Design of future TV service offerings

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Abstract

We study consumer attitudes towards future TV services and investigate models for service adoption based on expected consumer value. Knowledge of the consumer value function is essential in the design of business models for digital TV operators, including choice of service portfolio and prices for consumption of services.

1. Introduction

Digital TV operators compete for customers through the consumer surplus, i.e. the difference between consumer value and service price. Hence, by improving the consumer value or reducing the price, the consumer surplus and the competitive advantage can be increased. Consumer value is driven by a set of value-generating attributes that bring special functionality and quality.

Ambient intelligence is closely related to the long term vision of an intelligent service system in which technologies are able to automate a platform embedding the required devices for powering context aware, personalized, adaptive and anticipatory services. A typical context of ambient intelligence environment is a Home environment. An important step towards an intelligent service system in the home is to integrate the PC and TV systems via a home network.

User control is at the center in the design of intelligent services. In particular, TV viewing will be transformed from a lean-back to a lean-forward activity. Users will interact with the TV system via a remote control. Viewers will share their viewing experience on-line with family and friends via voice or text messages.

Some users will create own digital contents such as photos, video, music and text. After recording the multimedia information, a multimedia browser running on a PC will enable users to edit their home videos and apply image enhancement to family photos. The content could be uploaded to public multimedia portals such as YouTube or send to family and friends over Internet, or simply displayed on some of the TV screens connected to the home network.

The Set Top Box (STB) has an application software called Electronic Program Guide (EPG) that is responsible for interaction with the user. It is paramount that the EPG has attributes that increases the user presence during the viewing experience.

Digital TV operators differentiate themselves through the functionality and quality of the TV services. Format and content of the TV experience is very important. Some TV content such as sports will benefit from the sharper HDTV format and perhaps also 3DTV that promises

three dimensional effects. Content will include 10,000+ VoD movie titles and hundreds of broadcast TV channels.

A home network bring new possibilities for value-added services. Existing services such as Called ID will be integrated into the TV environment. Services with high potential include games, betting, Karaoke, parental control, doctor and nurse home call.

2. Value-generating attributes of IPTV services

Main attributes

- Flexible service offerings (portfolio, pricing)
- Control of experience of televised content (time, place, storage)
- Personalized graphical user interface (ease of use)
- System quality (fidelity of information, low response time after commands, reliability and availability)
- Content quality (large mix of broadcast channels and VoD titles)
- Access to a niche content (cognitive need)
- Catch-up watching of favorite programs (home and network PVR, Time-shifted TV, VoD)
- Sharing of user-created content
- Sharing of watching experience (social TV)
- Social networking
- Intelligent/adaptive value-added services with high utility
- EPG-aware Internet search
- User authentication and video source protection (security)

Interactivity

- Selecting specific programs and view from the beginning
- Control Chat, Messaging, Buddy List and File Sharing over TV set
- Only individual program without on-going broadcast program
- Multimedia keyboard instead of remote control
- Using various services via remote control
- Detailed information research in addition to actual program
- Participation in game shows via remote control
- Buy e.g. groceries via TV set

Ubiquity

- Access to actual movies and blockbusters to watch at any time
- Start, stop and resume
- Record content, access time and location-independent
- Access to series (or entire seasons) time-independent
- Watching TV broadcast mobile (on the way, at PC, in car, ...)
- Access to the same content on several (mobile) devices

- Watch series (or entire episodes) on mobile devices

Personalization

- Listen to own music and receive personalized music recommendations
- Personalized advertising reducing TV consumption fees
- Personalized information to actual program
- Electronic Program Guide with personal recommendations
- Receive personal recommendations in alternative ways
- Personal advertising for products within viewers special internet
- Receive notification for the beginning of favorite series
- Special product recommendations, personalized to viewer

Web convergence

- Music and video clip download via remote control
- Control Chat, Messaging, Buddy List or File Sharing over TV set
- Calling friends via TV set
- Play games with friends over TV set
- Access to User Generated Content
- Order food delivery via TV set
- Participate in online auctions via TV set
- Providing access to self created content

3. IPTV service taxonomies

ITU-T

Recommendation H.720, October 2008:

- Distributed content services
- Interactive services
- Communication services
- Other services

Distributed IPTV content services:

- Broadcast services (linear TV)
- On-demand services
- Advertising services
- Time-shifting and place-shifting services
- Supplementary content

Interactive IPTV services:

- Information services
- Commerce services

- Entertainment services
- Learning services
- Medical services
- Monitoring services
- Portal services
- Interactive advertsing

Other IPTV services:

- Public interest services
- Hosting services
- Presence services
- Session mobility services

Open IPTV forum

Services and Functions for Release 2, October 2008:

- Scheduled content service
- Content on demand
- Personal video recorder
- Time shift
- Content guide
- Notification service
- Integration with communication services
- Web access
- Information service
- Interactive applications
- Parental control including remote control
- Home networking
- Remote access
- Support for hybrid services
- Personalized channel service
- Digital media purchase
- Content sharing

Scheduled Content Service (also known as Broadcast or Linear TV Service)

Scheduled Content Services is an audio and video content service where the play-out schedule is fixed. The content is delivered to the user for immediate consumption or recording. Service and Content protection mechanisms may be applied to the content.

Content on Demand (also known as Video on Demand and including Content Download)

Content on Demand is a service where a user can select individual content items they want to watch from a list of available content. Play-out of the content is started at the user's request. Content can be streamed from network-based storage for immediate consumption, or played out from the local storage of the ITF device after user or service provider initiated download to the ITF device.

Personal Video Recorder (PVR)

PVR is a service which enables a user to record scheduled content program events using local or network-based storage. The recorded items can be played back under the control of the user.

Time shift

The time shift service allows a user to halt a scheduled content service and continue watching the program later, by providing buffering for pause, rewind and resume.

Content Guide

Content guide is an information service tailored to user preferences that provides a searchable list of Scheduled Content Service and Content on Demand items. The presentation to the user can be created from metadata available on local equipment or received over the network in a form equivalent to web pages.

Notification service

The Notification service enables a user to be informed of delivered messages, including emergency alert notifications, and events. This service also enables a user to set reminders and be informed of scheduled content program events. Reminder notifications will be displayed on the customer equipment at the pre-configured time before the program event starts.

Integration with Communication services

This service provides IPTV users with access to person-to-person communication services. Aspects of such communication services may be integrated with the IPTV service, providing a richer experience to both. Examples of communication services include presentation of Caller ID, textual messaging, chatting and presence.

Web access

Allows IPTV users to navigate and display information provided in the World Wide Web in a manner dependent upon the presentation capabilities of the display equipment.

Information service

Portal for presenting tailored information to the IPTV user with or without relation to the content.

Interactive Applications

Interactive applications are those that allow user interaction via the ITF device or other user devices. Both network-based applications, which interact with the ITF device using web

technologies, as well as local applications in the home network are supported. The applications can be both related and unrelated to the content. Applications might interact with the IPTV services using standardized APIs. Applications might be authenticated to prevent misuse and the service provider might charge for applications.

Parental control including remote control

This service limits access by minors to certain content and services based on parental ratings and spending limits. Parents should be capable of using remote devices to check the usage and grant access to requested items.

Home networking

The ITF device will provide access to DLNA content stored on other devices in the home as well as offering IPTV content to DLNA devices.

Remote Access

Release 2 will provide access to the home via a remote device (e.g. a mobile phone), anabling a user to, for example, schedule recordings or access content stored within the home.

Support of hybrid services

The ITF device may provide access to TV services delivered over traditional broadcast networks (satellite, cable or terrestrial broadcast) in addition to, or as a substitute for, IPTV services.

Personalized channel service

Release 2 will provide a variation of a scheduled content service where the program line up is modified on a per user basis according to the user's preferences, viewing habits or service provider recommendations. This will be reflected in the user's Content Guide.

Digital media purchase

Digital media relates to content items such as ring tones and video clips, which can be purchased by users. Release 2 supports the advertisement of purchasable digital media, the purchase of digitial media using the ITF and delivery of digital media to various end-user devices.

Content Sharing

Content sharing allows a user, when allowed by DRM policies, to share content with other users. Release 2 will allow a user to select content available at its ITF and send it to other users. The receiving user can select the appropriate ITF for consumption of the content.

4. Quality models

4.1 General model

There are three notions of QoS defined in (Gozdecki, 2003)—intrinsic, perceived, and assessed — that constitute the general model (Fig. 1). Intrinsic QoS pertains to service features stemming from technical aspects. Thus, intrinsic quality is determined by a transport network design and provisioning of network access, terminations, and connections. The required quality is achieved, among other things, by an appropriate selection of transport protocols, the QoS assurance mechanisms, and related values of parameters. Intrinsic QoS is evaluated by the comparison of measured and expected performance characteristics, including packet loss and delay. User perception of the service does not influence the intrinsic QoS rating.

Perceived QoS reflects the customer's experience of using a particular service. It is influenced by the customer's expectations compared to observed service performance. In turn, personal expectations are usually affected by the customer's experience with a similar telecommunications service and other customers' opinions. Thus, the QoS with the same intrinsic features may be perceived differently by various customers.

The QoS offered by a provider must reflect the intrinsic QoS as well as some nontechnical parameters that are meaningful to the customer and relevant to a particular community's expectations. The assessed QoS starts to be seen when the customer decides whether to continue using the service or not. This decision depends on the perceived quality, service price, and responses of the provider to submitted complaints and problems. It follows that even a customer service representative's attitude to a client may be an important factor in rating the assessed QoS. Neither ITU nor ETSI nor IETF deal with the assessed QoS.

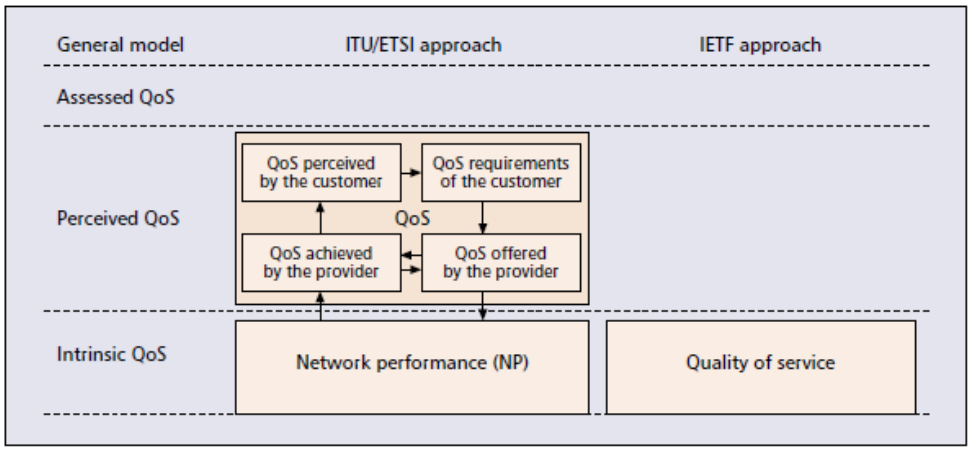

Figure 1. The general QoS model, and ITU/ETSI and IETF approaches (Gozdecki, 2003).

4.2 IPTV quality model

4.2.1 Introduction to Quality of Experience (QoE)

QoE is defined in [ITU-T P.10/G.100] as the overall acceptability of an application or service, as perceived subjectively by the end-user. It includes the complete end-to-end system effects

(client, terminal, network, services infrastructure, etc.) and may be influenced by user expectations and context. Hence the QoE is measured subjectively by the end-user and may differ from one user to the other. However it is often estimated using objective measurements.

QoE reflects the customer's experience and is expressed by objective and subjective service performance measures. Contributing to the objective measures are service factors, application factors and transport factors. Those objective measures together with human components that may include emotions, linguistic background, attitude, motivation, etc. determine the overall acceptability of the service by the end-user. Figure 2 shows factors contributing to QoE. These factors are organized as those related to quality of service and those that can be classified as human components.

QoE for video is often measured via carefully controlled subjective tests [ITU-R BT.500-11], [ITU-T P.800], where video samples are played to viewers, who are asked to rate them on a scale. The rating assigned to each case are averaged together to yield the mean opinion score (MOS).

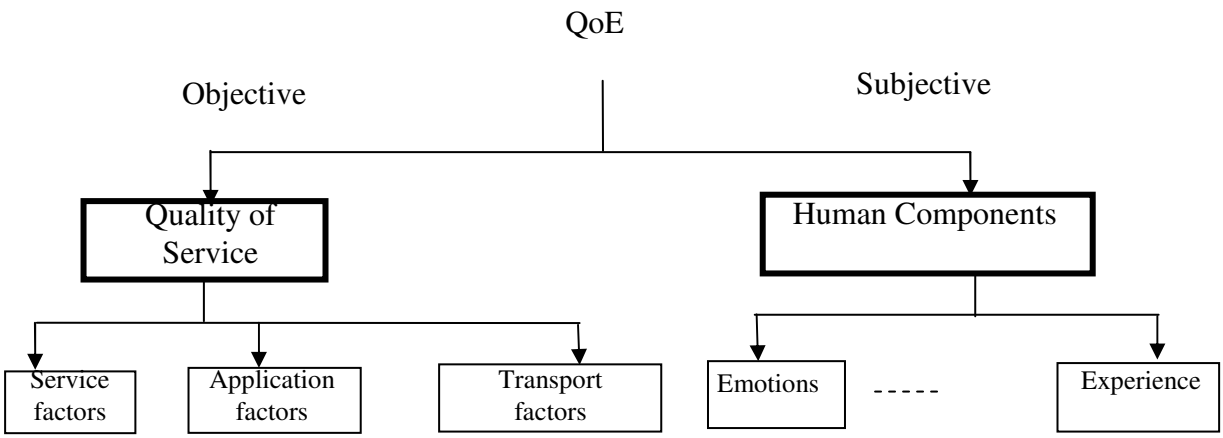

Figure 2. QoE dimensions.

Quality of service (QoS) is defined in [ITU-T E.800] as the collective effect of performance which determines the degree of satisfaction of a user of the service. In telecommunications, QoS is usually a measure of performance of the network itself.

Related to QoS are the QoS performance parameters that can be defined for different layers. At the network layer those parameters usually include information loss rate and information delay and delay variations. In general there is correlation between the subjective QoE as measured by the MOS and various objective parameters of service performance (e.g. encoding bit rate, packet loss, delay, availability, etc.).

Typically there will be multiple service level performance (QoS) metrics that impact overall QoE. The relation between QoE and service performance (QoS) metrics is typically derived empirically. Having identified the QoE/QoS relationship, it can be used in two ways:

a) Given a QoS measurement, one could predict the expected QoE for a user

b) Given a target QoE for a user, one could deduce the net required service layer performance.

4.2.2 QoE/QoS layered model

Multiple layers impact the overall user experience for any application. The key layers from a QoE/QoS perspective can be defined:

- **Service layer**: it represents the perceptual pseudo-layer on top of the application layer. It is the layer exposed to the user, and where the QoE is measured. QoE metrics are typically measurements of user opinion of the service quality such as Mean Opinion Score (MOS) or approximations of user opinions measured via objective means.

- **Application Layer**: where parameters related to the video application (e.g.: resolution, frame rate, color, video/audio codecs, number of channels) are managed in order to achieve expected QoE levels.

- **Transport / Network layer**: where parameters related to the transport and network performance (e.g.: jitter, delay, packet loss) are managed in order to meet the adequate QoE levels.

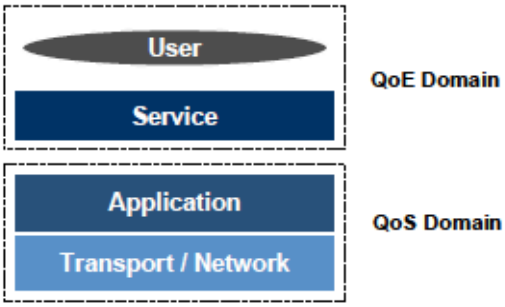

Figure 3. QoE/QoS layered model.

Several metrics can be used to monitor and evaluate the performance of an IPTV service:

- **Service Layer**

    - Subjective video quality
    - System start-up time
    - Navigation responsiveness time
    - Channel zapping time
    - VOD control time responsiveness (e.g.: Play, Fast Forward, Pause, and Rewind)

- **Application Layer**

    - Objective video quality
    - Middleware delay
    - Encoder delay
    - Decoder delay
    - Set-top box boot time
    - Set-top box command processing delay

- VOD servers processing delay

- **Network/Transport Layer**

  - Packet loss ratio (PLR)
  - Bit error rate (BER)
  - Packet latency
  - Packet jitter
  - Out-of-order packets
  - Join / Leave IGMP Delay

Based on a benchmark by the **Video Quality Experts Group** (VQEG) some objective video quality metrics were standardized as ITU-T Recommendations. J.246 and J.247 in 2008. The performance of an objective video quality metric is evaluated by computing the correlation between the objective scores and the subjective test results, known as mean opinion score (MOS).

QoS for IPTV networks typically means no more than 10^{-6} packet loss probability, 200 ms delay, and 50 ms jitter. Low delay is essential for satisfactory trick mode performance (pause, resume, fast forward) for VoD, and fast channel change time for BTV.

5. TAM model for IPTV

Technology Acceptance Model (TAM) is intended to provide a conceptual model featuring a theoretic foundation and parsimony, to explain and predict the behavioral intention and practical behaviors of information technology users, based on the acceptance and use of information technology. Based on the suggestions of previous studies, (Davis, 1989) presented two factors that determine user's acceptance or rejection of information technology, namely perceived usefulness and perceived ease of use. Users who perceive higher ease of use of a certain system think the system is easier to use, generating a positive attitude towards the adoption of the system. If the perceived ease of use is low, then user attitudes are negative. Moreover, perceived ease of use can strengthen perceived usefulness, while attitude and perceived usefulness have significantly positive effects on behavioral intention.

TAM is based on the theory of reasoned action (TRA) which originally were derived from the social psychology setting by The components of TRA are three general constructs: behavioral intention (BI), attitude (A), and subjective norm (SN). TRA suggests that a person's behavioral intention depends on the person's attitude about the behavior and subjective norms (BI = A + SN). Behavioral intention measures a person's relative strength of intention to perform a behavior. Attitude consists of beliefs about the consequences of performing the behavior multiplied by his or her valuation of these consequences. Subjective norm is seen as a combination of perceived expectations from relevant individuals or groups along with intentions to comply with these expectations. Fishbein and Ajzen say, though, that attitudes and norms are not weighted equally in predicting behavior.

- **Attitudes**: belief about outcome of behavior;
- **Subjective norms**: beliefs about others attitude;

- **Behavioral intention**: a function of both attitudes toward a behavior and subjective norms toward that behavior, which has been found to predict actual behavior.

Similar to the Theory of TRA, TAM suggests that antecedents that directly affect perceived usefulness and perceived ease of use, such as user's personal attribute, system feature, and environmental variable, can be covered by an external variable.

Researchers in psychology have been interested in the moderating effect of prior experience with a product or service. The cognitive dissonance theory (Cummings & Venkatesan, 1976; Festinger, 1957) suggested that the prior experience with a product or service has influence on the change of users' perceptions. As a result, the antecedents of initial adoption are not the same as those of continued usage, and the relative importance of the determinants varies over time. Zanna and Rempel (1998) noted that a user's perceptions may be formed based on three general types of information: past behavior, affective information, and cognitive information.

To provide an explanation and prediction of the determinants of ICT service adoption, (Teo,1999) proposed a motivational model with two constructs: **intrinsic** and **extrinsic** motivation. Intrinsic motivation can be defined as the performance of an activity for no apparent reinforcement other than the process of performing the activity *per se*. In contrast, extrinsic motivation was seen as the performance of an activity because it was perceived instrumental in achieving valued outcomes distinct from the activity itself. Perceived usefulness can be an example of extrinsic motivation, while enjoyment is intrinsic.

Many researchers have proposed extended TAM models to explain adoption of ICT services, including mobile services, Internet services, and IPTV services. Below we summarise some representative proposals. The various TAM models differ in the choice of motivational factors used to predict users' attitude and behavioral intention.

(Shin, 2007) has proposed a TAM model to describe adoption of IPTV. The model assumes intention to use IPTV is formed from intrinsic factors, extrinsic factors, economic factors, individual differences and ease of use. Intrinsic variables/factors include timely/on-demand, special functionality and individualized content. Extrinsic factors include interactivity, value-added service and compatibility. Economic factors include equipment cost, monthly fee, additional service charge. Individual difference factors include age, education and previous experiences. Ease of use factors include usability.

(Shin, 2009a) has proposed a TAM model to describe adoption of IPTV. The model assumes users attitude towards IPTV is formed from perceived usefulness and perceived playfulness. Perceived usefulness is predicted by perceived quality of service and perceived control. Perceived playfulness is predicted by perceived content quality and perceived control. The author assumes users' attitude, perceived cost (service price) and perceived security predicts intention to use IPTV.

(Shin, 2009b) has proposed a TAM model to describe adoption of IPTV. The model assumes users attitude towards IPTV is formed from perceived usefulness and perceived enjoyment. Perceived usefulness is predicted by perceived system quality and customer demographics. Perceived enjoyment is predicted by perceived content quality and customer demographics.

The author assumes users' attitude, perceived cost and social pressure predicts intention to use IPTV.

(Shin, 2008) has proposed a TAM model to describe adoption of mobile IPTV. The model assumes users attitude towards IPTV is formed from perceived usefulness, perceived ease of use, flow experience, perceived enjoyment, and perceived loss. The author assumes users' attitude and social norm predicts intention to use mobile IPTV.

(Lu, 2009) has proposed a TAM model to describe adoption of instant messaging services on Internet. The model assumes actual IM usage is formed from intention to use IM and perceived behavioral control. Intention to use IM services is formed from users' attitude, subjective norm and perceived behavioral control. Attitude toward IM services is predicted from perceived usefulness, perceived ease of use, concentration and perceived enjoyment.

(Lee, 2009) has proposed a TAM model to describe Intranet usage within organizations. The model assumes intention to use Intranet services is formed from perceived usefulness, perceived ease of use and subjective norm. Perceived usefulness is predicted by IS related factors (technical support, web experience) and task characteristics (task equivocality, task interdependence). Perceived ease of use is predicted by IS related factors. Subjective norm is predicted by IS related factors and task characteristics.

(Jung, 2009) has proposed a TAM model to adoption of mobile TV. The model assumes intention to use mobile TV is formed from perceived usefulness and perceived ease of use. Perceived usefulness is predicted by content and cognitive concentration. Perceived ease of use is predicted by cognitive concentration.

(Kim, 2009) has proposed a TAM model to describe adoption of mobile data services. The model assumes intention to use mobile data services is formed from perceived usefulness, perceived ease of use, perceived enjoyment and perceived fee. The authors examine the moderating effect of prior experience by testing the model with novel and experienced users, respectively.

(Kuo, 2009) has proposed a TAM model to describe adoption of mobile 3G value-added services. The model assumes intention to use mobile 3G value-added services is formed from users' attitude, perceived usefulness and perceived cost. Users' attitude is predicted by usefulness, ease of use and perceived cost. Perceived usefulness and perceived ease of use is predicted by personal innovativeness.

(Qi, 2009) has proposed a TAM model to describe adoption of mobile data services. The model assumes intention to use mobile data services is formed from users' attitude, voice service experience, innovation experience, brand experience and flow experience. Users' attitude is predicted by usefulness, ease of use and the same experience factors.

(Li, 2009) has proposed a TAM model to describe adoption of mobile 3G services. The model assumes intention to use 3G services is formed from users' satisfaction and trust. Users' satisfaction is predicted by interactivity, customization, responsiveness, usefulness and ease of use.

(Gao, 2008) has proposed a TAM model to describe adoption of mobile services. The model assumes intention to use mobile services is formed from perceived usefulness, perceived ease of use, trust and personal initiatives and characteristics.

(Kwon, 2007) has proposed a TAM model to describe adoption of mobile services. The model assumes extent of use is predicted by extrinsic motivation (perceived usefulness) and intrinsic motivation (enjoyment/fun). Extrinsic and intrinsic motivations are predicted by ease of use and apprehensiveness. Ease of use and apprehensiveness are predicted by demographic factors (gender, age, nationality) and socio-economic factors (occupation, income).

(Kim, 2007) has proposed the Value-based Adoption Model to explain customers adoption of mobile Internet. The model assumes adoption intention is formed from the perceived value. Factors that predict perceived value are benefit factors (usefulness, enjoyment) and sacrifice factors (technicality, perceived fee).

(Wang, 2006) has proposed a TAM model to describe adoption of mobile services. The model assumes intention to use mobile services is formed from perceived usefulness, perceived ease of use, self-efficacy, perceived financial resource and perceived credibility.

(Cheong, 2005) has proposed a TAM model to describe adoption of mobile Internet. The model assumes intention to use mobile Internet service is formed from users' attitude and perceived cost. Users' attitude is predicted from perceived usefulness, perceived ease of use and perceived enjoyment. Perceived usefulness is predicted by perceived system quality and perceived content quality. Perceived ease of use is predicted by perceived system quality and users prior experience with the service. Perceived enjoyment is predicted by perceived content quality and service experience.

(Zhang, 2005) has proposed a TAM model to describe adoption of IT. The model assumes attitude towards IT is formed from perceived usefulness and perceived ease of use. Perceived affective quality is assumed to predict both perceived usefulness and perceived ease of use.

(Hung, 2003) has proposed a TAM model to describe adoption of WAP services for mobile commerce. The model assumes intention to use WAP services is formed from users' attitude, subjective norm and perceived behavioral control. Users' attitude is predicted by usefulness, ease of use, user satisfaction, personal innovativeness, connection speed, and service costs.

6. Value modelling

Value is emphasized in the field of economics, and it has its foundation in exchange, utility and labor value theories, as well as in marketing, accounting and finance, while also having roots in psychology and social psychology. Researchers have come up with many different terms to describe value, generally differentiating by context the same basic concept: consumption value (Sheth, 1991), acquisition and transaction value (Thaler, 1985), service value, customer value, consumer value (Woodruff, 1997) and perceived value (Zeithaml, 1988).

From the customers' perspective, products are viewed as a bundle of benefits, not attributes. In other words, customers are less interested in the technical features of a product or service than in what benefits they get from buying, using or consuming the product. (Sheth, 1991)

categorizes five product benefits or **consumption values** which influence the consumer's choice behavior: functional, social, emotional, epistemic and conditional. Functional values are associated with the utility level of the service compared to its alternatives. Social value is described as the willingness to please, and social acceptance. Emotional values are those choices made based upon feelings and aesthetics. Epistemic values refers to the benefit acquired from a service's capacity to satisfy curiosity, provide novelty, and/or meet a desire for knowledge. Conditional value refers to a set of circumstances depending on the situation. Socioeconomical and physical aspects are included in this value. These five values were conceptualized based on a diversity of disciplines including social psychology, clinical psychology, sociology, economics, and experimental psychology.

The five consumption values are combined in a weighted sum to form the **consumer value** of the considered DTV service. What marketing strategists mean by "customer value" is quite different from the meanings of the "consumer values" discussed in consumer behavior research. Generally speaking, "**customer value**" focuses on the buyers' evaluation of product purchase at the time of buying, while "consumer values" stress people's valuation on the consumption or possession of products.

Customers select digital TV operator based on the **consumer surplus** of service offerings on the market. Consumer surplus is defined as the difference between consumer value and price. The demand from customers is often described by a stochastic model, where each available operator is assigned a probability of being selected by a new customer. The selection probability for each operator depends on the consumer surplus values of all operators on the market. The customer's probability for choosing a particular operator reflects the intention to use in the TAM model.

Knowledge of the consumer surplus function is essential in planning of the service portfolio and pricing strategy. The price function can be determined from the table with prices for subscription and transaction services. The consumer value function is much more complex to formulate and requires a multi-disciplinary approach.

Results from contemporary TAM research, summarised in Section 5, suggests a number of motivation factors for explaining adoption of ICT services and synthesis of consumer value. Factors with direct influence on intention to use ICT service include usefulness (utility), ease of use (usability), enjoyment (affective quality), subjective norm, perceived cost, experience (w.r.t service, innovation, brand and flow), cognitive concentration, trust, personal initiatives/characteristics, apprehensiveness, self-efficacy, perceived financial resource and perceived credibility. Factors with indirect influence (i.e. they predicts direct factors) include personal innovativeness, user satisfaction, interactivity, customization, responsiveness and connection speed.

Each motivational factor contributes to the five consumption values representing functional, social, emotional, epistemic and conditional benefit aspects. The properties of the consumption values can be derived from human factor modelling of users' experience with DTV services. An major question is how to calibrate the consumption values in the calculation of consumer value. Such information can be obtained directly from customer surveys and indirectly from service usage statistics. The resulting consumer value represents users' maximum willingness to pay (WTP) for the service.

We are currently studying the literature on measuring and modelling human experience and consumer value of DTV services (Gaggioli, 2003; Takatalo, 2008). The online edition of the

Visual Thesaurus (Visual Thesaurus, 2004) defines the word experience with the following key points: (1) experience has two meanings: it can be something one has gone trough and gained knowledge of or it can be the content of direct observation or participation in an event, (2) experience may have both mental and bodily states, and (3) it is closely related to feelings and emotional sensations.

Some importance concepts in this study are:

- affective, cognitive, motivational factors
- levels of brain mechanisms: visceral, behavioural, reflective
- limitations of sensory systems
- limitation of working memory
- cognitive load, capacity, need
- learning and schemata formation
- dimensions of affect: pleasure, arousal, dominance
- presence and interactivity
- creation of optimal experience through flow

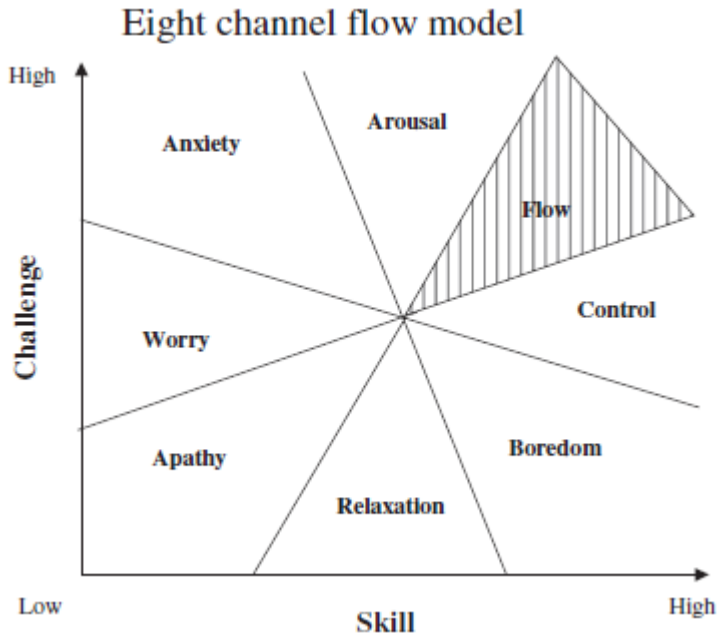

Figure 4. An eight-channel model for the analysis of experience by (Massimini, 1988).

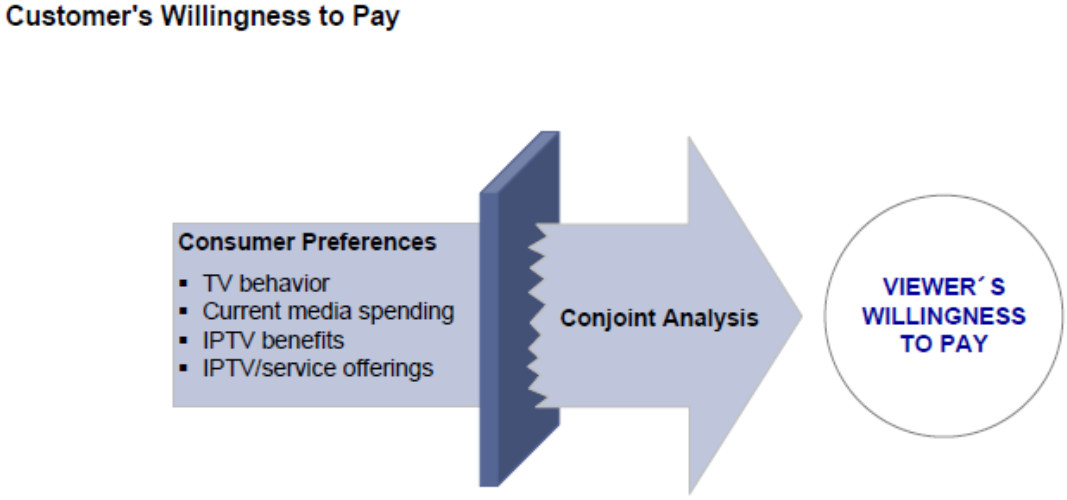

Figure 5. Estimation of WTP based on conjoint analysis and customer survey (Grove, 2007).

Customer's Willingness to Pay

Service	Relevance	Discrete WtP[1)]
High Definition TV (HDTV)	↑	10 EUR
Video on Demand (VoD)	↑	8 EUR
Personal Video Recorder (PVR)	↑	in VoD included
Exclusive Content	↑	in VoD included
High number of channels available	→	in VoD included
Advanced Electronic Program Guide (EPG)	→	assumed to be included
User Generated Content	→	in VoD included
Interactive Games and Quiz Shows	→	/
Shopping via Remote Control	↓	0 EUR

7. IPTV application platforms

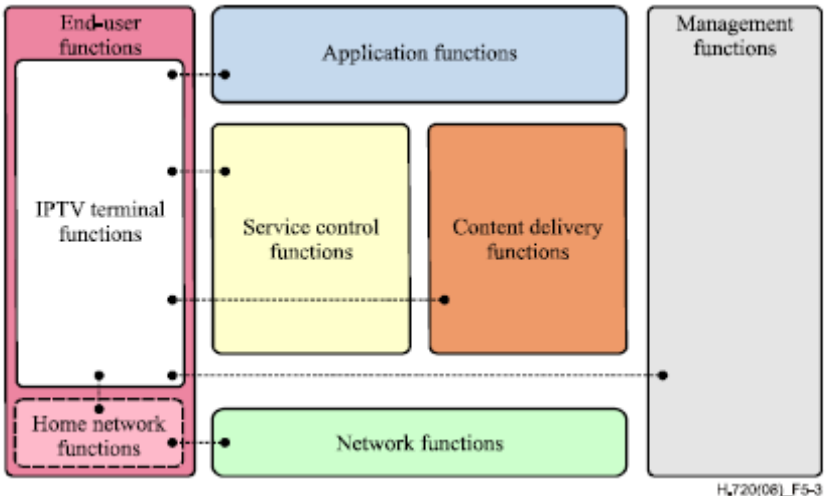

Figure 6. IPTV terminal device architectural overview (ITU-T Rec. H.720)

7.1 Platform examples

Alcatel-Lucent

The *MyOwnTV* application provides a set of tools that service providers can deliver to consumers interested in creating their own "TV channel". End users can then invite family and friends to tune into their own channel to share family photos, videos and other personal content. TV viewers can now become commentators, actors, directors and even content creators. In addition to individuals, local governments, small to medium-sized enterprises (SMEs) and retail stores can use MyOwnTV to distribute compelling multimedia content to a targeted audience via the TV.

The *AmigoTV* application enhances the TV experience by offering a number of interactive services to TV viewers. For example, AmigoTV allows you to invite friends to join you as you watch a program in a virtual living room — even though you live hundreds of miles apart. AmigoTV also provides a variety of tools that enable communications such as voice conferencing, sending text messages and on-screen animations called emoticons to friends and family around the world.

Huawei

Supported services/applications:

- Live broadcast TV
- Time-shifted TV
- Video on demand
- Interactive information
- Games
- Video blogger
- News chat room
- TV mail

ZTE

Supported services/applications:

- Live Broadcast TV
- Video on Demand
- Network Personal Video Recorder
- Time-shifted TV
- Video Communication
- Short message service
- Instant messages
- Walled garden
- Advertising
- Gaming

- Media sharing

UTStarcom

Supported services/applications:

- Broadcast TV
- Time-shifted TV
- Video on Demand
- Video phone
- Video conferencing
- T-commerce
- Video mail
- Personalized content programs

Microsoft

Supported services/applications:

- Live video
- On-demand video
- Video recording
- Time shifting
- Interactive program guide
- Recording two HD streams while watching two SD streams simultaneously
- Media sharing
- Multiview

Microsoft Mediaroom also includes *Microsoft Mediaroom Application Development toolkit* which can be used to author applications that run on the Microsoft Mediaroom platform.

Accedo

Supported services/applications:

- Casual games
- Casino
- Web 2.0 services
- News
- Weather
- Information
- Karaoke
- Video art
- Lifestyle
- Children and communication.

The *Accedo Application Portfolio*™ is compatible with all major IPTV platforms.

7.2 Open-standards-based platforms

Commercial off-the-shelf application platforms allow developers to leverage advanced technology, while remaining focused on core competencies. Open-standards-based platforms enable IPTV interoperability allowing service providers to customize and create value added services.

Alcatel-Lucent

Alcatel-Lucent's *Interactive media manager* (IMM) application toolkit enables content providers to easily and affordably design, create and manage interactive TV applications such as voting, enhanced TV and interactive advertising. IMM has an open architecture that allows integration to external data systems.

Ericsson

Open Multimedia Platform (OMP) is the foundation on which Ericsson develops new offerings, communication suites, and various other products based on IMS and other enablers. The main functional layer of OMP comprise a software applications execution framework. This is complemented by application services, such as database management system, protocol stacks, and directories, for implementing and deploying solutions. OMP includes the Java Platform Enterprise Edition (EE) execution environment and all major layers in the stack. Applications need not make any assumptions about hardware or operating system at design. More information can be found in the Ericsson Review journal, e.g (Olsson, 2008b; Andrén, 2009).

Nokia-Siemens

Nokia-Siemens' *Home Entertainment Release* 3.0 offers full User Interface (UI) customization, flexible third party application integration and powerful management tools and verification processing. Traditional IPTV development has been a closed exercise, primarily the responsibility of vendors based on proprietary architectures. Leveraging an open model, Nokia Siemens Networks is offering an intuitive Software Development Kit (SDK) that allows for third-party customizable User Interface development on HTML and Java platforms, operators can customize and enhance their offerings themselves.

Nortel

Nortel's *Video Services Platform* (VSP) 9500 is a services platform to facilitate the rapid introduction of new services on top of a video or IPTV network infrastructure. Using open interfaces based on SOA and web services, the Video Services Platform enables applications to be easily and cost-effectively developed and deployed on top of the platform. These applications can be created by Nortel, third-party developers or by the service providers themselves.

Motorola

Motorola's *KreaTV* application platform separates applications from the platform through well-defined open interfaces, leaving you in control of how the system is composed and how it should evolve. Integration of new components, development of new applications or customization of the user interface can all be done in-house, or by independent third party developers. Standardized Terminal Open Interfaces (TOI) support multiple application environments enabling you to use HTML/JavaScript, C/C++ or Java, when adding new services or functionality to your system.

8. IPTV service offerings

Today (2009), there are almost 600 commercial IPTV launches worldwide. The Swedish IPTV market is divided among several operators with TeliaSonera (500 thousand customers), Bredbandbolaget/Viasat, CanalDigital, and FastTV dominating the market. Worldwide, the top 10 IPTV operators are (September 2008):

1. Iliad (Free) - France
2. France Telecom (Orange) - France
3. PCCW - Hong Kong
4. Nuef Cegetel - France
5. Telefonica - Spain
6. Chunghwa Telecom - Taiwan
7. China Telecom - China
8. Belgacom - Belgium
9. TeliaSonera - Sweden
10. Fastweb - Italy

France telecom is by far the most successful IPTV operator in Europe with more than 7 million subscribers. Part of its success is explained by an attractive service offer featuring cheap pay-TV channels and HDTV format. Companies such as Chunghwa Telecom and Telefonica successfully compete with service offerings based on differentiated services (e.g. karaoke on demand, games, media center) and new subscription models (e.g. subscription to fixed number of VoD titles each month). The leading IPTV operator in Hong Kong, PCCW, offers a basic channels for free but charges for premium sports and HDTV. Canal Digital is the only IPTV operator that offers HDTV channels in Sweden.

AT&T:

U-verse service offer:

- Up to 320 channels, including 40+ HD channels
- Total home DVR -- any time, any TV
- Viewing/recording up to 4 programs simultaneously
- Parental controls
- Instant channel change
- High speed Internet service
- Voice over IP (VoIP)

- Online photos from Flickr
- AT&T Ubar, which brings customisable weather, stock, sports, and traffic information to the U-verse TV screen, without interrupting the current program
- AT&T Yahoo! Games, so U-verse TV customers can now play their favorite online games -- including Sudoku, Solitare, JT's Blocks, Mah-jongg Tiles and Chess -- on the TV screen

Expected evolution of service:

- Caller ID on TV
- Wireless remote access to manage DVR recordings and parental control

Verizon:

FIOS service offer:

- 300+ channels
- up to 100 HD channels
- 10,000+ VoD titles
- Dolby 5.1 surround sound
- DVR
- SD and HD STB
- Caller ID etc ?

Telefonica:

Current service offer:

- HDTV
- VoD
- News & entertainment (games)
- DVR/multiroom DVR
- Media center (PC in TV)
- Dedicated web 2.0 portals
- Flat rate Internet access

Expected evolution:

- High interactive TV services
- Domotic services integration, security
- 3D contents and value-added services
- HD user generated contents
- HD video communications
- Graphic intense network games

TeliaSonera

Current service offer:

- +70 channels
- +1000 VoD titles
- program reminder?
- image gallery
- surfing
- time shift TV?

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