

Transformation of Cable TV Driven by the Satellite TV Broadcast Revolution

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Abstract — The rapid evolution of satellite TV broadcast technology resulted in a tremendous increase in the number of available TV programs. Cable TV systems worldwide faced the challenge of expanding program capacity to catch up with the ever increasing number of programs being broadcast. In this paper, I will share the sequence of development, which transformed cable TV installations for Oil & Gas residential communities in Saudi Arabia and I will highlight the distinctive nature of such installations.

Index Terms — CATV, coaxial, digital television, DVB-C, satellite TV, satellite and terrestrial broadcasting.

I. INTRODUCTION

Cable TV installations for Oil & Gas residential communities in Saudi Arabia are non-commercial operations. It is provided as a free service for the Oil & Gas workers and their families. Since Oil & Gas is a multinational business with a workforce from all over the world, TV programs provided on the cable TV systems are multilingual to cater as much as possible to the diverse customer base.

20 years ago, TV programs were limited to the terrestrial government channels and the in-house movie channels. On average, only 12 TV programs were provided on each cable TV system. Growth in available TV programs was slow and the cable TV systems at that time were able to accommodate it.

The subsequent rapid development of satellite TV broadcast technology resulted in a remarkable increase in the number of available TV programs. This and the decreasing cost of TV satellite reception equipment were key drivers in accelerating the rate of cable TV system upgrades.

Information Technology from Saudi Aramco was a pioneer in deploying innovative, economical solutions for upgrading Oil & Gas residential cable TV installations to keep pace with the ever increasing number of programs being broadcast.

II. PRIOR TO SATELLITE BROADCASTING

Prior to Satellite Broadcasting, TV programs were limited to terrestrial government channels and in-house movie channels. The number of available terrestrial government channels varied from one Oil & Gas residential community to another based on the community's geographical location. The typical Oil & Gas residential community cable TV installation provided 9 terrestrial government channels, 2 in-house movie channels plus an in-house information channel. The typical cable TV system had a bandwidth of 45-300 MHz with

capacity for 16 analog TV programs using the PAL B channel system and double-sideband TV modulators. Cable TV systems at that time were able to accommodate the slow growth in TV programs, which was generally limited to the addition of government sponsored English language channels.

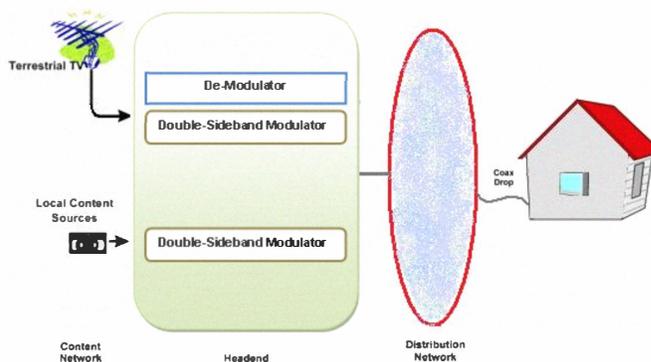


Fig. 1. Typical cable TV system layout prior to satellite broadcasting.

III. AVAILABILITY OF SATELLITE BROADCASTING

The commercial availability of Satellite Broadcasting in 1992 marked the beginning of the true transformation of the cable TV systems. Satellite broadcasting started mainly with government programs. Geographical location was no longer a predominant factor in determining the number of available TV programs for cable TV installations.

Cable TV system upgrades were initially accomplished by replacing the double-sideband TV modulators with single-sideband modulators. The replacement resulted in a nearly two-fold increase in system capacity, boosting the number of available channels to 30, thus providing the necessary capacity to accommodate the initial analog satellite TV broadcasts. This also necessitated the use of mid-band and super-band cable channels in addition to the standard VHF broadcast channels. However, since most of the TV sets sold locally at that time were not cable TV ready, cable TV converters were provided to residents to enable them to view the additional programs on cable TV channels.

V. HIGH POWER SATELLITES BROADCASTING

Satellite TV broadcasting continued to advance with the introduction of higher power satellites and relatively inexpensive broadcasting equipment. At the same time, satellite transponders previously used for 1 analog TV broadcast now accommodated up to 10 digital TV programs with a resulting decrease in transmission costs. Subsequently, the enormous increase of available Satellite TV content put more pressure to upgrade cable TV systems to accommodate additional programs.

In response, in 2004 cable TV system capacities were upgraded by replacing the UHF analog TV modulators with DVB-S to DVB-C transmodulators. The narrower bandwidth VHF channels below 300 MHz continued to provide analog TV programs using analog TV single-sideband modulators. This resulted in a hybrid analog/digital cable TV system. The lower band is a conventional analog cable TV system while the higher band is a digital DVB-C cable TV system. The hybrid analog/digital cable TV system provided 650+ program capacity. Digital DVB-C set-top boxes had to be provided to end-users.

Unlike the analog cable TV system, little control could be applied on the digital DVB-C cable TV system since only format conversation of the digital Satellite TV Broadcast data stream was applied. Having limited control over the digital DVB-C channels was not an issue since cable TV installations for Oil & Gas residential communities in Saudi Arabia are non-commercial operations. Moreover, this was a very cost effective solution considering the much lower cost for DVB-S to DVB-C transmodulator equipment compared to satellite receivers, multiplexors, digital DVB-C modulators and associated equipment needed to implement a digital cable TV head-end providing custom packaging of digital content. In other words; by deploying DVB-S to DVB-C transmodulators we were able to capitalize on the TV satellite broadcast operator's investment.

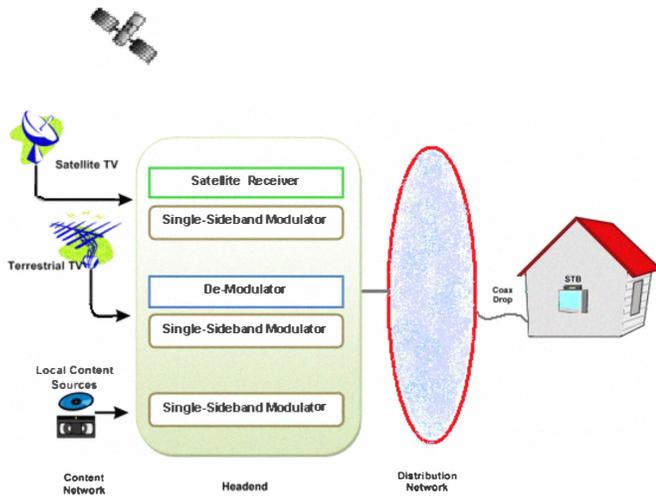


Fig. 2. Typical satellite cable TV system layout.

Soon non-government broadcasters started launching their TV broadcast services. The large potential customer-base and ability to bypass local authorities red tape was what attracted non-government broadcasters to initially launch their services. Moreover, continuing advances in satellite broadcast technology and the decreasing cost of satellite TV receive systems served to expand the television audience.

To accommodate this additional increase of available satellite TV programs, cable TV systems had to be expanded. However, to support the additional channel expansion, the cable TV outside distribution network including amplifiers and passive components had to be upgraded. Outside distribution network bandwidth was upgraded by increasing the upper frequency limit from 300 MHz to 550 MHz, thereby raising total capacity to 65 channels to provide for the increased availability of TV programs.

IV. COMMERCIAL DIGITAL SATELLITE BROADCASTING

The advent of commercial Digital Satellite Broadcasting to the region in 1994 accelerated the pace of change. More TV programs became available from different parts of the world, for example: Europe, the Middle East, the Indian subcontinent, and the Far East. The typical cable TV system bandwidth of 500 MHz could not accommodate the multinational customer's requests to add more and varied TV programs to the systems.

Cable TV systems had to be expanded. Once again, the cable TV outside distribution network including amplifiers and passive components were upgraded. By increasing the outside distribution network upper frequency limit to 862 MHz, the cable TV system bandwidth achieved the maximum capacity of 100 analog TV channels.

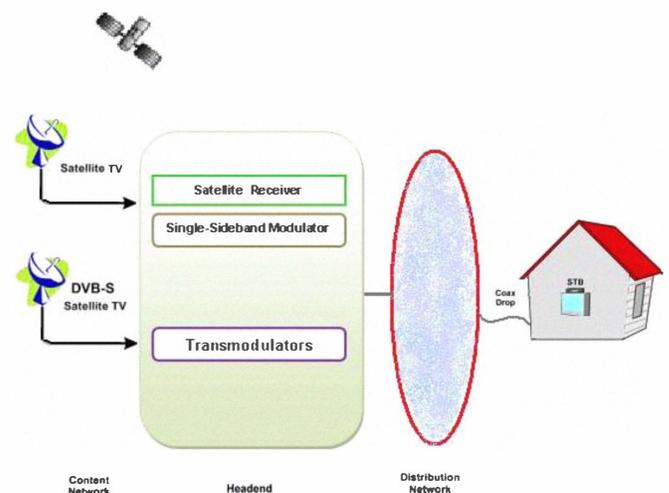


Fig. 3. Typical hybrid analog/digital cable TV system layout.

VI. CURRENT DIGITAL CABLE TV SYSTEM

With the available program content continuing to increase and taking into account the divergent interests of communities comprised of people from around the world, the hybrid analog/digital cable TV system providing 650+ programs was still not enough. In reality, the 650+ channels system capacity represented only 69 satellite transponders.

To accommodate demand, the digital cable TV systems are being supplemented with satellite IF multiswitching systems. The satellite IF multiswitching systems capitalize on the TV satellite broadcast operator's investment and utilize the existing cable TV distribution cables to provide each resident the additional capability to access thousands of programs from multiple satellites using consumer-grade DVB-S digital satellite receivers and locally mounted satellite antennas. Limited control could be applied on the satellite IF multiswitching systems since cable TV system act only as medium to transport satellite TV broadcasting digital data stream.

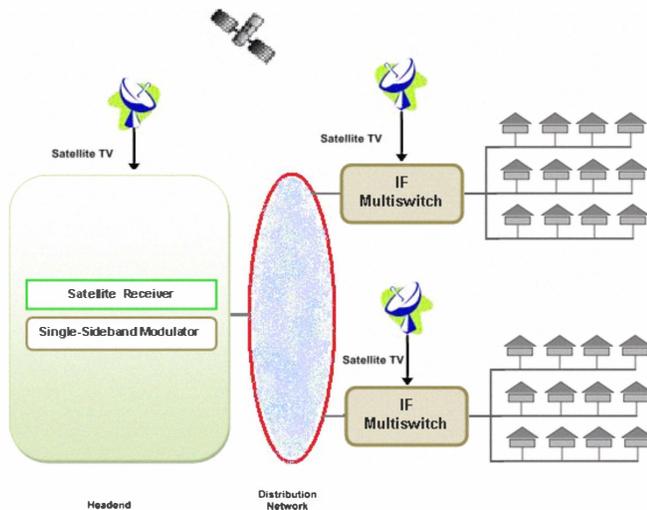


Fig. 4. Typical hybrid RF/IF cable TV system layout.

Cable TV program capacity of the hybrid RF/IF cable TV is nearly 150-fold more than cable TV system capacity prior to Satellite Broadcasting as illustrated in the following figure.

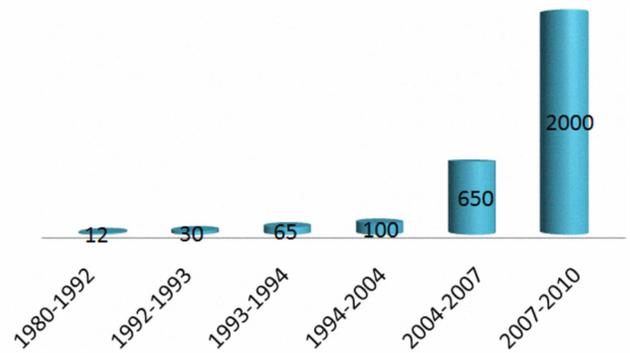


Fig. 5. Cable TV Programs Capacity over the last three decades

VII. CONCLUSION

20 years ago, cable TV operators could not imagine that Satellite TV broadcasting would threaten the existence of cable TV systems. The continuing advances in satellite broadcast technology and the decreasing cost of satellite TV receive systems, in addition to the cross-continent customer-base and ability to bypass local authorities regulations, resulted in having thousands of satellite TV programs available for the audience to watch. For non-commercial cable TV operators, supplementing cable TV systems with satellite IF multiswitching systems offers an economical solution for providing cable TV system customers with large number of programs.

ACKNOWLEDGEMENT

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REFERENCES

- [1] K. Lohse, "Upgrading CATV systems for interactive services", *IET Conferences, International Broadcasting Convention*, Conf. Publ. No. 428, pp. 219 – 229, 1996.
- [2] P. Brendle, and J. Speidel, "Upgrade of coaxial CATV networks for upstream high speed digital communication", *IEEE Journals, IEEE Transactions on Broadcasting*, vol: 44 , Issue: 3, pp. 353 – 362, September 1998.
- [3] T. Kratochvil, "From analog to Digital Television — the common way how to digitize European broadcasting", *HISTELCON 2008. IEEE*, pp 164 – 169, 2008
- [4] J. Thomas and F. Edgington *Digital Basics for Cable TV Systems*, Prentice Hall, November 26, 1998.
- [5] R, Freeman, *Fundamentals of Telecommunications*, IEEE Book, pp 431 -456, 2005.
- [6] W. Ciciora, J. Farmer, D. Large and M. Adams, *Modern Cable Television Technology*, Morgan Kaufmann; 2 edition, December 8, 2003.