Network Infrastructure and Services for the Alcoa Building

Preliminary proposal to the
Southwestern Pennsylvania Commission

Submitted by

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EXECUTIVE SUMMARY

Information Renaissance proposes two approaches to develop networking infrastructure and Internet services for the Alcoa Building 425 Sixth Avenue in Downtown Pittsburgh. One approach adopts a "Clever Building" concept, which provides low-cost entry into Internet services using existing building infrastructure where possible. This approach is useful when the percentage of network users in the building is low and the issue of initial cost is of paramount concern. The second approach is more comprehensive: it establishes "Smart Offices" throughout the building with an ultra high-speed backbone capable of providing advanced services such as desktop video conferencing. Although it requires a higher initial capital investment, the Smart Office approach will provide infrastructure with an expected lifetime in excess of ten years and allow for services at prices lower than the Clever Building model once a majority of the building's tenants are making regular use of the Internet.

I. Overview

Internet access and Internet services are fast becoming an essential element of the modern office. These services allow for fast, efficient and low-cost distribution of information; for rapid access to resources maintained by governments, businesses and educational organizations; and for the establishment of communities of interest centered around topic of common concern.

These factors are as important to organizations working in the area of economic development as they are to the businesses which will drive the economic future of the region. Additionally, the role of the Alcoa Building in uniting agencies working in the area of economic development suggests that the community-building function of the Internet could provide an important ingredient for the common work of these organizations.

The rapid and continuing growth of the Internet stems largely from its efficiencies of scale. On the building level there are additional economies of scale for infrastructure and services, which make it advantageous to implement a common architecture for tenants of a given building. Such an architecture is proposed for the Alcoa Building in the present document.

The architectures described in this proposal are based on widely-used networking standards, as employed by Information Renaissance and other network practitioners in numerous other projects. Two specific networking models are offered to the Southwestern Pennsylvania Commission for possible implementation in the Alcoa Building. The first model makes extensive use of existing building wiring. This approach allows for low-cost initial connections to any building tenant, with speeds adequate for common networking tasks. We refer to this approach as the "Clever Building" model. The Clever Building will employ new technologies to extend the capacity of existing building wiring, allowing for peak communication speeds of over 1 million bits per second (1 Mbps) from any office in the building. This is approximately twenty times faster than the speeds available over conventional dialup network links. These high-speed links can be deployed very rapidly, since a minimum of new construction will be involved in the Clever Building approach.

The second model establishes a networking environment that will provide a showcase for the use of Internet technologies in office buildings and will demonstrate the application of these technologies in the area of economic development. Building tenants will have access to advanced services such as desktop video conferencing, and the building will be able to accommodate new services as they are developed over the next decade. This model requires a higher initial investment in building infrastructure, but it is actually cheaper in the long term, when a majority of the building's tenants will have availed themselves of the services provided. The networking speeds available in this approach are even higher than those of the Clever Building approach: communication links within the building will be available at speeds of 10 Mbps, 100 Mbps and 1000 Mbps.

In addition to providing an advanced networking infrastructure, the Smart Office approach will provide the individual and institutional support necessary for building tenants to make easy and effective use of the new technologies that will be enabled by this infrastructure. An operations staff will maintain these services from a Network Operations Center that will be established on the first floor of the building. This staff will provide user training and support as well as network trouble-shooting and advice in the areas of network design and setup.

In either the Clever Building or Smart Office approach, there will be a networking environment which allows for a number of building-wide services. One of these services – known as caching – provides an enhancement to basic Internet connectivity and will be deployed in lieu of a more expensive external Internet link. Additional services, such as electronic mail, file serving and automated backup procedures can economically be provided on a building-wide level and will be supported in either the Clever Building or Smart Office model. Other services, which entail additional personnel and hence additional cost, will be proposed only as part of the Smart Office model. These services relate to data security, network monitoring, system maintenance and user support.

The networking environment that will be provided in the Clever Building model will enable any tenant of the Alcoa building to gain immediate access to commonly-used Internet services. The environment that will be provided by the Smart Office approach goes beyond this and offers network services and performance on a par with those available at any networked site in the world. This will establish the Alcoa Building as a regional showcase for the implementation and use of Internet technologies and enhance the building's role as a focus and stimulus for regional economic development.

II. Smart Office

The central tenet of the Smart Office is ease of use. To this end, all offices in the Alcoa Building will be wired for telecommunications services. Tenants will be able to configure computers for operation on the Internet by simply plugging them into data outlets that will be supplied under this wiring scheme. In this manner new computers can be taken out of the box and brought into service with a minimum of setup time and expense.

Office wiring will be industry-standard Category 5, suitable for telephony or data services at speeds up to 100 million bits per second (100 Mbps). This will provide an ideal environment for bandwidth-intensive applications such as map servers, video servers and desktop video conferencing. The cost per user of this system depends upon the fraction of building tenants who make use of the services offered. With full deployment (100% utilization), the cost per user would actually be lower than the cost of individual dialup service for this user population.

Within the building fiber optic cabling will carry signals from wiring closets located on every third floor to a building network hub on the 18th floor. The fiber optic lines will operate at data speeds of 1000 Mbps (or 1 Gbps), so there will be no bottlenecks for any interoffice traffic within the building. The building hub will be connected to the Internet through a single shared 10 Mbps link. This architecture offers great economies of scale for the external Internet connection, and it allows individual users to enjoy peak bandwidth up to the full 10 Mbps connection.

Another important feature of Information Renaissance's Smart Office concept is the support of Virtual Local Area Networks (VLANs). This feature provides for the security of each client's network, separating that network from other network segments in the building. The VLAN concept allows clients and groups of clients to maintain secure, logically independent networks, even if their offices are in different parts of the building.

The overall architecture that will be supplied in support of the Smart Office Model will have the capacity for advanced services such as desktop video conferencing, data security and personal privacy. In addition to network services, Information Renaissance will supply support for individual users and organizations so that they can make effective use of the supplied technology. Services for organizations will include:

- Maintenance of Local Area Networks
- Domain Name Service and Dynamic Host Control Protocol
- File serving and backup
- E-mail accounts and management of mailing lists
- Web caching
- Provision of consumable supplies
- Electronic concierge (consulting in technical architecture and assistance in purchasing)
- Access to high-performance peripherals (printers, plotters, tape drives, recordable compact disks)
- Firewalls
- PGP keys and other certificates for privacy and security
- Assistance in disaster recovery

In addition to these institutional services, Information Renaissance will provide services for individuals – both end users and technical specialists in organizations in the building. These services will include:

- PC and application training
- Design and setup of Local Area Networks
- Setup of Internet servers and services

Implementation of the Smart Office concept involves the following architecture, as illustrated in Figure 1:

- Network hub with high-speed building Internet connection. This hub will be located on the 18th floor in space that already provides necessary air conditioning and cable access. Server space will be available for rent to individual clients in this climate-controlled and securely maintained space.
- Fiber runs from the network hub to satellite wiring closets located on every third floor. These rooms are the current wire distribution sites. With the removal of existing wiring, these rooms will provide good access to floors immediately above, below and on their level.
- Copper build-outs of Category 5 wire on each floor.
- Optional deployment of a roaming (wireless) environment in selected areas of the building.
- Ethernet switches in the wiring closets to provide VLANs throughout the building.
- A Gigabit Ethernet or Asynchronous Transfer Mode switch at the network hub connecting to the Ethernet switches in the satellite closets. These high-speed links allow for data, video and voice connections to each floor.
- Servers to provide common building services, including Web caching, e-mail, Web hosting and data security. These servers will be located on the 18th at the network hub.
- A Network Operations Center and user support facility will be constructed on the first floor on the site of the former newsstand.

The environment that will be established with this infrastructure will give all building tenants access to the most advanced services currently available on the Internet. The building infrastructure anticipates technical developments likely to occur over the next half dozen years and should have a lifetime well in excess of this period.

III. Clever Building

The Clever Building model is limited in scope relative to the Smart Office approach, but it offers a number of advantages over an approach in which individual tenants must fend for themselves in the acquisition of Internet services. Since deployment of the Clever Building model does not require any extensive construction, it can be staged in over a time period compatible with the building's growth in demand for network services. Key infrastructure features of this scenario are as follows:

- Opportunistic use of existing building wiring. This would include the deployment of devices to allow older IBM network wiring to be used for Ethernet transport and the deployment of Digital Subscriber Line (DSL) modems to allow high-speed data transport (at speeds of 1-2 Mbps) over telephone wiring in existing vertical risers.
- Ad hoc deployment of networks for individual clients. Rather than wiring the whole building as in the Smart Office concept, the Clever Building approach would provide network connections only as requested by individual clients in the building.
- Domain Name Service and Dynamical Host Control Protocol would provide computers in the building with Internet addresses with minimal setup effort on the part of individual users.
- User training and support would be provided by contracts at the request of individual clients in the building.
- Shared building Internet connection, with a caching Web server to enhance network performance.
- Building network hub on the 18th floor to house routers, servers and DSL modems.

From a user's perspective the Clever Building would offer low-cost access to the Internet and to internal building network services. Inter-office data communications could flow at speeds of at least 1 Mbps. A shared Internet connection with a speed of 4 Mbps would assure that there would be no bottleneck for Internet access. Services oriented for external access could be located at the building's network hub and have access to the full 4 Mbps external link. Unlike the Smart Office approach, the Clever Building has no price penalty if only a small percentage of the building's tenants make use of the service. If, however, a large fraction of the tenants require Internet services on a regular basis, the Clever Building approach loses much of its appeal, since the shared infrastructure of the Smart Office approach wins out once a majority of building tenants are making use of it.

Some elements of the Clever Building model are already being supplied by network providers with facilities in the Alcoa Building. Specifically, there is already a provider who offers DSL service over existing building wiring. But this provider is offering rates more in line with those charged by providers who must bring new lines to the building for each additional subscriber. The economies of a shared building infrastructure do not appear to have been passed on to building tenants in this approach. Information Renaissance's Clever Building model would pass on these cost savings. Additionally, Information Renaissance would provide common services such as shared electronic mail, shared file serving, shared backup facilities and a shared caching Web server to all building tenants. These services will add to user convenience and network performance with minimal added cost to building tenants.

Implementation of the Clever Building concept involves the relatively simple architecture illustrated in Figure 2:

- Building hub and network operations center on the 18th floor
- Switch/router to provide connectivity to individual clients on an as-needed basis
- DSL service over existing building copper, where possible
- Ethernet hubs for each client

IV. Comparison of Models

The following table offers a point-by-point comparison of the Smart Office and Clever Building concepts:

CONCEPT	Smart Office	Clever Building
Building-level connectivity	High performance router to 10 Mbps upstream link	High performance router to 4 Mbps upstream link
Building hub	Network hub on the 18th floor with upstream router, downstream switch, building servers and space for customer servers	Network hub on the 18th floor with upstream router, downstream switch and caching server for building tenants
Building backbone	1000 Mbps (1 Gbps)	1 Mbps
Riser cabling	Fiber to each satellite closet	DSL over existing copper to each client; fiber only as needed
Customer LANs	10/100 Mbps Ethernet; ATM optional	10/100 Mbps Ethernet
Satellite closet electronics	Switch/router	Ethernet hub, if needed
Network Operations Center	Network Operations Center on 1st floor with user service center and computer supplies	Offsite network management
Building servers	Internet services, caching, file serving, firewall, archive	Internet services, caching, file serving
Personnel	System administration, network administration and user support, resident in 1st floor showcase	Network design, network monitoring and user support, offsite, by optional individual contract

V. Smart Office Pricing

BUILDING INFRASTRUCTURE		
Building hub (18th floor)		
Upstream router with SMDSU (Cisco 4700)		$ 40,000
Downstream switch/router		$ 73,000
Caching servers		$ 25,000
Rack, power conditioning, patch cables		$ 6,000
Riser wiring		
12 strands of fiber to each satellite closet		
10 runs with average length of 225'		
4500' of 6-strand fiber (installed)		$ 25,000
Satellite wiring closets (every third floor)		
10 10-port switch/routers @ $10,000		$100,000
100 16-port managed hubs @ $1,500		$150,000
Rack, power conditioning, patch cables (10 @ $3,400)		$ 34,000
Horizontal runs		
30 floors, 50 dual drops per floor, 1500 dual drops total		
average run of 125', 6250' per floor		
187,500' Category 5 wiring total		
$250 per dual drop, typical		$375,000
TOTAL BUILDING INFRASTRUCTURE		**$828,000**
NETWORK OPERATIONS CENTER		
Design	$ 3,500	
Remodeling	$20,000	
Furniture	$ 3,500	
Staff computers	$ 7,500	
Network monitoring hardware/software	$ 7,500	
TOTAL NOC		**$ 42,000**
EXTERNAL CONNECTIVITY		
10 Mbps SMDS (Bell Atlantic)	$32,000	
Verio Internet connection	$55,000	
TOTAL EXTERNAL CONNECTIVITY		**$ 87,000**

PERSONNEL

Salaries			
	User consultant (1 FTE)	$ 40,000	
	Office support (0.5 FTE)	$ 15,000	
	System/network management (1.5 FTE)	$ 90,000	
	TOTAL SALARIES		$155,000
Benefits (@ 30%)			$ 46,500
TOTAL PERSONNEL			**$201,500**

SMART OFFICE COST SUMMARY

ONE-TIME COSTS			
	Infrastructure	$828,000	
	Network Operation Center	$ 42,000	
	Installation for external connectivity	$ 2,000	
	TOTAL ONE-TIME COSTS		$872,000
CONTINUING COSTS			
	External Connectivity	$ 85,000	
	Personnel	$201,500	
	TOTAL CONTINUING COSTS		$286,500
SUBTOTAL			**$1,158,500**
INFO-REN DESIGN AND MANAGEMENT (15%)			$173,775
TOTAL PROJECT COST			**$1,332,275**

VI. Clever Building Pricing

BUILDING INFRASTRUCTURE		
Building hub (18th floor)		
Upstream router		$ 30,000
Downstream Switch/Router		$ 50,000
Caching server		$ 5,000
File server		$ 5,000
Riser wiring		
Existing copper (typical)		
DSL electronics (per customer)	$ 2,000	
Satellite wiring closets		
Managed hubs (per port, typical)	$ 200	
Horizontal runs		
Category 5 (125' feet typical)	$ 200	
Termination/testing (per dual drop)	$ 50	
TOTAL (10 dual drops, typical)	$ 6,500	
TOTAL COST, 50% COVERAGE (75 clients):		$487,500
TOTAL BUILDING INFRASTRUCTURE		**$577,500**
EXTERNAL CONNECTIVITY		
4 Mbps SMDS (Bell Atlantic)	$26,000	
Verio Internet connection	$30,000	
TOTAL EXTERNAL CONNECTIVITY		**$ 56,000**
PERSONNEL		
Network Design: (0.5 FTE)	$ 25,000	
Benefits (@ 30%)	$ 7,500	
TOTAL PERSONNEL		**$ 32,500**

CLEVER BUILDING COST SUMMARY

ONE-TIME COSTS		
Infrastructure	$577,500	
Installation for external connectivity	$ 2,000	
TOTAL ONE-TIME COSTS		$579,500
CONTINUING COSTS		
External Connectivity	$ 54,000	
Personnel	$ 32,500	
TOTAL CONTINUING COSTS		$ 86,500
SUBTOTAL		**$666,000**
INFO-REN DESIGN AND MANAGEMENT (15%)		$ 99,900
TOTAL PROJECT COST		**$765,900**

VII. Notes

- Equipment specified for Clever Building can migrate in the direction of the end user as the building is upgraded to provide Smart Offices.
- Need clear demarcation of building-level services and fees versus user-contracted services and fees.
- Need payment schedule – monthly, in advance of month's work?
- Need performance requirements.
- Need budget for remodeling and furniture for Building Hub on 18th floor.
- Clarify ownership of wiring, network electronics and servers.
- Clarify payment for NOC and Building hub space.
- Clarify payment for electrical power, including emergency power.
- Wiring estimates have not been verified by walk-through and bid from possible installer.
- Continuing costs should include money for equipment upgrades.