

Summary

The principle objective of the project is to create the plan of new technology in terms of Customer Premises Equipment (CPE) for pay Spanish sport TV channel, Gol Television. This plan shall provide to obtain new equipment design, modern and efficient, that allows the company to reduce the costs, that are generated by current DTT equipment. Identification of the gaps within the organization sectors supports the plan development. Moreover the company, by implementation of the new technology plan, shall be able to offer its service in more affordable prices, and in effect increase the sales.

The technology roadmap methodology is used in the study, in order to create the future channel technology strategy plan. The roadmapping process of technology planning in terms of CPE is supported by different analysis presented in the chapter 6 and chapter 7.

Design process of technology roadmap consists of the company vision for the future and description of the CPE problems, based on the presented in chapter 5 current situation of Gol Television. Analysis of the technology roadmap scope, which is CPE, includes identification of the problems, gaps, and definition of the additional costs that are generated by actual DTT equipment.

CPE technology roadmap consists of equipment requirements analysis that is used in order to create the technology plan with established CPE pre-solution. This analysis has beginning in the customers' and company's needs identification. Based on these needs general functional requirements in terms of future CPE are defined. These requirements underline the necessities and expectedness in terms of the new equipment characteristics. The functional requirements provide to identify different technology specifications that give the CPE pre-solution proposals.

As a project conclusion is establishment of the CPE plan that includes all identified technology solutions, ordered and arranged within the time.

The final choice of the CPE features depends on the company decision. The investment of assumed proposal of new CPE design, realized for this study, has an impact on the Mediapro company economy and, as it is presented in the chapter 8, can bring important advantage.



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Glossary

API	Application Programming Interface
App	Application
BO	Back office
B2D	Business to Distribution
CAK6	Conditional Access Key 6
CAM	Conditional Access Module
CAS	Control Access Systems
CDN	Content Delivery Network
COFDM	Coded Orthogonal Frequency Division Multiplexing
CPE	Customer Premises Equipment
CRM	Customer Relationship Management
CW	Control Word
DRM	Digital Right Management
DTT	Digital Terrestrial Television
DTV	Digital Television
ECM	Entitlement Control Messages
EMM	Entitlement Management Messages
FAQ	Frequency Asked Questions
FO	Front Office
HD	High Definition
HDD	Hard Disk Drive
HBBTV	Hybrid Broadcast Broadband Television
HW	Hardware
IRD	Integrated Receiver/Decoder
IAG	Interface Agent-Guide
IVR	Interactive voice response
MPEG	Moving Picture Experts Group
PVR	Personal Video Recorder
RAM	Random Access Memory
RSA	Algorithm for Key Cryptography
SAS	Subscriber Authorization System
SMS	Subscriber Management System

STB	Set top box
SW	Software
TDT	Television Digital Terrestre (in English DTT)
TRM	Technology Roadmap
TS	Technical Specification
UI	User Interface

1. Outline

1.1. Origen of the project

Making internship, during last semester, in one of Spanish consulting company I was proposed to develop a project for one of the company client, Gol Television, pay TV sport channel. The project objective was to create new technology plan that could provide the company business grow in time of economy recession.

This technology plan focuses on the CPE (Customer Premises Equipment). Due to Gol Television is pay digital content provider the equipment is needed to receipt the signal of DTT and decrypt it in order to display the picture on the TV screen. This project pretends to create new CPE based on current requirements of both players: company and customer in terms of DTT equipment. Identified players' needs allow define the CPE features. New equipment characteristics need to be appropriate identified and adapted to current economy situation in order to provide low cost service.

1.2. Motivation

Nowadays technology is dynamic and changing sector. It has essential impact on organization and can bring huge opportunities to company. Mediapro, the company that funded Gol Television, has noticed this opportunities and intends to use it in order to achieve its objectives.

CPE made inseparable element of provided by Gol Television service to its customers. Current situation forces the company to fabricate new equipment sets because of running out of stock. Taking into account actual economy recession, company decided to develop the plan of future CPE in order to recognize the possible benefits that could be achieved by new equipment features. Mediapro is going to use CPE as a driver of business improvement. It consists of reduction of costs generated by actual CPE and increasing the sale providing affordable service. Due to this company objective technology roadmap is going to be created.

2. Introduction

Nowadays, technology plays a leading role as a strategy importance in delivering top line value, business transformation and competitive advantage for organizations [1]. The companies develop new technologies in order to build, maintain and exploit a company's technological assets. Moreover it involves predicting and preparing for the opportunities and challenges that new technologies offer. But to increase the business benefits, technology requires effective processes and systems to be put in place and to ensure that existing and potential technological resources within the organization are aligned with its needs.

The study of this project is focused on the technology strategy plan for Gol Television, soccer sports TV pay channel. In the multimedia sector, technology has huge impact on the business and its competitiveness on the market. The majority of problems, that the company has to face, .are not only connected with appropriate content selection but also with the necessity, driven by customers, of low cost service provision, caused by economy recession in Spain. The impact of changes on the market needs to be considered to define potential threats and opportunities for company and use them in the technology plan process creation.

This technology strategy plan focuses on the CPE sector of Gol Television. The equipment set is essential part of provided by the channel service. It generates some costs for the company and also has impact on the sale. These two factors dive the technology roadmap in order to design new CPE that allows the company to offer its customers affordable service and in effect gain more benefits.

The technology roadmap is the methodology that is used to create this strategy plan for Gol Television. It helps to identify the opportunities that can be brought to the company by broadcast equipment improvements. The analysis of the current situation allows identify the gaps within the CPE sector. The analysis includes also investigation of the customer and company requirements in order to meet both players' needs. Based on it, technology solutions will be identified and matched with defined and fused requirements as opportunities of improvements for this company sector. The technology roadmap will present alternative solutions that can be chosen and implemented by Gol Television. The financial analysis will be made for one of selected solution.

2.1. Roadmap objectives

This study aims to identify the current situation within the Gol Television CPE sector and to recognize customers and company requirements in terms of the DTT equipment. Analysis of these requirements in the broadcast area helps to convert them into appropriate technology solutions that are defined in order to improve service, make it more profitable for the company and affordable for more clients.

The roadmap main objective is to create technology plan for Gol Television in order to allow the channel to offer its clients low cost service on the Spanish multimedia Market. This plan gives a proposal of technology strategy for the channel in terms of CPE possible improvements. The analyzed impact of CPE on the company and on its other departments helps to achieve roadmap objective. The roadmap as technology strategy plan, proposes technology solutions that allow the company increase its benefits, by cost reduction in terms of CPE.

2.2. Scope

The project focus area is Spanish multimedia technology sector related to the Customer Premises Equipment. This functional part of Gol Television has important impact on the channel service. The project scope considers the current situation within the channel and its departments in order to define the existed gaps in terms of CPE. Apart of it, the company and customer requirements are identified. These recognized needs give base to create the strategy technology plan for the channel future.

To support roadmap development are processed following analysis:

- Identification of customer and company requirements to list functional specifications in terms of CPE
- Identification of technical specifications and its solutions for designing new CPE sets

The technology roadmap integrates all made analysis and display solution proposal for the business future. In that way the roadmap objective is achieved and the technology strategy plan for the next two years for Gol Television is created.

3. Roadmap as the project methodology

Roadmap is a complex mechanism, which shows the future path of the business, enabling organization to visualize their critical assets, the relationship between these and the skills, technologies, and competencies required to meet future market demands. The roadmapping is a process of good strategy planning that supports integration with other needed strategic and operational management processes to achieve success by organization. It connects the company's vision, values and objectives with strategic actions, required to achieve the business, technology or service destination. The process leads a cross-functional planning to fully examine potential competitive strategies and ways to implement those strategies, showing different roads that can be taken by the company [2].

General process for crating technology roadmaps strategy include following elements:

- Integration of business/market information with technology identification in order to define and evaluate options of product – technology relations
- Creation roadmap – map of solutions and its alternatives
- Targets definition
- Project short and long term product/service/technology proposals

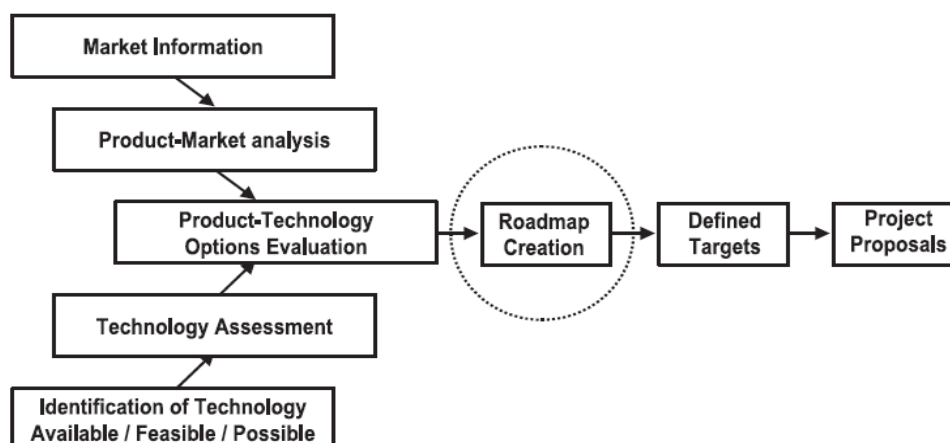


Figure 3.1: Roadmaps integrate commercial and technological knowledge [3]

Technology roadmaps include technology strategy, marketing, planning, and management (shown in figure 3.1). It enhances communications among researchers, technologists, product managers, users, and other stakeholders. It helps to identify gaps and opportunities

in technology programs and build the bridge between technology opportunities, developments and market [4], [5].

3.1. Types and techniques of technology Roadmapping

The technology roadmapping approach is open and can be easily adapted to the company requirements. It can concern different organizational aims that can address to tangible goods for example a company product, or intangible for example business or strategy. Therefore we can distinguish following types of the roadmapping that are identified by intended purpose (figure 3.2):

- Product planning: relating to the implementation of technology into manufactured products. The roadmaps, in this type, are linking planned technology and product developments.
- Service or capability planning: relating with service-based enterprises. This roadmap focuses on organizational capabilities and how the technology can support it and improve the business
- Strategic planning: give a support to evaluate different opportunities or threats of the business. This roadmap focuses on the development of a vision of the future business, in terms of markets, business, products, technologies, skills, culture, etc.
- Long-range planning: is used to support long-range planning and extending the planning horizon. The roadmap can help to identify potentially disruptive technologies and markets.
- Knowledge asset planning: that aligns knowledge assets and knowledge management initiatives with business objectives. This roadmap enables to visualize their critical knowledge assets, and the linkages to the skills, technologies and competencies required to meet future market demands.
- Program planning: is focusing on implementation of strategy, and more directly relates to project planning. This roadmap focuses on the management and enables to see the relationships between technology development, program phases and milestones.

- Process planning: it supports the management of knowledge, focusing on a particular process area, like new product development. The roadmap is focusing on the knowledge flows to facilitate the process and make it more effectively.
- Integration planning: is focuses on integration and/or evolution of technology, in terms of how different technologies combine within products and systems, or to form new technologies.

The roadmapping can be used in any organization. It can be matched up easily with the enterprise profile or business and can provide reliable analysis of different organizational aims. Moreover the format for roadmap developing is also flexible and the format is free to match with the purpose. The picture 3.2 list purposes and formats of the roadmap and display the free form of make the general technology roadmap [3], [4].

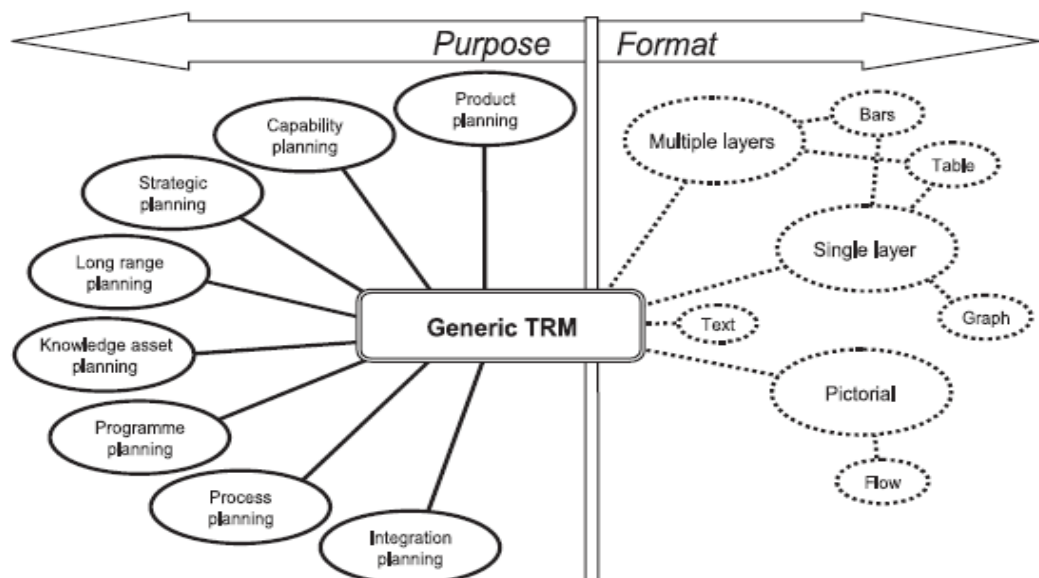


Figure 3.2: Purposes and formats of the roadmap [3]

As it is presented on the picture, the roadmap is a methodology that can be applied in different way not only in terms of organizational aims and intended purpose but also in terms of used techniques of the roadmapping process presentation.

There are the following techniques of graphical roadmapping presentation (figure 3.3):

A. Multiple layers

The most common technique of technology roadmap displaying, it consists a number of layers, and sublayers. The roadmap allows the evolution within each layer to be explored and facilitate the integration between them.

B. Tables

This technique presents the different activities and performances suited in specific time periods.

C. Single layer

This form of roadmap is focusing on a single layer of the multiple layers. Is less complex and the linkages between the layers are not shown.

D. Bars

This technique expresses the set of bars, for each layer or sublayer. It is simplifying and unifying the required outputs, which facilitates communication, integration of roadmaps, and the development of software to support roadmapping.

E. Graphs

In this format product or technology performance can be quantified. Each roadmap sublayer is expressed as single graph or plot.

F. Flow chart

This technique typically is used to relate the organization's objectives, actions and outcomes.

G. Pictorial/Tree graph

This roadmap technique is used to communicate technology integration and plans, and to support the objective, relating to the development of products and product families, based on a set of liquid crystal display technologies.

H. Text

Last roadmaps format are entirely or mostly text based, describing the same issues that are included in more conventional graphical roadmaps. The white papers support understanding of the technological and other influence sectors on the organization's business.

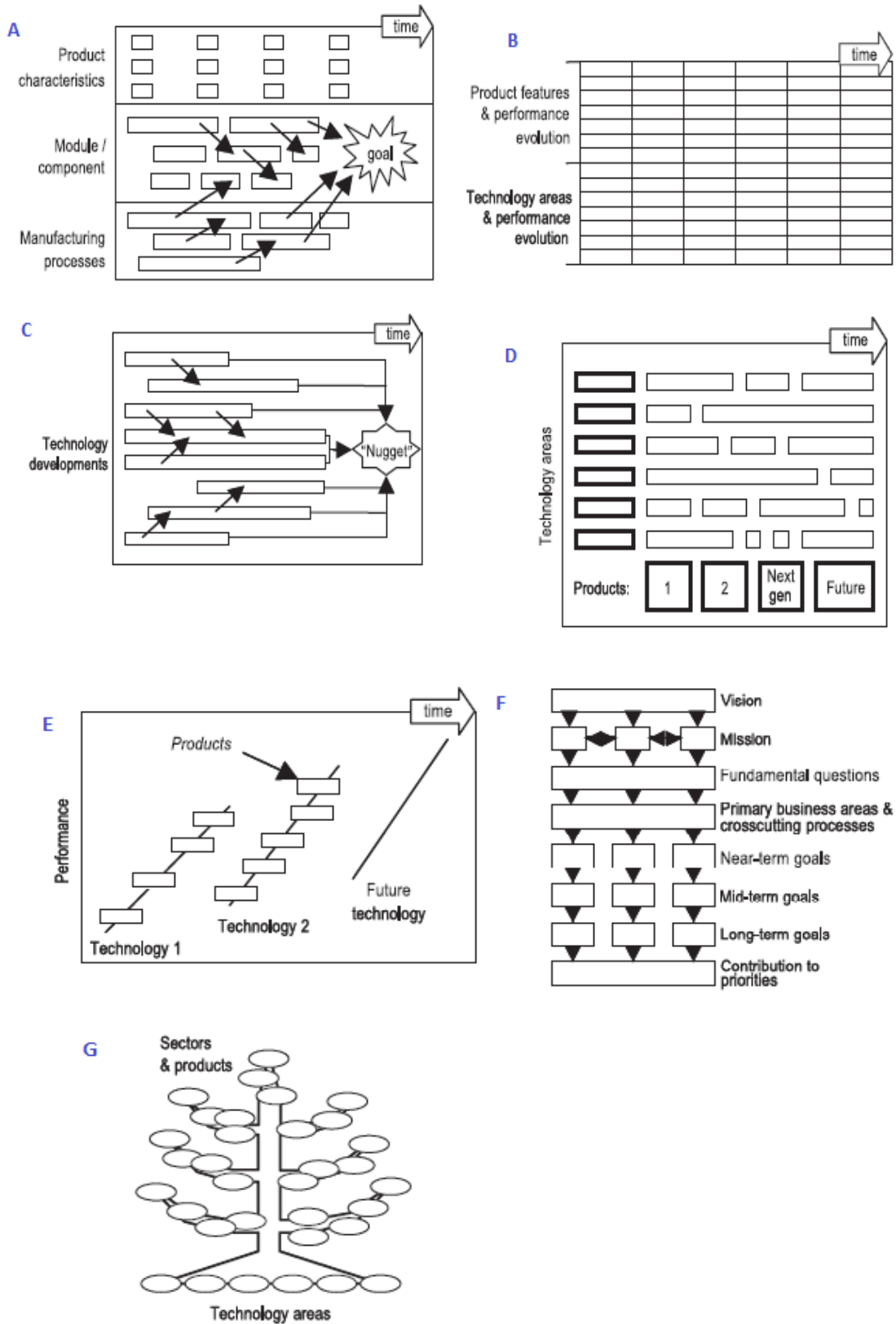


Figure 3.3: Different techniques of roadmap: (A) Multiple layer, (B) Table, (C) Single layers, (D) Bars, (E) Graph, (F) Flowchart, (G) Pictorial/Tree graph [4]

Roadmap is flexible tool and has many techniques of presentation as well as different areas where can be developed and implemented in order to improve organization business, product or service.

3.2. Roadmap framework

Technology roadmapping represents a powerful technique for supporting technology management and planning. The dynamic linkages between technological resources, organizational objectives and the changing environment cause that the technology strategy cannot be developed independently from the business strategy. Moreover, also technological resources have to be considered as an integral part of business planning.

The framework of technology roadmapping guides the construction of a roadmap, making sure that it sets a clear future objective. Another important aspect of creation good roadmap, are critical questions: "why-what-how-when" that define and explain a clear action plan for reaching the objective [4], [6].

The figure 3.4 displays generalized structure of the roadmap. There are two important extremes that drive the roadmap:

- Market Pull - the key needs of the marketplace and customers
- Technology Push - the key technology to seek and define the market needs that could be served with the new technology

It covers also for following layers:

- The top layers are related with the organizational purpose that is driving the roadmap. This part, know-why, consist the customers' needs in product or service. We can divide it for customer objectives - what is needed, and application - how it will work and for what it will be used.
- The middle layers of the roadmap are crucial, because provide a bridging or delivery mechanism between the purpose and resources, bottom layer. Generally the middle layer is focused on know-what, in other words on product development. This is the route through which technology is often deployed to meet market and customer needs. However, for other situations services, capabilities, systems, risks or opportunities may be more appropriate for the middle layer, to understand

how technology can be delivered to provide benefits to the organization and its stakeholders.

- The bottom layers relate to the resources, particularly technological knowledge, that will be deployed to address the demand from the top layers of the roadmap. The focus area is know-how.

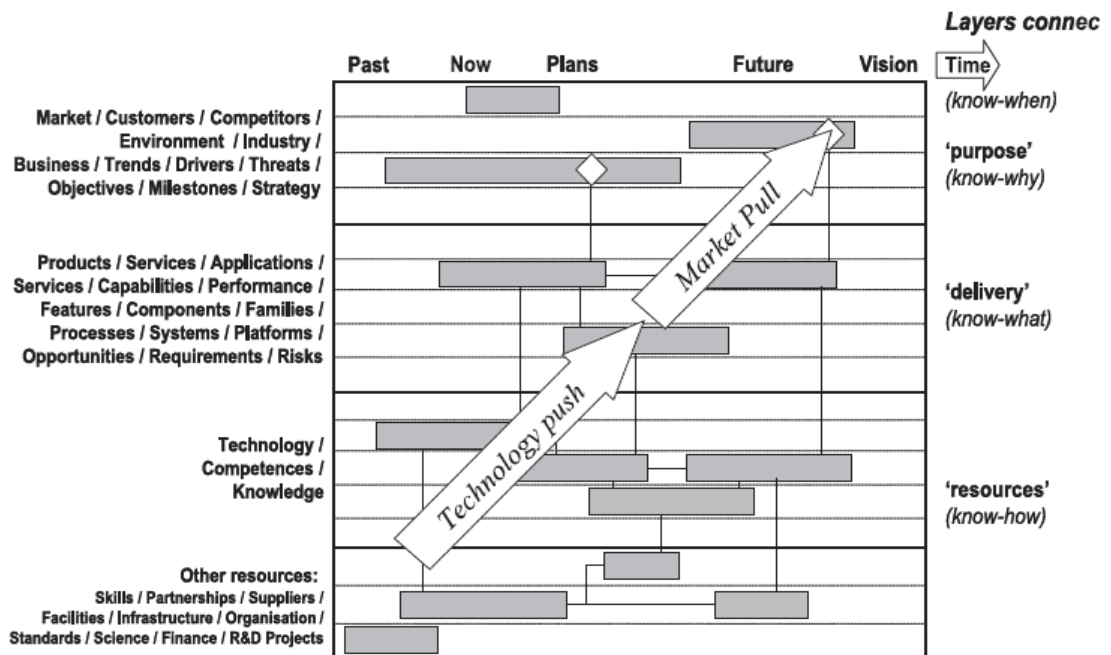


Figure 3.4: Generalized technology roadmap framework [4]

Another dimension of the roadmap is time, know- when, and is adapted to suit the particular situation of the company. It can present for short, medium and long term consideration period of planning as well as for vision, together with the current situation or history [6].

Roadmaps show the time dimension explicitly, ensuring about synchronization of technological, product, service, business and market developments.

4. Presentation of the channel

4.1. Brief history of Gol Television

Gol Television is a Spanish sports pay TV network dedicated fully to football. The channel was created in September 2008 by a multimedia communication Spanish group, Mediapro, involved in movie, television and media production.

The initial propose of launching pay TV network was made by the Mediapro president in October 2007. The original intention was to broadcast the channel through terrestrial television, opening a slot for pay television. In August 2008, Mediapro announced the upcoming launching of a football channel called "Gol T", which would emit in its programming international leagues competitions through cable operators and Internet television. After making several emission tests the channel has started operating in September 2008. Next step were negotiations with the Spanish Government that the company began and acquisitions of sports rights of football clubs and new competitions emission. Actually the channel has rights to following competitions [7]:

- Liga BBVA - the professional Spanish football league competitions,
- Copa del Rey - the annual football cup competition for Spanish football teams,
- UEFA Europa League - the annual European club football competition organized by UEFA,
- Premier League - the English professional league,
- DFB Pokal - the German professional league,
- Portuguese Liga - the Portuguese professional league,
- Jupiter Pro League - the Belgium professional league,
- Russian Premier League – the Russian professional league
- Copa Libertadores - the most prestigious annual club football competition in South organized by CONMEBOL

Apart of matches Gol Television emits other programs focused on football and sport contents. Some of those channels are listed below:

- Gol Zap- It's an own production zapping program that collects the most curious and impressive moments of the world's football.

- Edición Limitada- It's an own production program that shows the exclusive images captured by the Gol T cameras and that no other channels could have shown.
- La Liga World- Program dedicated to the BBVA league.
- Directo Gol- This program provides a summary and analysis of each round of the Spanish professional Leagues, BBVA and Adelante.
- Multigol- a program with analysis of the different matches of the day.
- El Partidazo- A program that shows the best match of each round and always with guest from Real Madrid and Barcelona Teams.
- Informes Gol- A series of reports based on the historic teams and players.
- Los 10- This program makes a selection and analysis of the best goals, catches and moments of the day competitions.
- Entrevistas- A program of interviews to the most popular coaches.
- La Liga Show: Liga BBVA- A program that analyzes all the details during the previous moments of each match of the BBVA league.
- Planeta Axel- A series of reports made about international players and teams, made by the football specialist Axel Torres.
- Premier World- A program dedicated exclusively to the Premier League round, showing the best matches, goals and moments.

4.2. Functional structure of the channel

The channel is dedicated only to football world. The emitted programs are mostly produced by Gol Television and all of them are about the football events. Due to Gol Television is paid network, its business objective is to increase the number of subscribed users and sell more channel packages. Nevertheless relations with present clients and building loyalty with them are another priority for channel.

In order to the channel accomplishes its objects we can distinguish four main pillars that help the company organize its work and fill in all functional necessities that paid channel TV network has. In figure number 4.1 are shown these main pillars, representing the functional architecture of the channel.

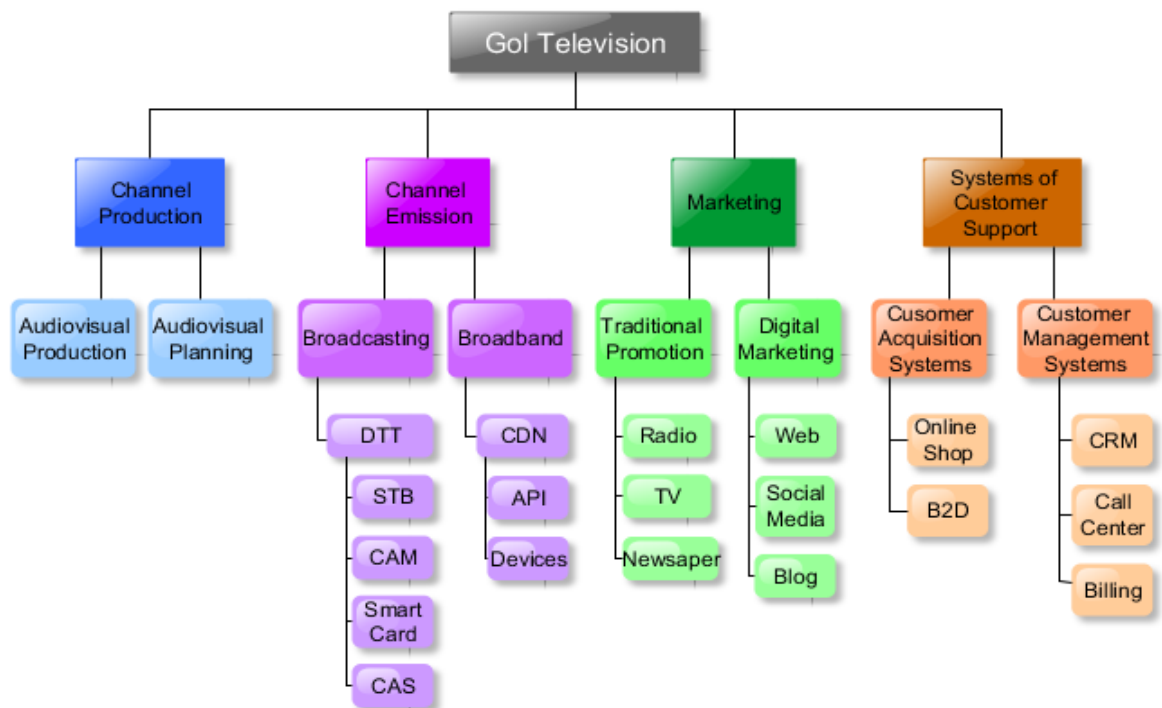


Figure 4.1: Gol Television functional structure

These four elements: channel production and emission, marketing and systems of customer support create this TV network. Every functional pillar has essential impart on the channel operating performance.

Channel production consists of audiovisual production and planning. Audiovisual production includes all actions and components involved in order to record, modify and transmit the high definition contents of broadcast at the TV screen. Gol Television emits matches and programs. Main of these programs Gol Television produces or edits by itself. Life matches of Spanish leagues are recorded and transmitted in real time by Gol Television, for others international leagues the channel has purchase rights to emit them.

The planning part involves organizing broadcast schedule. It is responsible for filling in 24 hours of each day with proper contents not only matches and programs but also with publicities and announcements.

Channel emission consists of two digital signal distribution solutions, broadcast and broadband transmission. It provides the customers to watch the channel on TV screen in DTT by using support equipment, STB/ CAM and smart card, and through the Internet using

any mobile devices. In this part particular thing is authorization system that in both solutions provides access to the channel only for customers that have permission.

Marketing is a part responsible for attracting, retaining and growing customers. It is achieving by captured and loyal activities, promotional campaigns, publicities and television, papers and radio advertisements. The actions of the marketing department are promoted in order to captain new clients and build loyalty with already subscribed customers.

The last pillar is more complex. It consists of customer management and acquisition systems. Both types of systems are to regulate and control relations with the channel customers. Moreover they provide Gol Television clients good prospering and wide service and support in due to the offering product.

In the next part of the study, the functional pillars of the channel will be presented more detailed. According to the scope of the project, more importance is attached to technology of the channel emission and systems of the customers support. Other parts, marketing and channel production will be only briefly described.

5. Gol Television – current situation

5.1. Market sector description

Gol Television was funded in 2008. As pay TV Mediapro is interested in increasing gradually the number of subscribers. More subscribers drive business growth and profit increase.

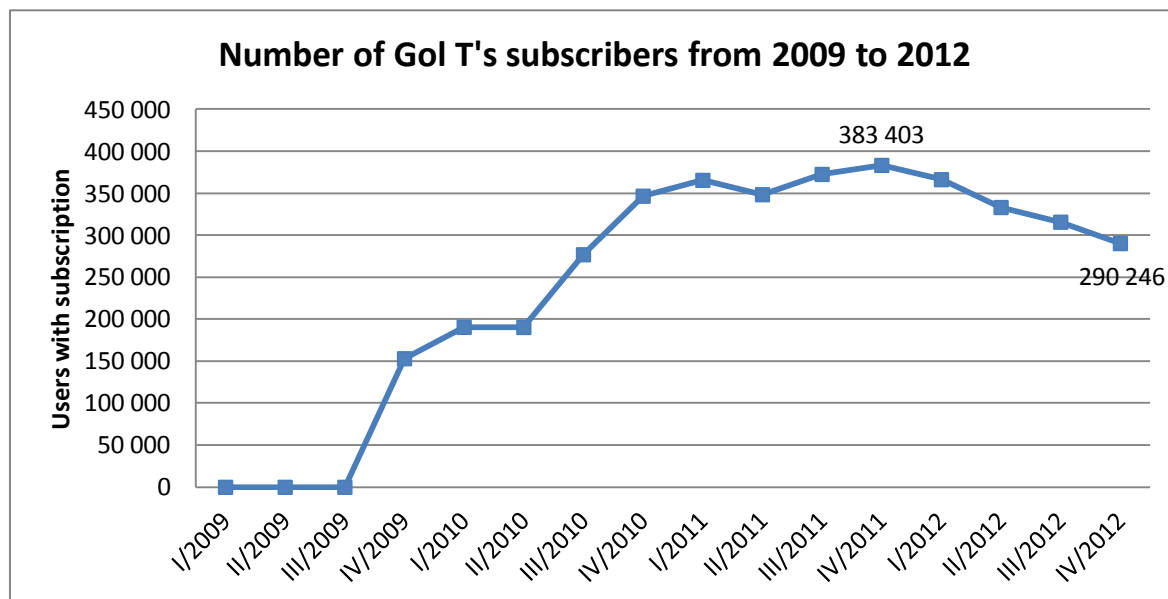


Figure 5.1: Number of Gol Television's subscribers

The channel has started commercial activities since the third quarter of 2009. The number of subscribers was growing until the end of 2011 when reached more than 383 thousands of paid customers. During last year the results was going down and at the end of 2012 the channel had about 24% less subscribers than in 2011 to impact of economic recession and change of competitors in the Spanish sector (figure 5.1) [8].

Nevertheless, the technology of multimedia sector is developing very fast and brings new solutions and opportunities that can be used by the channel to take future advantage. If the channel does not adapt to new customers behavior, business will go down. According to analysis, published by Internet Analytics Company Comscore, of Spanish digital market, current consumers of digital contents replace traditional platforms for new mobile devices in order to have access wherever they are. Therefore it implies a threat if the company does not adapt it business a customers' behaviors. The number of person that has Smartphone and tablet in last year, from 2011 to 2012, went up by 70%. The common access of these

devices caused that from December 2011 to December 2012 the number of spectators watching video on mobile increased by 164%, from 3.550 to 9.240 users and online audience increased by 9% in relation to last year [9]. This data are important for the company business future.

However mobile devices market is developing very fast and has more users, television stills matter in the entertainment of the society. According to the analysis of digital media sector TV is capturing 57% of total screen time spent by people. Moreover television is perceived as primarily a medium for entertainment and laughter and secondarily as a source of news and information [10].

To meet current customers' expectations, is important that the business follows society's habits and changes. New technology, like broadband emission, devices' applications and others, provides solutions with huge opportunities that can be used by channel to improve offered service and meet customers' needs.

5.2. Channel emission

The channel contents are distributed in two ways, through DTT broadcasting with TDT Premium system that helps to control the channel access and through Internet using CDN system, shown in figure 5.2.

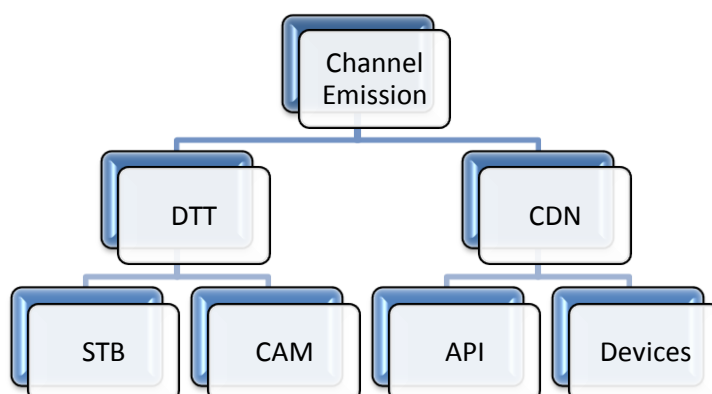


Figure 5.2: Structure of channel emission in Gol Television

All elements are presented in detail in next sub-chapters.

5.2.1. DTT (Digital Terrestrial Television)

DTT, digital terrestrial television is a breakthrough in the field of television which means an important improvement in compared with the analog TV. The digital sound and picture permit receive the transmission clearer and more realistic.

The purposes of digital terrestrial television, similar to digital versus analog in other platforms such as cable, satellite, and telecommunications, reduced use of spectrum and to provide more capacity than analog. It allows providing better quality picture to lower operating costs for broadcast. A terrestrial implementation of digital television (DTV) technology uses mainly an aerial to broadcast to a conventional television antenna instead of a satellite dish or cable television connections.

In Spain as well as other more than hundred countries used standard of DTT transmission is Digital Video Broadcast- Terrestrial (DVB-T). This standard uses COFDM (Coded Orthogonal Frequency Division Multiplexing) modulation that provides robust signal, and protection against the echoes that are produced by multiple paths that the signal takes to spread, reusing the same frequencies in neighboring antennas [11].

To receive digital signal is needed DTT coverage with adapted antenna. Territory of Spain has 98% of areas with access to DTT coverage. The map below (figure 5.3) shows distribution of DTT coverage that is displayed in green color.



Figure 5.3: DTT coverage in Spain [12]

For others 2% of habitants there is satellite solution, TDT SAT, that provide reception of the DTT signal in the area without coverage [12].

The process of diffusion and reception of the DTT signal can be present in tree main parts and is shown in figure 5.4:

1. Signal contribution from the production studio to head multiplexer
Produced signal is encoded and multiplexed. The process contribution includes also adding the channel service information and generating the transport stream of the signal.
2. Distribution and subsequent broadcasting
The signal is transported from multiplexer to emissions centers like satellite, where modulation and amplification of the signal is processed.
3. Reception of the signal
Installations of the buildings, like antenna, that receives the signal. Later signal is distributed to individual user equipment like, decoder- Set-Top-Box, where signal is decoded and displayed on TV screen [13].

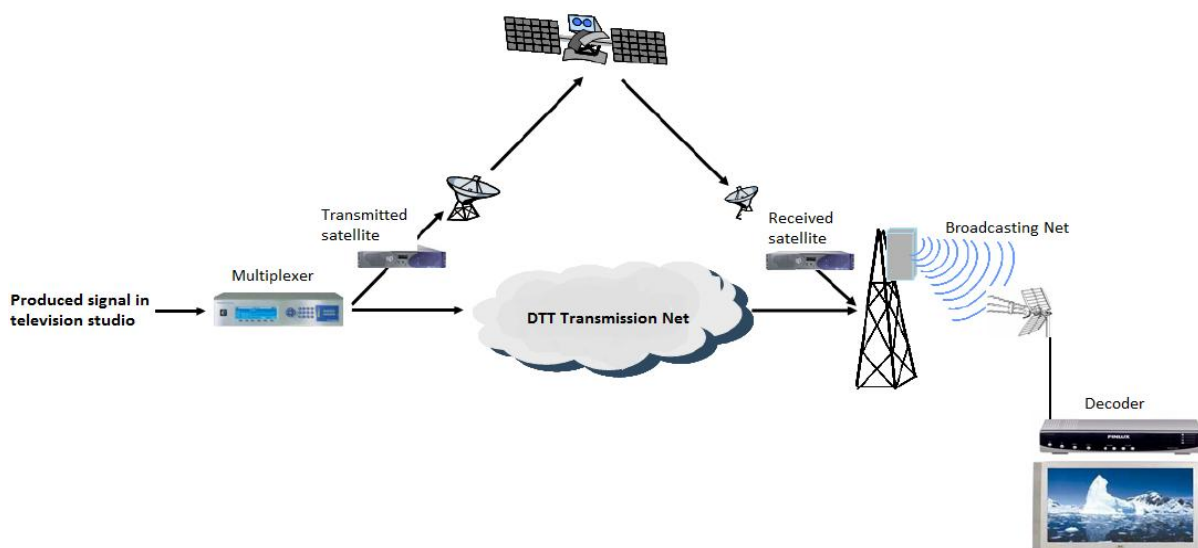


Figure 5.4: DTT transmission process [13]

For Barcelona city Gol Television is emitted in the canal 67 with frequency 850,0 MHz. The provider of the channel is channel TV, La Sexta. The bandwidth of 8MHz is shared with other four channels.

Due to the Gol Television is pay TV channel its contents are available only to subscribed customers. The system that provides transmission of encrypted DTT signal of the channel is TDT Premium. Provider of this system is Abertis Telecom Company. Receiver equipment of digital signal of Gol Television contains:

- Set- top box (decoder) or,
- CAM device that is inserted into the Common Interface, slot of the digital television.

Both receivers have a slot to insert smart card that provides the access to the Gol T service. That electronic card consists of receptor that is compatible with the TDT Premium system and can be read, or in other words, decrypt by the receivers system, the set-top box or the CAM device, giving authorization and displaying the appropriate channel contents that the customer paid for. CAS (Control Access System) additionally supports access control and provides authorization of the signal. In next part the following aspects will be described.

5.2.1.1. CPE (Customer Premises Equipment)

Subscribed customers to obtain the channel access need special equipment that will receive digital signal. In the set of equipment enters:

- A. Set-top box
- B. CAM drivers
- C. Smart card

STB and CAM are alternative receptors that can be used by customer. CAM is solution for person that has digital, compatible with TDT Premium system television. STB is decoder used for both, digital TVs (but not compatible with TDT Premium system) and non-digital TVs [13].

The channel equipment set is not produced by Gol Television. The company is example of horizontal model of business. It deals with variety producers of the STBs and CAMs devices that are compatible with TDT Premium system thanks the special stamp introduced into devices.

A. **set-top box** is a receiver that enables television set to receive and decode digital television broadcasts (figure 5.5). Digital set-top box is necessary to television viewers who wish to use their current analog television sets to receive digital broadcasts.



A. The set-top box

Figure 5.5: Set-top box equipment

In the digital TV realm, a typical digital set-top box contains one or more microprocessors for running the operating system, usually Linux or Windows CE, and for parsing the MPEG (Moving Picture Experts Group, develops standards for digital video and digital audio compression) transport stream. A set-top box also includes RAM, an MPEG decoder chip, and more chips for audio decoding and processing. More sophisticated set-top boxes contain a hard drive for storing recorded television broadcasts, for downloaded software, and for other applications provided by digital TV service provider.

Gol Television service is possible to receive only when used receiver has TDT Premium stamp. There are a number of different recommended set-top boxes' marks and models that provide compatible reception with the TDT Premium system (table 5.1).

Table 5.1: Set-top boxes compatible with TDT Premium

Producer	Model
AIRIS	TD201P
	TD201T
BESTBUY	Easy Home TDT Premium
ENGEL	RT7000 ENGEL PRO
	RT7001
	RT7001R
FAGOR	70050 IOMIRO 500T
	70051 IOMIRO 500G
FTE Maximal	i-PVR ST 192 CI HDMI + CAM

	i-PVR T 152 CI HDMI + CAM
	PVR ST 192 CI HDMI + CAM
	PVR T 160 CI HDMI + CAM
GIGASET	Gigaset M295 T CA
HUMAX	NA-SD10T
IKUSI	Smart Premium
OKI	iZapper TPA
	iZapper TPB
	iZapper TPC
PACE	DTR2530
PROMAX	PremiumBox
SAGEM	ITD71 ES
SCOOP PS	DVB-Tpremium
TELEVES	Q.BO 7152

All 14 recommended by TDT Premium set-top boxes are compatible with provider system and allow to the customer install the channel easily and successfully [14].

B. A **CAM device** is used to receive the digital broadcast (figure 5.6). It is a solution that works simultaneously with DTT integrated television and is inserted into the television.



B. The CAM device

Figure 5.6: CAM device

The CAM device, used by Gol Television, needs to be also compatible with TDT Premium system in order to transmit the channel. Moreover not all digital TVs are prepared to cooperate with this special system. The channel recommends following producers of the DTT integrated television and CAM device compatible with the TDT Premium system [14], shown in table 5.2:

Table 5.2: DTT integrated TV's and CAM devices compatibles with TDT Premium

DTT integrated TVs	CAM devices
BLU:SENS	BLU:SENS
Ikea TV	ENGEL
LG	FTE Maximal
LOEWE	GIGASET
OKI	KENTRON
PANASONIC	OKI
PEAQ	SHOP+
PHILIPS	STRONG
SAMSUNG	TELEVES
SONY	
THOMSON	
TCL	
TOSHIBA	

C. The **smart card** consists of the TDT Premium stamp that guarantees the compatibility and access to the Gol Television service. The smart card Nagra stamp (chip) keeps operator information of the access and is translated by the STB/CAM, in effect the image is displayed. There are to design of that card [14].

- The first one is for specify platform, particular paid channel of TDT Premium, in this case Gol Television (figure 5.7). The design, that the card has, is of the channel commercial image.



Figure 5.7: Gol Television Smart Card

- The second one has a TDT Premium design. The card is not linked with a non particular channel (figure 5.8). It allows to the user subscribe for any TDT Premium channel, all presents and future ones.



Figure 5.8: TDT Premium Smart Card

The provider of the smart card system is Nagra Company. The card has TDT Premium stamp that encrypts access to the channel signal. The number of the card, below the bar code is unique for every customer. By any number of the smart card, personal data of the client as well as information of his access can be found in data base of customers.

5.2.1.2. CAS (Conditional Access Systems)

The technology used to control access to Gol Television services, and to authorize users by encrypting the transmitted programming is CAS, Control Access Systems. These systems (CAS) are used to hide the contents to users who do not have the appropriate permissions and at the same time permit the access for those users who have such permits.

A conditional access system consists of a content coding system with key encryption system and rights to prevent unauthorized reception. Mainly CAS systems are based on standard algorithm that is a recipe for scrambling and descrambling the digital signal. The multiplexer encodes the contents sent by provider and later the signal is sent to the subscriber. The subscriber plugs a smartcard into his/her STB or CAM, which decrypts the signal so programs can be displayed on the screen. The architecture of this system is described in figure 5.9.

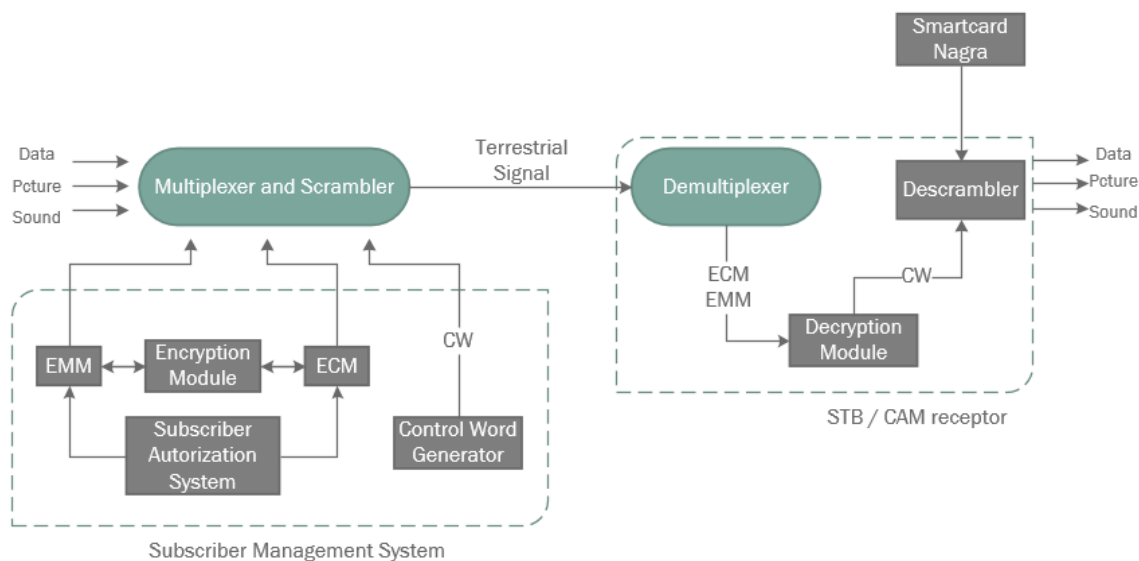


Figure 5.9: Conditional Access System

CW (Control Word) that is generated in the process is used to encode the digital content by used algorithm, and the same CW is sent to the receiver so that it can decrypt this content using the smartcard and receptor.

A CAS system consists of several basic components that taken part in the control process:

- Subscriber Management System (SMS): The SMS is a subsystem of the CAS that manages the subscriber's information and requests entitlement management messages (EMM) from the Subscriber Authorization System (SAS). An EMM provides general information about the subscriber and the status of the subscription. The EMM is sent with the ECM, data unit that contains the key for decrypting the transmitted programs.
- Subscriber Authorization System (SAS): The SAS is a subsystem of the CAS that translates the information about the subscriber into an EMM at the request of the SMS. The SAS also ensures that the subscriber's security module receives the authorization needed to view the programs, and the SAS acts as a backup system in case of failure.
- Conditional Access Module (CAM): The device with security module, in the form of a smart card, extracts the EMM and ECM necessary for decrypting the transmitted programs. The CAM incorporates a slot for a smart card. This set needs to be plugged into Common Interface, of the digital television. Once plugged, the card recognizes the ECM and EMM needed for authorization of program transmission.

- Set-top box (STB): The set-top box also houses the security module that gives authorization for decrypting the transmitted programs. It works similarly to CAM driver in order to display the program.
- Smart card Nagra: a plastic card with a chip. When the card is inserted, the chip is plugged into the decoder, allowing the CAM or STB to get the decryption key. In effect the signal is displayed. Other information is also stored on the chip, like subscriber ID, subscription details, billing details, etc.

A typical CAS process involves three basic elements: the broadcast equipment, the set-top box/CAM driver, and the security module- smart card. The broadcast equipment generates the encrypted programs that are transmitted to the subscriber. When these are transmitted, the STB/CAM filters out the signals and passes them to the security module. The security module then authorizes these programs for decryption. The programs are then decrypted in real time and sent back to the STB, CAM driver for display [15].

Actual STBs and CAM as well as a Nagra have an encryption key, Conditional Access Key 6 (CAK6) in other words it is security system, in 6th version, that provides the Gol Television contents protection. This system does not give the total security level. Actually hacking is the channel big problem. There are following incidents of the fraud [16].

- 300.000 cases of cardsharing – copy of the card key and hacking of the system of the set top box
- About 55.000 subscribers that hack their own web stream and display it illegally through the Internet

5.2.2. Broadband Emission

5.2.2.1. CDN (Content Delivery Network)

The broadband emission is second way of channel distribution, which goes ahead through the Internet. This alternative channel of contents distribution is designed for clients that watch Gol Television on mobile devices connected with Internet. The channel has a special application on its website, Gol Stadium that enables subscribed customer to watch contents online. The infrastructure that facilitates the channel delivery through Internet is Content Delivery Network (CDN), shown in figure 5.10. It is a service, provided by NicePeopeAtWork Company, for instant distribution of the channel content from replica server, or in other words

nodes, that is located “closer” to the end user. This solution provides quick response, high overall performance and potentially low costs of broadcast.

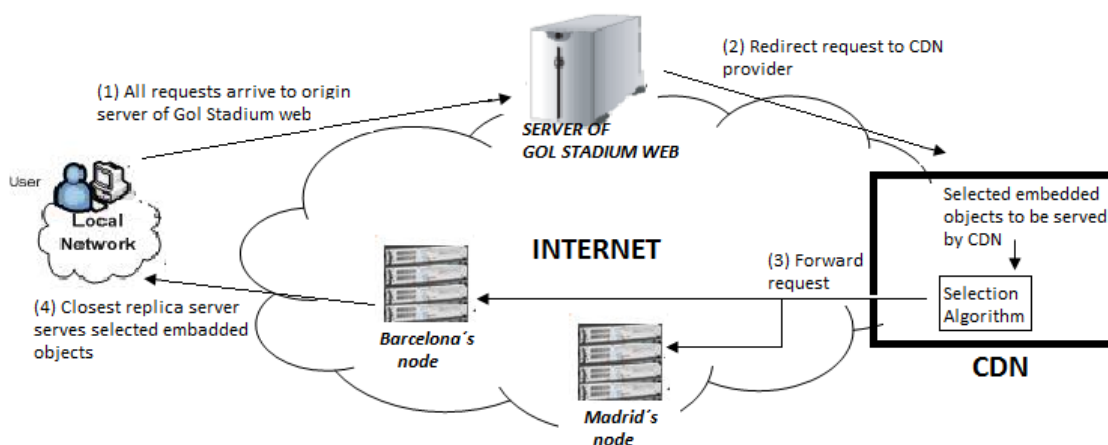


Figure 5.10: Content Delivery Network architecture

The Gol Television network is split into two equivalent nodes, points of connection, located in Madrid and Barcelona. The content is distributed to the user by the shortest path and from the closest replica server. Thanks to the equivalent of the connection network, the breakdown one of the nodes does not stop the content distribution but delivery goes ahead through the working one.

The channel, through CDN, distributes two types of contents:

- Videos, published only by the channel (not published by YouTube)
- Life steam, life contents that are constantly received by and presented to an end-user while being delivered by the channel.

The system provider company provides following services to enable broadband of the channel emission [17]:

- DRM, is Digital Right Management, access control technology that inhibits uses of digital content that are not desired or intended by the content provider. Nowadays Gol Television does not have license for this solution.
- Content delivery through various nodes, are located in Barcelona and Madrid
- Visibility and control over user experience Quality of Service. This solution is not adapted for the life stream, only for videos on demand.

- API for all system, that provides communication between user, origin server of Gol Stadium web and CDN.
- Secure Delivery, rules that control the content access, like hot-linking, unique access link for each user.

5.2.2.2. API

An application programming interface (API) is a protocol used as an interface by software components to communicate with each other. The structure of the API is the group of methods that consists entrance and exit factors (figure 5.11). It formulates the question and response key. The system contains two APIs:

- API of the Gol Stadium , the web page that allows the user to watch the contents of the channel through the internet
- API of CDN system that manages the Gol Television contents and controls the access.

API plays the role of the middleware between the CDN and Gol Stadium web server. It allows a user to access through the Internet to the channel contents. The user can obtain these contents by available mobile device, like iPod, iPhone, etc.



Figure 5.11: Application Programming Interface System

The user enters to the channel web, Gol Stadium and sends requests to get a video. Gol Stadium server by API firstly checks the user access and if is correct sends information of the request to the CDN system API. It sends back to the API Gol Stadium an URL, web page address with hot linking protection. The API web sends it to the user device, where can be displayed.

5.2.2.3. Devices

6.1.2.2.1. Web

The web page of Gol Television is made in open source content system management, Drupal 6, that is written in PHP programming language. The standard release of Drupal, contains basic features common to content management systems. These include user account registration and maintenance, menu management, RSS feeds, page layout customization, and system administration. Main advantage of Drupal is that the system supports both a web server and a database to store content of the channel.

Gol Television website, thanks the Drupal system, can offer its user: registration, subscription, purchase of needed broadcasting equipment, easy matches searching in programming by RSS feeds, etc. Registered user can customize his website choosing and following favorite football teams.

Gol Television website is also integrated with web application that is designed to watch the channel by broadband emission. The user can access following contains:

- life matches,
- foreign competitions of football games,
- videos of matches' summaries
- Gol Television programs like: Gol Zap, Liga Worldwide, Premier World, Planeta Axel.

Gol Stadium is a hybrid application. It means that is generalized for multiple platforms, like iPhones, Androids, iPod, etc., and is not installed locally but is made available over the Internet. Gol Stadium, to display its contents, communicates by its server with CDN. Due to the channel is paid network, API has also function to check the user's access to Gol Television contents.

6.1.2.2.2. X-Box

X-Box is a video game console, an interactive entertainment computer system, manufactured by Microsoft. The produced signal can be display on monitor or television screen. This device, firstly used as only game console, now is enabled also to emit the Gol Television channel by broadband connection, thanks to the web application of Gol Stadium for X-boxes devices.

The X-box application allows the subscriber the channel emission and access to all its contents. This solution was programmed in C++ language, and is totally native application. It means that has been developed only for use on a particular platform which is X-Box device. Application of this device communicates with Gol Stadium server in order to display channel contents.

6.1.2.2.3. Mobile

IPhones, Androids and as well as iPads and netbooks are another devices that provide the channel emission with the broadband connection. These mobile devices allow the customers to watch the channel wherever they are. The access is possible to obtain by special application designed for these devices.

This application is a hybrid one, however has some native parts like: user management, access management and player. It behaves and appears on device as a native application, although it depends upon web sources and internet connection.

Because of the differences in the iPhone, Android and iPad size screen the application has different versions, appropriate for each device.

6.1.2.2.4. HBBTV

HbbTV is a standard that combines traditional broadcast television services with television services that are delivered over a broadband connection. It establishes a standard for the delivery of broadcast TV and broadband TV to the customer's home, through connected Smart TV, that serves as a hybrid terminal. This solution does not need any installation or additional application downloading. DTT signal emitted by broadcast corporation contains also URL, web address, that can be received and displayed on the TV, but only when is connected with internet [18]. This system is shown in figure 5.12.

This technology platform is adapted to receive only video contents of Gol Television. The life contents emission is not possible on Smart TV.



Figure 5.12: HbbTV architecture [18]

5.3. Channel Production

The elementary function of the channel is displaying its contents on the TV screen. But in order to achieve it, firstly the contents have to be created. Other characteristic and principal part is the channel scheduling which put all contents in appropriate order. Production of the channel includes both parts that give the channel existing base.

5.3.1. Audiovisual Production

Gol Television produces audiovisual contents of the channel by its own. Production process of video depends on the type of the content and type of its publication. We can distinguish two types of Gol Television contents that come from:

- proper production: mainly national football games or programs
- foreign production, with purchased rights to transmission: mainly international or foreign competitions or programs

Contents from foreign production mainly have to be adapted and voice covered in order to emit them for Spanish audience. Moreover the channel edits many of them to make summaries of foreign competitions games and produce programs, like: La Liga World etc.

Other classification of the audiovisual production is:

- life emissions, generally this group includes contents like:
 - football matches
 - some of the channel programs

- edited emissions, includes all Gol Television programs that are prepared before the transmission and all modified contents like summaries of matches, interviews with footballers etc.

5.3.2. Audiovisual Planning

Audiovisual planning handles schedule creation of the channel contents. The schedule needs to be complete and arranged with detailed precision to fill in spare time, provide continuous displaying and accomplish the emission timetable. The channel emission includes additionally broadcast of:

- announcements and publicities
- Gol Television inserts

These components have also marketing background. It related to the channel patronage and agreements with Gol Television sponsors that are: San Miguel and Seat.

In order to organize the schedule and plan timetable of emitted programs, two indicators have to be taken into account:

- Legal limitations
 - Publicities can be shown only for 6 minutes per hour of displayed contents
 - Announcements or programs that involve pornography or violence cannot be display before at 22 o'clock at night as well as publicities of alcohol beverages

- Fulfillment audience expectations

Due to the channel is paid, its contents and programming need to meet the spectators' expectations and satisfied them. Emitted content is orientated mainly on two football teams that are protagonists in mayor competitions: FC Barcelona and Real Madrid. Mayor spectators need to be enabled to watch interested them matches and programs after working hours and at home in front of TV.

5.4. Marketing

Marketing is essential to promote and grow the business. Nowadays is important to know how to reach the customers and attract them. Gol Television marketing can be divided into traditional marketing promotions and digital marketing actions, as shown in figure 5.13. Both types have function to increase the people awareness of the channel existence.

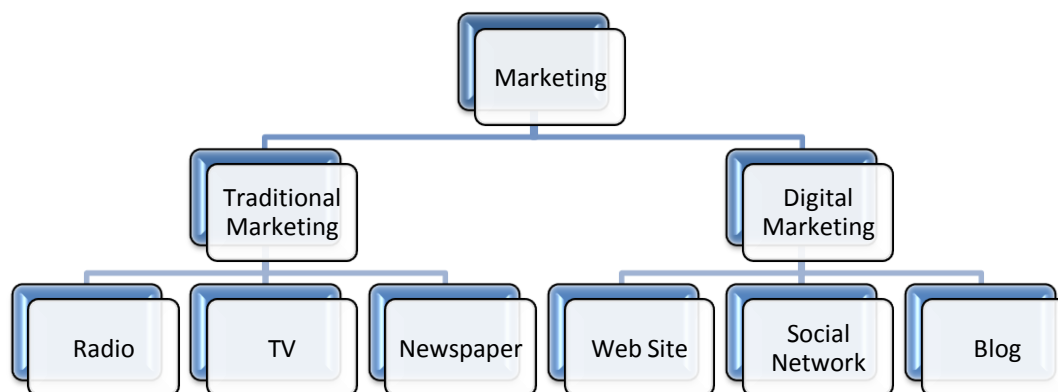


Figure 5.13: Gol Television marketing structure

In the case of Gol Television we can say that its marketing is focusing on the customer marketing model, which illustrates the theoretical customer journey towards the purchase of a service (figure 5.14). This process consists of five stages:

- Awareness

To raise the people awareness of existence of the channel and its offers Gol Television uses both: traditional and digital marketing actions. Offline methods to introduce to customers the channel brand are advertisements and publicities in newspapers, TV and Radio. Online methods include digital technologies that create new channels to the market. It consists of social media like Facebook, Twitter or Google+, Gol Television website and channel blog.

- Consideration

In next stage, customer that has been made aware of the product starts to consider its purchase. He can take into account recommendations, incentives, benefit etc.

- **Purchase**
Subscription to Gol Television service is available by the website, call center or in distribution point like Carrefour, Media Markt or El Corte Ingles. The customer can choose the best and the most comfortable option.
- **Loyalty**
After the purchase of channel service begins the loyalty process. Gol Television offers to its subscribers many promotions and campaigns like: Telepizza gratis, win an iPhone, therapy pillows, promotions for families, etc. All these actions are to keep actual customers and make them more satisfied.
- **Advocacy**
In the last stage happy customers internalize a sense of loyalty and take part in service promotion by recommendations, positive opinions, etc. To realize this stage social media is also very helpful.

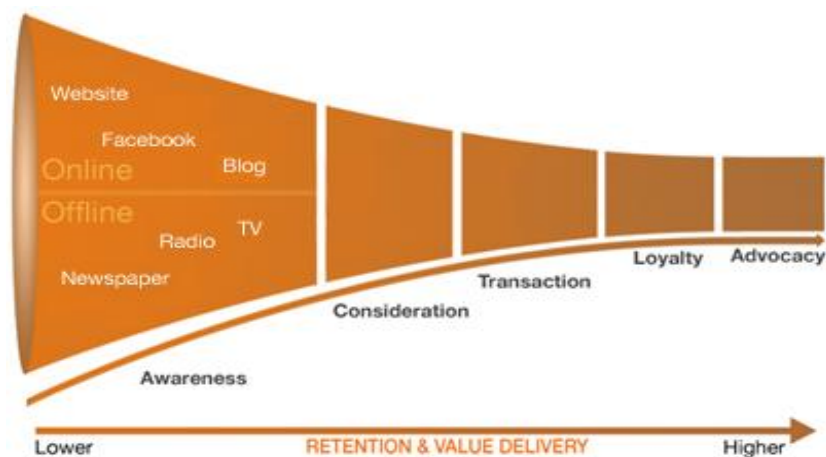


Figure 5.14: Customer journey towards the service purchase

Figure 5.14 displays the value that is delivered to the company by following stages. Gol Television marketing targets are not only subscribed customers that made transaction of purchasing of the channel offer but also loyalty actions with present clients, taken in order to raise customer satisfaction with service.

Present marketing actions are mostly orientated on channel promotion using following online methods that nowadays are an absolute must [19]:

- Web site

Gol Television web has a capture function for the channel. Taking into consideration the fact that most people get information only from Internet, the structure, facilitate of navigation, visual and functional characteristics are essential for users. On website visitors can watch some channel contents, join to Gol Television social networks, get more information about the offers and buy channel packages, etc. The importance of this webpage underline the results of made analysis that shown that only during one month Gol Television web has more than 400.000 visits.

- Social networks

The profile of the company on social media websites is an absolute must nowadays. Gol Television has its profile on the three most known social networks: Twitter, Facebook and Google +. Taking into account the fact that almost every user daily enters to check his social media profile, these tools help the channel to inform its followers directly about the schedule of football games, matches results, actual programming and news of the most interesting events published on the channel. Additionally Gol Television provides on its profiles videos of summaries of recent games.

According to marketing results from May, the audience of the channel profile on Facebook reached 325 millions. It is result 6 times better than from May 2011. Moreover Gol Television has 152.312 fans on Facebook, 50.803 on Twitter, 11.000 on G+ and its number increase with every month [19].

- Blog

Gol Television blog informs viewers about all channel events and subject of network programs, like Liga Worldwide, Premier World, Planeta Axel, given a user detailed description and complex information. The Gol T blog is dedicated for all enthusiasts of this type of social media and has almost 30.000 of fans.

5.5. Systems of Customer Support

In relation with Gol Television business profile we distinguish two main segments of the Customer Support Systems (figure 5.15). They function is to provide satisfied customers with the channel service and meet clients expectations.

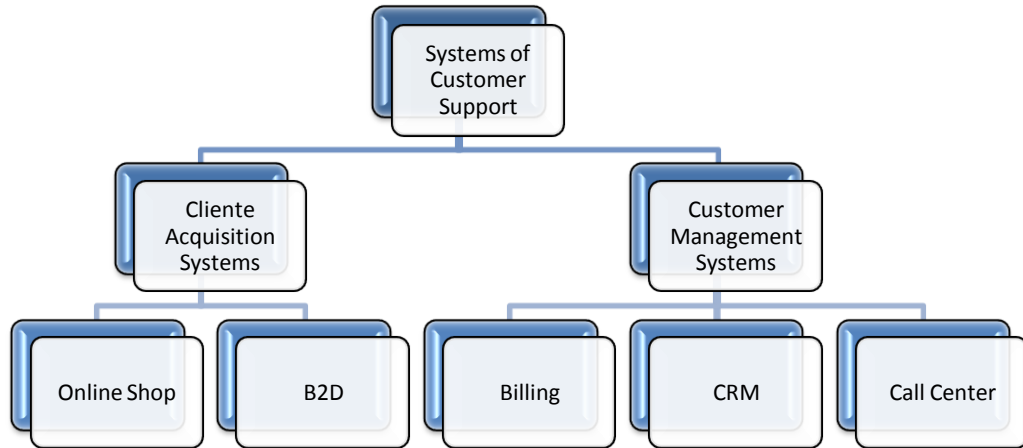


Figure 5.15: Structure of Customer Support Systems

First segment consists of Online Shop and Business to Distributor systems. These acquisitions systems are distribution channels of packages and equipment sets of Gol Television. Second segment is to manage all customers' data, process and activities.

5.5.1. Customer Management Systems

Systems of customer management are important to maintain and control customers' data. They help to manage all processes relational with customer like invoicing or billing, as well as to provide clients help with sailing service and product. In Gol Television functional structure we can distinguish three main systems that give the company support in managing its customers: CRM, Billing and Call Center.

5.5.1.1. CRM

CRM is a solution system provided by Microsoft Dynamics. The data base of the channel customers of the platform is maintaining by external company, Abertis Telecom Company. It involves using technology to organize, automate, and synchronize company sales, marketing, customer service, and technical support.

The CRM system is strongly related with customers, their involvements and participations in cooperation with Gol Television. The system gathers and helps to manage all data, information and client history from the beginning of cooperation until the contract end. We can name it as a life cycle of Gol Television client. This term describes the progression of steps a customer goes through when considering, purchasing, using, and maintaining loyalty to Gol Television service. The figure 5.16 presents Gol Television customer life cycle and how the changes of client status effect on CRM and what type of actions take place in data base [20].

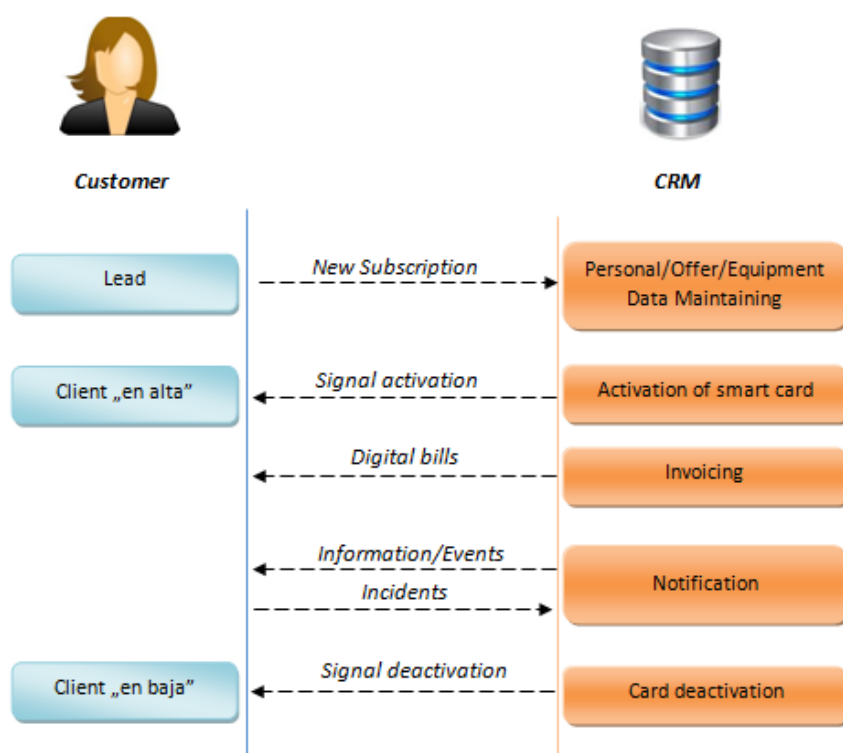


Figure 5.16: Processes of the customer life cycle in CRM system

Potential clients are persons that are conscious of the channel existence. They can use the Gol Television website to get information about actual matches or can follow the football news through the channel social media networks like facebook, twitter, etc. When user has interest in buying the channel offer in order to get access to its contents, is converting in “lead”. “Lead” can make subscription online or in the distribution point as commercial centers and post offices. By subscription, the customer personal data are introduced to CRM system and the person is added to the customers’ data base as a new client. Moreover request of equipment set is sent to distributor. Status of customer client “en alta” means that he has a

contract with Gol Television, however to get the channel access he needs to first activate the smart card. Process of activation of the client smart card can be made in three ways, by client using Online Shop (is one of Online Shop process), by Call Center calling or immediately in the distribution point (process of B2D system), where the channel package was bought. Other processes took place in CRM relational with client “en alta” are:

- Client’s invoices creation and digitalizing
- Notifications of incidents, promotions, etc.
- Others, like data changing

The client “en baja” is customer that has deactivated access to the channel by accumulation of non-payments (more that from one month) or by finalizing and not renewing of his contract. Data of this client are stored in CRM system and he is tread as ex-customer and in the same moment as a potential client that in any time can come back to access Gol Television service. By reactivation, which is a process of Online Shop, ex-client can easily get back the channel access.

Processes of interactions between the client “en alta” and CRM system (figure 5.17) are available to check for the customer on the client portal online, integrates with CRM tool accessible for once subscribed users through Gol Television website. These processes include:

- Personal data modifications or updates, like client address, mobile number, etc
- New subscription of Gol Television offer
- Invoice sending to the client
- Notifications about the promotions or incidents,
- Information with consult about occurred incidents

To make some summary CRM data base, from the moment of new client subscription gathers following data:

- General personal data (address, contact data, contract information)
Client Portal functional architecture
- Purchased products data
- Customer taken activities
- History of customer as a Gol Television client

- Non-payments
- Questionnaires that are made by call center agents
- Subscriptions data (bank account, subscription address data, equipment data)
- Notifications (changes of status, occurred problems, announcements, etc.)
- Invoicing history
- Friends, associated friends with client (tool used to one of channel promotion)

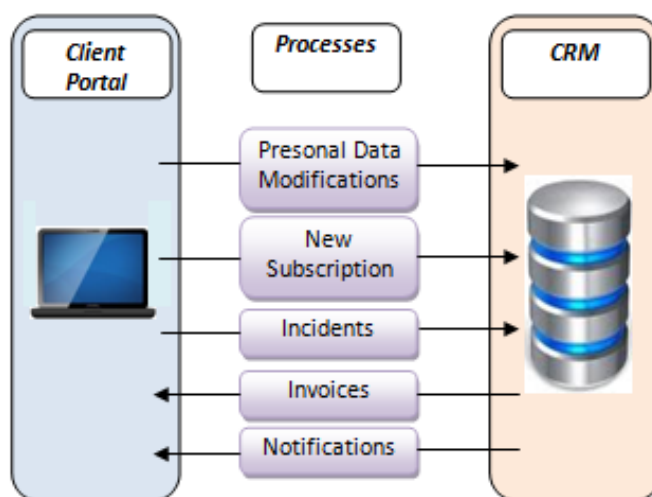


Figure 5.17: Processes made by clients through Client Portal

5.5.1.2. Call center

Call center gives product and service support to Gol Television's customers. But it also gives a support in managing the channel customers' contacts. It provides that valuable information of the company is routed to appropriate people, contacts are tracked and data is gathered in CRM. Agents of call centers can realize through telephone activities like: subscribe new client or activate smart card. All this data are introduced to Gol Television CRM by call centers agents. Generally call center creates important part of Gol Television customer relationship management (CRM) and has influence on customer satisfaction as member and user of channel service. Intelligent network of Gol Television call center provides Dialoga Company. The call center network includes different tools and applications that automate some part of customer service. A diagram of the Call Center process is shown in figure 5.18.

Other company, Unisonó provides the agent teams' service to direct contact with client.

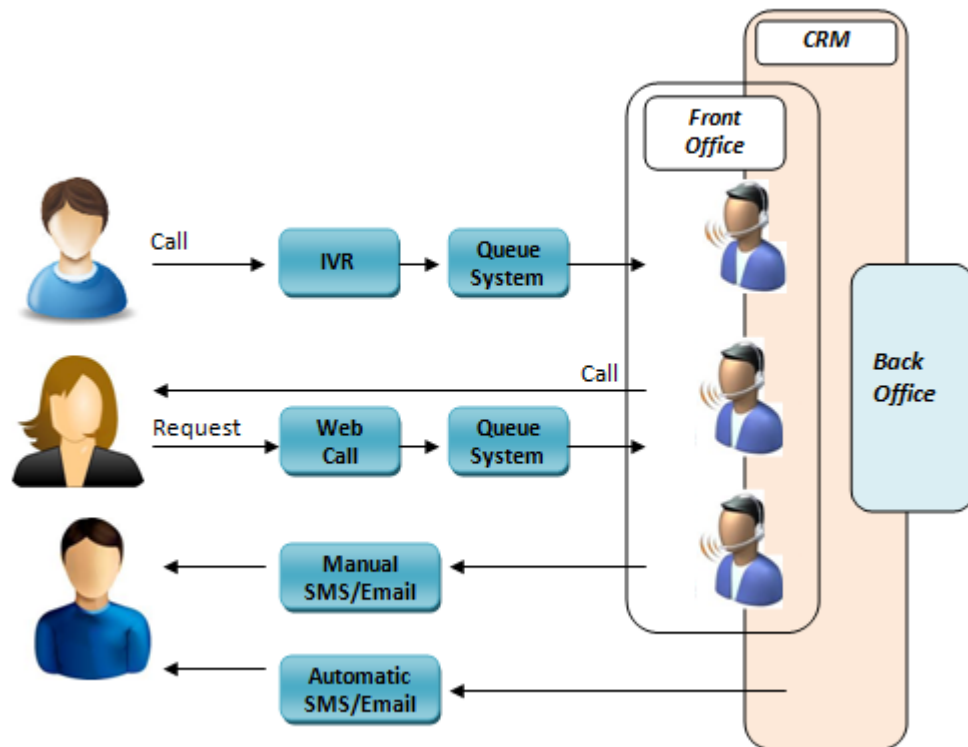


Figure 5.18: Call Center functional architecture

The Call Center consists of Back and Front Office. In Front Office (FO) are agents that have direct contact with customers. They have also access to CRM to get information about the customer in order to help him with occurred problem or realize customer's request like:

- Modifications of customer personal data,
- Subscription
- Smart card activation
- Incidents reporting

Agents work supports a guide application with Frequency Asked Questions (FAQ) from all consult sections. Additional application of Dialoga Group gives report of all made calls. Every reason of customer call is put in CRM.

Back office (BO) is part of consult and operation service but for agents form Front Office (FO). The function of BO is to resolve technical problems of customers or agents from FO,

like wrong payment collecting, problem with channel access, etc. Agents from BO have more permissions of access to data base of CRM.

Call center to facilitate work of agents, and to support systems of customer management uses tools that create different types of information channels. Available solutions implemented by Gol Television call center includes:

- Interactive voice response (IVR)

This system used to identify and segment callers. The caller by pulsing adequate number from the mobile keypad can receive information and help what he needs. The options to choose are as follow:

1. Information about the channel actual offers for new clients
2. Consulting service for Gol Television clients
3. Activation of the channel card
4. Enquiry of connection problems
5. General information about the channel

Choosing one of possible consults, customer contacts with adequate person, call center agent that helps the client to resolve occurred problem or give needed information. If callers do not find the information they need or require further assistance, their calls are transferred directly to an agent.

This application automates service and manages calls. Depends of the caller's need and chosen option, the service automatically prioritize the individual's call and move customer to the front of a specific queue system. IVR tool helps to organize work of the agents in effective way and provides callers better consulting service.

- Web call back

This solution is another available consulting alternative given to Gol Television customers. A person introduces his or her name, telephone number and selects issue of enquiry on an available form that can be found on website of the Gol Television. Call center receives the web callback request and an agent calls the person who made the request back on the number he or she entered. This solution allows the callers to select either an immediate

callback when an agent becomes available or a callback at their preferred available time and date, avoiding the inconvenience of waiting on hold [21].

- Queue System

This tool supports calls management. It controls customers' calls and put them in the queue, special order, that move and distribute caller to the available agent.

- Email/ Short Message Service (SMS) sending system

The main function that has this tool is to send to clients of Gol Television direct information. Call center of the channel uses both, email and SMS messages. In case of emails are used two channel of messages distribution:

- 1) Through application mailchimp that is used to sending massive emails in automotive way with information about available promotions, loyalty campaigns and incidents of non-payments.
- 2) Through CRM, messages are sending manually to individual clients in response for his specified requests.

In case of sent Short Message Service (SMS) messages:

- 1) Integrated with CRM application allows to send in automated way to clients notifications about non-payments.
- 2) Application of Dialoga provider that allows sending messages in manual way about any other advertisements or notice.

- Call Recording

This application allows recording all calling made between agents of call centers and customers. This solution is used to control and improve offered service. The application stores recorded callas during one year and later are archive in internal server.

5.5.1.3. Billing

Another system of customer management is billing system (figure 5.20). Generally it provides the support in following interaction with customer:

- make subscription for Gol Television service
- payments of service activation
- payments of service provision costs
- purchase of the DTT equipment through the Internet or in the distribution point of selling.

The architecture of this system can be displayed is displayed in the figure 5.19

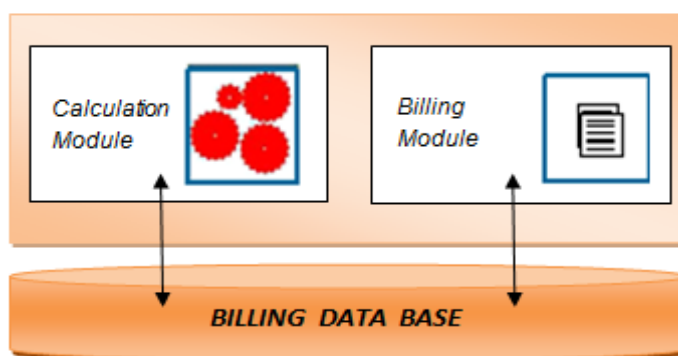


Figure 5.19: Calculation and Billing Modules of Billing System

Data base of billing system is a part of main CRM data base of the Gol Television. It is responsible for introducing the data of new subscribed customers and for maintaining data of actual customers by updating changes of address, bank account number etc.

Calculation module is responsible for values. It starts the billing process with the accumulations and calculations, taking into consideration applying taxes. The second one, Billing Module, is responsible for serializing, composing, storing and digitalizing invoices. Moreover it prepares and submits the necessary information to generate accurate reports.

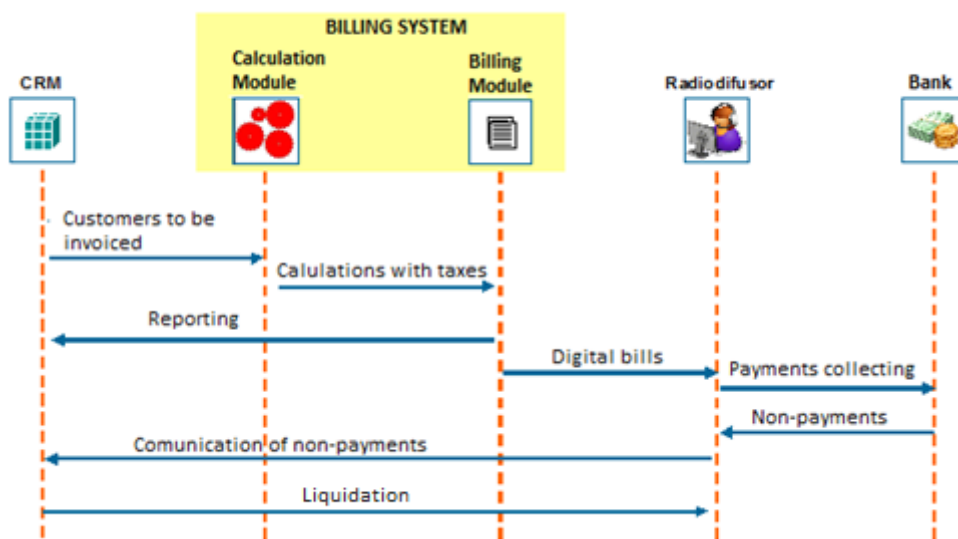


Figure 5.20: Sequence of billing process [22]

Money collections from Gol Television clients are possible thanks to XRT Banking Software, the service supporting the channel electronic banking, payment, and collections. Automation between CRM, Billing system and Banks helps to charge money for offered service from clients' account. Additionally bills exchanging between Gol Television system and Banking system support EDI method [22].

5.5.2. Client Acquisition Systems

Gol Television has two systems that facilitate new customers the cannel packages purchase: Online shop where Gol Television product can be bought with needed equipment set through Internet and B2D, system of traditional sale in commercial centers.

5.5.2.1. Online Shop

Current Online Shop of Gol Television is adapted to provide service of subscription for new customers. Detailed process is presented in the figure 5.21.

Users enter to the online shop by Gol Television website, selecting the tab of subscription. There can chose the option of available promotions to buy. Currently there are two offers:

- temporary duty time of 12 months and with CAM/STB and smart card Nagra gratis,
- without temporary duty time but paying for equipment: STB/CAM and smart card

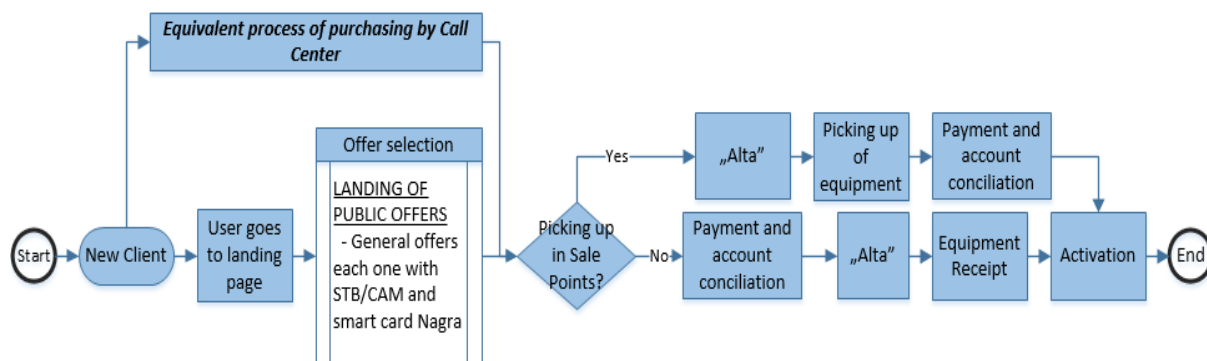


Figure 5.21: Subscription process for new customer

These offers do not have separated processes of selection of product/equipment. Subscription process with purchase of product and equipment online is equivalent to the process of subscription made in Call Center by the agent at request of customer by telephone. Next step depends on customer decision to pick up in the points of product sale or by package dispatch. The customer that wants to pick up the product select the place and the product is assigned to the client (“pre-alta”). Then picks up the product and pay in the picking place. If the purchased product is sending, customer makes payments and account conciliation is processed. After it the customer status is “alta” (paid and subscribed). When equipment is already receipt customer, to finish the process, has to activate the equipment by proper installation of STB/CAM with smart card Nagra and channel activation, displaying the content for the first time.

Online shop is integrated with CRM, Call Center and systems of developer, provider of equipment sets, as shown in figure 5.22. This developer is responsible for sending purchased product to customer. Introduced personal data of customer are collected in the shop central data base. Information about the client, made order and purchased product are stored in CRM data based where can be also modified and updated by customer or by agent at customer’s request [23].

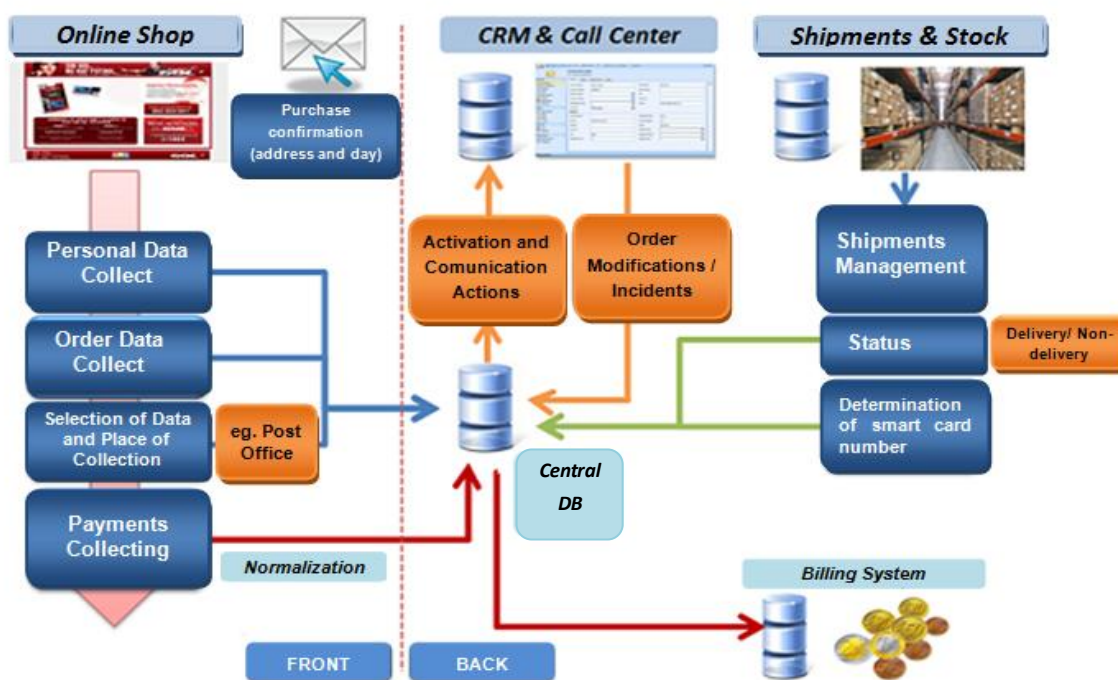


Figure 5.22: Integration between Online shop, CRM & Call Center and system of developer [23]

The purchasing process that is included in subscription of new client, has two parts of actions, front ones, realized and visible for the customer and the second part, back actions that are processed by customer support systems. All payments collections are normalized by the channel systems.

5.5.2.2. B2D

B2D, business to distribution, is alternative distribution channel of Gol Television packages available to persons interested in channel access buying. Purchase can be made in more than 20 different supermarket chains, like: Media Markt, El Corte Ingles, Carrefour, Spanish post offices, etc. System B2D developed by the channel and implemented in each distribution point helps to manage the Gol Television sales of packages.

The processes made by sellers in distribution points are presented in the chart flow below, figure 5.23.

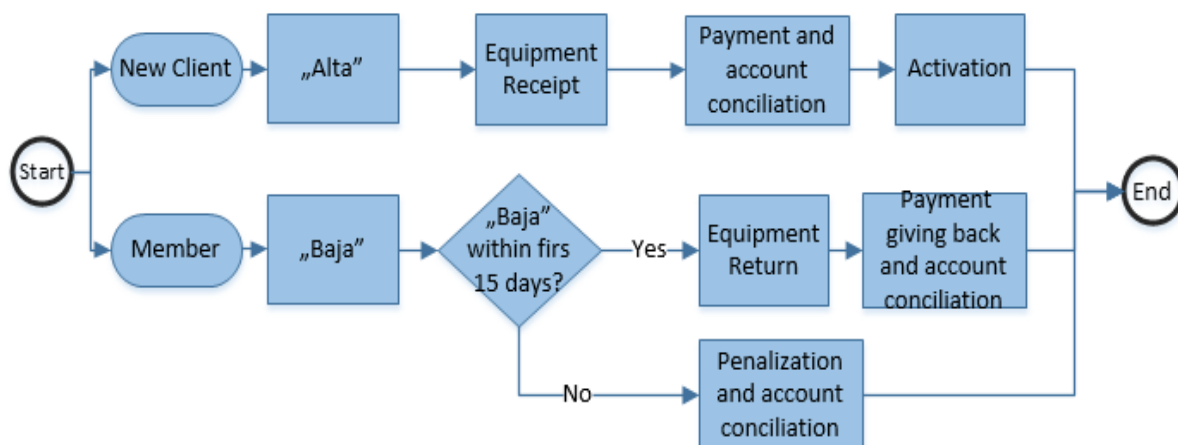


Figure 5.23: Processes made by sellers in distribution points

There are two processes: “alta” - subscription and payments collecting and “baja” - cancelation of subscription and rights suspension. The offer of the product in distribution point is only with temporary duty of 12 months. Due to this fact there are some conditions in case of “baja”. The money of purchase product is given back only when the customer applies for “baja” within the first 15 days after the product purchase. In the other case the customer has to pay some penalization.

The system of sale available in the distribution points is integrated with CRM data base. The system obligate the seller to introduced firstly data of buying equipment set, number of card and brand of the decoder or adaptor CAM. Later appear customer personal data like number of ID, address and bank account number. The activation of the card is made immediately in the distribution point. All customer data are sending and store in CRM system data base, where processes like, invoicing, billing, data maintaining and modifying can be controlled. This process is displayed in the figure 5.24, that present the architecture of the systems integration.

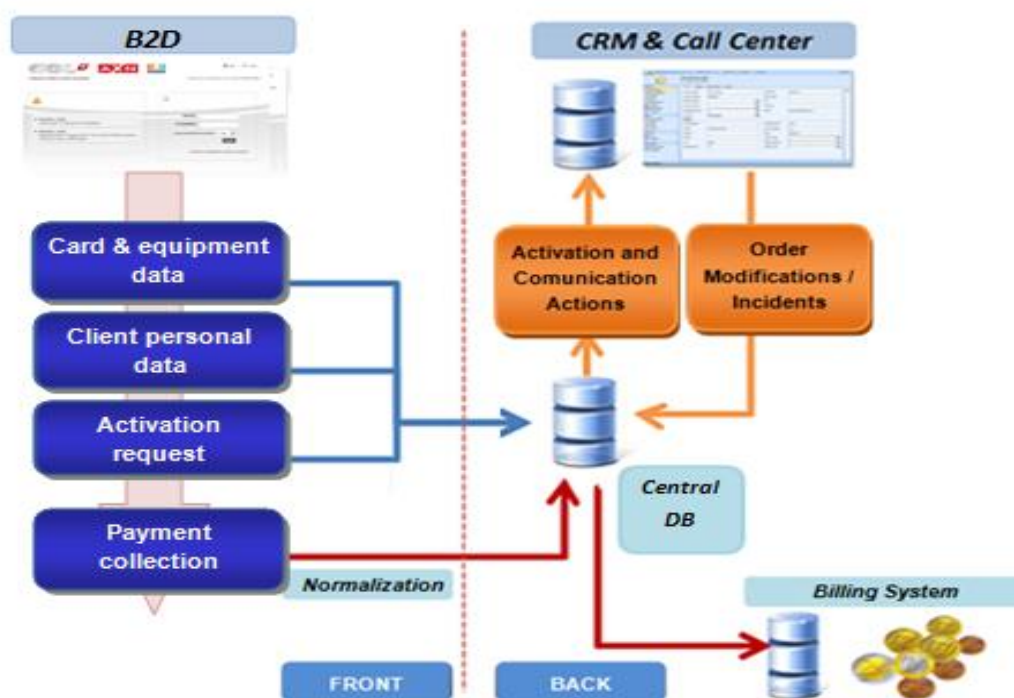


Figure 5.24: Storage of customer data in CRM system

The process of “baja” has the same architecture. The only things of differences are in the seller actions that provide the subscription cancelation and rights suspension. The actions consists following tasks: introduction within the system the smart card Nagra number with equipment data, confirmation of the status changes, money refund with account conciliation.

6. Preliminary analysis for Technology Roadmap

The technology roadmap of Gol Television is concentrated more on the Market Pull than on the Technology Push. It is because the offered product/service already exists however it needs some improvements in the short term of planning. The Technology Push analysis will be used to develop by roadmapping the future plan that consists of innovation methods or solutions that will be implemented to improve already existing product/service to meet the company vision and needs as well as customers expectations in terms of offered service.

6.1. Gol Television vision

Economy recession in Spain affects on the Gol Television business. Due to the actual situation, the company is going to convert the current channel business into low cost service. This business change is a big opportunity for the channel during the period of economy recession that Spain is faced to. The channel vision for this next two years is to be a leader of the football content provider in Spain, offering the customers the most affordable service on digital TV market. In order to realize the company vision the channel is going to decrease significantly the costs. It allows the company to reduce the offer price and in effect increase the sale volume (figure 6.1). All these actions, cost reduction and sale volume increasing, let the company to increase its benefits.

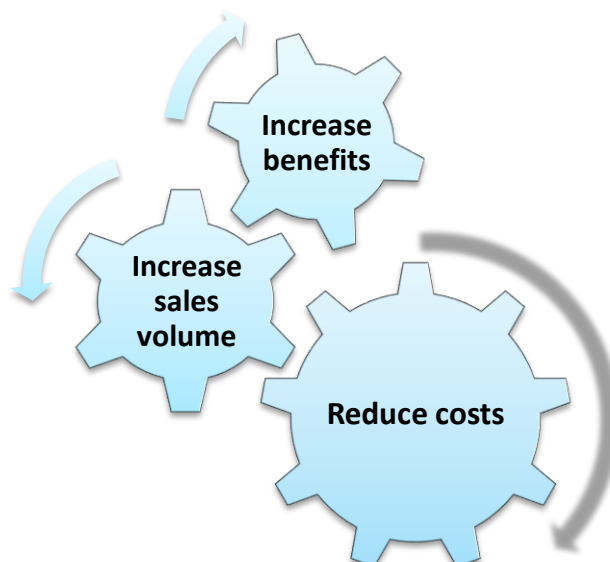


Figure 6.1: Mediapro vision for Gol Television

The channel vision allows the company to convert its business in low cost service. Due to it the company increases the sales of Gol Television offers and in effect increases annual revenues. Costs reduction analysis, in case of this study, is focused on the broadcast equipment set. CPE impact on the company business is considered in order to identify the gaps that generate costs. New equipment is going to be designed to support the channel vision and help to reduce the costs of offered service.

6.2. CPE Technology Roadmap Scope Description

The scope of the technology roadmap is broadcast equipment. It includes also the influence of CPE on other channel departments. According to the company vision technology roadmap allows analyze actual situation within the CPE sector and designed new equipment in order to reduce the costs. New CPE shall provide a support in converting the company business in low cost service.

Broadcasting features of DTT signal of Gol Television are strongly connected with diffusion and reception process. DTT signal reception as well as decryption provides the channel equipment set. This part considers why roadmap is important to take into account the broadcast aspects and what features can be changed in order to improve broadcasting and service quality delivered to the user. It has been taken into consideration the influence of equipment on the channel costs structure situation.

Broadcast equipment and CPE are required to offer customers the channel service. It plays high impact in new customers' acquisition because it is an entry barrier that either the user has to pay or the company has to subsidize.

Some problems have been already identified in the overall CPE aspects (table 6.1).

Table 6.1: Gol Television problems in the overall CPE aspects

CPE Problem	Consequences	Solution
<p>Equipment sets will be sold out soon.</p> <p>Only stock left for one season more</p> <p>2013/2014</p>	<p>⇒ No equipment to subscribe new customers</p> <p>No equipment to replace members' broken</p>	<p>⇒ Produce new CPE</p>

STB/CAM in season 2014/2015			
Inefficient system of channel content security	⇒	Hacking generates 365.000 cases of illegal access.	⇒ Produce new CPE with efficient content protection
Inefficiency in equipment set up and activation.	⇒	Users' discouragement caused by unclear processes. To solve problems users call to Call center and it generates additional operational costs.	⇒ Redesign the system of the equipment so that could guide user better through the set up and activation processes

The equipment set of Gol Television will be sold out soon. 100.000 of equipment that currently the channel has in stock is going to be enough for this next season 2013/2014. However the season of 2014/2015 the channel will not have any more equipment to make new subscription. It forces the company to make decision of what to do and how to do it.

The first gap that can be identified in CPE sector is illegal usage of signal. Current equipment generates big problem related with hacking of the CAS security equipment system. There are three ways that the signal is used in fraudulent way, by card-sharing, streaming and illegal transmissions in public places.

- Card-sharing method is the hacking action of obtaining the Nagra, smart card, RSA key. The algorithm, that permits the channel access, once found, is shared or sold to other persons that want to watch Gol Television in fraudulent way. The hacker put the decrypted key in the private server through which he shares it and gives the access to other users. The key decrypts the Control Word and receptor is allowed to send the signal and display it on the TV screen.
- Streaming is another case of illegal channel content accessing. This is a form of picture sharing that can be retransmitted through internet, giving access to other persons to watch Gol Television content in fraudulent way.

- Illegal transmission in public places is related to the football emissions in bars or restaurants. The owners display the channel contents having only individual offer of Gol Television bought. They use this method to save money by not purchasing more expensive offer that is assigned for bars.

Not efficient content security is a big problem for the company. There are about 365.000 cases of illegal channel access. It generates big annual losses for the company. Summary of the Gol Television hacking occurrence is presented in the table 6.2 [24].

Table 6.2: Gol Television hacking incidents

Hack	Number of Cases	Annual Losses (€/year)	Recovery estimation after hacking elimination	Annual Real Losses (€/year)
Card-sharing	300.000	72.000.000	15%	10.800.000
Streaming	55.000	13.200.000	10%	1.320.000
Illegal emission in bars	10.000	1.800.000	95%	1.710.000

These hacking methods generate real losses for the company of about 14.000.000€ per year. This is about 20% of annual revenues of the channel.

Another problem that causes CPE is related to the software of the equipment. Gol Television equipment sets generate many problems for customers during installation, and channel signal activation. It means the lack of usability of the Gol Television system equipment that causes customers' disappointment, despondency and many calls for Call Center asking for help to reach activation or set up.

Main problems with equipment have new subscribed customers. It is because installation of STB/CAM as well as activation of the signal is necessary to make only once, when for the first time all equipment set is connecting with TV. From Call Center's report comes out that round 45% of new customers call Call Center once or more during first 4-5 days after realization of subscription with occurred problems [25]. The figure 6.2 presents the call distribution for last year 2012.

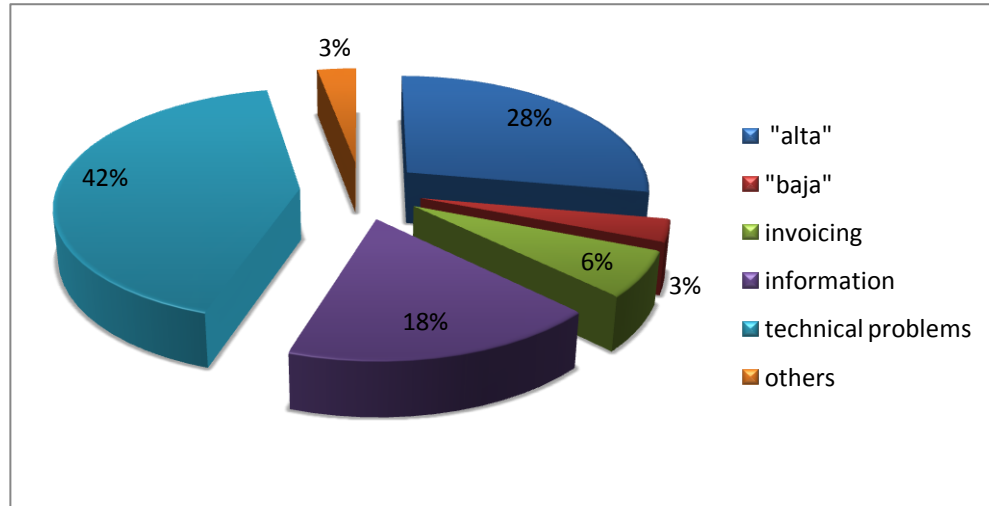


Figure 6.2: Distribution of calls causes to Call Center in 2012

As it is displayed on the figure above 42% of all calls are related to the technical problems. It is the highest result and is higher about 14% than number of calls to make subscription. The figure 6.3 shows more details about these technical problems calls.

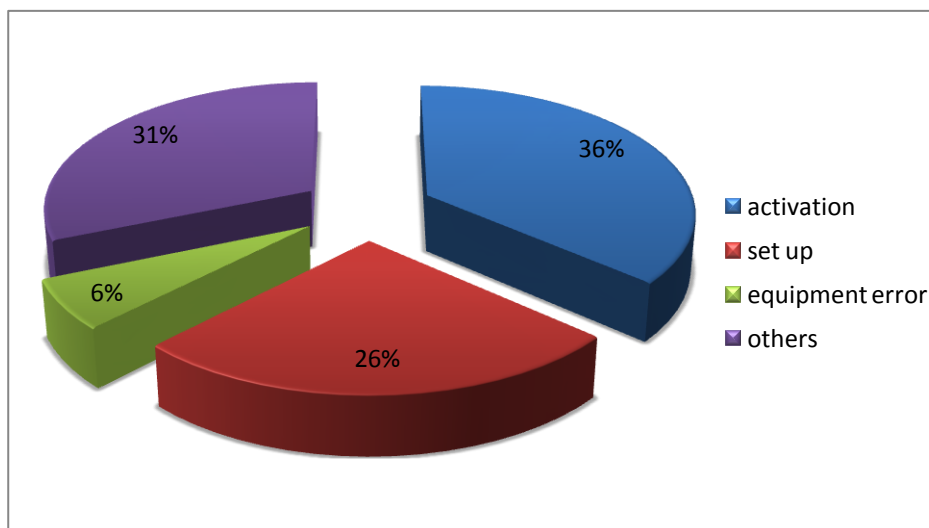


Figure 6.3: Reasons of technical problems calls

As it shows the figure 6.3, 26% of all technical problems calls are related to set up of equipment. Calls related to the activation problems have even higher result that equals 36%.

It contributes 11% of calls in terms of set up and 15% of activation in of all Call Center calls made in 2012.

Taking into account that the average of one call last between 3 and 4,5 minutes and the price per minute equals around 4 euro, costs of these calls are as follow (table 6.3):

Table 6.3: Total costs of customer support served by Call Center

Type	Number of calls in 2012	Costs of calls
Set up	13.300	212.800
Activation	18.600	297.600
Total	31.900	510.400

These calls, related to the customer support, generate additional operational costs for Gol Television equal around 510.400 euro. The equipment inefficiency produces these costs. Nevertheless these costs need to be reduced in order to increase the channel annual benefits.

7. CPE Technology Roadmap

The technology roadmap for the CPE is supported by the process presented in European Cooperation for Space Standardization documents about Space Engineering: Technical Requirement Specifications [26]. The process consists of input that in this case are customer and company needs in terms of CPE, and output, CPE pre-solution that is achieved as result of the process (figure 7.1).

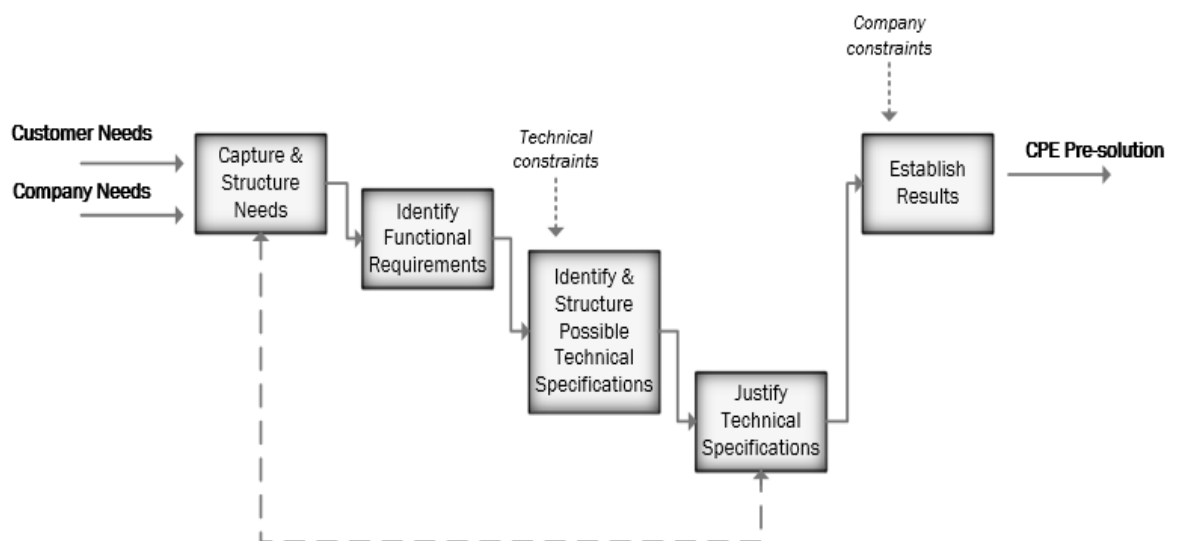


Figure 7.1 The process of CPE pre-solution establishing

First activity of the process analysis is identification of customer and company needs within the selected boundaries of roadmap. They are captured and structured properly. Based on it functional requirements are identified. Next step is definition of the possible technical specifications taking into account technical constraints of technology maturity. Identified technical specifications need to be justified in terms of players' needs in order to demonstrate the correct analysis. Results are established with considered company economic constraints. Achieved output gives CPE pre-solution.

7.1. Identification of CPE functional requirements

According to the selected scope, the analysis of needs is related to broadcast equipment. Taking into account current features of the DTT equipment, roadmap helps to identify the future possibilities that can be implemented in order to improve user experience and

company business. To identify functional specifications, as it is presented in the figure 7.2, the analysis of performers needs will be developed as follow:

- Customers needs segmented along the CPE life cycle
- Company needs in terms of CPE are divided into three parts:
 - Focused on CPE relation with sale increase
 - Focused on CPE relation with cost reduction
 - Focused on CPE and perspectives that could be brought for others department

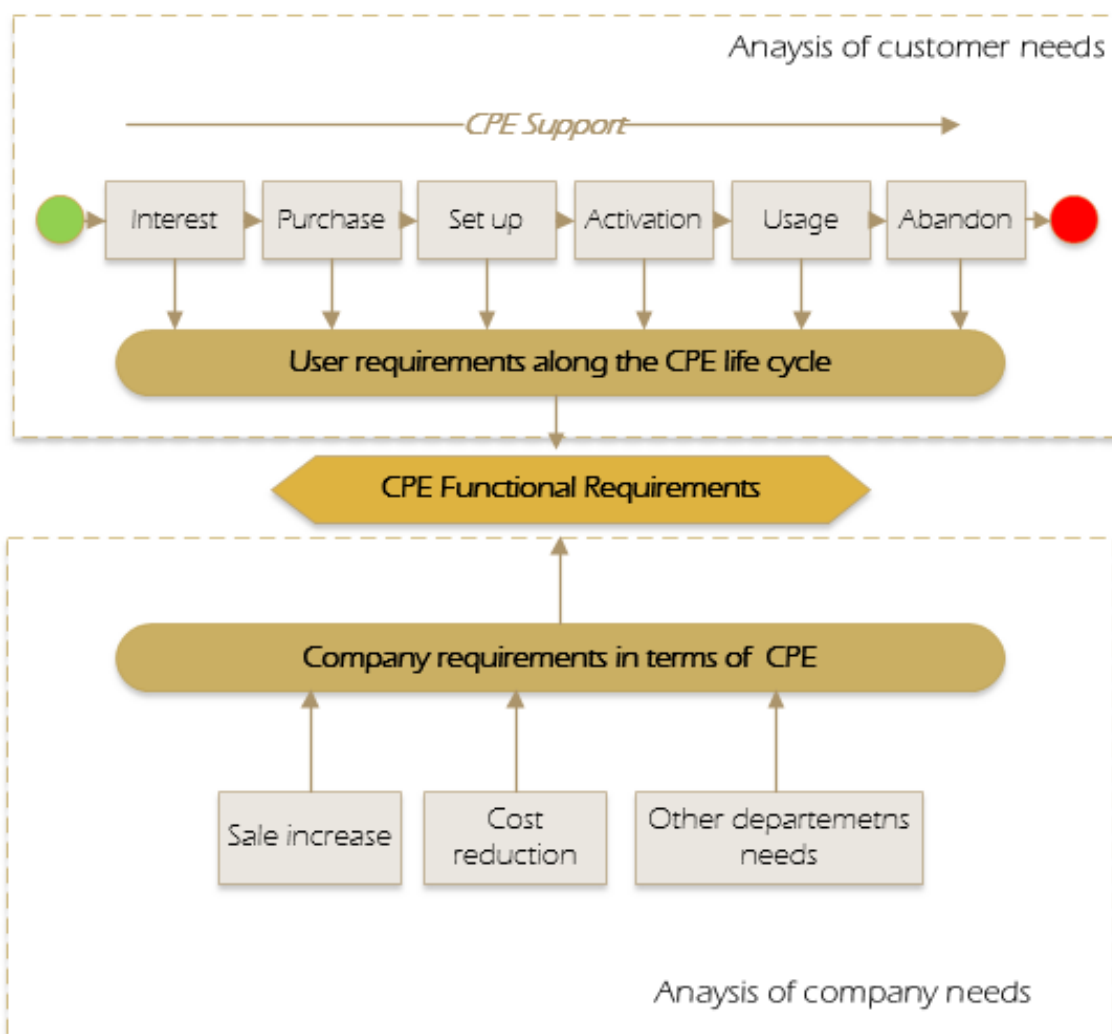


Figure 7.2: The process of players' needs analysis to obtain CPE functional requirements

7.1.1. Identification of customer requirements for CPE

Customer requirements are changing with the technology development. In order to satisfy the user with used equipment is important to take into consideration his expectations and needs. To identify better these needs the analysis is segmented for each stage of equipment life cycle.

CPE of Gol Television has a life cycle within can be distinguished following stages:

- Interest
- Purchase
- Set up
- Activation
- Usage
- Abandon

To express better a customer needs and define his expectations, each stage of DTT equipment life cycle is presented and explained.

1. Interest

This stage includes all aspects that make the user interested by the product. It has to make on the user good impression and catch him. The user has to be enabled to make choice in order to select the most suitable receptor type, compatible with customer TV set and which allows and ensure him that will be able to enjoy the football, in the best, easy and most comfortable way.

Taking into account this stage description we can distinguish follow requirements:

- Receptor shall has nice appearance with modern design
- Shall be available variety rage of equipment choice, differentiated by color, type of receptor, etc
- User shall be assured of usage facilities of receptor and its simple set up
- Shall offer features that increase viewer and user experience like HD, recording of contents, etc.
- Receptor shall receives also other free channels and be compatible with analog TV set

2. Purchase

The purchase process has to be simple for the user as much as it can be. Equipment need to be easy to find no matter in which way of purchasing: distribution point or online shop, the customer has chosen, and always has to be available to buy. Purchase and contract conditions, way of paying and subscription process has to be easy and not generate problems. The final decision need to be facilitated by positive customer impression of the sale service and product features.

According to the second stage of CPE life cycle we distinguish following requirements:

- Product shall be easy to buy, available in many shops and commercial centers
- Receptor shall be available in different colors or types in order to let the customer chose the best for him
- Product shall be comfortable and easy to transport and nice packed
- User shall be assured of usage facilities of receptor and its simple set up
- Receptor shall offer additional functions that increase product usability and user possibilities

3. Set up

In this stage user goes home and for the first time has direct experience with the product. The receptor need to be switched on and connected correctly with TV set and antenna. The user has to be provided to make this connection successfully by himself. To achieve user satisfaction the set up needs to be simple and fast processed.

Taking into account the characteristic of equipment set up following requirements in point of view the customer can be distinguish:

- Receptor shall permit intuitive process execution
- User shall be supported to connect all accessories correctly by colors/signs indicated on the elements
- Receptor shall guide users during whole process
- User shall be informed about incorrect equipment set up
- Receptor shall allowed to recognize the process successful end
- Receptor shall permit the successful and fast process end

4. Activation

Activation is next step to finally reach the signal displayed on TV screen. The customer has to set the receptor by making basic settings like, language selection, channel searching, and other configurations. The user has to be allowed to make it by itself following through receptor system commands. It cannot generate problems or make user to waste time in order to not disappoint him and let him to start watching football as soon as it possible.

For activation stage following customer requirements can be distinguished:

- Receptor shall permit intuitive process execution
- Receptor shall allowed to recognize the process successful end
- Receptor shall guide users during whole process
- User shall be informed about incorrect move during activation
- Receptor shall provide user simple navigation with remote control through the settings options
- Receptor shall permit the successful and fast process end

5. Usage

The user has to be satisfied through all time of equipment exploitation. It has to make the users happy and give them what they expect in the simplest way to enjoy efficiently and with pleasure the channel content.

- Equipment functions shall be simple, intuitive and useful
- Receptor shall permit intuitive navigation through the functions and menu options
- Receptor shall provide all information about the program schedule
- Receptor shall provide nice feel and look in respect of graphical design of menu and electronic guide and their functions
- Equipment shall be discreet and enable to hide
- Other equipment features that are not for viewer utilization but have more business significations shall not have influence on the user and shall not complicate receptor usage

6. Abandon

The last stage of CPE life cycle is the equipment abandon. The customer stops using the receptor when he found it not useful any more by different causes.

The customer requirements in order to abandon the equipment are as follow:

- Equipment shall stop working or break down
- Receptor shall not displaying the channel
- Receptor shall have some cheaper substitutive product

Knowing the customer expectations for CPE, that have been detailed presented for each stage of DTT equipment, now can be segmented in order of functional requirements that are essential for users (table 7.1).

Table 7.1: Customer requirements in terms of new CPE

Requirements	Expectation form CPE	CPR life cycle stage
Physical Design Requirements	○ modern appearance and design	Interest
	○ available in different colors or types	Purchase
	○ support correct connection by colors/signs indicators	Set up
	○ discreet and enable to hide	Usage
Process Execution Requirements	○ assurance of facilities of receptor usage and its simple set up	Interest, Purchase
	○ intuitive process execution	Set up, Activation
	○ information about program schedule	Usage
	○ information about incorrect move during activation and set up	Set up, Activation
	○ successful and fast process end	Set up, Activation
	○ guiding during all customer actions	Set up, Activation, Usage
	○ confirmation of process successful end	Set up, Activation
	○ simple navigation with remote control through the settings options	Activation, Usage
	○ not displaying the channel	Abandon

	○ stop working, break down	Abandon
Availability Requirements	○ variety range of equipment choice, differentiated by color, type of receptor, etc	Interest, Purchase
	○ easy to buy, available in many shops and commercial centers	Purchase
	○ cheaper substitutive product	Abandon
Distribution Requirements	○ nice packed and easy to transport	Purchase
	○ available in many shops and commercial centers	Purchase
Functional Requirements	○ features that increase viewer and user experience like HD or recording of contents	Interest
	○ compatible with analog TV	Interest
	○ receipt of other free channels	Interest
	○ additional functions that increase product usability and user possibilities	Purchase
	○ nice feel and look in respect of graphical design of menu and electronic guide and their functions	Usage
	○ functions simple in usage, intuitive and useful	Usage
	○ features that are not for viewer utilization but have more business significations shall not have influence on the user and shall not complicate receptor usage	Usage

7.1.2. Identification of company requirements for CPE

The technology progress and possibilities create also opportunities for the company. To gain the advantage, which comes from this progress, the company needs still work on its service, improve it and implement the novelties that offer technology.

The company prior objective is to increase benefits from its business. It can be made in two ways: by sales increase or by cost reduction. In order to achieve this objective CPE sector is considered with its influences on sale and channel costs. And in order to these conclusions the company requirements will be identified to find the gaps within the CPE and to resolve and improve existing problems within this area.

The company to increase its benefits has to make it service more affordable. The cost reduction can provide it. Moreover the impact on the company benefits has the sales increase. Both cases will be considered and analyzed within the CPE sector in order to identify requirements of new equipment that could help to realize the company objective of benefits increase.

7.1.2.1. Increase sale

A sale, in significant part, depends on the CPE that permits users DTT signal receipt. Many elements have the impact on the sale increasing, like marketing techniques, service quality as well as offered product. The product of Gol Television consists of channel content and the equipment to receive this content. That is why it can be said that by improving the CPE the channel could attract new clients and in consequence increase the sale.

In order to know how improve the equipment the company shall know the customer needs and adapt according to them the CPE. Already made analysis of customers' requirements for CPE will be used in order to create equipment that will meet users' needs.

The company needs related to the CPE to increase the sale are equivalent with customer needs and expectedness. It is because the company to attract user with the new equipment has to meet the customer needs. Because of it these needs are not analyzed but only fused with other company needs in order to define the CPE global functional requirements.

7.1.2.2. Cost reduction

The costs that are involved with CPE are known and can be distinguish in two groups:

- Operating costs of equipment: costs of customer support related with equipment, offered by call center
- Costs of content hacking: that has influence on the loses of company revenues

The costs generated by call center are analyzed in terms of CPE live cycle and additional operational costs that are produces for set up and activation steps.

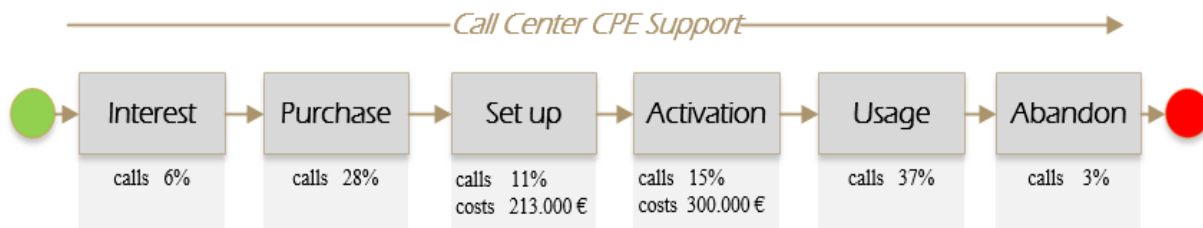


Figure 7.3: Calls distribution and additional operational costs through the CPE life cycle

The figure 7.3 presents the current situation within the Call Center support served to the Gol Television customers. Additional operational costs that new CPE could reduce are generated in set up and activation stages. These costs are produced because these two processes generate many problems for the user during their execution. The analysis of company requirements in terms of CPE support is made to capture and resolve equipment inefficiency. It allows identify easily equipment necessity of improvements that could affect on the users' problems reduction. In the result, it reduces the number of calls that generate company high operational costs of customer support.

Company expectations of the set up process execution of new equipment:

- Set up processes shall be intuitive, simple and fast to make for any user no matter of the user's age or technology knowledge
- Receptor design shall includes all needed guides in form of color/sign indicators to execute set up correctly
- Receptor shall be interactive with user in order to inform him about the process errors, incorrect moves or just about the successful steps or finished actions
- Receptor shall be users' informant about the process progress and following steps in order to user has all process action clear and knows what to do
- Receptor commands shall be short and simple to understand
- Receptor shall be responsible for control of correct set up realization
- Receptor shall includes instruction/information/help available in specific process step in order to explain user doubts and let him to continue

Company expectations of activation process execution of new equipment:

- Activation processes shall be intuitive, simple and fast to make for any user no matter of the user's age or technology knowledge
- Receptor shall provide users simple navigation through the system

- Receptor system design shall be adapted to the users capabilities and displays logical arranged steps with good visibility, unequivocal settings options
- Receptor shall be users' informant and guide him along the process progress and following steps in order to user has all process action clear and knows what to do
- Receptor shall be interactive with user in order to inform him about the process errors, incorrect moves or just about the successful steps or finished actions
- Receptor commands shall be short and simple to understand
- Receptor shall be responsible for control of correct activation realization
- Receptor shall includes instruction/information/help available in specific process step in order to explain user doubts and help him to continue

In the case of costs of content hacking the analysis is made by identifying the sources of hack processing. To identify these sources the process of the content encryption and decryption is analyzed. The figure 7.4 presents where the hackers activities are produced in order to distribute Gol Television content illegally.

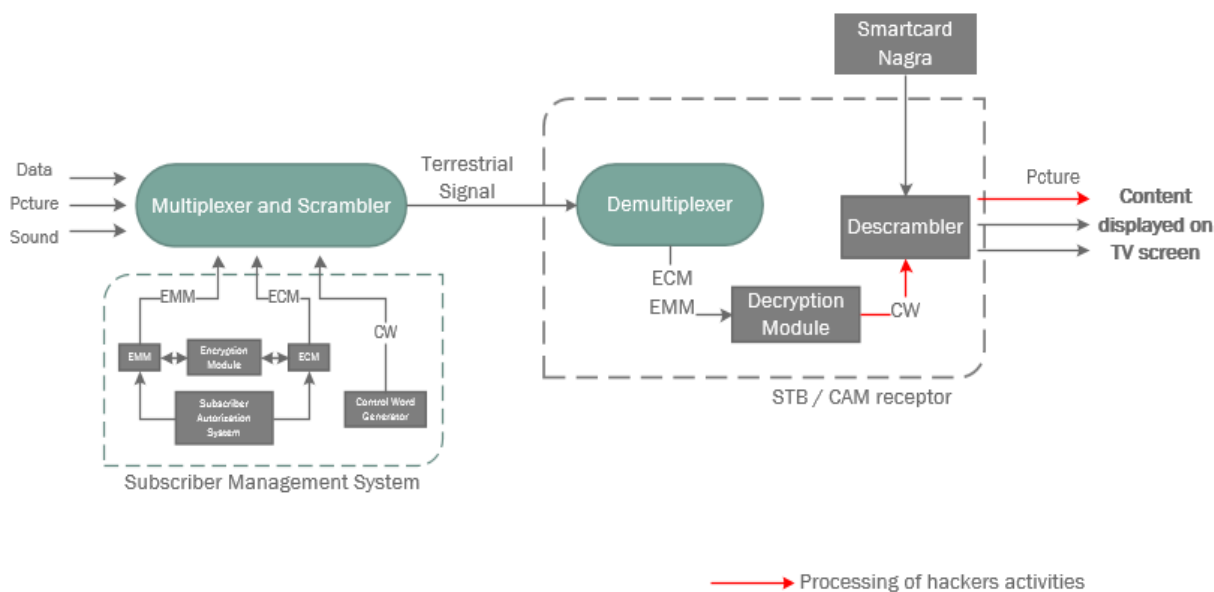


Figure 7.4: Identification of the hacker activities through the CAS

The content is attacked by hackers in two points of decryption process. The first one is the path from decryption module to descrambler where the control word is sending and another

is on descrambler exit and it is related to the picture. Due to these hackers' activities there can be distinguished following types of hacking method:

- Card sharing

It applies to sharing the Control Word. The user with the subscribed Nagra card runs a Card Server on their reconfigured open receiver. The Entitlement Management Messages (EMMs) and Entitlement Control Messages (ECMs) are sent to the server which in turn decrypts and returns the control words [27]. It allows the hacker to keep the decrypted control word in the server and share it across a computer network with others. Very often access to this server is restricted to those who pay the server's owner their own subscription fee.

To prevent the hacking of the control word, it shall be better protected. This protection could involve changes of smartcard key more often in order to change the CW combination and disturb the illegal distribution.

- Streaming

This method applies to the picture hacking. It uses already decrypted stream that is sharing through the internet. This stream can be retransmitted using receptor that is connected to the internet or by recording the signal and emitting it through internet networks.

To prevent this hacking method the hackers that distribute the stream need to be identified and their access permission shall be cancelled.

- Illegal transmissions in public places

The last method is processed in the end of the encryption process and is related to the picture distribution. Some customers emit the content in the public places like bars or restaurants. This emission is illegal because the offers for bars are different and not available any more in the Gol Television.

To prevent these illegal transmissions illegal emissions need to be identified and the signal needs to be cut.

Taking into account the content security needs there can be distinguished following company expectations related with the equipment and its protection capacities.

- Equipment, both the Nagra smartcard and receptor, shall have encryption key that is unknown for hackers

- Equipment system shall be modern and adapted to make system updates that will permit the CAS key changes
- Equipment shall prevent the key discovery and key sharing by hackers
- Receptor shall help to identify displaying content and easily assign it with the user
- Equipment shall help to identify and control the public places where the content is transmitted illegally
- Equipment shall reduce hacking significantly and convert hackers in channel clients

After the consideration of all aspects of company needs related to the CPE in order to increase the sales volume and reduce the costs by developing equipment improvements, these needs can be united and according to them some company requirements can be distinguish (table 7.2).

Table 7.2: Company requirements in terms of new CPE

Requirements	CPE Expectation	Source
Processes Automation Requirements	○ interaction with user in order to inform him about the process errors, incorrect moves or just about the successful steps or finished actions	Support set up and activation)
	○ Information sending about the process progress and following steps in order to user has all process action clear and knows what to do	
	○ controlling of correct set up/activation realization	
	○ simple navigation through the system	Support costs (activation)
Physical Design Requirements	○ inclusion of guides in form of color/sign indicators to execute set up correctly	Support costs (set up)
Operational Reliability Requirements	○ processes intuitive, simple and fast to make for any user no mater of the user's age or technology knowledge	Support costs (set up and activation)

	<ul style="list-style-type: none"> ○ inclusion of instruction/information/help available in specific process step in order to explain user doubts and let him to continue 	Support costs (set up and activation)
Human Factor Requirements	<ul style="list-style-type: none"> ○ commands shall be short and simple to understand 	Support costs (activation and activation)
	<ul style="list-style-type: none"> ○ adaption to the users capabilities and displaying of logical arranged steps with good visibility and unequivocal settings options 	
Content Security Requirements	<ul style="list-style-type: none"> ○ encryption key that is unknown for hackers 	Costs of hacking
	<ul style="list-style-type: none"> ○ prevention of key discovery and sharing 	
	<ul style="list-style-type: none"> ○ support in identification of user by displayed content 	
	<ul style="list-style-type: none"> ○ support in control and identification of illegal content transmission in bars/restaurants 	

7.1.2.3. Other departments needs

The equipment is closely connected also with other departments of Gol Television. For each of them new equipment features could bring some profits and simplify work. To identify this requirements each department needs will be defined (table 7.3).

1. Marketing expectations in terms of new CPE features
 - Equipment shall give support in promotion of loyalty actions and other marketing actions
2. Broadband
 - Equipment shall enable to receive and display on TV screen also multimedia content delivered through internet connection
3. Customer Service Support
 - Equipment shall permit user to contact with service provider and inform about service incidents or make new subscription
 - Equipment shall permit Gol Television send to user notification and display it on the screen

4. Acquisition Systems

- Equipment shall permit user to Online Shop access and purchase realization

Table 7.3: Other company departments' requirements in terms of new CPE

Requirements	Need	Department
Functional Requirement	○ support in channel promotion actions	Marketing
	○ broadband content receipt and displaying	Channel Emission: Broadband
	○ contact with customer using equipment	Customer Support Systems: CRM
	○ reception of customer incidents, requests	Customer Support Systems: CRM
	○ purchase realization through equipment	Acquisition Systems

7.1.3. Company and customer functional requirements fusion

To obtain global functional requirements both customer and company requirements must be evaluated and fused together. The table 7.4 shows the join process of performers' requirements. The fusion gives the global requirement list that expresses the guidelines for CPE technology specification development.

Table 7.4: Company and customer requirements fusion

Customer requirements	Company requirements	Global functional requirements	Description
Physical Design	Physical Design	Physical Design	Include esthetic and ergonomic design of external part of equipment
Process Execution	Process Automation	User Interface (UI) System Design	Enhance the equipment system by improving the user interaction with equipment making the system effective and efficient.
	Operational Reliability		

	Human Factor	Human Factor	Provide the equipment compatible with human capacities, skills and limitations.
	Content Security	Content Security	Include the equipment system efficiency to prevent the content hacking
Availability		Availability	Provide the customer wider range of equipment type choice
Functional	Functional	Functional	Enhance and expand equipment features and its functions
Distribution			No influence on the CPE development

The matrix presented in the table 7.5 shows dependence the functional requirements on the CPE life cycle stages. This combination permits to assess the requirements importance and define their priority taking into consideration the influence of each of requirement on the DTT equipment, divided into six life cycle phases.

Table 7.5: Dependence of functional requirements on the CPE life cycle

Requirements/ CPE life cycle stage	Physical Design	Availability	Functional	Human Factor	UI System Design	Content Security	Sum
Interest	x	x	x		x	x	5
Purchase	x	x	x		x	x	5
Set up	x			x	x	x	4
Activation				x	x	x	3
Usage	x		x	x	x	x	5
Abandon					x	x	2
Sum	4	2	3	3	6	6	

From this matrix can be also analyzed each CPE life cycle phase and define importance of each phase. However it will not be considered in this study.

Analyzing the results from matrix comparison, the critical functional requirements can be identified. They have the highest sum number from 6 to 3 points. These points express the requirement dependence or influence on CPE life cycle phase. The priority of the requirements is presented in the figure 7.5.

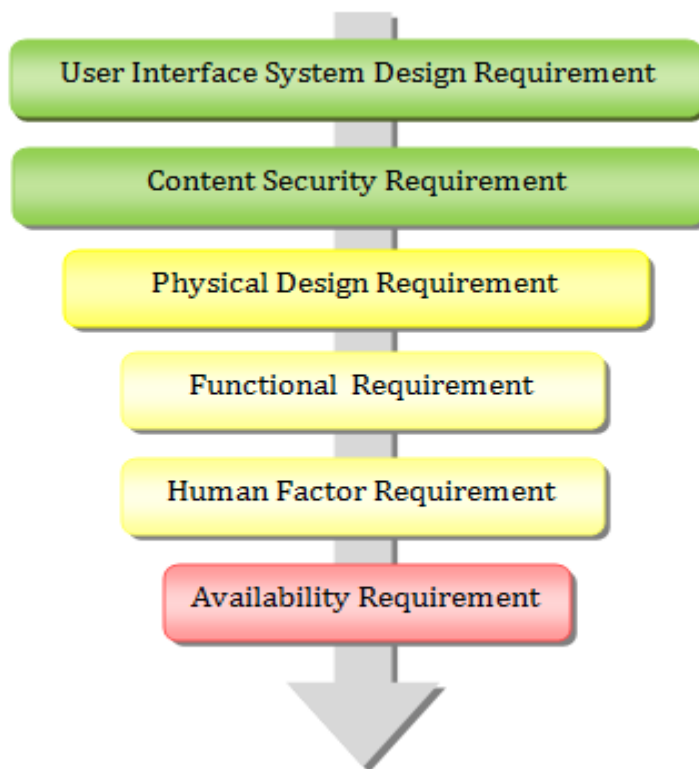


Figure 7.5: Functional requirements priority

The critical functional requirements, requirements that will be taken into consideration for next step, identification of technical specification in terms of CPE, are as follow: User Interface System, Content Security, Physical Design, Functional, and Human Factor. Development of the future features of CPE will be focus on these requirements. Availability requirements will be discarded because according to the matrix it does not have much importance and significant on general CPE future characteristics.

7.2. Identification of CPE technology specifications

Functional requirements analysis will be performed to capture technology specifications. These specifications propose the technical solutions for the CPE. For each functional requirement, obtained in the previous part, the possible concepts of solution will be identified.

1. User interface system design requirement

This requirement involves the features of equipment software system with its abilities and capacities that will be offered and used by Gol Television customer. The futures will be related with look and feel of the system. It consists of graphical aspects of its design, including elements such as layout, colors and behavior of dynamic elements such as menu, bottoms. Moreover it will contain also the functional aspects of the system to increase the iteration of equipment with user in order to achieve effective operations, facility in usage and give customer support with equipment utilization. The solution concepts for this requirement are as follow:

- **Conversational Interface Agent-Guide of the system**
Solution that will guide the user through the set up, equipment and channel first activation as well as through the equipment usage period in order to help user get to know the equipment and its functions better and facilitate the processes.
- **Equipment voice informer**
Voice informer will has function of controlling set up and activation processes as well as will provide instructions commands to execute both processes correctly.
- **Electronic instruction with video and text explanations**
Voice informer could be supported with video instructions added through the process steps to display for eg. card introduction to STB. Some instructions can be also shown as text explanation to inform user about the correct option selection, or some option usage.
- **System enables to download applications and widgets**
The equipment with advanced system permits user to download applications and widgets that will provide additional functions and increase usability of equipment.
- **Interactive electronic program guide**
This solution is a continuously updated broadcast programming and scheduling information for current and upcoming programming that allows obtaining

information faster and with more details. Also it can provide navigation through programming selecting time or title and other possibilities.

2. Content security requirement

This requirement includes possible concepts of content protection against hacking and used methods to obtain channel illegal access. It also consists of concepts of hackers' identification in order to identify the sources of illegal channel distribution that could help to stop content sharing.

- Advance system CAS implementation with new RSA key
This concept of CAS change will provide new RSA key of content encryption that will be unknown for the hackers.
- System with updates ability
This ability will let the channel to make equipment system updates without equipment changing. This solution can be helpful for the channel content security performance.
- Audio Tag Technology
Is technology solution that sends the Nagra number in Morse code form receptor and witch can be received and displayed by special mobile application. This solution could be useful in signal controlling of channel emissions in bars or restaurants.
- Nagra number demonstration on the screen
Technology solution, that can support identification of the hackers, permits to display the smartcard Nagra number on the TV screen of the customer. It can help to identify the user that retransmits the content illegally through internet.

3. Physical Design Requirement

It includes the physical appearance of the equipment. It has to be modern, attract the user and make on him nice impression. Moreover it has to be made the most of equipment design to facilitate user set up realization. It can refer to inputs colors indications that coincide with the cable color. The solution concepts are as follow:

- Size: not bigger than 160mm x 30mm x 110mm
The size is important factor for the equipment physical aspect. Users are get used to have small devices and more discrete.

- Weight limitation not higher than 350g
Similar to the equipment size, the weight is also important aspect that makes equipment modern and gives the user impression of advance technology of device.
- Graphite color of external surface
The equipment will be available in the one, discrete and universal color to adapt for the majority of users' preferences and taste.
- Connect accessories and equipment plugs with color indicators
This proposal is more functional concept of design that will support user set up realization.

4. Functional Requirement

This requirement was distinguished from customer and company expectations. It consists of different new features of CPE that will provide equipment more functions for both, user and channel. The solution concepts in order to increase CPE functionality are as follow:

- Encoded and free digital signal receipt
This is the concept of providing user receipt of not only encoded channel but also free digital channel that can be detected by the equipment.
- Digital-analog signal converter
This solution is to permit users receipt the digital channel with analog TV set.
- Remote control integration
The navigation through the equipment system as well as navigation of the channel will be provided by using remote control. Additionally commands of remote control will be received when receptor is kept in some cupboard.
- Networking support- WiFi, Ethernet, satellite
This concept will permit the user to connect receptor with Internet and satellite if it is necessary
- USB input.
This input will permit user to connect other external drivers.
- HBBTV component
This solution permits to receive also broadband content on TV set only when the receptor will be connected with Internet.
- HD video standard

This solution implemented in the receptor system permits user to obtain the content in HD standard.

- Memory HDD (Hard Disk Drive)
Additional memory will provide user to keep on receptor memory movies or photos and watch them on the TV screen.
- PVR (Personal Video Recorder) ability
This solution gives user possibility to record the contents and much more like go forward, stop video, go back
- Mobile application support
This concept will allow users to make operations on the distance through mobile application that will be integrated with receptor. It can be for example access to Interactive Program Guide or start recording.
- IRD (Integrated Receiver/ Decoder) Command
This technology will permit to display text messages on the TV screen. Message will be send and display only when user will turn on Gol Television channel content.

5. Human Factor Requirement

This requirement is to create equipment as much simple for user as it is possible. It includes ergonomic factors of the system and of equipment taking into accounts the user capacities and skills. Equipment has to be simple in usage for any user no matter of his age or education.

- Color indicators for connectors
This solution is to provide user simple and fast set up.
- Ergonomic solutions in receptor processes' steps and messages
This concept refers to the look and feel part of the system. It consists of logical arrange of the set up and activation process step as well as appropriate layout design and color usage.

7.2.1. Structure CPE technical specifications

Identified preliminary concepts of solutions need to be structured in order to group all proposals to select prefer and possible to implement solutions. The structure of the concepts is presented in the figure 7.6.

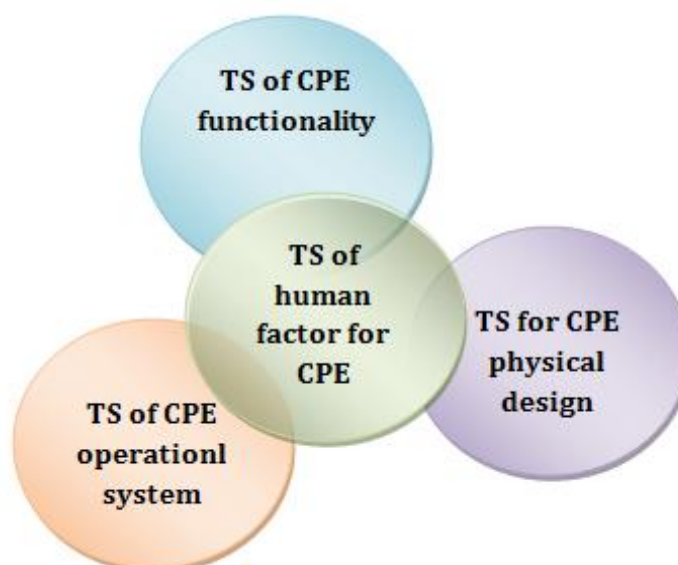


Figure 7.6: Structure of TS groups of new CPE

Fusion of the solutions for UI System Design Requirements and Content Security Requirements give the features of the CPE operational system, hardware and software characteristics. It can be assumed as follow technical specification.

CPE operational system (HW+SW) has following features:

- New CAS with new RSA key
- Software enable to updates
- Nagra number displaying with content on TV screen
- Audio Tag technology
- Conversational Interface Agent-Guide
- Video/text electronic instructions
- Voice informer
- Interactive electronic program guide
- App/widgets download ability

Receptor Design with features:

- Not bigger than 160mm x 30mm x 110mm
- Not heavier than 350g
- Graphite surface with color indicators in the back part of connection inputs

Functionality of CPE will include following characteristics:

- Standard functions: receipt of encoded, free channels with conversion into digital/analog signal; remote control integration
- HD visualization standard
- Internet connection
- Memory HDD
- USB input
- HBBTV component
- IRD Command
- PVR ability
- App (Application) for mobile

Solutions of Human Factor are taken into account for every concept of each functional requirement in order to create the simplest and more ergonomic as it is possible CPE system and its operational functions.

7.3. Justification of CPE technical specifications

Justification is used to monitor the evaluation of the DTT equipment design. The justification of CPE technical specification is essential to demonstrate that defined solutions are correctly identify and indeed cover the needs of company and customer in terms of CPE features [28]. In order to verify defined technical specifications, for each one will be assigned the corresponded performer's need. The technical specifications will be justified in group identified by structuring, made in the previous part.

Figure7.7 presents justification of the technology specifications that are related to the CPE operational system features. For each given technology specification is assigned one or more correspondent need of customer or company. It assures that the specification is appropriate identified and defined needs in the first part of chapter 8. are met proposals of technology solutions.

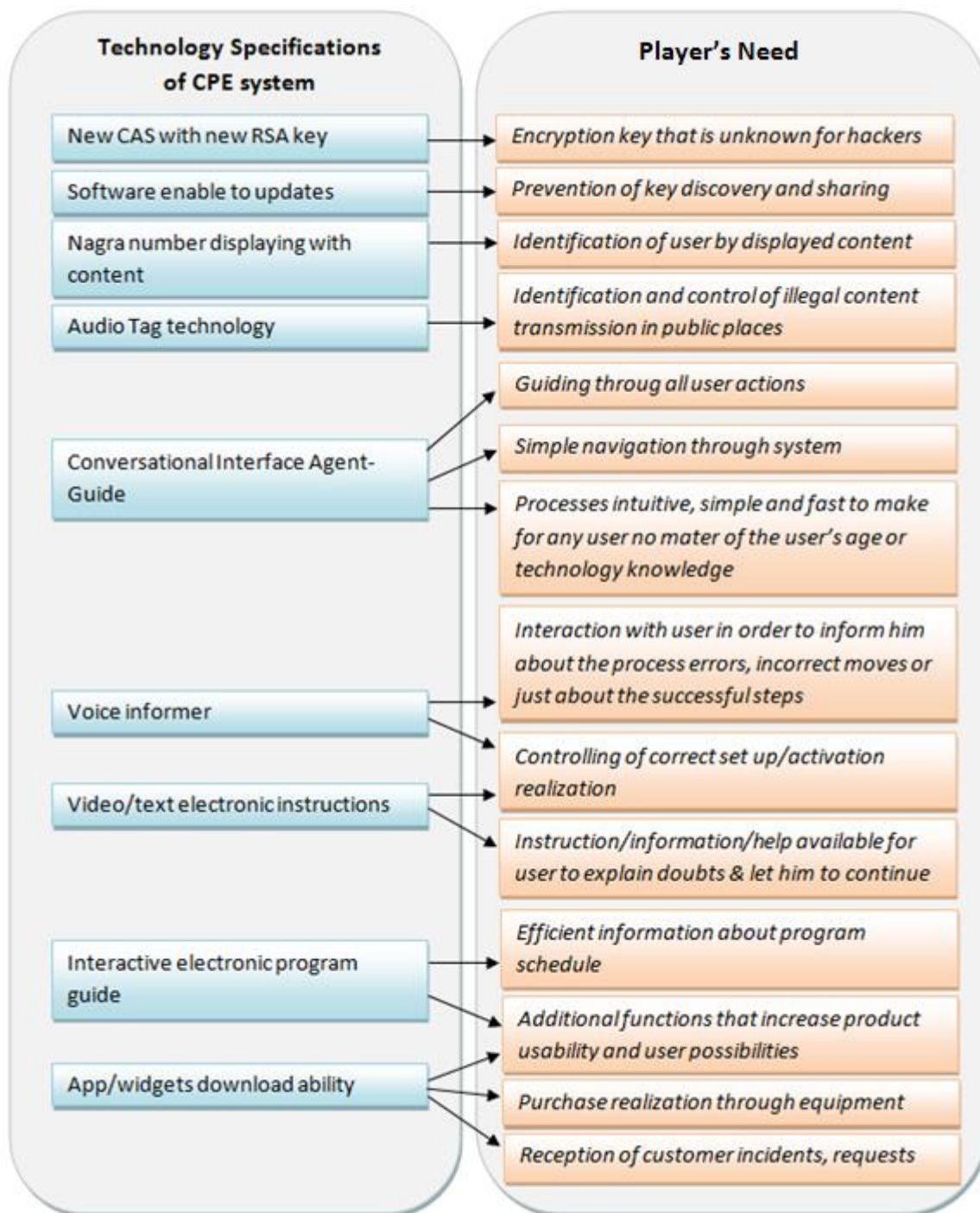


Figure 7.7: Justification of TS of CPE operational system

Each technology solution is justified by allocation to the correspondent need. It assures that the solution is appropriate identified and indeed cover previously defined necessity.

In the same way will be justified the technology specifications to improve the functionality of the CPE (figure 7.8). For each solution will be assigned one or more customers' or company's need.

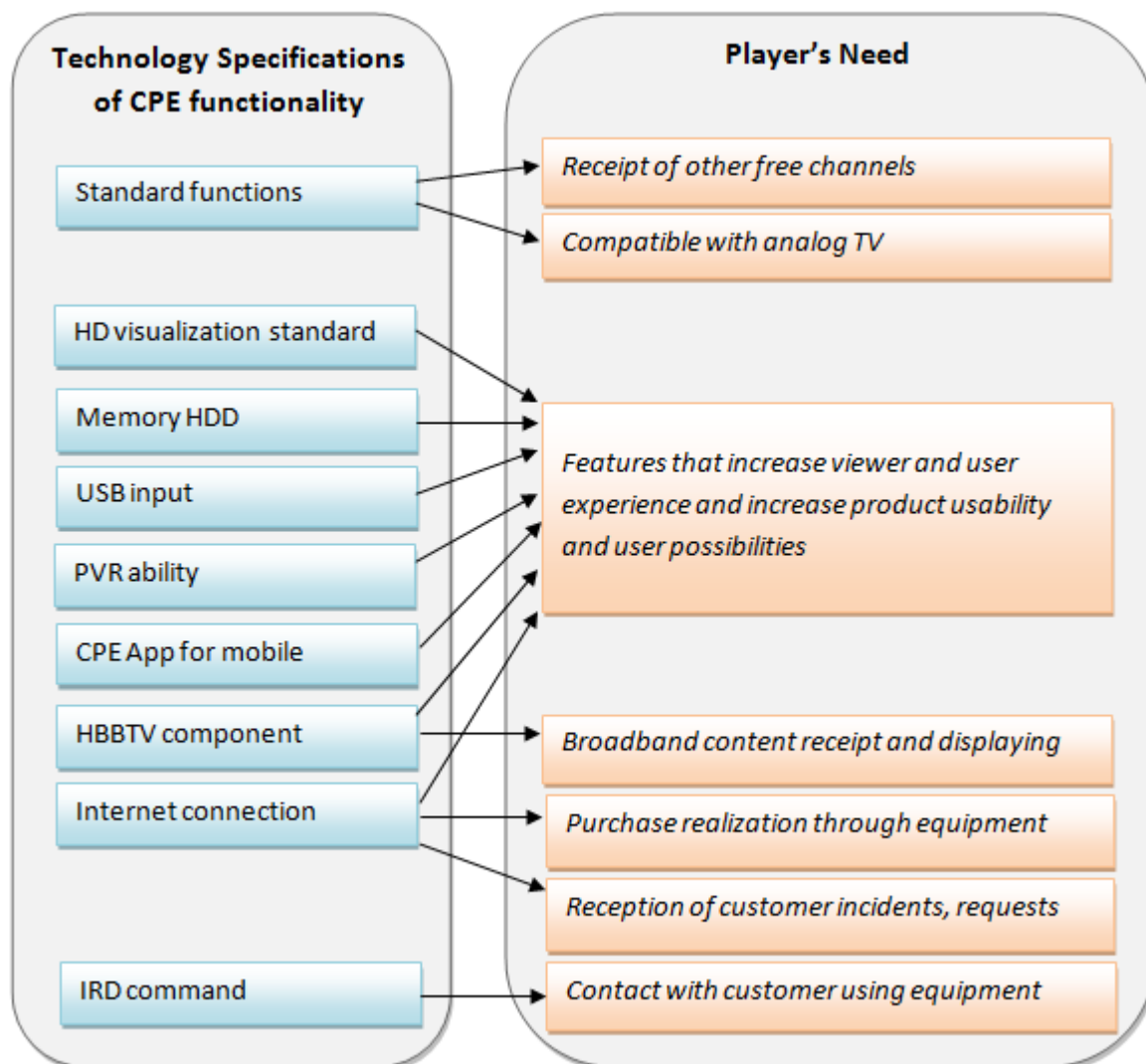


Figure 7.8: Justification of TS in terms of CPE functionality

All identified technical specifications in terms of CPE functionality respond to performers needs. Each specification meets company's or customers' expectations in order to improve CPE and satisfy user and provider.

Justification of technology specifications in terms of CPE physical design are presented in next figure 7.9.

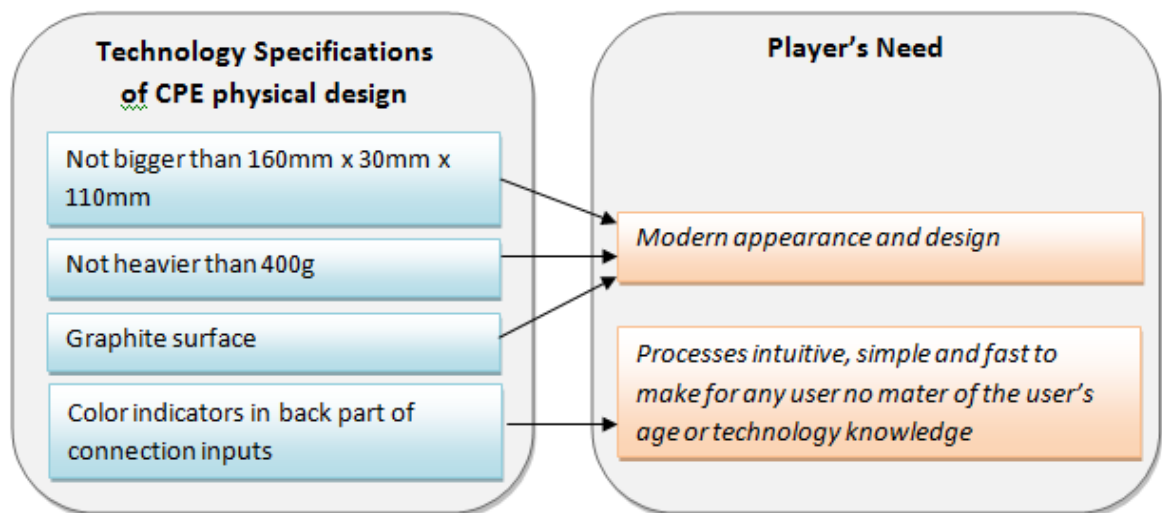


Figure 7.9: Justification of TS for CPE physical design

Each one technology specification, that was identified, meet some of earlier established customer or company needs. It assures that specification are properly identified and its justification is corret.

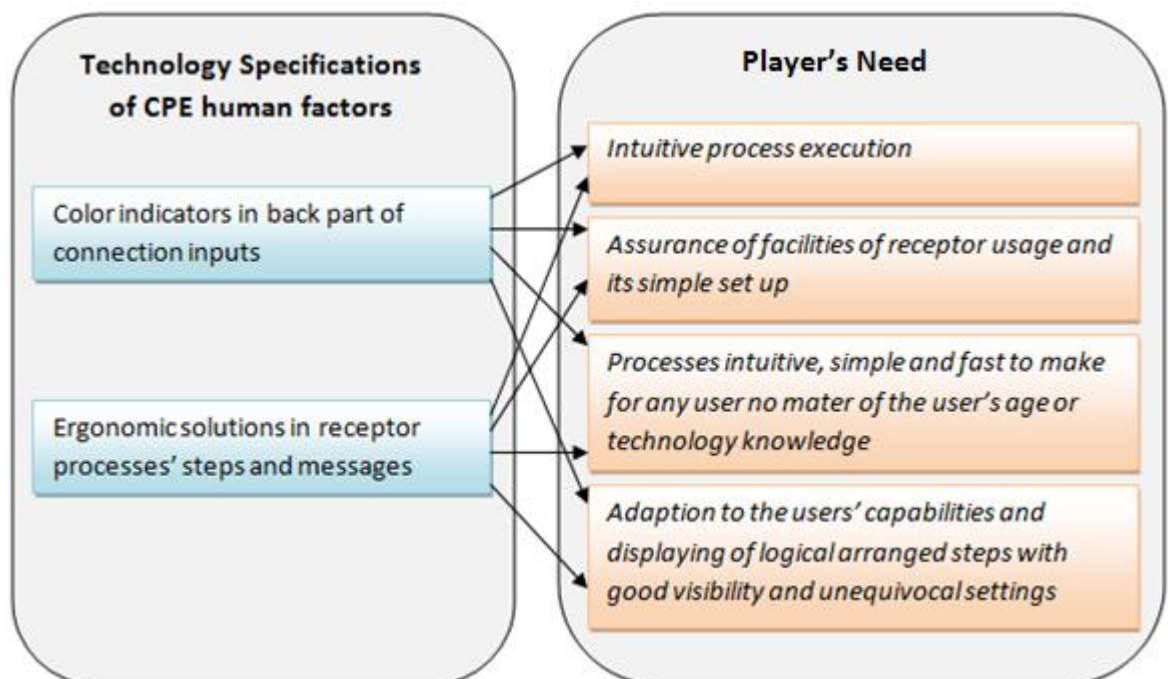


Figure 7.10: Justification of TS of CPE human factors

The last group of identified technology specifications are related to human factors. This group fills oterhs specifications in order to provide user equipment ergonomic and intuitive in

usage. The figure 7.10 presents justification of these specifications. Each specification meets correspondent performers' need.

Justification of the technical specifications of CPE demonstrate that concepts of solutions in terms of future DTT equipment are correctly identified and they meet the company's and customers' needs. These specifications will be considered and assessed to establish the pre-solution proposal of future CPE of Gol Television.

7.4. Establishment of CPE pre-solution

Technical specifications that were identified will be assessed and verified in order to propose some pre-solution of CPE, taking into account the company conditions and constraints.

Identified solutions are accurate and as it is presented in the part of justification, meet performers' needs so that will contribute to CPE improvement. However because of the company economy constraint not all solutions can be implemented in the next fabricated version of CPE. Company has limited budget, and the price of production of one receptor cannot exceed 40 euro. In order to use this opportunity and take advantage of new CPE designing, pre solution need to be planned and established.

The economy constraint causes that identified solution have to be analyzed and validated in order to make good decision in terms of CPE future characteristics and create efficient equipment that meets majority of performers' needs. The solutions of technical specifications need to be prioritized. Some solutions will have to be discarded and another, if it is possible, implemented later. That is why it is so important to consider well what CPE features have to be applied as first making the technical base for other characteristics that can be supplemented in the future without additional costs of equipment changes.

Is necessary to take into account the objective that new CPE design needs to meet customer and company needs and moreover has to provide operation life during next ten years. Due to these characteristics the CPE design planning needs to be considered in terms of what features will create the equipment base in order to in close future the company could add to CPE other functions. The figure 7.11 presents positioning diagram of cost and importance comparison of CPE features. The importance factor is related to the requirement priority analyzed in chapter 7.1.3 (figure 7.5).

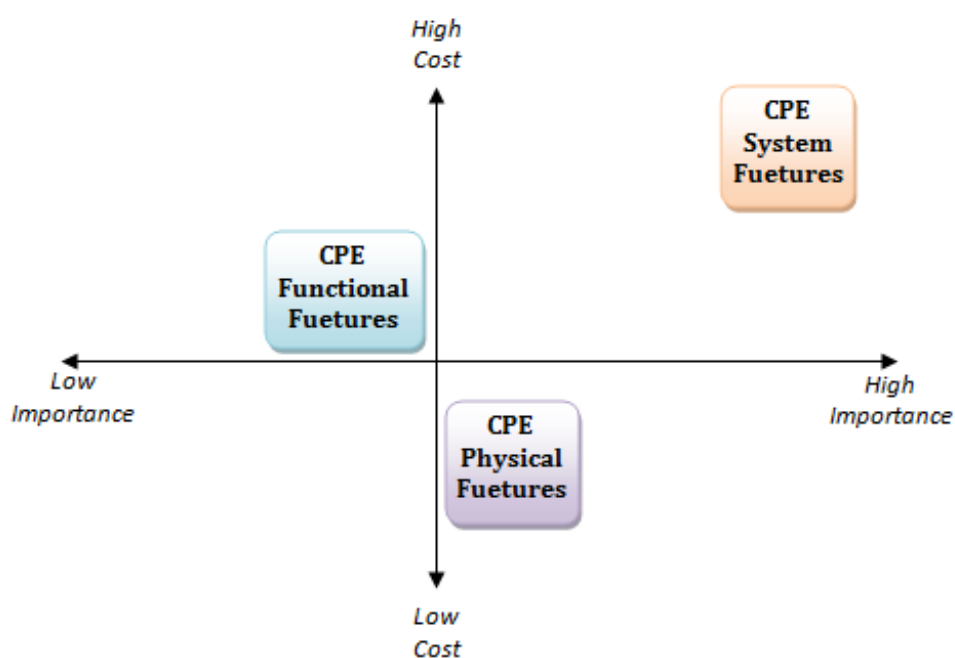


Figure 7.11: Positioning diagram of cost and importance of CPE features

In terms of equipment operational life assumption that equals 10 years, physical aspect of the CPE that cannot be changed within this is very important. Taking into account that technical specifications are not complex, they refer to size, weight color and color indicators, and cost of CPE physical features design is relatively low, all these technical specifications will be developed in new equipment.

To facilitate the decision making process of CPE features referred to system and functional features in order to meet the budget constraints, the comparison matrix will be created to consider the solutions importance and dependence between them. The table 7.6 presents dependence confrontation between identified technical specifications in terms of system and functional CPE characteristics.

Table 7.6: Confrontation of TS related with operating system and functional characteristics

	new CAS + new RSA	System Updates	Audio Tag	Nagra nr displaying	Conversational IAG	Voice Informer	Video/text instructions	Interactive EPG	App/widgets download	Standard functions	HD	Internet input	HDD memory	USB input	HBBTV	IRD Commands	PVR	CPE App for Mobile	Ergonomic factor
new CAS + new RSA	x																		
System Updates	x	x	x	x	x	x	x	x	x							x	x	x	x
Audio Tag		x	x																
Nagra nr displaying		x		x															
Conversational IAG		x			x														x
Voice Informer		x				x													x
Video/text instruc.		x					x												x
Interactive EPG		x						x											x
App/widgets dl.		x							x				x						
Standard functions										x									
HD											x								
Internet input												x							
HDD memory									x				x				x		
USB input														x					
HBBTV															x				
IRD Commands		x														x			x
PVR		x											x				x		
CPE App for Mobile		x																x	
Ergonomic factor		x			x	x	x	x								x			x

System ability to make software updates is a critical specification for future CPE. It is because from this ability depend many other features and if equipment has this ability other specifications could be added to the system in the future by making update of system software. Another critical specification is the equipment memory HDD. CPE equipped with this characteristic will be able in the future, thanks to also the updated ability, implement PVR feature and user will be enable to download applications and widgets to increase the CPE functionality. There is also group of characteristics that have to been implemented during product fabrication like: Internet input, USB input, HD standard visualization or HBBTV

component. It means, if company decides to include these features into CPE they need to be implemented as a primary set of characteristics in the product design and fabrication. In the future it will not be possible to increase the product capacity in terms of these features. Figure 7.12 presents the structured features for primary and secondary characteristics.

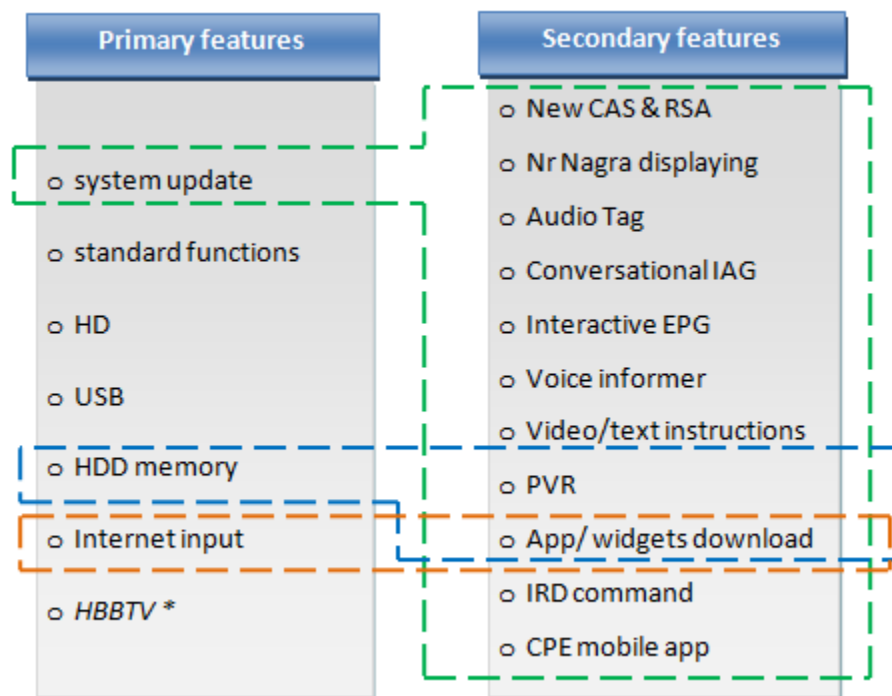


Figure 7.12: CPE features structure

Primary features have to be taken into account during the first design that is created for product fabrication. All secondary features can be added only when the system is enabled to software updates. Supplement of HDD memory will provide to increase the equipment capacity to PVR. Additionally ability of internet connection of equipment will provide user to download different applications and widgets and use them on the TV set. Moreover if company decide to supplement HBBTV the internet connection is a must in order to provide HBBTV utilization.

Decision of primary features choice has big influence on the future CPE characteristics. Nevertheless decision depends on the company director boards and budget constraints.

7.5. CPE Technology Roadmap results

The establishment of CPE pre solution permits to make proposal of equipment design plan. The CPE proposal is presented in the figure 7.13 in format of multiple layers technology roadmap that shows the strategy plan for Gol Television for next two years.

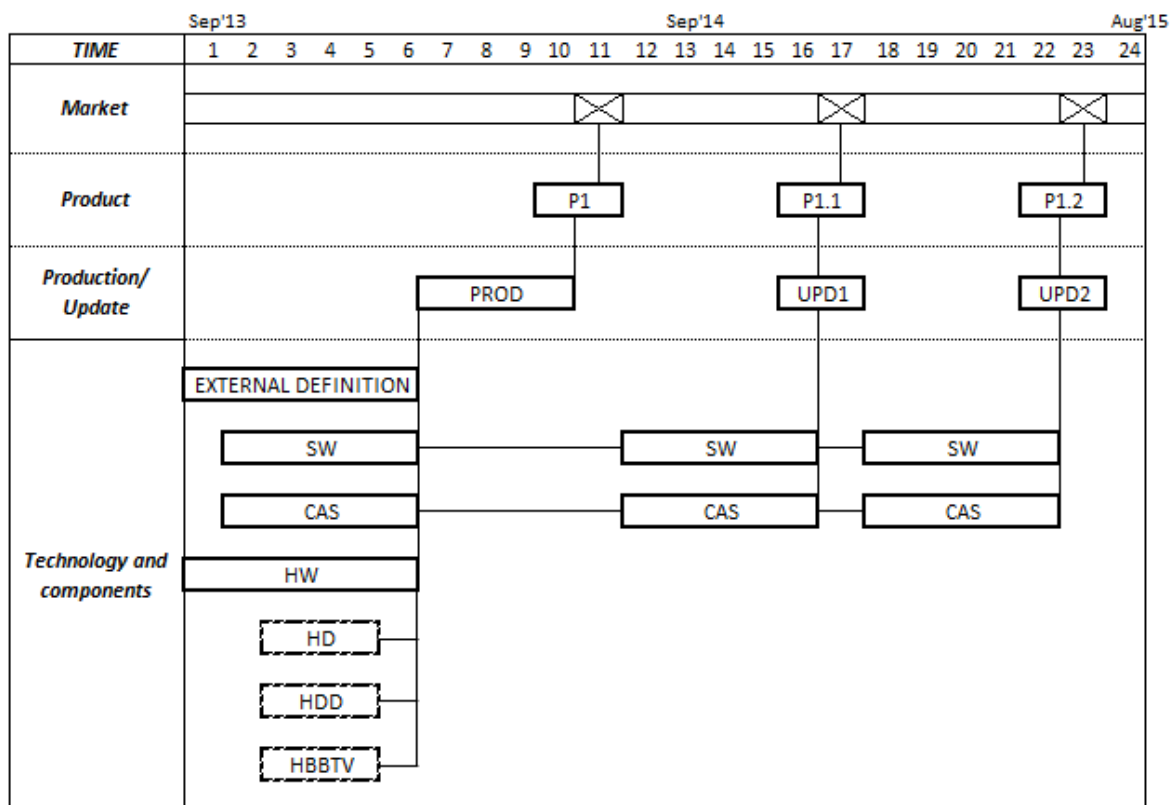


Figure 7.13: Technology Roadmap for CPE design and implementation

The future CPE design can be extended through the time. The hardware (HW) is designed only ones. The components of HW: high definition of the picture (HD), hybrid television (HBBTV), hard disc drive (HDD) have to been considered during design in order to give the CPE specific features and functionally, wished and chosen by the company. The software (SW) as well as control access system (CAS) can be developed, improved and changed, without the physical equipment replacement, through the time, on condition that the HW is enabled to system updates.

System design, with HW, SW and CAS, takes about six months. For equipment manufacturing is needed about four months. According to this production time estimations, new CPE can be put in the market in the beginning of the season 2014, between July and

August 2014. The systems update allows develop and improve both equipment SW and CAS. Number of possible updates depends on the complexity of system changes. This solution of system updates allows the company to meet the budget in the first year of investment and continue the CPE improvements through next years.

The SW can be redesigned for following system updates with solutions indentified in the previous part: Conversational Interface Agent-Guide, voice informer, video/text electronic instructions, Interactive Electronic Program Guide, IRD Command, PVR, CPE mobile application and app/widgets downloads. The sequence of the solutions implementation is open and depends on the company decision.

The CAS, similarly to the equipment SW, can be implemented in first year or in next year of investment. The solutions supplement depends on the company priorities and budget constraints.

The external definition treats the equipment physical design (size, color, color indicators) and it components (USB and Internet inputs).

8. Economical valuation

8.1. Budget analysis

The first part of the economical evaluation presents the budget analysis of made study. In order to understand better costs and time needed to prepare the technology roadmap for the company, the analysis is supported by gantt chart (figure 8.1) of the project.

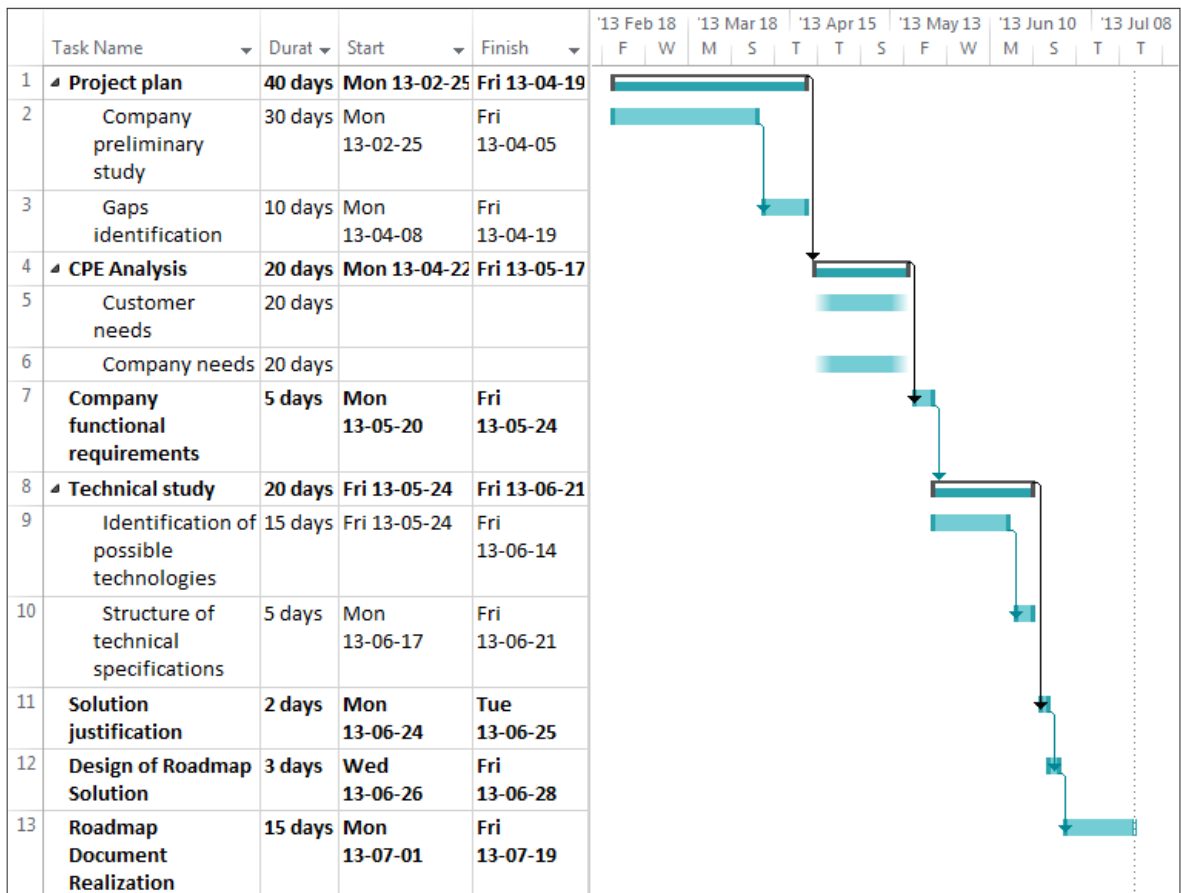


Figure 8.1: Gantt Chart of the CPE Technology Roadmap

Figure above shows following tasks for the CPE Technology Roadmap project realization. Duration of each task depends on the complexity of the work. The figure presents approximately how many days were needs for task execution. Taking into account that the number of working days is 105 and each day took about 5 hours of the work on the project and the cost per hour for the student that was working for the company was 7 €, the salary came 3 675 €. Additionally in order to count total cost there have to be counted also energy

costs and the cost of laptop usage. The results of the total costs of the project realization are presented in the table 8.1.

Table 8.1: Total cost of Technology Roadmap project realization

Type	Cost per unit	Units	Assigned cost
Salary for student	7 €	525	3 675 €
Energy consumption	0,14 €/kWh	42 kWh	5,88 €
Laptop	600 €		83 €
Total cost			3 763,88 €

Taking into account that the laptop used for this project consumes 90W per hour and was used during 525 h, the number of total kWh is 42. It gives 5,88 € for energy consumption. Supposing that new laptop costs around 600 € and its useful life equals 3 years, its annual cost of usage comes 200 €. Nevertheless for this project cost of usage of the laptop during 5 months is 83 €.

Assuming, the consultant company, that works for Mediapro Gol Television channel, had to prepare the budget equals 3 763,88 € for realization of the CPE Technology Roadmap project.

8.2. Financial analysis of CPE Technology Roadmap

The financial analysis includes profitability evaluation of the channel investment in new CPE according to the Technology Roadmap indications. The change of CPE is a huge investment for the channel. However, because of the stock out it is a must for the company future. Moreover it is also chance to reduce the costs that the current equipment generates and convert business in low cost pay TV service.

To make the financial analysis and evaluate the profitability of the company investment in terms of new CPE production for the channel, there is necessary to specify the product and its features. Hypothetically we assume that the company decides on the following scenario.

The planning of investment budget in terms of new CPE development, maintenance and system development costs is made for 3 years into the future. The production volume is declared for 225.000 STB and 125.000 CAM units. However, because of the budget limits each unit of CPE cannot exceed 35 € of initial investment. It has impact on the technical specification of equipment.

In the following financial evaluation it is assumed that the channel revenues in 2012 come to about 72 000 000 €. The costs of the Mediapro investment are presented in the table 8.1.

Table 8.2: New CPE investment costs

Investment element	Working hours	No of workers	Price/hour (€)	Cost/unit (€)	Estimated cost (€)
CPE Design	480	2	40,5		38 880,00
New hardware				25,2	8 820 000,00
HD*				4,5	1 012 500,00
Operating System	640	3	50		96 000,00
Smart Card Rider				1,8	630 000,00
Material					59 000,00
CPE Inputs*					38 500,00
CAS Tech. with deployment					651 300,00
New CAS&RSA	960	7	65		436 800,00
Nr Nagra displaying	660	5	65		214 500,00
Development					106 920,00
Conversational IAG	480	3	40,5		58 320,00
IEPG	400	3	40,5		48 600,00
Manufacturing	620	18	35,5		396 180,00
Logistic Costs					353 320,00
Sum					12 202 600,00
Budget reserve					1 282 000,00
SUM					13 484 600,00

* Elements purchased only for STB

Moreover appropriate budget reserve is very important in project budgeting and planning. Usually it is assumed to be equal to 10-15% of the total implementation value. In this case it composes 10,5% of initial investment. The budget for CPE investment meets the company limitation without reserves using. The price per unit of initial investment is around 35€

$$12\,202\,600\text{€} : 350\,000\text{ units} = 34,86\text{ €/unit}$$

This financial evaluation includes also other costs that are mentioned to the equipment maintenance and system development/updates. These costs are divided into 3 years and presents in the following table 8.2.

Table 8.3: CPE maintenance and development costs

Source of costs	Working hours	No of workers	Cost/hour (€)	Estimated costs (€)
Year 1				
System update	182 400,00			
CAS	960	2	65	124 800,00
Software	640	2	45	57 600,00
Additional IT staff	1752	1	40	70 080,00
Sum	252 480,00			
Year 2				
System update	187 520,00			
CAS	960	2	67	128 640,00
Software	640	2	46	58 880,00
Additional IT staff	1752	1	42	73 584,00
Sum	261 104,00			
Year 3				
System update	161 280,00			
CAS	960	2	68	130 560,00
Software	640	1	48	30 720,00
Additional IT staff	1752	1	45	78 840,00
Sum	240 120,00			
Total costs	753 704,00			

The estimation of benefits of the investment in new CPE implementation is displayed in the table 8.3.

Table 8.4: New CPE benefits

Benefits of new CPE features	Impact
1. Elimination of card sharing hacking method	Recovery of 15% of card sharing users. It generates additional incomes equal 10 800 000€ per year
2. Reduction about 80% of cases of streaming hacking	Recovery of 10% of streaming watchers generates 1 056 000€ extra incomes per year
3. Reduction of 60% of support calls related to the equipment processes of set up and activation	Saving at the level of 306 240€ per year
TOTAL	12 164 240€ in the first year (in the following years the sum is changed according to the inflation level of 1% - CPI inflation from 03/2013) [http://sdw.ecb.europa.eu/]

The table 8.3 assumed annual forecasted operational inflows that are expected to occur during the first 3 years of new CPE introduction on the market. This CPE is going to replace the current DTT equipment. The following table 8.4 displayed investment outflows and operational inflows.

Table 8.5: Cash flow statement

Investment	0	1	2	3
CPE Design	-38 880,00			
New hardware	-8 820 000,00			
HD	-1 012 500,00			
Operating System	-96 000,00			
Smart Card Rider	-630 000,00			
Material	-59 000,00			
CPE Inputs*	-38 500,00			
CAS Tech. with deployment	-651 300,00			
Development (CIAG,IEPG)	-106 920,00			
Manufacturing	-396 180,00			
Logistic Costs	-353 320,00			
Budget reserve	-1 282 000,00			
Total initial investment outflow	-13 484 600,00			
Maintenance and development	0	1	2	3
System update (CAS,SW)		-182 400,00	-187 520,00	-161 280,00
Additional IT staff		-70 080,00	-73 584,00	-78 840,00
Total investment outflow (€)		-252 480,00	-261 104,00	-240 120,00
Operational inflows	0	1	2	3
		10 800 000,00	10 908 000,00	11 017 080,00
		1 056 000,00	1 066 560,00	1 077 225,60
		306 240,00	309 302,40	312 395,42
Total operational inflows		12 162 240,00	12 283 862,40	12 406 701,02
Total flows	0	1	2	3
Investment outflows	-13 484 600,00	-252 480,00	-261 104,00	-240 120,00
Operational inflows		12 162 240,00	12 283 862,40	12 406 701,02
Total Free Cash Flow	-13 484 600,00	11 909 760,00	12 022 758,40	12 166 581,02

Evaluation of the investment plan profitability helps to verify the effectiveness of the new CPE proposal. It also has strong impact on the decision making process of acceptance or rejection of the investment project. There are many methods to make this evaluation. Some of them are used in this part of study and are presented in the following chapters.

8.2.1. Net Present Value

NPV is the difference between the present value of cash inflows and the present value of cash outflows. NPV compares the value of euro today to the value of that same euro in the future, taking into account inflation and returns. If the NPV of a given project is positive, it should be accepted.

Table 8.6: Free Cash Flow calculation

Year	Cash		Net Cash Flow (€)
	Outflow	Inflow	
0	13 484 600,00	0,00	-13 484 600,00
1	252 480,00	12 162 240,00	11 909 760,00
2	261 104,00	12 283 862,40	12 022 758,40
3	240 120,00	12 406 701,02	12 166 581,02

In order to calculate NPV the above data of net cash flow (table 8.5) is used in the following calculation formula.

$$PV_t = \frac{1}{(1+r)^t} \times FV_t$$

Where:

- *PV* is present value,
- *r* is a discount rate, equal to 8% ,
- *t* is a period, year,
- *FV*, future value that is net cash flow value.

NPV of the project of new CPE production is a sum of PV. The calculation is shown in the table 8.6.

Table 8.7: Net Present Value calculation

Year	PV (t)
0	-13 484 600,00
1	11 027 555,56
2	10 307 577,50
3	9 658 224,28
NPV (€)	17 508 757,34

NPV of the company CPE plan for the future is a positive value (NPV>0). According to the investment efficiency measurements, the investment of new CPE is profitability for the company.

8.2.2. Payback Period

PP presents the time after which the amount initially invested will be paid back. Method of calculation is presented in the table 8.7.

Table 8.8: Payback Period calculation

Year	Cash Flow (€)	Cumulative Cash Flow (€)
0	-13 484 600,00	-13 484 600,00
1	11 909 760,00	-1 574 840,00
2	12 022 758,40	10 447 918,40
3	12 166 581,02	22 614 499,42

The formula is as follow:

$$PP = 1 + \frac{1\,574\,840}{12\,166\,581,02} = 1,13 \text{ years}$$

The result means that after about 1 year and two months the company investment is going to be returned.

8.2.3. Return on Investment

ROI is a performance measure used to evaluate profits obtained in relation to capital invested. The higher the ROI the more cost-effective is an investment. Method of calculation is as follow:

$$ROI = (\text{profit from investment} - \text{cost of investment}) / \text{cost of investment}$$

The table 8.8 presents the costs and profit of the company investment with the total sum.

Table 8.9: Return on Investment calculation

Year	Investment	
	Cost (€)	Profit (€)
0	13 484 600,00	0,00
1	252 480,00	12 162 240,00
2	261 104,00	12 283 862,40
3	240 120,00	12 406 701,02
Sum	14 238 304,00	36 852 803,42

$$ROI = \frac{(36\,852\,803,42 - 14\,238\,304)}{14\,238\,304} \approx 1,59$$

ROI indicator means that the company investing in the new CPE project, every 1 euro of this investment brings additional 1,59 euro of profit.

9. Impact on environment

The environment impact, that the project has affected, can be divided into two groups, which are distinguished from two different points of view:

- Impact on environment of made study
- Impact on environment of realized and implemented in the future CPE technology roadmap plan.

The first group of environmental impact consists of the energy consumption that was used to create this document. Assuming that the laptop uses maximum power equals 80 W per hour and that the study took about 525 working hours, total power consumption of the project realization equals 42 kWh.

Additionally printing of the paper version of the study, in two copies, consumed about 250 pages of paper.

The second group of environmental impact is connected with the new CPE technology plan realization. Designing, producing and later implementing of new equipment will cause replacement of the current STB and CAM sets. It will increase the amount of electronic equipment waste. Taking into account the actual number of Gol Television users, the number of equipment not in use any more will be around 300.000 of units. It will produce around 75 000 kg of waste.

The impact on environment of producing amount of waste caused by new CPE replacement could be decreased by proper waste managing. Appropriate recycling of the electronic equipment could provide material or some pieces reusing in order to improve environment protection.

10. Conclusions

Roadmap methodology used in terms of the new CPE designing allowed create the proposal of technology strategy for the Gol Television for next two years. It helped to take right direction for the company business future definition, joining the extensive analysis of the current situation within the scope with company's and customers' necessities. It gave essential information about existed gaps that new equipment needed to fill and introduce improvements. Identified technical specifications were considered as possible solutions and were justified in order to ensure that the future plan meets the players' needs and is following into the right direction.

Technology roadmap of new CPE for Gol Television has presented the number of different technology solutions that chosen to implementation can help the company to increase annual benefits, reduce the costs and convert its business into low cost sport channel service. Identified pre solutions for new CPE provides:

- Better channel content protection and elimination of illegal channel accessing.
- Increase the user experience in terms of CPE functionality and processes efficiency.
- Facilitate work of other company departments and make it more efficiency.

Nevertheless the future technical specifications of CPE depend on the company decision and the budget constraints. As it was presented in the chapter 8, financial evaluation of the CPE with basic features is profitable for the company. The Payback Period takes about one year and two months. This is very short time for such big investment (more than 13 000 000 €). Other indicators, NPV and ROI are also positive and optimistic for the project. This investment can bring the company additional profits and give opportunity to take leader position on pay TV multimedia market.

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Appendix A. Digital Terrestrial Television in Spain

A.1. DTT in details

Digital Terrestrial Television (DTT)¹ is the result of the application of digital technology to the television signal, that later is transited via terrestrial airwaves, in other words those that are transmitted through the atmosphere without cable or satellite and received through conventional UHF antenna.



Figure A.1: UHF antenna

The standard used in Spain for DTT transmission, as in over 110 countries throughout the world, among which are all the European Union, is the DVB-T (Digital Video Broadcasting - Terrestrial).

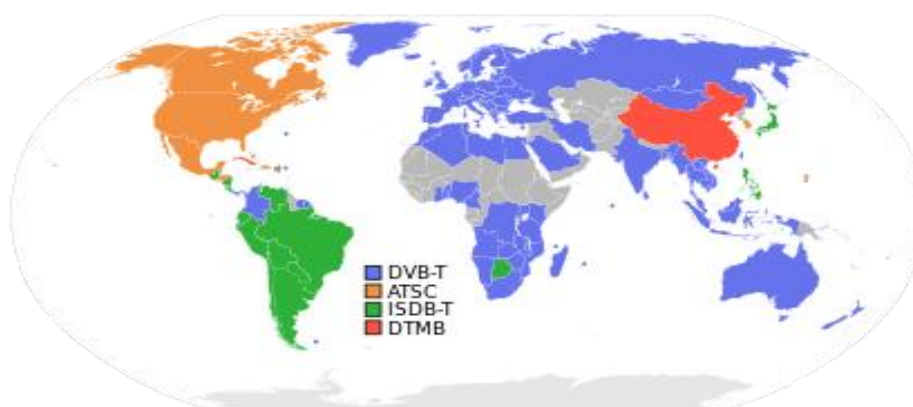


Figure A.2: DTT broadcasting systems by country

¹ Digital Television in Spain, Spanish Government website: <http://www.televisiondigital.es>

DVB-T uses modulation type which offers a robust signal and also provides protection against the echoes produced by the multiple paths that takes the signal propagation, allowing reuse the same frequencies in neighboring antennas.

The TDT replaced, due to its many advantages, the Analogue Terrestrial Television, which was being received so far in most Spanish homes. This change occurred after the date of cessation of broadcasts on analog technology, which was set in Spain on April 3, 2010.

A.2. How to receive DTT

To receive DTT signal at home it is needed to follow these steps:

1. The living area coverage checking

DTT coverage was increased progressively to reach, before terminating analog broadcasts of April 3, 2010, the goals of the National Technical Plan for Digital Terrestrial Television, approved by Royal Decree 944/2005 of 29 July, and correspond to 96% of the Spanish population to private channels and 98% for public. The DTT coverage can be checked in the following link: <http://www.televisiondigital.es/Ciudadano/Paginas/cobertura.aspx>

2. The antenna adjusting

To receive the DTT signal can still use the conventional UHF antenna, individually or collectively, which had been using for analogue terrestrial television. However, it is necessary to make a number of adjustments to their facility, which must be performed by an installer registered telecommunications.

The modifications can depend on the current antenna. Usually all analog antennas consist of installing signal amplifier modules for DTT frequencies.

3. DTT receiving equipment having

Digital signal is permitted to receive at home by using some device connected directly to your TV (STB), or through a television with an integrated receiver.

Nevertheless there is some public that needs alternative solution in order to receive DTT signal. The additional required which is satellite systems, known in Spain as TDT SAT, is estimated to reach around 1.5% of the population that is located in scattered and isolated areas of the territory and whose coverage by terrestrial television transmitters is a disproportionate.

A.3. DTT channels in Spanish TV

Current location of Spanish television operators in the available multiplexers:²

Red of DTT coverage in the country	Channel 67	Channel 68	Channel 69
RTVE	Sogecuatro	Telecinco	Antena 3
RTVE	Sogecuatro	Telecinco	Antena 3
RTVE	Sogecuatro	Telecinco	Antena 3
RTVE	La Sexta	NET TV	VEO TV
	La Sexta	NET TV	VEO TV
	La Sexta		

RGE2	MPE1	MPE2	MPE3
RTVE	Sogecuatro	Telecinco	Antena 3
RTVE	Sogecuatro	Telecinco	Antena 3
	La Sexta	NET TV	VEO TV
	La Sexta	NET TV	VEO TV
	La Sexta		

The offer national channels operators is as follow:

Televisión Española

- La 1: First TV channel of RTVE
- La 2: Second TV channel of RTVE
- 24 Horas: Thematic channel based on broadcast news and current affairs programs, in which currently provides coverage for national, international, business and sports, and others.
- Clan: Thematic channel aimed at children.
- Teledeporte: Thematic channel focused on information and sporting events.
- TVE-HD: Offer TVE HD for the highest quality output with various content of its programming: movies, series, sports, documentaries.

² Digital Television in Spain, Spanish Government website: <http://www.televisiondigital.es>

Antena 3 TV

- Antena 3: General TV channel from the news, magazines, film and fiction series.
- Neox: Channel aimed at young people, with children and youth series and entertainment programs.
- Nova: Channel leisure and lifestyle spaces where health, quality of life, cooking or travel, share space with soap operas and movies.
- Nitro: Channel of the male audience.
- Antena 3 HD: The channel offers the highest image quality programming Antena 3.

Telecinco

- Telecinco: Generalist channel between its programming highlights magazines and self-produced series with reality shows.
- La Siete: Thematic channel which provides coverage to news programs, reality shows, sports bulletins and class competitions.
- FDF: Thematic channel dedicated to fiction programs and successful series. The film also made an appearance in the program at noon.
- Boing: Channel aimed at children and teenagers.
- Telecinco HD: The channel offers the highest image quality programming Telecinco.

Sogecuatro

- Cuatro: General TV station with a varied program, focused primarily at young people, based on entertainment, humor, series, documentaries and information.
- Divinity: Channel to offer movies, series, soap operas and areas aimed mainly at women.
- Energy: Channel aimed at a primarily male, young and urban, with sports broadcasts, documentaries currently available films and foreign fiction series.
- Nueve: The channel broadcasts soap operas, reality shows and magazines female oriented public.
- Cuatro HD: The channel offers the highest picture quality Four programming.

La Sexta

- La Sexta: General TV channel, based mainly on humor and entertainment, is aimed at families.
- Xplora: documentaries, documentary-reality and documentary film form axes Xplora programming.
- La Sexta3: Thematic channel dedicated to movies, series and soap operas.
- La Sexta HD: The channel offers the highest image quality programming Sixth.
- GOL TV: pay football Canal.

Net TV

- Intereconomía TV: General TV channel content specialist economic, political, social and sports.
- Disney Channel: Channel-themed children's programming.
- MTV: series, reality shows and lots of music form the channel grid, oriented to young audiences.
- Paramount Channel: The channel offers movies of all genres including drama, comedy, action, thriller, animation, westerns, horror and timeless classics of film history.

Vevo

- Discovery Max: The channel broadcasts programming covering genres ranging from survival to entertainment kitchen, through the engine, the wild, the documentary-reality or crime, addressing a wide audience.
- AXN: Pay Channel specializes in action-adventure content. The channel offers American series and film for 24 hours a day.
- 13TV: General TV channel that offers programming spaces between their religious content, documentaries, movies, and series information.
- La Tienda en Casa: Canal which offers home sales over the phone and internet.