

Part A

**WDM based
Visible Light Communication
System**

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WDM based Visible Light Communication System

*A Thesis Submitted In Fulfillment of The
Requirements For The Degree of*

**Master of Technology
In
Wireless and Optical Communication
Engineering**



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DECLARATION

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List of Important Abbreviations

VLC	visible light communication
LED	light emitting diode
WDM	wavelength division multiplexing
DWDM	dense wavelength division multiplexing
LASER	light amplification by stimulated emission of radiation
OFDM	orthogonal frequency division multiplexing
QAM	quadrature amplitude modulation
PWM	pulse width modulation
YAG	yttrium aluminium garnet
DMT	discrete modulation technique
MIMO	multiple input multiple output
VCSEL	vertical cavity surface emitting laser
ISI	intersymbol interference
LOS	line of sight
Pre-FEC	pre forward error correction
BER	bit error rate
FET	field effect transistor

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Abstract

Visible light communication (VLC) is a wireless technology that uses visible light as a carrier to transmit the signal. LEDs are used as source and photo diodes are used as the detectors for VLC system. LED can be used as dual purpose one is lightening and another one is for transmission purpose. LEDs require low power for their operation and have very high switching speeds and preferable for communication as compare to radio frequency communication. In this communication is done through visible light. The higher bandwidth of the visible light is exploited for high speed data transmissions. Visible white light is the combination of three basic colors that are red, green and blue. These different colors are generated by using different color LEDs which are operated at different wavelengths according to their respective colors. These LEDs are operated by different data signals and then by using the wavelength division multiplexing (WDM) these optical modulated data signals are converted into a single optical multiplexed data stream. At receiver side, this optical data stream is divided into different colors or wavelengths by using color filters and then by using photo detectors and hence, their respective data are decoded. Due to WDM data is transmitted in parallel form so the higher data rate can be achieved. In this report, a WDM based VLC system is demonstrated on Opti-System software. The achievable data rate is upto 100 Mbps with the maximum bit error rate of 5.3×10^{-8} which is less than the pre-Foreword Error Correction limit i.e. 3.8×10^{-3} .

Key Words - Visible light communication, Wavelength division multiplexing, LED, LASER, Orthogonal frequency division multiplexing, Photo diode.

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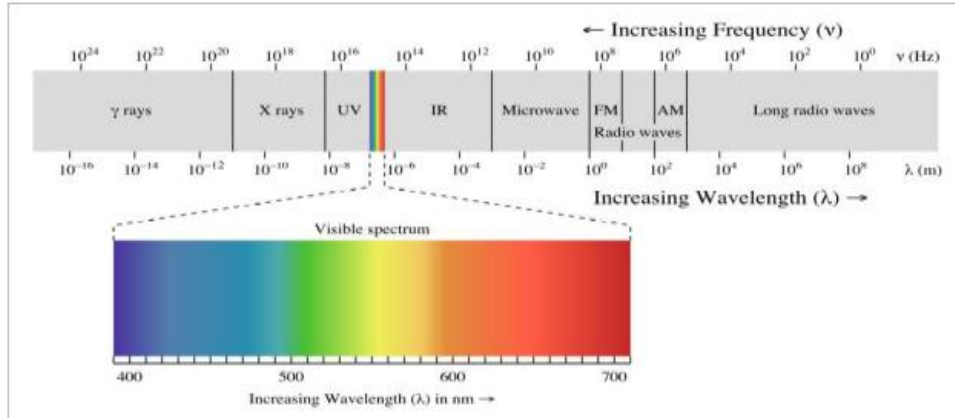
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CHAPTER 1

Introduction

As the technology is improving in wireless field, the traffic in the radio spectrum is increases rapidly and this results in a huge congestion. Most of the communication based applications and systems which are implemented without using any wire, use radio spectrum for communication purpose. The radio spectrum is in the range of 3 kHz to 3 THz. There is another wide band spectrum which can also be used for communication purpose that is visible light spectrum which is in the range of 428 THz to 750 THz or in terms of wavelength from 400 nm to 750 nm. There are numerous advantages of visible light spectrum over the radio spectrum i.e. it is license free broad spectrum, free from electromagnetic interference, less hazardous to human eyes, transmission speed is higher than radio waves, etc. Also the light can be enclosed in a small geographical area, so the privacy and security can also be improved [1]. Firstly, Alexander Graham Bell had transmitted the optical signal to his newly invented photo phone in 1880 [12]. The research on visible light spectrum (VLC) is initiated by VLC consortium, Japan [6] and the first

Figure 1.1: *visible light spectrum*

VLC standard is given by Institute of Electrical and Electronics Engineering (IEEE) as IEEE802.15.7 [2]. In visible light communication system, LEDs or LASERS are used as sources and photo diodes and photo transistors are used as detectors. The signal which is to be transmitted is modulated in the light form which is visible to human eyes and transmitted through free space. As the technology of LED is improving, fluorescent bulbs are replaced by LEDs in building infrastructure and vehicle lights that is much suitable infrastructure for VLC [11]. The data rate of the VLC system depends on some factors like modulation techniques used to modulate the information signal, switching speed of light source and responsibility of photo detector. Most commonly used light source in VLC is white LED which fulfills two requirements that are illumination and communication. There are two techniques to get the white light. The first one is by passing the output of blue LED through yellow phosphor i.e. YAG (Yellow Atrium Grating) but it has limited bandwidth up to 400 MHz [1] because of the presence of the remaining carriers when it turns ON from OFF. The second one is by combining the output of red, green and blue LEDs, this white light has high bandwidth and also provides the parallel transmission. Nowadays some special purpose

LEDs are also available like resonant cavity LED has higher bandwidth as compared to general purpose LED. LED and Laser have switching speed in the range of MHz and GHz that cannot be perceived by human eyes. The LED has broad spectral width but the Laser has narrow spectral width so it cannot be used for indoor illumination purpose and only used for communication. There are some another techniques to improve the data rate of the VLC system. By using red and green laser diodes at transmitter side and pre-amplifier and adaptive filtering at receiver side, data rate up to 500 Mbps can be achieved [7]. The combination of RGB luminary LED and discrete modulation technique(DMT) provide the data rate of 813 Mbps [9]. A high speed 680 nm laser diode with 600 micro-watt transmitted power and illumination of 250 lx can be used to generate the data rate of 2.5 Gbps [4]. Data rate of 3 Gbps can be achieved by using double optical diversity (DOD) technique in time and frequency, i.e. the transmission of a signal with its delayed version by multiplying with orthogonal frequencies simultaneously is DOD [2]. A quadrature amplitude modulation(QAM) with orthogonal frequency division multiplexing(OFDM) is more popular to increase the data rate in VLC system, e.g. when a laser diode is driven by a 4-QAM OFDM signal then the data rate of 10 Gbps can be achieved [5], a 12.5 Gbps data rate can be achieved by using vertical cavity surface emitting laser(VCSEL) diode with 16-QAM OFDM signal and if eight channels similar to this are combined and form a MIMO system then it is possible to get 100 Gbps data rate[13].

Q factor which is a measure of goodness of a system and can be given by the ratio of power stored to the power dissipated in the circuit reactance and resistance [14].

$$Q = \frac{P_{stored}}{P_{dissipated}}$$

Higher value of Q factor corresponds to narrower bandwidth. This relation is given by,

$$Q = \frac{f_c}{BW}$$

And we also know that

$$f_c = \frac{c}{\lambda}$$

Hence, we can write,

$$Q = \frac{c}{BW \times \lambda}$$

Q factor characterizes the signal based on signal to noise ratio. In practical system, it is determined by the difference between signal level and noise level.

Distance of the signal level from the noise level can be determined from,

$$DSNR = 10 \times \log_{10} \frac{P_i}{N_i} + 10 \times \log_{10} \frac{B_m}{B_r}$$

$P_i = \text{average power of the optical signal [W]}$

$N_i = \text{average power of the noise signal [W]}$

$B_m = \text{spectral width [nm]}$

$B_r = \text{reference BW}$

VLC design based on WDM

Wavelength division multiplexing is a technique to transmit more than one data stream simultaneously through a single channel. In this, the complete channel is divided into different slots according to different wavelengths and each source of signal is allocated a separate wavelength slot. All signals travel simultaneously on the same channel and at the receiver side the data streams are distinguished and forwarded to the respective destinations. In VLC system, the channel has the spectrum of 400 nm to 750 nm, i.e. an optical domain. The light of different wavelengths can be generated by using different color sources. Every color has different wavelengths. If we consider white light then the purpose of indoor lighting as well as communication can be fulfilled and it contains the complete visible spectrum. If the output of red, green and blue LED is combined then it generates low quality white light but the combination of red, orange, yellow, green, violet, blue and indigo results in good quality white light and the channel utilization is also increased. As the spectral width of LED is broad, the separation between

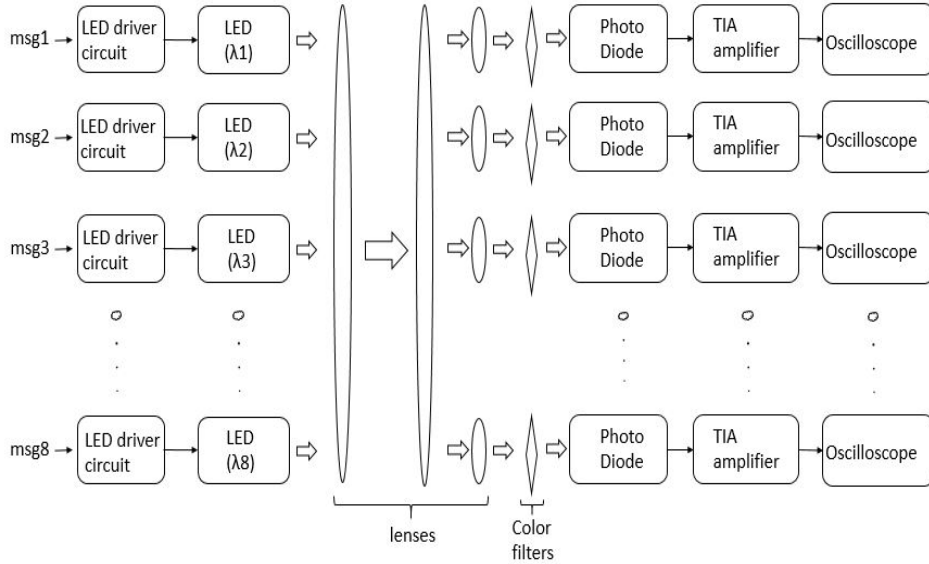


Figure 2.1: WDM based VLC system

the channels needs to be maintained in order to prevent from inter symbol interference (ISI). But if pointed lasers are used which have very narrow spectral width and the channel spacing is around 1-2 nm then the channel can be divide into more slots and higher number of data streams can be transmitted simultaneously. This is referred as dense wavelength division multiplexing (DWDM). Due to this, the data rate is also enhanced because of simultaneous transmission of different data signals and higher switching speed of laser.

Here, a system shown in figure 2.1, is demonstrated on Opti-System software. In this different signals are generated in form of square wave. These signals modulate the light by switching the states of eight different color LEDs. In this particular work, the intensity modulation technique is used i.e. the intensity of output light is varying according to the amplitude of applied input signal. The output light from these different color LEDs is

combined by using passive optical devices like lenses, resulting in white light. This is referred as optical wavelength division multiplexing or color division multiplexing. This multiplexed signal is transmitted through free space. In this case the transmission distance is limited and it requires LOS path but the achievable data rate is very high. Here, the system is simulated for the distance of 1500 meters, suitable for indoor environment. At receiver side by using different color filters each color light is separated from the white light. These color filters are passive optical components and act as the band pass filter for their respective color wavelengths. Then by using different photo detectors for each color signal the transmitted light is detected and converted into electrical domain and compared with the pre-FEC limit. As the achievable BER is less than the FEC limit so the system is acceptable.

This system can be easily developed on hardware. Different color LEDs are driven individually by using different data signals. According to their wavelengths different color filters and photo diodes are used for each LED. To increase the distance between transmitter and receiver optical power level has to be increased which can be achieved by using high power LEDs, special LEDs(Resonant Cavity coupled LED) or LED arrays.

The achievable data rate for this system is 100 Mbps with BER less than the FEC limits i.e. 3.8×10^{-3} for the distance which is varied from 100 meters to 1700 meters. The spectrum of white light containing the all color wavelengths is as shown in figure 2.2.

Resulting Q-factor plot for different colors with respect to transmission distances is shown in figure 2.3. It shows that as the transmission distance increases the BER increases. The best BER plot is of 530 nm wavelength of green color.

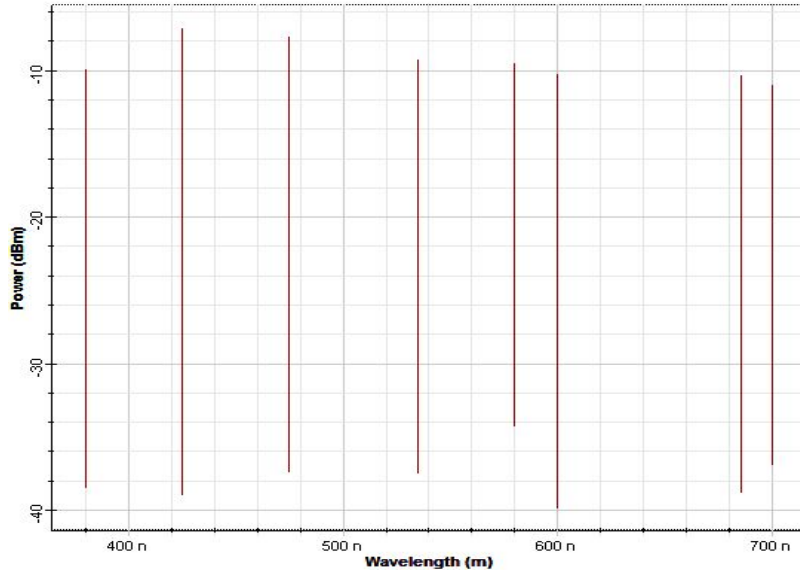


Figure 2.2: *White light spectrum*

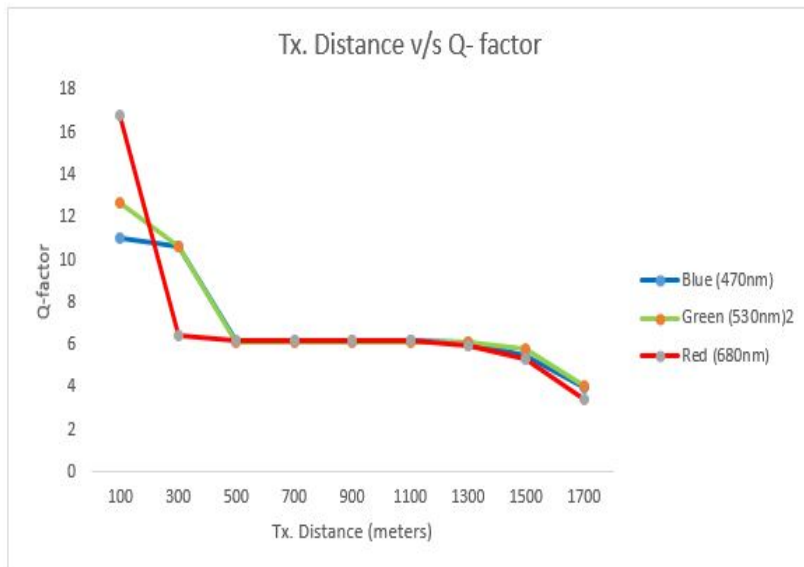


Figure 2.3: *Plot between transmission distance and Q factor*

LED driver circuits

3.1 Use a driver circuit for LED to drawing-out the remaining carriers

LED is more preferable as light source of a visible light communications as compare to laser because of its low cost and availability. The modulating speed which can be achieved by using the LED is around 10's of Mbps. The white LED fabricate with the a phosphor that is responsible for this limited bandwidth, as the remaining carriers in the junction have large discharge time constant during the transition of LED from on to off. To overcome this problem a drawing-out circuit is used. This circuit reduces the fall time of an LED by by using an FET switch which short both the terminals of LED. The output responce is improved by dropping out the driving voltage to zero. A blue LED and yellow phosphor is used in fabrication of white LED. To extract the information emitted by the blue LED the blue filter is used

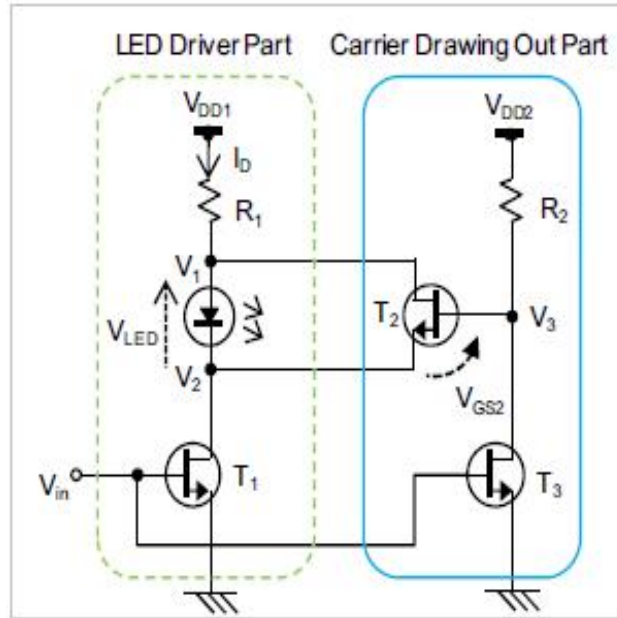


Figure 3.1: LED driver with carrier drawing-out circuit

at the receiver side. Blue LED is almost similar to the white LED.

For drive the LED a common-source circuit is used and the used transistor is denoted by T1. Transistor T3 is used to control the T2 which receive the inverted signal as compare to T1. When input signal is applied then the T1 will on and T3 is also on which makes the T2 off and the LED will glow. When the input signal is not applied or 0 is applied at input then the T1 and T3 will off so the LED will off. T3 makes T2 on which short the terminals of LED and drawing out the remaining carriers and the fall time is reduced. Circuit is shown in figure 3.1 and its PCD layout which is prepared on Express PCB is shown in figure 3.2.

By using high speed transistors at place of T1, T2 and T3 the switching speed of LED can be increased, then the overall data rate is improved. Some high speed transistors are 2N2222A, 2N2219A, 2N2269A etc. Layout of this driver circuit which is prepared on PCB Wizard is shown in figure 3.2.

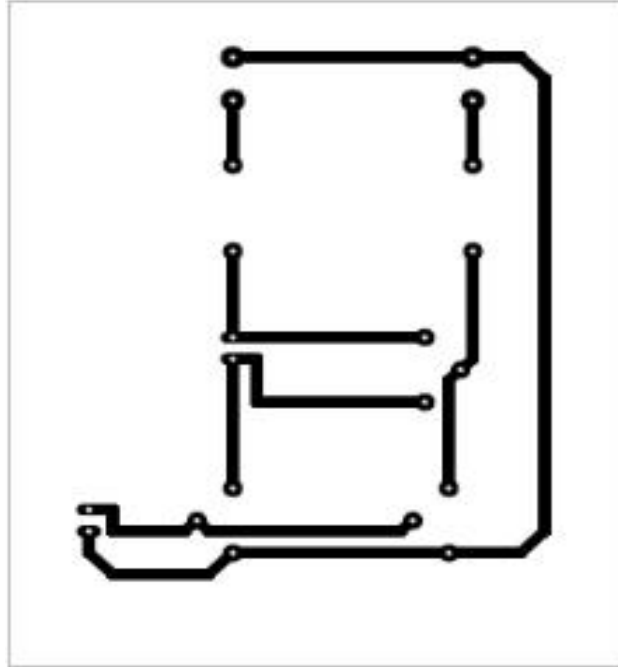


Figure 3.2: *Layout of drawing out carrier circuit*

3.2 LM3401 Hysteretic PFET Controller for High Power LED Drive

LM3401 is used as the constant current source for high power LEDs. It is act as the switching controller. It also used for in step down regulators to drive the external switches. For high power LEDs that are more than 1A, external current sensing resistors are used to adjust the output current. It have many benefits like improve the accuracy and efficiency of the circuit, dual side hysteresis, less propagation delay etc. To overcome the problem of over current and short circuit failure it provides the cycle by cycle current. Its switching speed is 1.5 MHz and also provides the adjustable hysteresis.

Layout prepared on Express PCB is shown in figure 3.4.

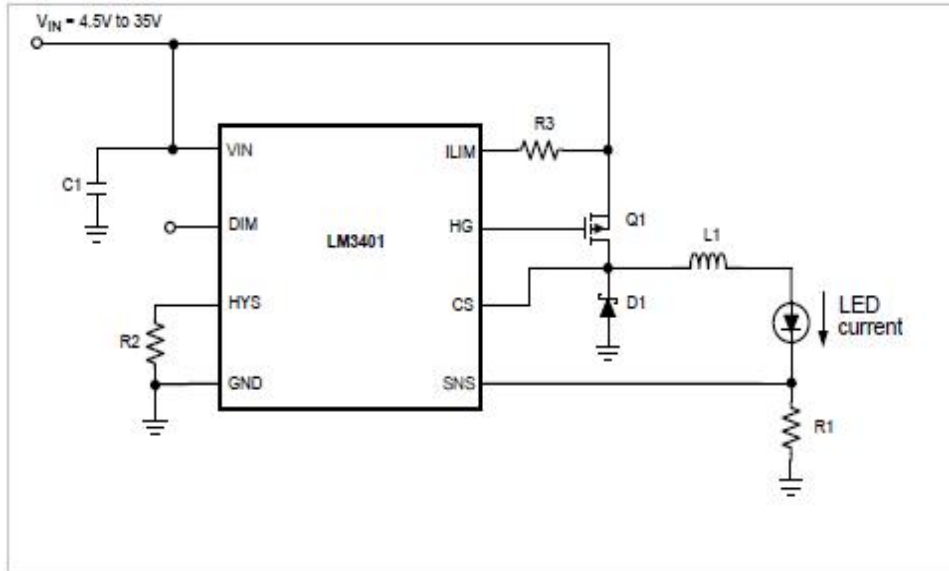


Figure 3.3: LED driver circuit using LM 3401

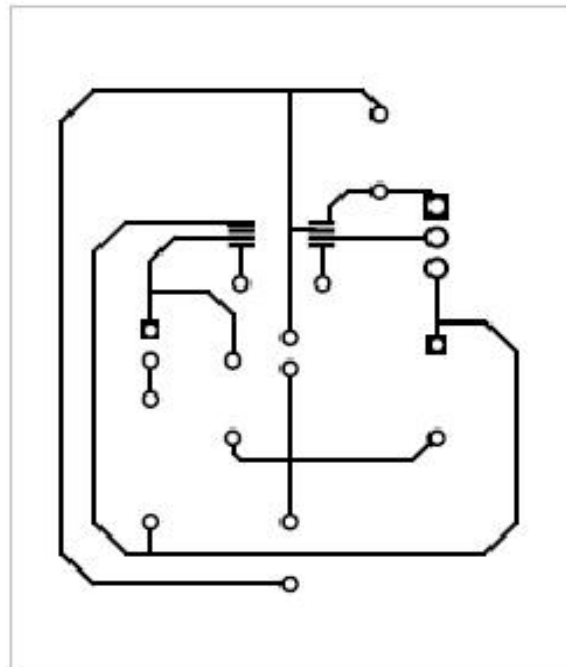


Figure 3.4: layout of LED driver circuit using LM 3401

3.3 TPS61165 High-Brightness, White LED Driver in WSON and SOT 23 Packages

It is a integrated switch FET rated with 40 V and also known as a boost converter which is used to derive a series combination of LEDs. This boost converter operates on the fixed frequency of 1.2 MHz and it requires 1.2 A current to generates the light with high brightness. It also require an external sensor resistor and the feedback voltage of 200mV. CTRL pin is an one wire digital interface used to control the LED current. To determine the feedback reference voltage and duty cycle the CTRL pin operate with the pulse width modulated signal. TPS61165 device does not burst the LED current in either digital or PWM mode. So on the output capacitor it does not generate the noises of audio frequency. It provides the integrated feature of open LED protection. The driver circuit is shown in figure 3.5 and its layout is prepared on Express PCB is shown in figure 3.6.

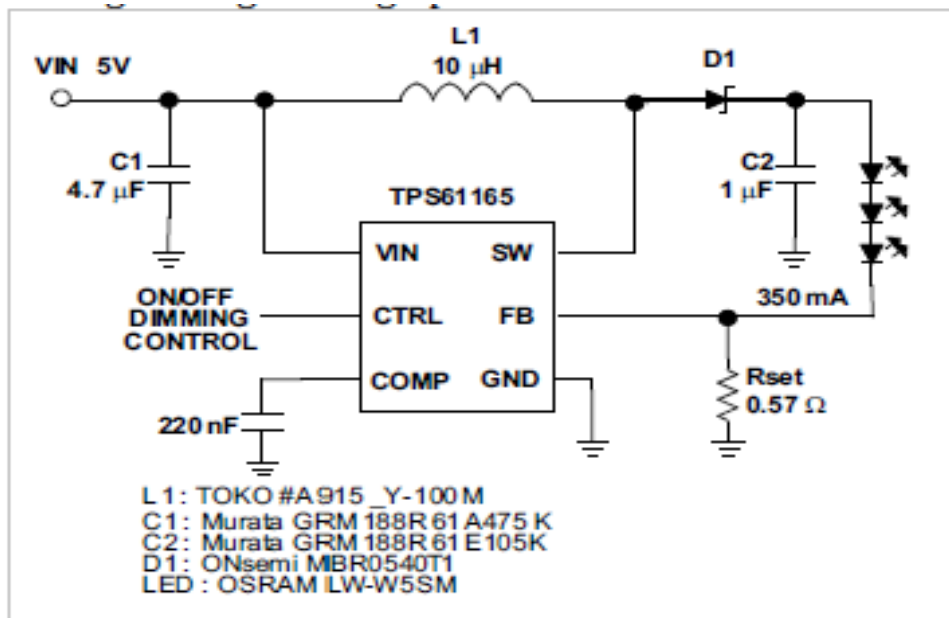


Figure 3.5: LED driver circuit using TPS61165

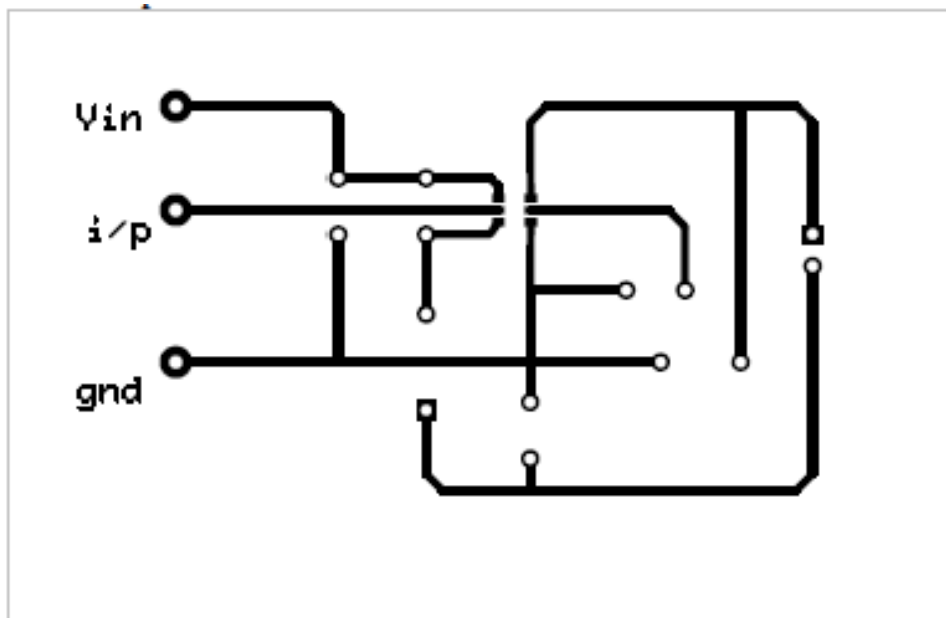


Figure 3.6: Layout of LED driver circuit using TPS61165

Photo detector circuits

4.1 One Stage Photo Diode Driver Circuit

In this circuit a single operational amplifier is used along with the photo detector to detect the transmitted light signal from the LED source. The circuit is shown in figure 4.1 where as its layout in figure 4.2.

The following specifications should be considered during the establishment of circuit.

4.1.1 Photo diode bias

For highest DC accuracy: photo diode can be works in two modes. When the bias voltage is 0 V then it acts as the photovoltaic mode other wise works in photo conductive mode. To achieve the highest DC accuracy it should be operates in photovoltaic mode, so there is no dark current and it minimize the offset at output. The noise generated in the photovoltaic mode is the

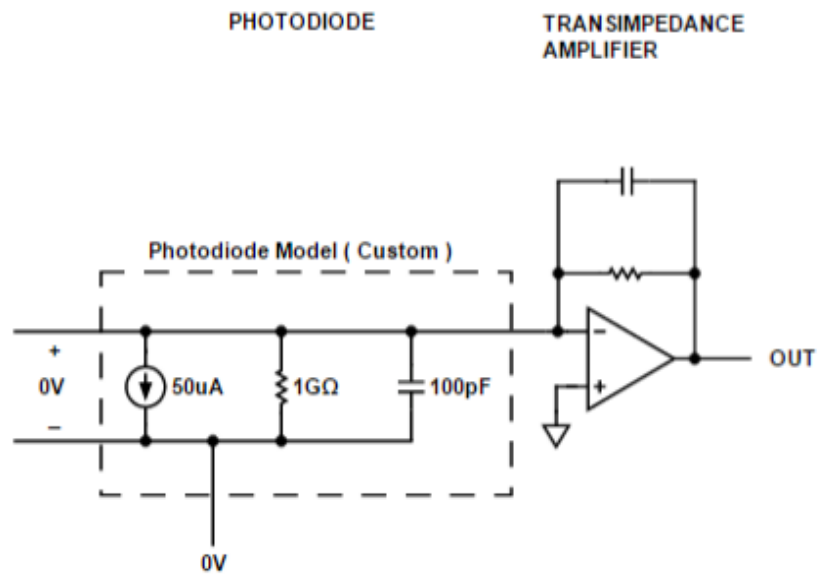


Figure 4.1: One Stage Photo Diode Driver Circuit

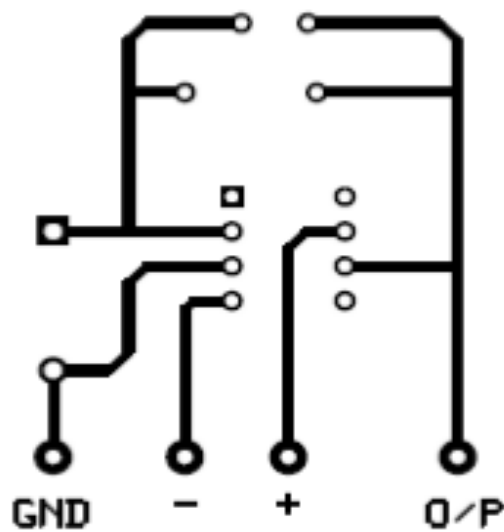


Figure 4.2: Layout of One Stage Photo Diode Driver Circuit

thermal noise which is produced because of its shunt resistance. The shunt resistance is also known as the linear region of the photo diode but it also produce the transition capacitance which reduces its speed.

For highest bandwidth: To achieve the high bandwidth it should be operate in the photo conductive mode in which the bias voltage greater than zero is applied. As the PD is reverse biased its depletion layer increase as increase in the applied bias voltage which increase the width of depletion layer and at result the capacitance decreases, so the high bandwidth is achieved. But it produces high-noise, non-linearity etc.

Circuit biasing is depends on the design of circuit, it may positive or negative, but the photo diode should be remain in reverse bias and its other end is connected to virtual ground at inverting input of op-amp. In single stage, the polarity of the output voltage is inverse of the photodiode bias. For example, if the biasing voltage of photodiode is positive, then the output voltage of the circuit will be negative.

4.1.2 Photodiode Specs

The bandwidth of the photo diode is effected by the the junction capacitance which is depends on the junction area and bias voltage of photo diode. The dark current is the current that flows through the photo diode when there is no light is incident on the photo diode. But there is also a non zero dark current present at non zero reverse bias voltage that is at the reference voltage. This reference voltage have the relation with dark current as,

$$R_{sh} = \frac{V_R}{I_{dark}}$$

$V_R = \textit{Reference_voltage}$

$R_{sh} = \textit{Shunt_resistance}$

$I_{dark} = \textit{Dark_current}$

The maximum current of the photodiode is dependent on the photosensitivity of the photodiode, and the intensity of the light incident on it.

4.1.3 Output Signal

The output voltage of the circuit varies according to the photo diode current that depends on the incident light on photo diode. The output voltage is affected by the feedback resistance which depends on the number of amplifier stages used, as

- *OneStage* : $Rf = \frac{\textit{PeakVoltage}}{\textit{photodiodecurrent}}$
- *TwoStage* : $Rf < \frac{\textit{PeakVoltage}}{\textit{photodiodecurrent}}$

The output voltage changes the value of feedback resistance which also affects the bandwidth and the peak current of the circuit. The gain-bandwidth product of the op-amp affects the speed of the photo diode circuit.

4.2 Two Stage Photo Diode Driver Circuit

In this circuit there are two operational amplifiers are used to bias the photo diode. This have many advantages, like

- It reduces the noise by including extra filtering in the second stage.
- If the positive biasing is used then the output of one stage is negative that can not be used directly in the ADC so by using the second stage

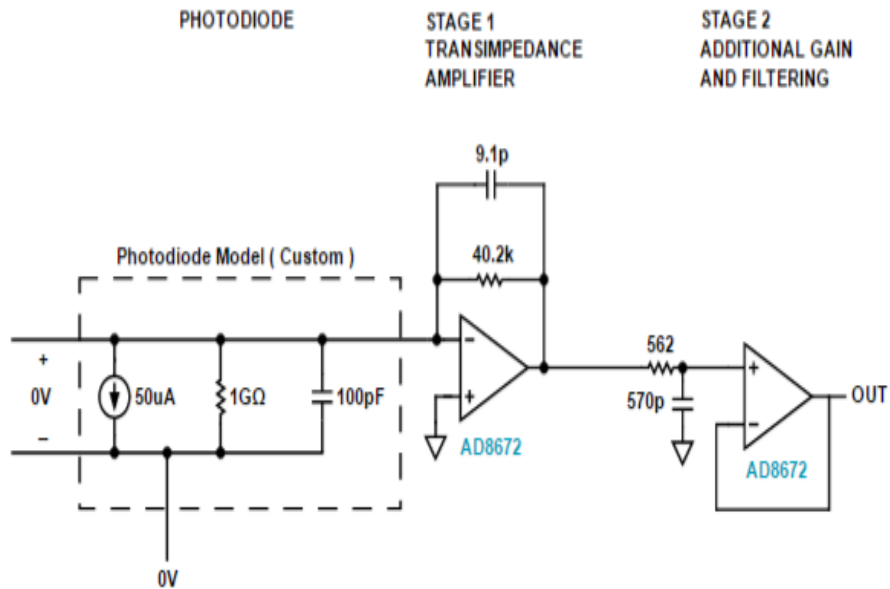


Figure 4.3: *Two Stage Photo Diode Driver Circuit*

this is converted in to the positive output that is directly fed to the ADC.

- two stage design allows for higher gains because gain is distributed across two stages and also provide the higher speeds than one stage.
- Op-amp can be choose from a wider range.

The circuit for the two stage driver circuit for photo diode is shown in figure 4.3 and its layout in figure 4.4.

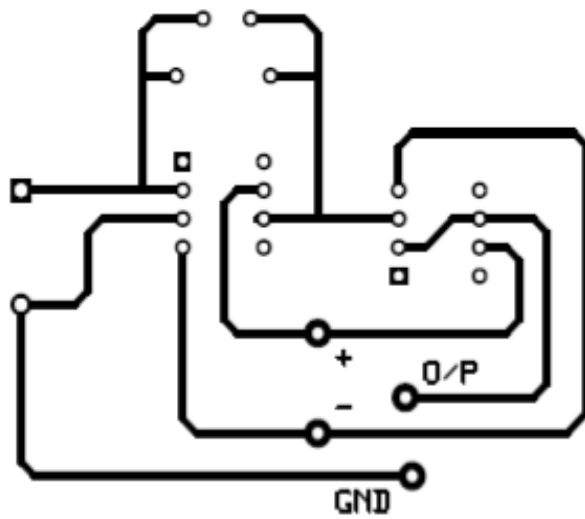


Figure 4.4: *Layout of Two Stage Photo Diode Driver Circuit*

CHAPTER 5

Conclusion

VLC offers the potential of very high data rate in wireless communication as compare to RF wireless approach. The bandwidth offered is in the terahertz range. By drawing out remaining carriers fall time of LED is five times lower and the sensitivity is doubled. If GaN based LED is used with the OFDM signal data rate of 3Gbps can be obtained and the link margin also improve by using the array of small photo detectors. Combining wavelengths of red, green and blue to achieve white light gives a large bandwidth as compared to phosphor based white LED. Optical diversity scheme gives the data rate up to 3Gbps.

This system is demonstrated for transmission distance of 1500 meters and we are getting the data rate of 100 Mbps with the maximum bit error rate of 5.3×10^{-8} , which is very low as compare to pre forward error correction limit. The optical power level can be increased by using the LED arrays so the transmission distance can also be increased. It also can be increased by using pointed laser diodes which provide the high intensity monochromatic

light, which also increases the data rate. The data rate can also be increased by improving modulation techniques. One of the most suitable technique for VLC is OFDM with QAM modulation. As the 4-QAM OFDM modulation technique provides the data rate of 10Gbps, by using 16, 32, 64, 128 or 256 - QAM OFDM signal it can be further increased. By applying the WDM multiplexing with higher QAM OFDM signal data rate of more than 100Gbps can be achieved.

In future work the data rate can be increased by using the advanced LEDs like resonant cavity coupled LED. If the LEDs in WDM system are replaced by the laser diodes then more channels can be generated in a limited band of frequency that can be suitable for multiple data transmission so the data rate will be increase.

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Part B

**Samsung Digital TV
Development**

Anil Kumar Jangir

Samsung Digital TV Development

*A Thesis Submitted In Fulfillment of The
Requirements For The Degree of*

**Master of Technology
In
Wireless and Optical Communication
Engineering**



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DECLARATION

I certify that

1. the work contained in this thesis is original and has been done by me under the guidance of my supervisor.
2. the work has not been submitted to any other Institute for any degree or diploma.
3. I have followed the guidelines provided by the Institute in preparing the thesis.
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List of Important Abbreviations

EFL	enlightment foundation library
SDH	synchronous digital hierarchy
DTV	digital television
DUMA	detect unintended memory access
DML	dynamic memory leak
CCIR	international radio consultative committee
NTSC	national television system committee
PAL	phase alteration by line
SECAM	sequential couleurs a memoire
CCTV	closed circuit television
VHF	very high frequency
UHF	ultra high frequency
ATS	applications technology satellite
INSAT	indian national satellite system
PCM	pulse code modulation
DVB	digital video broadcasting
ATSC	advance television system committee
ISDB	integrated services digital broadcast
DTMB	digital terrestrial multimedia broadcasting
DMB	digital multimedia broadcasting
LED	light emitting diode
OLED	organic light emitting diode
LCD	liquid crystal display
HD	high definition
FHD	full high definition
QFHD	quad full high definition

UHD	ultra high definition
VCR	video cassette recorder
VCD	video compact disc
DVD	digital versatile disc
USB	universal system bus
HBB TV	hybride TV
RF	radio frequency
ETSI	European telecommunications standards institute
CRT	cathod ray tube
GaN	gallium nitride
RGB LED	red green blue LED
HTML	hypertext markup language
API	application programming interface
W3C	world wide web consortium
URI	uniform resource identifier
MIME	multi-purpose internet mail extensions
LAN	local area network
HTTP	hyper text transfer protocol
NFC	near field communication
GPU	graphics processing unit
3D	three-dimensional
2D	two-dimensional
LBS	location based service
GPS	global positioning system
WPS	wi-fi positioning system
CDMA	code division multiplexing
UMTS	universal mobile telecommunication system
SIM	subscriber identification module
URI	uniform resources identifiers
SDK	software development kit
IDE	integrated development environment
RAM	random access memory
UI	user interface
GUI	Graphical user interface
EDC	electronic data capture
DAG	directed acyclic graphs
OTN	over the network
LFD TV	large format display TV
DVI	digital visual interface

DP	display picture
VGA	video graphics array
HDMI	high definition multimedia interface
CEC	consumer electronic control
MDC	multi display control
UART	universal asynchronous receiver-transmitter
IP	internet protocol
ATV	analog TV
PnP	plug and play

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Abstract

The digital TV comes into picture after second world war. This is the complete replacement of analog TV into digital TV in the form its hardware design and its broadcasting standards. The broadcasting standards based on the region (according to country wise) and their broadcasting frequency and providing facilities varies standard to standard. Then there is a revolution in technology that replaces the picture tube by the solid state semiconductor and the width of the TV is reduces, also the functionality improves as it provide the facility of internet in TV itself i.e. *smart TV*. Smart TV requires a software plateform to drive its functions. Samsung smart TV uses the tizen operating system as the software platform. It is very user friendly and provide more stability as compare to other platforms because it developed on the linux platform. Tizen is three layer software platform that provides the different libraries like EFL, SDH etc. which are user friendly and provides the all resources to develop an application for this. Tizen architecture is explained in chapter 3 and ite framework for TV is in chapter 4.

The software that is used to drive the Samsung DTV is treated as the images, which is mainly three types: Debug, Release and Performance their importance is discussed in detail in chapter 5.

As the developer write the code for any software that is provided to the integrators by properly arranged it then a quick build software tool is used to integrate this code and generate the binary for user interface.

Image is an interface between the user and TV, here the user may be customers or integrator. In *Samsung Electronics India Private Limited, Delhi*, we works as

integrators, to integrate the code and provides the required changes to developer, so they can modify their code to remove the bugs.

Also the memory memory processing plays a main role in any software platform that should be in a proper manner. The issues related to memory like segmentation faults are captured by using the software like DUMA and DML that are explained in chapter 6.

Key Words - Samsung DTV, Image build, DUMA, DML, Resolution, Broadcasting standard.

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CHAPTER 1

Introduction

Television is stands for vision from distance. The picture information is capture and converted into electrical signal and transmitted to the destination, this functionality is performed with the help of camera which capture the information in form of different shades of light. Then, at receiver side these information which is in the form of electrical signal is converted back into the picture information with the help of television. Now-a-days, the transmission of signal can be in any form like it may be in electrical form transmitted via the twisted pair copper cable or via coaxial cable which is generally treated as cableTVs, microwaves which is tranmitted via free space generally used in dishTVs. It is also possible to send the TV signal in form of optical signal. The concept of camera and TV is based on the the principle of electro-optic relation or photo-sensitivity.

First TV is invented by the scientist *J.L. Baird* in UK and *C.F. Jenkins* in USA in 1927, they uses mechanical scanning technique on rotating disc to display the information. Then the cathode ray tube is invented by *V.K.*

Zworykin in the USA which is the replacement of mechanical scanning technique into electromagnetic scanning technique. Then this is employed with supportive circuitary as beam deflection, video amplification etc. which is explained in chapter-2. Then the broadcasting for television is started and it covers the whole world after the second world war. In starting days the broadcasting for whole world based on a same standard was not possible so mainly three types of standards become popular for monochrome transmission or black and white transmission those are 525 line American system, 625 lines European system and 819 lines French system. These are based on the different countries and transmission is according to their requirement. Then the broadcasting committee comes into picture named as International Radio Consultative Committee (CCIR) and these standards are modified and the 625 lines standard became a common standard. These three standards also developed same as for color television also. In 1953 the USA adopted the original color system as National Television System Committee (NTSC) system which is compatible with 525 line system. Later two more systems also invented as PAL and SECAM which was the part of NTSC system. Later the NTSC system is also followed by Japan and Canada. The Phase Alteration by Line (PAL) system is based on 625 lines system and followed by most of the European countries as Germany, Australia, Spain, Iran, UK and west and south Asia including India. The Sequential Couleures a memoire (SECAM) is based on the 819 lines system and adupted by France, USSR, German Democratic Republic, Hungary, some other East European countries and Algeria.[1]

Everyone is aware to the television these days, it has many applications in different fields like education, entertainment, mass communication, newscast, political committees, advertisement, guidance at public places, security

purpose etc. A special equipment called as closed circuit television (CCTV) is used to provide the camera information on the cable circuits and forward to the particular destination. Where the human being can not be available all the time it is used to provide monitoring of those places, it may be for security point of view, in surgical operations for group demonstration, in the dangerous industries where the availability of human being is not safe but monitoring is required etc.

There may be a live broadcasting like cricket match and may be a recorded broadcasting like any movie is done by the standards according to the satisfaction of consumer. These broadcasting is divided in the form of channels, for each channel the average bandwidth of 7 MHz is allotted as 8 MHz in European system, 6 MHz in American system where as 14 MHz in French system. Initially the TV broadcasting is done only in very high frequency (VHF) band i.e. from 41 to 68 MHz and 174 to 230 MHz, then the ultra high frequency (UHF) band i.e. from 470 to 890 MHz is also used in TV broadcasting. VHF and UHF band require the direct line of sight transmission that is limited for the small geographical area. The alternate solution for this is either use the coaxial cable or the satellite for broadcasting. These days many satellites are used for TV broadcasting purpose those cover the entire geographical area, e.g. ATS, INSAT etc.[1]

As the TV signal contains both video and audio signal so there transmission should be in synchronise manner. For video transmission the amplitude modulation is used which is now replaced by the pulse code modulation (PCM) and the sound signal is transmitted using frequency modulation to prevent the interference between these.

The transmission of the TV signal is explained below in figure 1. The video is the combination of pictures displaying at very fast rate so that the

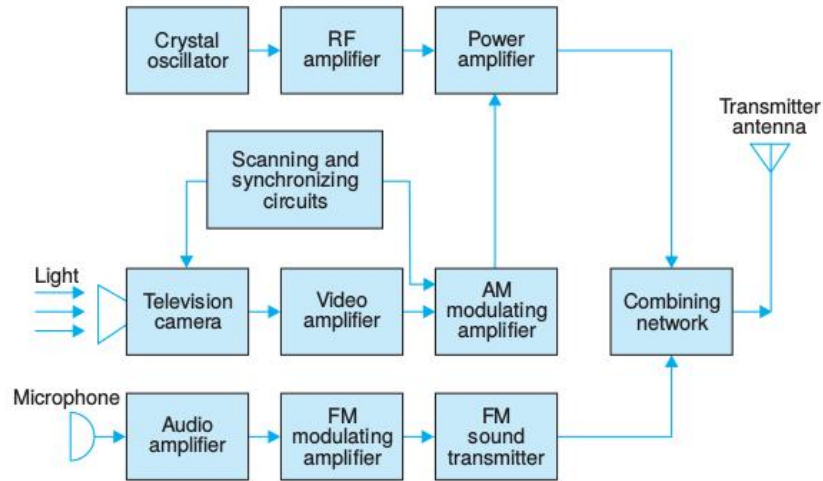


Figure 1.1: *Basic monochrome television transmitter*[1]

human eye could see only the smooth variation of picture in a video. As a picture is contains by different levels of brightness, which have infinite picture elements. These information is first converted into electrical form and then transmit via electrical medium, called as scanning and converted back into the picture elements at receiver side. In picture transmission the camera is used which have a camera picture tube used to collect the picture information and converted it into the corresponding electrical form used for further processing. The amplitude of resultant electrical signal is changes according to the variations in brightness of picture. The camera picture tube contains glass plate with inner transparent conductive coating, lens for focus the optical image of scene on this plate, so the conductivity of the plate is varies according to the intensity of picture elements. An electron beam is used to collect the information projected at the glass plate, and interact with the different resistance of the photoconducting plate and a flow of current takes place which is directly proportional to the picture element information. This information is the function of both time and space. This

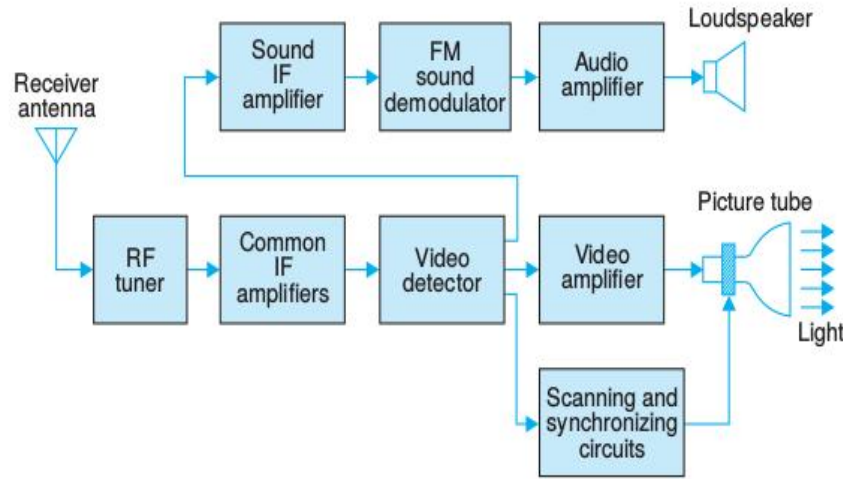


Figure 1.2: *Basic monochrome television receiver*[1]

resultant electrical signal is then amplified by a video amplifier and then it used to modulate the amplitude of carrier signal which is synchronized with the camera tube. The signal frequency which is amplitude modulated is in the range of radio frequency which will be actually transmitted to the destination. The audio signal which is also a part of video signal is treated separately and frequency modulated and then both video and audio signals are combined and transmitted to the free space using the transmitting antenna.

At receiver side or TV side (shown in figure 2), the signal is received by using an antenna along with the RF amplifier which is a tuned amplifier select only the desired frequency signal on which it is tuned, then a multistage intermediate amplifier amplify signal to the desired state and then video detector will separate the video, sound and synchronised signal and then treat them individually. video signal is forwarded to the picture tube (explained in chapter 2) which converts it from electrical form to picture form. The sound signal is separately demodulate and forward to the loud speaker. The synchronization between the camera tube and picture tube is an essen-

tail requirement, to fulfill it some synchronization bits are transmitted during the scanning process.[1]

As the technology improve the analog modulation technique is replaced by the digital technique, amplitude modulation is converted into pulse code modulation and the digital base TV is called as **digital television (DTV)** in which both audio and video signal are handled in digital form. The main improvement in DTV as compare to analog TV is it can transmit more than one program on the same channel bandwidth required in analog TV to transmit one channel. As DTV is replacement of analog TV so the transmission standards for DTV are also different as[2]:

1. **DVB:** DVB stands for Digital Video Broadcast, which uses coded orthogonal frequency division multiplexing technique with 16/64 - QAM (quadrature amplitude modulation) and provide the hierarchical transmission. This system is adopted by around 120 countries in Europe, Africa and middle east like Singapore, Australia, New Zealand and European countries. DVB transmission is in UHF band i.e. 470-862 MHz band and provides 7-8 MHz bandwidth per channel.
2. **ATSC:** ATSC is short form of Advanced Television System Committee, which use the eight level vestigial sideband modulation (VSB) technique with 6MHz frequency bandwidth for each channel. Freed spectrum for TV broadcast is decided by the Federal Communication Committee is 108 MHz ranging from 698 MHz to 806 MHz. It is adopted by the countries United States, Canada, Mexico, South Korea, Dominican Republic and Honduras.
3. **ISDB:** ISDB mean Integrated Services Digital Broadcasting that is suitable for both the fixed and portable receivers. It uses orthogo-

nal frequency division multiplexing and two-dimensional interleaving technique with per channel bandwidth of 6/7/8 MHz. As DVB it also supports the hierarchical transmissions of up to three layers. It also supports the MPEG-2 videos and advance audio coding techniques. This is adopted by Japan and Philippines. Most of the South America and Portuguese countries also adopt its higher versions.

4. **DTMB:** DTMB stands for Digital Terrestrial Multimedia Broadcast, it uses time domain synchronous (TDS) OFDM technique. For the purpose of guard interval of OFDM block and training symbols it uses a pseudorandom signal frame. This standard is adopted in China.
5. **DMB:** DMB means Digital Multimedia Broadcasting. It is a radio transmission technology which is developed in South Korea.

As the technology improves the analog TV is replaced by digital TV broadcasting, same way the hardware of the TV is also improve. Initially the mechanical TV was invented that is replaced by electronics monochromatic TV (black and white TV) and then the monochromatic pixels are replaced by the color pixels and the color TV comes in to picture then the replacement of picture tube by semiconductor devices reduces the width of TV as in plasma and LCD that are explained in chapter 2. After that the LED TV and its different variants comes into picture like OLED and the thickness of TV is reduces to very extent and the clarity is also improve in the form of resolution. Resolution stands for how many pixels present in one module, here the pixels are the elements of the phosphore screen of TV. In LED TV one pixel means the combinations of two red, one green and one blue elements which are arranged in alternate manners. Resolution depends upon the distance between the pixels that is called as pitch scaled in millimeter (mm). Actually

Table 1.1: Resolution Standards

NAME	COLUMN WIDHT	COLUMN HEIGHT	COMMON MEDIA
480p/Standard	640/720	480	DVD/Standard Channel
720p / HD	1280	720	HD Channels
1080p / FHD	1920	1920	Blue Ray Disk
2k FHD	2048	1080	–
4k QFHD	3840	3840	–
4k UHD	4096	2160	–

the resolution is inversally proportional to the pitch. The resolution defines the level of brightness which is measured in terms of *cadmiuim per square meter* or *nit*. Resolution mainly depends on three factors, those are,[3]

- Size of the TV
- Distance between person and TV
- Quality of footage dislay on TV

As the 3840×2160 pixels is quad full high defination and also treated as 4k, but it not accurate 4k. The actual 4k defination is 4096×2160 .

$$Total_pixels = 3840 \times 2160 = 8.29millionpixels$$

$$Pixels_inQFHD = 4 \times 1920 \times 1080 = 8.29millionpixels$$

As the technology advanced the features of TV also improves. Initialy TV can display only the broadcasting channels but after some time it also support to display the stored contents on VCR, DVD using there respective players. Then some other features also introduce in it like it contains games,

support USB drives etc. Now-a-days the TV can support the internet facilities also those are called as **Smart TV**. Smart TV means connected TV that deals with both the broadcasting and broadband. To connect the TV with broadband different methods can be used like direct, wired ethernet connection, build in Wi-Fi to connect to home network etc. Most of the smart TVs supports Netflix, Hulu, Amazon instant video, Youtube, Pandora etc. It also compatible with the TV broadcasting via cable and satellite, and support Facebook, blue ray disk player, bluetooth connectivity, bluetooth speakers, wi-fi direct, web browser, games etc. These TVs have different operating systems and interfacing. The main software platforms that are required to operate above functionalities are :

- Ruku
- Android
- Tizen

Samsung DTV is worked on the Tizen platform which is explained in chapter 3. These also provides a optimal features of video camera accessories and provides video calling services. One advance type of TV also available that is **HBB TV**, stands for hybrid broadcast broadband. which support both broadband and broadcast at the same time. It provide three features:

- RF + RF features
- RF + Internet features
- Internet features

In HBB TV all the features including internet are provided by the RF service provider. HBB TV group work with DVB project and open IPTV forum standard and develop the HBB TV, which is standardized by ETSI, pioneered by

public service broadcasters in Germany and France. It provides the services like teletext, catch-up services, video on demand, EPG, interactive advertising, personalization, voting, games, social networking and other multimedia services.[4]

History of Electronics

Television

2.1 Black and White TV

The first electronic TV is black and white also called as monochromatic TV because it display the picture in different shades of gray color. The heart of this TV is picture tube as shown in figure 2.1 which is large in size. It consists of an glass envelop including electronic gun assembly, a pair of deflecting coils mounted on its neck, and a fluroscnt screen inside it. When the electrical signal applied on electron gun assembly then it produces a electron beam of high intensity which is moving towards the screen and when it strikes to the screen consisting of phosphor emission of light takes place. Accelerating anode and focusing anode make the beam more convergent and then the deflecting coil controls the position of beam on screen. The deflection of beam on screen should be synchronize with the rate of scan the target by

C H A P T E R 2. HISTORY OF ELECTRONICS TELEVISION12

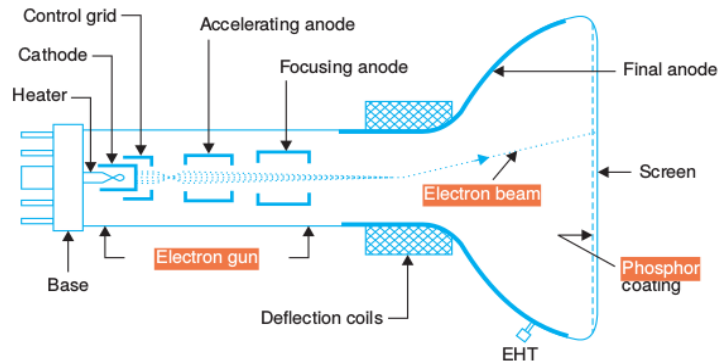


Figure 2.1: *Picture tube*

camera.

The TV receiver receives the signal which is in electrical form consisting by both video and audio signal. These are separated from each other and treated independently. The video signal is fed to the picture tube after a level of amplification. Though the video signal is the variation of voltages and when it applies to the cathode of electron gun then the electron beam is produced and moves towards the phosphor screen. The phosphor screen emits the light according to the intensity of electron beam and a picture is displayed on the phosphor screen. The deflection of beam on screen should be synchronized with the scanning beam of camera tube. The picture on screen is the combination of different shades of gray color because the pixels contained by the screen are of only gray color.[5]

2.2 Color TV

After the monochromatic TV it comes in to picture and it is similar to black and white TV except the pixels of phosphor screen and picture tube with three electron guns. The screen of color TV has three color phosphors i.e. red, green and blue which are arranged alternately. These are three basic

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Figure 2.2: *Black and white TV*

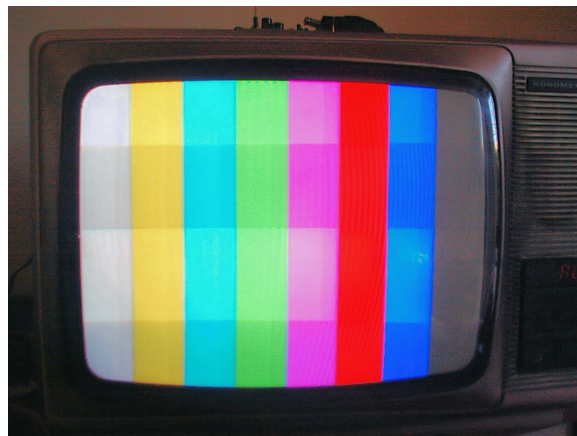


Figure 2.3: *Color TV*

colors and every color is the resultant combination of these three colors. The transmission of color video signal is also different as compare to monochromatic signal transmission as the camera picks the information in three different colors. But these are make compatible as the monochromatic video signal can be received by color TV and the color video signal can be received by monochromatic TV. As the color video signal received by the color TV receiver then it applied on three electron guns separately and then treated as individual electron beam.[5]



Figure 2.4: *LCD TV*

2.3 LCD TV

LCD means Liquid Crystal Display because a special type of crystals used to fabricate it. Liquid crystals have the two types of states one is as liquid and other is as solid. These flow like liquid and polarized like solid. These are more heat sensitive, a minute increase in heat just converted its state from solid to liquid. These crystals are sandwiched between two glass electrodes, the emission of light can be controlled by using applied electric current. If the both electrodes are transparent then it is transmittive type cell and if one electrode is transparent and other is reflective type then it is reflective type cell. There are two types of LCD display: **Dynamic scattering display** and **Field effect display**. If the energy is applied on dynamic scattering display then molecules become excited and light is scattered in all directions. In field effect display front and back polarizers are placed right angle, the light comes from front polarizer is rotated rectangularly in the fluid.

In construction there are two glasses one is coated with polarized film and on other the grooves are made by rubbing it with a special type of polymer which are in same direction as the polarization. One filter is coated with the liquid crystals and then the other glass plate along with the polarizing film

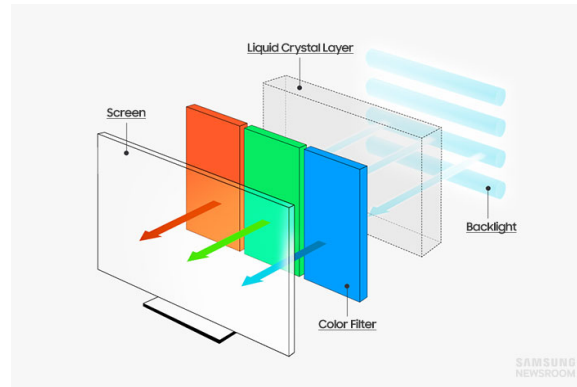


Figure 2.5: *LCD structure*

is aligned rectangly to this. The light is passes through first automatically polarized filter and each layer, so it interacts with molecules of crystal and changes its polerization. At the end of the liquid crystal substance the angle of light vibration is same as the molecules of final layer. With no current applied the light through the front of LCD is reflected back by the reflecting electrode and when the current is applied then the liquide crystals changes their shape from rectangle to untwisted, so the light is blocked from passing through it and a perticular area appears blank.[6]

LCD has a low power consumption in order of microwatts, low cost, and good contrast. Some drawbacks of LCDs includes additional requirement of light source, temperature range of operation is limited i.e. between 0 and 60 C, low reliability, short operating life, poor visibility in low ambient lighting.

2.4 Plasma TV

The first plasma display is comes in to picture in 1964 in Urbana-champaign. In this TV the requirement of CRT screen is removed, mainly two components are important one is flouroscent light for backlighting and other is plasma gas consisting by Xenon and Neon that contains ions and electrons. When

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Figure 2.6: Plasma TV

there is no voltage is applied or under normal conditions the gas remains uncharged, when supply voltage is applied then it excites the gas particles and there is an increment in number of electrons and then these electrons hit the atoms and a hierarchical collision takes place so the large number of electrons are generated. These electrons help to generate the light output. The complete process can be divided into three steps: When a collision takes place among moving particles then the atom is excited and the electron jumps to the higher energy state. After some time (around few nano seconds) it falls again to the lower energy level and an energy is released in the form of light photons. The fluorescent pixel is consisting of three color lights which help to make an image on screen.[5]

Some characteristics of plasma TV include very low luminance black level, very high contrast, life time is almost 1,00,000 hours. The panel thickness is about 2.5 inches and the total thickness is around 4 inches. It has many advantages just like contrast ratio is 1: 2,000,000, less bulky because it is very slim, high view angle, clarity, better color reproduction and disadvantages are high cost, more energy consumption, produces glare due to reflections, area flickering may be possible, it may be temporary damage or a buzzing

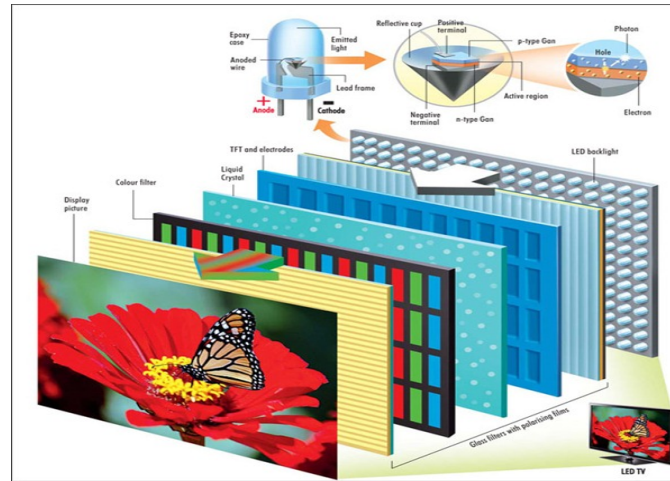


Figure 2.7: LED structure

noise because of pressure difference between the gas and air.

2.5 LED TV

As the LED is a semiconductor device which is consisting by an junction betwweb P and N type of semiconductors, when the voltage is applied on it then the electrons and holes are generated and excited to the higher enrgy state and move to the oposite type means electrons moves from N-type to P-type and holes moves from P-type to N-type. Then recombination takes place near the junction and an energy is released in the form of light. The most popular material used for LED fabrication is galium arsenide (GaAs) and galium nitride (GaN).

In LED TV, LEDs are used for the backlight purpose where as in LCD TV the fluroscent lamps are used, so these are also called as LCD TV with LED backlight. These displays have many advantages over the previous ones like consumption of energy is very low, thinner than LCD and plasma, support high resolution etc. LED screens are divided in two categories one

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Figure 2.8: LED TV

is Graph-Text screen that is used for display letters and pictures which are synchronized with computers, other is Video screen that is used for display text, pictures, 2D and 3D flash, videos, TV programs VCD programs and broadcast. It mainly consists by two blocks one is Display units or display panel or display cabinet unit which is consisting by LEDs where as other is controller used for controlling purpose and deals with signal received. There are three types of LED TVs technologies:

- **Edge-lit LED:** These are very thin displays which uses LEDs around the edge of the screen and a diffusion panel employed to illuminate the display evenly.
- **Dynamic RGB LED:** In this the LEDs are situated at back side panel used to make the target area more precisely for dimming which plays very important role for reproduction of black and white.
- **Full array LED:** This very similar to RGB LED display but these have no any localization for dimming.

There is an another type of LED display that is OLED (Organic LED display) which uses organic material like carbon to generate the backlight,

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Figure 2.9: OLED TV

when the current passes through these organic materials then generation of light takes place. Here the requirement of fluorescent lamps and solid state devices are no longer for backlight so the OLED display is very thin as compare to others, also it provides the better contrast, fast image processing, more flexibility but it's cost is still very high that is not much suitable for customer side.[5]

Tizen Architecture

Today, we are surrounded by many electronic devices which have multifunctionality and used for various purposes like smart phones, tablets, smart TVs, smart watches etc. To operate these devices they need driver softwares and operating systems just like android, bada and so many others. Similarly there is a linux based open source platform i.e. **Tizen**. It is a linux based open source software platform that is based on HTML5 standard. It is mainly used in smart phones, tablets, smart TVs etc. The main feature of tizen is that it supports both the native API (Application Programming Interface) and web API that is suitable for web application development. Tizen architecture contains three layers:[7]

- Application Layer
- Core Layer
- Kernel Layer

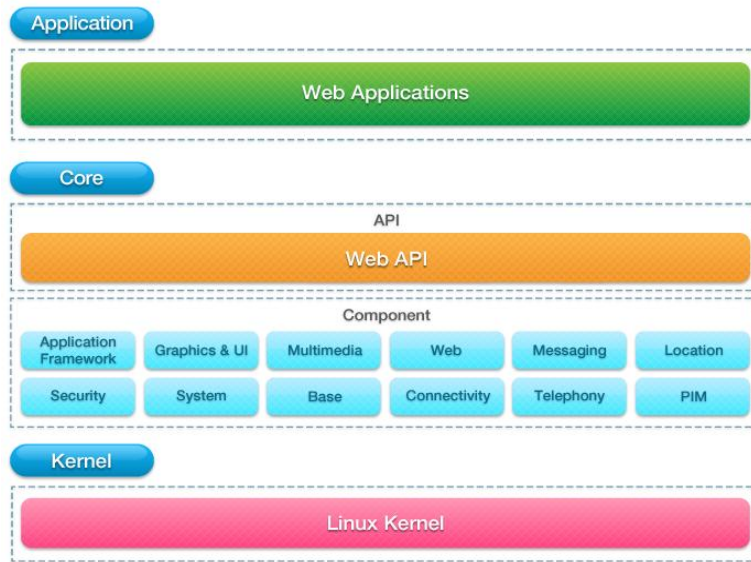


Figure 3.1: *Tizen Architecture*

3.1 Application Layer

As the tizen includes the web API, as the native applications it takes the complete advantages of the functionality of platform.

3.2 Core Layer

It is the combination of tizen API and tizen core services.

3.3 Tizen API Layer

The tizen web API is used to developed the different web applications and launched in the market. Tizen web API includes many interfaces which are based on W3C or HTML5 or more, like Khronos, WebGL etc.

3.4 Tizen Core Services

3.4.1 Application Framework

It provides two types of services, one is application management which are launching the application using the package name, URI, MIME type. other is system dialer applications which are pre-define services. It also include the general notifying services like low meemory, low barrery, puch notifications and variation in screen orientations etc.

3.4.2 Base

It includes the system library that is based on linux and provide the essential functionality like database support, internationalization and XML parsing.

3.4.3 Connectivity

It provides all the wired or wireless connectivity functions. In wired LAN or RF cable connections are included where as in wireless Wi-Fi, 3G, HTTP (hypertext transfer protocol), bluetooth and near field communication (NFC) are included. The 3G and Wi-Fi based networks are provided by ConnMan i.e. Connection Manager.

3.4.4 Graphics and UI

It includes the user interface stacks and graphics stacks, there main part is EFL library i.e. Enlightenment Foundation Librarues and also includes Open-GLES, an X11-based window management system and input methods.

The GPU (Graphic Processing Unit) have the controlls the complete functionality related to graphics and user interface using EFL library that creates

the high level graphics and all UI resolutions. This library manage the things in layers and support the high level resolutions such as 3D or more transformations. It consists by canvas API library and the elementry widget library.

3.4.5 Location

These are the services based on LBS (location based services) that are satellite information, grocoding, GPS status, position informations etc. GPS, Cell ID, WPS (Wi-Fi Positioning System) are the important sources which provides the geoclue informations.

3.4.6 Messaging

In messaging the information is in the form of text, the SMS (Short Message Service) and for the pictures are transmitted via MMS (Multi-media service) and Emails.

3.4.7 Multimedia

The functionality related to multimedia is controlled by Gstreamer that supports the all media applications like video, audio, picture etc. It is an framework that is based on video pipeline and also supports the high end audio applications.

3.4.8 Personal Information Management

It is a user interface that is deals with the information related to user's personal use, like calander, contacts, memos, tasks etc. It also provides some optional privacy to user data.

3.4.9 Security

It monitor the complete system and provide the security development for it. It includes many platforms for security purpose such as certificate management, access control and application security. In this some user base security is also included which give the flexibility to access the system for only those limited users which have permission for it.

3.4.10 System

It is the defines the complete structure of the setup or the different sections of the system and its management.

- It provides the interfacing between user and the system using different sensors, display etc.
- It manage the power required to run any hardware of the system and perform any desired function. Also provide the control on LCD back-lighting.
- It also manage the connections required to interface with external devices like USB, charger, headphone jack etc.
- It also provides the software updation of the system.

3.4.11 Telephony

It provides the cellular functionality and communicate with other system. It includes the code division multiple access technique (CDMA) and universal mobile telecommunication system (UMTS).

- It manage both the services for UMTS and CDMA which may be call-related or non-call-related.

- The information is send in the form of packets over the network for both UMTS and CDMA, it manage the information related to it.
- As discussed above it supports the SMS service, it also manage the text related service.
- Also manage the user's personal information which is relatd to telephony like phone book, SIM (Subscriber Identification Module) files.

3.4.12 Web

As the tizen architetur includes the web API which includes the webkit for it. It can be possible to generate its own web application using this webkit. Webkit is a layout engine that provides the suggetion regarding to search contents in browser, manage the history visited by the user and also save the paths for forward and backward movement in browser.

3.5 Kernel Layer

It is the base layer of architecture that contains the source code and control and operate all the functions using drivers.

Tizen operating system supports two types of application programming interface, Web API and Native API.

- **Native API:** It supports the TV facilities like broadcasting based on different broadcating standards. It provides the features that are required to the web framework. It includes application framewaork, graphics and user interface, web services, multimedia, location, security, system, base, connectivity, messaging, PIM and telephony those are already discussed above.

- **Web API:** It provides the broadband services and supports mainly three types of services: *device API*, *W3C*, *supplementary*. Device APIs are the advance services that are based on JAVA scripts and provides the facilities of device platform like bluetooth, message, contacts, calendar, NFC (Near Field Communication) etc. W3C (World Wide Web consortium) is an international committee which develops the web standards and protocols and guidelines for web. It is based on HTML5 which uses the URIs (Uniform Resources Identifiers). HTML is hypertext markup language which is a complete document as simple text written in notepad or wordpad and open in browser like netscape or navigator. The HTML provide the interface between its commands and user and then display the contents on screen. Supplementary includes the WebGL, full screen API etc.

3.6 Comparison between Tizen and Android

Tizen is an open source platform that is based on some standards. It provides an advanced and original operating system, applications and a user-friendly system that is suitable for multiple devices. As the Tizen projects are based on Linux so these reside within the Linux foundation and governed by the Technical Steering Group. This group deals with the open source projects and decides the standards for these, the main aim of this group is on platform development and provide to the customers as well as to provide the supports for these platforms in parallel. As the Tizen applications are based on HTML-5, it provides an environment with robustness and flexibility that is suitable for application developers. It provides two types of libraries to the developers, software development kit (SDK) and application programming

interface (API). SDKs include IDE, Emulator, Toolchain, Sample code and documentation.

Android is a software platform that is mainly used in mobile devices. It is also based on linux but to write the code it requires JAVA platform. Firstly it is developed by Google but then transfer to Open handset alliances, but it is funded by Andy Rubin in Palo Alto, Californio, United State then google acquired the Android INC in Aug.2015. It is also open source platform that anyone can use it. To store the data it uses SQLite. The versions of android is based on alphabets from A to Z, like: Aestro, Blende, Cupcake, Donut, Eclair, Froyo, Gingerbread, Honeycomb, Ice-cream sandwich, Jelly-bean, Kit-kat, lollipop, Marshmallow, Nougat.

A software platform can be said as mature if it get huge customer support in terms of its hardware use and application development APIs. Both the tizen and android are simillar software but the android is more mature compare to tizen because of its market reach in mobiles. If any software is mature and occupy a broad market then more issues can be reported and then thier solution is provided by developer and there is no futher generation of that issue and the software is more stable. Simillarily the android is more mature and provide more compatibility to different applications both in public and private sectors. Tizen is build on the basis of linux kernel and the linux is very stable kernel so it provide a most stable unix based kernel in form of tizen. C-group is responsible for the memory management, its process and the resources allotment in tizen. The process and the process group move in same manner as the process comes in foreground from background then the process group is automatically moves to the foreground C-group. The C-group ensure that the process should not kill due to low memory circumstances. As the process wants more memory than availble free memory

or when the system free memory decreases to a low memory threshold then the kernel send a notification to resources and request for more memory. So the resources provides the free memory from the background group. There is a specialization of tizen is that it can be run inside the android in two ways, one is by completely replace the android platform and other is by using the *kexec* to multiboot android device. *Kexec* is linux booting itself and it is a syscall that allows linux kernel to boot another linux kernel without restarting the device. As it does not require restarting so it can boot faster, because it skips the boot loader and the RAM is on intermediate state because of previous kernel.

Tizen TV UI Framework

EFL (Enlightenment Foundation Library) is the heart of the based TV. It is the complete toolkit for lower power devices, like phones and tablets. It is set of library that is actually build to support a functioning window manager. This is a library which covers a range of functionality from main loop to graphics, scene graphs, networking, widgets, data storage, IPC etc. Enlightenment also provides the multiple virtual desktops and other functionality. Samsung tizen user interface framework uses EFL as the core library toolkit in their next generation devices.[9]

4.1 UI Framework Architecture

The UI framework architecture consists of following componenets:

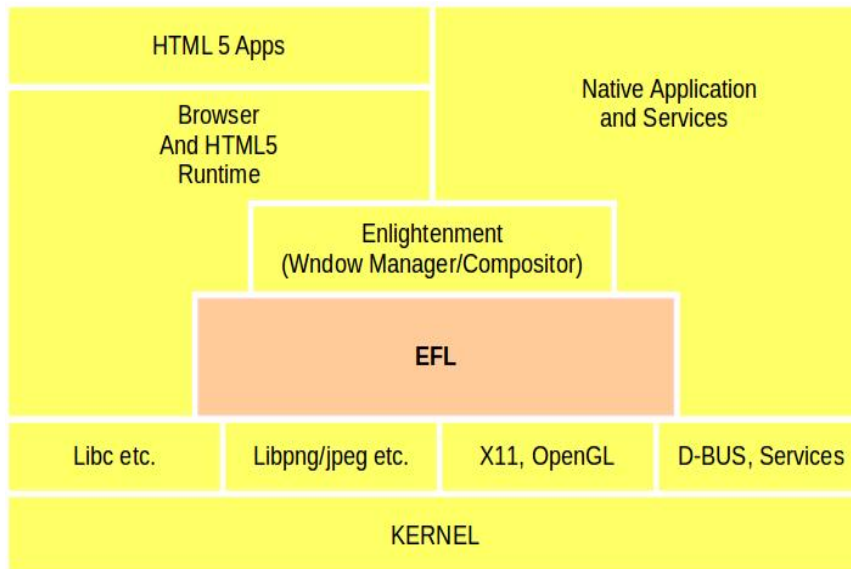


Figure 4.1: Enlightenment foundation library

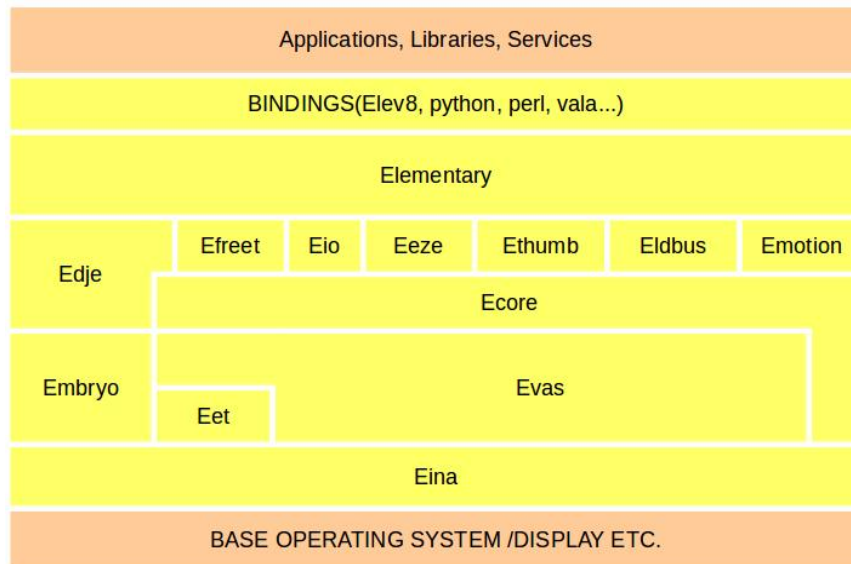


Figure 4.2: UI framework architecture

4.1.1 Elementary

This a library which contains the widgets used for EFL application development. It provides all the functions used to create a window, simple and complex layouts, manage the life cycle of view and add widgets. It has many advantages like it is fast, finger friendly, scalable, theme changable etc. It provides both semi-traditional toolkit set in elementary as well as the object canvas (evas) and powerfull abstracted objects (edge). It also support 3D transformations.

4.1.2 Ecore

It is library that perform the managing task of the main loop of an application. In main loop the events are handled and interact with the users through call back machanism. It also provides timers , animators and working with X.

4.1.3 Evas

It is a canvas engine that is resposible for managing the drawing of our contents. All the objects those are created using the graphic support are evas objects. It monitor the entire state of the window and provide the required widget to it. Actually, it is not a drawing library but a scene graph library that retains the state of all objects. Drawing libraries are Cario, OpenGL,XRender.

4.1.4 Edge

Edge is a library that is used by elementry to provide a powerfull theme which are contained using EET generated files. It seperates the user interface

from the applications. It allows the application to be skinnable, so that it is possible to change the graphical user interface (GUI) of an application without changing the application itself.

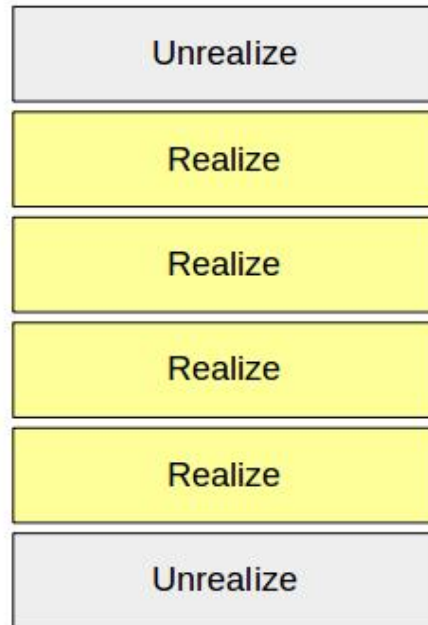
4.1.5 Eina

It is also a library which is used for data structure. It provides fast data structures like lists, queues etc. which are used by all other libraries in the EFL stack.

4.2 Major Elementry Widget

4.2.1 Genlist

- **How to use:** It is a complex widget which should be used only when 20 or more items need to add in the list. If the items are less than 20 and requirement of simple list with items then use normal list object, box with bottums, scroller with box and bottum. It is implimented to occupy less memory by keeping number of actual canvas objects low. Genlist allocate the memory when the item is realised and deallocate when derealized.
- **How to optimize:**
 1. **Realise and unrealize:** It is a lazy loading means it is slow during the introducing and deleting the list. It dynamically draw item which exist in viewport and erase unshown items. Here the need to process callbacks or event between realized and unrealized about item view objects.

Figure 4.3: *Genlist*

2. **Homogeneous mode:** It maintain a queue for adding items in the list. As the every item is different sizes, these need a seperate calculation, so the population of calculation is increases then the adding items to the genlist are slowing down. If application have fixed size (in width and height) of items in genlists, its always recommended to set homogeneous mode on genlist. For this process first set the homogenous mode then go to the genlist mode. It makes the genlist items to fast initializing.
3. **Changing the item class of an item after its creation:** It is an easy way to change the appearance upon selection or others actions of the user.
4. **Optimizing genlist with append or prepend functions:** In this the focus is set at the required item then prepend and append

the from focused position. e.g. consider 300 items in a genlist and focus should be on 200th item. Normally, first append 300 items and then show 200th item and set focus on it. Optimized scenario, application should append 200th items then 199th to 1st prepend then append 201th to 300th items.

- **Important things:** There are some important things which should be considered while writing the genlist theme. Item in genlist can have null and more texts, zero or more contents and zero or more boolean states whose behaviour is depends on user. Edge part name for each of these property will be looked up, in the theme file for the genlist under the edge (string) data items named *labels*, *contents* and *states* respectively. For each of those properties, if more than one part is provided, they must have name listed separated by space in the data fields. Genlist focus and other states in EDC (Electronic Data Capture) are handled by elementary. Elementary emits signals to EDC in order to set focus/unfocus/ selected states.

4.2.2 Gengrid

Genlist used for positioning objects in 2D or grid layout while actually creating and rendering only the visible ones using the same idea as genlist. Users may interact with a gengrid via the mouse or via the keyboard, navigating through item with the arrow keys.

- **Item realization and unrealiztion:** In item realization the item is created and viewed when it is in view port, where as when the item is not in the view port of gengrid then delete its view. Item view is an edge object and it is not exposed to application developer as it is

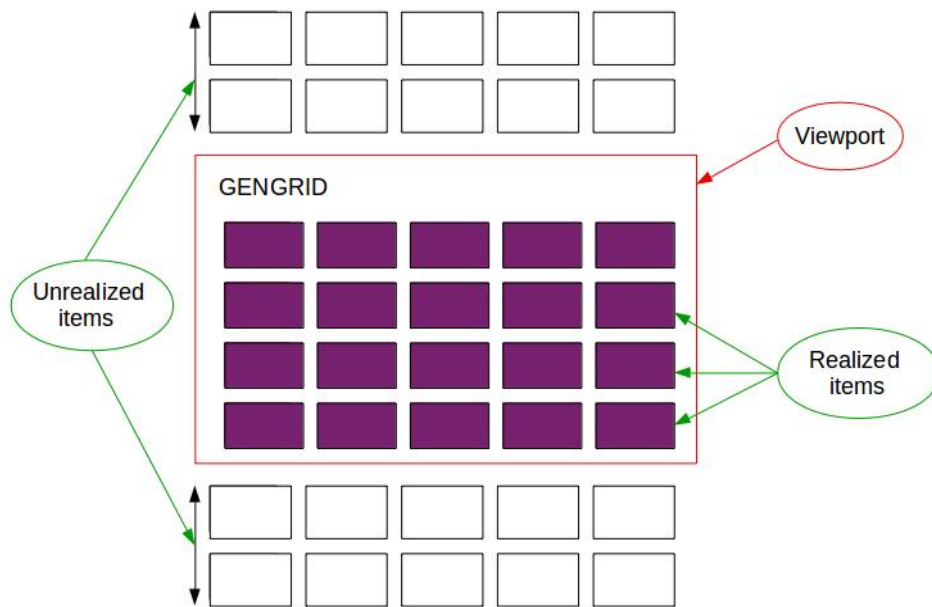


Figure 4.4: *Gengrid*

internally managed by gengrid. It deals with the elementary gengrid, 2D list widget for large sets of elements.

4.2.3 Entry

- How to use:** It is a convenience widget which shows a box that the user can enter text into. To enter to entry the text both the hardware and virtual keyboard can be used. In tizen platform, the virtual keyboard is shown as soon as the entry objects gets the input focus. It also handles the selection, copy and paste as well as single and multiple lines in an entry along with inlined markup that can modify formatting and even add inlined images or items.

This widget impliments a interface, so that all functions for the base scroller widget also work for entry. Entries by default don't scroll, so

they grow to accomodate the entire text, resizing the parent window as needed. The entry can also be single line or multiple lines and when set to multiline mode they support text wrapping in any of the modes. It have the other features as password mode, filtering of inserted text and related functions, inline items and formatted markup text.

- **Formatted text:** The markup tags support by the entry are defined by the theme, but even when writting new themes or extensions, it's a good idea to stick to a same default, to maintain coherency and avoid application breakages. There are two types of markup tages or special tags that are used to insert click able portions of text and items inlined with in the text.
- **Anchors:** As the tizen plateform based on HTML so the anchers used in it are same as HTML anchers. Text can be surrounded by `< a >` and `< /a >` tags and an event will be generated when this text is clicked. In this the *href* attribute in opening tag gives the name that will be used to identify the anchor and it can be any valid HTML string. When an anchor is clicked, an *anchor clicked* signal is emitted in the *event info* parameter for the call back function.
- **Items:** Inlined in the text, any other evas object can be inserted by using the `< item >` tag. To indicate the size of an entry, *absize* or *relsize* attributes of any item can be used. These attributes take their value in the W x H format, where W is the width and H is the height of the item.
 - **absize:** Absolute pixel size for the item. Whatever value is set will be the size of item. The final line height will be adjusted to fit larger items.

- **Size:** It is similar to `absize`, but it is adjusted to the scale value set for the objects.
- **Relsize:** The size is adjusted for the item to fit within the current line height.

Items are specified as *vsize* value that affects how their final size and positions are calculated. The possible vales are:

- **Ascent:** Item will be placed within the baseline of lines and its ascent, i.e. the height between the lines where all characters are positioned and the highest point in the line. For `size` and `absize` items, the descent value will be added to the total line height to make them fit, `relsize` item will be adjusted to fit with in this space.
 - **Full:** Items will be placed between the descent and ascent or the lowest point in the line and its highest.
- **Setting Entry style:** There are two major ways to change the entry,s style:
 - **Theme:** Set the *base* field to the desired style.
 - **User style:** Pushing overrides to the theme style to the text block object.

When concerned with beauty, modify the theme and for specific change in run time then user style should be modified.

- **Loading and saving files:** Entries have convenience function to load from a file and save changes back to it after a short delay. In this the automatic saving is optional, as default it is enabled.

Entry focus and other states in EDC are handled by elementry. Elementry emits signals to EDC in order to set focus/ defocus/ select states.

4.2.4 List

- **How to use:** It is an container whose contents are displayed vertical or horizontal order and can be selected. List don't have icons and labels, but rather they have items. Each in turn may have a label and two icons, one before the label and one after it. The list can accept only one or multiple item selection. Also have many modes of items displaying.
- **When to use:** If the number of items are small (less than 20) then use the genlist will be the complex to realize as involves many calculations, so the list is used instead of genlist.

4.2.5 Pop-up

If the user wants to have more than three buttons then these buttons can be put inside the items of a list as contents. When the pop-up get hidden then it doesn't mean that it get destroyed automatically, application should destroyed the pop-up instance after use. User needs to handle the clicked signal of these action buttons if required. No event is processed automatically when clicked on these action buttons. It is also possible to avoid the block area event. Pop-up set the focus to itself when the *evas object show* is called on pop-up. To set the focus into pop-up's contents and buttons automatically, *evas object show* on pop-up should be called after setting all the contents and buttons of pop-up.

The content part of the pop-up can be one of the file among evas objects, text box discription and set of items. These content parts should not be

mixed. The signals which are used by the pop-up are time out, block clicked, unfocused, language and changed.

4.2.6 Layout

- **How to use:** Layout is a container widget that takes a standard edge design file and wraps it very thinly in a widget. An edge design (theme) file has a very wide range of possibilities to describe the behaviour of elements forming a layout. If list, box and widget is added to the layout will become its child, meaning that it will be deleted if the layout is deleted, moved if the layout is moved and so on. Layout widget may contain as many parts/ children as described in its theme file. Some of these children have special types, such as contents holder ones, boxes or tables. There are three possible types of parts where a child can be added:

1. **Box:** Edje box is similar to elementary box widget. It allows one to add objects to the box and have them distributed along its area, accordingly to the specified layout property. A similar effect for having a box with its position, size and other things controlled by the layout theme would be to create an elementary box widget. Layout format, padding, align etc. will all be controlled by the theme.
2. **Table:** Layout table widget is similar to the elementary table widget. It allows one to add table by specifying the row and column where the object should be added.
3. **Swallow part:** Only one object can be added to the swallow part at a time.

- **Using layout theme:** The layout offers predefined themes that comes with default elementary themes. All of them have layout as class, application as group and style is one from following options:
 - Toolbar-content
 - Toolbar-content-back
 - Toolbar-content-back-next
 - content-back
 - content-back-next
 - Toolbar-vbox
 - Toolbar-table

4.3 Ecore major componenets

4.3.1 Threads

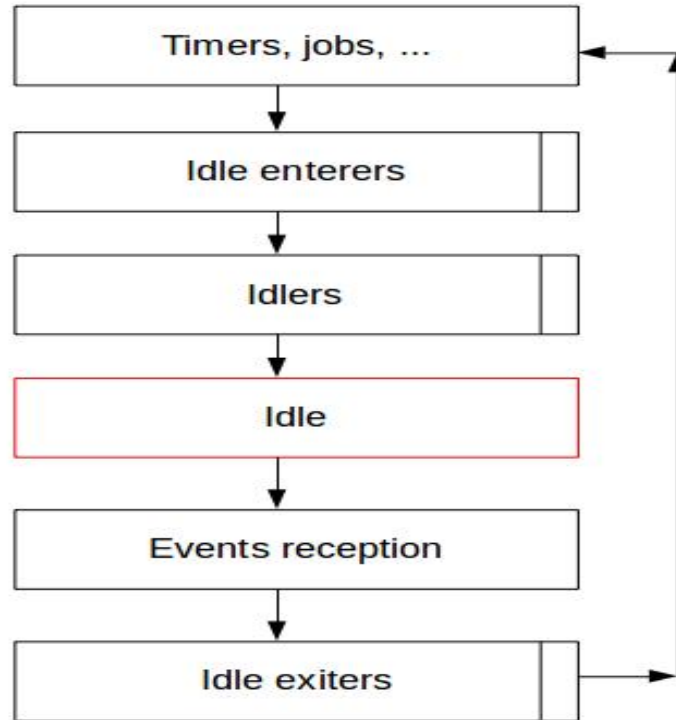
- **Creating threads:**
 - `Ecore_thread_run`: It provides a facility for easily managing blocking task in a parallel thread. In this there are mainly three functions, **func_blocking** that will do the blocking work in another thread (so it is not necessary to use the EFL in it except Eina). **func_end**, that is called in ecore main loop when *func_blocking* is done (use all the EFL inside this function). **func_cancel**, if the thread is cancelled or could not run at all then it is called.
 - `Ecore_thread_feedback_run`: It provides a facility for easily managing heavy task in a parallel thread. It includes four functions

in it. Those are, **func_heavy**, it will do all heavy work in another thread (not use EFL in it except Eina). **func_notify**, it will receive the data send from the thread function (func_heavy) by *ecore_thread_notify* in themain loop. **func_end**, it will be called in main loop when *func_heavy* is done. **func_cancel**, it will called in main loop if the thread is cancelled or could not run at all. If we set *try_no_queue*, it will try to run outside of thread pool, this can bring the CPU down. It can not start a new thread, it will try to use one from the pool.

- **Controlling threads:**

- **Ecore_thread_cancel**: It will cancel a running thread and return *EINA_TRUE* if the thread has been cancelled, *EINA_FALSE* if it is pending. It gives a possibility to cancel a task still running. This function work in the main loop and in the thread, but you should not pass the *ecore_thread* variable from main loop to the worker thread in any structure. *func_end,func_cancel* will destroy the handler, so don't use it after.
- **Canceling_pthread**: Threads can be cancell from main loop by using flag.

- **Communicating to running thread:** The command *Ecore_thread_local_data_add* is used in this. In this the data is added to the thread for subsequent use. If there is success then it returns to *EINA_TRUE* and return to *EINA_FALSE* on failure. All data added to the thread will be freed with its associated callback upon thread termination. If no callback is specified, it is expected that the user will free the data, but this is most likely not what you want.

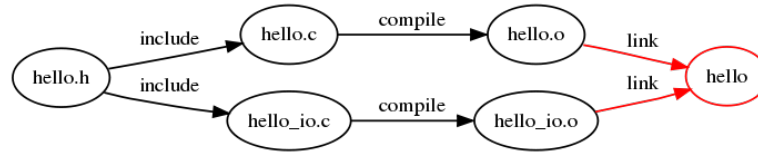
Figure 4.5: *Idler chart*

4.3.2 Idlers

When the rendering is done and all work is finished, the main loop enters its idle state until the next loop. We can get the function of our application called back before the main loop enters (*ecore_idle_enterer*) or exists the idle states (*ecore_idle_exiter*), or when it is in the idle state (*ecore_idler*). The *ecore_idle_enterer_add* and *ecore_idle_enterer_del* functions are used to adding and deleting idler enterer in the applications. Idler flowchart is shown in figure.

Process of Image Build

Programs can be automatically compiled using software tool that software is known as Build system. Their availability can be in many forms according to the requirement of which type of programs have to be compiled. They generate the executable file as a result of build process and also provides some other functionalities. The main body of the build system is based on a language and perform the mapping of source resources to the target that is code files to executable files. The main requirement of any build system is that it's result should not be change when it runs multiple times, means it should be idempotent, if the same input variables and same commands are used to build as previous one then it is necessary to generate the result as previous one. This makes the build system able to optimize the result according to the previous inputs and outputs and perform the build only for the new resources which helps in speed up the system functionality. For this purpose the build system should have the knowledge about the requirement of resources for a given command. In general during the build process of

Figure 5.1: *Example*

one file it requires the another secondary file which makes the build process difficult. In general this problem can be represented by a dependency DAG i.e. directed acyclic graph. In this example, the source files are *hello.c*, *hello_io.c*, and *hello.h*. The *.h* file is have two *.c* files. The compiler accept the *.c* file as input, it also reads in *hello.h* as part of the preprocessing and produces the *.o* files as output. The linker is used to link the *.o* files and generate the executable file. The DAG informs the system about the change required or not. If *hello.c* is altered everything reachable from that node in the DAG must be rebuilt.

5.1 Smoke Testing

Smoke Testing or build verification testing, is a way to test the software that check the some of the elements or aspects tests to ensuring the functionality of most important functions. If the test is positive then it means the build is stable enough to proceed further for testing otherwise it is unstable and require improvement in build. Smoke testing is done many time in a release process to varyify the functionality of the software, it is also done before the accepting the build on any base software to remove the chances of failure the build due to its base version defects. It is performed on both newly created software and enhanced software. Smoke test is require to prove the stability for a software in which some new functionality is added. Smoke testing is

used in the following scenarios:

- It is performed by developers before giving build to the testing team.
- It is conducted by the testers before they start the detailed testing to save the time and efforts.
- Smoke testing is performed to ensure the basic functionalities and compatibility of the software are working fine or not.

Importance of smoke testing:

1. **Saves Time:** Smoke testing includes the total test cases if they all are correctly satisfied then the build is ready for further testing, otherwise rebuild with the required changes. If the detailed testing starts without performing the smoke testing and there is an issue on the last page then the testing will fail at the end point and the build is rejected to fix the issue and unnecessarily the wastage of time. A new build has to start which is also a wastage of time again. Otherwise if the smoke testing is performed earlier then the issue can be detected in lesser time because the smoke testing is a subset of the performance testing.
2. **Saves Effort:** Smoke testing leads to saving of effort as it is done before the submission of complete build and the issue is detected earlier the build so there will be no any rejection in build.
3. **Integration Risk:** To detect the blocker type issue the end-to-end testing is required on each and every build, so that the integration issue can be reduced earlier.
4. **Quality Improvement:** When the major issues are detected earlier and the software is rebuilt by excluding these issues then there is an improvement in the quality of software.

5. **Progress Assessment:** As the end-to-end testing is performed in the smoke testing then it mean that it varifies the correct working of the previous features as well as the newly added features. So it is easier to development progress of for the project managers.

5.1.1 Performance Testing

Performance testing is used to determine the load that can handled by the system and the speed of system under the normal load condition. It confirm the working condition of facilities those are claimed by the vendor. In this the comparision between two process is also performed in terms of parameters like speed, qualitative attributes such as reliability, scalability and interoperability. The focus of Performance testing is checking the attributes of software program like,

- **Speed:** determines how fast the application responds under the normal condition load.
- **Scalability:** determines maximum user load that can be handled by the software application.
- **Stability:** determines if the laod is varying than how the system is stable.

The main issues that are reported in the performance test are related to speed, load time and poor scalability etc. If the loading time and the speed of any system is poor then it is irritating for the user to operate it. Performance testing is done to make sure an app runs fast enough to keep a user's attention and interest.

5.2 Process of image build

In the release process or image build process the code for image is written by the developer or coder then the Perforce tool will integrate this code and provide to the integrators. Integrators will collect these codes and run the build on it via quick build tool, which includes the different packages of all the functionality provided by it. If any change is required in the image or the solution of any issue then it will include here in the form of packages. As the result of quick build we get the snapshot, which have all types of images and some other files.

This snapshot is converted into image binary using script. It will just separate the all images from a single snapshot. Binary image is that image which can directly upload to the TV set, and perform the smoke test. If all the test cases included in smoke testing are passed or satisfied then the image will broadcast to the release server otherwise the feedback is given to the developer to remove the issues. Broadcasting of image means it is shared to the inner network of company and the further processing is performed on it. When the broadcasting is performed then a post should be registered which contains the location of image on the release server, identification of image (checksum) and the list of packages that included in it, and the issues which are solved or not solved. It also contains the result of smoke test. It shows the recorded form of the release.

5.2.1 Perforce

Perforce is related to the digital assets which may be any data stored on computer like source code, text, graphics, video, sound files etc. For this assets perforce control their version information. A version control system

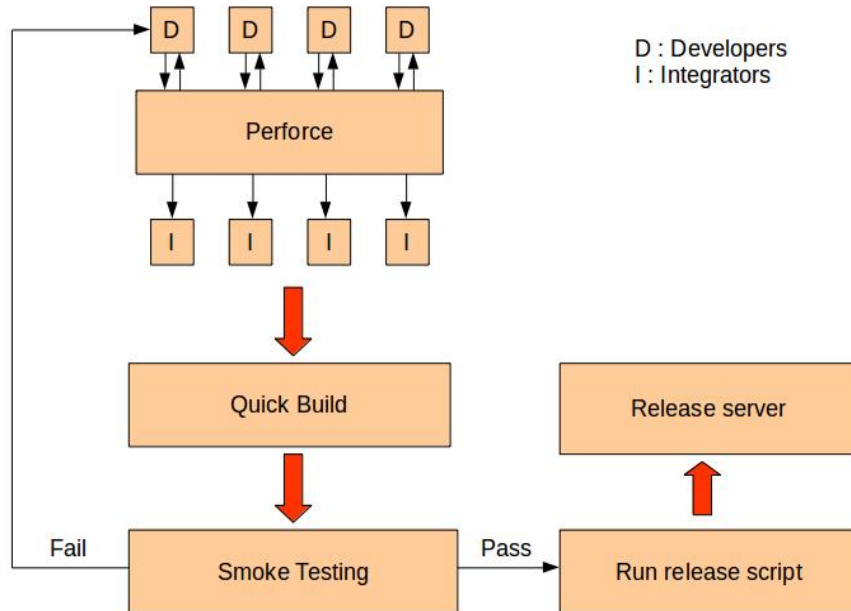


Figure 5.2: *Process of Image build*

maintain a records that includes the deletions, additions and editing to digital assets as separate file versions across the lifecycle of a project or application. It is an open source software and can be used by anyone who required to manage the lifecycle of data on which they are working in an environment of collaborative development.

Perforce is actually a client/server architecture. In a client/server architecture, separates machines are used to install the server and client components individually, but they are accessible across a single network. A standard protocol is used to provide a link between server and client components like TCP-IP, OSI model. The Perforce server host machine accept for commands from Perforce clients on a dedicated port. A Perforce client connects with the server using the host name of server machine and the dedicated port number. Applications written for client/server environments distribute work across the client and server components to optimize performance and usabil-

ity. The high level computational work and resource intensive is typically carried out at the server. The server component might also act as a central repository and manage the application data and metadata, and coordinate activities and service requests from multiple client instances, such as reporting, data maintenance, and indexing. User input based work that also require a few resources and include less computing, such as manual data editing, is typically performed at the client. The application components transmit data and service requests between the client and server only on requirement basis.

5.2.2 Quick Build

QuickBuild is a open source available build system that provide the continuous integration and deployment feature and build definition inheritance over riding to easily handle large number of projects. It acts as a central place or control system to produce, test, deploy, and release software builds. Building an image using QuickBuild consists of following three steps:

- Proof Build
 - Verify Build
 - Release Build
1. **Proof Build:** Concept of proof build is to build and test uncommitted changes at server side. With proof build, the risk of polluting with bad code will be reduced to minimum as developer can submit a proof build and only commit their changes if the proof build is successful.
 2. **Verify Build:** If proof build is successful, then verify build is triggered. Verify build is responsible for fetching all the packages from the previous build.

3. **Release Build:** Release build is started after the completion of Verify Build. In release build, packages are added, deleted and modified as per the requirements of developer.

5.2.3 Smoke Testing

Smoke testing, the preliminary level of testing is done to ensure whether the major functionalities of a build/software is functioning properly. In simpler words, we can say that it is an entry criteria for ensuring that a software is ready for further testing.

Following test cases are verified during smoke testing:

Checksum

A checksum is a small sized datum or information derived from a block of digital data for the purpose of its identification and detecting errors which may have been introduced during its transmission or storage. It is a unique identification of the image. Checksum function or checksum algorithm is the actual procedure which provide the checksum from a data input. Depending on its design goals and requirements, a good checksum algorithm will usually output a significantly different value, even for small changes made to the input. This is especially true of cryptographic hash functions, which may be used to detect many data corruption errors and verify overall data integrity, if the computed checksum for the current data input matches the stored value of a previously computed checksum, there is a very high probability the data has not been accidentally altered or corrupted. Checksum functions are related to hash functions, fingerprints, randomization functions, and cryptographic hash functions. It is a uniqueness of the software that treats individually.

To find the checksum open the factory menu on the large format display

(LFD) TV using a factory remote. To open the factory settings, press *info* button then the *pause* button in quick succession. Once the factory menu opens, go to *Control* then *sub option* to *checksum*. Open *checksum* option and click *ok*. After some time it would show the checksum.

Image Update

The image update is a program that updates installed software and their associated packages with important software updates for security or with recommended patches on the TV set. Image updates are usually done to detect and fix bugs or introduce features by upgrading the firmware of TV which runs as a program to manipulate all the characteristics and applications that works in a TV. In other words it is a actual soul of TV. Every device which is connected to it is operate and instruct by this software like speakers etc. Manufacturers usually update the devices time to time and therefore to adapt to these changes it is needed to update TV software. If it is not done, the upcoming upgraded devices will not work on TV.

There are mainly three types of images that are used for different purposes, these are:

- **Debug Image:** In this all logs are completely active in detail so the speed is very slow. Only programmer have this image to perform the debugging of any issue, it is used to detect that at which point any issue is present and what is the reason behind it.
- **Performance Image:** In this image only required logs are active and others are deactive, it is used to check the speed of performance and it is done on the normal load condition. This is mainly used for memory profiling.

- **Release Image:** In this image the logs are completely deactive, so it faster as compair to abovve two. It is provided in market to the customer and it is very secure image so no one can backtrack to the source code of it.

These three images have individual importance but all three are completely dependent on each other. These can be flash or update on TV set via three different ways i.e.

- USB update
- Serial update
- OTN update

So to update the image, after build is successful, download the corresponding image on a usb flash drive with appropriate folder name and image name. Plug the usb drive into the usb port of LFD TV. In USB update, open *menu* using a standard or factory remote, go to *support* option and select *software update*. You will be asked if you want to update the software version. Select *yes* and wait for the image update to complete. If the update is completed then the test cases have to be pass. In serial update, the TV is connected to the computer serialy and then by using the shell commands the updation is performed. In OTN update, the image is updated on TV set by directly pick it from the server where the images are actually present.

Booting

Booting (or boot up) is restarting operating system software. A boot loader is a computer program that loads an operating system. The booting process can be **hard** i.e. after electrical power supplied to the TV set is switched

from off to on (in order to diagnose particular hardware errors), or **soft** when those power-on self-tests can be avoided. On some systems a soft boot may optionally clear RAM to zero. Both hard and soft booting can be initiated by hardware such as a button press, or by software command. Booting is complete when the normal, operative, runtime environment is attained. Both types of booting clear out (for the time being) the bugs, memory conflicts, and other idiosyncrasies of the operating system.

To test this case, just turn off the LFD TV and turn off the power from wall socket. Turn the power on and try to turn the LFD on using the remote. If it boots successfully, then the test case has passed.

Factory Reset

When any electronics gadget is launched into market then it provided with a default information is stored on it or it can be treated as default settings. When this is provided to the customer then this defaultly stored information is modified according to the customer requirements.

A factory reset or master reset is the process of restore the software of electronic device and bring it to its original system state by erasing all the changes in information stored on the device that are done according to the customer demand and restore the software of device to its original manufacturer settings. Then it will effectively erase all of the data, settings, and applications that were previously changes on the device. This is often performed to fix a software issue that the device is facing, but it could also be done to restore the device to its original settings. Since a factory reset entails deleting all information stored in the device, it is essentially the same concept as reformatting a hard drive. A factory reset should be performed with caution, as it effectively destroys all data stored in the unit. Factory

resets can often fix many chronic performance issues such as freezing and will not remove the device's operating system. Common reasons to perform a factory reset include:

- To fix a malfunctioning electronic device.
- To remove a harmful files or virus that are difficult to remove.
- To reset the configuration and settings of the electronic device to the default settings.
- To clear the unwanted occupied memory space on the electronic device.
- To remove personal information from the device before selling, giving away or disposing of the device.

To do factory reset, a factory remote is required. Open factory settings using the remote. Then go to *options* and click *factory reset*. The LFD will turn off after a moment. Turn the LFD on again and complete the setup procedure. After it is done open factory menu again. Then go to factory reset menu again and check if the type, local set and SW model are same as before. If it matches then the test case has passed.

Plug and Play

Plug and Play is one with a specification that facilitates the discovery of a hardware component in a system without the need for physical device configuration or user intervention in resolving resource conflicts.

Its also called PnP and it basically is a test that the LFD starts the setup procedure after it has been factory reset. If it starts and completes then the test case has passed.

Menu Control

The Menu control has two modes of display:

- Static
- Dynamic

Static display means that the Menu control is fully expanded all the time. The entire structure is visible, and a user can click on any part. In a dynamically displayed menu, only the portions you specify are static, while their child menu items are displayed when the user holds the mouse pointer over the parent node.

To test this test case, open up LFD menu using *menu* button on remote. Then browse through options and try changing some values and features. The menu should not get stuck or take too much time to respond. If no such case occurs then test case has passed.

All Source Play

This test case involves checking whether the DVI (Digital Visual Interface), DP (Display Picture) and VGA (Video Graphics Array) ports are functioning properly or not. This requires DVI cable, DP cable and VGA cable if the LFD TV has input ports for the same. Connect each cable to an appropriate source and plug the cable into the LFD's corresponding ports. Check input from each source using the source button on the remote. Check for display in case of VGA and DVI. Check for Audio and Video in case of DP by plugging headphones in to the LFD if required. If all works, then the Test case has passed.

HDMI Input

HDMI (High-Definition Multimedia Interface) is a proprietary audio/video interface for transmitting uncompressed video data and compressed or uncompressed digital audio data from a HDMI-compliant source device, such as a display controller, to a compatible computer monitor, video projector, digital television, or digital audio device. HDMI is a digital replacement for analog video standards. Several versions of HDMI have been developed and deployed since initial release of the technology but all use the same cable and connector. Other than improved audio and video capacity, performance, resolution and color spaces, newer versions have optional advanced features such as 3D, Ethernet data connection, and CEC (Consumer Electronics Control) extensions.

This is required only if the LFD has HDMI input port. Plug in the HDMI cable into the HDMI port and connect it to a HDMI source(PC or Wave generator). Select the input source as HDMI using the source button on the remote. See if you get a display on the LFD from the HDMI source. Play a video on PC connected to the LFD and plug in a headphone set into the audio out port of the LFD and check if you get audio on headphones. If the video plays and audio is audible then the test case has passed.

MDC Control

MDC stands for Multi Display Control which allows to control the LFD TV using an application from PC. For this, MDC unified app is to be installed on PC. Connect the cable into PC com port and the other 3.5mm jack into RS232 in port of LFD. Then, open *factory setting* on LFD and go to *control* then *sup option* to *RS232 jack*. Set the value in RS232 jack to *UART*. Now open MDC Unified application on pc and you should see the device

in the device list. Open the device and the try turning down the volume using options on the of the MDC app. Try other options as well, such as turning LFD on and off and adjusting brightness etc. If the LFD responds appropriately then the test case has passed.

Magic Info Server Connection

It is a web app which is used to publish content in LFD TV. To execute this test, connect the LFD to internet. After this, connect LFD to magic info server by using the appropriate IP address. Now setup a schedule on the Magic info server and publish the schedule. Now open magic info player in LFD and open a network channel. If the network channel starts paying content then the test case has passed.

5.2.4 Run Release Script:

In this the output of the quick build is converted into the form which is suitable for the user interface and it is the executable file which can be directly uploaded on the TV set to verify its functionality. And also a encrypted version of this is provided to the customers.

5.2.5 Release Server:

After the completion of build and its executable binary make it available for the customers, but these customers are limited into the company itself. The server contains the all types of images for a fixed time that is approximate two months. After that it is deleted from the server because of the memory space problem.

Table 5.1: Smoke test result

ITEM	RESULT	COMMENT	ATTEMPTS
Image update	Pass		1/1
Bootimg	Pass		1/1
Factory Reset	Pass	Type, Local set, SW model	1/1
PnP	Pass		1/1
Menu Control	Pass		3/3
Auto Program	Pass		1/1
Network Setting	Pass		3/3
Multimedia - Picture	Pass		3/3
Multimedia - Music	Pass		3/3
Multimedia - Video	Pass		3/3
ATV Play	Pass		3/3
DTV Play	Pass		3/3
PVR_ATV	Pass		3/3
PVR_DTV	Pass		3/3
First Screen	Pass		3/3
Web browser	Pass		3/3
App download	Pass		3/3
Run App	Pass		3/3
Youtube (Browser)	Pass		3/3
App- boot:browser	Pass		3/3
App- boot:Youtube	Pass		3/3
App- boot:Netflix	Pass		3/3
Instant ON	Pass		3/3
Multi-tasking	Pass		3/3
HBB TV	Pass		3/3

CHAPTER 6

DUMA / DML

DUMA stands for Detect Unintended Memory Access which is an open source library used to detect the overflow and underflow in linux, C, C++. DUMA have the following features:[10]

- It defines the overflow for the memory allocation functions like `malloc()`, `calloc()`, `strdup()`, `operator new` etc and underflow for the memory deallocation functions like `free()`, `operator delete` and `operator delete[]`.
- It deals with the memory management unit and attach pages to the demanded memory location buffer, size of this memory page is around 4k byte.
- It detects the exact location where the fault is occurs or at which point the processor try to deals with the protected area.
- Also detect the mismatching in the instructions used for allocating and deallocating the memory like allocation is done with `malloc()` and deallocation is done with `operator delete` then it will be an error.

- It is compatible with both the Linux and windows operating system.
- It includes a library by which the it detects the error.

As in DUMA a page is added as header and footer to the demand memory for any malloc() function call, these pages are the protected page, if the target wants to access memory locations which are lying in the protected pages then it will give the segmentation fault. DUMA detect the errors only in dynamic memory.

DML stands for the Dynamic Memory Leak, it is used to detect the memory leak in any process. If any process demand for memory and did not free it after completion of its purpose and then further demands for memory then it will consumes more memory and a situation of dead-lock is occurs due to this the processor will kill same or other processes which could not allocate any memory and couldn't able to send its heart beat. This is due to the memory leak. DML monitor the complete situation of memory occupied by any process and draw it in form of a graph which shows the behaviour of process. The process of VD setting for DML is similar to the DUMA.

The memory in the system is in the form of a pool of memory locations, when any function demands for memory then it will allotted from this pool of memory. The memory location list that is presently not allotted to any process (free memory locations) is called as AVAIL list. Same as the memory locations which are use to store variables for any other process that is used spaced. Memory is allocated when any new node is introduced, that is from the unused memory space. And when a node is deleted then the released memory is added to the free memory space.

Memory allocation is two types:

Whenever a new node is created, memory is allocated by the system. This memory is taken from list of those memory locations which are free i.e.

not allocated. This list is called AVAIL List. Similarly, whenever a node is deleted, the deleted space becomes reusable and is added to the list of unused space i.e. to AVAIL List. This unused space can be used in future for memory allocation.[8] Memory allocation is of two types-

1. **Static Memory Allocation:** This memory is a fixed memory allocation allocated in compilation time. This memory can not be altered after allocation once. If the more memory is allotted then it is wasting of memory where as if the memory is allotted more then the program will not work properly. It demands for the exact knowledge of required memory.
2. **Dynamic Memory Allocation:** This memory is variable size memory which is not fixed and varies instruction to instruction according to the demand by any functionality. It is a run or execution time memory. There no any wastage of memory as it is varies not necessary to know the requirement of demand memory.

Garbage Collection:

A deletion of node will generate free memory that can be used for other process in future. To make this memory reusable there are two methods. First one is add the free memory to the available list immediately as the memory is free, but every time the adding process is quite time consuming process. So the another method is used that is garbage collection in which the free memory is collected and added to the available memory list after a particular time. Firstly, The operating scan the complete memory once and tag the presently used memory locations and then second time scan the complete memory and pickup the untagged location and added these to the available list.

Overflow and Underflow:

At the time of insertion any data the overflow takes place where as the underflow occurs during the time of deletion. When the memory is completely full and there is no any space available and the system demands for the memory then this situation is called as overflow. When the data structure is completely empty and the system instruct the structure to delete some data from it then it is underflow.

Segmentation fault:

If any any program try to access (read or write) to the illegal memory locations then a crash is occurs that is called as segmentation fault or segfault. It is corrusponds to the core files. The program memory is divided into four segments:

- **TEXT segment:** It stores only the instructions of a program which defines the task to be performed.
- **DATA segment:** It stores the operand (data or variables) of a program on which the task to be performed.
- **STACK segment:** It stores the variable during the call of subroutine functions. It stores the data on temporary basis.
- **HEAP segment:** It store the variables or data during run time process of a program, like *malloc()* and *allocate()*.

6.1 DUMA modes

6.1.1 Protected page mode

- If it access the free memory, overflow, underflow then it creates core-dump.
- These errors does not appers in TViS windows.
- Gdb debugging is used to find the location of memory corruption.
- Since the memory consumotion is high, it needs to define different ranges of allocation and run many times to verify all the ranges.
- The ranges are configured in configration and allocation of that ranges are only covered e.g. if the ranges is 0 - 16 then only loication of 0 - 16 bytes are covered by DUMA.
- DUMA should be varify all the ranges.

6.1.2 Magic page mode

- In this mode magic bytes are added in header and footer of each location, when the allocation is getting freed, headers and footers are checked for magic bytes and overflow and underflow detected.
- Location for corruption in protect page mode is identified from core-dump while in magic page mode corruption is identified during memory get fried.
- Memory consumption in magic page mode is less and no need to divide allocation in ranges.

- The overflow detection range is very from low as compare to protected page mode.

6.1.3 Auto range mode

- Automatic ranges are generated for protected page mode.
- All the ranges are automatically test for the process.
- If test scenario is completed then use another mode.
- If this mode is selected then the target will reboot in every one minute, the reboot period can change in TViS.

6.2 VD tools target setting guide

1. Enter in the console after target reboot.
 - Shell can be obtain as
 - To enable the serial key : 20102011
 - To stop the logs : ctrl + pp
 - To open debug menu : 20089999
 - To run shell mode : 98
2. Target setting
 - Set the IP address from product menu.
 - Stand alone mode is used if network is not available (file mode).
3. Run `./make_agent.sh` command
Path : `/usr/bin/vdtools`

- Select VD tool mode
 - **Network mode:** Used for run time debugging. TVis is connects from network and run time debugging is performed.
 - **Stand Alone mode:** Offline mode, used when the network is not available. In this los are generated and same can be processed offline using TVis. Complete debugging features of TVis are not available in this mode.
- Select Network type (only for network mode)
 - **Wired:** It is selected if the LAN is used. If it is selected and not modifications to be done then press enter it will select wired as default setting.
 - **Wireless:** Select if the wireless network is used. Since most of the case wireless is using Dynamic Host Configuration Protocol (DHCP) then skip the IP setting steps.
- Press any key to modify the target IP address (only for network mode) and enter the IP address of the target.
- Enter the target MAC address.
- Enter the default server port
- Enter the server IP, enter the IP of PC where TVis user interface is runing.
- Select VD tools:
 - DUMA
 - DML
 - KDEBUG
 - KDML

– MEMORY PROFILER

- Select required option
 - In DUMA (select DUMA modes)
 - Protect page (Previous using method)
 - Magic page (Checking head / tail magic information)
 - Autorange (Automatically set memory check range)
 - Enter the memory range for which the DUMA should be operate.
4. Applying LD_PRELOAD Environment variable to the process to debug.
- If service file is available for the process, check the service file present in path : */usr/lib/systemd/system* in the target, open the service of related process.
Add line in the environment section.
Environment=LD_PRELOAD=/usr/bin/vdtools/libvdtools.so
5. Run the TVis software to monitor the memory of the target. If any overflow, underflow is occurs then it will create a coredump that give exact situation of the memory at the time of crash.

CHAPTER 7

Conclusion

In this report the work that is done during the internship in period from January 09, 2017 to July 07, 2017 in **Samsung Research and Development Institute, Delhi** is described. This work is based on the development of software of smart TVs. How the transmission and reception takes place in TV and also the broadcasting standards are described briefly in chapter 1. And also introduced about the resolution of the screen. Chapter 2 contains the steps of the revolution in TV technology. It started with the mechanical TV then converted into the electronic TV and then the size is reduced by replacing the cathode ray tube by some advance technology. Also the fluroscent lamps are replaced by the LEDs for backlight purpose due to this there is a considurable reduction in the width of TV.

As the samsung DTV uses tizen plateform as the software operating system which is written in linux. It is described in chapter 3 which shows its three layer architecture and their individual importance. It is much comfortable with the user end which is described in chapter 4 as the user interface

framework. In which the widgets and the process of addition, deletion and modification of components in widgets explained.

Chapter 5 shows the main development work that is actually performed in the company on the DTV. The code of image is integrate by the FET team by using *system platform* and *basic system platform* process and then it comes to INT team which integrate and release it for the product team that further provide it to the users. As any product (image) comes into market then it is necessary that its functionality should be proper. If there is an issue reported then it should be solved as soon as possible. There are two ways as the issue can reported one is from the testing team itself during the testing of image and other is from the user side (market issue) that occurs after the release which is very critical and solved on urgent basis. To prevent the market issue the smoke test, performance test and many other tests are performed before release it in the market. If any issue is produced then the rebuild of image takes place and it is carried out with many steps that are described in this chapter. In chapter 6 the detection of issues related to the memory is described by using the process DUMA and DML. These issues may be due segmentation fault, underflow, overflow or memory leak.

As the furtherance in technology the advance version of LED TV will come into the market like organic LED, quantum dot LED. Q-LED screen has the nano crystals those generate the light own so the clarity is improve. Also development in the platform is improves to provide better functionality to the viewers.

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