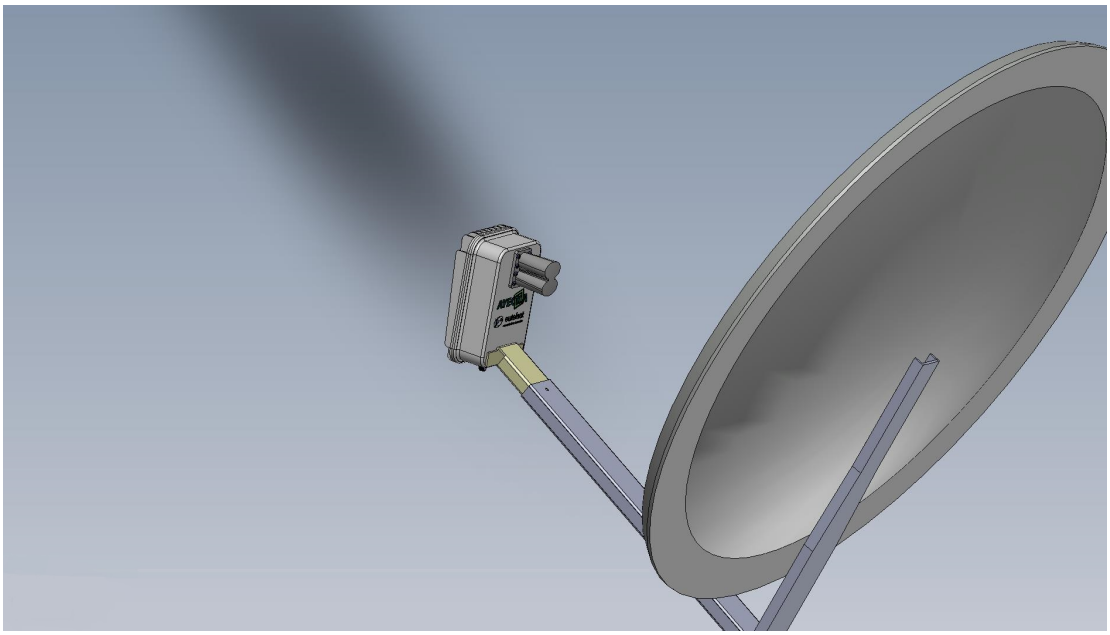
AYECKA
Communication Systems Ltd.

Smart LNB White Paper



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About this Document

Scope of Document

This document discusses the challenges and considerations in designing Interactive Satellite Terminal.

This document focuses on the challenges and solutions provided by the Smart LNB that allows having ***interactive services without any need to rely on terrestrial links or other service providers. This document presents the solution, developed by Ayecka, its advantages and design considerations in all aspects.***

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1 Satellite Interactive TV Challenges and Solutions

1.1 No Need for Terrestrial Infrastructure

Satellite Broadcast networks have a long history of delivering broadcast channels to customers, in the past, they were one of the main channels for delivering a wide range of content to households. In recent years, their share has been undermined by IPTV technology and internet service providers. In addition, the recent explosion of OTT technology has increased competition in the field of Interactive TV.

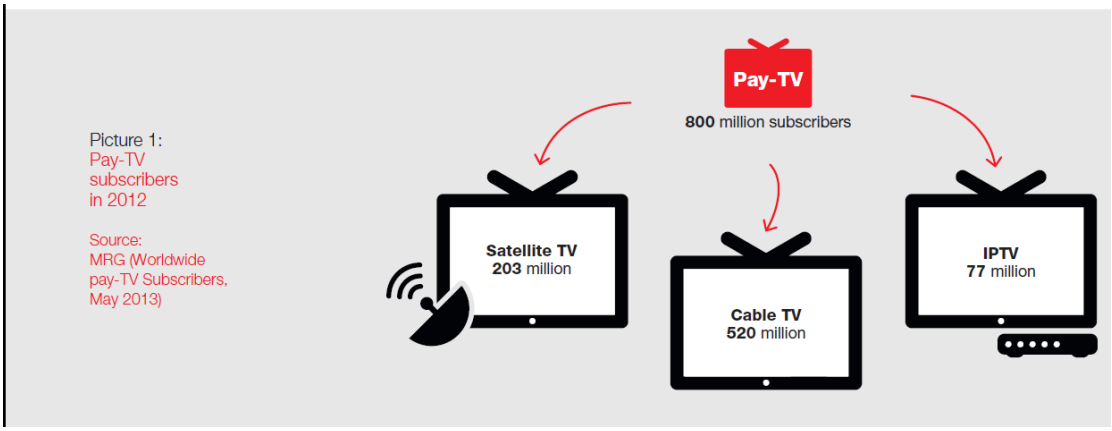

Figure 1: Pay TV subscribers

Interactivity and convergent applications are the main differentiators that can easily be added in IPTV or OTT environments. However, this is not easily achieved in traditional satellite network. In order not to fall behind in terms of market demand for television services, satellite broadcasters need to add interactivity alongside the digital signal to the customers. Even though it is more or less clear which services the operators should offer on the market in order to regain competitive advantage, the path to such

goal is not an easy one. Satellite broadcasters are facing the problem of upgrading their networks with Interactive TV which includes recordings, time-shift TV, VOD content, enhanced EPG, second-screen features as well as internet and social TV features. There are different approaches to achieving these functionalities. Broadcasters can use terrestrial infrastructure to allow a return channel for the interactive services or they could add the smart LNB to their existing network and allow an interactive 2-way connectivity over satellite.

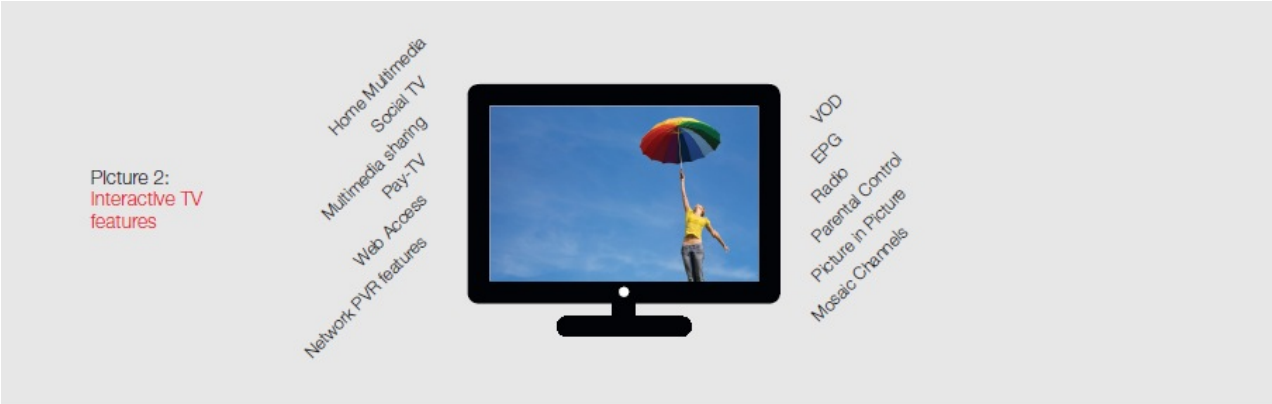

Figure 2: Interactive TV services

1.2 Reusing the existing Infrastructure

Satellite broadcasters who want to preserve their investment in the existing network may choose a hybrid approach as a first step to Interactive TV. The DVB-S/S2 network is used for linear TV streaming and for the forward channel of the Interactive services, while an IP return channel is required for the communication of STB

with the middleware and provision of all the Interactive TV features.

We can assume a scenario that VOD and PVR services are added to a network. The broadcaster needs to invest in a VOD server for video on demand and network-based recordings, middleware, IP-based DRM for VOD (if the existing one cannot be reused) and in a smart LNB terminal. The smart LNB reuses the existing infrastructure at the end user's site. It re-uses the DTH antenna, coax cables and the Set Top Box.

The customer only needs to replace the existing LNB with the smart LNB ODU unit and add a small IDU unit next to the Set Top Box.

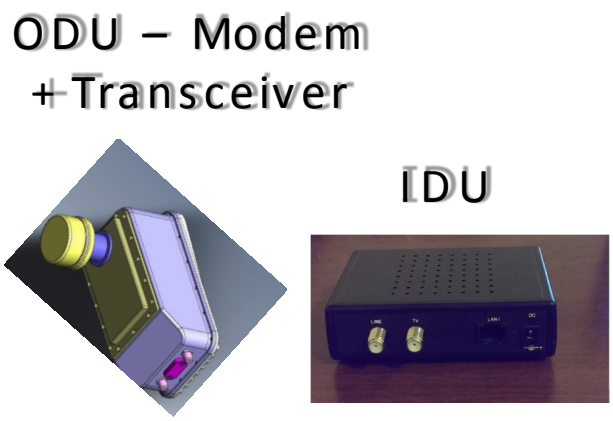

Figure 3: Smart LNB ODU and IDU

1.3 Global Coverage

The Smart LNB is designed to work with existing Satellite DTH services on Ku band which are serving customers around the globe with wide coverage of satellite beams. The new smart LNB adds a return channel in Ka band. Few

Ka band satellites are already available, and many more are being launched. These satellites have higher capacity and more power than traditional Ku band satellites. Thus Ka, band satellites can serve more for much lower price. The Ka band satellites work as spot beams satellites (similar to a cellular network) and in the next years will have global coverage.

The use of smart LNB allows connection and interaction even at the most remote locations. In rural areas with poor infrastructure or no infrastructure at all, the smart LNB will serve for communication and interactive services.

The smart LNB is a step forward towards a connected world without limits even in the most remote places in the world where each village, street and house are connected.

Figure 4: Global Coverage

1.4 Ultra-Low Price

It is worth asking why broadcasters do not use VSAT systems to provide interactive TV services in rural areas. The answer to this question lies in costs involved which

include. Both equipment cost, and service cost - high CAPEX and high OPEX.

Interactive TV services are feasible only if CAPEX and OPEX are both negligible to both for the service operator as well as the consumer.

The Smart LNB is a Low Cost Terminal, Sub 100$, utilizing Ayecka's RFModem – a Modem, a BUC and ***LNB integrated all together in*** an ***ODU.***

The cost of the additional service is also very attractive. It is optimized to reduce operating costs:

- ***Supports millions of remote units***
- ***Optimized for Ka band satellites***
- ***Spread Spectrum to reduce Antenna cost***

1.4.1 Supports millions of remote units

The Smart LNB system is designed to provide service to millions of terminals. The system is designed to support More than 8 ***Million terminals on a 5MHz space segment. It is assumed that an average user will be using 10K Bytes per day for the return channel on interactive TV messages and queries. The assumed channel bandwidth is 5MHz (the system can be configured also for 2.5MHz or 10MHz channels). With the 5 MHz channel, the bit rate of the channel is 7.5 mbps, so the practical system utilization is 1.5 bps/Hz.***

The total number of interactive TV subscribers that can be served on a 5MHz channel is calculated as follows: 7.5Mbps * 3600 [sec/hour] *24 [hour/day] / 8 /10K = 8.1 ***Million users***

Assuming the price for 1 MHz of space segment on a Ka satellite is $2k per MHz per month, the service cost per month per user is very low and comes down to: $***2k*5/***8.1M

= $\$1.234^{-3}$ ***This assures that the additional cost for the interactive TV services is on the low level.***

Figure 5: Large number of connected users

1.4.2 Optimized for Ka band satellites

The smart LNB is optimized for Ka band. The Ka transmission is not as in standard VSAT systems where the ODU converts the L-band modulated carrier to Ka frequency. The smart LNB uses innovative direct conversion from base band frequency which saves the cost of the L-band modulation path.

Transmitting narrow band traffic with deep spread spectrum consumes very low power from the satellite.

Ka satellites are designed to have high power and wide bandwidth available. The Ka space segment is mostly used

by broadband services looking to boost the highest bit per Hz possible, which means consuming very high power. The smart LNB consumes very low power and thus can reuse the same satellite resources. This can further decrease the service price of the smart LNB interactive services.

1.4.3 Spread Spectrum to reduce Antenna cost

The smart LNB is designed to use low cost DTH receive-only antenna. The smart LNB aims to reuse the existing antenna at the consumer's site for the new interactive TV services. The utilization of spread spectrum on the transmission side allows this usage. Since the DTH antenna is designed for Ku band reception only, it is usually with low quality and not suitable "as is" for transmission, and furthermore, for transmission in Ka. The smart LNB with its spread spectrum transmission overcome***s this obstacle and enables the use of such a low quality antenna for transmission in Ka band, assuring compliance with regulations. By applying spread spectrum to the transmission, even if the transmission is not accurate, it will not interfere with adjacent satellites. This makes it possible to reduce antenna cost dramatically.***

Figure 6: Low cost DTH antenna

1.5 Optimized for Narrow Band – message type Return Channel

The return channel uses Asynchronous Random Access which is ideal for the following services:

- ***Messaging***
- ***Transaction traffic***
- ***STB return channel***
- ***Smart Grid***

The following mechanisms make the smart LNB optimized for narrow band:

- ***Efficient Access scheme***
- ***Time synchronization***

1.5.1 Efficient Access scheme

The Smart LNB uses low power Transmission type. It transmits QPSK modulation with very strong error correcting Turbo code The transmission employs Enhanced Spread Spectrum Aloha (ESSA) with CDMA codes, which is now a standard defined by Eutelsat. The resource allocation on the channel is pure random access Un-slotted. The Hub receiver supports Iterative Successive Cancellation which compensates for the re-transmissions and increases the channel efficiency, taking it to a very high level. The Hub demodulator is a SW defined ***Radio. The smart LNB terminal supports additional sophisticated techniques to enable optimization of the total channel*** capacity ***– a key for successful commercial implementation.***

The combination of the un-slotted aloha technology of the ESSA coupled with the sophisticated hub receiver enables both low latency for data packets and very high efficiency of the channel. This combination not available before and is mandatory for huge networks such as those supported by the smart LNB

1.5.2 Time synchronization

The time synchronization of the smart LNB is achieved by the insertion of NCR timestamp in the TS stream and is done in order to manage the SI/PSI table signalization.

The central frequency of each emitted signal from the smart LNB terminal should have very high accuracy. The hub signaling consists of timestamp based on the hub clock reference, transmitted as NCR, within PCR packets in a specific PID, in the signaling forward channel in DVB-S2, at a rate of at least 10 times/second. The smart LNB terminal uses the information contained in the NCR to obtain precise internal clock synchronous to the Hub clock reference. This way the frequency drift is minimal and the time for burst sending is fully synchronized with the hub that can demodulate narrow band traffic.

1.6 Second-Screen and Digital Rights Management

1.6.1 Second Screen

Multiroom TV – the distribution of pay TV services to multiple TV screens within each home served – has become an established feature of most service providers' offerings. Multiroom TV is now being supplemented by second screen or multi-device offerings, meaning that TV services are available to users via consumer electronics devices such as tablets and smartphones as well as via traditional set-top boxes within the home. TV operators face a range of challenges in delivering these services and, in particular, in ensuring a consistent user experience across networks over which they have limited or no control. The expectation is that the service delivered to TVs, tablets, smartphones, game consoles and other devices within one

house should be at least as good as that delivered to the main TV screen.

When watching movies or programs on his tablet or smart phone, he wants the same channels delivered in the same quality as what he watches on his TV..

Figure 7: Second Screen

This requires rights management to assure the payment for watching this movie. In linear TV, the CAS solved the issue. The STB had a smart card that provided the licensing and rights to the device.

When a second screen gets video stream over a Wi-Fi ***link, the licensing issue should be solved. The way to solve it is by employing DRM – digital right management.***

1.6.2 DRM – Digital Right Management

DRM is a class of technologies that are used by hardware manufacturers, publishers, copyright holders, and

individuals with the intent to control the use of digital content and devices after sale. There is no standard DRM architecture as there are many different frameworks offered by different vendors. The overall functional DRM framework presented in the Figure below is suited for building digital rights-enabled systems:

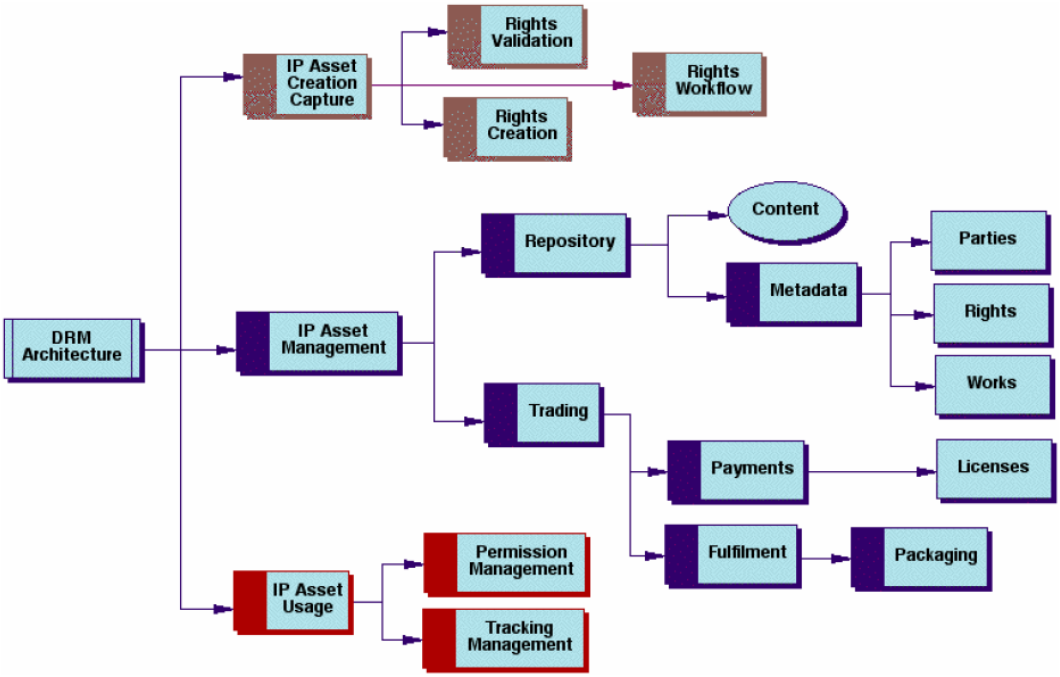

Figure 8: DRM functional Architecture

DRM systems typically include the following techniques:

- ***Encryption***
- ***Public / private keys***
- ***Digital certificates***
- ***Watermarking***
- ***Access control***
- ***Secure communications protocols***
- ***Fingerprinting***
- ***Rights specification language***
- ***Trust infrastructure***
- ***Hashing***

DRM uses a cryptographic algorithm to encrypt content that needs a secret key. Another very important aspect is managing the decryption key. The creation of the key and

its transfer to the customers is the main concern of the smart LNB. The smart LNB allows to exchange the keys for the encryption and decryption of the content,, and most commonly for DRM. Secure Sockets Layer (SSL) and Transport Layer Security (TLS) are those protocols which are used to provide secure communications and are IP-based. The protocols allow client/server applications to communicate in a way designed to prevent eavesdropping. The smart LNB is designed for 2-way IP over satellite.

2 Conclusion

Satellite TV operators are showing strong interest in interactive services, particularly those that enhance the video element in their offerings such as video-on-demand, OTT TV and PVR. Other services that enhance the user experience such as companion screen applications and social networking also attract interest. The smart LNB will allow Satellite TV Operators to launch or plan to launch a range of video-centric interactive services in the near future. OTT is seen as both a threat and an opportunity by service providers, with a clear majority viewing it at least in part as an opportunity.

The smart LNB can provide the infrastructure for a satellite-based OTT supporting network, and bring additional advanced services to the Satellite TV consumers.

The smart LNB is optimized to use Ka satellites at the lowest cost in the most efficient manner.

To the Operator and the consumer, the smart LNB is most appealing from CAPEX and OPEX perspectives.