CHAPTER ONE: Literature Review and Problem Statement

1.1 Motivation

Satellite communications developed to a tremendous global success in the field of analog and then digital audio/TV broadcasting by exploiting the inherent wide-area coverage for the distribution of content. It appeared a “natural” consequence to extend the satellite services for point-to-point multimedia applications, by taking advantage of the ability of satellite to efficiently distribute multimedia information over very large geographical areas and of the existing/potential large available bandwidth in the Ku/Ka band [1]. Particularly in Europe, due to the successful introduction of digital video broadcasting via satellite (DVB-S).The progress of digital technologies in production, transmission and emission of television is rapidly changing the established concepts of broadcasting.

Figure 1.1 shows a typical scheme of the digital television environment, where satellite links may be used for contribution, distribution and broadcasting purposes. The availability of consumer VLSI components has significantly contributed to the rapid emergence of digital audio/video receivers based on the MPEG technique .which are now available on the market at affordable prices.

Today, basic satellite STB units are equipped with interactive features such as video-on-demand (VOD), electronic program guide (EPG), and digital rights management (DRM). More advanced units go a step further to provide a suite of interactive and multimedia services directly through a user television system [2], for example Internet browsing, email, instant -front RF chip-messaging (IM), and voice over IP (VoIP) in addition to basic functionality. Single

enable also can They .boxes top-set for design power even and RF simplify can ends
markets. volume for products OEM in features distinguishing

transmission V/A consumer in standardization global for successes few the of One
for continents all on broadcasters countless by standard single a of choice the is methods
transmissions cable and terrestrial digital or analog Unlike .DBS)TV (satellite broadcast direct
worldwide single, a of adoption the region, world each in standard different a follow that
to grow to box (STB) market top-set satellite digital the spurred has S-DVB standard satellite
standard S-DVB the to compliant are which of majority the receivers, million 60 than more
by design end-front RF satellite the of details the from shielded were OEMs recently, Until.[3]
band-L MHz 2150 to MHz 950 the convert which modules, RF ’canned-metal‘ dedicated using
noise-low the by band Ku or C a from downconverted ”band IF“ an itself by — signal input
stream. MPEG-2 transport an to — assembly dish receiver the inside converter) LNB (block
more of availability the and cost, system reduce to makers STB on pressure constant The
and board main the on function this provide to OEMs enabling is tuners, silicon integrated
.module RF canned the eliminate

relatively the :reasons of number a for trivial not is end-front a such of design The
27 typically (transponder satellite a of bandwidth signal wide the ؛frequency input RF high
fact the and؛) dBm 0 to dBm -8 (power input composite of range wide the) MHz 36 or MHz
power dc a require) multiswitch ,.g.e (peripherals satellite other possibly and LNB the that
the as cable coaxial same the over upstream carried are which feed, control ac an and
justifiably are OEMs environment, hypercompetitive this in Furthermore,.signal received
recorder video personal as such features, added-value on resources design their focusing
their from require OEMs Therefore, .etc extensions, networking home interactivity, capability,
development and research their minimizes which end,-front RF the for solution a vendors
or standards performance receiver required meet confidently to them allows but investment
.criteria certification s'operator TV-pay particular a

the for requirements functional and performance key outline to aims thesis This satellite compare to use can OEM the checklist a provides it essence, In .end-front RF satellite .vendors different from solutions end-front RF

benefits end-front chip-1.1.1 Single

-DVB in) TS (stream MPEG-2 transport an of syntax stream bit common the to Thanks environments, transmission portable recently, more and, terrestrial cable, satellite, compliant and scope of economies to due approach platform common a favored generally have OEMs different for receivers across IC host/decoder MPEG single a of use the means scale. This provides then end-front) IP satellite, terrestrial, cable, (dependent-medium A .media access demodulator and tuner the includes end-front a networks, RF For.host the to input TS the filter and tuning RF AGC, both between interaction physical significant is There .functions .IC tuner to IC demodulator from signals control analog dedicated via selection bandwidth level-board with confronted is module RF canned a replace to wanting OEM the Therefore, external of impact the minimize and operation consistent maintain to issues integrity signal .performance receiver on) tolerances component and layout PCB (factors

single a into demodulator and tuner the integrate to advantageous be would it Clearly, .signals feedback level-board these for need the avoid to IC

loss 1.1.2 Implementation

.specification important most single the is loss implementation end,-front S-DVB a For theoretical the to performance receiver actual of proximity the quantifies measure This required actual between) dB in (difference the as expressed is loss Implementation .optimum given a achieve to demodulator ideal an of N/C required the and level) N/C (noise-to-carrier parameter transmission of combination specific a at) BER (rate error bit output allowable a specifies S-DVB .) frequency RF power, input rate, code Viterbi rate, symbol (settings the at measured as $^{4,-}$10 × 2 of BER a at dB of 0.8 loss implementation acceptable maximum of combination any for required is performance This .decoder Viterbi the of output desensitization receiver minimize to better is value smaller A .settings parameter transmission .[4]

RF and levels power input varying over loss implementation characterize to useful is It can products intermodulation s'receiver a levels, power higher at instance, For .frequencies can frequency LO particular a at signals spurious similarly, ؛loss implementation worsen of curve performance typical a 1.1 shows channels. Figure certain on performance degrade Viterbi after BER $^{4-}$10 × 2 as defined (operation QEF at level, power input.vs No/Eb required .¾rate code convolutional at Mbaud 5.22 of rate symbol a for) decoding

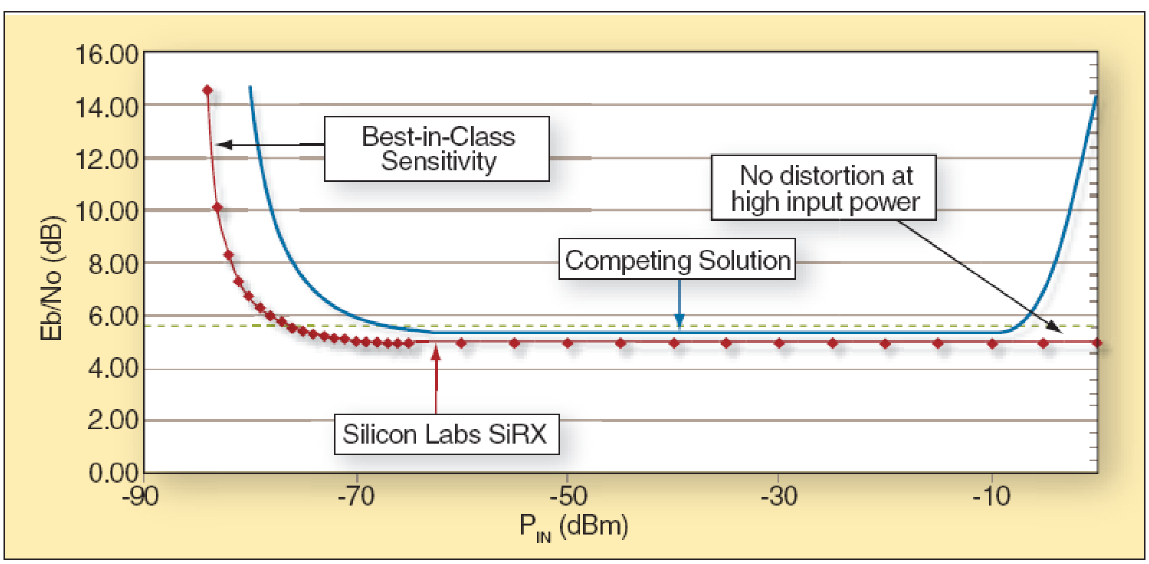

Figure 1.1: Eb/No vs. input power (22.5 Mbaud, code rate 3/4).

metrics performance 1.1.3 Additional

to addition In.calculation sensitivity receiver satellite a of example an shows 1.2 Figure .sensitivity receiver impacts) NF (figure noise tuner the loss, implementation demodulator the and (band-L many of presence the to due dB 80 than more vary can power input Total losses, cable and fading rain incidental of effects the to due and channels) UHF possibly satellite the hand, other the .On) effect skin (range input RF the of end-high the at especially terrestrial Unlike .requirements selectivity of terms in benign relatively is environment approximately in resulting location same the from originate transponders all transmission, receiver Again. the of input at the channels adjacent for levels power input equal

Mbaud 1 (channels individual of rate symbol varying the TV, cable or terrestrial unlike of filter matched a have to receiver the require bandwidth signal varying and) Mbaud 45 to high requires also input power composite high potentially The .bandwidth programmable high at performance receiver deteriorating avoid to mixer and LNA the in) IP3 IP2, linearity) .levels power input

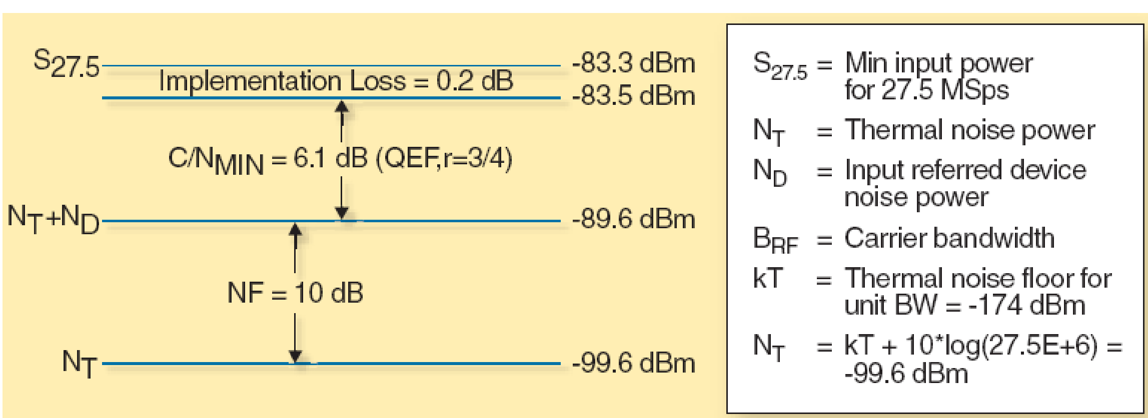

Figure 1.2: DVB-S receiver sensitivity calculation for 27.5 Mbaud and code rate of ¾.

-, direct) ZIF (IF-zero a using been have tuners satellite requirements, these satisfy To adjacent strong and signal desired weak a with systems in Especially .architecture conversion image and selectivity meeting for advantageous is architecture receiver ZIF the channels, and channel desired the actually is channel image the because is This .requirements rejection an of less is resilience this However, .channel adjacent stronger much potentially a not .input receiver the at power similar of be will channels because systems satellite in advantage

the to identical is frequency LO the which in architecture ZIF a of disadvantage key A the onto signal LO the of feed through potential the is tuned, being is it which to channel RF requires which down mixing, after offset dc a to leads This .) leakage LO (input signal received ZIF the of coupling ac for demodulator and tuner the between capacitors larger of use the the of frequency center the equals frequency LO the because Furthermore,.signals Q/I analog, noise phase in-close to sensitive particularly also is topology receiver ZIF a channel, RF desired .oscillator the of

vs. noise phase in-close higher to leads CMOS of characteristic noise f/1 the Since -direct of implementation the processes, SiGe or BiCMOS bipolar in implemented oscillators avoided be can effects Both.achieve to difficult been has CMOS in tuners satellite conversion Figure in architecture ZIF the with together shown is which architecture,) LIF (IF-low a with the from away channel one about tuned is frequency LO the architecture, LIF the In .1.3 by baseband to converted and digitized subsequently is signal IF The .channel band-L desired tuner, satellite width-band wide a to architecture LIF a applying By .mixer digital second a die, CMOS single a onto demodulator and tuner both integrated has Laboratories Silicon combine to approach) SIP (package -in-system expensive more a to reverting than rather .package single a inside die demodulator CMOS and tuner BiCMOS separate

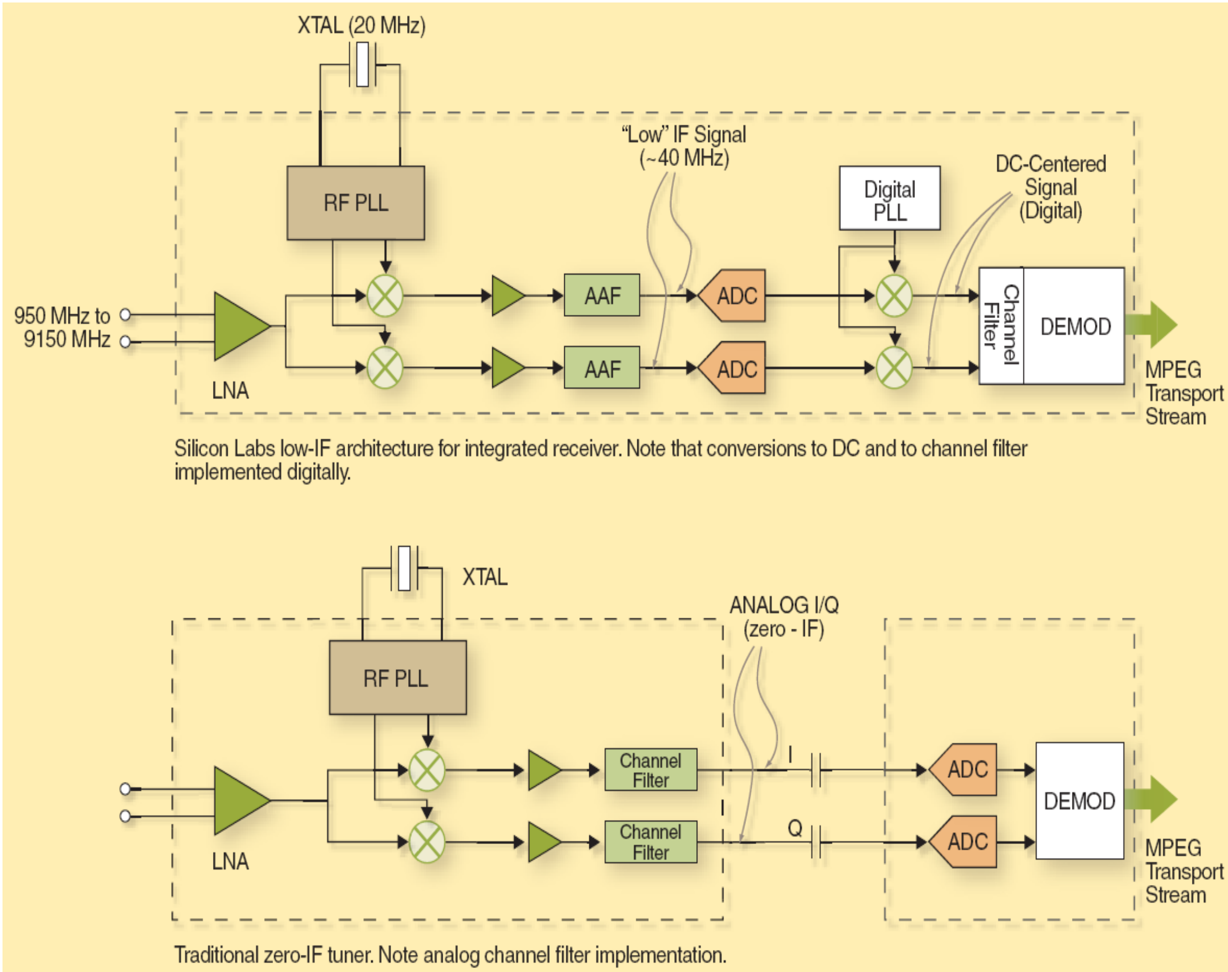

Figure 1.3: Block diagram of ZIF vs. LIF.

features added-1.1.4 Value

but discussed, features the to visibility little has customer end the that argue would Some customer the on impact box-the-of-out direct a with features specific two are there her/his of quality the of indication an user the giving of interest the in First,.experience signal‘ a implements maker box the strength, signal received resulting and setup dish receiver S-DVB Since .decoder channel the from results error corrected the on based ’indicator quality this FEC), (correction error forward) Solomon-Reed (outer and) Viterbi (inner separate a uses can errors uncorrected/corrected of number the when accurate most made be can indicator to provided be could modes test Additional.decoder channel the of parts both from read be a as such (equipment test lab specific with testing characterization during OEM the aid pseudorando