RTS vendor.

Discussion

Universal wiring is the installation of unshielded twisted pairs (UTP) of data-grade copper wire according to site standards for facility wiring in each SRS building and all WSRC offsite locations. Wiring being installed today (Category 5 wire) supports the 10BaseT standard for Ethernet LANs as well as future standards for FDDI and ATM technologies over UTP.

Action Items

- 1) Identify and prioritize building wiring requirements.
- 2) Determine funding mechanism by project.
- 3) Initiate wiring projects and complete them where funded.

Dependencies

Networks.A.1 Set Site Direction, Funding, and Priority

Benefits

This milestone provides the necessary building wiring upon which the user access segments of SRSnet will be constructed. UTP wire cabling provides good growth potential. Current implementation at 10 mbps may be upgraded to much faster data rates (up to 155 mbps) in the future. This milestone enables milestones for current Ethernet installations as well as switched Ethernet hub installation and ATM workgroup implementations.

Networks.I.4 Complete Building LANs

Responsible Organization

IRM

Sponsoring Organization

IRM

Initiation Date

1Q/94

Status

Under way; one third complete and one third to be completed in 1994

Anticipated Duration

24 months

Resource Considerations

Equipment required to complete the second third of this activity is currently on hand. Additional network connections expected to cost an additional \$3 million.

Discussion

Completion of the site building LANs involves the installation of Ethernet hub equipment, LAN adapters in SRS personal computers, and supporting LAN interconnect devices (bridges and repeaters) required to complete Ethernet LANs for all WSRC/BSRI work locations. This will provide each work location at least one 10BaseT Ethernet port for connecting devices to SRSnet and the means to connect personal computers to the Ethernet ports.

Action Items

- 1) Identify work locations and special requirements.
- 2) Establish funding mechanism for obtaining network equipment and implementation priorities.
- 3) Install LAN hubs and bridges to support these requirements.
- 4) Install LAN adapters in user personal computers.

Dependencies

Networks.I.3	Complete Site Universal Wiring
Networks.A.1	Set Site Direction, Funding, and Priority

Benefits

This milestone provides the basic Ethernet connection capability for every SRS work location, establishing access to a building or workgroup LAN operating at 10 mbps.

Networks.I.5 Install Ethernet/FDDI Network Trunks

Responsible Organization

IRM

Sponsoring Organization

IRM

Initiation Date

1Q/94

Status

Under way with several separate initiatives

Anticipated Duration

36 months

Resource Considerations

Major equipment to support network trunks are network routers and bridges. Although there is an existing inventory of this gear to complete the site's Ethernet trunks, upgrades to this equipment will require additional capital to convert Ethernet trunks to FDDI. These upgrades will be driven by network traffic and utilization rates.

Discussion

This milestone provides for the installation of network connection equipment (routers and bridges) to utilize existing and future fiber optic or coax cables that connect each facility (building or trailer) in a given SRS area or WSRC offsite location. Intra-area and inter-area cabling will support both FDDI and Ethernet trunks. Choice of which to use in a particular situation requires a cost/performance calculation. Over time, all trunks will be upgraded from Ethernet to FDDI (or ATM) as the faster technology becomes cost effective and user data transport requirements grow.

Action Items

- 1) Identify intra-area network trunk topology requirements.
- 2) Identify additional equipment required.
- 3) Establish funding and purchase additional equipment.
- 4) Install network routers and bridges to support these requirements.

Dependencies

Networks.I.2	Complete Inter-area Cabling
Networks.I.3	Complete Site Universal Wiring
Networks.I.4	Complete Building LANs
Networks.A.1	Set Site Direction, Funding, and Priority

Benefits

This milestone provides the prerequisite intra-area network facilities upon which all SRS area LANs will be constructed. It is dependent on having physical cabling in place and provides the devices that utilize the cabling to provide robust LAN facilities. This will be the starting point from which all upgrades to network capabilities will follow.

Benefits

This milestone provides an upgrade path for the workgroup segments of SRSnet. User workstations, LAN adapters, and network wiring need not be upgraded to complete this milestone. Each user on a switched Ethernet hub (SEH) gains a dedicated 10 mbps channel to every other user in the workgroup—ideal for certain multi-media applications. Access to shared servers is provided by FDDI or ATM interfaces built into the SEH.

Networks.I.7 Install ATM Network Trunks

Responsible Organization

IRM

Sponsoring Organization

IRM

Initiation Date

1Q/96

Status

Technology under study. Replacement Telephone System vendor promises ATM capabilities.

Anticipated Duration

48 months

Resource Considerations

ATM is new technology and very expensive today. Fully converting the site inter-area network trunk to ATM could cost as much as \$1 to \$2 million in capital spending. Conversion of the each area's LAN trunk to ATM could cost nearly as much, depending on area size and network complexity. These costs will certainly come down by the time the site is ready to go to ATM.

Discussion

This milestone provides an upgrade path for the site inter-area and intra-area network facilities upon which all SRS area LAN's are constructed. It is dependent on having physical cabling (inter- and intra-area fiber) in place and provides the devices that utilize the cabling to provide robust LAN facilities. In some cases, existing devices will be upgraded to support ATM; in other cases, new devices (switches and routers) will be required to add ATM capability.

Action Items

- 1) Define network trunk data requirements.
- 2) Pilot technology between two site areas.
- 3) Establish funding for network upgrade to ATM.
- 4) Install ATM switches and upgrades to network routers to support these requirements.

Dependencies

Networks.I.2	Complete Inter-area Cabling
Networks.I.3	Complete Site Universal Wiring
Networks.A.1	Set Site Direction, Funding, and Priority
Networks.A.2	Relocate Most Network Users onsite
Networks.T.2	Complete ATM Standards
Networks.T.3	Complete ATM Interfaces for Routers/Hubs

Benefits

Fully implemented, this milestone would support all identified future network requirements and improve network robustness, as ATM technology works equally well between site areas as within a building.

Networks.I.8 Install ATM Workgroup Networks

Responsible Organization

IRM

Sponsoring Organization

WSRC

Initiation Date

4Q/95

Status

Technology under study

Anticipated Duration

48 months

Resource Considerations

ATM workstation connections cost approximately \$10,000 per workstation today. This is very new technology, and the price is projected to fall below \$1,000 per workstation within two years.

Discussion

This milestone provides the ability to link high performance workstations or host computers/servers into a LAN segment with very high performance. Today, vendors are shipping hubs and ATM interfaces at 155 mbps, but equipment at 620 mbps is promised for the near future. This would provide a good upgrade path for the CCF FDDI ring, as well as for situations (scientific visualization) requiring high bandwidth. The installation of workgroup local area networks based on ATM technology consists of ATM adapters in workstations, ATM local switching hubs, and data-grade UTP or fiber optic cabling between workstation and hubs. Data-grade UTP will support most applications, but fiber cabling will be required for those applications needing more than 155 mbps.

Action Items

- 1) Define high performance LAN requirements defined.
- 2) Install ATM hubs and upgrades to network interfaces on host systems, servers, and workstations to support these requirements.
- 3) Connect ATM workgroup to site ATM switching fabric.

Dependencies

Networks.I.2	Complete Inter-area Cabling
Networks.I.3	Complete Site Universal Wiring
Networks.T.2	Complete ATM Standards
Networks.T.4	Complete ATM Interfaces for Workstations/Host Computers

Benefits

This milestone provides the high speed and dedicated bandwidth required to build very high performance workstation networks. The key components of ATM are or will soon be standardized to provide the benefits of support by all key systems and communications vendors.

Networks.I.9 Complete Network Management System

Responsible Organization

IRM

Sponsoring Organization

IRM

Initiation Date

1Q/94

Status

Individual efforts in progress for both trunk and server management

Anticipated Duration

36 months

Resource Considerations

Hardware and software to support a Network Management System (NMS) has been obtained. Greatest resource requirements involve dedicating network analyst(s) to customizing and integrating purchased NMS components and the continued commitment to keep network documentation current and entered in the NMS. Additional NMS components may be required, but these would not represent a large capital or cost investment.

Discussion

A comprehensive NMS is a key to creating a robust network. It gives network operators the ability to detect problems and device failures early and to diagnose and solve network error conditions remotely. Completion of a comprehensive and proactive network and network-attached resource management platform requires integrating network management capabilities supplied by several vendors and documenting the current network down to user-device attachments.

Action Items

- 1) Purchase integrating Network Management System (NMS).
- 2) Integrate product-specific management information (MIB) into NMS.
- 3) Set up network event alerts to include loss of key host systems or servers.
- 4) Integrate NMS access software into personal computers to allow remote queries/sets.

Dependencies

Netsys.I.3

Ensure Broad Availability of Networked Workstations

Netsys.I.12

Implement Reliable Performance Monitoring

Benefits

A comprehensive NMS reduces or eliminates network down time and provides the data necessary to improve the robustness of the network.

Networks.I.10 Initiate Network Authentication Service

Responsible Organization

IRM

Sponsoring Organization

IRM

Initiation Date

1Q/95

Status

Technology under study

Anticipated Duration

36 months

Resource Considerations

A migration to network-based authentication is primarily a software issue, as operating system, workstation, and data access software will have to be upgraded to support network authentication. A number (possibly one per site area) of security servers will be required as well. These could be relatively low cost (\$20,000) high performance workstations. Major cost component could be licensing security client software on all site workstations.

Discussion

Network authentication provides users with network-transparent computing. That is, a user is able to authenticate him- or herself once and gain access to various network services and data without further authentication. This helps provide the effect that there is a single location for services and data, the network. This milestone provides for conversion of system-based user authentication to network-based authentication. This requires network authentication server(s) and modification of host/server operating systems to support network-based authentication protocols.

Action Items

- 1) Perform laboratory-scale testing based on early DCE products.
- 2) Work with key vendors to attempt to influence DCE development.
- 3) Install DCE-compliant operating systems as they become available.
- 4) Install redundant network authentication servers.

Dependencies

Netsys.I.3	Ensure Broad Availability of Networked Workstations
Netsys.P.1	Implement Single User Login to Network
Networks.A.4	Obtain Computer Security Endorsement of Network-based Authentication
Networks.T.5	Make DCE Security Services Available in Key Environments
Netsys.I.12	Implement Reliable Performance Monitoring

Benefits

Network authentication greatly eases system administration tasks, as each user need be entered in only one comprehensive authentication database. Greatest benefit is simplified operations for the network user and transparent access to data for which the user is authorized.

Networks.I.11 Install Wireless LANs as Extension to SRSnet

Responsible Organization

IRM

Sponsoring Organization

IRM

Initiation Date

4Q/94

Status

Concept being studied

Anticipated Duration

24 months

Resource Considerations

Widespread adoption of wireless LAN devices is not anticipated. Rather, this technology is proposed for special situations where wired-LANs are inadequate. Cost per wireless connection expected to be in the \$500 per connection range.

Discussion

The capability to extend the LAN with wireless technology provides cost effective network connections in those situations where rewiring a facility is cost prohibitive or restricted for other reasons. Wireless technology also supports the concept of mobile computing (that is, the ability to utilize a workstation from anywhere on the site, in the local area, or even in the world to connect up to services and data sources provided by SRSnet).

Action Items

- 1) Conduct laboratory-scale testing of wireless components.
- 2) Pilot in SRS production area.
- 3) Develop guidelines on when and where to use wireless rather than wired solutions.
- 4) Complete limited production implementation.

Dependencies

Networks.A.3 Resolve Security and Spectrum Management Issues for Wireless LAN

Benefits

The installation of wireless LAN connections provides network users with services equivalent to those enjoyed by wired users. This technology will permit extension of the network to areas not feasible for wiring.

Networks.I.12 Complete Analysis of Network, Telephone, and Dedicated Fiber Usage Requirements

Responsible Organization

IRM

Sponsoring Organization

IRM

Initiation Date

4Q/94

Status

Not started

Anticipated Duration

24 months

Resource Considerations

This milestone requires no hardware or software acquisitions, but will require a limited amount of IRM manpower to complete.

Discussion

Multimedia and other applications will require the ability to transfer data (mostly digital but some analog such as voice and video) across the organization at increasingly faster rates. New capabilities are planned for the site network and telephone system (including dedicated fiber optic cables between buildings and areas) that provide a great increase in current capabilities to accomplish this task. A use/capabilities study is required to gain a more detailed understanding of the new data transfer requirements and the best way to meet these needs.

Action Items

- 1) Identify/monitor multimedia capabilities embedded in new telephone system and new cabling.
- 2) Evaluate SRSnet capabilities to transfer data across various locations and determine limitations.
- 3) Design multimedia and other high bandwidth applications to take advantage of the strengths of the infrastructure.
- 4) Propose necessary changes to the infrastructure to support new application requirements.

Dependencies

None

Benefits

SRS will optimize usage of the data network, the new telephone system, and direct fiber delivery for multimedia and other high bandwidth applications, and will avoid duplication of services between LAN, direct fiber, and analog delivery of data.

Networks.I.13 Provide Access Between SRSnet and Offsite Locations

Responsible Organization

IRM

Sponsoring Organization

IRM

Initiation Date

3Q/94

Status

Concept being studied

Anticipated Duration

18 months

Resource Considerations

A limited amount of hardware and/or software will be required to implement gateways to offsite locations. Special requirements may require significant IRM staff resources to implement, especially security-related requirements.

Discussion

SRSnet today has limited ability for access from offsite and for access to offsite information resources by SRS employees. Security and operational issues will be addressed to improve this capability so that site employees can access their electronic mail from offsite, outside organizations can access selected SRS data, and SRS employees can gain ready access to information stored on worldwide network facilities.

Action Items

- 1) Identify requirements for offsite access.
- 2) Develop technology plan to meet these requirements.
- 3) Pilot offsite access on small scale.
- 4) Extend pilot to all SRS employees.

Dependencies

Networks.A.5 Resolve Security and Network Use Issues for Offsite Access to and from SRSnet

Benefits

New SRS mission requirements are driving the needs for SRS employees to gain access to offsite information and for others (DOE, universities, suppliers, etc.) to gain access to selected SRS data. Allowing employees to access their electronic mail from home or when traveling offsite will improve site productivity through improved communications.

Networks Administrative Milestones

The following administrative milestones must be resolved to adopt the technology. Each is described in more detail in the following sections.

Networks.A.1	Set Site Direction, Funding, and Priority
Networks.A.2	Relocate Most Network Users Onsite
Networks.A.3	Resolve Security and Spectrum Management Issues for Wireless LAN
Networks.A.4	Obtain Computer Security Endorsement of Network-based Authentication
Networks.A.5	Resolve Security and Network Use Issues for Offsite Access to and from SRSnet

Networks.A.1 Set Site Direction, Funding, and Priority

Responsible Organization

ALD

Sponsoring Organization

SRS Computer Council

Initiation Date

1Q/94

Status

Computer Council established and IRM leading development of strategic plans for I/T at SRS

Anticipated Duration

12 months

Resource Considerations

Management (both IRM and WSRC) commitment is required to establish the appropriate levels of support for establishing and maintaining the site network as a valuable site resource.

Discussion

Establishment of site policy and practices to support central direction, funding, and priority for site information technology initiatives (I/T).

Action Items

- 1) Activate SRS Computing Council to establish site I/T priorities.
- 2) Endorse site Strategic Plan for I/T.
- 3) Develop IRM cost estimates and timing required for site network initiatives for Computer Council approval.

Dependencies

None

Benefits

Completion of the site network is a significant site infrastructure issue. Current and future mission assignments require a robust and reliable network that is uniformly implemented across SRS. Without central direction and funding, network implementations tend to be uneven, as certain departments or facilities see the need to fund the network and others do not.

Networks.A.2 Relocate Most Network Users Onsite

Responsible Organization

SRS Management

Sponsoring Organization

DOE-SR

Initiation Date

1Q/94

Status

Directed by DOE over multi-year plan

Anticipated Duration

60 months

Resource Considerations

New onsite office space will be universally wired as part of construction. As users abandon offsite facilities, network equipment can be recovered and utilized in onsite locations.

Discussion

Most SRS employees currently located in office facilities in Aiken, Augusta, and other surrounding locations will return to onsite facilities. Because of the fiber network being installed as part of the Replacement Telephone System (RTS), onsite communications potential is nearly unlimited. Inter-area communications rates of 100 mbps will be established initially, a major improvement in the 1.5 mbps rate used to link offsite facilities today.

Action Items

- 1) Designate employees to move by site management.
- 2) Install network in new onsite facilities.
- 3) Remove network lines and support equipment for abandoned offsite locations.

Dependencies

None

Benefits

With most employees onsite, network implementations are not subject to use of tariffed circuits from the phone company. High speed links between areas become much more economical over site-owned communications facilities, especially site inter-area fiber optic cable. Anyone left offsite will necessarily have reduced levels of network service.

Networks.A.3 Resolve Security and Spectrum Management Issues for Wireless LAN

Responsible Organization

IRM

Sponsoring Organization

IRM

Initiation Date

2Q/94

Status

Under way

Anticipated Duration

24 months

Resource Considerations

IRM will work with Security to investigate the technology and run pilot wireless networks to prove security.

Discussion

Establishment of site policy and practices on the use of wireless communications that address security concerns as well as avoidance of frequency allocation problems in the radio frequency spectrum used by the most effective wireless LANs.

Action Items

- 1) Establish Wireless Working Group to include IRM, Security, and DC&S.
- 2) Develop Wireless Policy and Guidelines.

Dependencies

None

Benefits

The capability to extend the LAN with wireless technology provides cost-effective network connections in those situations where rewiring a facility is cost prohibitive or restricted for other reasons. Security and frequency management concerns must be addressed prior to any wireless implementations.

Networks.A.4 Obtain Computer Security Endorsement of Network-based Authentication

Responsible Organization

SSP

Sponsoring Organization

WSRC

Initiation Date

2Q/94

Status

Concepts under Discussion

Anticipated Duration

24 months

Resources Considerations

IRM-sponsored pilot implementations will be required.

Discussion

Establishment of site policy, procedures, and guidelines acceptable to site security organizations for the use of network-based user authentication and access control.

Action Items

- 1) Pilot a limited project to demonstrate security features of network authentication.
- 2) Develop network authentication policy, procedures, and guidelines.

Dependencies

None

Benefits

Network authentication provides users with network-transparent computing. That is, a user is able to authenticate him or herself once and gain access to various network services and data without further authentication. This helps provide the effect that there is a single location for services and data, the network.

Networks.A.5 Resolve Security and Network Use Issues for Offsite Access to and from SRSnet

Responsible Organization

SSP

Sponsoring Organization

WSRC

Initiation Date

2Q/94

Status

Concepts under Discussion

Anticipated Duration

24 months

Resource Considerations

IRM participation with Security in team to study issues and make recommendations.

Discussion

Establishment of site policy, procedures, and guidelines acceptable to site security organizations and site management for the access of selected site information resources from offsite and improving the access of offsite information resources for site personnel.

Action Items

- 1) Develop study to define offsite access requirements.
- 2) Conduct limited pilot project to demonstrate security features of offsite access.
- 3) Develop network access policy, procedures, and guidelines.

Dependencies

None

Benefits

New SRS mission requirements are driving the need for SRS employees to gain access to offsite information and for others (DOE, universities, suppliers, etc.) to gain access to selected SRS data. Allowing employees to access their electronic mail from home or when traveling offsite will improve site productivity through improved communications.

Networks Technology Milestones

The following technology milestones must be resolved to adopt the technology. Each is described in more detail in the following sections.

Networks.T.1	Implement Cost-effective Switched Ethernet Hubs
Networks.T.2	Complete ATM Standards
Networks.T.3	Complete ATM Interfaces for Routers/Hubs
Networks.T.4	Complete ATM Interfaces for Workstations/Host Computers
Networks.T.5	Make DCE Security Services Available in Key Environments

Networks.T.1 Implement Cost-effective Switched Ethernet Hubs

Responsible Organization

N/A

Sponsoring Organization

N/A

Initiation Date

1Q/94

Status

Initial switched Ethernet products became available during 1993 for approximately \$1,500 per port. Follow-on products being announced at approximately \$500 per port.

Anticipated Duration

24 months

Resource Considerations

Minimal effort required to follow development of new network technology.

Discussion

The availability of switched Ethernet hubs (SEH) with price per port costs that approximate current shared Ethernet hub prices (~\$150 per port) is the ultimate goal. Today's higher performance SEHs cost more than traditional hubs. Early production implementations at SRS are expected to be a hybrid approach, putting several users on a dedicated Ethernet port.

Action Items

- 1) Conduct laboratory pilot for proof of concept.
- 2) Follow and influence vendor developments.
- 3) Procure new site standard for SEH when price becomes attractive.

Dependencies

None

Benefits

This milestone provides the necessary technology for an upgrade path for the workgroup segments of SRSnet. User workstations, LAN adapters, and network wiring need not be upgraded to complete this milestone. Each user on a switched Ethernet hub (SEH) gains a dedicated 10 mbps channel to every other user in the workgroup—ideal for certain multimedia applications. Access to shared servers is provided by FDDI or ATM interfaces built into the SEH.

Networks.T.2 Complete ATM Standards

Responsible Organization

N/A

Sponsoring Organization

N/A

Initiation Date

1Q/94

Status

Various national, international, and vendor bodies are considering the definition of the interoperability standards for building ATM-based communications networks.

Anticipated Duration

36 months

Resource Considerations

Minimal effort required to follow development of new network technology.

Discussion

ATM-related standards must be completed to allow the completion of heterogeneous wide area and local area data networks based on ATM technology. An active vendor alliance, the ATM Forum, is proving more effective than formal standards organization in identifying and resolving ATM interoperability issues. Formal standards are expected to codify the work of the ATM Forum.

Action Items

- 1) Follow industry ATM standards efforts.
- 2) Encourage vendors to promote and follow standards.

Dependencies

None

Benefits

This milestone is required before the site can build multi-vendor ATM trunks as illustrated in Figure 2 of this Roadmap. Without standards, early implementations of private ATM switches and interface devices are limited to single vendor solutions. ATM standards have been proposed for lower speed ATM networks (155 mbps or less) over UTP.

Networks.T.3 Complete ATM Interfaces for Routers/Hubs

Responsible Organization

N/A

Sponsoring Organization

N/A

Initiation Date

4Q/95

Status

Most LAN router and hub vendors have released product plans detailing expectations to produce ATM interfaces in the future.

Anticipated Duration

12 months

Resource Considerations

Minimal effort required to follow development of new network technology.

Discussion

ATM hardware and software interfaces are required for communications routers and LAN hubs in use at SRS to provide a high-speed connectivity option for these devices. Early (and cost-prohibitive) implementations are becoming available.

Action Items

- 1) Follow industry ATM product development efforts.
- 2) Encourage key network vendors to develop products that provide SRS a cost-effective transition path to ATM.

Dependencies

Networks.T.2 Complete ATM Standards

Benefits

This milestone is required before the site can build multi-vendor ATM trunks as illustrated in Figure 2. Currently, it appears that existing (high-end) network routers at SRS will have an upgrade path to ATM, but it is uncertain whether there will be an upgrade migration to ATM for existing hubs.

Networks.T.4 Complete ATM Interfaces for Workstations/ Host Computers

Responsible Organization

N/A

Sponsoring Organization

N/A

Initiation Date

4Q/94

Status

Various (vendor-specific) interfaces are available today for UNIX-based workstations. Other system vendors have announced plans for products.

Anticipated Duration

12 months

Resource Considerations

Minimal effort required to follow development of new network technology.

Discussion

ATM hardware and software interfaces are required for workstations, host computers, and servers in use at SRS to provide high speed connectivity options for these systems. Early implementations are becoming available, but these are costly and provide only marginal improvement over FDDI today.

Action Items

- 1) Follow industry ATM product development efforts.
- 2) Encourage key network vendors to develop products that provide SRS a cost-effective transition path to ATM.

Dependencies

Networks.T.2 Complete ATM Standards

Benefits

This milestone is required before the site can build multi-vendor ATM LANs in support of high end workstations, host computers, and servers, as illustrated in Figure 2.

Networks.T.5 Make DCE Security Services Available in Key Environments

Responsible Organization

N/A

Sponsoring Organization

N/A

Initiation Date

1Q/95

Status

DCE security service standard has been released by the Open Systems Foundation, and key systems vendors have announced plans to support this in their operating systems.

Anticipated Duration

24 months

Resource Considerations

Minimal effort required to follow development of new network technology. A DCE demonstration in the laboratory will provide proof of the operational principles of distributed security.

Discussion

Distributed Computing Environment (DCE) security services provide the standard protocol for network-based user authentication and are supported on the CCF, VAX/VMS, AIX, and the site standard NOS.

Action Items

- 1) Follow industry DCE product development efforts.
- 2) Encourage key network vendors to develop products that provide SRS a cost-effective transition path to DCE-based security services.
- 3) Follow NOS vendor global directory standards and gateway interface to DCE security.
- 4) Conduct a laboratory-scale DCE implementation.

Dependencies

None

Benefits

This milestone is required before the site can implement network-wide user authentication based on the DCE security services standard. Most large systems vendors plan to support DCE. NOS vendors are generally looking at some sort of gateway approach to provide linkage to DCE-based authentication.

III. Networked Systems Roadmap

Introduction and Destination

As stated in the *SRS Computing Architecture*, the future vision of computing at the Savannah River Site is "standards-based, data-driven, and workstation-oriented, with larger systems being utilized for the delivery of needed information to users in a client-server relationship." Just as the implementation of host-based applications required a robust, secure, and consistent platform, the delivery of client/server applications also requires a supporting infrastructure.

Today we depend on an infrastructure of roads and transportation systems, water and sewage systems, and electric power and communications systems. Personal and commercial vehicles utilize the roads, sharing the infrastructure. At the highest level (interstate highway system), we realize the benefit of centralized planning and implementation, especially when we encounter the dreaded "Freeway Ends" signs. At lower levels (perhaps community level), we often find streets that end unexpectedly or change name as they cross other streets. By necessity, there is a connection between the interstate system and local roads. If the computing infrastructure is to serve the needs of the enterprise, it must be planned and implemented as a total system.

Networked systems can be defined as an infrastructure which includes site network components, protocols, topology, administrative practices, workstations, peripherals, various server systems (such as file and information servers), document manipulation, interpersonal messaging, groupware, etc. A robust communications infrastructure must be established and maintained to leverage the true power of workstations through client/server computing and to support rapid access to large amounts of data. Through standardization, workstations and file servers will also become an integral part of the platform infrastructure to provide the workstation connectivity, manageability, and usability features which all applications will require.

The basic objective of networked systems is to maximize the benefits of personal computing by providing standardization and central management, workstation inter-operability, data interchange, user support, and operating freedom, while reducing the overall cost of ownership. The system encourages the interchange of data regardless of user location or type of computer equipment. Most importantly, this new system provides a well-defined platform upon which applications may be built and an environment flexible enough to adapt to the inevitable changes in the computing industry and Savannah River Site missions. By its nature, an infrastructure must attempt to accommodate diverse needs, necessitating some compromises.

When completed, networked systems should provide the following functionality:

- Provide access to knowledge for business decision-making.

Information which is not easily accessible to the correct people at the correct location, and which is not both trustworthy and private, cannot be used in the business decision-making process. Data and applications must be reliably available from all locations. This means that there should be sharable workstations at most geographic locations and that workstations must be capable of accessing user data which is stored in the networked system rather than at individual workstations.

This data must be quickly and easily accessible by those people authorized to access it and yet be protected from damage by hardware or software

failure or malicious action. This assumes improved data integrity and security with routine backup of user data located on file servers, virus protection, and disaster-recovery processes.

The use of network-wide authentication means the user authenticates to a security service once, and this service communicates authentication information when required by other service nodes. The directory service aids in synchronizing the information with other networked services.

- Provide cost-effective management of personal computing assets.

Networked systems should help establish standards for the personal computer operating systems, graphical user interfaces, and network interfaces. These standards should provide for diverse user needs and yet encourage extensive use of shared workstations and networked peripherals. The current installed base utilizing the Macintosh OS and DOS/Windows OS will migrate toward future operating systems, but must leverage current assets. Interoperability will be required among all computers via common file and printer sharing and common application software.

A system of hardware asset management and software license management at site or server level rather than individual workstations will be required. Networked systems must provide a delivery vehicle for installation and update of purchased or developed software to file servers and personal computer workstations.

- Enable workers or applications to adopt new approaches in business processes.

Networked systems must provide the ability to manage change without impeding it. It must provide mechanisms to increase functionality while reducing administrative overhead.

There must be easy distributed workgroup management with minimized central administration overhead.

Starting Point

Realizing the importance of controlling the costs of personal computer ownership and the need to effectively utilize the site's investment in computing technology, particularly the large base of personal workstations, the WSRC Information Resource Management Department initiated a pilot program to develop a common networked workstation infrastructure. This pilot system is not a software product, but a system defined by a set of guiding principles. The system is built from commercially available hardware and software components, with custom-developed software where necessary to provide the personal computer management capabilities. An essential part of the design is the ability to adapt to changing site requirements and changing commercial hardware and software products.

Networked systems will be based on the following technologies:

- Network Operating System (NOS)

Today's NOS is server-oriented, creating islands of information and administration. It does not encourage an enterprise view. Movement to an enterprise-oriented NOS with hooks into other network services will provide the basis for building the infrastructure.

■ Graphical User Interface (GUI) Workstations

Apple Macintosh System 7.1 and Microsoft Windows (3.1) currently provide the basis for a graphical user interface (GUI) approach. An IBM (or compatible) PC with a 386 (or better) processor or an Apple Macintosh II (or better) is required to run the client software. Approximately one third of the personal computer systems in use onsite are functionally obsolete and are not capable of running the GUI-required environments. These older machines range in age from 5 to 10 years.

■ NOS Global Directory Services

Directory services are provided by the NOS as a service, but must cooperate with other network services such as electronic mail and user authentication services. In addition to the technology itself, organizational or administrative changes will be required to plan and administer the directory.

Network Systems Infrastructure Milestones

The following infrastructure milestones must be resolved to adopt the technology. Each is described in more detail in the following sections.

Netsys.I.1	Install Robust Client Workstations
Netsys.I.2	Upgrade Workstations to Support Netsys Requirements
Netsys.I.3	Ensure Broad Availability of Networked Workstations
Netsys.I.4	Migrate to New NOS
Netsys.I.5	Initiate NOS Global Directory
Netsys.I.6	Initiate Network Authentication Service
Netsys.I.7	Complete Installation of Territorial File Servers
Netsys.I.8	Manage IP Addresses
Netsys.I.9	Implement Robust File/Print/Application Services
Netsys.I.10	Implement Automatic Software Distribution
Netsys.I.11	Connect Office Peripherals Directly to Network
Netsys.I.12	Implement Reliable Performance Monitoring

Netsys.I.1 Install Robust Client Workstations

Responsible Organization

IRM

Sponsoring Organization

WSRC

Recommended Initiation Date

1Q/94

Status

PC upgrade and replacement strategy proposed to DOE as part of WSRC Strategic Plan for Business Computing

Anticipated Duration

24 months

Resource Considerations

This milestone requires an ongoing commitment of funds for computer replacement and upgrade. At a five-year turnover rate, this currently amounts to about \$6 million per year.

Discussion

Client workstations must have sufficient power and memory to store dynamic tables for field validation by client/server applications, to respond quickly to user inquiries, and to cache frequently used information. At a very minimum, machines more than 5 years old must be replaced. Graphics accelerator cards should be used where needed to provide fast screen painting and refreshing for graphical applications. Sound devices must be available to provide output of speech via headphones.

Action Items

- 1) Establish minimum standard for client workstation.
- 2) Upgrade or replace all inadequate workstations.
- 3) Periodically revise standard.

Dependencies

Netsys.A.1

Set Site Direction, Funding, and Priority

Benefits

Inadequate or obsolete workstations will not be acceptable to run sitewide applications, will be difficult or impossible to maintain at the site software standards, and increase the support burden while decreasing employee efficiency. Establishing a centralized policy and procedure will reduce administrative overhead and allow application developers to assume a minimum level of performance.

Netsys.I.2 Upgrade Workstations to Support Netsys Requirements

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

2Q/94

Status

Ad hoc upgrades in progress; systematic program required to identify upgrade and complete requirements

Anticipated Duration

36 months

Resource Considerations

Much of this work could be outsourced.

Discussion

Each workstation must have sufficient hardware, proper software, and a network connection to participate in the enterprise network. In some cases, this requires only a reconfiguration of the existing hardware and reloading of software. A plan for upgrade should be prioritized by availability of network file/print services. Once upgraded, the workstation software will be maintained current, the user will access standard applications from the file servers, and the workstation may be easily shared.

Action Items

- 1) Determine order of file/print services availability.
- 2) Assign staff to upgrade hardware/software.
- 3) Coordinate user training.

Dependencies

Networks I.3	Complete Site Universal Wiring
Netsys.I.1	Install Robust Client Workstations
Netsys.A.1	Set Site Direction, Funding, and Priority
Netsys.M.1	Implement PC Utilization Plan

Benefits

This milestone reduces support requirements, automates maintenance of current software, and encourages equipment sharing. Each personal computer is attached directly to the site Ethernet LAN via an adapter card and is assigned a home file server, so that application and communications software can be centralized in the server for access by the client workstations. This requires a degree of standardization in software and hardware configurations on individual personal computers, but greatly simplifies support requirements for personal computer users. This standardization is also required to ensure that applications based on communications between site computers and personal computers function reliably.

Netsys.I.3 Ensure Broad Availability of Networked Workstations

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

2Q/94

Status

Effort under way to complete networks and PC utilization plan

Anticipated Duration

24 months

Resource Considerations

Implementation of a PC utilization plan in conjunction with procurement will ensure available workstations. Staff should be provided (or outsourcing utilized) to install all new workstations in a standard fashion.

Discussion

Sitewide applications cannot be delivered until a sufficient user population has access available. Where individuals do not have adequate workstations, shared workstations should be conveniently located.

Action Items

- 1) Ensure that supporting network (building and area) in place.
- 2) Complete personal computer utilization plan.
- 3) Reconfigure workstations to Netsys standards.

Dependencies

Networks.I.3	Complete Site Universal Wiring
Netsys.A.1	Set Site Direction, Funding, and Priority
Netsys.A.2	Define Security Principles
Netsys.I.1	Install Robust Client Workstations
Netsys.I.2	Upgrade Workstations to Support Netsys Requirements

Benefits

This milestone produces a critical mass of standardized clients, making development of site-wide applications cost effective.

Netsys.I.4 Migrate to New NOS

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

2Q/94

Status

Implementation team identified and planning in progress

Anticipated Duration

12 months

Resource Considerations

Sitewide input and participation during the planning and early implementation may require significant resources. Once established, the resource load should be less than is currently used. The support for the current file servers, if redeployed, would be sufficient.

Discussion

The implementation of an enterprise NOS produces the infrastructure necessary to provide centralized administration, de-centralized management, and stratified security. Movement away from a server-based NOS toward an enterprise NOS will facilitate the other infrastructure operations.

Action Items

- 1) Design and implement centralized structure.
- 2) Convert existing client workstations.
- 3) Install new servers and migrate existing servers.
- 4) Document security and management procedures.

Dependencies

Netsys.A.3

Establish NOS Operations Group

Benefits

This milestone provides reduced administrative overhead while increasing enterprise network security, functionality, and management.

Netsys.I.5 Initiate NOS Global Directory

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

2Q/94

Status

Implementation team identified and planning in progress

Anticipated Duration

12 months

Resource Considerations

Relatively high-load short-term planning/consulting will become a low-resource operations task.

Discussion

The NOS directory system is the access mechanism to control enterprise network services, manage user accounts, and authenticate users for file and print services. Some data in this system will be synchronized with information from the site personnel roster and HR databases. In the future, the NOS directory may interface to host services directly or via central network authentication service.

Action Items

- 1) Establish group to determine site requirements.
- 2) Performs NOS upgrade.
- 3) Migrate remaining services
- 4) Synchronize connection with HR data.

Dependencies

Netsys.I.4	Migrate to New NOS
Netsys.A.3	Establish NOS Operations Group

Benefits

This milestone results in a single user ID and login process for all file and print services. By eliminating multiple user accounts, it significantly reduces administrative overhead and improves user functionality.

Netsys.I.6 Initiate Network Authentication Service

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

1Q/95

Status

Not started

Anticipated Duration

24 months

Resource Considerations

Procurement of DCE-based software interfaces or gateways will vary by platform. It is reasonable to expect host pricing to be significant, while mid-range and small servers might obtain their interfaces by upgrade of the operating system under maintenance. Testing and implementation will require one to two FTEs per platform during the migration process.

Discussion

Conversion of system-based user authentication to network-based authentication further reduces administrative overhead and increases user functionality. This requires network authentication server(s) and modification of host/server operating systems to support network-based authentication protocols, technologies which are currently emerging.

Action Item

- 1) Conduct laboratory-scale testing based on early DCE products.
- 2) Work with key vendors to attempt to influence DCE development.
- 3) Install DCE-compliant operating systems as they become available.
- 4) Interface NOS directory services to DCE.

Dependencies

Netsys.I.3	Ensure Broad Availability of Networked Workstations
Netsys.I.4	Migrate to New NOS
Netsys.I.5	Initiate NOS Global Directory
Networks.T.5	Make DCE Security Services Available in Key Environments

Benefits

Network authentication provides users with network-transparent computing. That is, a user is able to authenticate him- or herself once and gain access to various network services and data without further authentication. This helps provide the effect that there is a single location for services and data, the network.

Netsys.I.7 Complete Installation of Territorial File Servers

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

1Q/94

Status

30 % complete

Anticipated Duration

30 months

Resource Considerations

Capital funding for server purchases and/or upgrades is planned under the current MIEs. It will require at least two FTEs to perform the installations.

Discussion

Installation of an infrastructure-standard file server for each sub-network in a given SRS area or WSRC offsite location will be required to provide the file, print, and application services, as well as the software distribution function.

Action Items

- 1) Identify sub-network requirements.
- 2) Install existing servers.
- 3) Develop specifications and procure new servers.
- 4) Install new file servers.

Dependencies

Netsys.A.1	Set Site Direction, Funding, and Priority
Netsys.A.3	Establish NOS Operations Group
Netsys.I.4	Migrate to New NOS
Netsys.I.5	Initiate NOS Global Directory

Benefits

The territorial file server is the basis for client software distribution and asset management. These servers provide the site-standard applications and private storage space for users. To minimize network traffic, one of these servers must exist in each routed sub-network. Client workstations in the sub-net served must be properly configured to reduce network traffic.

Netsys.I.8 Manage IP Addresses

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

1Q/94

Status

BOOTP IP management program in progress

Anticipated Duration

Six months

Resource Considerations

All new workstations must be configured properly at installation; current workstations will require reconfiguration. These are significant but one-time labor-intensive tasks.

Discussion

All workstations will eventually require an IP address, both for current host access and for future NOS access. A limited number of addresses in each sub-net must be uniquely assigned. Automated processes to assign and maintain these addresses must be developed and implemented to ensure reliability and reduce administrative overhead.

Action Items

- 1) Identify sub-network requirements.
- 2) Install BOOTP servers in each sub-net.
- 3) Convert workstations to utilize BOOTP process.
- 4) Establish SRS procedures to manage IP address tables.

Dependencies

None

Benefits

A unique IP address is needed to access current IBM and DEC hosts and future Unix application servers. This address must be re-configured when a workstation is physically moved from one sub-net to another or when the sub-net itself is re-configured. Automation of this process reduces support calls from the user community, improves security, assists in asset tracking, and reduces overall administration burden.

Netsys.I.9 Implement Robust File/Print/Application Services

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

3Q/94

Status

Not started

Anticipated Duration

24 months

Resource Considerations

Ongoing user-input steering team.

Discussion

An infrastructure system will not be utilized or trusted unless the services provided are more desirable than what is locally available, reliable, and of consistently high quality. Once users can obtain infrastructure services by default, they will embrace those services. This will in turn encourage the use of standards and eliminate some user resistance. It is technically feasible to print from all host and PC-based applications to all LAN and host-attached printers.

Action Items

- 1) Continuously review user needs.
- 2) Establish an automated procedure for obtaining alternate services.
- 3) Establish consolidated printing program.
- 4) Encourage site-wide applications.

Dependencies

Netsys.I.7	Complete Installation of Territorial File Servers
Netsys.I.8	Manage IP Addresses
Netsys.P.4	Implement Disaster Recovery Procedure
Netsys.T.2	Implement Transparent Print Services on All Platforms

Benefits

Site licensed or site-developed applications may be distributed and/or maintained more easily on a limited number of application (territorial) servers. The total amount of disk storage necessary is reduced when shared on a server. Peripheral and data sharing will be encouraged.

Netsys.I.10 Implement Automatic Software Distribution

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

1Q/94

Status

10% complete

Anticipated Duration

36 months

Resource Considerations

Software purchase or development will not be costly. The policies and procedures needed to implement good software distribution will require at least two FTEs for implementation.

Discussion

Software installation and upgrade is a highly labor-intensive task. Automated processes will be used to ensure that both servers and clients are maintained at current levels.

Action Items

- 1) Continue to implement network/workstation/NOS infrastructure.
- 2) Formalize site distribution of personal computer via this infrastructure.
- 3) Work with vendors to develop concurrent-use licensing for special use software.

Dependencies

Netsys.C.1	Implement Standards
Netsys.I.2	Upgrade Workstations to Support Netsys Requirements
Netsys.I.7	Complete Installation of Territorial File Servers
Netsys.A.2	Define Security Principles

Benefits

Ensuring that software is automatically at current levels reduces support and administration and will be key to proper utilization of true client/server applications in the future.

Netsys.I.11 Connect Office Peripherals Directly to Network

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

1Q/94

Status

Started

Anticipated Duration

36 months

Resource Considerations

All new peripherals should be purchased network-ready. Where not part of the standard peripheral, the incremental upgrade cost will be small. A one-time installation effort is required for each peripheral. Proper documentation will reduce this effort to a very minimal number. The cost (hardware and labor) of moving existing peripherals must be evaluated in terms of the current value of the existing equipment.

Discussion

Although hardware costs have generally declined, there is an increasing need and desire for higher quality peripherals. Proper sharing of enhanced peripherals satisfies this need while still reducing overall costs.

Action Items

- 1) Document guidelines for procurement of shared peripherals.
- 2) Migrate current peripherals to direct network connection.
- 3) Facilitate use of shared peripherals with better user interfaces.

Dependencies

Netsys.A.1	Set Site Direction, Funding, and Priority
Netsys.I.3	Ensure Broad Availability of Networked Workstations
Netsys.I.9	Implement Robust File/Print/Application Services
Netsys.C.1	Implement Standards
Netsys.C.2	Share Equipment/Peripherals

Benefits

This milestone encourages cost-effective utilization of network resources and provides increased user functionality.

Netsys.I.12 Implement Reliable Performance Monitoring

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

3Q/94

Status

Not started

Anticipated Duration

12 months

Resource Considerations

Most of the required software has already been procured. Implementation will require about six months of an FTE. Once placed into operation, one FTE should accommodate the monitoring and tuning functions.

Discussion

Consistent, reliable network services to the user can only be guaranteed if the infrastructure as a whole is monitored for performance and failure alerts. Proactive monitoring can also help tune the system for better response and equipment utilization. Additions of monitoring software at the client workstation will allow performance monitoring of both network protocols and file/print/application services.

Action Items

- 1) Implement basic network services management.
- 2) Re-organize central group responsibilities.
- 3) Install network management components on workstations (SNMP).

Dependencies

Netsys.I.3	Ensure Broad Availability of Networked Workstations
Netsys.A.3	Establish NOS Operations Group

Benefits

Proper monitoring will reduce the possibility of failure, improve overall up-time, and create a trusted system. Automated procedures will reduce central staff workload.

Network Systems Administrative Milestones

The following administrative milestones must be resolved to adopt the technology. Each is described in more detail in the following sections.

Netsys.A.1	Set Site Direction, Funding, and Priority
Netsys.A.2	Define Security Principles
Netsys.A.3	Establish NOS Operations Group

Netsys.A.1 Set Site Direction, Funding, and Priority

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

1Q/94

Status

Management acceptance of WSRC Strategic Plan for Business Computing provides focus for this milestone.

Anticipated Duration

48 months

Resource Considerations

Computer hardware procurement will be a significant expense. Direction and funding will be part of the strategic planning process.

Discussion

Establishment of site policy and practices to support central direction, funding, and priority for site information technology (I/T) initiatives.

Action Items

- 1) Activate SRS Computing Council to establish site I/T priorities.
- 2) Endorse site Strategic Plan for I/T.
- 3) Develop IRM cost estimates and timing required for site network initiatives for Computer Council approval.

Dependencies

None

Benefits

Completion of the site network is a significant site infrastructure issue. Current and future mission assignments require a robust and reliable network that is uniformly implemented across SRS. Without central direction and funding, network implementations tend to be uneven, as certain departments or facilities see the need to fund the network and others do not.

Netsys.A.2 Define Security Principles

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

2Q/94

Status

Not started

Anticipated Duration

12 months

Resource Considerations

This will require about three FTEs over the six-month duration. There are no hardware or software costs.

Discussion

Workgroup computing assumes a posture that the owner of the data designates who should be allowed what level of access. A fully stratified security model will provide various levels of administration such that the data owner can take stewardship. The purpose of this milestone is to envision and document the security model to which the technology should strive.

Action Items

- 1) Assemble user, administrator, and security audit needs.
- 2) Construct a security model.
- 3) Review applicable DOE orders.
- 4) Publish policy, procedure, and principles documentation.

Dependencies

None

Benefits

By creating and publishing a desired security architecture, all associated groups will gain a clear understanding of the total needs and restrictions. At each point in the implementation, the technology and procedures may be compared to the model and verified. Although it might not be possible to meet all needs at the outset, this plan provides the guidance necessary to move toward the final goal.

Netsys.A.3 Establish NOS Operations Group

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

2Q/94

Status

Not started—awaiting IRM reorganization

Anticipated Duration

12 months

Resource Considerations

Once established, this is an ongoing operation which is likely to require two FTEs.

Discussion

The NOS is an infrastructure upon which networked applications and services are layered. Centralization of the NOS operations is more cost-effective, provides a process for easy upgrade, and ensures a uniform implementation. Establishment of site policy and practices, daily operations, and disaster recovery would be conducted by this group.

Action Items

- 1) Establish centralized IRM group.
- 2) Conduct internal training.

Dependencies

None

Benefits

Increased standardization, reduced support costs, uniform infrastructure.

Network Systems Cultural Milestones

The following site culture milestones must be resolved to adopt the technology. Each milestone is discussed in more detail in the following sections.

Netsys.C.1	Implement Standards
Netsys.C.2	Share Equipment/Peripherals
Netsys.C.3	Save Data to Network

Netsys.C.1 Implement Standards

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

2Q/94

Status

Not started

Anticipated Duration

24 months

Resource Considerations

There are no hardware or software costs. A level of marketing may be required to sample the needs of the user community and communicate information to them.

Discussion

In the past, standard products were established by CAST, and their applicability was documented. A similar process must be created. Where possible (and cost-effective), site licenses are established as part of the standards-setting process so that users are not required to track individual licenses. Once a site standard product is established, it can be installed on file servers on the site network. Users can use the software directly from the file servers so that end users no longer need to devote their time to software product installation. Likewise, installation of new software version updates can be automated to save end-user time. Management should discourage the use of older, non-standard products and encourage a continuous migration which keeps current with the use of the defined standards.

Action Items

- 1) Define IRM/T&PC standards-setting process.
- 2) Document standards.
- 3) Issue management directives to encourage use of standards.

Dependencies

None

Benefits

Use of IT standards provides improved interoperability of SRS systems and applications, as well as lower overall costs.

Netsys.C.2 Share Equipment/Peripherals

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

1Q/94

Status

10% complete

Anticipated Duration

36 months

Resource Considerations

Shared resources required will be less than the current practices.

Discussion

Future technologies will allow greater personalization of shared equipment. There must be a user move away from the notion that the workstation or printer is personal property. Moving personalization and data to the enterprise network and providing more robust infrastructure services will aid the required management directives.

Action Items

- 1) Complete the network infrastructure.
- 2) Factor greater user personalization into the enterprise system.
- 3) Provide better services on the network than can be locally obtained.
- 4) Encourage management to direct users toward this goal.

Dependencies

Netsys.I.3	Ensure Broad Availability of Networked Workstations
Netsys.I.7	Complete Installation of Territorial File Servers
Netsys.I.9	Implement Robust File/Print/Application Services
Netsys.I.11	Connect Office Peripherals Directly to Network
Netsys.C.1	Implement Standards
Netsys.C.3	Save Data to Network
Netsys.P.4	Implement Disaster Recovery Procedure

Benefits

Once embraced by the user community, sharing networked resources will provide large cost savings, will improve data sharing and productivity, and will improve security and reliability.

Netsys.C.3 Save Data to Network

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

1Q/94

Status

10% complete

Anticipated Duration

36 months

Resource Considerations

This milestone requires completion of the infrastructure and assumes a large amount of reliable, available disk space. Capital funding might be the limiting factor.

Discussion

Users must feel that data saved to the enterprise network is more reliable and available than that which might be saved locally. By developing security plans which encourage placing information within the network, by demonstrating the values of shared data, and through some management directive concerning data management there will be a shift in process.

Action Items

- 1) Complete infrastructure.
- 2) Review disk space considerations (on-going).
- 3) User education/training on policies and procedures.

Dependencies

Netsys.I.3	Ensure Broad Availability of Networked Workstations
Netsys.I.7	Complete Installation of Territorial File Servers
Netsys.I.9	Implement Robust File/Print/Application Services
Netsys.I.11	Office Peripherals with Direct Network Connection
Netsys.C.1	Implement Standards
Netsys.P.4	Implement Disaster Recovery Procedure

Benefits

The basis for enterprise workgroup data-sharing is the availability of data from any location. Both personal and workgroup data will be more reliably available if saved to the network.

Network Systems Process Milestones

The following work-flow milestones must be resolved to adopt the technology. Each is described in detail in the following sections.

Netsys.P.1	Implement Single User Login to Network
Netsys.P.2	Implement Distributed Workgroup Management
Netsys.P.3	Implement Software License Management
Netsys.P.4	Implement Disaster Recovery Procedure
Netsys.P.5	Implement Infrastructure Enhancement Process

Netsys.P.1 Implement Single User Login to Network

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

3Q/94

Status

Planning stage

Anticipated Duration

24 months

Resource Considerations

Hardware and software costs are accounted for in milestone Netsys.I.6. Future systems should be designed to utilize the available authentication on a routine basis. Internal training of system designers might be necessary.

Discussion

This milestone involves developing process changes to establish an environment where users log in once to the network. Subsequent use of SRS host computers, applications, or databases is provided without additional user login requirements, taking advantage of networked-based authentication technology.

Action Items

- 1) Establish user login procedures.
- 2) Implement security gateways where possible.
- 3) Migrate systems to DCE.

Dependencies

Netsys.I.3	Ensure Broad Availability of Networked Workstations
Netsys.I.5	Initiate NOS Global Directory
Netsys.I.6	Initiate Network Authentication Service
Networks.T.5	Make DCE Security Services Available in Key Environments

Benefits

Network authentication provides users with network-transparent computing. That is, a user is able to authenticate him- or herself once and gain access to various network services and data without further authentication. This helps provide the effect that there is a single location for services and data, the network.

Netsys.P.2 Implement Distributed Workgroup Management

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

3Q/94

Status

Not started

Anticipated Duration

36 months

Resource Considerations

No commercial hardware or software products are required. Some locally developed user interface tools might be utilized. Formulation of policies and procedures, internal systems planning/training, and user training will be required.

Discussion

This milestone moves the control of data access to the owner of the data and removes centralized administrative burden.

Action Items

- 1) Define policies and procedures.
- 2) Implement central administration of overall disk space.
- 3) Conduct user education.

Dependencies

Netsys.I.5	Initiate NOS Global Directory
Netsys.I.6	Initiate Network Authentication Service
Netsys.I.7	Complete Installation of Territorial File Servers
Netsys.A.3	Establish NOS Operations Group

Benefits

The movement of access control reduces central administration and improves data availability.

Netsys.P.3 Implement Software License Management

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

4Q/94

Status

Not started

Anticipated Duration

30 months

Resource Considerations

Procurement of additional software to work with the NOS will be required. In some cases this may be furnished as part of other purchased software. Effort to install and maintain the system should be minor.

Discussion

Widely used or site-standard software must be available to various workstations on an as-needed basis depending on user needs. Various license schemes which include site-agreement, concurrent-use, or specific machine or specific individual must be accommodated. Although market direction appears directed toward technologies which might address these needs (network license service), there must also be business policy regarding license administration.

Action Items

- 1) Continue to track market trends in software licensing.
- 2) Consider license administration in determining software costs.
- 3) Establish business policy on availability of software to individuals.

Dependencies

Netsys.I.3	Ensure Broad Availability of Networked Workstations
Netsys.I.7	Complete Installation of Territorial File Servers
Netsys.I.10	Automatic Software Distribution
Netsys.A.2	Define Security Principles
Netsys.C.1	Implement Standards

Benefits

It is imperative to provide policy, procedure, and implementation which provide a cost-effective way of ensuring that software use is legal and best suited to user requirements.

Netsys.P.4 Implement Disaster Recovery Procedure

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

3Q/94

Status

Not started

Anticipated Duration

12 months

Resource Considerations

This will require some capital for hot-spare equipment, and some short-term planning and testing efforts.

Discussion

A fully tested plan must be in place to replicate hardware and/or data in the event of a disaster. This plan should include simple loss of a single file server to an event such as a major building fire which destroyed the telecommunications and file server areas. The plan should document level of cost associated with each level of risk.

Action Items

- 1) Plan and procure hot spare equipment.
- 2) Provide reliable backup services and offsite storage.
- 3) Plan and test recovery procedures.
- 4) Document policies and procedures and level of acceptable risk.

Dependencies

Netsys.A.3 Establish NOS Operations Group

Benefits

Mission-critical data cannot be trusted to a system until the level of risk has been assessed and recovery plans established.

Netsys.P.5 Implement Infrastructure Enhancement Process

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

2Q/94

Status

Not started

Anticipated Duration

24 months

Resource Considerations

After an initial investment in creating and documenting the process, this will require only a small ongoing effort. Major changes in user needs or in the technologies implemented will cause resource needs to peak.

Discussion

A process must be established to allow planning input from users, developers, and technologists so that the ongoing networked services migrate as needs and solutions change. This process would establish priorities, provide change control, and ensure compatibility.

Action Items

- 1) Establish steering team.
- 2) Document current environment.
- 3) Document input and change-control process.
- 4) Provide for regular meetings/input from the team members.

Dependencies

None

Benefits

This will ensure that the enterprise system best meets the user needs in a timely fashion.

Network Systems Technology Milestones

The following technology milestones must be resolved to adopt the technology. Each is described in more detail in the following sections.

Netsys.T.1

Deliver NOS over TCP/IP

Netsys.T.2

Implement Transparent Print Services on All Platforms

Netsys.T.1 Deliver NOS over TCP/IP**Responsible Organization**

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

1Q/95

Status

Not started

Anticipated Duration

12 months

Resource Considerations

This is likely to be included in the maintenance of the current standard NOS.

Discussion

This will move NOS services to a single networking protocol (TCP/IP) more closely in line with other enterprise network services and hosts.

Action Items

- 1) Continue to communicate with NOS vendor.
- 2) Test emerging technologies.
- 3) Finalize IP address management.
- 4) Test future NOS products as early as possible.

Dependencies

Netsys.I.4	Migrate to New NOS
Netsys.I.8	Manage IP Addresses

Benefits

A single protocol for all networked services (NOS and hosts) provides improved performance and reduced administration.

Netsys.T.2 Implement Transparent Print Services on All Platforms

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

4Q/94

Status

Initial investigations point toward implementation approach.

Anticipated Duration

12 months

Resource Considerations

Might require some hardware/software purchases in the form of gateways or transfer processes. Development of the vision and first implementation might require several FTEs, but ongoing operations should require less than the current level of effort.

Discussion

Printing should be a network service, available equally to all platforms. All printing should occur at the most convenient and cost effective location for the user. The process for printing should be generalized across LAN and host services so as to appear to be the same to the user.

Action Items

- 1) Document printing needs for each platform.
- 2) Determine user operation profiles.
- 3) Investigate printing alternatives.
- 4) Plan user training.

Dependencies

Netsys.I.3	Ensure Broad Availability of Networked Workstations
Netsys.A.2	Define Security Principles
Netsys.A.3	Establish NOS Operations Group

Benefits

The implementation of an enterprise-wide approach to printing would better utilize shared printer equipment, improve user productivity, and reduce central administration costs.

Network Systems Miscellaneous Milestones

The following additional milestones, not covered by any other issue area, must be resolved to adopt the technology. Each of these is described in more detail in the sections below.

Netsys.M.1 Implement PC Utilization Plan

Netsys.M.1 Implement PC Utilization Plan

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

2Q/94

Status

In progress as part of *WSRC Strategic Plan for Business Computing*

Anticipated Duration

12 months; ongoing

Resource Considerations

There is an implication of available capital to purchase computers based on a recommendation from this planning process. The actual planning will require cross-division coordination.

Discussion

Workstations are the key to networked systems implementation. Purchase and re-distribution of equipment based on user needs and priorities will ensure that minimum equipment needs for enterprise applications will be met.

Action Items

- 1) Establish site policy on minimum PC requirements for network attachment.
- 2) Establish obsolete PC retirement policy.

Dependencies

Netsys.A.1 Set Site Direction, Funding, and Priority

Benefits

Effective management of user personal computers depends on attaching these system in a WISDOM-like environment. Such an environment provides for network monitoring of workstations as well as automatic configuration and software updates over the network. Obsolete systems are unable to participate and thus are unmanageable except by manpower-intensive efforts.

IV. Information Warehouse

Introduction and Destination

As stated in the *SRS Computing Architecture*, the future vision of computing at the Savannah River Site is a "standards-based, data-driven, and workstation-oriented computing environment." An information warehouse (IW) for end-user query and management information reporting is one means to achieve this vision. An information warehouse establishes a managed information environment where data, specific to the management of an enterprise (for example, WSRC), is extracted from the data collections or operational environment and migrated to an integrated reporting environment that is specifically tuned to query and end-user access. The IW will be managed by an information repository and supported by a standard suite of query/access tools. Data usage will be carefully monitored and controlled through audits, data policies, and procedures.

The IW becomes the standard source for management reporting, replacing the free market reporting and query environment described in the following section.

The principle objective for implementing an IW at WSRC is to substantially relieve mainframe capacity constraints and reduce the standing applications backlog. An IW will shift the reporting of management information away from the processes that collect the data (for example, data collections systems and applications) to the end-user community, the principal user of the data. The *WSRC Strategic Plan for Business Computing* identified four areas for IW support. These are:

1. *People* data to address site need for reliable and readily accessible person and organization data.
2. *Financial* data to directly address immediate customer needs.
3. *Assets and Facilities* data to provide a common point of integration of asset data gathered from financial, property management, and operational sources.
4. *Purchasing* data to relieve the significant Procurement Cycle System (PCS) backlog for reporting and eliminate redundant local databases used to track commitments.

The SRS information warehouse will consists of four components:

1. *Information Repository* where the meta-information (that is, information about information) is defined and accessible to all users.
2. *Data Extracts* which control the extraction of warehouse data from the data collection systems.
3. *Data Standardization* where data is integrated by subject or functional area, and summarized or otherwise transformed according to predefined rules and data management standards and policies.
4. *Data Stores* organized by subject or functional area.
 - a. Global warehouse which contains the management information supporting the business or management requirements of SRS.

- b. Local (or remote) warehouse which contains subsets of the global warehouse, specifically tuned for individual department or group level.
- c. Archival warehouse which contains inactive data.

Several publications are available, including the SRS Application Design Architecture (WSRC-IM-92-109), to explain the concepts of IW technology and the separation of management data from operational data.

Starting Point

Pockets of information warehouse activities exist today at SRS. IW type activities are found within application- or department-specific reporting, numerous data extracts and downloads, and individual what-if databases. Several business systems currently offer or plan to offer reporting databases. IW type activities are also supported by numerous query tools, workstation-oriented data products, and individual efforts to integrate data. These efforts are without overall management and direction, and have caused numerous data conflicts and misunderstandings.

In a typical IS development group, information reporting accounts for the majority of the maintenance backlog and development efforts. This may be true for SRS's application development organizations. This backlog will not diminish unless there is a fundamental change in the reporting of management information. Implementing an IW will fundamentally change the nature of reporting by transferring the responsibility for reporting away from the processes or systems which collect data to the end users responsible for its reporting, analysis, and content.

The following section contains a series of milestones which identify the events necessary for the successfully transition from the current state (starting point) of information reporting to the IW environment (destination).

Information Warehouse Infrastructure Milestones

The following infrastructure milestones must be resolved to adopt the technology. Each is described in more detail in the following sections.

IW.I.1	Establish a Communications Network Capability Supporting the Global and Local Warehouses
IW.I.2	Establish Client SQL-Network
IW.I.3	Establish/Populate IW Component of Data Repository
IW.I.4	Identify and Procure IW Support Tools and Hardware
IW.I.5	Identify and Procure Archival Management Tools and Hardware

IW.I.1 Establish a Communications Network Capability Supporting the Global and Local Warehouses

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommend Initiation Date

1Q/94

Status

In process

Anticipated Duration

48 months

Resource Considerations

See Networked Systems Roadmap.

Discussion

Success of IW program is dependent upon the rapid movement of data between/among platforms, DBMS, and workstations. The communications network must be capable of supporting the transfer of operational data to the global IW, supporting end-user data queries and data transfers, and supporting transfer of global IW data to local servers. The network requirements (that is, size and type) can be determined in part through the IW Model (IW.P.2). However, the load on the network attributed to IW will be highly variable, subject to the number of simultaneous users, type of queries, number of data transfers, and other related factors.

Action Items

- 1) Identify potential impact of IW on existing network.
- 2) Define IW network requirements.

Dependencies

IW.P.2	Define the IW Model
Netsys.I.3	Ensure Broad Availability of Networked Workstations
Netsys.I.7	Complete Installation of Territorial File Servers
Networks.I.5	Install Ethernet/FDDI Network Trunks

Benefits

See Roadmap for Networked Systems.

IW.I.2 Establish Client SQL-Network

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommend Initiation Date

2Q/94

Status

Initial efforts under way; SQL*net identified for addition to WISDOM

Anticipated Duration

24 months with the majority of the effort in the first year

Resource Considerations

In addition to the resources of the IW implementation team, this milestone requires the support of several IRM organizations.

Discussion

A client SQL connection may be required by the IW RDBMS. For example, the Oracle RDBMS requires a SQL connection (SQL*net) on both the server and client; other RDBMS may require the same. One of the major issues identified by the IW pilot project was the inability of team members to connect with the pilot warehouse via several different query tools due to differences in the SQL installed on the site's various workstations and local area networks.

Action Items

- 1) Identify client requirements for SQL connection to IW.
- 2) Procure standard client SQL connection product.
- 3) Identify software change management technique for managing distribution of the client SQL connection.
- 4) Install client SQL connection on WISDOM workstations.

Dependencies

IW.I.4	Identify and Procure IW Support Tools and Hardware
IW.A.1	Establish IW Implementation Team
IW.P.2	Define the IW Model
IW.P.5	Establish Local or Remote IWs
Netsys.I.3	Ensure Broad Availability of Networked Workstations
Netsys.I.7	Complete Installation of Territorial File Servers
Networks.I.5	Install Ethernet/FDDI Network Trunks

Benefits

Allows SQL end-user tools to connect with the Oracle data warehouses.

IW.I.3 Establish/Populate IW Component of Data Repository

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommend Initiation Date

1Q/94

Status

IW repository requirements under study

Anticipated Duration

36 months for initial effort

Resource Considerations

This milestone requires the resources of several IRM functions. The principal resource is the data management function, which has the responsibility for overall data management, and the IW implementation team, which has the IW metadata responsibilities. Additionally, the resources of several application programmers is necessary to automate the transfer of data definitions from existing catalog systems to the repository.

Discussion

Data is created, maintained, and utilized by a variety of automated systems, individuals, and organizations. Additionally, information necessary to the safe, cost-effective, and efficient operation and management of SRS is contained in a variety of DBMSs, file cabinets, and desk drawers. Knowledge that the data exists, its source, rules or constraints, and its definitions or attributes must be defined to and managed by a (logically) central data repository. The IW repository is an extension of the central repository. The metadata requirements for warehouse data are slightly different than those for a normal repository. A partial list of these requirements would include the rules for data extraction, rules for data transformation, extract job, system of record or source for the data, access restrictions, date of the most recent extraction, and information regarding archival requirements.

The rationale for a repository is discussed in the SRS Applications Design Architecture.

Action Items

- 1) Identify IW repository requirements.
- 2) Procure IW repository
- 3) Establish policies and procedures for IW repository.
- 4) Populate the repository with metadata from the IW logical model

Dependencies

IW.P.2 Define the IW Model

IW.I.4 Identify and Procure IW Support Tools and Hardware

Benefits

Effective utilization of an IW is facilitated by an IW repository. The repository documents the contents of the warehouse and provides a definitive or single source for the user community to

access when researching the availability of data, definition of data, or data attributes. The repository as a knowledge holder of meta-information identifies for each data item in the warehouse its system of record, custodian, business rules, and extract schedule and job, plus a host of other meta information.

IW.I.4 Identify and Procure IW Support Tools and Hardware

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommend Initiation Date

1Q/94

Status

Initial planning under way

Anticipated Duration

18 months

Resource Considerations

The IRM IW pilot project identified the prime tool suite (that is, repository manager, subscription service, query tools, DBMS, communications software, SQL, server/s, and storage hardware) required to support the global and summary warehouse. In addition to the core IW team, this milestone requires support from IRM organizations to define the requirements for end-user query tools and to install the software and hardware. Support is required from ALD's site procurement organization.

The Information Warehouse(s) will require dedicated platform(s) requiring substantial capital (hardware) and software costs. These costs are being factored in to the WSRC Strategic Plan for Business Computing.

Discussion

The WSRC Strategic Plan for Business Computing states that "Development of enterprise data information warehouse environment requires major computational resources to support large amounts of financial, personnel, asset, and environmental data." The thrust of this milestone is the procurement and installation of the tools and hardware to support the IW. It is the responsibility of the IW implementation team, working in conjunction with supporting IRM organizations, to define the requirements for the DBMS engine, query and reporting tools, repository, and storage devices.

Action Items

- 1) Procure IW hardware as identified in IW.P.2.
- 2) Define, procure, and install IW tool suite.

Dependencies

IW.P.2

Define the IW Model

IW.A.1

Establish IW Implementation Team

Benefits

A standardize/integrated tool suite (for example, query, IW management, repository, and data dictionary services) offers several advantages to the computing professional and end-user community. Fewer products to learn, interoperability between components of the technology, and reduced risk of data failures are several of the potential benefits associated with tools.

IW.I.5 Identify and Procure Archival Management Tools and Hardware

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommend Initiation Date

1Q/95

Status

Not started

Anticipated Duration

12 months

Resource Considerations

Manpower from ALD's PMMD and IRM organizations is required to support the procurement, installation, and testing of the IW software and hardware.

Discussion

As stated in the discussion of IW.P.6, archival management of an Information Warehouse is not well understood; therefore, the suite of tools necessary to support this warehouse has not been developed. However, as the requirements for archiving, retrieval, and repository management are identified, the IW software vendors will begin to develop products. It is anticipated that vendors will begin to develop products in the second half of 1994 or early in 1995.

Action Items

- 1) Procure archival storage hardware.
- 2) Procure archival management software.

Dependencies

None

Benefits

The archiving of non-active IW data with the ability to recall the data on demand has tremendous benefits to an IW. Some of the more obvious benefits are reduced online storage requirements or improved query response time due to smaller number of indexes and active data. However, archival management provides an additional benefit: long-term management of critical information. Features of this management would include tracking the location of the data with an ability to recall the data to active storage upon demand.

Information Warehouse Administrative Milestones

The following administrative milestones must be resolved to adopt the technology. Each is described in more detail in the following sections.

IW.A.1	Establish IW Implementation Team
IW.A.2	Establish Long-Term Support Organization
IW.A.3	Establish IW Policies and Procedures
IW.A.4	Replace Redundant Operational Reports, Screens, and Data Feeds

IW.A.1 Establish IW Implementation Team

Responsible Organization

IRM Management

Sponsoring Organization

IRM

Recommend Initiation Date

1Q/94

Status

IW implementation teams have been initiated as part of the WSRC Strategic Plan for Business Computing.

Anticipated Duration

Six months, or until succeeded by permanent IW support organization.

Resource Considerations

The core team should consist of three to four members with multiple skills. Some examples are data management, application development, database management, and business analysis. However, the team will require augmentation by several IRM and SRS organizations.

Discussion

Implementing an IW requires the knowledge, talents, and services of several organizations, knowledge users, and computer information specialists. Appointing a cross-sectional, multi-talented team to manage the implementation is necessary to the success of the IW implementation and the transition to an IW environment.

Action Items

- 1) Establish implementation team(s) and appoint team leader.
- 2) Select personnel.
- 3) Transfer selected personnel into group.
- 4) Conduct intensive IW training for group members.

Dependencies

None

Benefits

Each team is chartered and empowered to implement a production IW.

IW.A.2 Establish Long-term Support Organization

Responsible Organization

IRM Management

Sponsoring Organization

IRM

Recommend Initiation Date

3Q/94

Status

Not started

Anticipated Duration

Three months

Resource Considerations

A support organization consisting of two or more members would facilitate the transition to IW by providing long-term continuity, consistency in IW structure, and standardization of the process.

Discussion

Continuity and long-term management of an IW can best be served by a dedicated support organization whose charter is the day-to-day management of the warehouse. Ideally, the group would consist of persons skilled in data management, application development, database management, and business analysis. The group would provide the management oversight necessary to prevent the creation of isolated warehouses, coordinate warehouse development efforts, and manage the warehouse environment. This group is the successor to the IW implementation team.

Action Items

- 1) Select and transfer personnel to IW support group
- 2) Train organization members in IW concepts and principles (as required).

Dependencies

IW.A.1

Establish IW Implementation Team

Benefits

Establishing a formal support organization ensures the continuation of the work begun by the IW implementation team and provides the structure for successful transition to IW technology.

IW.A.3 Establish IW Policies and Procedures

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommend Initiation Date

2Q/94

Status

Not started

Anticipated Duration

Six months

Resource Considerations

Resources from several IRM organizations are required to support this milestone. Data resource has the lead responsibility for this milestone, augmented by the IW implementation team, application development methodology specialists, and application development organizations.

Discussion

Transition to an IW environment (as the standard management reporting vehicle) cannot be successful until technology is incorporated into the culture of the application development community.

Action Items

- 1) Establish policies and procedures for IW population, content, usage, data standards, and access.
- 2) Incorporate IW technology into IRM System Development Methodology Manual.

Dependencies

IW.A.1	Establish IW Implementation Team
IW.A.2	Establish Long-term Support Organization

Benefits

Incorporating IW into the IRM System Development Methodology Manual and establishing IW data policies and procedures will facilitate the transition to IW and help ensure the success of the warehouse.

IW.A.4 Replace Redundant Operational Reports, Screens, and Data Feeds

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommend Initiation Date

4Q/94

Status

Not started

Anticipated Duration

18 months

Resource Considerations

This milestone requires participation by IRM application development organizations with support from the IW support organization.

Discussion

A successful IW program has the potential to eliminate redundant data feeds, management reports, and online query screens. However, experience has proven that once a report or screen is created and ingrained into the culture, it simply never goes away. The intent of this milestone is to establish an on-going program to identify redundancies and schedule their replacement by the IW.

Action Items

- 1) Identify major data feeds, reports, and online transaction/query screens which can be supported via the warehouse.
- 2) Create migration strategy whose end goal is the elimination of redundant data feeds, reports, and online query screens.

Dependencies

IW.C.1	Establish Training for Application-development Community
IW.C.2	Establish Training for End-User Community
IW.A.2	Establish Long-term Support Organization
IW.P.2	Define the IW Model

Benefits

Eliminating redundant reports and online transaction/query screens has several benefits for IRM; for example, reduction of the number of screens or reports that must be maintained, and reduction of the resources which generate or otherwise support the redundancy.

Information Warehouse Cultural Milestones

The following cultural milestones must be resolved to adopt the technology. Each milestone is discussed in more detail in the following sections.

- IW.C.1 Establish Training for Application-Development Community
- IW.C.2 Establish Training for End-User Community

IW.C.1 Establish Training for Application-development Community

Responsible Organization

Training Integration

Sponsoring Organization

IRM/IW

Recommend Initiation Date

2Q/94

Status

Not started

Anticipated Duration

Nine months

Resource Considerations

Resources from several organizations (for example, Training Integration, ALD's PMMD, and IRM) are necessary to support this milestone. The core resources are the IW implementation team (IW.A.1), the IW support organization (IW.A.2), and Training Integration Department, augmented by industry experts.

Discussion

To successfully transition from our current environment to an IW environment will require a significant change in the site's approach to information reporting and appreciation of data utility (for example, that data is a resource to be shared with all who have a valid need). Training the application development community in the concepts of the IW technology is a necessary prerequisite for successful implementation of the technology. The training provides a foundation for SRS application developers to understand the role of data, the role of the end-user community in information reporting, and the concepts of data separation (management or decision support data from operational data). Training will enable application developers to build solutions that support the warehouse approach.

Action Items

- 1) Develop training plan and schedule with Training Integration (TI).
- 2) Develop training guide.
- 3) Train TI instructors.
- 4) Implement training program.
- 5) Review and modify plan and guide as necessary.

Dependencies

IW.A.1	Establish IW Implementation Team
IW.A.3	Establish IW Policies and Procedures
IW.I.3	Establish/Populate IW Component of Data Repository
IW.I.4	Identify and Procure IW Support Tools and Hardware

Benefits

The successful transition to an IW environment can be facilitated when the user community (application development and end user) understands the concepts, limitations, and potentials of the technology.

IW.C.2 Establish Training for End-User Community

Responsible Organization

Training Integration

Sponsoring Organization

IRM

Recommend Initiation Date

4Q/94

Status

Not started

Anticipated Duration

24 months

Resource Considerations

This milestone requires support from several organizations (for example, Training Integration, Procurement, and IRM) and touches many WSRC organizations. The core resources are the IW implementation team (IW.A.1), the IW support organization (IW.A.2) supplemented by Training Integration and industry experts.

Discussion

Transition to an IW environment places new demands on the SRS end-user community as the responsibility for management information reporting shifts from the application development community to the end-user community. Training is a necessary prerequisite for successful transition and end-user success with the Information Warehouse.

The areas in which the end-user community should receive training are the concepts of IW technology, techniques for accessing IW data, and use of the IW tool suite. Additionally, the training should review the policies and procedures governing usage of IW data.

Action Items

- 1) Develop training program with Training Integration.
- 2) Develop end-user training guide.
- 3) Identify and train instructors.
- 4) Initiate training program.
- 5) Review results and modify program as necessary.

Dependencies

IW.A.3	Establish IW Policies and Procedures
IW.I.3	Establish/Populate IW Component of Data Repository
IW.I.4	Identify and Procure IW Support Tools and Hardware

Benefits

The value of an IW is directly proportional to the ability of its users to competently and comfortably access the warehouse data. Through a continuing program of education, prospective users would become knowledgeable in the contents of the warehouse, ways to efficiently and effectively access its data, and the capabilities and use of in the IW tool suite.

Information Warehouse Process Milestones

The following work flow milestones must be resolved to adopt the technology. Each is described in detail in the following sections.

IW.P.1	Identify and Prioritize Business Requirements for Global and Local Warehouses
IW.P.2	Define the IW Model
IW.P.3	Implement the Global Warehouse
IW.P.4	Expand Global Warehouse
IW.P.5	Establish Local or Remote IWs
IW.P.6	Establish Archival IW

IW.P.1 Identify and Prioritize Business Requirements for Global and Local Warehouses

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommend Initiation Date

1Q/94

Status

In progress as part of WSRC Strategic Plan for Business Computing

Anticipated Duration

Six months

Resource Considerations

IW implementation team augmented by data management, application development, and end-user organizations.

Discussion

This milestone is critical to the success of the warehouse. Its main thrust is to identify the five or six key information drivers required by management for the effective, safe, and cost-efficient management of the Savannah River Site. These requirements become the source for selecting the data that will populate the global and local warehouses. Once identified, these requirements must be bounded (for example, by priority, feasibility, or other metrics established by the IW implementation team) to ensure a smooth and successful implementation. This may be an iterative process with successive levels of requirements. After the initial warehouse is established within the culture, the warehouse can be extended to include additional requirements.

The *WSRC Strategic Plan for Business Computing* identified four areas for IW support: personnel, financial, asset management, and purchasing. These are well established mainframe or core legacy applications with high-volume end-user access requirements. The financial and purchasing applications were identified in the business plan as candidates for replacement by commercial software.

Action Items

- 1) Identify top business informational requirements needs of SRS.
- 2) Identify existing data sources/usage satisfying these requirements.
- 3) Prioritize requirements.
- 4) Categorize requirements into global and/or department requirements.

Dependencies

IW.A.1 Establish IW Implementation Team

Benefits

Establishing a warehouse oriented towards the key information requirements of the site and populating it with well defined and accurate data easily accessible by the end-user community will establish the credibility of the technology and gain user confidence.

IW.P.2 Define the IW Model

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommend Initiation Date

2Q/94

Status

Initial efforts in support of WSRC Strategic Plan for Business Computing

Anticipated Duration

Nine months

Resource Considerations

The creation of the IW model involves several IRM specialties (for example, data and database management, application development, communications, and operations).

Discussion

The business requirements of IW.P.1 are the basis for creating the logical model of the warehouse. The logical model defines the schema for the global warehouse and preliminary schema for local warehouses. The purpose of the model is to establish the structure of the IW (for example, subject or functional areas), identify capacity requirements, and provide the basis for selecting the operating platform. The process of creating the model will identify a variety of issues. For example, data sources, data redundancies, and questions of ownership, sharability, and timing. All issues and questions should be resolved before moving to the next milestone, IW.P.3, Implementing the Global Warehouse. The selection of the platform is a critical issue for the warehouse. Capacity (storage, available MIPS), ease of access, and interoperability are important factors in selecting the platform. Levels of granularity are another (for example, high granularity, low granularity, zero granularity). The logical model should help resolve these questions.

Action Items

- 1) Create logical model of global IW.
- 2) Identify capacity requirements for global warehouse environment.
- 3) Select global IW platform.
- 4) Define structure or architecture for local warehouses.

Dependencies

IW.P.1	Identify and Prioritize Business Requirements for Global and Local Warehouses
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Benefits

Creating the IW logical model is the lynchpin milestone of the IW roadmap. Several of the milestones and implementation/design decisions are based on the model. For example, selection of the platform, DBMS engine, tools, storage requirements, and access method are dependent on the logical model.

IW.P.3 Implement the Global Warehouse

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommend Initiation Date

3Q/94

Status

Initial efforts in support of WSRC Strategic Plan for Business Computing

Anticipated Duration

24 months

Resource Considerations

Implementing the global warehouse involves the services of all IRM organizations:

- application development groups to develop or modify existing extract code
- data management to define data standards and resolve issues of data ownership, data sources, and data definitions
- network management and platform support

Discussion

Creating the processes for populating the global warehouse is the objective of this milestone. All other processes and supporting milestones lead to or support this effort. This milestone creates the processes for data extraction, data transformation, and warehouse population. The milestone presumes that the issues identified in IW.P.2 have been resolved, the repository has been populated with the metadata, the IW tool suite has been procured, and the policies and procedures are ready for implementation. Critical to implementing the global warehouse is milestone IW.I.4, the procurement of the hardware (for example, platform and adequate disk storage) and software (for example, repository, end-user access tools, and communications protocols).

Action Items

- 1) Populate IW repository with initial metadata.
- 2) Create extraction process.
- 3) Create transformation process.
- 4) Create load process.
- 5) Populate initial IW.

Dependencies

IW.A.3	Establish IW Policies and Procedures
IW.C.1	Establish Training for Application-development Community
IW.C.2	Establish Training for End-User Community

IW.I.1	Establish a Communications Network Capability Supporting the Global and Local Warehouses
IW.I.2	Establish Client SQL-Network
IW.I.4	Identify and Procure IW Support Tools and Hardware
IW.P.2	Define the IW Model

Benefits

Success of the warehouse concept is less dependent on the mechanics of populating the warehouse than on end-user ability to easily access and report on the information critical to their operations. The warehouse must be central to their reporting strategy. Having gained their confidence and the credentials of the warehouse having been established, only then will the benefits of the information warehouse become real and measurable.

IW.P.4 Expand Global Warehouse

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommend Initiation Date

2Q/96

Status

Not started

Anticipated Duration

24 months

Resource Considerations

The resources requirements for fully populating the global warehouse as modeled in IW.P.2 have several alternatives. First alternative is to continue the process via the original IW implementation team. Second alternative is to disband the team and transfer the responsibility to the IW support organization. A third alternative is to transfer the responsibility to the IRM application development groups with oversight by the IW support organization. Ultimately, the IRM organizations would assume responsibility for the global warehouse and underlying support processes.

Discussion

This milestone expands the global warehouse of IW.P.3 by fully populating the warehouse with the remaining business requirements identified in IW.P.1 and modeled in IW.P.2. However, the expansion should be incrementally phased to protect the warehouse and minimize end-user disruptions.

Action Items

- 1) Populate repository with meta-information for each iteration of data.
- 2) Expand processes created in IW.P.3.
- 3) Retune warehouse for end-user query.
- 4) Repeat items 1-3 as necessary to fully populate the warehouse with additional data.

Dependencies

IW.P.2

Define the IW Model

IW.P.3

Implement the Global Warehouse

Benefits

User satisfaction, faster and more accurate reporting, and reduction in maintenance backlog are some of the benefits that can be realized by a fully populated warehouse supported by a robust repository, data subscription service, and suite of data access and reporting tools.

IW.P.5 Establish Local or Remote IWs**Responsible Organization**

IRM

Sponsoring Organization

IRM

Recommend Initiation Date

1Q/95

Status

Not started

Anticipated Duration

18 months

Resource Considerations

Network services, data management and application development resources.

Discussion

Where the global warehouse services the information requirements of a majority of the SRS business organizations, organizations often have a requirement for subsets of the global data. Local warehouses support these requirements, which are often geared towards specific what-if analysis. Local warehouses contain a variety of data types (for example, summaries of global data, detailed subsets of specific data, or derived data where existing data is combined to form new data). A robust computing infrastructure and communications network is a must for local warehouses. Likewise, a well constructed data distribution architecture is required. Implementing local warehouses requires data distribution tools and software.

Action Items

- 1) Determine specific business requirements for local warehouses.
- 2) Establish server requirements (for example, frequency, location, and hardware).
- 3) Procure hardware and software.
- 3) Establish data distribution techniques (for example, subscription service, downloads).
- 4) Establish policies and procedures for data usage.
- 5) Populate initial summary/department warehouse.
- 6) Review results of initial warehouse and modify processes as necessary.

Dependencies

IW.I.1	Establish a Communications Network Capability Supporting the Global and Local Warehouses
IW.P.1	Identify and Prioritize Business Requirements for Global and Local Warehouses
IW.P.2	Define the IW Model
IW.P.3	Implement the Global Warehouse

Benefits

Local warehouses often support the specific information or analytical needs of individual business organizations or users. They provide the basis for analysis and what-if modeling, while reducing the adhoc demands on the global warehouse.

IW.P.6 Establish Archival IW

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommend Initiation Date

3Q/95

Status

Not started

Anticipated Duration

12 months

Resource Considerations

Implementing an archival warehouse involves the resources and skills of several IRM organizations: operations for network support, data transfers, storage and archival, and software installation; IRM's application development staff for requirement identification, and the IW support organization for oversight and implementation.

Discussion

The archival or offline storage of warehouse data is necessary to the efficient management of the global warehouse. However, this facet of information warehousing is the least understood or supported by the current software vendors. The actual transfer of aged data is purely a mechanical function. However, the interface with the IW repository, repopulation to the active warehouse based on user demand, and yet undefined requirements will require research by the IW team or support organization.

Action Items

- 1) Determine business requirements for archival warehouse.
- 2) Establish archival platform requirements (for example, frequency, location, and hardware).
- 3) Establish population/repopulation process.
- 4) Establish policies and procedures for data usage.
- 5) Populate initial archival warehouse.
- 6) Review results of initial warehouse and modify processes as necessary.

Dependencies

IW.P.1	Identify and Prioritize Business Requirements for Global and Local Warehouses
IW.P.2	Define the IW Model
IW.I.5	Identify and Procure Archival Management Tools and Hardware

Benefits

Archival warehouses usually contain data infrequently accessed or not required to support current business activities which cannot (for example, for legal reasons) be deleted. The archival warehouse often utilizes alternative forms of data storage such as tape or silos.

V. Client/Server Roadmap

Introduction and Destination

Client/server (C/S) is a term that defines the relationship of one computer to another based on their cooperation to execute a software application. There are many different configurations that are defined as client/server by the industry today, as shown in Figure 4 below, but we will use a more restrictive definition. An application is said to be a C/S application when one machine, usually on a desktop, performs some of the functions of an application and requests services of other machines to provide the remainder of the application function. In the typical example of a simple C/S application, the application runs entirely on the desktopPC with SQL calls to a relational database management system running on another machine somewhere on the network. In a more complex example, some of the business logic functions of the application are performed on the desktop or client, and some are performed on a server. In this instance, the communication between the two pieces would be at a lower level than SQL and would typically be done with remote procedure calls (RPCs).

Figure 4: Sample client/server configurations.

With the reduction in price of computer hardware and the advancement of application development tools and methodologies, it has become more cost-effective for business to develop applications which utilize the increasing computing power on the desktop to provide easy-to-use graphical applications. These graphical applications, with their radio button choices, push-button command interfaces, and their graphical presentation of information, allow end users to see clearly presented information derived from data instead of the raw data itself. A graphical application user can comprehend the application and the information being presented so that

informed decisions can be made with less application experience and in less time. Client/server applications provide the ability to validate and reorganize the data retrieved from a remote database without impacting the availability of the same data to other users at the same time and with a reduced impact on the network. The users are able to save various views of data directly to spreadsheets, word processors, and other office applications for the easy creation of graphs, charts, and reports which would be impossible to reproduce at the same cost and in the same amount of time from an old terminal-based system.

Ideally, the vast majority of applications will be developed or purchased with a client/server architecture. There would be only the occasional terminal or host-based application being constructed or maintained, but significant justification would need to be provided to management before the deviation from the norm would be allowed. Even these occasional exceptions would store their data in the site standard database so that distributed query and reporting are possible. These applications would be built by small teams made up of people with various backgrounds from both the information systems (IS) and the user/customer organizations.

The end result would be a business environment which provides full and open access to all the site data that any knowledge worker might need to perform his or her job duties. This access would be provided via a suite of application components which execute on the local workstation. This suite of components would be easily connected through drag and drop capabilities voice input, or other object-oriented technology to provide new sets of data as required by the knowledge worker.

Starting Point

The Savannah River Site has very little experience developing client/server applications. All of the core business systems currently being maintained by IRM's application development organizations are host-based systems that run mostly on IBM or DEC VAX mainframe computers. Although Information Resource Management has made some progress in laying the groundwork for developing client/server applications and has developed production client/server systems for use inside IRM, many issues must be resolved before IRM can begin providing core business systems in this type of environment.

For the past 10 years, ADABAS, a non-relational, inverted-list database management system, has been used as the primary tool for IRM business systems. In the last three years, several systems, including the core financial systems, have been developed and implemented using DB2, IBM's relational database. No production middleware products, either from Software AG, the ADABAS vendor, or from third-party vendors currently exist to provide remote data access to ADABAS tables. This practically eliminates the possibility of using ADABAS as a server in client/server development. Middleware does exist for accessing DB2 remotely, including connectivity products such as SQL*Connect from Oracle and database gateways from vendors such as MicroDecisionWare. DB2 also uses SQL, a standard query language supported by most relational DBMS products.

IRM has also built several Oracle applications, using both the Oracle database and Oracle tools in a mainframe terminal environment. The Oracle database has many middleware products, both from Oracle and third-parties, that allow remote data access. The Oracle database is also supported by all of the major vendors in the middleware and client/server development tool markets.

IRM has focused client/server development on the Oracle 7 database environment. A fourth generation language client/server, object-oriented, Windows-based development tool from was chosen by the IRM C/S team as the tool of choice for this type of development. A class library of reusable objects was developed by the team and used to develop the Request Management System (RMS). RMS is used internally in IRM to track and manage customer work requests and maintain information about systems currently in production or under development.

IRM has also evaluated several other client/server development environments. Recently, IRM performed an extensive evaluation of Forms 4.0, Oracle's entry into the graphical user interface, client/server environment. The evaluation team was unable to recommend Forms 4.0 as a strategic direction for department-wide client/server development due to user-interface problems, as well as the stability of the tool itself. IRM continues to pursue Forms 4.0 as an upgrade path for existing Oracle applications, and future releases of the software may resolve many of the interface and stability problems.

Today, there are many obstructions to the development of client/server applications. A vast collection of legacy applications are host-based. These applications consume a majority of application development resources for maintenance and enhancement functions. A large percentage of site data is stored in a mainframe database that is not relational and lacks remote connectivity, therefore limiting the flexibility and ease of access for reporting, query, and database expansion. Also, the current computer and network infrastructure is not sufficient to support a robust client/server operating and management environment. The *WSRC Strategic Plan for Business Computing* also outlines a strategy for the reduction of new system development in IRM in favor of an emphasis on purchased packages. Although the Strategic Plan calls for adherence to the computing architecture defined in the *Savannah River Site Computing Architecture*, which directs the move towards toward client/server applications and distributed database development, how purchased software will fit into this architecture is unclear. With a decrease in emphasis on new application development by IRM and the perceived need to

develop custom software in the same environment as purchased applications, the future of client/server application development in IRM faces many obstacles.

While a few obstacles to client/server application development fall into the category of technical deficiencies, especially the sitewide implementation of an enterprise Novell network, the majority are either administrative, cultural, or infrastructure related. Thus, IRM is justifiably concerned with making an important tactical decision regarding a client/server database and tool. At this point, client/server application development for IRM customers is suspended while new directions and the impact of the Strategic Plan are evaluated.

Client/Server Infrastructure Milestones

The following computing infrastructure milestones (networks, standardization, desktops. etc.) must be resolved to adopt the technology.

C/S.I.1	Install Robust Development Workstations
C/S.I.2	Implement Locally Distributed, Centrally Managed RDBMS Servers
C/S.I.3	Implement Single Network Transport Protocol for Client/Server Communication

C/S.I.1 Install Robust Development Workstations

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

1Q/94

Status

Started

Anticipated Duration

12 months

Resource Considerations

This milestone will require the procurement and configuration of fast CPU workstations in the Pentium class or higher with 17" or 21" monitors driven by fast, high-resolution graphics cards and 16MB or more of RAM for each application developer and designer.

Discussion

Client/Server application developers need high-powered workstations with large, high-resolution monitors and fast CPUs. The extra power is needed because of the multiple sessions running simultaneously under Windows. This part of their daily job function requires more processor speed, memory, video space, and hard disk space.

Action Items

- 1) Establish functional specifications for development workstations.
- 2) Determine number of application developers to be equipped.
- 3) Prepare acquisition plan for graphical developer's workstations.
- 4) Competitively procure workstations/place blanket order for workstations.

Dependencies

None

Benefits

By providing the developer with these high-end workstations, IRM can shorten the amount of time required to build and test application components. The developers will experience lower overall frustration levels because they don't need to wait for the computer to finish the next job, gain increased communication levels among team members, and are allowed greater freedom to explore more complicated application models.

C/S.I.2 Implement Locally Distributed, Centrally Managed RDBMS Servers

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

1Q/94

Status

Started as part of *WSRC Strategic Plan for Business Computing*

Anticipated Duration

24 months

Resource Considerations

This milestone will require the purchase and installation of a number of database server hardware and software platforms to be distributed to the various geographic locations onsite. Determining the number and size of the servers is a task included in the scope of this milestone and is part of IRM's implementation of the *WSRC Strategic Plan for Business Computing*.

Discussion

The local database servers are controlled by a single organization. The controlling organization has satellite groups dispersed geographically to provide timely support to each of the workgroup areas. Data that is utilized heavily by one specific organization in one location is stored on a local distributed database server. In addition to the location-specific data, all commonly accessed sitewide databases are replicated for reading only on the local database server for improved performance and reduced network traffic.

Action Items

- 1) Establish functional specifications for RDBMS servers.
- 2) Determine number of RDBMS servers to be purchased.
- 3) Prepare acquisition plan for RDBMS servers.
- 4) Competitively procure RDBMS servers/place blanket order for servers.
- 5) Create RDBMS management plan, including server system management.
- 6) Install RDBMS servers.

Dependencies

Networks.I.5 Install Ethernet/FDDI Network Trunks

Benefits

Provides for local workgroup data storage, centrally managed and backed up data, higher online availability of data, faster response time to data queries, lower mainframe overhead, robust site standard RDBMS for all important site data, and sitewide access to workgroup data.

C/S.I.3 **Implement Single Network Transport Protocol for Client/Server Communication**

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

3Q/94

Status

Not started

Anticipated Duration

Three months

Resource Considerations

This milestone will require only a small manpower commitment. There are no other resources required.

Discussion

Currently a number of protocols are used for various platforms. Many software packages require some communications protocol that is not universally supported nor strategic for SRS. A single site standard protocol (for example, TCP/IP) will be used for transport of all communications between client and server.

Action Items

- 1) Select protocol standard.
- 2) Establish procedure to enforce standard.

Dependencies

Netsys.I.8

Manage IP Addresses

Benefits

A single network protocol would allow more efficient management of network traffic at the client workstation. Additionally, this single standard helps to establish a single connection method to numerous site data repositories, servers, and host systems, thus reducing the system management load on all of these computers.

Client/Server Administrative Milestones

The following administrative milestones must be resolved to adopt the technology.

C/S.A.1	Develop Graphical User Interface Guidelines
C/S.A.2	Develop Naming Conventions
C/S.A.3	Enable Sitewide Data Access
C/S.A.4	Encourage Move Toward Client/Server Development
C/S.A.5	Migrate Selected Host-Based Legacy Systems to Client/Server

C/S.A.1 Develop Graphical User Interface Guidelines

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

2Q/94

Status

Started

Anticipated Duration

Six months

Resource Considerations

This milestone will require the time commitment of qualified individuals to study existing interface standards and choose or derive the best set of guidelines for the site.

Discussion

All graphical applications developed in-house will have the same general look and feel. Behavior will be consistent for graphical objects from one application to another. This cannot be accomplished without eliminating character-based application user interfaces, which can't be done until character-based terminals and under powered workstations have been replaced.

Action Items

- 1) Form team to establish guidelines.
- 2) Establish guidelines and publish team recommendations.
- 3) Implement policy of adherence to guidelines.

Dependencies

None

Benefits

End users will not be required to learn each application in depth and forget all former experience before they can be productive with a new application. Consistency reduces the required training time and expense significantly. The graphical nature of user interfaces increases the accuracy of work for transaction-processing applications.

C/S.A.2 Develop Naming Conventions

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

2Q/94

Status

Not started

Anticipated Duration

Six months

Resource Considerations

This milestone will require a part-time commitment of a number of individuals to study each language, database, and GUI environment to establish a naming convention compatible with other established conventions that is easily understood and adhered to.

Discussion

Naming conventions are established for the DBMS, the application development environment, and all other C/S application components. These conventions are formalized and available to developers and users alike.

Action Items

- 1) Form naming standards team from development organizations.
- 2) Define and publish standards.
- 3) Implement naming standards.

Dependencies

None

Benefits

Naming standards provide consistency among development groups so that developers can be easily reassigned from project to project with little lost productivity.

C/S.A.3 Enable Sitewide Data Access

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

4Q/94

Status

Not started

Anticipated Duration

12 months

Resource Considerations

This milestone cannot be accomplished without the commitment of a team of individuals trained in network security and authentication, middleware, and site data requirements.

Discussion

The major emphasis on this milestone is providing access to all site data repositories to which a user requires access with the single point of authentication to the network. This requires a major shift in the way application, system, and data security is handled. In order to keep the manpower required to control the access for each user at a manageable level, directory services and network authentication must be in place. This will allow a user to log in to the network once and have all systems, data, and applications to which he or she has access available without further logins or authentications.

Action Items

- 1) Establish a sitewide team to develop plan.
- 2) Identify existing methods of access control/authentication.
- 3) Establish policy and procedures for sharing of site data.
- 4) Produce and publish recommendations.
- 5) Establish procedure for sitewide data access from single login.

Dependencies

Networks.I.5

Install Ethernet/FDDI Network Trunks

Netsys.P.1

Implement Single User Login to Network

C/S.I.2

Implement Locally Distributed, Centrally Managed RDBMS Servers

Benefits

This simplifies the user interface to the C/S applications developed. Users will no longer have to remember multiple passwords and IDs to access their data. This milestone will simplify the management of accounts behind the scenes, making it much easier to create, update, and maintain user account information.

C/S.A.4 Encourage Move Toward Client/Server Development

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

1Q/94

Status

Started

Anticipated Duration

24 months

Resource Considerations

Other than the initial time commitment of the policy team, the resources required for this milestone are negligible.

Discussion

In addition to the built-in benefits of working with the latest tools, techniques, and hardware, client/server application developers will be assigned to work on new development of high-impact systems. Those who do not make the shift to the client/server paradigm will be assigned to perform maintenance on the steadily decreasing collection of legacy code.

Action Items

- 1) Form team to recommend policy changes.
- 2) Produce list of recommended policy changes.
- 3) Obtain management approval of policy recommendations.
- 4) Establish client/server training program.
- 5) Establish procedure incorporating policy recommendations.

Dependencies

C/S.A.3

Enable Sitewide Data Access

Benefits

With incentives provided to move toward client/server, and negative or neutral feedback for those who are not ready to change, IRM will be able to develop a highly skilled and motivated workforce. A skilled and motivated workforce will go a long way to make WSRC and the SRS a strong competitor for DOE business in the years ahead.

C/S.A.5 **Migrate Selected Host-Based Legacy Systems to Client/Server**

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

2Q/94

Status

Study of major host-based systems underway as part of *WSRC Strategic Plan for Business Computing*.

Anticipated Duration

48 months

Resource Considerations

This milestone will require a significant manpower commitment throughout its duration. Reducing the manpower commitment will greatly extend the elapsed time of these tasks, and may make attainment of this milestone impossible.

Discussion

All host-based systems must be analyzed to determine which can be re-engineered and moved to the C/S platform. Once this list is determined, then sunset dates need to be established each the host application. At that time, the host-based system will be taken offline. Until this is done, it will be difficult to find the time for analysts to be retrained in the new technology. The assumption is that once a sunset date is established on a host based system, then no more new development will be done on that system. This should provide enough free time to allow some of the analysts previously working on those systems to start their training process. Either applications will be rebuilt using client/server technology, or client/server applications will be purchased.

Action Items

- 1) Determine migration selection criteria.
- 2) Evaluate all existing systems against criteria.
- 3) Establish migration schedule.
- 4) For each application to be migrated, determine migration method.
- 5) For each application, create migration team and migrate application.
- 6) Re-evaluate selection criteria as needed.

Dependencies

C/S.A.1	Develop Graphical User Interface Guidelines
C/S.A.3	Enable Sitewide Data Access
C/S.P.1	Implement Standard Development Methodology and Tools Across Site

Benefits

As each application is migrated from the existing environment, the application's support personnel can be re-allocated to supporting and developing client/server applications. The enhanced ease of use of C/S applications will require less user support and training. Many of the mainframe-based systems can be eliminated, thereby freeing up CPU and DASD resources to be used by those remaining applications for which client/server migration is not a viable option.

Client/Server Culture Milestones

The following cultural milestones must be resolved to adopt the technology. Each milestone is discussed in more detail in the following sections.

C/S.C.1	Establish Small Development Team Methodology
C/S.C.2	Establish Policies Favoring Iterative Software Development

C/S.C.1 Establish Small Development Team Methodology

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

1Q/94

Status

Started

Anticipated Duration

24 months

Resource Considerations

This milestone requires no additional resources over the current method of doing business. It does, however, have the potential for increasing the amount of space allocated to an individual or team to a more reasonable and workable size.

Discussion

The arrangement of office space and meeting areas is designed around the small development team. The workspace consists of a common work space / meeting area with attached individual cubes or offices. This will increase team performance and productivity. Large projects will be broken down into several small sub-projects with communication interfaces established for integration of work and reduced duplication of effort.

Action Items

- 1) Pilot the small team concept to develop a medium-sized C/S application.
- 2) Publish recommendations from pilot.
- 3) Enlarge scale of pilot to encompass entire workgroup(s).
- 4) Arrange office space (cubicles) for optimizing small team projects.
- 5) Establish site guidelines for application developers' workspace.

Dependencies

None

Benefits

Small development teams are able to accomplish much higher quality work in a shorter period of time than large teams. Every effort made to reduce the complexity of communications between the group members will increase the performance of the group.

C/S.C.2 Establish Policies Favoring Iterative Software Development

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

2Q/94

Status

Not started

Anticipated Duration

24 months

Resource Considerations

This milestone will require no additional resources over our current levels.

Discussion

Since graphical client/server development is an iterative process, the process of building an application consists of repeated prototype refinements. The measurement of progress is based on the level of user satisfaction with the current iteration of the prototype. Object-oriented methodologies and programming techniques will allow increased scalability of an application project so that the first production release will be small, but each iteration will build on the core to expand to a large group of related components that are easily maintainable.

Action Items

- 1) Identify milestones in the iterative lifecycle.
- 2) Restructure project management and scheduling for iterative milestones.
- 3) Remove remnants of waterfall methodology thinking.

Dependencies

None

Benefits

Strict schedules and budgets will prevent long development cycles. Cost saving applications will be available earlier than was possible using the old methodology. Systems will more closely match the needs of end-user organizations.

Client/Server Process Milestones

The following work flow milestones must be resolved to adopt the technology.

C/S.P.1	Implement Standard Development Methodology and Tools Across Site
C/S.P.2	Integrate Software Tools, Development Methodology, Project, and Configuration Management Products

C/S.P.1 Implement Standard Development Methodology and Tools Across Site

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

1Q/94

Status

Started

Anticipated Duration

12 months

Resource Considerations

The software tools used in designing and constructing client/server applications are extremely powerful. To run this software, developers will need very fast workstations (Pentium or PowerPC class or faster) with at least 32 MB of RAM. CASE tool users will need at least 21" monitors and graphics cards capable of displaying very complex diagrams at resolutions of 1600 x 1200 or greater at high scan rates. These workstations will also require large local hard drives to act as temporary storage of the models to minimize network traffic as much as possible or high speed (FDDI or ATM) network access to high performance file servers. Developers who do not use CASE tools will require only the standard high-end developers workstation.

Discussion

With the establishment of a single set of tools and a development methodology, developers and integrators would be able to move from project to project with minimal to no additional training. There will also be no time required to adjust to a new way of working. The result will be a more flexible and efficient workforce.

Action Items

- 1) Identify organizations affected by standards to form standards team.
- 2) Identify methodology(ies) suitable for client/server development.
- 3) Identify tools suitable for automating methodology(ies).
- 4) Identify development language, libraries, etc.
- 5) Publish list of standard tools.
- 6) Establish procedures requiring adherence to the standards.

Dependencies

C/S.I.1

Install Robust Development Workstations

Benefits

Developers will not need to adapt to different methods and learn new tools when they are moved from project to project. Significant time and training money can be saved, and increased flexibility of the IRM organization can be realized.

C/S.P.2 Integrate Software Tools, Development Methodology, Project, and Configuration Management Products

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

1Q/94

Status

Started

Anticipated Duration

18 months

Resource Considerations

This milestone will require the purchase of software tools such as repository tools, CASE tools, and configuration management tools.

Discussion

The system development methodology that will be utilized by software developers is a commercially available package. It will have built in links to configuration management, object management, project management, and software development tools that ensure compliance. The SDM will be available online with built-in help facilities. The SDM will be flexible to allow for various categories of applications, so that different rules are applied to different levels of development. Low impact maintenance of objects will be very loosely controlled, while development of mission-critical applications will demand more rigorous requirements.

The level of automation of the software specification and development cycle will be extremely high. This will reduce the number of places where errors can be introduced early in the cycle and greatly increase software quality. Integrated into this same package suite will be some project management tools to assist the project leader in tracking project progress. The number of products composing the developers tool suite will be limited so that the developer will be able to achieve a higher degree of skill in each tool instead of a limited knowledge of many tools.

Action Items

- 1) Form a team to develop specifications for all parts of the environment.
- 2) Develop acquisition plan for the software to set up environment.
- 3) Implement software to establish environment.
- 4) Establish procedure for usage of environment.

Dependencies

C/S.P.1 Implement Standard Development Methodology and Tools Across Site

Benefits

This will allow small development teams to work efficiently yet still provide solid version control and project management to meet all DOE order requirements. This environment will

minimize the retraining required as a developer moves from one group to another group because of an online, automated developers' environment.

Client/Server Technology Milestones

The following technology evaluation and pilot project milestones must be resolved to adopt the technology.

C/S.T.1	Implement Standard RDBMS Accessibility
C/S.T.2	Implement Graphical Report Generators and Query Tools
C/S.T.3	Implement Nonrelational Database Access Through SQL Gateway
C/S.T.4	Implement Declarative Referential Integrity, Triggers, and Stored Procedures Supported by RDBMS
C/S.T.5	Implement Monitoring Tools
C/S.T.6	Implement Cross-platform Two-phase Commit Regardless of Vendor

C/S.T.1 Implement Standard RDBMS Accessibility

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

2Q/94

Status

In progress

Anticipated Duration

18 months

Resource Considerations

Manpower required to perform the conversion of data currently residing in ADABAS and other various flat file formats, and to replace or modify applications that work with the data in its non-relational format.

Discussion

All applications can be assured access to any required data through standard sitewide links between the standard database or gateways. No effort is expended writing extract routines to gather data from incompatible databases once the data is migrated to the standard RDBMS. Only extracts for the historical need of the site data warehouses will be done.

Action Items

- 1) Establish standard RDBMS connection standard specifications.
- 2) Compete standard for each platform tier.
- 3) Implement standard software on all platforms.

Dependencies

C/S.I.2

Implement Locally Distributed, Centrally Managed RDBMS Servers

Netsys.P.1

Implement Single User Login to Network

Benefits

When all site data is stored in a standard RDBMS, the cost of obtaining data as required for new applications will be greatly reduced. Most cost reductions will result from eliminating the need to write routines to extract data and convert it into a format that is acceptable to the particular application environment.

C/S.T.2 Implement Graphical Report Generators and Query Tools

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

3Q/94

Status

Not started

Anticipated Duration

Six months

Resource Considerations

Tools must allow developers and users to create shared reports, graphs, and queries. Tools must allow users to create their own ad hoc queries, reports, graphs, etc.

Discussion

Since user requirements are always changing to reflect changing business requirements, the set of reports, graphs, data extracts, etc. available to the application user must be infinite. Graphical and easy-to-use report, extract, view, and query tools must be provided to users so they can get the information they need to make business decisions on their own or use the growing set of user-defined queries in the common repository.

Action Items

- 1) Evaluate graphical reporting/query/extract tools, and write bid specifications.
- 2) Bid and purchase tools.
- 3) Pilot integration of tools in application.
- 4) Implement standard end-user tool set.

Dependencies

Netsys.I.1

Install Robust Client Workstations

C/S.A.1

Develop Graphical User Interface Guidelines

Benefits

The time that would normally be used to build applications to produce every report that could ever be desired from the application's data can be eliminated from the project schedule. With end user reporting tools, each user can quickly and easily build any custom report he/she wishes.

C/S.T.3 Implement Nonrelational Database Access Through SQL Gateway

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

2Q/94

Status

Not started

Anticipated Duration

Six months

Resource Considerations

A software product must be purchased to allow SQL access to all non-relational database systems in which site data resides. Hardware may also be required to operate this gateway software, depending on the product chosen.

Discussion

The data that remains in non-relational databases (that is, ADABAS) must be made available to clients. Access is accomplished transparently through an SQL gateway so that the non-relational nature of the database is hidden from the client.

Action Items

- 1) Establish bid specifications for SQL gateway to ADABAS.
- 2) Put out for bid based on specifications.
- 3) Implement gateway software.

Dependencies

None

Benefits

Although the ultimate goal is to have all site data available in relational format, the large quantity of data that currently resides in ADABAS can be used by client/server applications before the long and costly conversion to a relational format.

C/S.T.4 Implement Declarative Referential Integrity, Triggers, and Stored Procedures Supported by RDBMS

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

2Q/94

Status

Not started

Anticipated Duration

18 months

Resource Considerations

DBAs must be trained in the use of triggers and stored procedures to enforce business rules.

Discussion

It is the responsibility of the DBA to enforce the rules of the business at the database level. To accomplish this task, declarative referential integrity is available through the RDBMS. Triggers and stored procedures are available to code the more complex business rules. The developer need worry only about the manipulation of data for transaction processing, data entry, and data extraction for query and reporting.

Action Items

- 1) Upgrade all site databases to support RI, triggers, and stored procedures.
- 2) Define policy to maintain business rules at the RDBMS.
- 3) Define criteria for duplication of business rules within the application.

Dependencies

None

Benefits

With the wide availability of third party tools for manipulating data on an RDBMS, it will become increasingly difficult to enforce integrity constraints outside of the RDBMS. With the server maintaining integrity, all security loopholes will be closed. Addition of this code to the client application may be done for performance and network bandwidth reasons.

C/S.T.5 Implement Monitoring Tools

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

2Q/94

Status

Not started

Anticipated Duration

18 months

Resource Considerations

Hardware and software must perform the tasks of monitoring all of the pieces that make up the client/server application environment. This includes the RDBMS, database server platform, network, and client hardware and software processes.

Discussion

With the multitude of points where an application could be adversely affected, tools must be found to present in a graphical and intuitive fashion the current status and trends of all of the pieces of the client/server environment.

Action Items

- 1) Establish criteria for monitoring tools.
- 2) Procure monitoring tools or suites.
- 2) Implement tools.

Dependencies

Networks.I.5	Install Ethernet/FDDI Network Trunks
Netsys.I.1	Install Robust Client Workstations

Benefits

Graphical network, server, and client monitoring tools will enable support personnel to quickly pinpoint problems in the complex client/server environment. Without such tools, it would be impossible to support and maintain a sitewide client/server application.

C/S.T.6 **Implement Cross-platform Two-phase Commit Regardless of Vendor**

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

4Q/95

Status

Not started

Anticipated Duration

24 months

Resource Considerations

Additional network bandwidth may be required to support timely two-phase commit. No other resources will be required.

Discussion

This milestone indicates that distributed transactions will be supported between any databases in use onsite with two-phase commit. Two-phase commit will ensure data integrity even when the data to be updated resides on two different database servers in different site locations.

Action Items

- 1) Establish definition of two-phase commit.
- 2) Write bid specifications for upgrades to site standard RDBMSs to include this function.
- 3) Procure upgrades.
- 4) Implement upgrades.

Dependencies

C/S.T.1 Implement Standard RDBMS Accessibility

Benefits

Data integrity can be assured using two-phase commit. Decisions can be made based on data in different databases with assurance that the information is accurate.

VI. Multimedia Roadmap

Introduction and Destination

Multimedia is a collection of technologies that combines the formats of text, voice, video, audio, image, and animation for delivery to workstations, specialized platforms, or existing standard audiovisual equipment. While the individual functions incorporated in multimedia have been in the consumer domain for decades (television, VCR, telephone, cameras, tape recorders), their convergence at the computer desktop for interactive and simultaneous use has created the opportunity for a revolution in information access.

The major innovation in interactive multimedia will be the ability to access it in the same manner as existing data. When audio, video, image, and motion are treated as conventional data types, the access to this information can be as effortless as access to today's word processing files. Use of the workstation to effectively manage and assist users in linking the various information types on an ad hoc basis is the key to bringing multimedia into the mainstream of office and business computing.

Multimedia enables presentation and user retention of information in far greater detail and depth than through conventional means, and provides for greater flexibility. The addition of color, voice, music, and motion to information serves both to capture the attention of the recipient and to enhance the value of the information.

Multimedia's capabilities are not limited to the presentation of data but can allow user manipulation of the data, interactive multimedia. Interactive multimedia allows for nonlinear navigation through the information; that is, direct access to specific content, cross-references, and the ability to accelerate or slow down animations, zoom in on images, and combine voice annotation with otherwise static data.

Multimedia data exchange will extend beyond the sharing of applications in a desktop product environment. A navigable document format becomes the basic token or envelope for routing, presentation, markup, and archival of information. It will not necessarily transmit information in a single file but encompass a suite of data and product standards that enable seamless transfer and storage of the information in editable, searchable, and presentation formats without conversion by the user. The format will include index and search tools, as well as navigational tools such as hyperlinks and ties to the applications that created the embedded data.

The SRS multimedia workstation of 1995 will be fully digital; that is, all the audio, video, and other information will be stored digitally on local or remote disks, and will be delivered via an application to the workstation monitor and internal sound equipment. Information Resource Management (IRM) and other site organizations, particularly Training Integration and Technical Publications, are evaluating and piloting fully digital multimedia technology projects to determine multimedia's potential in the business and office environment.

Starting Point

The majority of the technology and infrastructure items described herein did not exist two years ago, and will likely be undergo significant changes over the next five years. Most current desktop platforms at the Savannah River Site are not multimedia-capable. While Macintosh systems have native sound playback capability, most are not equipped for sound capture. Audio capability for Windows users will likely require an additional board. High-speed networking is an essential component of networked multimedia so that the data-intensive audio and color image/motion files can be centrally stored and accessed on demand. Only 40% of the site workstations today are adequately networked (Ethernet-attached at 10 mbit/sec) for basic desktop multimedia (audio and color image). High performance multimedia (motion video to simultaneous users) will require 100 mbit/sec connectivity and backbones. Video playback software has recently become available in the marketplace for both Macintosh and Windows systems, but the ability to capture such files requires substantial upgrades to workstations.

The deployment of SRS-developed multimedia applications depends on coordinated improvements to three areas of the computing environment:

- Decisions to support uniformity in software and workstations
- Availability of authoring tools and multimedia capture stations (Figure 5)
- Upgrades to network, desktop workstations, and support infrastructure (Figure 6)

Figure 5: Multimedia capture workstation.

Figure 6: Multimedia playback workstation.

When multimedia applications begin to require access by a wider user base, an investment must also be made in infrastructure improvements. While nearly 40% of the site's desktop office workstations are currently networked, the original WISDOM design requirements written in 1990 (before multimedia was considered a reality) are not currently sized or configured for effective multimedia support. An immediate need will be the requirement for tens of gigabytes (1 GB = 1,000 MB) of disk storage on area and workgroup servers. It is unlikely that all of this storage will be provided through magnetic, online storage. Sitewide CD-ROM services and possibly rewritable optical disk will be established for access to pre-recorded titles as well as locally written applications. A determination will be made for the appropriate, use of CD-ROM versus optical disk, as well as which data types are more effective when accessed from local disk.

By late 1994, an evaluation and selection of standard data formats, desktop applications, and technologies should begin for all multimedia data types, with preliminary standards in place during 1995. Once the appropriate technology standards are identified, work will begin to identify compliant products that maximize adherence and the probability of cross-platform interoperability.

Multimedia Infrastructure Milestones

The following milestones infrastructure must be resolved to adopt the technology in an enterprise manner.

MMedia.I.1	Dévelop Multimedia Principles
MMedia.I.2	Adopt Cross-platform Fonts and Image Formats
MMedia.I.3	Establish Navigable Compound Document Format
MMedia.I.4	Enable Routine Capture and Playback of Cross-platform Audio
MMedia.I.5	Implement Storage, Multimedia Servers, CD-ROM, and Improved Monitors
MMedia.I.6	Enable Playback Motion Video at Desktop
MMedia.I.7	Implement Workgroup Video-capture Stations
MMedia.I.8	Implement Cross-platform Authoring Tools

MMedia.I.1 Develop Multimedia Principles

Responsible Organization

IRM, Training, MSD

Sponsoring Organization

IRM

Recommended Initiation Date

1Q/94

Status

Started

Anticipated Duration

Nine months

Resource Considerations

Team effort, consensus, and review by a consultant.

Discussion

Principles are developed to lay the foundation for a unified approach to the implementation of a new architectural component. Initial bounds on the applicability and business cases for multimedia will be determined here.

Action Items

- 1) Identify the participants in the principles development group.
- 2) Research successes in industry regarding multimedia.
- 3) Identify three-year objectives and scope.
- 4) Determine initial set of supported data types.
- 5) Write multimedia principles and route for review.
- 6) Gain endorsement of multimedia principles from stakeholders.
- 7) Determine impact of multimedia principles on site architecture.

Dependencies

MMedia.T.1

Pilot Multimedia Enablement of Desktop Products

Benefits

Since multimedia technology is rapidly evolving and is characterized by new products with short lives, some guidance for selection of technologies and products based on business needs is needed. The principles will limit the initial applications and product selections to those which offer significant benefit and adhere to site infrastructure guidelines.

MMedia.I.2 Adopt Cross-platform Fonts and Image Formats

Responsible Organization

IRM, MSD

Sponsoring Organization

IRM

Recommended Initiation Date

1Q/94

Status

Started

Anticipated Duration

18 months

Resource Considerations

Team consensus, DMS support considerations. Sitewide license of desktop software ~ \$50/user.

Discussion

Multimedia deployment cannot proceed until the basic ability to accurately interchange textual and image information exists. Currently, the lack of standardization in fonts prevents accurate interchange of word processing files, and even fonts with the same names from different manufacturers will cause a document to repaginate and/or have different line endings when exchanged with another user. It is anticipated that the bulk of existing paper documents will be scanned into image format for retrieval at the desktop. Infrastructure support including file format and applications software must be provided. This milestone also depends on the site Document Management System (DMS) expansion project.

Action Items

- 1) Select Adobe ATM or Microsoft True Type technology.
- 2) Identify core set of a dozen site standard typefaces.
- 3) Determine image file format and mechanisms for cross-platform use.
- 4) Procure associated products.
- 5) Propagate products to users.

Dependencies

MMedia.I.1	Develop Multimedia Principles
Office.I.2	Install Online Scanners
Office.I.7	Implement Viewers/Translators
Netsys.P.3	Implement Software License Management

Benefits

Text and image formats are the fundamental data types for any information exchange. The ability to exchange fully-formatted or image documents must exist as a basis for document routing, and electronic document management. While these data types are not typically considered to be multimedia, having this infrastructure in place before widespread deployment of multimedia will eliminate the need to consider these data type standards within the realm of multimedia data types, and limit multimedia integration issues to the newer data types.

MMedia.I.3 Establish Navigable Compound Document Format

Responsible Organization

IRM, MSD

Sponsoring Organization

IRM

Recommended Initiation Date

2Q/94

Status

Not started

Anticipated Duration

18 months

Resource Considerations

IRM analysis to identify key business requirements.

Discussion

A navigable document format becomes the basic token or envelope for routing, presentation, markup, and archival of information. Compound document architectures such as SGML lay the foundation for such capabilities but are not currently multimedia-capable. Hytime and HTML are emerging extensions for multimedia to the SGML standard.

Action Items

- 1) Begin participation on ANSI and DOE-wide steering committees.
- 2) Determine basic requirements.
- 3) Complete requirements based on pilots.
- 4) Procure associated products.
- 5) Propagate products to users.

Dependencies

MMedia.I.1	Develop Multimedia Principles
MMedia.I.2	Adopt Cross-platform Fonts and Image Formats
MMedia.T.1	Pilot Multimedia Enablement of Desktop Products
MMedia.T.2	Pilot Navigable Compound Documents

Benefits

A navigable document format becomes the basic token or envelope for routing, presentation, markup, and archival of information. It will not necessarily transmit information in a single file, but will encompass a suite of data and product standards that enable seamless transfer and storage of the information in editable, searchable, and presentation formats without conversion by the user.

MMedia.I.4 Enable Routine Capture and Playback of Cross-platform Audio

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

2Q/94

Status

Not started

Anticipated Duration

12 months

Resource Considerations

\$150 per workstation for sound cards for IBM (and clone) PCs. Inclusion of audio software in WISDOM standard.

Discussion

Audio capture and playback is the first multimedia data type planned for routine use. It is widely available in consumer PCs. The next set of workstations procured for the site should be specified to include audio capture and playback hardware. The use of audio at the desktop will begin the shift from the reliance on printed information to the use of multimedia data which may have no printable counterpart. Administrative and technical issues raised by audio deployment must be resolved before further routine use of multimedia can continue.

Action Items

- 1) Determine functional specifications for audio add-ons.
- 2) Complete competitive bid of site-standard audio add-ons.
- 3) Procure and install audio hardware and software.
- 4) Complete training for use of audio add-ons.

Dependencies

MMedia.I.5	Implement Storage, Multimedia Servers, CD-ROM, and Improved Monitors
MMedia.T.1	Pilot Multimedia Enablement of Desktop Products
Office.I.8	Integrate Voice-mail and E-mail Systems

Benefits

Audio, typically in the form of voice annotation, is the first common form of multimedia data in desktop office products. SRS should take advantage of this as the initial step into full multimedia workstation implementation.

MMedia.I.5 Implement Storage, Multimedia Servers, CD-ROM, and Improved Monitors

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

2Q/94

Status

Not started

Anticipated Duration

24 months

Resource Considerations

\$8 million for server and workstation improvements. Major modifications to WISDOM scope.

Discussion

Multimedia implementation will require standardization and support of infrastructure items including fonts, document standards, sound cards, better monitors, and additional server capabilities.

Action Items

- 1) Provide support to procurement of identified items.
- 2) Establish policy on backup of multimedia data.
- 3) Determine applicability of dedicated multimedia servers.
- 4) Improve monitors to 256 or more colors.
- 5) Acquire additional disk space, CD-ROM, and/or rewritable optical storage.

Dependencies

MMedia.I.1	Develop Multimedia Principles
Netsys.I.1	Implement Robust Client Workstations
Netsys.I.9	Implement Robust File/Print/Application Services
Netsys.C.3	Save Data to Network

Benefits

Having software and data available from the server (not from the workstation) will keep all workstations and applications in synchronization. Server-based capabilities must be improved to meet new workstation requirements. Monitors with better color resolution and memory will improve performance and enhance multimedia display.

MMedia.I.6 Enable Playback Motion Video at Desktop

Responsible Organization

IRM, Video Services

Sponsoring Organization

IRM

Recommended Initiation Date

1Q/95

Status

Not started

Anticipated Duration

12 months

Resource Considerations

Adequate network bandwidth to the desktop (10 mbit/sec). Monitor upgrades to support thousands of colors (\$250 per workstation; see Netsys Infrastructure).

Discussion

The ability to play back motion video at the desktop is the short-term goal of multimedia enablement. Video delivery will challenge both the network and the workstation capacities due to its demands for network bandwidth and computational resources in orders of magnitude beyond those required for text-based applications. Commercial databases and applications are becoming multimedia capable, and SRS should deploy this technology in selected areas such as training.

Action Items

- 1) Determine cross-platform video format.
- 2) Determine impact on LAN bandwidth and WISDOM servers.
- 3) Procure and install associated software.

Dependencies

MMedia.I.2	Adopt Cross-platform Fonts and Image Formats
MMedia.I.4	Enable Routine Capture and Playback of Cross-platform Audio
MMedia.I.5	Implement Storage, Multimedia Servers, CD-ROM, and Improved Monitors
Networks.I.5	Install Ethernet/FDDI Network Trunks
Netsys.I.1	Install Robust Client Workstations

Benefits

Motion video enablement is the foundation for additional applications. Its availability can enable other applications such as training and desktop videoconferencing.

MMedia.I.7 Implement Workgroup Video-capture Stations

Responsible Organization

IRM, Video Services

Sponsoring Organization

IRM

Recommended Initiation Date

3Q/95

Status

Not started

Anticipated Duration

Six months

Resource Considerations

\$1 million for sitewide hardware upgrades, or \$15,000 per commodity-center workstation.

Discussion

Due to the expected cost of capturing and editing video clips, it is expected that departmental stations will be provided for video capture, much the same way copiers are available to workgroups. Alternatively, video capture services could be provided through commodity centers where video professionals would help users match their needs to the appropriate technology or equipment.

Action Items

- 1) Determine preferred configuration for equipment.
- 2) Purchase equipment via blanket orders.
- 3) Create IRM support teams for video services.

Dependencies

Netsys.P.2

Implement Distributed Workgroup Management

Benefits

By standardizing and consolidating video capture functions, a savings will be realized in equipment costs and support.

MMedia.I.8 Implement Cross-platform Authoring Tools

Responsible Organization

IRM, MSD

Sponsoring Organization

IRM

Recommended Initiation Date

3Q/95

Status

Not started

Anticipated Duration

12 months

Resource Considerations

\$1 million for software licenses, \$200 per seat.

Likely to be deployed on department basis as opposed to every desktop.

Discussion

Authoring tools, which consolidate multimedia data into self-contained applications, will become easier to use and commonplace at the desktop. Inclusion of this capability as a standard is important. It does not replace the adhoc philosophy of access to multimedia on an as-needed basis by desktop users, but supplements that capability by making certain sets of multimedia data portable. The use of authoring tools provides packaging for associated files of multimedia data in applications such as training and presentations, ensuring the integrity of all the data and its links.

Action Items

- 1) Establish site standard.
- 2) Integrate existing assets into authoring toolsets.
- 3) Roll-in authoring tools to WISDOM.

Dependencies

MMedia.I.5 Implement Storage, Multimedia Servers, CD-ROM, and Improved Monitors

Netsys.P.3 Implement Software License Management

Benefits

By standardizing and consolidating authoring software, a savings will be realized in license costs and support. The use of authoring tools to easily package collections of multimedia to points on- and offsite will assure that there are no omissions from the data.

Multimedia Administrative Milestones

The following administrative milestones must be resolved to adopt the technology.

MMedia.A.1	Approve Use of Multimedia Data Types
MMedia.A.2	Formulate Policy for Authentication of Nonprintable Data Types
MMedia.A.3	Determine Business Case for Desktop Video Capture

MMedia.A.1 Approve Use of Multimedia Data Types

Responsible Organization

Computer Security, Site Legal

Sponsoring Organization

IRM

Recommended Initiation Date

2Q/94

Status

Not started

Anticipated Duration

12 months

Resource Considerations

Participation by Computer Security, Site Legal, and Management Practices, and review by independent consultants.

Discussion

Audio and video capture devices used in conjunction with multimedia development may cause concerns regarding protection of information, audit capability, labeling of information, and the connection of recording devices to computer and/or telephone equipment.

Action Items

- 1) Develop management policy on multimedia data.
- 2) Determine new requirements for access control and physical security.
- 3) Determine new requirements labeling of information.
- 4) Identify and make changes to Computer Security Principles.

Dependencies

MMedia.I.1	Develop Multimedia Principles
Netsys.A.2	Define Security Principles

Benefits

Early identification of the impact of multimedia data and capture devices on vulnerability and protection of data will ensure that widespread deployment of multimedia will proceed with approval from all affected oversight organizations, and will be designed to maximize access to information without threatening the security.

MMedia.A.2 Formulate Policy for Authentication of Nonprintable Data Types

Responsible Organization

MSD

Sponsoring Organization

MSD

Recommended Initiation Date

3Q/94

Status

Not started

Anticipated Duration

12 months

Resource Considerations

Review by independent consultants.

Discussion

The presence of audio and video data which have no printable archival format is likely to cause concern for records management procedures. Industry and national standards are lacking in this area. Since the recognized standards for paper archival have not been updated in over a decade despite the advent of image systems, that same delay is expected for the newer data types such as audio and video. By monitoring and adhering to emerging trends in industry, the site can establish operating guidelines for internal use that can likely be grandfathered upon the establishment of national standards.

Action Items

- 1) Research industry and NARA activities.
- 2) Draft site policy for authentication of non-printed data.
- 3) Gain Legal and DOE management approval of policy.

Dependencies

MMedia.I.2	Adopt Cross-platform Fonts and Image Formats
MMedia.A.1	Approve Use of Multimedia Data Types
Netsys.A.2	Define Security Principles

Benefits

Early identification of the impact of multimedia data on records management practices will ensure that widespread deployment of multimedia will proceed with approval from all affected oversight organizations.

MMedia.A.3 Determine Business Case for Desktop Video Capture

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

1Q/96

Status

Not started

Anticipated Duration

12 months

Resource Considerations

\$4 million (potentially).

Discussion

A decision whether or when to encourage routine use of desktop video capture will be made. It is costly but may become integrated into new-generation PCs. Alternative uses of the site telecommunications system may provide desktop video through telephony equipment or other means. While desktop video capture cannot be justified for all users in the early stages of multimedia deployment, eventual analysis will determine whether to continue this practice on a departmental or commodity center basis, or whether the emergence of new technologies makes ubiquitous deployment cost-beneficial.

Action Items

- 1) Determine compatible products and implementation costs.
- 2) Determine applications requiring desktop video and value.
- 3) Make business case for desktop video.

Dependencies

MMedia.T.5 Pilot Desktop Videoconferencing

Benefits

If desktop video can be deployed for under \$250 per workstation, and tie-in is made to commercial videoconference systems, the site can save millions in travel costs. Even for site-only videoconferencing, significant savings can be achieved in reduced travel time by employees across the site.

Multimedia Process Milestones

The following work flow milestones must be resolved to adopt the technology.

MMedia.P.1	Manage Stored Digital Video Clips
MMedia.P.2	Implement Routine Use of Multimedia Data in Office Documents

MMedia.P.1 Manage Stored Digital Video Clips

Responsible Organization

IRM, MSD, Video Services

Sponsoring Organization

IRM

Recommended Initiation Date

3Q/95

Status

Not started

Anticipated Duration

Six months

Resource Considerations

Stakeholders from affected organizations will contribute to this process analysis.

Discussion

Policies and procedures must be established for the treatment of video data in the same manner as numerical and text information. Data ownership and distribution mechanisms must be put in place. Migration issues regarding the information warehouse will be considered, as well as the establishment of backup, access security, and data reuse guidelines.

Action Items

- 1) Expand WISDOM servers and/or procure video servers.
- 2) Create or acquire video assets.
- 3) Determine appropriate uses of video clips in business environment.

Dependencies

MMedia.I.5	Implement Storage, Multimedia Servers, CD-ROM, and Improved Monitors
MMedia.I.6	Enable Playback Motion Video at Desktop
MMedia.I.7	Implement Workgroup Video-capture Stations
Netsys.C.3	Save Data to Network

Benefits

Routine use of video services will reduce the dependency on meetings, presentations, and one-on-one demonstrations. Multimedia data is expensive to acquire and requires massive disk storage, but is potentially invaluable when it can be found, delivered, and reused.

MMedia.P.2 Implement Routine Use of Multimedia Data in Office Documents

Responsible Organization

IRM, MSD

Sponsoring Organization

IRM

Recommended Initiation Date

1Q/95

Status

Not started

Anticipated Duration

24 months

Resource Considerations

Stakeholders from affected organizations will contribute to this process analysis.

Discussion

The end-user support groups and customers must use multimedia to gain its benefits. Training and operational procedures should be adapted to utilize the technology. Analysis should determine the high-payback areas for multimedia deployment and used to decide when widespread deployment of such applications is justified.

Action Items

- 1) Re-evaluate multimedia enablement of existing applications.
- 2) Include multimedia capabilities in applicable procurement specifications.

Dependencies

MMedia.I.1 Develop Multimedia Principles

MMedia.I.5 Implement Storage, Multimedia Servers, CD-ROM, and Improved Monitors

Networks.A.4 Obtain Computer Security Endorsement of Network-based Authentication

Benefits

Users can potentially spend up to \$1,000 to purchase multimedia software and hardware without valid business justification. The desire to deploy multimedia should not be driven by the desire of users to see it, but based on business justifications. By deploying multimedia where needed and when needed, spending can be minimized and procurements grouped to obtain volume discounts and site-compliant applications.

Multimedia Technology Milestones

The following technology evaluation and pilot project milestones must be resolved to adopt the technology.

MMedia.T.1	Pilot Multimedia Enablement of Desktop Products
MMedia.T.2	Pilot Navigable Compound Documents
MMedia.T.3	Pilot Speech and Handwriting Recognition
MMedia.T.4	Pilot Applicability of Object Databases to Multimedia
MMedia.T.5	Pilot Desktop Videoconferencing

MMedia.T.1 Pilot Multimedia Enablement of Desktop Products

Responsible Organization

IRM, MSD

Sponsoring Organization

IRM

Recommended Initiation Date

1Q/94

Status

Started

Anticipated Duration

Nine months

Resource Considerations

One-half FTE to monitor and pilot technologies and track industry trends. Cooperation and participation from MSD and Training Integration. \$30,000 in equipment and software.

Discussion

Since multimedia technology is rapidly evolving and is characterized by new products with short lives, some guidance is needed for selection of technologies and products based on business needs. Pilots will limit initial applications and product selections to those which have significant benefit and adhere to site infrastructure guidelines.

Action Items

- 1) Pilot voice, image, and video enablement at the desktop.
- 2) Determine a suite of cross-platform data types for initial deployment.

Dependencies

Office.I.2

Install Online Scanners

Benefits

Pilots in determining valid uses of multimedia within existing desktop products will assist the development of standards and identification of necessary infrastructure improvements.

MMedia.T.2 Pilot Navigable Compound Documents

Responsible Organization

IRM, MSD

Sponsoring Organization

IRM

Recommended Initiation Date

2Q/94

Status

Started

Anticipated Duration

Nine months

Resource Considerations

One-half FTE to monitor and pilot technologies and track industry trends. Cooperation and participation from MSD. \$10,000 in equipment and software.

Discussion

The site has little experience with compound documents architectures (CDA) and their ability to provide unified access to multiple data types within the document paradigm. A draft DOE order will require the use of SGML compound document formats for transmission of data to DOE document repositories by 1995. The site needs to determine the owner organization for compound documents and pilot the technologies in anticipation of DMS projects and compliance with DOE requirements.

Action Items

- 1) Identify CDA to pilot and data types to include.
- 2) Conduct pilot and make recommendations.
- 3) Demonstrate technology to affected organizations.
- 4) Participate on DOE SGML teams.

Dependencies

MMedia.I.1 Develop Multimedia Principles

MMedia.I.2 Adopt Cross-platform Fonts and Image Formats

Benefits

Experience gained in a pilot of compound documents will reveal the capabilities and limitations for dealing with data other than text within such a paradigm. It will identify infrastructure support issues and potential for object database applications, and educate the participants in the activities of standards bodies.

MMedia.T.3 Pilot Speech and Handwriting Recognition

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

2Q/95

Status

Not started

Anticipated Duration

Six months

Resource Considerations

One-quarter FTE; \$10,000 in equipment and software.

Discussion

Speech and handwriting recognition are highly publicized technologies that need exploration as to business applicability. The use of spoken commands could simplify user interfaces, and handwriting recognition could translate handwritten data, such as research notes, into computer-stored text data. Niche applications exist in security, authentication, and computing for the physically challenged.

Action Items

- 1) Conduct pilot for speech recognition.
- 2) Conduct pilot for handwriting recognition.
- 3) Determine whether business case exists for use of piloted technologies.

Dependencies

MMedia.I.2

Adopt Cross-platform Fonts and Image Formats

MMedia.I.4

Enable Routine Capture and Playback of Cross-platform Audio

Benefits

Recognition technologies can provide alternative methods for data entry or program commands improving end-user productivity.

MMedia.T.4 Pilot Applicability of Object Databases to Multimedia

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

3Q/95

Status

Not started

Anticipated Duration

12 months

Resource Considerations

Coordination of multimedia requirements into design of object strategies.

Discussion

Multimedia applications by nature will not be self-contained but will refer to varying types of data in multiple locations. Object technology could provide the tools for collection and management of multimedia assets.

Action Items

- 1) Create the object model for multimedia.
- 2) Pilot linkages between object database and desktop products.
- 3) Make recommendations regarding future use of object technology.

Dependencies

Object.C.2 Develop Site Expertise in Object-oriented Technology

Benefits

Multimedia data should be treated as mainstream data, not a special case. Its inclusion in the data and object business models is essential.

MMedia.T.5 Pilot Desktop Videoconferencing

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

1Q/95

Status

Not started

Anticipated Duration

Six months

Resource Considerations

\$6,000 in hardware and software.

Discussion

Desktop Videoconference is the first potential application to require a fully-integrated desktop multimedia workstation. The pilot will establish the technical viability for widespread implementation at SRS.

Action Items

- 1) Determine available and compatible products.
- 2) Examine integration issues into existing infrastructure.

Dependencies

Networks.I.13 Provide Access Between SRSnet and Offsite Locations

Benefits

If desktop video can be deployed for under \$250 per workstation and tie-in is made to commercial videoconference systems, the site can save millions in travel costs. Even for site-only videoconferencing, significant savings can be achieved in reduced travel time by employees across the site.

VII. Electronic Office Roadmap

Introduction and Destination

To define the destination for this roadmap the following typical workday scenario is used:

You arrive at your office in the morning and log in to the network. The first thing that you do is check your electronic organizer to see what your schedule is for the day. You see that your day is open with the exception of one meeting at 4:00 PM with Dave Smith. You do not remember what the meeting is about, so you select the meeting time in your electronic calendar. Your electronic notepad opens up, and you see the purpose of the meeting as well as a preliminary agenda and list of invitees which Dave distributed.

Next you request your electronic To Do list and see your list of action items for today. You notice that along with today's action items, there are three items on the list which have automatically been carried forward from yesterday because you did not complete them. You decide to get to work on your action items after you check your mail.

You select your Electronic Inbox and a window pops up, listing five e-mail messages and describing who they are from, what they are about, and approximately how long each is. The window also lists seven voice-mail messages and three incoming faxes with date, time, and sender's name and location. Some messages of each type (e-mail, voice-mail, and fax) have already been automatically deleted, stored, forwarded, or replied to based on your personal business rules and recognition of the subject matter, originator, and/or content.

As you are scanning the subject matter of your e-mail messages, you see that one is from Dave Smith and concerns this afternoon's meeting, so you decide to read it first. Dave tells you that something has come up and he needs to reschedule the meeting for next Monday at 4:00 PM. You accept this change, and your electronic calendar is automatically updated, removing this afternoon's meeting and scheduling you for Monday afternoon's meeting. Dave is automatically notified that you have accepted the meeting change.

You don't see any other e-mail messages that you need to deal with right now, so you decide to check your voice-mail messages. Each message can be replayed through your computer speaker, earphone, or telephone handset. Your screen then presents you with several options. You can delete a message, save it, forward it, or reply to it. You request to forward a message. The system asks you if you want to append a message to it. You answer yes, and your computer or earphone beeps, signaling that it is waiting for you to record your message. (Optionally, your telephone rings, and your message is recorded until you return the handset on-hook.) After finishing your recording, you are able to address it to several people. You select the send command, and off it goes. The message is distributed to recipients using e-mail, voice-mail, and fax, as appropriate, with text-to-speech and speech-to-text processing accomplished on the fly.

You return to your Electronic Inbox and review your list of incoming faxes. You select the first one, and it is displayed on your screen. After reading it, you discard it. The second fax has some information that you need to use in a report. You copy a section of the fax image into the online Optical Character Recognition (OCR) system, and receive a text interpretation in return. You move the text into your working files storage for later inclusion in your document.

The third fax is from one of your most important customers. He has included new sketches indicating a problem which you need to deal with as soon as possible. There are three other people that you need to meet with to discuss the problem. You request your Electronic Calendar

and tell it whom you need to meet with, for how long, what the subject of the meeting is, and where you want to meet. You also indicate that you need the department's video teleconferencing and projection equipment for the meeting. Then you request the scheduling service to find the earliest time that all four attendees, the audiovisual (AV) equipment, and the conference room are available. It finds a time at 9 AM tomorrow, automatically schedules the AV equipment and the conference room, and sends meeting notifications to the other attendees.

While you were working, a new message entered your Electronic Inbox. The subject of the message indicates that there is an electronic purchase requisition waiting for your approval. You select the new message, and an electronic form is displayed on the screen. You spend a few minutes reviewing the form, approve it electronically, and send it on its way. (Your electronic approval is binding, like any other signature. It is secure and traceable via the database transaction security and log, and a reference to your public-key cryptographic signer.) You don't know who the next person to review the form is but it doesn't matter, because the form knows where it is supposed to go next and has been correctly forwarded.

You are now ready to return to your ToDo list. The item that you choose to work on first is a report that you are writing. There are several documents which you need to reference in writing this report. You request the document retrieval service, and it provides you a menu to use for entering selection criteria. The Document Management System (DMS) uses this information to retrieve the document from the archive area. The document was stored in the DMS with embedded images. You want to include some of the diagrams in your report, so you drag and drop copies of the images into your document. You also copy text, tables, and a reference to the source document into your report before closing your work.

The next item on your To Do list is to read and comment on a report written by one of your coworkers. You check out the document from the In-Process area of the DMS and read it over. You make several suggestions by electronic markup and tagged comments. Your coworker will recognize your comments (along with those of other reviewers), and will know in what order the comments were made. When you are finished, you return possession of the document to the DMS.

Another item on your To Do list is to finish a section of a technology white paper which you are co-authoring with three other people. You retrieve the document and look over the progress that the others have made. You notice that one of the other authors is busy working on his section of the paper, but that does not matter because neither of you has write access to the other's section. You can, however, post annotations to each other's sections, even as the other writer is making updates. You notice that others have made a few comments about your previous entries, and you try to incorporate their suggestions as you continue to write. Your creative juices run dry before you finish, so you save it to come back to later.

The final item in your To Do list for the day is an item which was placed there by the work-flow management system. Your department is busy working on next year's budget requirements. Input has been received from other members of the group on training requirements for next year. You are to take that input, summarize it, and come up with the departmental training requirements. This is the last section of the budget to be done before your manager has to review and approve. Once you are finished, your manager is notified that he has an action item on the budget process.

To make the preceding scenario a reality, software and hardware for the following electronic office technologies must be available.

- Client/server electronic mail
- Electronic organizer
- Document Management System

- Shared authoring
- Electronic forms routing and approval
- FAX gateway
- Electronic work flow management
- Voice-mail/e-mail integration

It should be noted that all of the items listed above are existing technologies and are available today from a variety of vendors. The goal is not to develop new technologies, but rather to implement and integrate existing technologies into a cohesive, highly productive electronic office.

Starting Point

The core of the electronic office will be the future client/server messaging system. This system will be founded on an infrastructure of personal computers, servers, high-speed networks, distributed management and security systems, and global directory services. The state of this infrastructure is the subject of the Networked Systems roadmap.

Currently, the site electronic mail system is the host-based, multi-user ALL-IN-1 system which serves over 1,4000 users. The majority of the electronic office scenario will require a conversion over time from the existing system to a client/server system. A handful of departments onsite have already implemented group client/server mail systems; however, their connectivity to the site system is questionable at best. A team is currently working on defining a site standard for client/server mail.

A team is also now working on defining requirements for the voice-mail/e-mail integration. This project is being given additional emphasis as we look toward implementation of a sitewide voice mail system with the Replacement Telephone System which is currently being installed.

Various other limited pilots are being pursued to examine some of the technologies required for the electronic office.

- Networks
- Network Systems
- Object-oriented Computing
- Client/Server Computing
- Information Warehouse
- Multimedia Computing

Electronic Office Infrastructure Milestones

The following infrastructure milestones must be resolved to adopt the technology.

Office.I.1	Implement FAX Input/Output
Office.I.2	Install Online Scanners
Office.I.3	Install Ubiquitous OCR
Office.I.4	Install Client/Server E-mail
Office.I.5	Implement Mail-enabled Applications
Office.I.6	Implement Electronic Forms Routing and Authorization
Office.I.7	Implement Viewers/Translators
Office.I.8	Integrate Voice-mail and E-mail Systems

Office.I.1 Implement FAX Input/Output

Responsible Organization

IRM

Sponsoring Organization

IRM

Initiation Date

1Q/94

Status

Project in pilot

Anticipated Duration

24 months

Resource Considerations

Funding will be required for the purchase of the network fax equipment, as well as hardware and software required to route inbound faxes.

Discussion

FAX services must be provided on the network. These services must include inbound routing to each user's individual electronic inbox, as well as outbound print-to-FAX and mail-to-FAX. Users must be able to scan paper documents into their electronic desktops and send them out over network faxes. They must also be able to easily OCR any incoming fax for inclusion into revisable electronic documents.

Action Items

- 1) Purchase and deploy network FAX equipment for outbound faxes.
- 2) Establish routing to inbound FAX recipients.
- 3) Enter initial list of out-bound FAX recipients in global directory.

Dependencies

Office.I.2	Install Online Scanners
Office.I.3	Install Ubiquitous OCR
Office.I.7	Implement Viewers/Translators
Office.A.1	Implement Security Policy and Procedures

Benefits

Many SRS employees depend on fax technology for external communications. Network fax input/output will allow those employees to process their fax communications in the same manner in which they process all other communications—from within their electronic desktop.

Office.I.2. Install Online Scanners

Responsible Organization

IRM

Sponsoring Organization

IRM

Initiation Date

1Q/94

Status

Project in pilot

Anticipated Duration

24 months

Resource Considerations

Funding will be required to purchase scanner hardware and software.

Discussion

Because paper-based information will no longer be handled, scanners must be available (via user access or centralized service) to enter paper-based data into the electronic system. Personal/group scanners should be easily accessible for small, frequent scans, and larger scanners, should be available for batch scanning larger jobs. Easily accessible scanners are also needed to facilitate desktop fax input/output.

Action Items

- 1) Evaluate requirements for personal, group, and central scanners.
- 2) Purchase and deploy scanners.
- 3) Set policy on use of scanners.

Dependencies

Netsys.I.11 Connect Office Peripherals Directly to Network

Benefits

With online scanners readily available users will be able to easily enter paper-based data into their electronic desktop. Once this data is entered electronically, it can then be stored, included in electronic documents, modified, mailed, or faxed.

Office.I.3 Install Ubiquitous OCR

Responsible Organization

IRM

Sponsoring Organization

IRM

Initiation Date

1Q/94

Status

Project in pilot

Anticipated Duration

24 months

Resource Considerations

Six man-months.

Funding will be required to purchase OCR software.

Discussion

Because paper-based information will no longer be handled, optical character recognition (OCR) services must be available for batch and on-request conversion of scanned and faxed bit-mapped images into text for editing and further routing via non-graphic transports (for example, voice-mail.) OCR software should be available on individual workstations for on-request conversions, as well as on batch scanner/OCR stations for batch processing of larger jobs.

Action Items

- 1) Purchase and deploy OCR software.
- 2) Train users in use of OCR system.
- 3) Integrate OCR into automatic and manual transmission and translation processes.

Dependencies

Office.I.2

Install Online Scanners

Benefits

OCR software will work in conjunction with online scanners to provide users the capability to include paper-based or faxed data on their electronic desktops.

Office.I.4. Install Client/Server E-mail

Responsible Organization

IRM

Sponsoring Organization

IRM

Initiation Date

1Q/94

Status

Project in pilot and part of *WSRC Strategic Plan for Business Computing*

Anticipated Duration

36 months

Resource Considerations

Nine man-years.

Funding will be required to purchase client/server e-mail client software, as well as server hardware and software.

Discussion

To enable an electronic (paperless) office, true client/server (C/S) e-mail with specific mail-enabled applications must be provided on the SRS network system. C/S e-mail must provide rules which are processed on the server for automatic message translation, forwarding, and reply. The mail system will be the backbone of the electronic desktop. All communications, including e-mail, fax, voice-mail, and eventually video-mail messages, should be received through the electronic inbox. The C/S e-mail system must interface with mail-enabled applications such as group scheduling, voice-mail integration, electronic routing and approval, word-processing, spreadsheets, etc.

Action Items

- 1) Select a site-standard C/S e-mail.
- 2) Design C/S mail infrastructure.
- 3) Formulate installation and migration plans.
- 4) Purchase and install the C/S mail system software.
- 5) Train users on use of C/S mail.
- 6) Migrate accounts from ALL-IN-1 to C/S e-mail.

Dependencies

Netsys.I.3	Ensure Broad Availability of Networked Workstations
Netsys.I.4	Migrate to New NOS
Netsys.I.5	Initiate NOS Global Directory
Netsys.I.7	Complete Installation of Territorial File Servers
Netsys.I.11	Connect Office Peripherals Directly to Network
Office.I.1	Implement FAX Input/Output

Office.I.7 Implement Viewers/Translators
Office.A.1 Implement Security Policy and Procedures

Benefits

Electronic mail usage at SRS is already pervasive, with approximately 15,000 current subscribers. In addition to traditional text-based electronic mail, which is becoming increasingly important as a communications mechanism, the client/server e-mail system will provide users with a single electronic inbox for all electronic communications. Also, applications are now relying on electronic mail as a mechanism for notification and information distribution as they become mail-enabled. In addition to providing the infrastructure for electronic communications and mail-enabled applications, the client/server e-mail products provide enhanced mail processing capabilities. These capabilities include automatic rules-based filtering of messages, improved user interfaces through GUI clients, and multimedia support.

Office.I.5 Implement Mail-enabled Applications

Responsible Organization

IRM

Sponsoring Organization

IRM

Initiation Date

4Q/94

Status

In pilot

Anticipated Duration

30 months

Resource Considerations

One man-year.

Discussion

One of the major benefits of the client/server mail system is its use as a notification and distribution mechanism for various applications. To take full advantage of the C/S mail system, applications must be able to transparently use it for distributions. Examples include ability to send a word-processing document, spreadsheet, electronic form, or electronic meeting request without ever leaving the applications in which they are created.

Action Items

- 1) Determine which existing applications need to be mail-enabled.
- 2) Determine which mail-enabled applications to implement.
- 3) Purchase and deploy mail-enabled applications.
- 4) Train users in use of functionality.

Dependencies

Office.I.4

Install Client/Server E-mail

Office.A.1

Implement Security Policy and Procedures

Benefits

Implementation of mail-enabled applications will simplify many tasks which are now cumbersome and time consuming.

Office.I.6 Implement Electronic Forms Routing and Authorization

Responsible Organization

IRM

Sponsoring Organization

IRM

Initiation Date

3Q/94

Status

Not yet started

Anticipated Duration

30 months

Resource Considerations

Six man-months.

Funding will be required to purchase routing and authorization software.

Discussion

An electronic forms routing and authorization system is needed to simplify and speed up the processing of existing paper forms. This system should be integrated with the site client/server e-mail system so that forms needing to be processed can be accessed directly from a user's electronic inbox.

Action Items

- 1) Formulate electronic forms routing and authorization system infrastructure design.
- 2) Implement forms routing pilot.
- 3) Purchase and deploy electronic forms routing and authorization system.
- 3) Train users in use of new system.

Dependencies

Office.I.4	Install Client/Server E-mail
Office.A.1	Implement Security Policy and Procedures
Office.A.3	Migrate Forms
Office.A.5	Recognize Electronic Signatures as Binding

Benefits

The use of electronic forms, as well as the electronic routing and authorization of those forms, will simplify and speed up the processing and approval of existing paper forms. In addition, data fields from electronic forms can be captured and stored for use in other applications and reports. For example, the amount due an employee on a travel expense report could be captured after all electronic approvals are complete. A check could then be automatically cut and sent to the employee.

Office.I.7 Implement Viewers/Translators

Responsible Organization

IRM

Sponsoring Organization

IRM

Initiation Date

3Q/94

Status

Stand-alone translators under evaluation

Anticipated Duration

18 months

Resource Considerations

Six man-months. Funding will be required to acquire viewer/translator software.

Discussion

A variety of data formats will continue to play a part in the electronic office. Data formats will be translated into a form usable by the workstation. The translation should be transparent to the user. The following list serves as an example of the desired translators and viewers:

- Standard archiving format for multiple data forms (for example, PDF)
- Standard text viewer (for example, SGML)
- Standard table viewer
- Standard graphic viewer
- Standard full-motion and sound video viewer (for example, Quicktime)
- Standard sound player
- Word processing translators
- Spreadsheet translators
- Database translators
- Graphic translators (including presentation package reformators)
- Sound translators
- Video translators
- Compression translators

Action Items

- 1) Ensure required translators are available.
- 2) Ensure required viewers are available.
- 3) Acquire/implement a translation server or automatic service.

Dependencies

Netsys.I.1 Install Robust Client Workstations

Benefits

With consistent data viewers and translators in place, users will be able to view any type of data which may be sent to them.

Office.I.8 Integrate Voice-mail and E-mail Systems

Responsible Organization

IRM

Sponsoring Organization

IRM

Initiation Date

1Q/94

Status

Working group started

Anticipated Duration

36 months

Resource Considerations

36 man-months. Funding will be required to purchase voice/electronic mail gateway.

Discussion

The electronic office will also be what has been referred to as a spartan office; that is, only one communication device is required in the office. That communication device will be capable of placing and supporting voice-communication (telephone) calls, and will eventually handle desktop videoconferencing, as required. With this technology in place, integration of message methods, voice-mail and e-mail, will be accomplished. The integration will occur in several phases:

Action Items

- 1) Establish notification of voice-mail messages in e-mail.
- 2) Achieve management (delete, listen to via phone, file, forward, reply) of voice-mail messages via e-mail interface.
- 3) Integrate call management functions (dial, hold, conference, forward) into computer.
- 4) Integrate phone audio functions (speak, listen, voice-message) into computer.
- 5) Integrate e-mail and voice-mail backend into single messaging database.
- 6) Integrate e-mail and voice-mail directories, and include x.500, Internet, and phone-service provider directory lookups.

Dependencies

Networks.I.1	Install the Replacement Telephone System
MMedia.I.5	Implement Storage, Multimedia Servers, CD-ROM, and Improved Monitors
MMedia.I.4	Enable Routine Capture and Playback of Cross-platform Audio
MMedia.A.1	Approve Use of Multimedia Data Types
Office.I.4	Install Client/Server E-mail
Office.I.5	Implement Mail-enabled Applications
Office.A.1	Implement Security Policy and Procedures

Benefits

Once the voice-mail and e-mail systems are integrated, all communications will be handled through a single device. Productivity will be improved as users will be able to quickly scan and process all types of communication in a consistent format.

Electronic Office Administrative Milestones

The following administrative milestones must be resolved to adopt the technology. Each is described in more detail in the following sections.

Office.A.1	Implement Security Policy and Procedures
Office.A.2	Scan in Historical and Reference Data
Office.A.3	Migrate Forms
Office.A.4	Implement Online Librarian and Document Repository
Office.A.5	Recognize Electronic Signatures as Binding
Office.A.6	Implement the Paperless Office

Office.A.1 Implement Security Policy and Procedures

Responsible Organization

Computer Security

Sponsoring Organization

IRM

Initiation Date

3Q/94

Status

Not started

Anticipated Duration

12 Months

Resource Considerations

One man-year.

Discussion

New security policies, procedures, and supporting technologies must be developed to accommodate information workers without paper. Policies must be established to accommodate the trend to portable computing by allowing remote access and defining requirements for data on portable machines. Also necessary will be policies allowing for electronic distribution of data and electronic authorization and signatures.

Action Items

- 1) Establish policy and procedures to allow remote access.
- 2) Establish policy and procedure for portable data.
- 3) Establish policy and procedure for data interchange and distribution.

Dependencies

None

Benefits

These new policies will allow implementation of the electronic office from the security point of view. The users will be more productive because they will be able to use their portable equipment while away from the office. Also, the current flood of paper forms will be reduced by migrating to electronic forms and authorizations.

Office.A.2 Scan in Historical and Reference Data

Responsible Organization

MSD

Sponsoring Organization

IRM

Initiation Date

1Q/95

Status

Current predecessor started

Anticipated Duration

36 months

Resource Considerations

Nine man-years.

Discussion

Some historical and reference data exists only in paper form at present, but must continue to be readily available and referenced by information workers in the electronic office. That data must be identified and scanned into electronic format. Indexing and/or OCR should be accomplished for each document.

This should be coordinated with ongoing site DMS scanning efforts.

Action Items

- 1) Identify data for scanning.
- 2) Batch scan and OCR documents.
- 3) Index documents and place in data repository.

Dependencies

Office.I.2	Install Online Scanners
Office.I.3	Install Ubiquitous OCR
Office.I.7	Implement Viewers/Translators
Office.A.4	Implement Online Librarian and Document Repository
Office.P.1	Implement Document Management System

Benefits

Information workers will have easy access historical and reference data, saving time and money when searching for needed data.

Office.A.3 Migrate Forms

Responsible Organization

MSD

Sponsoring Organization

MSD

Initiation Date

1Q/94

Status

Ongoing

Anticipated Duration

24 months

Resource Considerations

Nine man-years.

Discussion

SRS must disband the use of single- and multi-part paper forms in favor of electronic forms with mail-enabled electronic routing and approval. Once an electronic forms routing and approval system is in place, existing paper forms must be migrated to electronic format.

Action Items

- 1) Determine what existing forms to carry forward into the electronic office.
- 2) Determine which forms require visual replication on screen, and which forms need to be reformatted so as to be better suited for electronic presentation.
- 3) Rebuild the forms and the backend data structures.
- 4) Build and initiate (electronically) business rules for forms processing.
- 5) Deploy forms and train users.

Dependencies

Office.I.4	Install Client/Server E-mail
Office.I.5	Implement Mail-enabled Applications
Office.A.5	Recognize Electronic Signatures as Binding

Benefits

The use of electronic forms, as well as the electronic routing and approval of those forms, will simplify and speed up the processing and approval of existing paper forms.

Office.A.4 Implement Online Librarian and Document Repository

Responsible Organization

IRM

Sponsoring Organization

IRM

Initiation Date

1Q/95

Status

Ongoing

Anticipated Duration

24 months

Resource Considerations

Two man-years.

Discussion

Not only must the electronic office have online access to historical and other references as well as current operational data, but a document management function, in the form of online library administration, must also be provided. Processes of this librarian include user submission and indexing, administrator acceptance and cataloging, user research, and administrative archiving to cheaper, long-term storage.

This is to be coordinated with ongoing site DMS effort.

Action Items

- 1) Configure online document repository.
- 2) Establish policies for online document repository.
- 3) Identify and train supportive online document repository administrative resources.
- 4) Train users on submission and access for research and reference in online document repository.

Dependencies

Office.A.2	Scan in Historical and Reference Data
Office.I.7	Implement Viewers/Translators

Benefits

Easier access to, along with better organization and control of electronic documents.

Office.A.5 Recognize Electronic Signatures as Binding

Responsible Organization

Site Legal

Sponsoring Organization

IRM

Initiation Date

1Q/95

Status

Not started

Anticipated Duration

12 months

Resource Considerations

Three man-months.

Discussion

The secure electronic signature must be formally recognized as an ethically and contractually binding authorization. Electronic forms routing and authorization, a major component of the electronic office, cannot be implemented without this.

Action Items

- 1) Formalize policy on electronic signatures.
- 2) Coordinate electronic signature policy with all internal and external customers and suppliers.
- 3) Select technology for electronic signatures.
- 4) Deploy, integrate, and utilize electronic signature technology.

Dependencies

None

Benefits

Electronic forms may be routed and approved without ever having to go to paper form. This will greatly reduce the time and effort required for forms to be processed.

Office.A.6 Implement the Paperless Office

Responsible Organization

IRM

Sponsoring Organization

IRM

Initiation Date

1Q/96

Status

Not started

Anticipated Duration

12 months

Resource Considerations

One man-year.

Discussion

To fully implement the electronic office and effectively migrate to it, the use and distribution of paper must be analyzed and reduced for electronic office locations. While users will ideally recognize the benefits of the electronic office and voluntarily move toward it, it is expected that the electronic office will be fully implemented only after management policies requiring it are put in place.

Action Items

- 1) Develop policy on use of electronic documents and forms.
- 2) Establish procedures for reducing dependency on paper forms and documents.
- 3) Implement electronic document and forms policy.

Dependencies

Office.I.1	Implement FAX Input/Output
Office.I.2	Install Online Scanners
Office.I.3	Install Ubiquitous OCR
Office.I.4	Install Client/Server E-mail
Office.I.5	Implement Mail-enabled Applications
Office.I.6	Implement Electronic Forms Routing and Authorization
Office.I.7	Implement Viewers/Translators
Office.I.8	Integrate Voice-mail and E-mail Systems
Office.A.2	Scan in Historical and Reference Data
Office.P.1	Implement Document Management System
Office.P.2	Implement Electronic Data Interchange

Benefits

The implementation of the paperless office will result in conservation of paper supplies, more efficient work by office workers, easier access to electronic resources, and traceability of work and data.

Electronic Office Process Milestones

The following work flow milestones must be resolved to adopt the technology. Each is described in detail in the following sections.

Office.P.1	Implement Document Management System
Office.P.2	Implement Electronic Data Interchange

Office.P.1 Implement Document Management System

Responsible Organization

IRM

Sponsoring Organization

MSD

Initiation Date

1Q/94

Status

Ongoing program to establish DMS

Anticipated Duration

24 months

Resource Considerations

Funding will be required to acquire the Document Management System hardware and software.

Discussion

The electronic office will depend heavily on a fully capable and integrated document management system. The system will provide for group authoring with multiple access, section check-out and -in, security and access control, indexing, index and full-text search, and archiving. The system will be administered by automatic and manual librarian functions.

Action Items

- 1) Determine DMS functional specifications.
- 2) Acquire DMS components.
- 3) Establish DMS policies and procedures (business rules).
- 4) Implement DMS.

Dependencies

Office.I.4	Install Client/Server E-mail
Office.A.2	Scan in Historical and Reference Data
Office.A.3	Migrate Forms
Office.A.4	Implement Online Librarian and Document Repository
Neysys.I.1	Install Robust Client Workstations

Benefits

Group authoring. Better control of and access to personal and group documents

Office.P.2 Electronic Data Interchange

Responsible Organization

Contracting

Sponsoring Organization

IRM

Initiation Date

3Q/96

Status

Not started

Anticipated Duration

18 months

Resource Considerations

12 man-months.

Discussion

Begin transactions and data deliveries and receipts from/to internal and external customers and suppliers via electronic routing and distribution using electronic data interchange (EDI) standards.

Action Items

- 1) Establish working agreements with all internal and external customers and suppliers to transact business and reporting electronically.
- 2) Develop EDI communications capability with gateways to suppliers.

Dependencies

Office.I.1	Implement FAX Input/Output
Office.I.4	Install Client/Server E-mail
Office.A.1	Implement Security Policy and Procedures
Office.A.3	Migrate Forms
Office.A.5	Recognize Electronic Signatures as Binding

Benefits

Faster, more consistent communication with customers and suppliers. Quicker turnaround on communications with suppliers.

Electronic Office Technology Milestones

The following technology milestone must be resolved to adopt the technology. Each is described in more detail in the following sections.

Office.T.1 Implement Voice Processing

Office.T.1 Implement Voice Processing

Responsible Organization

IRM

Sponsoring Organization

IRM

Initiation Date

1Q/97

Status

Not started

Anticipated Duration

48 months

Resource Considerations

Two man-years.

Discussion

Current voice-processing capability on standard office workstations includes simple voice recording and playback; unreliable, user-specific (trained) voice command; and rudimentary text-to-voice simulation. The following action items represent SRS incorporation of coming technology.

Action Items

- 1) Incorporate high-speed digital signal-processing engines into all workstations capable of video and voice processing.
- 2) Acquire artificial intelligence voice command processing software for workstations.
- 3) Build initial voice-command functionality and deploy to all workstations.
- 4) Acquire real-time, speaker-independent voice recognition software for all workstations.

Dependencies

MMedia.A.1

Approve Use of Multimedia Data Types

Benefits

Hands-off computer interface and voice-to-text processing (dictation).

VIII. Object-oriented Technology

Introduction and Destination

All site computing resources—desktop workstations, servers, and mainframes—exist as nodes on a unified site network that can conceptually be thought of as the site computer. Data is well-modeled, managed, and located on the most appropriate platform for its intended use.

Applications as they are known today do not exist. Instead, there are libraries of well-defined objects that conform to accepted object technology concepts and structures. These objects are interconnectable and re-usable and can be combined as desired to create functionality.

Application development, then, is more focused on creating unique combinations of objects than on implementation of logic. Business processes and functions execute in a client/server environment such that data, processing logic, and user interfaces are distributed and implemented over the network at the most appropriate computer node for that specific activity.

A technical support function provides administration of the object libraries analogous to that for DBMSs. A technical object development and maintenance function is responsible for developing new objects and maintaining and revising existing objects. Well documented and enforced procedures and standards exist to administer these activities.

Instances of objects are stored within commercially available DBMSs that are extensions of traditional RDBMSs.

The site computer development staffs have all been well trained in the concepts of object technology and in the use of objects to provide end user functionality. The site system development and project management methodologies are built around object technology. The application development staff routinely employs object technology in their work. All programming to enable the use of objects is performed using the site standard programming language. Objects are purchased where commercially available. They are revised and extended by the site object technical staff as necessary to accomplish the desired purpose. All site purchased software is object-based and compatible with site object standards.

Legacy systems—the set of applications that have evolved over time to run the business and which embody a wide spectrum of past technologies and business expediencies—continue to provide essential business functionality in the object-oriented environment for as long as economically and functionally justified. Technologies and functionalities embedded in legacy systems are continually reviewed and analyzed for the purpose of replacing them with objected-oriented (OO) equivalents when technically and economically feasible. However, the reality of the long-term existence of legacy systems in the future is recognized, and the object-oriented environment is structured and developed to ensure coexistence with legacy systems. Initiatives are supported to enable the gradual evolution and migration of legacy systems to a completely object environment in a cost-effective manner. No computer development initiatives are implemented outside of the object environment unless shown to be in the site's best interest.

Starting Point

The site has a solid (and improving) network foundation. Additionally, the growth of WISDOM will provide a framework for centrally managed, distributed services to end users. Planned improvements to the site desktop will provide the increased computing capability required to handle the demands of object-oriented technology. In other words, the hardware infrastructure necessary to support objects is now or soon will be in place.

The software side of the object picture is a different story. The first major issue is a lack of general understanding of the technology within site computing organizations. What understanding exists is, for the most part, cursory in nature. Creating a core of object professionals will require a commitment to provide training and develop a strong mentoring program.

One of the prime motivations for moving to object technology is to broker core code to many applications in the same way that DBMSs broker data to many applications. There exist a great many functional objects (window, button, menu, database access, video, audio, etc.) which can be purchased for this use. Unfortunately, the data objects (employee, facility, document) which would provide the most value to site developers are not available and must be custom built. The site must make the investment in terms of skilled developers to create data objects that reflect the site business. An organization must be chartered to create such a Site Object Framework (SOF).

The site computer development staffs have all been well trained in the concepts of procedural technology. The site system development and project management methodologies are built around procedural technology. Most core systems development is performed using a proprietary programming language. Core business systems are seldom purchased, although this is changing. Those that are purchased are usually extended to the point that the site is unable to incorporate future releases.

Legacy systems, those applications that have evolved over time to run the business, are continually patched and repatched to meet changing customer requirements, even when these changing requirements are inconsistent with the original design criteria of the application. As these systems degenerate from a pure design, modifications to the systems become increasingly difficult. Eventually, the lack of encapsulation of procedural systems will cause ripple effects when seemingly innocuous changes present serious challenges to the application maintainer. As a result, core application maintenance is increasingly constrained by its own efforts.

There is currently no significant presence of object development tools here at the site. Requirements and specifications for the tools must be established and worked through the purchasing system.

Object-oriented Infrastructure Milestones

The following computing infrastructure milestones must be resolved to adopt the technology.

Object.I.1	Establish Site Object Framework Team (SOFT)
Object.I.2	Adopt Site Object Messaging Standard
Object.I.3	Establish Object Framework
Object.I.4	Determine and Implement the Necessary Changes to WISDOM to Support an Object-oriented Environment
Object.I.5	Re-engineer Existing Core Applications as Object Applications

Object.I.1 Establish Site Object Framework Team (SOFT)

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

3Q/94

Status

None

Anticipated Duration

24 months

Resource Considerations

The SOFT will be composed of a few (4-7) full-time, highly talented software developers and business process and technical analysts, with significant augmentation by business area experts for short duration as needed.

Discussion

The goal of the SOFT is to develop a hierarchy of business and technical objects that reflect the mission of the site. Examples of these objects might be "Facility" and "Employee," concepts which exist in virtually every piece of software at the site. By creating robust implementation of these concepts as objects, software which utilizes these concepts can be rapidly constructed and easily maintained. In other words, the purpose of the SOFT is to develop the site object library in conjunction with the end users of those objects.

Action Items

- 1) Establish SOFT as an SRS entity (probably under ALD).
- 2) Select a prototyping tool.
- 3) Analyze existing site software and databases to find candidate objects.
- 4) Work candidate objects into a coherent framework and test the framework by prototyping existing site software utilizing the framework.
- 5) Repeat items 3 and 4 until the framework stabilizes.

Dependencies

None

Benefits

Provides a central organization responsible for the development, maintenance, and extension of the site object framework.

Object.1.2 Adopt Site Object Messaging Standard

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

3Q/94

Status

None

Anticipated Duration

Six months

Resource Considerations

Will require the creation of a short-term team of technical personnel with an appreciation of objects. The team should be as small as is consistent with gaining consensus among impacted site development and network groups.

Discussion

Objects communicate via messages. Several different standards are emerging in this area (for example, Sun's DOE, HP and NeXT's PDO, and others). The Object Management Group's CORBA standard is an effort to create a uniform object messaging standard, and most major players have agreed to support this common standard. This support, however, is likely to be at the same level as that at which the industry supports SQL. That is, each vendor supports a minimal set of constructs, while providing most desirable features in proprietary extensions to the basic standard, thus limiting interoperability among objects from competing vendors.

Action Items

- 1) Form team.
- 2) Examine available options to determine salient features.
- 3) Recommend standard.
- 4) Gain approval as site-standard.

Dependencies

None

Benefits

An object messaging standard allows objects from different hierarchies to communicate with one another.

Object.I.3 Establish Object Framework

Responsible Organization

IRM

Sponsoring Organization

SITE

Recommended Initiation Date

1Q/95

Status

None

Anticipated Duration

24 months

Resource Considerations

This is one of the key stumbling blocks to an object implementation. This Site Object Framework will require the continued effort of a number (4-8) of the site's most talented developers.

Discussion

The Object Framework is a set of object classes arranged in a hierarchical structure. This set of classes is reused and extended by application developers to construct applications. Functional (domain-independent) objects can be obtained commercially and will form the basis of the object framework. Data (domain-dependent) objects, such as "Employee," "Part," and "Meeting," are necessarily business-specific and will have to be specially developed to incorporate the site requirements for these representations.

Action Items

- 1) Design and implement a trial object framework.
- 2) Test Site Object Framework by construction of a robust pilot core application (repeat design step as necessary).
- 3) Release Site Object Framework.
- 4) Incorporate generalizations of appropriate application-specific code into site object framework.
- 5) Extend Site Object Framework in new areas to further empower developers.

Dependencies

Object.I.1

Establish Site Object Framework Team (SOFT)

Benefits

The Site Object Framework provides a core of functionality which can be easily used and extended to meet site application requirements, providing higher quality applications in a much more responsive time frame.

Object.I.4 Determine and Implement the Necessary Changes to WISDOM to Support an Object-oriented Environment

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

4Q/94

Status

None

Anticipated Duration

Six months

Resource Considerations

This should be a joint effort between the SOFT, the organization responsible for WISDOM maintenance, and those responsible for WISDOM evolution. This is a relatively small effort involving, at most, 3 man-months.

Discussion

At this point, WISDOM appears to be the most likely vehicle for the client/server, workstation-centric applications called for by the site computing architecture. As such, it is imperative that WISDOM be extended to support object-oriented applications. In large part, the modifications to WISDOM will be minor. No major changes to the WISDOM framework are anticipated, but certain products will have to be added to facilitate objects, particularly in terms of remote messaging between objects.

Action Items

- 1) Form team.
- 2) Determine object impact on WISDOM.
- 3) Recommend WISDOM modifications to support objects.
- 4) Implement modifications.

Dependencies

Object.I.1	Establish Site Object Framework Team (SOFT)
Netsys.I.1	Install Robust Client Workstations

Benefits

Extends WISDOM to serve as the distribution and management vehicle for local and remote objects.

Object.I.5 Re-engineer Existing Core Applications as Object Applications

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

4Q/96

Status

None

Anticipated Duration

36 months

Resource Considerations

This will obviously consume a significant percentage of application development resources for the duration of the re-engineering project(s).

Discussion

It is certainly not necessary to re-implement all site core applications as OO applications. Whether or not a particular application should be re-engineered is a function of the maintenance costs, usability, and integration needs of the application in question. An application should be re-engineered when the frustration level of the end users and the maintenance costs of the existing system exceed equilibrium with the development costs using an increasingly robust object framework.

Action Items

- 1) Re-implement selected site core systems as OO systems as per respective object migration plans.

Dependencies

Object.I.3	Establish Object Framework	
Object.C.2	Develop Site Expertise in Object-oriented Technology	
Object.T.1	Survey Industry Experience in Migrating Legacy Systems to an	Object-oriented Environment

Benefits

Re-engineering selected site applications as OO applications should reduce maintenance costs for these applications, increase functionality of these applications, provide for enhanced interoperability between applications, and significantly improve the user interface of these applications.

Object-oriented Administrative Milestones

The following administrative milestones must be resolved to adopt the technology.

Object.A.1	Direct that Future Site Applications Should Be Object-oriented
Object.A.2	Procure Object-oriented Technology
Object.A.3	Develop Object Migration Plans for Existing Systems

Object.A.1 Direct that Future Site Applications Should Be Object-oriented

Responsible Organization

IRM

Sponsoring Organization

Site

Recommended Initiation Date

3Q/94

Status

None

Anticipated Duration

12 months

Resource Considerations

This is the process of achieving consensus among high-level management that OO technology is to be pursued as the technical direction of choice. This will require four to six man-months of technical effort to prepare a proposed OO strategy and sell that strategy to management. Management effort will also be required to sell this strategy to higher levels of management. This will require a champion for objects, willing to devote a significant effort (10% - 20%) for the duration of this process. Senior level management will also be impacted in coordinating responses to any proposed strategy. While the actual amount of effort required for this step is fairly low, it requires the expenditure of effort at fairly high levels.

Discussion

An activity as broad as object migration should not be undertaken without an implementation. This document forms a first step in that direction. An effort of this type requires active high level management support in order to succeed. Resistance to change is natural, and object-oriented technology requires substantial amount of change. Without strong support (bordering on mandate), migration to objects will not succeed.

Action Items

- 1) Education of IRM, Computer Council, general Site, and DOE in the Benefits of Objects
- 2) Development of a Straw Man Object Policy for Approval by the Site
- 3) High-level approval of object-oriented technology as the Site default standard

Dependencies

None

Benefits

Object-oriented technology has its price in terms of infrastructure enhancement and developer training, but this cost is far outweighed by a development time that is three to six times faster than conventional technology, increased application flexibility and reliability, decreased program maintenance costs, increased application interoperability, and improved user interface.

Object.A.2 Procure Object-oriented Technology

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

1Q/95

Status

None

Anticipated Duration

18 months

Resource Considerations

The difficulty of a major software acquisition is well known to most of the site. This initial specification phase will require four to six man-months to develop. This activity will be hampered by a shortage of trained object developers at the site. Purchasing will be required to commit a significant percentage of a buyer (two man-months) over the duration of the acquisition process. Installation of the tool should be fairly straightforward (one man-month).

Discussion

Object-oriented technology is going to require substantial changes in the developer toolset. Acquisition of these tools is going to require a major effort.

Action Items

- 1) Develop specifications for object-oriented development tool.
- 2) Purchase tool.
- 3) Install tool.

Dependencies

Object.A.1 Direct that Future Site Applications Should Be Object-oriented

Benefits

While OO technology is, in theory, applicable to any development environment, practical considerations require that a commercial tool be acquired to facilitate the use of objects. Successful conclusion of this milestone provides the site with such a tool.

Object.A.3 Develop Object Migration Plans for Existing Systems

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

3Q/95

Status

None

Anticipated Duration

18 months

Resource Considerations

The merits of migrating a particular application to objects must be considered on a case-by-case basis. The effort required to develop a migration plan for a particular system depends upon the complexity of the system and the type of migration desired. Generally speaking, the development of a migration plan will require one-man month (simplest case) to 12 man-months (worst case) for each system.

Discussion

Each core business system developed and/or maintained by IRM should be considered for possible migration to objects. Possible types of migration (in increasing order of effort and long-term desirability) include the following:

- 1) None. Use the system as is.
- 2) Replace the 3270 front-end with an object front-end (middleware).
- 3) Port the existing application directly to OO technology using commercial/SOF objects where possible and developing application-specific objects where necessary.
- 4) Port the existing application directly to OO technology using commercial/SOF objects where possible and extending the SOF where necessary.
- 5) Redoing the existing application from the requirements on up, using commercial/SOF objects where possible and developing application specific objects where necessary.
- 6) Redoing the existing application from the requirements on up, using commercial/SOF objects where possible and extending the SOF where necessary.

Action Items

- 1) Manager responsible for each system develops migration plan.
- 2) Plans reviewed by IRM management to determine priority of re-implementation.

Dependencies

Object.I.3 Establish Object Framework

Benefits

Just as it is desirable to enhance the interoperability of new systems using object technology, it is desirable to enhance the interoperability between existing systems with new systems (or with other existing systems). Some mechanism must exist to encourage the migration of these legacy systems to objects over a reasonable time frame.

Object-oriented Cultural Milestones

The following cultural milestones must be resolved to adopt the technology. Each milestone is discussed in more detail in the following sections.

Object.C.1	Implement Matrix Project Team Approach
Object.C.2	Develop Site Expertise in Object-oriented Technology
Object.C.3	Establish Reward System for Code Reuse

Object.C.1 Implement Matrix Project Team Approach

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

3Q/95

Status

None

Anticipated Duration

Six months

Resource Considerations

For the most part, this is being accomplished by the IRM reorganization.

Discussion

An object-oriented development environment requires that several roles be accounted for during application development (some roles may require several people, or one person may handle multiple roles depending on the application). These roles include the application designer, the domain expert, the application developer, the object developer, and the object architect/consultant. To pull people together to create an application, a mechanism must exist to handle the exchange of people matrixed from different organizations to perform a specific task.

Action Items

- 1) Organize IRM into discrete talent pools.
- 2) Develop/maintain applications by drawing teams from these pools.

Dependencies

None

Benefits

This milestone organizes IRM into a structure that is more conducive to object development than the current project-based organization.

Object.C.2 Develop Site Expertise In Object-oriented Technology

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

1Q/95

Status

None

Anticipated Duration

12 months

Resource Considerations

Training will require a substantial effort. For the most part, site expertise in this area is at a premium, and we will probably have to go outside of WSRC to obtain trainers for this technology (at least, initially). Setting up training for all developers in IRM is not trivial (two man-months) and running all of the developers through the training requires a large effort (24 man-months). Moreover, transition to OO technology is not merely learning to use a new tool, it requires a paradigm shift on the part of developers. A transition period of three to six months will exist, during which application developer productivity will fairly low. Additionally, more adept object developers will serve in a mentor role during this period.

Discussion

The single most sweeping change required by object-oriented technology is the change in focus required by application developers. This sort of shift is not effected by a week or two of training. It requires an extensive effort on the part of the development organizations to redefine the way that applications are conceived.

Action Items

- 1) Rotate all developers through a course in basic object concepts.
- 2) Develop object experts with more rigorous training in object-oriented concepts, tools, and techniques.
- 3) Develop a plan to systematically rotate development personnel through tool-specific object training as required to maintain staffing levels for emerging object projects. Significant lead time must be allowed for newly trained employees to experiment with the technology before being assigned to production development teams.
- 4) Utilize previously trained employees to act as mentors to newly trained ones.

Dependencies

Object.A.1

Direct that Future Site Applications Should Be Object-oriented

Benefits

This is a necessary step to prepare the site to take advantage of OO technology.

Object.C.3 Establish Reward System for Code Reuse

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

1Q/95

Status

None

Anticipated Duration

12 months

Resource Considerations

Resources for this milestone are fairly low and, for the most part, can be handled within the context of current activity.

Discussion

The reward system for application developers needs to place a premium on code reuse, rather than code creation.

Action Items

- 1) Encourage personnel to include IADP items relating to code reuse.
- 2) Present code reuse awards at a section and personal level.

Dependencies

Object.P.3 Implement Online, Centrally Managed, Distributed Access for Site Object Framework Developer Documentation

Benefits

One of the primary benefits of OO technology is code reuse, but one of the basic instincts of a developer is to build software yourself. Developers need to be encouraged to work within the object framework.

Object-oriented Process Milestones

The following work flow milestones must be resolved to adopt the technology.

Object.P.1	Establish Object-oriented Documentation Requirements
Object.P.2	Establish Object-oriented Development Methodologies
Object.P.3	Implement Online, Centrally Managed, Distributed Access for Site Object Framework Developer Documentation

Object.P.1 Establish Object-oriented Documentation Requirements

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

2Q/95

Status

None

Anticipated Duration

Six months

Resource Considerations

A team of technical specialists and technical writers contribute a total of six man-months.

Discussion

At least two different types of software documentation must be delivered for a system: the user's guide and the software maintenance document. In a system that fosters reuse, it is unnecessary to replicate Site Object Framework documentation for every application. Object software requires, instead, detailed documentation on the implementation of application-specific objects and documentation on how the core framework objects were utilized (as opposed to implemented). Similarly, it is less necessary to focus the user documentation on the details of how a particular Graphical User Interface (GUI) object operates (unless its behavior is different than that normally provided by that GUI object) and instead focus more on how to utilize the capabilities of the application.

Action Items

- 1) Establish documentation team.
- 2) Develop standards for site framework documentation.
- 3) Develop standards for application specific object documentation.
- 4) Develop standards for object usage documentation. (Consider the possibility of an object browser as a form of object usage documentation).
- 5) Develop standards for application level user documentation.
- 6) Develop application level user documentation for the site object framework.
- 7) Gain IRM approval of documentation standards.

Dependencies

Object.I.1

Establish Site Object Framework Team (SOFT)

Object.C.2

Develop Site Expertise in Object-oriented Technology

Benefits

Standardizing on site documentation facilitates code reuse (since other developers have a common framework for understanding documentation) and improves consistency in end-user documentation.

Object.P.2 Establish Object-oriented Development Methodologies

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

1Q/95

Status

None

Anticipated Duration

12 months

Resource Considerations

A team of object specialists will require time to evaluate alternative OO development methodologies and recommend one. This will require effort on the part of the specialists (12 man-months) and potentially the costs of acquiring/training on various tools which utilize these methodologies.

Discussion

Conventional analysis and development methodologies do not fit well into the object paradigm.

Action Items

- 1) Form object-oriented development methodology team.
- 2) Evaluate object-oriented development methodologies.
- 3) Recommend/develop an object-oriented development methodology.
- 4) Gain IRM approval of object-oriented development methodology.
- 5) Gain site approval of object-oriented development methodology.

Dependencies

Object.I.1	Establish Site Object Framework Team (SOFT)
Object.C.2	Develop Site Expertise in Object-oriented Technology

Benefits

Several different object-oriented analysis and design methodologies exist. The site needs to choose one as the standard.

Object.P.3 Implement Online, Centrally Managed, Distributed Access for Site Object Framework Developer Documentation

Responsible Organization

SOFT/IRM

Sponsoring Organization

IRM

Recommended Initiation Date

3Q/95

Status

None

Anticipated Duration

Six months

Resource Considerations

Most of the resources necessary to support this effort exist within the WISDOM framework. It is also highly desirable that developer documentation templates be derivable from the object source code. Tools to perform this service are freely available for many object environments, but undoubtedly, will have to be modified to conform to the site standard. The amount of effort required is dependent upon the selected object tool standard, but a pessimistic estimate is six man-months. A modest effort on the part of the SOFT will be required to act as the librarian for this documentation.

Discussion

The primary vehicle for code reuse will be the Site Object Framework. To maximize the reuse of this framework, the developer documentation must be consistently updated to reflect the latest extensions and modifications. Electronic access to a central document database is the only viable approach to making this information available in a timely fashion.

Action Items

- 1) Establish a team composed of networks, WISDOM, development, and object technologists to specify a tool that provides documentation templating based upon class definitions, per the site documentation standard.
- 2) Develops the tool.
- 3) Provides a common access method for resultant documentation (that is, a documentation database).

Dependencies

Object.P.1

Establish Object-oriented Documentation Requirements

Benefits

Ready access to current documentation (online) will not only result in more correct use of the current revision level of the SOF, but will increase the likelihood of timely updates to that documentation as well.

Object-oriented Technology Milestones

Object.T.1	Survey Industry Experience in Migrating Legacy Systems to an Object-oriented Environment
Object.T.2	Demonstrate Relational Database Access from Object-oriented Systems
Object.T.3	Evaluation of Operating Systems (Object-oriented)
Object.T.4	Evaluation of Object-oriented Development Tools
Object.T.5	Explore Distributed Object Server Technology

Object.T.1 Survey Industry Experience in Migrating Legacy Systems to an Object-oriented Environment

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

2Q/94

Status

Underway

Anticipated Duration

36 months

Resource Considerations

The lengthy duration of this milestone is not a reflection of the amount of effort it requires, but more a recognition that this needs to be an on-going effort during WSRC's object transition. An effort of one man-month per year is probably sufficient.

Discussion

WSRC is not the only organization that is faced with migration to an object environment. Other companies are pursuing this path as well and the site is well advised to take advantage of as much experience from other organizations as possible.

Action Items

- 1) Pursue joint projects with other organizations within DOE.
- 2) Close association with end-user object action groups.
- 3) Form a continue literature research.

Dependencies

None

Benefits

Studying the successes and failures of other companies in their object migration can save SRS from making the same mistakes and provide guidance on how to make the transition in a cost-effective manner. Joint projects with other sites may also lead to additional extensions to the Site Object Framework.

Object.T.2 Demonstrate Relational Database Access from Object-oriented Systems

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

4Q/94

Status

Complete

Anticipated Duration

12 months

Resource Considerations

Discussion

During a long transitional period, it is important that object-oriented applications coexist with traditional applications and that data can be shared between legacy applications and object applications.

Action Items

- 1) Test object-oriented database access to relational databases.
- 2) Test Oracle access via object-oriented development tool.

Dependencies

None

Benefits

Object.T.3 Evaluation of Operating Systems (Object-oriented)

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

1Q/95

Status

None

Anticipated Duration

12 months

Resource Considerations

Initially, this will require small output of resources in order to keep informed of what possibilities exist within the commercial world (two to three man-months per year). As the tools reach maturity, the site may elect to expend more effort on a full-scale evaluation of one or more potential operating systems.

Discussion

To determine the site standard for object-oriented operating systems, we must explore the available options. Note the tenuous nature of the recommended starting date for this milestone. As yet, OO operating systems are virtually nonexistent (PenPoint excepted). However, several key vendors are poised to supply these tools (that is, Cairo, Taligent, NextStep). The start date of this milestone is dependent upon vendor readiness. 1Q/95 is expected to be the earliest time when the site will be able to begin working with this technology.

Action Items

- 1) Obtain sample versions of announced object-oriented operating systems as available.
- 2) Develop close working relationships with major vendors.

Dependencies

None

Benefits

OO operating systems provide the benefits of object orientation at the operating system and utilities level. These systems will also remove a boundary at which OO applications are forced to act in procedural ways (to interact with non-OO operating systems).

Object.T.4 Evaluation of Object-oriented Development Tools

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

1Q/94

Status

Under way

Anticipated Duration

36 months

Resource Considerations

This milestone will require more resources than might be suspected at first. Learning to fully use a development tool is not a quick proposition. Time is required to fully understand the possibilities and the shortcomings of a particular development tool. A minimum of three man-months per tool should be allowed. At present, there are half a dozen serious contenders for a site standard object development tool.

Discussion

To determine the site standard for object-oriented development tool systems, we must explore the available options. Several tools exist for this purpose, each with its own strengths and weaknesses. Careful examination of the alternatives should be made prior to selecting a site standard.

Action Items

- 1) Obtain object-oriented development tools as available.
- 2) Develop close working relationships with major vendors.

Dependencies

None

Benefits

One of the most powerful (and time-saving) features of most object development environments is the strength of the development tools that are offered. To a large degree, selection of a good tool will allow the site to obtain the full benefit of objects. Conversely, selection of a poor tool will restrict the amount of benefit that objects can provide.

Object.T.5 Explore Distributed Object Server Technology

Responsible Organization

IRM

Sponsoring Organization

IRM

Recommended Initiation Date

4Q/94

Status

None

Anticipated Duration

18 months

Resource Considerations

As should be obvious from the action items, this is a fairly low-level effort (two man-months) until the pilot phase. The pilot may require as much as six man-months.

Discussion

One of the major unanswered questions about object-oriented technology is the mechanism for sharing global site objects between applications. While some of the Object Management Group's (OMG) effort is addressing this issue, a solution is far from clear. WSRC will have to monitor developments of this key technological component carefully.

Action Items

- 1) Continue literature research on distributed objects.
- 2) Obtain associate membership in CORBA.
- 3) Obtain participatory membership in object user organizations.
- 4) Conduct pilot studies of emerging distributed object technologies.

Dependencies

None

Benefits

Allows the site to prepare to take advantage of emerging distributed object messaging standards.

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4. WSRC-IM-92-23, *SRS Computing Standards and Guidelines Reference*
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Appendix A: Glossary

10baseT

Ethernet local area network utilizing unshielded twisted pair (UTP) cables

3270

A low-speed character-cell terminal interface to IBM Mainframe systems.

4GL

Fourth-generation language. A type of computer language that accepts system requirements as input and generates computer code to meet those requirements as output.

ADABAS

Database management system that supports most legacy applications on the IBM Central Computing Facility. ADABAS is non-relational.

ADP

Automated Data Processing.

AIX

The version of UNIX that runs on the IBM RS/6000.

ALD

Administration and Logistics Division of WSRC.

ANSI

American National Standards Institute: a national standards body.

Analysis

Separation of an intellectual or substantial whole into its constituent parts for individual study. The stated findings of such separation or determination.

API

Application program interface. Protocols and software that enable consistent interfaces for communications and transfer of information between applications.

Application

The data manipulation and processing operations that are related to specific requirements of an information system. Software or program that is specific to the solution of a specific business problem or process.

Application System

A collection of applications which utilizes the services provided by the human-computer interface, communications facility, and data management system to perform the processing necessary to meet the requirements of the information system.

Architecture

The manner in which hardware, software, or data is structured. Architecture typically describes how the system or program is constructed, how its components fit together, and the protocols and interfaces used for communication and cooperation among modules or components of the system.

Archive

To place infrequently accessed data into permanent storage.

AT Bus

The cardset form-factor for original IBM PCs and the mass installed base of so-called "clones." Still a dominant bus in consumer and business computers. Also called the ISA bus.

ATM

Adobe Type Manager: a packaged set of Postscript fonts and associated utilities.

Asynchronous transfer mode. A new network strategy that provides dedicated 100 megabit per second network connections between workstations and servers for the duration of the session.

Attribute

A single fact about a business entity or relationship. A property inherent in, or associated with, an entity. (Referred to as a data element in an information system.)

BOOTP

Standard for providing IP addresses to workstations dynamically.

BSRI

Bechtel Savannah River Incorporated.

Business Rules

The basic operation constraints under which a given organization does business. A statement reflecting a policy, operating standard of practice, or some other form of constraint which governs the correctness and usefulness of enterprise information. A business rule statement must always be true within the context to which it applies, never sometimes true or partially true

C/S

Client/Server, a style of computing based on cooperating computers, especially utilizing an intelligent workstation.

CASE

Computer Aided Software Engineering.

CASE Tools

A wide range of software products that provide automated productivity and quality support, to varying degrees of rigor, for phases (stages) of applications development and maintenance. For example, CASE tools can allow application developers to perform analysis and design using a commonly understood graphical representation, such as Yourdon, Gane & Sarson, Jackson, or Chin's diagrams. In the database arena, CASE tools are used to build and test database designs on the workstation and to port these designs to a host computer.

CAST

Computing Architecture and Standards Team.

CCF

Central Computer Facility.

CDA

Compound Document Architecture, a strategy for combining text, graphics, and other datatypes.

CD or CD-ROM

Compact disc. A 5 inch disk containing digital information introduced by Sony and Phillips in 1982. It holds 660 megabytes of information that is read by laser beam.

Change Control

The process of managing changes to individual components within each version of information that may include source code, version control, documentation, and system configuration.

The process of controlling, authorizing, and tracking changes to manual or automated data.

Class (Class Object)

In object-oriented technology a template for the creation of a group of instances that share common characteristics. A class is also an object in its own right and, as such, has access to class data and methods and can respond to messages.

Client

The workstation and/or software running at the workstation in a distributed computing environment.

Client/Server

Cooperative processing is a general computing model in which an application's functions are logically split such that two or more complementary programs interact and execute concurrently on one (typically, two or more) or more machines as part of an overall business function. Client/Server is a form of cooperative processing in which one of the participating applications is a personnel work station through which the user interacts with the network. To qualify as Client/Server, the workstation must execute some of the application logic beyond emulation:

Client: The driving or initiating component on an workstation, delegating redefined types of tasks to a server and making requests of a server, usually for which it awaits a response.

Server: A host acting on behalf of a client for predefined functions, for example, database requests.

Clone

The generic term for computer that utilizes the Intel microprocessor typically running DOS and/or Windows applications.

Computer-Aided Software Engineering (CASE)

The use of automated interactive graphical design techniques, design checking rules, encyclopedias of design elements, and simulation to drive or facilitate the analysis, design, documentation, construction, and maintenance of computer applications.

Computer System

A collection of hardware which is managed as a single unit by software such as an operating system which may also provide common services such as access control, interprocess communications, and a Graphical User Interface.

Configuration Management

The environment that establishes and administers the process for uniform change control to ensure stability, consistency, reliability, quality, and traceability of any/all forms of change within any enterprise.

The systematic evaluation, coordination, and approval or disapproval of changes, and the implementation of all approved changes of an item after formal establishment of its configuration identification.

CORBA

Common Object Request Broker Architecture. Emerging standard from the Object Management Group (OMG) for messaging between objects from multiple vendors.

DASD

Direct Access Storage Device, a magnetic disk storage system for IBM mainframes.

Data

A representation of facts, concepts, or instructions in a formalized manner suitable for communication, interpretation, or processing by humans or by automatic means.

Symbols, written or stored on some recording medium, representing certain things, ideas, or values and conveying meaningful information in particular contexts; the encoded representation of information.

Data Administration

The function of developing and administering the policies, procedures, practices, and plans for the definition, organization, protection, and efficient use of data as a corporate resource.

Database

A collection of data logically organized to meet the information and time requirements of a universe of users.

A collection of interrelated, largely unique, data items or records, in one or more computer files, that may be processed by many different application programs.

Database Administrator (DBA)

An individual with responsibility for one or more databases, who controls the design and use of these databases.

Data Collection

A collection of data implemented as a unit, which contains facts of interest to the enterprise.

Data Dictionary

A software package that manages the storage of information about data such as data item names, definitions, formats, and relationships to other data.

A description of the characteristics of data. The system tables that contain descriptions of the database objects and how they are structured.

An inventory that describes, defines, and lists all of the data elements that are stored in a database.

Data-Driven

A development philosophy that emphasizes data architecture design separate and independent of application functionality.

A term used to describe the orientation of an information engineering approach to information resource management. This approach results in optimum reliability, sharability and usefulness of information across all enterprise activities. It maximizes the reusability of all system components.

Data Integrity

The ability to preserve the completeness, currency, and accuracy of the data without unintentional changes; the ability to produce results that are correct to a predefined level and to maintain data availability.

Data Management

A general term that collectively describes those functions of the system that provide creation of, and access to, stored data, enforce data storage conventions, and regulate the use of input/output devices.

Data Stewardship Program

A concept that defines individual and company responsibility to manage corporate data resources in compliance with established standards, policies, and procedures. The Program provides a consistent approach for effective data management across the entire company.

DC&S

Digital Control & Systems (Department) of WSRC

DB2

IBM's primary relational database management system.

DBA

Database Administrator.

DBMS

Database Management System.

DCE

Distributed Computing Environment (OSF).

DEC

Digital Equipment Corporation.

Derived Data

Data values that are derived from the values of other data by a specified algorithm.

DMS

Document Management System: a major WSRC procurement to improve document and records automation planned for 1995.

DOE

Department of Energy

Domain

The general area of expertise of a particular expert system.

DOS

Disk Operating System developed by Microsoft for the IBM-PC. (also MS-DOS , PC-DOS)

E-mail

Electronic mail, a computer-based messaging system.

EDI

Electronic Data Interchange: a standard format and protocol for the exchange of business information (typically numeric and database fields).

Encapsulation

A term describing the indivisible nature of the data and operations that make up an object.

Enterprise

A government agency; a contractor with a government agency; an organization in the public sector; or a company in the private sector.

Used in place of such terms as corporation, company, government agency, government program and firm. Generally applies to any kind of organization with autonomous control over its own approach to information resource management.

Ethernet

Local area network technology (DEC/XEROX/INTEL).

FAX

A scanned image of a paper document transmitted over telephone lines.

FDDI (Fiber Distributed Data Interface)

A token-passing LAN that uses optical cabling to pass data at speed up to 100 megabits per second. Recent implementations can use site universal wiring.

File

A collection of related data that is stored and retrieved by an assigned name; synonymous with data set.

A collection of rows (or records) that have associated columns (or files); the logical equivalent of a table.

A named set of records stored or processed as a unit.

FTE

Full-time equivalent: the cost or effort expended by an employee in a 12 month period.

GB (Gigabyte)

A measure of data storage approximately equal to 1 billion characters.

GUI

Graphical User Interface.

HTML

Hypertext markup language. A standard set of tags used in preparing a document for hypertext retrieval.

Hub

Device used to build 10BaseT local area networks.

IBM

International Business Machines Corporation

Information Resource Management

The study, planning, management, and control of information as a corporate asset. IRM encompasses the management of network, hardware, data, software, and organization resources.

IP Address

Internet Protocol address, a unique numeric assignment to a host or workstation used for network connection in an Internet data network.

IRM

Information resource management function or Information Resource Management (Department) of WSRC

IS

Information Systems.

I/T or IT

Information Technology.

IW

Information Warehouse.

KB (Kilobyte)

A measure of data storage approximately equal to 1,000 characters.

Kerberos

A network login and authentication standard that allows a single login to access multiple network resources.

LAN

Local Area Network.

Legacy Data (System)

Existing data or applications to which integration or migration must occur.

Local Area Network (LAN)

The interconnection of computers (PCs, workstations, mid-range, and mainframes) in a building or campus to enable the sharing of files, printers, and other resources.

Macintosh

Apple Computer's personal computer family.

Mainframe

Large computer system (often associated with IBM), usually associated with running an organization's major business systems

MB (Megabyte)

A measure of data storage approximately equal to 1 million characters.

Mbps (Megabits per second)

LAN transfer rate expressed in terms of bits rather than bytes. A byte is nominally 8 bits, so a 10 Mbps LAN has the potential for data transfer at the rate of 1.25 MB per second.

Methodology

A structured, procedural process that decomposes system development into phases with phase-specific tasks and well-defined deliverables.

MIB

Management Information Base, a collection of information describing how devices can be managed in a NMS using SNMP.

Middleware

Software services that reside above a system's basic operating system that provide data access and communications services for application software.

MIE

Major Item of Equipment: a procurement exceeding \$1,000,000.

MSD

Management Services Department of WSRC.

NARA

National Archives and Records Administration: the government affiliated standards body for records management.

Network

A computer communications system linking a series of computer elements. A system of interconnected computing devices that can communicate and share resources. Networks may be private (for one user) or shared (for many users).

NeXTStep

Object Development/Execution environment developed by NeXT Computer, Inc. Generally regarded as the most complete object environment commercially available today.

NMS

Network Management System, a comprehensive system for managing a data network.

NOS

Network Operating System, software that provides file and printer services across a LAN.

Novell

Novell Inc., vendor of Netware, the site standard NOS.

Object

A software packet containing a collection of related data (in the form of variables) and methods (procedures) for operating on that data. It is a specific instance of a class and includes the characteristics of that class.

Object Framework

A hierarchical collection of object classes defining a set data and behaviors (operations) and the relationship between these object classes. Objects within the framework pertain to a central concept (that is, User Interface or Human Resources). Frameworks can themselves be combined to create larger frameworks.

Object Management Group (OMG)

Industry group dedicated to promoting object-oriented technology and establishing OOT standards.

OCR

Optical Character Recognition: conversion of image pages back to the text that comprises the printed words.

ODA

Open Document Architecture: an international standard for compound document representation.

OO

Object-oriented

OOP

Object-oriented programming

OOPS

Object-oriented Programming System.

OSF

Open Systems Foundation, an industry consortium that promotes open computing standards

PC

Personal Computer (for example, Macintosh, IBM PS/2).

PDF

Portable Document Format: Adobe's Postscript-based format for cross-platform view/print document interchange products.

PMMD

Procurement & Materials Management Department of WSRC

Quicktime

Apple Macintosh digital video architecture.

RAM

Random Access Memory: the volatile storage in a computer system.

RDBMS

Relational Database Management System.

Reference Data

Includes all the common data elements for which a business establishes and imposes a consistent structure and a limited set of values. Reference data has meaning and definition

across WSRC and is used for reference and validation. Reference data is fundamental to the operation of the business.

Referential Integrity

That property of a relational database management system that enables it to prevent the introduction of inconsistent data into the database. For instance, when a new employee is entered into the database, he or she cannot be assigned to a department that does not exist. RI consists of relationships, or rules, that a database designer defines. These rules describe pairs of tables in which the values of the rows in one table depend on the value of the rows in another table (as in the above example).

Relational Database

A database that is organized and accessed according to relationships between data items.

A data structure perceived by its users as a collection of tables. A relational database consists of tables, rows, and columns. Most mini-computers and frames today have relational database systems available for business use. Typical examples are DB2 from IBM and RDB from Digital Equipment Corp. Relational databases differ from non relational databases in that there are no system dependencies stored within the data; for example, hierarchical databases are not relational because they contain pointers to other data. SQL Server is a relational DBMS.

A data base management system in which data is represented in two-dimensional tables. A DBMS with the integrity, structural, and manipulative features of the relational model.

Repository

A database that contains metadata, that is, information about the data itself (where data is located, what names are used, format, rules, etc.) and other application components.

Router

Data communications device for joining networks together.

RPC

Remote Procedure Call.

RTS

Replacement Telephone System, new telephone system for SRS.

SDM

System Development Methodology: a set of guidelines for software development and software project management.

SEH

Switched Ethernet Hub, a hub that provides a dedicated Ethernet bandwidth to each attached workstation.

Server

A computer system that provides one or more specific support functions for workstations such as file sharing, applications storage, or databases.

SGML

Standard Generalized Markup Language: an international set of standards for tagging compound documents.

SNMP

Simple Network Management Protocol, an open protocol instrumental in developing a NMS

SOFT

Software Object Framework Team. A proposed WSRC organization with primary responsibility for the development and maintenance of the site object framework.

Software

Computer code that can be compiled.

All or part of the programs, procedures, rules, and associated documentation of computer system.

SQL

Structured Query Language.

SRS

The Savannah River Site, a Department of Energy facility in Aiken, South Carolina.

SRSnet

The SRS data communications network

Strategic Information/Data Planning

The development of plans to support the organization's long-range information, data, and applications systems requirements.

Defining data requirements from strategic business plans, developing global logical data models, establishing data policies, assessing opportunities, and relating information planning strategies to business requirements.

System

An organized combination of the services of machines, materials, and people to accomplish a function.

A collection of data processing jobs and application programs that interact to perform a business function (that is, ledger system, financial data system, environmental control and tracking system).

System Development Life Cycle (SDLC)

The time span and the spheres of activity from the inception of a system until it is abandoned or replaced. This time span generically includes system analysis, design, development/coding, implementation, operation, and maintenance.

T1

Digital telephone circuit rated at 1.544 million bits per second.

Taligent

Object-oriented environment under development by Taligent, Inc. (a joint venture of IBM and Apple). Slated for beta release in early 1995, Taligent promises to deliver a robust, operating system independent environment for object execution.

TCP/IP

Transmission Control Protocol / Internet Protocol, the set of open communications protocols that were developed to build the Internet global computer network.

TI

Training Integration (Department) of WSRC.

TP&C

Technical and Process Computing (Department) of WSRC

Trigger

Also called "database event alerters," triggers allow the database server to communicate information about database events to a client application. In turn, triggers can be configured to fire off one or more business rules, run an SQL script against the database, run a program on the client or server computer, or simply alert a user that an event has occurred.

UNIX

Popular computer operating system, invented at AT&T, and ported to many different types of computer systems.

Universal Wiring

Site standard for installing UTP for data networks

UTP

Unshielded Twisted Pair, data grade telephone wiring based on 4 pairs of copper wire.

User

Anyone who uses data.

Anyone who uses the services of a computer system or its products.

VAX

Primary DEC computer family.

VCR

Video cassette recorder.

VMS

Virtual Memory System (VAX operating system).

WAN

Wide Area Network, a data network based on leased telephone circuits and connecting geographically dispersed locations.

Windows (Microsoft Windows)

The industry standard windowed operating system for Intel 386 and 486 computers running DOS.

WISDOM (Workstation Integration System for Desktop Office Machines)

The WSRC implementation of Windows and Macintosh workstations in a networked configuration.

Workstation

A computer designed to support a single user for applications such as word processing, spreadsheets, databases, and calculational programs to accomplish work. Workstations are often categorized as either personal computers or scientific/engineering workstations based on performance levels and the tasks which they are designed to accomplish.

WSRC

Westinghouse Savannah River Company, the prime contractor for the Department of Energy's Savannah River Site in South Carolina.

X.500

International standard for electronic directories.

Appendix B: Roadmaps Milestones Summary

Milestone	Start Date	Duration
Networks.I.1 Install the Replacement Telephone System	Jan-94	24
Networks.I.2 Complete Intra-area Cabling	Jan-94	24
Networks.I.3 Complete Site Universal Wiring	Jan-94	24
Networks.I.4 Complete Building LANs	Jan-94	24
Networks.I.5 Install Ethernet/FDDI Network Trunks	Jan-94	36
Networks.I.6 Install Switched Ethernet Hubs	Oct-94	36
Networks.I.7 Install ATM Network Trunks	Jan-96	48
Networks.I.8 Install ATM Workgroup Networks	Oct-95	48
Networks.I.9 Complete Network Management System	Jan-94	36
Networks.I.10 Initiate Network Authentication Service	Jan-95	36
Networks.I.11 Install Wireless LANs as Extension to SRSnet	Oct-94	24
Networks.I.12 Complete Analysis of Network, Telephone, and Dedicated Fiber Usage Requirements	Oct-94	24
Networks.I.13 Provide Access Between SRSnet and Offsite Locations	Jul-94	18
Networks.A.1 Set Site Direction, Funding, and Priority	Jan-94	12
Networks.A.2 Relocate Most Network Users Onsite	Jan-94	60
Networks.A.3 Resolve Security and Spectrum Management Issues for Wireless LAN	Apr-94	24
Networks.A.4 Obtain Computer Security Endorsement of Network-based Authentication	Apr-94	24

Roadmap to the SRS Computing Architecture

Networks.A.5 Resolve Security and Network Use Issues for Offsite Access to and from SRSnet	Apr-94	24
Networks.T.1 Implement Cost-effective Switched Ethernet Hubs	Jan-94	24
Networks.T.2 Complete ATM Standards	Jan-94	36
Networks.T.3 Complete ATM Interfaces for Routers/Hubs	Oct-95	12
Networks.T.4 Complete ATM Interfaces for Workstations/Host Computers	Oct-94	12
Networks.T.5 Make DCE Security Services Available in Key Environments	Jan-95	24
Netsys.I.1 Install Robust Client Workstations	Jan-94	24
Netsys.I.2 Upgrade Workstations to Support Netsys Requirements	Apr-94	36
Netsys.I.3 Ensure Broad Availability of Networked Workstations	Apr-94	24
Netsys.I.4 Migrate to New NOS	Apr-94	12
Netsys.I.5 Initiate NOS Global Directory	Apr-94	12
Netsys.I.6 Initiate Network Authentication Service	Jan-95	24
Netsys.I.7 Complete Installation of Territorial File Servers	Jan-94	30
Netsys.I.8 Manage IP Address	Jan-94	6
Netsys.I.9 Implement Robust File/Print/Application Services	Jul-94	24
Netsys.I.10 Implement Automatic Software Distribution	Jan-94	36
Netsys.I.11 Connect Office Peripherals Directly to Network	Jan-94	36
Netsys.I.12 Implement Reliable Performance Monitoring	Jul-94	12
Netsys.A.1 Set Site Direction, Funding, and Priority	Jan-94	48
Netsys.A.2 Define Security Principles	Apr-94	12

Roadmap to the SRS Computing Architecture

Netsys.A.3 Establish NOS Operations Group	Apr-94	12
Netsys.C.1 Implement Standards	Apr-94	24
Netsys.C.2 Share Equipment/Peripherals	Jan-94	36
Netsys.C.3 Save Data to Network	Jan-94	36
Netsys.P.1 Implement Single User Login to Network	Jul-94	24
Netsys.P.2 Implement Distributed Workgroup Management	Jul-94	36
Netsys.P.3 Implement Software License Management	Oct-94	30
Netsys.P.4 Implement Disaster Recovery Procedure	Jul-94	12
Netsys.P.5 Implement Infrastructure Enhancement Process	Apr-94	24
Netsys.T.1 Deliver NOS over TCP/IP	Jan-95	12
Netsys.T.2 Implement Transparent Print Services on All Platforms	Oct-94	12
Netsys.M.1 Implement PC Utilization Plan	Apr-94	12
IW.I.1 Establish a Communications Network Capability Supporting the Global and Local Warehouses	Jan-94	48
IW.I.2 Establish Client SQL-Network	Apr-94	24
IW.I.3 Establish/Populate IW Component of Data Repository	Jan-94	36
IW.I.4 Identify and Procure IW Support Tools and Hardware	Jan-94	18
IW.I.5 Identify and Procure Archival Management Tools and Hardware	Jan-95	12
IW.A.1 Establish IW Implementation Team	Jan-94	6
IW.A.2 Establish Long-term Support Organization	Jul-94	3
IW.A.3 Establish IW Policies and Procedures	Apr-94	6

Roadmap to the SRS Computing Architecture

IW.A.4 Replace Redundant Operational Reports, Screens, and Data Feeds	Oct-94	18
IW.C.1 Establish Training for Applications-development Community	Apr-94	9
IW.C.2 Establish Training for End-User Community	Oct-94	24
IW.P.1 Identify and Prioritize Business Requirements for Global and Local Warehouses	Jan-94	6
IW.P.2 Define the IW Model	Apr-94	9
IW.P.3 Implement the Global Warehouse	Jul-94	24
IW.P.4 Expand Global Warehouse	Jul-96	24
IW.P.5 Establish Local or Remote IWs	Jan-95	18
IW.P.6 Establish Archival IW	Jul-95	12
C/S.I.1 Install Robust Development Workstations	Jan-94	12
C/S.I.2 Implement Locally Distributed, Centrally Managed RDBMS Servers	Jan-94	24
C/S.I.3 Implement Single Network Transport Protocol for Client/Server Communication	Jul-94	3
C/S.A.1 Develop Graphical User Interface Guidelines	Apr-94	6
C/S.A.2 Develop Naming Conventions	Apr-94	6
C/S.A.3 Enable Sitewide Data Access	Oct-94	12
C/S.A.4 Encourage Move Toward Client/Server Development	Jan-94	24
C/S.A.5 Migrate Selected Host-Based Legacy Systems to Client/Server	Apr-94	48
C/S.C.1 Establish Small Development Team Methodology	Jan-94	24
C/S.C.2 Establish Policies Favoring Iterative Software Development	Apr-94	24

Roadmap to the SRS Computing Architecture

C/S.P.1 Implement Standard Development Methodology and Tools Across Site	Jan-94	12
C/S.P.2 Integrate Software Tools, Development Methodology, Project, and Configuration Management Products	Jan-94	18
C/S.T.1 Implement Standard RDBMS Accessibility	Apr-94	18
C/S.T.2 Implement Graphical Report Generators and Query Tools	Jul-94	6
C/S.T.3 Implement Nonrelational Database Access Through SQL Gateway	Apr-94	6
C/S.T.4 Implement Declarative Referential Integrity, Triggers, and Stored Procedures Supported by RDBMS	Apr-94	18
C/S.T.5 Implement Monitoring Tools	Apr-94	18
C/S.T.6 Implement Cross-platform Two-phase Commit Regardless of Vendor	Oct-95	24
MMedia.I.1 Develop Multimedia Principles	Jan-94	9
MMedia.I.2 Adopt Cross-platform Fonts and Image Formats	Jan-94	18
MMedia.I.3 Establish Navigable Compound Document Format	Apr-94	18
MMedia.I.4 Enable Routine Capture and Playback of Cross-platform Audio	Apr-94	12
MMedia.I.5 Implement Storage, Multimedia Servers, CD-ROM, and Improved Monitors	Apr-94	24
MMedia.I.6 Enable Playback Motion Video at Desktop	Jan-95	12
MMedia.I.7 Implement Workgroup Video-capture Stations	Jul-95	6
MMedia.I.8 Implement Cross-platform Authoring Tools	Jul-95	12
MMedia.A.1 Approve Use of Multimedia Data Types	Apr-94	12
MMedia.A.2 Formulate Policy for Authentication of Nonprintable Data Types	Jul-94	12

Roadmap to the SRS Computing Architecture

MMedia.A.3 Determine Business Case for Desktop Video Capture	Jan-96	12
MMedia.P.1 Manage Stored Digital Video Clips	Jul-95	6
MMedia.P.2 Implement Routine Use of Multimedia Data in Office Documents	Jan-95	24
MMedia.T.1 Pilot Multimedia Enablement of Desktop Products	Jan-94	9
MMedia.T.2 Pilot Navigable Compound Documents	Apr-94	9
MMedia.T.3 Pilot Speech and Handwriting Recognition	Apr-95	6
MMedia.T.4 Pilot Applicability of Object Databases to Multimedia	Jul-95	12
MMedia.T.5 Pilot Desktop Videoconferencing	Jan-95	6
Office.I.1 Implement FAX Input/Output	Jan-94	24
Office.I.2 Install Online Scanners	Jan-94	24
Office.I.3 Install Ubiquitous OCR	Jan-94	24
Office.I.4 Install Client/Server E-mail	Jan-94	36
Office.I.5 Implement Mail-enabled Applications	Oct-94	30
Office.I.6 Implement Electronic Forms Routing and Authorization	Jul-94	30
Office.I.7 Implement Viewers/Translators	Jul-94	18
Office.I.8 Integrate Voice-mail and E-mail Systems	Jan-94	36
Office.A.1 Implement Security Policy and Procedures	Jan-94	12
Office.A.2 Scan in Historical and Reference Data	Jan-95	36
Office.A.3 Migrate Forms	Jan-94	24
Office.A.4 Implement Online Librarian and Document Repository	Jan-95	24
Office.A.5 Recognize Electronic Signatures as Binding	Jan-95	12

Roadmap to the SRS Computing Architecture

Office.A.6 Implement the Paperless Office	Jan-96	12
Office.P.1 Implement Document Management System	Jul-94	24
Office.P.2 Implement Electronic Data Interchange	Jul-96	18
Office.T.1 Implement Voice Processing	Jan-97	48
Object.I.1 Establish Site Object Framework Team (SOFT)	Jul-94	24
Object.I.2 Adopt Site Object Messaging Standard	Jul-94	6
Object.I.3 Establish Object Framework	Jan-95	24
Object.I.4 Determine and Implement the Necessary Changes to WISDOM to Support an Object-oriented Environment	Oct-94	6
Object.I.5 Re-engineer Existing Core as Object Applications	Oct-96	36
Object.A.1 Direct that Future Site Applications Should be Object-oriented	Jul-94	12
Object.A.2 Procure Object-oriented Technology	Jan-95	18
Object.A.3 Develop Object Migration Plans for Existing Systems	Jul-95	18
Object.C.1 Implement Matrix Project Team Approach	Jul-95	6
Object.C.2 Develop Site Expertise In Object-oriented Technology	Jan-95	12
Object.C.3 Establish Reward System for Code Reuse	Jan-95	12
Object.P.1 Establish Object-oriented Documentation Requirements	Apr-95	6
Object.P.2 Establish Object-oriented Development Methodologies	Jan-95	12
Object.P.3 Implement Online, Centrally Managed, Distributed Access for Site Object Framework Developer Documentation	Jul-95	6
Object.T.1 Survey Industry Experience in Migrating Legacy Systems to an Object-oriented Environment	Apr-94	36

Object.T.2 Demonstrate Relational Database Access from Object-oriented Systems	Oct-94	12
Object.T.3 Evaluation of Operating Systems (Object-oriented)	Jan-95	12
Object.T.4 Evaluation of Object-oriented Development Tools	Jan-94	36
Object.T.5 Explore Distributed Object Server Technology	Oct-94	18