Home Computing Services

1 Introduction

1.2 Relevance of the Topic

The 1990s and the current decade have experienced tremendous growth in computers and telecommunications, and for the first time developments in technologies in the home followed in close proximity to their correlates in the corporate world. 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 have expanded.

In some cases, corporate use of technologies followed private home use (e.g. for Instant Messenger and other chat applications). Popular private applications such as music and video downloads initially required access to large corporate or academic networks due to capacity needs. 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) may experience growth during times of economic slowdown due to price decline or network effects (DVD; Internet in the early 1990s; currently wireless).

While convergence is a predominant trend, a market for private IT applications separate from the corporate market is evolving as well. Price decline and miniaturization encourage the perspective of ubiquitous computing and of a networked society.

1.2 Definitions

A range of concepts have evolved which permit the conceptual separation of business/public computing services from those related to the home and/or private use. One definition points to *all the infrastructures and applications the private user can take advantage of for private uses.* This definition encompasses most applications discussed in this article, notably entertainment, information, communication, and shopping. Some other applications cross over into the public or business realm, in particular telework and distance learning. While this article focuses on services in the home, more recently miniaturization and mobile technologies have blurred the line between home and other locations. 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.

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.

1.3 Structure of this article

While understanding the technological advances in this area is important, much of the technology is derived from corporate computing applications and adopted for home use. Thus, the present article will focus on content and usage of home computing more so than on technical details.

This article explores key issues pertaining to home computing products and services. In particular it will discuss convergence of technology and other current technological trends related to end-user devices and networking. Selected services for the home will be addressed in light of technological changes.
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 with which they are associated.

The article concludes with future Home IT trends.

2 Drivers of Technology Adoption in the Private Home

2.1 Convergence

Convergence of technologies has a critical impact on home computing as well as information and entertainment. 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, chat, children's entertainment, and on-line shopping or banking. 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, convergence is seen as limited due to demographics, lifestyle preferences and other factors (Stipp 1998). For instance, the convergence of Television and computers on the user side has not advanced as rapidly as expected, even though streaming video of TV programming is available on the Internet, cable systems offer "Digital Cable," and cell phones have cameras which permit instant emailing of pictures. Most Americans still watch television one program at a time, even though many rely increasingly on the Internet for news, weather, stock market and other information.

However, at least on the supply side, convergence is gradually advancing. Responding to digital satellite competition, cable companies have enhanced the existing fiber/coax physical plant of their systems with digital set-top boxes and digital distribution technology. These upgrades permit greater channel capacity, as well as interactive features. On-screen program guides, several dozen PPV channels, as well as multiplexed premium cable channels, and digital music channels are common. Digital picture, flat screen technology, surround sound and HDTV encourage the trend towards

home □heatres. 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; PPV ordering, as well as selection, programming, and recording of future programs through the 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. Some systems offer Video on Demand (VoD), where users can order movies and other video from a large selection in a real-time setting. The more common "in-demand" offerings simulate a near-VoD experience, where the most popular movies are available at half-hour starting times.

Several providers experiment with interactive applications that 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).

2.2 User Interface: TV, PC, Phone

Much discussion of home IT focuses on the Internet. Innovations associated with traditional media also offer considerable potential, in part because all electronic media are evolving rapidly, converging with other media, and becoming increasingly interactive. These hybrid media often reach the majority of the population (in some countries, a vast majority) that lacks regular, adequate Internet access (Cairncross 1997; 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 also tend to be outdated within a few years. By contrast, television sets last for decades, they are easy to use, not prone to viruses, and are 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 patterns are changing rapidly, for some

time consumers may continue to choose television for news and entertainment and PC for other sources of information and electronic commerce. 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 (e.g. Comedy Central). Even though it is a digital technology, the tremendously rapid adoption of the DVD player is largely a replacement for VHS home video with higher video quality.

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), most households invest in big-screen televisions and surround sound. TiVo was also adopted more slowly than expected.

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 mobile technology epitomizes trends in personal technology. Due to simple use, ubiquity, 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 is available via narrowband channels. However, the next generation of mobile broadband is currently being deployed. In concert with smartphones and wireless PDAs, broadband mobile networks, e.g. those based on the UMTS (Universal Mobile Telecommunications System) standard, 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.

2.3 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 PPV with 50-100 channels offering current movies as well as specialized (e.g. "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.

Several television providers have experimented with interactive applications that give the viewer options beyond simply choosing a program. These 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 (Bloom 2000), 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. Audience demand for interactivity is not yet 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 (Lockwood Tooher 2000). Most likely the push for greater interactivity will come from advertising, which already relies on cross-promotion between different media including TV and Internet. Since the marketing increasingly focuses on individualization, the ability to provide targeted advertising even within the same program is likely to have great appeal to advertisers. Also, since commercial avoidance is increasingly common, the push for product placement within programs may also lead to increasingly individualized product inserts.

Broadcast television stations are expanding their channel offerings as a result of conversion to High Definition Television and the resulting availability of greater channel capacity. However, the expectation is that they will, at least initially, offer greater selection and targeting rather than actual interactivity.

2.4 The digital home

The ultimate interactive experience may involve a home that is equipped with technology that can respond to the residents' needs. Smart house technology typically is developed for 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.

Especially, home networking technologies such as the European EIBus or the US-led CEBus enable the interconnection of different household devices such as heating, shades or lighting. In addition, wireless LANs are gaining ground in the private sphere, connecting IT devices. Eventually, audio/video-, PC- and other household networks will converge (Lee 2002; Higgins 2003).

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 realtime databases with information on availability or price quotes. Those out-of-home infrastructures are connected to the home via networks such cable, telephone, powerline, or wireless connections.

4 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, the private household – even more than a corporate user is 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 (Kolbe 1997) proposed a classification scheme for analyzing and describing the respective classes of home applications in existence. According to Brenner and Kolbe (Brenner/Kolbe 1995) there are eight main services for the private household which can be supported by IT (see Figure 1):

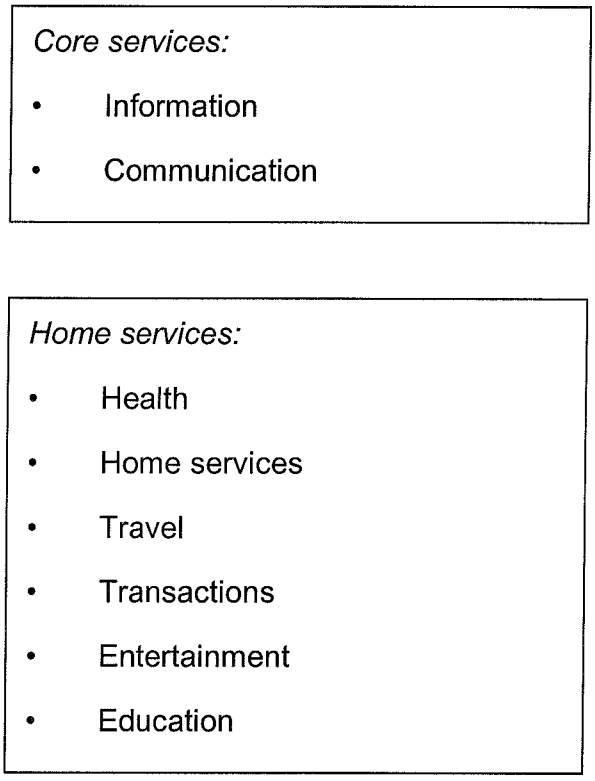

Figure 1: IT-influenced services for the private household

The basic services "information" and "communication" take mutually advantage of each other: There is no communication possible without at least basic information provided on one end, sometimes referred to as message or content. 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.
They will referred to as *core services* while the other ones are looked upon as primary *home services* ones because they are based on information and communication features. Nevertheless "communication" and "information" are described separately as some services exclusively provide bi- or, multilateral information (e.g. electronic books, news) or communication (e.g. email, short message service (SMS)) benefits. Market revenues are most substantial in those basic areas.

Miles (1988) and others (Higgins 2003) after him observed that more and more aspects of private life are affected by home services. We can differentiate three forms 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. The next step is locally interconnected applications within the confines of the private home such as entertainment networks for home cinema applications or controlling the heating via TV or PC. The third form is the out-of-the-home connected applications 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, these types of services are used in conjunction with each other, e.g. during activities 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 encyclopedias or electronic learning toys for children.

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 portal or some smart phone features. 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.

4.1 Core services

Information

Information is offered by all services in which the dissemination of information to the private household 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 coverage such as news or weather information. Together with search capabilities 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 your own newspaper on personal preferences and interests like sports or stock exchange news as examined by MIT's Media Lab.
- Electronic books and newspapers such as the electronic version of the New York Times which is available online for a fraction of the newsstand price. Electronic books with portable e-book players are one of the most notable examples for pure information. Encyclopaedias, 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 that traditional books haven't to show.
- Push services of events and product news: Mobile marketing is gaining ground fast. The latest research in Finland shows that 23 percent of all mobile-phone-using Finns (80 percent of all Finns) have received SMS push marketing (ATKearney 2002).
- Information kiosks, which provide basic information for travellers or shoppers

Communication

Communication enables the private household 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 released by the Mobile Data Organisation. A total of 1.3 billion text messages were sent person-to-person throughout April, an increase of one million on March. Britons now send 44 million text messages each day on average, compared to 30 million in April 2001. Around 5.2 billion text messages have been sent so far this year, and the Mobile Data Association predicts that the total number of text messages for 2002 will reach 16 billion by the end of the year (Jüptner 2002).

4.2 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

Health applications for today's household are very limited in its range. In some countries smart cards carry patients' 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 each home without leaving the private bed.

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 the private household.

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 the 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.

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:

- 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). KaZaA Media Desktop (KMD), using the P2P network FastTrack, dominates strongly among file sharing clients. KMD connects to the FastTrack network together with the much smaller services iMesh and Grokster. Every week KMD is downloaded about 3 million times at Download.com. Internet users can share and download commercial music, movies, and programs using different file-sharing clients. (Jim Olsson 2003)
- 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.

Distance Learning (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.

5 Summary and Outlook

Table x summarizes the home services and shows some of the expected developments for the next years. The above table 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 (see Figure 2).

Type of service	*Service area*	*Status quo 2004*	*Scenario 2007*	*Scenario 2010*

CORE SERVICES	*Information*	Electronic books, news portals	Fully electronic newspaper based on personalized profile	Electronic newspaper on e-paper
	Communication	Home-fax and mobile digital telephone	E-Mail from every mobile device	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	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-IT

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