NII in the Home

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Abstract

To accelerate the growth of interactive services in the home and small office markets there are a number of areas that need to be develop and/or improved. In terms of content, the services need to build the infrastructure to support product advertising and point-to-point information sharing with acceptable security and quality.[1] The product advertising needs to represent a new, more cost effective paradigm for brand-name providers that generates more or additional retail sales compared to more conventional means. It is likely that for quality and transaction reasons this will require a color printer.[2] On the technology side of the service in addition to security there is a unmet need for scalability in architecture and data/image standards, and scalable API's need to be develop that insulate content developers from servers from networks from computers and settop boxes from user interfaces. These API's are essential to allow for independent development and growth of each technology. Lastly, the content providers need to continue thinking in terms of entertaining applications and the user interfaces need to continue to emphasize easy-to-use and fun-to-operate.

Introduction

Interactive Information access is considered by both the US government and US industry to be one of the fastest growing markets in the later half of the '90's and beyond. Market and social forces such as significantly reduced personal time, consumer interest in global access to merchandise and services, and the increasing blur among computer, communication, retail, electronics, manufacturing, and service companies, and technology forces such as new high bandwidth networks, better application software, consumer affordable digital scanners, cameras, and printers, and increasingly capable computer platforms are mutually driving this growth. Early "explorers" in the industry are conducting trials, offering services, developing components and systems, authoring content, and constructing business partnerships and models at a staggering pace. All these participants share the notion that there must be a "pony in here somewhere", but no one has stumbled on it as yet. The killer application has given way to an array of interactive services including personalized news, automated bill paying, home shopping, education and health information, games, and video-on-demand. Although a seemingly compelling array, products that have experimented with such offerings such as the GTE Mainstreet and Videoway cable services and the Prodigy computer network service have experienced penetration rates of less than 20% with high turn over and break even businesses at best. This is true even with fairly low cost deployments, e.g., the GTE Mainstreet settop box technology adds only incrementally to the cost of the conventional cable converter. This sort of market response certainly can not support the high cost of equipment that is currently being deployed in cable trials such as Time Warner in Orlando, Florida or US West in Omaha, Nebraska.[3] A review of the learnings to data point out five areas where progress is required to break the logjam; 1) improvements in image quality and extensions to still image content to drive advertising and printable image data, 2) network architectures that support shareable image content, 3) general, scalable API's for authoring that is platform and operating system independent, 4) stable and scalable standards for video and still image content, and 5) data and transaction security systems that protect content, purchases, and information exchange.

Advertising, Printing, and Image Quality

To fund the interactive information infrastructure sufficiently to achieve wide market acceptance, most early enablers have recognized that the key economic fuel is advertising. This should be no surprise. The four major communication industries; newspapers, printing and publishing, television, and telephony (yellow pages and phone solicitation) have all been constructed on the over one trillion dollar retail industry through advertising. It is this author's opinion, that without a path for major advertisers interactive information services will never be more than a low penetration curiosity. The good news is that the retail industry is indeed looking for more effective ways to reach consumers with their merchandise. Personalized, interactive services can be significantly more directed than the broadcast advertising of catalogues, magazines, and newspapers, and with the right level of quality much more appealing to the increasingly savvy consumer than the oftentimes numbing and offensive advertising of TV. The problem for interactive services is that newspapers are inordinately cheap, catalogues and magazines are very high quality, and both represent interactive bandwidths that are and will be for a long time the envy of any electronic substitute. In addition, television is extremely entertaining at a fairly low cost with a reasonable degree of user control, i.e, the clicker, and yellow pages and the invention of answering machines has made telephony a fairly user friendly source of merchandising information. In the spirit of more for less, information services need to offer significantly more value in one or more of the key areas of cost, quality, choice, fun, convenience, and security with being significantly disadvantaged in any one of the other areas. For example, the advertising content on an interactive information service could bring high quality image content to the home with personalized daily updates for the local area in which the consumer resides. This could be thought of as a high quality newspaper or a personalized catalogue or both. As

such, it would push the envelope for advertising content and stimulate a new market. It is these shifts in paradigms that are necessary to kick-start the interactive information services.

Before moving to the next category, a number of customer focus groups and market trials and surveys have pointed out the need and value of a printer in interactive services.[2] For home shopping services, the reasons for this are fairly obvious. People buy today in only a very few ways. It is either live and in person as in a mall, retail store, car dealer, etc., through a catalogue, or through the new phenomena of home shopping cable channels with a key learning in the last area that without a high quality viewable representation of the merchandise return percentages are extremely high. In each case, the buyer is basing his purchase on a degree of trust that he is getting what he saw. The more sure he is that what he saw is what is in the box, the more willing he is to buy. Color printers have improved in quality significantly in recent years to the point where low cost, magazine quality printing on mid-range computer platforms will soon be a reality for consumers. These prints can be personalized, e.g., personal catalogue, and they can be color accurate and significantly higher resolution than TV's or computer monitors. Will customers buy more and keep more if they have access to a high quality rendition of the merchandise from a bundled color printer? It is this author's position that the answer is yes. It is also true that consumers are keenly interested in keeping track of the transaction with some sort of real time receipt or written confirmation of the transactions. They are also motivated by deals such as coupons, give-aways, contests, etc. but their level of confidence in the value of the deal is highly driven by having something in writing that they can carry around with them and store for safe keeping. Such a printout also builds a direct link to the merchandiser and can be personalized so that a consumer feels that there is a person on the other end. Color printers also open up new application opportunities such as personal imaging.[2]

Information Sharing and Transactions

Another key learning from current interactive services and market trials is that users like to share.[4] The chat boards on the Internet are indicative of this, although they are certainly not for the average consumer. Taking sharing to the next level of point-to-point information exchange of data and images touches a chord of human insecurity far beyond that of audio. Pictures and written words contain emotions that are much more personal than audio, and how many people are comfortable saying personal things over the phone. Conveying the perception to the consumer that his personal data and image information is secure in terms of both access and transmission is key to expanding the communication opportunity to the wider market of personal sharing.[4] This is also true for commercial information sharing. Professional imaging labs and graphics and prepress houses currently lease "private" lines for image communication. The image content they share is their product! If they in any way sense that that product is insecure, they will switch to alternate forms of communication without hesitation. The first concern that is expressed by the major corporate players in these industries is security. They currently hesitate to consider any centralized network service for their information exchange because they do not trust the security of such systems.

Point-to-point sharing also adds significant switching complexity to high bandwidth systems, but an important first realization of this capability does not have to involve video. There is a huge commercial and consumer market for still image sharing given the increased capabilities of computer platforms and displays, new low cost digital color printers and scanners, Kodak's PhotoCD, and the emergence of commercially affordable digital cameras from Kodak and Apple. It is not unreasonable to see the future sharing of photographs and magazine pages as easy and cheap as telephony is today.

Scalable Image Standards and Architectures

The evolving infrastructure of the information superhighway will be able to support a wide range of imaging applications from low resolution entertainment such as video-on-demand to the high resolution image exchange of the medical and graphics arts industries. This wide range of applications and businesses will put pressure on the flexibility of the storage, processing, manipulation, and delivery of image data throughout the telecommunication network. The last section discusses the storage and bandwidth requirements of various imaging applications, but a key element of the system architecture and imaging standards is scalability.[5] Figure 1 illustrates the concept of a scalable architecture in terms of input, storage, communication, and output. For still images a key aspect of this scalability is the need to have images at various levels of resolution. One can easily imagine image access and image editing applications running in a client-server model over the network. Putting an image resolution "knob" in the hands of the client for search and select applications, image insertion, composition, and editing in document for publishing applications, and image analysis for medical applications is a key example of scalability that opens up a wide range of applications compared single high or low end solution. An example is shown in Figure 2 where for each resolution there is also a choice of color space and com- pression as additional application dependent parameters. In general, the lower resolutions are used for search, color correction, layout, and image insert functions, while the higher resolutions are used for review, printing, and more sophisticated image editing functions like composition. As such the lower resolution images serve real-time or near real-time requirements, and the higher resolution images are generally reserved for off line processes. The lower resolutions therefore want to be in display color spaces, i.e, RGB, and highly compressed, and the higher resolutions want to be in luminance/chrominance color spaces, i.e, CieLab and PhotoYCC, and uncompressed or compressed with little loss. The standards also need to support color management.[5] Given such formats and color management, application developers can choose to access just the information they need for a given task creating a color accurate, more real time experience for users.

An additional aspect of scalability is in the area of application development. It is essential that interface standards are developed between content providers and servers, servers and networks, networks and computers or settop

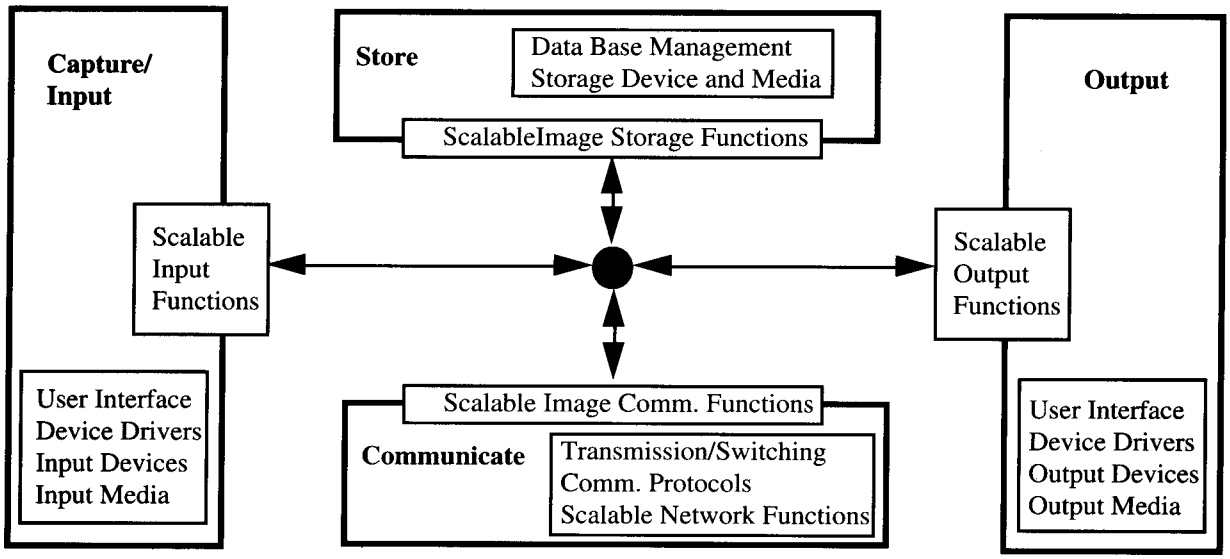

Figure 1. Reference architecture for general image telecommunication

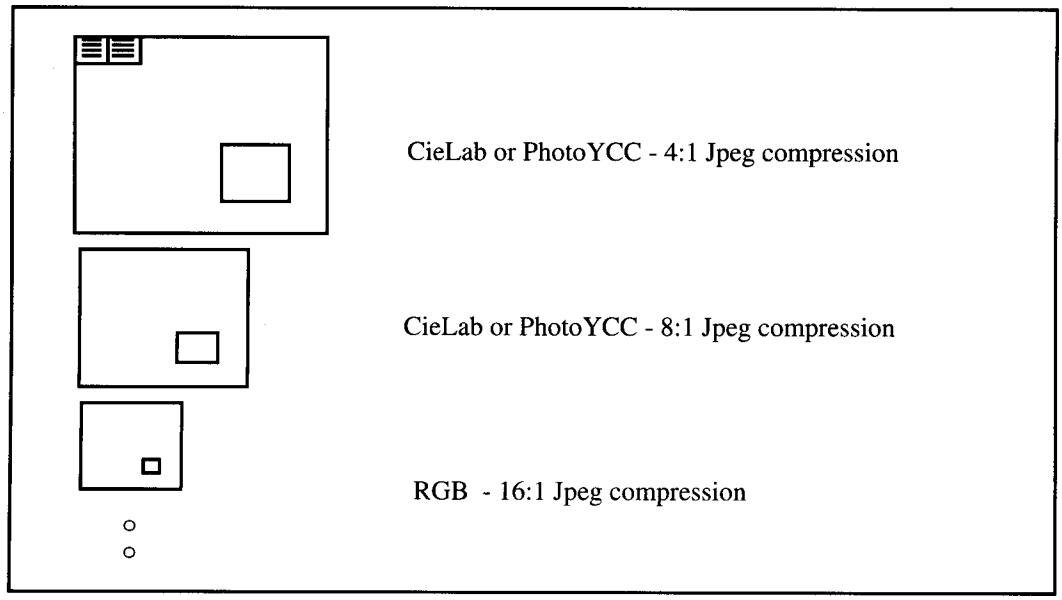

Figure 2. Graphical example of tiled, hietrarchical still image format

Application	Image Size	Compression	File Size	Trans Time	Bandwidth	Storage
Printing	2k × 3k × 3B	24:1	750 kB	60 sec	100kb/sec	750 mB
Editing	256 × 384 × 3B	12:1	25 kB	1 sec	200kb/sec	750 mB
Review	512 × 768 × 3B	24:1	50 kB	4 sec	100kb/sec	50 mB
Searching	128 × 192 × 3B	12:1	6 kB	1/4 sec	200kb/sec	6 mB

Figure 3. Bandwidth and storage requirements for various still image applications

boxes, and settop boxes and user interfaces. Each area uses different languages and protocols and is at a different level of maturity, and buffers are needed to allow for independent development. Content providers don't want to know about operating systems, networks, or servers. System architectures that provide this level of modularity will be the winners.

Still Imaging Requirements

Discussions with interactive service providers, especially those engaged in cable trials, point out that when they consider integrating high resolution still images into their services they think that it will cause information overload. Depending on the application the bandwidth and storage requirements can be significantly less for still images than video. Based on good quality video requiring approximately 4 mbit/sec bandwidth, the still image bandwidth requirements can be 40 times less. In terms of storage, 1000, 1.5 hour video titles at 4 mbit/sec requires 3 terabytes. This is equivalent to 3.6 million print quality, i.e., 2k × 3k × 3 bytes @ 24:1 compression for 8" × 10" page, images. If the images are stored hierarchi- cally with the five resolution layers illustrated in Figure 2 the redundancy is 33% which only reduces this number to 2.7 million. This is a significant number of images that would likely serve most still imaging applications. Figure 3 shows bandwidth and 1000 image storage requirements for different imaging tasks where for editing it is assumed that the area being edited fills 1/4 of a computer monitor but the storage required is full printing resolution. The figure shows that ISDN-like bandwidths are sufficient but that modem-like bandwidths will be highly constraining.

Summary and Conclusions

In summary, it is this author's opinion that to become a market success NII must provide value added for advertisers and still image sharing. The NII must also include printing capability for transactions and compound image pages, and secure access and transmission. Still image standards must also be implemented that serve all levels of applications and include color management, hierarchical resolution formats, and support for various compression technologies. Still image applications can be implemented with significantly lower bandwidth and storage requirements than video. Lastly, API's must be develop to insulate content developers from servers, networks, computers, and settop boxes, and entertaining content and simple user interfaces must continue to be major thrusts.

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