Chapter VII

Ambient Media and Home Entertainment

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Abstract

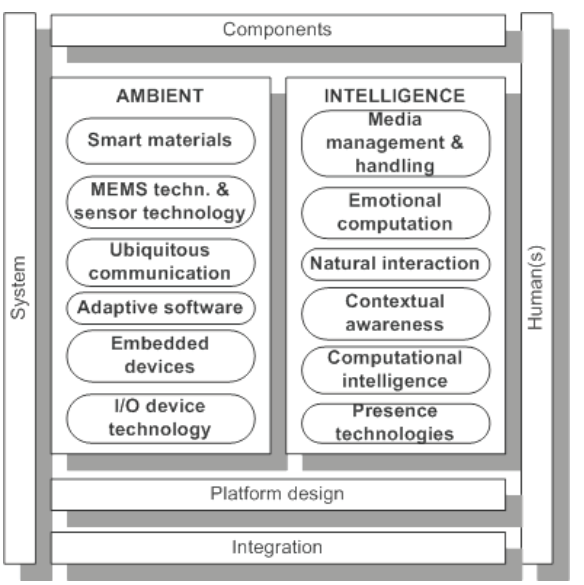
Media are "[media] means effecting or conveying something such as (1) a surrounding or enveloping substance; or (2) a condition or environment in which something may function or flourish; or (3) mode of artistic expression or communication." (Merriam-Webster, n.d.) In the case of ambient media, the humans' natural environment becomes to the "enveloping media" as an environment in which content functions. This work therefore deals with the development of ambient media, far beyond seeing TV as a major entertainment platform in consumers' homes. To satisfy the entertainment-hungry consumer, more and more advanced home entertainment (HE) systems and facilities are required to provide interactive and smart leisure content. This chapter glimpses the future of modern ambient HE systems. Experts in the field of ambient media discuss and contribute to four major lines of the future development of ambient media: (1) social implications, (2) converging media, (3) consumer content, and (4) smart devices.

Introduction

Rather than the consumer explicitly telling a computer system what to do, the system will act autonomously in the way the consumer desires. Natural interaction, personalization, smart metadata, wireless technology, ubiquitous systems, pervasive computation, and embedded systems are technologically enabled. The vision for *ambient media* or *ambient intelligence* has been developed by the European Commission as goal for research projects until the year 2010. The IST Advisory Group (ISTAG) developed the components (see Figure 1) contributing to this vision in their working documents in the beginning of this century (ISTAG, 2001, 2003). The goal of this book chapter is to look far beyond the scope of the utilization of compression techniques for transmitting content or digital television in consumers' homes (Luomajoki, Niinanen, & Kalli, 2004). Ambient intelligence or ambient media seek to make smart technology available for the consumer throughout their natural environment.

Currently many European projects are contributing to this vision with the realization of ambient-media-related projects ranging from digital TV, smart living spaces, media content management, and so forth.

Figure 1. Components of ambient intelligence or ambient media according ISTAG



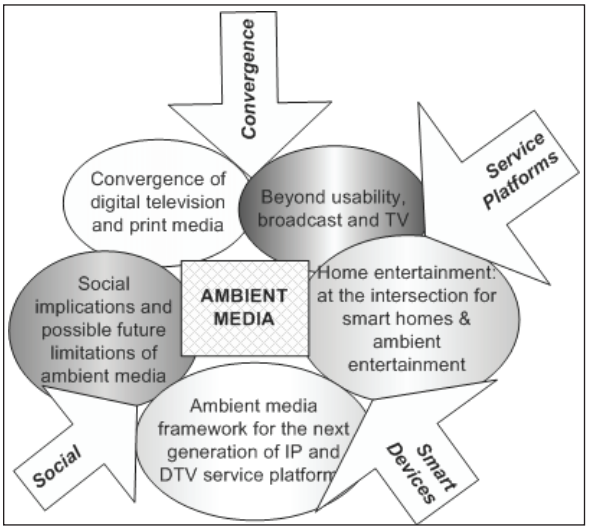
Going further back in the development of multimedia systems, we see the following major development steps in media evolution (defined in Lugmayr, 2003; Lugmayr, Saarinen, & Tournut, 2006):

1. **Natural media:** Forms not requiring electronic technology (e.g., dances, songs, or cave paintings)
2. **Multimedia:** Integrated presentation in one form (e.g., TV, Web pages, interactive installations)
3. **Virtual reality:** Embedding the user into a computer generated world (e.g., CAVEs, computer games, immersive environments)
4. **Ambient multimedia:** The user is exposed to the actual media in their natural environment rather than to computer interfaces (e.g., smart home and spaces, intelligent mobile phones)
5. **Bio-media:** A fully real/synthetic world undistinguishable pure media integrating human capacity (e.g., as aspired by Hollywood films such as Matrix)

Figure 2 gives an overview of the overall chapter topics organized in the following sections:

- The first section focuses on new technology trends of the ubiquitous computing era fostering substantial changes in all application domains in *Home Entertainment: At the Intersection of Smart Homes & Ambient Entertainment.*

Figure 2. Chapter topic overview



- The second section focuses on media convergence, especially on the future of digital TV with a rather consumer-centered viewpoint in *Beyond Usability, Broadcast, and TV*.
- The third section focuses on the development of design principles for ambient intelligent systems in *Design Principles for Ambient Interactivity*.
- The fourth section deals with the convergence of print media and interactive digital TV (IDTV) as a possible new channel for print media content in *Digital Television, Print Media and Their Convergence*.

This chapter starts with an introduction of HE and potential future trends in the age of ambient media. The first section is followed by sections showing the application of the theories of ambient media in the context of IDTV. IDTV equipment will be one of the major multimedia HE platforms in consumers' homes. The advance of existing services and convergence is of major concern to enable a future-oriented and consumer-friendly platform for accessing ambient media services. Adding interactivity and the development of a set of guidelines and rules on which level they can be implemented on the IDTV platform is described within the scope of this chapter. It is essential to show how media are mediated from their traditional analogue form to their new digital counterparts. This is especially shown in the last section, where print media and their convergence with IDTV are discussed.

Home Entainment: At the Intersection of Smart Homes and Ambient Entertainment

The post PC era of ubiquitous computing (aka pervasive computing, aka ambient intelligence) provides technology trends that will heavily influence the future of IT application domains. The single most important trend is the *pulverization* of hardware and software, which in turn enables an opposite, that is, amalgamating trends towards large application hyper domains, where the pulverized devices and functions are dynamically federated for various purposes. In the remainder, we will summarize the main threat of technology development, together with examples of the immediate consequences for HE hardware and software. For an investigation of midterm consequences, we will investigate the application hyper domains *smart homes* and *ambient entertainment*. The main statements of the present article are depicted in Figure 2. (For further reading see also Braun & Mühlhäuser, 2005; Pering & al., 2005; Straub & Heinemann, 2004.)

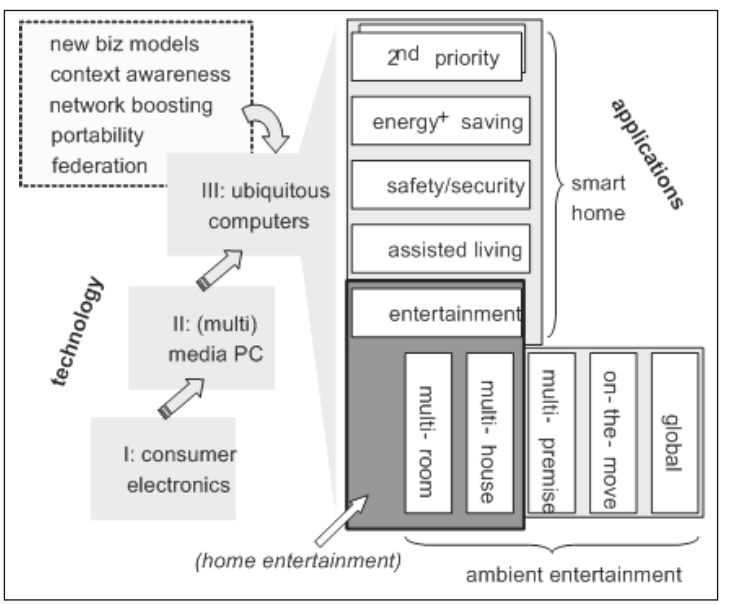
Ubiquitous Computing Technology and Consequences for HE

The convergence of consumer electronics (CE) and IT can be considered almost completed, marking the passing on from generation I (CE devices) to generation II as depicted; thereby, the difference between media centers (a CE term) and multimedia PCs (an IT term) became blurred, HE demands pushed powerful graphics into CE and PCs, and IT technology made PCs and networks available in the living room. The latter trend brought along additional features and tore down protectionist walls (sometimes illegally, cf. content piracy).

Generation III approached with the advent of ubiquitous computing, thereby, more substantial and far-reaching changes occurred. Recent product news show early but clear signs; three devices shall therefore be listed here, all meeting at the concept of "federation-enabled business/entertainment nodes" (FedNodes, for short):

- The Sony Playstation Portable PSP™ was acclaimed for its wLAN and Internet capabilities, making it appear like a versatile micronotebook with excellent graphics and computing power.
- Apple's iPod™ is discovered for serious information dissemination (CRM news, lecture videos, etc.).

Figure 3. At the intersection of smart homes and ambient entertainment



- The Personal Server™ from Intel, a prototype of a wearable Web server with full media capabilities, enters the business-entertainment bridge from the "serious" end.

The latter two, in particular, provide some insight into the role of such nodes in a federated world. The iPod has brought forth an entire industry of peripherals for docking or networking; the Personal Server has, on one hand, been shown with a wrist watch as display and as a twin with a Motorola™ cell phone; on the other hand, it is more or less compatible with Intel's Stargate™ platform intended, among others, as a hub in MICA2™ based sensor networks from Crossbow. In addition, dynamic, zero-configuration federation with ambient peripherals (publicly available wall LCDs, kiosks, car sound systems, etc.) is currently investigated in research (cf. Braun & Mühlhäuser, 2005) and will complement FedNode functionality.

The previous examples substantiate the claim that ubiquitous computing nodes will, in the future, draw much power from being federated, whether or not they serve special purposes; instead of dedicated HE hardware, we will see "HE-inclined" devices, which will be used for other purposes, too, and dynamically federated with various other devices. Major features and consequences are depicted in Figure 3 (upper left): (1) new business models emerge: for example, devices and services can be offered for users on the move, less profitable areas can benefit from hardware, and features "cross-subsidized" from other application domains; (2) context awareness hardware and software can be offered across domains; (3) whenever network connectivity is available/affordable, added functionality can be provided (network boosting); (4) portability and business models have mutual influence and trigger application hyper domains as described later on; and (5) dynamic federation of (rather special-purpose) devices—still a research domain as mentioned—will speed up the trends mentioned before.

Ambient Entertainment

A study by Intel (Pering & al., 2005) shows that wearable entertainment devices lead to a seamless integration of home and nomadic use cases. Video sharing in the digital home (hardly interactive), photograph sharing (interactive in small groups), music sharing (interactive in larger groups), and sharing with the environment spread from very personal to increasingly public areas and introduce new roles, like contributor and proprietor (e.g., a café owner), which complement the provider/consumer stereotype. In a more general perspective, we see that HE scenarios have no reason to stop at the distribution level reached in generation II: *multi-room* networking (cf. Philips Streamium™). The iPod provides for easy *multi-house* distribution (at friends' houses, from home to office, etc.); legal and standards issues rather than technology issues hamper *multi-premise* sharing of content, with new business models arising,

for example, for the proprietors mentioned previously. Computer science researchers have investigated a next degree, *on-the-move*, where content can be shared even without intervention of the human whose devices "encounter each other" (cf. iClouds; Straub & Heinemann, 2004). The largest, *global* scale has already seen a tremendous boost with the deployment of peer-to-peer (P2P) technology since the advent of Napster; new resource sharing models for (free-rider-preventing) mobile use and the incorporation of FedNodes will be added.

All in one, HE R&D must be carefully lead in order to not restrict itself to multi-room/house scenarios; the wider the distribution range, the more important the consideration of recent computer science research.

Smart Home

It has been argued previously that the pulverization of hardware and software and the amalgamation into application hyper domains go hand in hand. This applies to the different degrees of distribution in ambient entertainment, but it also applies to different goals of smart home technology; again, it is important to draw upon the potential synergies and overcome hurdles on the way to using them and understand complementary research contributions. Quite a number of smart-home-related research projects were terminated without immediate business impact. A dominating reason is the (perceived) unattractive cost-benefit ratio of corresponding devices and scenarios for average users. It is therefore crucial to concentrate on—and integrate—areas where this ratio can be trusted to improve the foreseeable future (called first priority areas). In terms of needs and potential cost savings, *assisted living* is most promising, especially for the elderly and handicapped. Areas of immediate *saving*, such as fine-grained energy optimization, and areas of high perceived need, as well as *safety/security*, make an ideal complement if re-use can be stressed. At first sight, HE is at the other side of the spectrum: desire rather than need dominates spending. Two arguments support the quest for integrating this smart home subdomain with the others mentioned: (1) the *combined* value of desire- and need-driven consumption justifies prices (and therefore, technology sophistication levels) that would otherwise be inhibitory; and (2) each subdomain contributes to overall solutions with unique strengths; for instance, the user interface (UI) expertise built up in HE is definitely beneficial for areas like safety/security where UIs were underemphasized in the past. Based on the advancements, that is, declining prices to be expected from such a synergy in the first priority areas mentioned previously, second priority areas may finally gain market acceptance. This way, the often discussed smart fridges and smart microwave ovens may finally hit the mass market and communicate with our grocery store—but that remains a long way to go, as opposed to newspaper visions.

Beyond Usability, Broadcast, and TV

Some Reflections on TV Development

Since television emerged as a medium in the early days of the past century, it has been evolving constantly—and so it is today. This process of constant further development does not only concern its external appearance, but is foremost due to the changing of its program structures and offering, its forms of usage by the end user, and thus, how it is perceived as a medium as such in society.

With media digitization and the switch over from analogue to digital broadcasting technologies during the 1990s, the further development of television sped up significantly. Digitalization enabled the merger of formerly separated media domains and technologies of different technology sectors. Commonly referred to as *media convergence* this process can be seen as one of the driving forces of media evolution during the last 15 years.

Media Convergence and Its Implications

The concept of media convergence stands for the coalescence and/or mergence of formerly separated media types or media domains such as the IT/computing sector, the broadcasting, and the telecommunications sector. Foremost, three aspects of media convergence have to be considered: (1) the technical convergence of media technologies (from transmission networks to end devices), (2) the convergence of content (program forms, multimedia services), and (3) the functional convergence (convergence of media functionalities and forms of usage). As to the further development of media, all three aspects of media convergence impact each other and go hand in hand with the alteration of the end-user needs and requirements on the different media.

There are three common convergence theories of how convergence happens and influences the current and future development of digital media:

1. **Theory of replacement.** New media will replace old media types and assume their functions.
2. **Theory of media completion.** New media will complement old media in peaceful coexistence and/or enhance it with new functionalities.
3. **Theory of media fusion.** New and old media will merge into "all in one" media, assuming all functions of its predecessors.

Apparently media development proceeds according to a mixture of all three theories of media convergence: On the one hand, history gives evidence that old media will not disappear but instead will advance and mutate constantly, adapting itself to new user requirements. On the other hand, new types of media will not replace former media but instead influence and/or modify them, for example, enhancing them with new functionalities. Beyond, new types of media could also absorb functions of older predecessors, if this means an improvement or a benefit to the end users.

Today, media is diversifying according to altering socioeconomic exigencies and consumer needs: Different complementary media with different program and service offers comply with manifold requirements in order to satisfy specific end-user needs in different usages contexts.

Thus, convergence must be considered as the decoupling and re-modulation of technology, content and functionalities of different media types, enabling on the one hand the further development of traditional media and its enhancement with new functionalities, and on the other hand the creation and establishment of novel forms of hybrid media.

Current and Future Strands of TV Development and Its Impact for Broadcasters/Service Producers

The development of digital television today seems to be twofold and along two strands. Driven by the merger of broadcasting and IT/computing technologies, traditional TV becomes a multimedia platform accumulating more and more different functionalities and usage options for its end users. For example, content transmission over heterogeneous networks and additional end-device functionalities also provides end users with the option to use and retrieve TV programs differently—for example, to use content (inter)actively via a backchannel. In return, broadcasters are encouraged to create new multimedia services and novel program forms that correspond to the new requirements of their audience. As a result, interactive television (iTV) and programming established some years ago as one new form of television.

The second trend of the last 10 years is the emergence of several novel hybrid TV derivates. Among them, the most important are Internet protocol television (IPTV) and—as the latest development—mobile TV. Most of such hybrid forms of television provide traditional TV programs—or parts thereof—over other transmission networks for the reception on new-end devices. This allows the TV audience to receive such program offers and services in new usage contexts and to also use it differently according to new functionalities and capabilities of the receiving end device.

Today, the four most popular ways of content and service production for hybrid TV are:

1. The takeover and provision of the complete program 1:1 from traditional
2. To re-purpose parts of the original program or service, enhancing it with additional usage options according to the different functionalities of the end device
3. To combine the original program with content from other media and thus, to create novel program forms and services which correspond to the different
4. The creation of new content and program forms or services, targeted at the specific requirements of the devices and usage context

Thanks to technical innovations such as non-proprietary, scalable, content formats, generic metadata standards and intelligent digital production systems, it will be technically feasible very soon to transmit and display each kind of content on every display for its reception on each end device. This option of complete content syndication is of great benefit for broadcasters and service providers since it opens up for them a "million" new options for service production and provision. Their maximum target is and will remain to be to provide their programs and services to the maximum number of end users on different end devices and usage situations.

However, the duties for broadcasters and service providers in terms of intelligent service and program creation will not become obsolete. Instead, in order to provide services and programs, which offer a real added value to their audience, it will be even more important for them to evaluate beforehand which kind of content really makes sense on which device and in which usage context—and foremost to first consider their end users' interests.

Design Principles for Ambient Interactivity

Within the scope of this section different principles for the creation of ambient interactivity are shown. They shall guide service creators to successfully add interactivity to their applications and services.

Opportunistic Interaction

The introduction and wide adoption of the Web has been promoted and attributed to the interactive nature of the new medium. It often goes without much thought that if something is interactive then it is also preferable. Interactivity with the user might seem as the major benefit of iTV, but this is a fallacy that designers with computer experience should learn to avoid. Most notably, there is evidence that in some cases

interactivity may be disruptive to the entertainment experience. Vorderer, Knobloch, and Schramm (2001) found that there are some categories of users who do not like to have the option to change the flow of a TV story; they just prefer to watch passively. Indeed, the passive uses and emotional needs gratified by the broadcast media are desirable (Lee & Lee, 1995). Still, there might be cases such as video games, in which the addition of interactive elements enhances the entertainment experience (Malone, 1982). As a principle, empower the viewer with features borrowed from a TV production studio. For example, users could control the display of sports statistics and play along with the players of quiz games. Interactivity should not be enforced to the users, but should be always pervasive for changing the flow of the running program or augmenting with additional information on demand.

Multiple Levels of Attention

A common fallacy is that TV viewers are always concentrated on the TV content, but there is ample evidence that TV usage takes many forms, as far as the levels of attention of the viewer are concerned. Jenkins (2001) opposes the popular view that iTV will support only the needs of the channel surfers by making an analogy: "*With the rise of printing, intensive reading was theoretically displaced by extensive reading: readers read more books and spent less time on each. But intensive reading never totally vanished*." Lee and Lee (1995) found that there is a wide diversity of attention levels to the television set—from background noise to full concentration. For example, a viewer may sit down and watch a TV program attentively, or leave the TV on as a radio and only watch when something interesting comes up (Clancey, 1994). These findings contrast "*to the image of the highly interactive viewer intently engaged with the television set that is often summoned up in talking about new possibilities*" (Lee & Lee, 1995). Instead of assuming a user, who is eager to navigate through persistent dialog boxes, designers should consider that users do not have to be attentive for the application to proceed.

Content Navigation and Selection

During the 1990s there had been a lot of speculation about the 500 channels future of iTV. In contrast, mass communication researchers found that viewers recall and attend to fewer than a dozen TV channels (Ferguson & Perse, 1993). The fallacy of the 500 channels future was turned upside down into a new fallacy during the next decade, when researchers put forward the vision of a single personalized channel. The study of TV consumption in the home reveals that TV viewing is usually a planned activity, which is a finding that sharply contrasts with the focus on the electronic program guide (EPG) as a method to select a program to watch each time a user

opens the TV. Indeed, ritualized TV viewing was confirmed by a survey, in which 63% of the respondents had watched the program before and knew it was going to be on (Lee & Lee, 1995). Still, there is a fraction of the viewers that impulsively select a program to watch, especially among the younger demographic (Gauntlett & Hill, 1999). As a consequence, designers should consider that most TV viewing starts with familiar content, but it might continue with browsing of relevant items. Therefore, iTV applications should support relaxed exploration, instead of information seeking. This principle becomes especially important in the age of hybrid content distribution systems, which include P2P, IPTV, and mobile TV.

Content Delivery Schedule

Using the television as a time tool to structure activities and organize time has been documented at an ethnographic study of a set-top box (STB) trial (O'Brien, Rodden, Rouncefield, & Hughes, 1999). The fact that most TV viewing is considered to be "ritualistic" (Lee & Lee, 1995) does not preclude the exploitation of out-of-band techniques for collecting the content at user's premises. Broadcast distribution is suitable for the delivery of high-demand, high-bit-rate items, which have a real-time appeal (e.g., popular sport events, news). Designers should justify the use of persistent local storage and broadband Internet connections, which are becoming standard, into many iTV products (e.g., video game consoles, digital media players). Digital local storage technology takes viewer control one big step further—from simple channel selection with the remote—by offering the opportunity for conveniently time-shifted local programming and content selection. As a principle, designers should try to release the content from the fixed broadcast schedule and augment it with out-of-band content delivery. Therefore, an appropriate UI for content delivery should allow the user to customize the preferred sources of additional and alternative information and video content.

User-Contributed Content

TV content production has been regarded as a one-way activity that begins with the professional TV producers and editors and ends with post-production at the broadcast station. As a matter of fact, television viewers have long been considered passive receivers of available content, but a new generation of computer literate TV viewers has been accustomed to make and share edits of video content online. The most obvious example of the need for user contributions in available TV content is the activity of TV content forums and related Web sites. There are many types of user communities from the purely instrumental insertion of subtitles in hard-to-find

Japanese anime to the creative competition on scenarios of discontinued favorable TV series. In any case, there are many opportunities for user-contributed content, such as annotations, sharing, and virtual edits. Furthermore, the wide availability of video capture (e.g., in mobile phones, photo cameras) and easy-to-use video editing software, opens up additional opportunities for wider distribution of homemade content (e.g., P2P, portable video players, etc.).

Group Viewing

Just like PC input devices, most TV sets come with one remote control, which excludes the possibility for interactivity to anyone, but the one who keeps the remote control. Despite this shortcoming, TV usage has been always considered a group activity (Gauntlett & Hill, 1999), and it might provide a better experience when watched with family members (Kubey & Csikszentmihalyi, 1990). In contrast, PC usage is mostly solitary, partly because the arrangement of equipment does not provide affordances for group use. Then, a possible pitfall is to consider only one user interacting with the TV, because there is only one remote control. Therefore, designers should consider social viewing that might take place locally. For example, an iTV quiz game might provide opportunities for competition between family members. In the case of distant groups of synchronous viewing, there are further opportunities for group collaboration, which are discussed next.

Content-Enriched Communication

Besides enjoying TV watching together, people enjoy talking about, or referring to TV content (Lee & Lee, 1995). This finding could be regarded as a combination of the previous *group viewing* and *user-contributed content* principles, but in an asynchronous, or distant communication fashion. Therefore, iTV applications should support the communication of groups of people who have watched the same content item, although not at the same time (e.g., family members living in the same or diasporic households). Moreover, iTV applications should facilitate the real-time communication of distant groups of viewers, who watch TV concurrently. An additional aspect of this principle is that it poses an implicit argument against personalization. If TV content is such an important placeholder for discussion, then personalization reduces the chances that any two might have watched the same program. On the other hand, this social aspect of TV viewing might also point towards new directions for personalization, which are based on the behavior of small social circles of affiliated people.

TV Grammar and Aesthetics

A common pitfall, which is facilitated by contemporary authoring tools, is the employment of UI programming toolkits with elements from the PC and the Web, such from buttons, icons, and links (Chorianopoulos & Spinellis, 2004). An additional difficulty in the domain of iTV UI design is the interface's inability to stay attractive over time. TV audiences have become familiar with a visual grammar that requires all programs, as well as presentation styles, to be dynamic and surprising (Meuleman, Heister, Kohar, & Tedd, 1998), which is in sharp contrast with the traditional usability principle of consistency (Nielsen, 1994). In summary, designers should enhance the core and familiar TV notions (e.g., characters, stories) with programmable behaviors (e.g., objects, actions). Then, an iTV UI might not look like a button or a dialog box. Instead, it could be an animated character, which features multimodal behaviors. Furthermore, user selections that activate scene changes should be performed in accordance with the established and familiar TV visual grammar (e.g., dissolves, transitions, fade-outs).

Digital Television, Print Media, and Their Convergence

Increased digitalization since the 1990s caused a transformation in media industry towards an economical concentration and technological integration (media convergence) (Chon, Choi, Barnett, Danowski, & Joo, 2003). Convergence of media aims at increasing the entertainment experience of consumers, which "*appears more and more to be to be a crucial condition for the successful information processing*" (Vorderer, 2001). Especially the future of print media is a challenge as such, due to changing consumer behavior. An increased competition between digital media and print media, forces print media companies to publish their content also on other channels, such as the Internet. And the Internet means an increased active role of the consumer as media aggregator, active user, and a shift of the decision of when and how media are used (Livaditi, Vassilopoulou, Lougos, & Chorianopolos, 2003).

Convergence Between Television and Print Media

Based on the aforementioned empirical findings and the supportive role of entertaining experiences on the users' processing of information we want to point out that the integration of content having print and television origins creates several challenges. If the users consume television and electronic "print" media simultaneously, then

we want to focus on three problem areas that may influence their entertainment experience.

First, the content and interaction design needs to address the users' roles of both the print media readers as well as the television viewers. Depending on the genre, the broadcasted print content requires the same quality as its respective printed equivalent. This guarantees that the reader can print out the broadcasted version and perceive no difference between this and a preprinted copy of the same product. Moreover, the navigation and the content interaction require the same simplicity that the user expects from dealing with iTV applications. Furthermore, the provision of print content on the television platform for active media users that access the content at will reveals the problems of the underlying concepts: the push versus the pull model.

Second, the technological provision and distribution of high-quality print content on the digital television platform requires high bandwidths in order to minimize the latency times between the user's executed action to access the print content and its final rendering on the television screen. This applies to both when the content is downloaded to the STB from the object carousel and when it is delivered via other channels such as the Internet. Furthermore, appropriate printing technology needs to be present in order to deliver the user the expected quality of a print product.

Third, the creation, provision, and distribution of the print content require several parties to be involved. A media company creates the print content, provides it digitally, and a broadcast company broadcasts it. Thereby, the print content may be related to the television content. In case the users want to print it out they may delegate the task to an external printing house ensuring the desired quality. Thus, an efficient collaboration between these four parties is necessary to create revenue.

The DigiTVandPrint Project

Regarding the DigiTVandPrint project carried out by the Helsinki University of Technology—VTT Information Technology under participation of several media companies—we wish to explore the provision and distribution of print content over the broadcast network to media consumers using self-developed prototypes. We consider the previous elaborated problem areas as centric. From these perspectives, we state that today's HE systems fulfil the needs for simultaneous consumption of entertaining television and print content only in a limited way. The seamless integration of print content on the digital television platform demands more from the technology. We state that among other factors higher display resolutions, bandwidths, and a complete packet-based television infrastructure are required in order to provide the necessary quality and flexibility in the delivery of the mediated information.

Recent available technological developments such as high definition television (HDTV) and IPTV contribute to this.

Addressing the first problem area, we stimulate the users with interactive HDTV simulations where several experimental variables, such as text length, content genre, or the number of interactive features will be changed in order to find the most crucial factors. We use psychophysiological and subjective evaluation methodologies to research the users' cognitive and emotional states. With regard to information processing, we measure their ability to understand and remember various television and print content. We ask the users to rate their entertainment experience to compare these results with the data gathered during the experiments.

Concerning the second problem area, we plan, design, and implement a prototypical system that allows us to perform tests and thus to find out possible architectural bottlenecks, to develop design guidelines, and to define specific technological requirements. The used technology involves a digital video broadcasting (DVB) test play-out center, various hardware and software components, and digital printers, all partially provided by the named research institutes and the participating media companies.

We develop business models to clarify the technological and economical responsibilities of the involved parties. The results of the research of the first and the second problem area influence these models and deepen the knowledge about possible scenarios and successful applications.

After the first period from May 2004 to May 2005—developing early prototypes and planning initial tests—we are currently planning new experiments and designing prototypical applications that contribute to the pilot tests that are to be performed in spring 2006. We expect to present the final results of the project in November 2006.

Conclusion

It is still to be seen how ambient media will be developing in the future. However, this chapter showed advanced application scenarios for the future of media, which are further elaborated in Lugmayr (in press). Other topics highly relevant for the further development of ambient media include:

- The fact, that in the forthcoming years, mobile services platforms will undoubtedly be deployed into beyond-third-generation (B3G) environments
- Social implication and possible future limitations of rapid technology development in the field of mobile ambient intelligent services

- The characteristics and potential of these innovations in the context of ambient information technology tools for wellness services

It is still to be seen how ambient media will develop during the next years. The year 2010 has been chosen by the European Commission as a target when ambient intelligence should be in place. From this year on very concrete applications should be available to the consumer, and their practical viability will be tested.

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