INFORMATION TECHNOLOGY AND DIGITAL SERVICES FOR RESIDENTIAL USERS

INTRODUCTION

Relevance of the Topic

Unlike the computing environments through the 1980s, many technologies in the home now follow in close proximity to their correlates in the corporate world. In some cases, corporate use of technologies even trails private home use (e.g. Google, chat applications). Notably, the diffusion of the Internet into the private sector has proceeded at enormous pace. Not only has the number of households with Internet access skyrocketed, but also access speed, number of users within the household, types of uses, and mobility of access. Popular private applications such as music and video downloads require fast access to large networks. Such applications encouraged the increasing diffusion of broadband into private homes.

Home and business technologies are increasingly intertwined because of the increasingly rapid pace of innovation. Also, home information technology (IT) often grows during times of economic slowdown due to price decline or network effects (DVD and Internet in the early 1990s; wireless and mobile during the early 2000s). While convergence prevails, markets for private IT applications separate from the corporate market evolved as well. Price decline and miniaturization encourage a trend towards ubiquitous computing and a networked society.

Definitions

Home computing trends revolve around various household functionalities, notably entertainment, information, purchasing, education, work, and health. During an age of networks these applications are often no longer merely household related, but they require integration of home and business technologies. A key trend observed during the past decade has been the convergence of technologies, of content, and of applications (Friedman, 2006).

The conceptual separation of business/public computing services from those related to the home and/or private use is increasingly difficult. This article focuses on services in the home; but miniaturization, networking, and mobile technologies have blurred the line between home and other locations. Brenner and Kolbe's *(1995)* definition includes all the infrastructures and applications the user can take advantage of for private uses incorporates entertainment, information, communication, and shopping. Some other applications cross over into the public or business realm, in particular telework and distance learning. Mobile phones, PDAs, personal entertainment technologies all are designed to extend applications which are conveniently available in the home to any location the user chooses.

Structure of this Article

This article explores key issues pertaining to home computing products and services. In particular it will discuss convergence and other current technological trends related to end-user devices and networking. Since much of the technology discussed is derived from corporate computing applications and adopted for home use the present article will focus on content and usage of home computing more so than on technical details.

As the technology becomes more available and common, concepts such as "computerized homes", "home-IT", "information society" or "networked society" are increasingly defined by the services and uses with which they are associated. The article concludes with an analysis of technology trends as they pertain to these uses and services.

DRIVERS OF TECHNOLOGY ADOPTION IN THE PRIVATE HOME

Convergence

Convergence of technologies has a critical impact on home computing as well as information and entertainment (Mundorf & Bryant, 2002; Pavlik and McIntosh, 2005). While analog technologies generally coincided with a limited one-on-one relationship of applications and appliances, digital technologies have made it possible to perform multiple functions with the same piece of equipment. This has lead to an increasing overlap between the telecommunications, television, and consumer electronics industries. For the user it means that the same appliance can be used for work-at-home, private communication such as email, chat, telephony or sharing of family media (e.g. photos and videos), children's entertainment, on-line shopping or home banking, health care, and interaction with public agencies. Apart from technological innovation and cooperation among industry sectors, adoption of interactive media consumption patterns by the users is the third dimension of convergence. There is a continuing debate as to how rapidly convergence will be embraced by consumers. Even though it has been technically feasible for some time, in the past the diffusion of convergence was seen as limited due to demographics, lifestyle preferences and other factors (Stipp 1998). For instance, the initially slow convergence of Television and computers on the user side did not advanced as rapidly in the 1990s as expected by many in the industry. Meanwhile streaming video of TV programming is available on the Internet, cable systems offer "Digital Cable," and based on standards such as DMB and DVB-H, the latest cell phones can be used as TV sets as well.

Convergence is gradually advancing. Cable companies enhanced the existing fiber/coax physical plant of their systems with digital set-top boxes and digital distribution technology. More recently capabilities such as DV-R have been added. These upgrades permit greater channel capacity, as well as interactive features. On-screen program guides, hundreds of on demand channels, as well as multiplexed premium cable channels, and digital music are common.

In a typical digital cable offering interactivity is limited to two levels of information, which can be retrieved while watching a program or perusing the on-screen program guide; *on demand* ordering, as well as selection, programming, and programmed recording of programs through the

J. Webster (ed.), *Wiley Encyclopedia of Electrical and Electronics Engineering*.

on-screen guide are also interactive features. The systems are designed to allow for future expansion, especially online ordering of services as well as other purchases. Video on Demand (VoD) permits users to order movies and other video from a large selection in a real-time setting. Viewers rely on background information for TV programs, such as news, or even video clips—which can now be downloaded to iPods and similar devices. Also, mobile phones and radio have converged as talk radio relies on cell phone users to call in during 'drive time' (Eastman and Ferguson, 2006). Content for these video offerings comes from various sources, private and commercial, legal and illegal. Providers of VoD services are not limited to TV and cable networks, but in some cases they are telephony or internet service provider industries or entirely new start-ups.

Some 'free' VoD options permit subscribers to cable networks to choose movies and programs from those networks on an on-demand basis. Few interactive applications give the viewer options beyond simply choosing a program. These include game show participation, choice of camera angles at sports games, access to background information for products advertised in commercials, and choice of plot lines and endings in movies. Other interactive uses of TV are calling up additional information on news and sports or TV/PC multitasking. Increasingly TV and radio is supplemented by websites for information retrieval as well as audience feedback and service applications (such as buying tickets or merchandise).

In the consumer electronics sector, convergence features home entertainment. Digital picture, flat screen technology, surround sound and HDTV as well as high definition DVDs (HD-DVD) encourage the trend towards home theatres. Media players allow integration of video, audio, photos, and even television content and IT companies invest in companies creating digital consumer products (Computer companies. . . , 2004; Bremmer 2006). On the other hand, cable set top boxes and digital TV sets are equipped with PC card slots that will enable multiple functions, such as the addition of "digital-video recording functions or a wireless connection to a home computer network" (Consumer electronics, 2004, B8).

User Interface: TV, PC, Phone

Much discussion of home IT focuses on the Internet. Innovations associated with traditional media also offer considerable potential, because such media evolve rapidly, converge with other media, and becoming increasingly interactive, while remaining 'downward compatible' with traditional media use patterns. These media often reach the majority of the population (in some countries, a vast majority) which lacks regular, adequate Internet access (NTIA 2006, Schonfeld 2000). Also, in spite of improvements in 'user friendliness' many users see the PC as work-related, difficult to use (requires typing) and prone to breakdowns and viruses. PCs and other digital equipment also tend to be outdated within a few years, if not months. By contrast, television sets last for decades (useable though outdated), they are easier to use, not prone to viruses, and are still less expensive.

Worldwide, television consumption is still the prevalent leisure activity, mainly because of its universal, low-cost accessibility and its ability to afford hours of entertainment and information with minimal effort. Although usage is changing rapidly, for some time consumers may continue to choose television for news and entertainment and PC for other sources of information, electronic commerce, work and school. Also there seems to be a demographic pattern in that young viewers increasingly stray away from conventional TV news either to Internet news or entertainment/news programs. The DVD player is largely a replacement for VHS home video with higher video quality and should thus be considered a pre-convergence single use extension to TV viewing.

While the expectation was that video delivery would increasingly involve home computing devices, such as combination PC-TV or Web-TV and digital recording technology such as TiVo (Schonfeld 2000), households initially invest in big-screen televisions and surround sound. TiVo was also adopted more slowly than expected, but it has gained considerable popularity, along with the comparable digital video recorder (DV-R) functionality for cable. A third, popular user interface is the telephone. Due to their rapid replacement cycle compared to regular line phones, cellular phones in particular tend to be equipped with the latest technological gadgets.

As prime value is placed on instant "24/7" communication personal technology is increasingly mobile. Due to simplicity of use, ubiquity, and compatibility with existing technology (i.e. the existing telephone network), adoption and upgrading of mobile phones are rapid. Besides regular voice use, text messaging has gained popularity among younger users, especially in Europe and Japan. Currently web access on mobile phones is available via narrowband channels. However, a new generation of mobile broadband (so called 3G networks) is currently being deployed. In concert with smartphones and wireless PDAs, broadband mobile networks, provide multimedia services such as videophone or content streaming. First roll-out in Asia started 2003. Pricing and compelling services are again key to success.

Voice-over-IP telephony represents added convergence of PC and phone technology in the private home, where companies such as Skype or Jajah offer free Internet-based voice and video service to members of the community and cheap rates when calling outside telephone numbers. As the latest development, video components and client software for mobile devices are added to the offerings.

Interactive Entertainment

Content is the key to adoption of advanced interactive services. Because of the high visibility of movies, the great public interest in this type of content, and their easy availability, Movies-on-Demand was the offering of choice for early interactive trials. Meanwhile cable systems and satellite providers offer near VoD with 100+ channels of current movies as well as specialized (e.g. "sports", "comedy", "adult") programming and sports or music events.

Music, sports, and special interest programming also have received their share of attention by the programmers

of interactive cable systems. Interactive game channels are added to some systems. In-home gambling has strong economic appeal; regulatory barriers prevail, however. Anecdotal evidence suggests that participants in interactive trials enjoyed watching regular television programs they missed during the week, newscasts tailored to individual preferences (Time Warner is pulling the plug 1997), as well as erotica. Current offering also tend to focus on movies, sports, and erotica—with the added bonus of time shifting. Current use of TiVo and DV-R permits viewers to schedule viewing at a convenient time. It also facilitates avoidance of TV commercials (if desired).

Individualized viewing is gaining popularity. But some interactive applications give the viewer options beyond simply choosing a program. Past examples include participation in game shows such as *Wheel of Fortune* and *Jeopardy*, "pick-the-play" games for *Monday Night Football*, ordering pizza using Web-TV during a *Star Trek* marathon, access to background information for products advertised in commercials, and choice of plot lines and endings in movies.

Compared to the massive number of traditional movies available, interactive movies are few and far between. They are difficult to produce and require considerable technology. Even most sites for Internet video provide mainly repackaged conventional programming or content provided by private users. Audience demand for interactivity is not yet fully understood. Many children and teens feel comfortable with it due to exposure to video and computer games; in fact, a considerable number of toys now include interactive components and interface with the WWW; a new trend in Japan is to market interactive toys to older adults as *virtual grandchildren* (Bartlett 2006). The push for greater interactivity will come from interactivity between users and user generated content as well as advertising, which already relies on cross-promotion between different media, including TV and Internet. Since marketing focuses on individualization, the ability to provide targeted advertising even within the same program is likely to have great appeal to advertisers. With commercial avoidance increasingly common, the push for product placement within programs may also lead to increasingly individualized product inserts. Broadcast television stations are expected to expand their channel offerings as a result of conversion to High Definition Television (HDTV) and greater channel capacity. It stands to reason that we will see selection and targeting rather than actual interactivity.

The Digital Home

The ultimate interactive experience may involve a home which is equipped with technology that can respond to the residents' needs. Smart house technology typically is developed for new high-end or special needs homes, and these technologies filter down into existing and mid-level homes. Some smart-house solutions for the elderly use the TV set as an interface for appliance control and surveillance. A key feature of future smart-house technology is the ability of various appliances to "talk to the Internet and to each other" (Levy 1999, p. 59). This allows a maximum of control by the user, as well as coordination of technologies. In the long run, shifting control onto the Web could generate considerable cost savings by reducing the complexity of the technology within each device.

Home networking technologies, such as the European EIBus or the US-led CEBus, enable the interconnection of different household functions such as heating, shades or lighting. In addition, wireless LANs have gained substantial ground in the private sphere, connecting IT devices. Audio/video-, PC- and other household networks are converging into the same infrastructure (Lee 2002; Higgins 2003), e.g. digital storage of music on a central server streaming custom audio programs into user-defined areas of the house via wireless LAN (e.g. Sonos' home audio system).

While many such technologies are available they have not been adopted on a broad scale. However, one might expect that demographic trends will drive such adoption: aging baby boomers have an increased need for home based conveniences and efficiencies; young home buyers have grown up with network technologies and may expect a high level of technology in their future homes. Also, elderly family members need increased attention, which may be facilitated via available technologies.

However, services to be delivered to the home not only require in-home technologies. Service providers such as banks or media firms need to prepare back-end infrastructures such as fault-tolerant servers, load-balancing access pipes and real time databases with information on availability or price quotes. Those out-of-home infrastructures are connected to the home via networks such cable, telephone, power lines, or wireless connections.

Similarly, the connected home is not limited to connections within the home, but also to the interactive WWW. Family members spread far apart can interact with each other in a much richer way using digital home technologies such as media sharing with online photo and video albums (such as flickr.com or youtube.com) and video telephony.

SERVICES FOR THE HOME

Media attention has been focused on innovative infrastructures for the residential area such as wireless LAN in the home or broadband connections to the Internet.

However, residential users — even more than corporate users are interested in the application side, i.e. an easy to use, reasonably-priced and fun service provision. Many applications exist in reality, yet they provide a quite unstructured picture.

Kolbe (1997) proposed a classification scheme for analyzing and describing the respective classes of home applications in existence. According to Brenner and Kolbe (1995) there are eight main services for residential users which can be supported by IT (see Figure 1):

"Information" and "communication" are mutually dependent: No communication is possible without at least some basic content provided on one end. In turn, information needs to be conveyed in order to provide any benefit. E.g. any news story posted by an Internet portal is meant as 'communicating information' to the (anonymous or personalized) users of that portal.

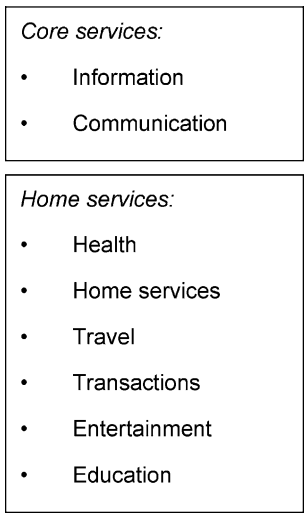

Figure 1. IT-influenced services for residential users.

Home services ones because they are based on these *core services* of information and communication. Nevertheless "communication" and "information" are also separate, as some services exclusively provide bi- or multilateral information (e.g. electronic books, news) or communication (e.g. email, short message service (SMS) benefits and derive revenues from those basic areas.

Miles (1988) and others (e.g. Higgins 2003) observed that more and more aspects of private life are affected by home services. We can differentiate three stages of usage according to the degree of networking. Prior to widespread networking stand-alone applications such as an electronic encyclopaedia or a game on a PC were common. Next, applications are connected within the confines of the private home, such as entertainment networks for home cinema applications or temperature control via TV or PC. The third stage consists of applications connected outside the home, such as applications using the Internet for email or shopping as well as remote monitoring services. All services can be structured long these three areas.

In practice, *core* and *home* services are used in conjunction with each other; e.g. while communicating on the Internet the household seeks weather information (information and travel) for air travel via a portal or a price comparison for airfares (travel), then executes the purchase (transactions) using a travel portal and then pays online using a credit card (transactions) and finally gets an email or mobile message confirmation of this order (communication). Another example is the 'Info- or Edutainment' area that unites information, entertainment, and education aspects, e.g. in interactive multimedia encyclopaedias or electronic learning toys for children (and adults).

Work, transaction, and private aspects of life are converging as are technologies and applications. In some instances, private and business usage is almost indistinguishable, e.g. the use of an Internet travel portal or smart phone features for personal information management (PIM). Therefore, some of the services described below may also provide business value as selective business applications benefit the private user, especially in a home office environment.

Core Services

Information. *Information* is offered by all services in which the dissemination of information to residential users is central. Information provides the basis for more complex service types to be discussed later.

The following residential applications fall into this category:

- News portals providing up to date news, weather, and stock market coverage. They provide access to the vast resources of the Internet to the private user. Interactive TV and multimedia broadband networks are pre-requisites for customized individual news services that compile newspapers individualized based on personal preferences and interests.
- Electronic books and newspapers such as the electronic version of the New York Times which is available online at no charge for basic coverage, and for a fee for premium content. Electronic books with portable e-book players are one of the most notable examples for pure information. Encyclopedias, magazines, dictionaries or special topics are available on different formats for proprietary players. Hyperlink functionality, connectivity to video printers, find and select algorithms are advantages vs. traditional books.
- A major trend is reading and discussing online information provided by individuals in so called blogs (a contraction from "web log"), which represent online fora that informally express ideas or even author fictional or non-fictional events. Some of those blogs have become influential and are visited by hundred thousands of readers daily. Major portals such as Yahoo and Google feature some blogs on their home pages.

Information meets social needs. A community of authors builds a knowledge base for common access like the online encyclopedia Wikipedia (www.wikipedia.org). Structured knowledge of unprecented depth and breadth has been built by this "one for all, all for one" approach to knowledge presentation and retrieval.

Communication. *Communication* enables residential users to establish bi- or multi-lateral contact with the immediate or extended environment. This core service provides information as the basis for a variety of further services. However, communication as a basic need of users is evident in the residential home. Traditional media like telephone, fax have been complemented by innovative ones such as email or mobile communications both text and voice.

Short text messaging (SMS) has achieved near 80 percent usage rates in some European countries, and SMS advertising has exploded. Mobile text messages generate a substantial part of telecom operators' revenue. In Europe, SMS revenues were at Euro bn 12 for 2002 (Economist 2001).

Mobile phone users in the UK sent over one billion text messages during April 2002, according to new figures re-

leased by the Mobile Data Organisation. A total of 1.56 billion text messages were sent person-to-person throughout October 2002, an increase of three million on March. Britons now send almost 90 million text messages each day on average (September 2005), compared to 30 million in April 2001. The Mobile Data Association predicted that the total number of text messages in the UK for 2002 will reach 16 billion (Jüptner 2002). The National Telecommunications Commission of the Phillipines estimates a total of 250 million text messages being sent per day across all national GSM networks in 2005 (NTC 2005).

The usage of chat for private communications has increased dramatically via tools like instant messager from AOL, Microsoft, Google or Sametime (IBM/Lotus) although no figures are available separating private from corporate use. Furthermore, the "socializing" effect of communication meets a prime need of residential users and is reflected in the intense use of online communities which are used for dating, exchanging ideas or seeking advice on everyday's problems.

Since the early days of file sharing using Napster and similar music services, peer to peer [P2P] communication on the Internet has gained increasing momentum. This type of communication capitalizes on the original 'grass roots' potential of this network to connect private users worldwide. Individualized online interaction, using chat, text messaging, desktop video and a range of available P2P vehicles, is expected to increasingly substitute conventional media consumption. Not only will it better target the intended audience, it may also have greater efficacy since messages are 'pull' rather than 'push.' More importantly, the communication tends to be non-linear, shifting from one mode to the next, and involving different players on an ad-hoc basis. This new mode of communication is challenging to communicators and marketers relying on conventional modes.

Corporate takeovers of *Skype* (*Ebay*), *MySpace* (*News Corp*), and recently *YouTube* (*Google*) point to the economic potential of personal networking. These networks have realized the tremendous capacity of the Web to target diverse groups—in particular teen and college age demographics–quickly and at low cost to the user. Combined with online chat and text messaging they also foster new modes of exchange. MySpace and Facebook have become prominent social networking tools for high school and college students—in spite of reports of abuse. Students meet new friends when they move away to study, they look up people from their home town, they explore a person's Facebook site before going on a date. Artists use *Facebook*/*MySpace* as a PR tool, and increasingly employers use it to find out about the 'other' persona of a job applicant or employee.

Home services

Health. *Health* refers to all applications concerned with making provision for, maintaining and monitoring the health of a person or social group.

Related services in the area are:

- Telemedicine with patient monitoring (surveillance of vital signs outside the hospital setting) and monitoring of dosage (including real-time adjustment based on the patient's response). Wireless sensors can be attached to the body and send signals to measurement equipment. Popular in countries with widely dispersed populations (e.g. Norway); increasingly developing countries.
- Electronic fitness devices that support training and wellness of the private user
- Health related Websites

IT based health applications for today's household are very limited in their range. In some countries smart cards carry patient data for billing and insurance companies or health consultancy software for private diagnosis and information about certain diseases. In the future, expert systems will enable medical advice from home without the patient having to leave the bedroom.

The Internet has considerable influence on doctor-patient relations, but apparently it has not lead to a wholesale replacement of doctor's visits. Some patients consult the Web prior to doctor's visits. In many cases, patients go to the Internet when a doctor recommends that they get more information (Josefsson, 2006; Rice and Katz, 2006). In that case it can take on the role of a 'second opinion.'

Doctors also use the Internet to obtain medical information, and in some healthcare settings to communicate with patients via the Internet. On average, younger physicians display higher levels of internet use (Rice and Katz, 2006). Also, patient support groups are increasingly taking advantage of the Internet, not only in the U.S., but also in Europe (Kral, 2006). A content analysis by Barnett and Hwang (2006) found that these groups are used both for information about disease and treatment, but even more so for emotional support. Applications of remote monitoring of health data allow elderly people to remain in their private environment instead of having to move to nursing homes or other institutions where personnel is available to monitor their health status. In case of alerting conditions care services are notified and can come to assist within minutes. Similar equipment can be used in cases of where symptoms only occur in certain situations which can't be reproduced during a doctor's visit. Whenever the symptoms occur, real-time health data can be recorded (e.g. blood pressure, pulse, temperature, etc.) to allow for an in-depth analysis by a doctor later on.

Home Services. *Home services* consist of systems that support home security, safety, meal preparation, heating, cooling, lighting and laundry.

Currently, home services comprise only special devices such as those in a networked kitchen. Future scenarios project comprehensive home automation with interconnected kitchen appliances, audio and video electronics and other systems like heating or laundry. Some prototypes by the German company Miele (called Miele@home) showed early in the development of 'smart homes' that the TV can control the washing machine. The interconnection to out-of-home cable TV or telephone networks leads to the remote control services, e.g. security. Much media attention was received by the Internet refrigerator by NCR which

orders needed groceries without human interaction.

Key areas comprise:

- Central control of heating, air conditioning from home computer or TV
- Lighting, shutters and temperature control
- Remote monitoring of home devices for security, laundry, refrigeration or cooking

Intelligent clothing and wearable computing are seen as emerging areas.

Travel. *Travel* includes all applications that support the selection, preparation and undertaking of journeys. Travel applications make the central booking information systems for hotel or flight reservation accessible to the residential user. Individual preferences provide a search pattern for finding the places of interest. Future visions includes interactive, multimedia booking from the TV chair via broadband network with instant acknowledgements.

Main focus areas are:

- Travel planning on the Internet: Ranges from planning the entire trip via travel portals Travelocity or Expedia to selected information on public transportation or plane departures. These travel data can also be pushed to mobile devices or delivered according to the geographic position of the user.
- Automotive services: Increasingly the car becomes an entertainment and information center with complete audio and video system. In addition, global positioning functionality helps planning and undertaking trips.
- Ticketless Travel: E-ticket of airlines and ticketless boarding with contactless smart cards.

Transactions. *Transactions* combine all the administrative services and transactions, such as shopping and banking by residential users.

The main applications of administration, e-banking and -shopping, are applications serving "traditional" functions (Jupiter Communications 1994). Those services help the home to fulfill necessary administrative obligations with more efficiency and ease.

Using the PC and Internet connection the private user can perform his bank business or order certain merchandise. Today's services (e.g. management of payments) will extend to broader range (e.g. complete investment and mortgage affairs).

Of particular importance are the following transaction-oriented services:

- Electronic execution of administrative activities such as monitoring the household's budget with spreadsheets or planning software such as Quicken.
- Using personal information management (PIM) software such as scheduling, personal address book or task lists, often provided in combination with PDAs or smart phone software.
- Deployment of productivity tools such as word processing, presentations or spreadsheets for private letters, invitations or planning purposes.
- Electronic banking and investing is the main service in this category. Though the focus is still on well-structured transactions such as payments e.g. electronic bill presentment and payment (EBPP), more complex tasks such as investment advice and research is delivered to private banking clients.
- In Switzerland, more than 50% of all private banking clients use the Internet for banking. 13% of all brokerage transactions and 26% of all payments are done via e-banking. Also financial information is accessed by households. The big Swiss bank, UBS, lists prices of more than 370,000 stocks. Alerts can be sent to a mobile device. Some bank offer mobile banking services that resemble the features of the Internet offering.
- Shopping on the Internet has become an important service. Although purchases focus on standardized products, everything from furniture to groceries is available. The percentage of online purchases relative to total shopping revenue remains at moderate levels but is gradually increasing. The 2003 Christmas season experienced a strong increase in Internet sales: 18 billion (out of 217.4 billion total sales), up from 13.8 billion in the last quarter of 2002. More importantly, many retailers have offered a seamless shopping experience of catalogs, Internet, and stores (Grimaldi 2003). Especially auctions like eBay have received much attention from the private user: Amazon.com, a Fortune 500 company based in Seattle, opened its virtual doors on the World Wide Web in July 1995 and today offers Earth's Biggest Selection. Amazon.com and other sellers list millions of unique new and used items in categories such as apparel and accessories, sporting goods, electronics, computers, kitchenware and housewares, books, music, DVDs, videos, cameras and photo items, toys, baby items and baby registry, software, computer and video games, cell phones and service, tools and hardware, travel services, magazine subscriptions and outdoor living items.

A new trend is the so called social commerce or collaborative commerce, where the interactivity between the shoppers is the major determinant of the shopping experience. Platforms such as spreadshirt.com or threadless.com allow users to create their own designs for t-shirts and have them manufactured individually. In addition, users can also order t-shirts with the design created by others while the design creators receive a share of the revenue of t-shirts with their design. Other aspects of the experience are interactive product discussions and reviews in which any user can take part and which give a fairly authentic impression of the product, created by users who have similar needs and preferences and who are not influenced by marketers.

Entertainment. *Entertainment* includes those applications that can be used for leisure activities or for the purpose of entertaining household members.

Particular areas of entertainment services are:

Type of service	*Service area*	*Status quo 2006*	*Scenario 2010*	*Scenario 2014*
CORE SERVICES	*Information*	Electronic books, news portals, podcasts	Fully electronic newspaper based on personalized profile	Electronic newspaper on e-paper
	Communication	Email on home PC, mobile digital telephone, emergence of VOIP at home	E-Mail and video communication via VoIP from every mobile device (broadband mobile or ubiquitous WLAN)	Worldwide multimedia video communications
HOME SERVICES	*Health*	Consultancy software	Interactive, remote health services	Medicinal diagnostics at home by expert systems
	Home services	Only special interconnected household technologies, no standards, remote monitoring	Increased home automation via standard interfaces, entertainment and home services converge	All household equipment networked to in- and out-of-home devices, the 'wired' home
	Travel	Travel portals, complete journey booking from home, GPS services	Intelligent guiding services for cars, location-based services, Internet access in cars	Automatic driving services, fully telematic information for the car
	Transactions	Home-shopping over the Internet Integration of 'clicks and bricks'	Multimedia-home-shopping also for complex products	Virtual electronic shopping mall
		Home-banking for selected transactions	Home-banking for all activities	Multimedia banking, cybercash
	Entertainment	One way pay-TV, interactivity via telephone lines, HDTV, HD DVD	Pay-per-view, limited number of services	Fully communicative TV (personal influence on action) and Video-on-demand
	Education	Computer Based Training software or Internet offerings	Distant multimedia learning at home, public electronic libraries	Individual virtual teachers using artificial intelligence and virtual reality simulations

Figure 2. The evolution of home computing services.

- Home cinema with digital surround audio and home media server that connect flat Plasma- or LCD-TVs, audio systems, and multimedia PC environments with the Internet. In 2003 for the first time US DVD sales surpassed videotape figures.
- On-demand digital TV with hundreds of channels of audio and video content
- Music and video sharing: The dominating file sharing network FastTrack has a maximum of 4 million simultaneous users sharing up to 800 million files. In the

middle of May 2003 there were a maximum of 5 million simultaneous users sharing up to 900 million files. In April the Recording Industry Association of America (RIAA) targeted individual music sharers with warnings and later with suits (Olsson 2003, Lee 2003). In the meantime Apple has built its legal music download platform "itunes" with great success and others follow suit. Currently, this is also expanded to video clips and downloads of TV sequels and movies. Here another convergence is visible between the online content (music, video, podcasts) and offline platforms such as MP3 players (ipod etc.), game consoles or PDAs. The sharing of video content ("broadcast yourself") is already on the rise as the recent acquisition of YouTube (www.youtube.com) by Google (www.google.com) for USD 1.6m proves.

- Games and gambling both via the Internet and mobile networks and in electronic stand-alone devices such as game boys and gambling machines.
- Digital toys such as Sony's smart dog or Lego's Mindstorms programmable brick sets developed in collaboration with MIT's MediaLab. Here, a close relationship to the learning component is evident.
- Using multimedia devices such as digital video cameras or digital photography in combination with home PCs and video authoring software for creating multimedia shows at home.
- Free and premium Internet radio with endless options of genres and downloadable music on portable devices such as MP3 players or smartphones.
- Adult content.

Education. *Education* refers to all applications that train and educate members of the household in special skills or knowledge. In an increasingly dynamic private environment, this function will gain in importance. Especially, Distance Learning from home has experienced tremendous growth as a result of technological change.

The growth of Distance Learning (DL) has coincided with the emphasis on lifelong learning as many traditional career paths are rapidly changing and employees expect to switch careers several times during their lifetime. Also, mid-career professionals often feel the need to update their skills in order to remain competitive with recent college graduates. The typical DL student is a returning student, who is older, and often goes to school part-time. DL offerings have to be tailored to the needs of such students.

DL is frequently a self-selected activity for students with work and family commitments. Effects of social isolation should thus be limited. For instance, DL can facilitate daycare arrangements. In some circumstances exclusion from the social network of the face-to-face classroom can be one of the drawbacks of DL (Mundorf 2004). The private household uses this type of "education" for the training of special skills it is interested in. Using offline computer based training (CBT) software on CD-ROM or DVD to improve e.g. on a foreign language for the next holiday abroad or naval rules in order to pass the sailing exam, are some examples. In addition, electronic accessible libraries and content on the internet open the field for self-education processes to the private area. The usage artificial intelligence will substitute human teachers as far as possible and make them more efficient for special tasks. Virtual reality will help by visualization and demonstration of complex issues. Increasingly Colleges and Universities offer Distance Learning classes based on strong demand from traditional and non-traditional students. Besides the added flexibility and benefit for students who are reluctant to speak up in class, distance learning benefit those students living far from the place of instruction. Dholakia et al. (2002) found that Distance Learning has the potential to reduce or modify student commutes.

OUTLOOK

Information technology has become an integral part of residential users' lives. Not only is infrastructure affected by its existence, but even more a set of residential applications has emerged in part identical, overlapping or different from traditional corporate IT use. Customer relationship management using electronic channels (eCRM) has to be aware of these developments in order to provide offerings or self-service options to those information technology-savvy customers. Given the speed of developments in the internet and related technologies we are only at the beginning of a development.

Therefore, Figure 2 summarizes the home services and shows some of the expected developments for the next years. It summarizes three possible scenarios (status quo 2004, scenario 2007, scenario 2010) based on the assessment of past, current and future trends, and developments of services.

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