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RESEARCH ARTICLE

Last Mile Access Solution For the Provisioning Of Affordable Internet In The Rural & Semi Urban Areas.

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Manuscript Info	Abstract
	Today world is a global village because of Internet. Everything is movingtowards automation either it can be a person with a heart monitor implant, sensors to alert a farmer about humidity or water level under the fields, to a driver about the low pressure of tire, e-health and other manmade objects. All this is possible when it can be assigned IP address [1] and ability to transfer data over the network. Such network has been close relationships with machine-to-machine (M-2-M) communication [2] in gas, power and oil utilities. Smart is often being referred products built with M-2-M capabilities. The main challenge to meet above is to extend footprint of broadband (IP network) networks across the world including rural, semi urban and hilly areas of each country by using cost effective solution. In this paper we explain how to transport triple play services [3] over the coaxial cable by using the existing network of CATV [3] TV cable service providers. In my research we take case study of Pakistan cable TV market.

Introduction:-

Johan Walson was the man introduces the CATV first time in 1948.Walson was a owner of a sale store of TV sets in Mahanoy city, Pennsylvania, a hilly area. Due to this the reception of TV signal was poor. This terrain situation had badly impacted his business of selling the TV sets. One day an idea came to his mind and he installed an antenna on a mountain and lays a coaxial cable from antenna to his store. In this way he got good picture on his TV set. That day, in June 1948 was first CATV group setup displayed on the shop of Johan Walson. Later he laid coaxial cable from his shop to the home of his customer to satisfy about reception of TV set. To provide a good quality reception of TV signals to his far away located customer he added an amplifier in order to boost the RF TV signal.

In Pakistan the Cable TV CATVintroduced in Karachi in early 1980s [4]. It was a small scale network, providing 3 to 5 channels including PTV. In 1990 many broadcast channels started via satellite transmission which made the cable TV more attractive for the viewers.

According to PEMRA Report [5] the basic statistics for the Financial Year 2010-2014 an overview of Cable Tv industry is given below in table 1,2 and Figure 1 [5].

Table 1

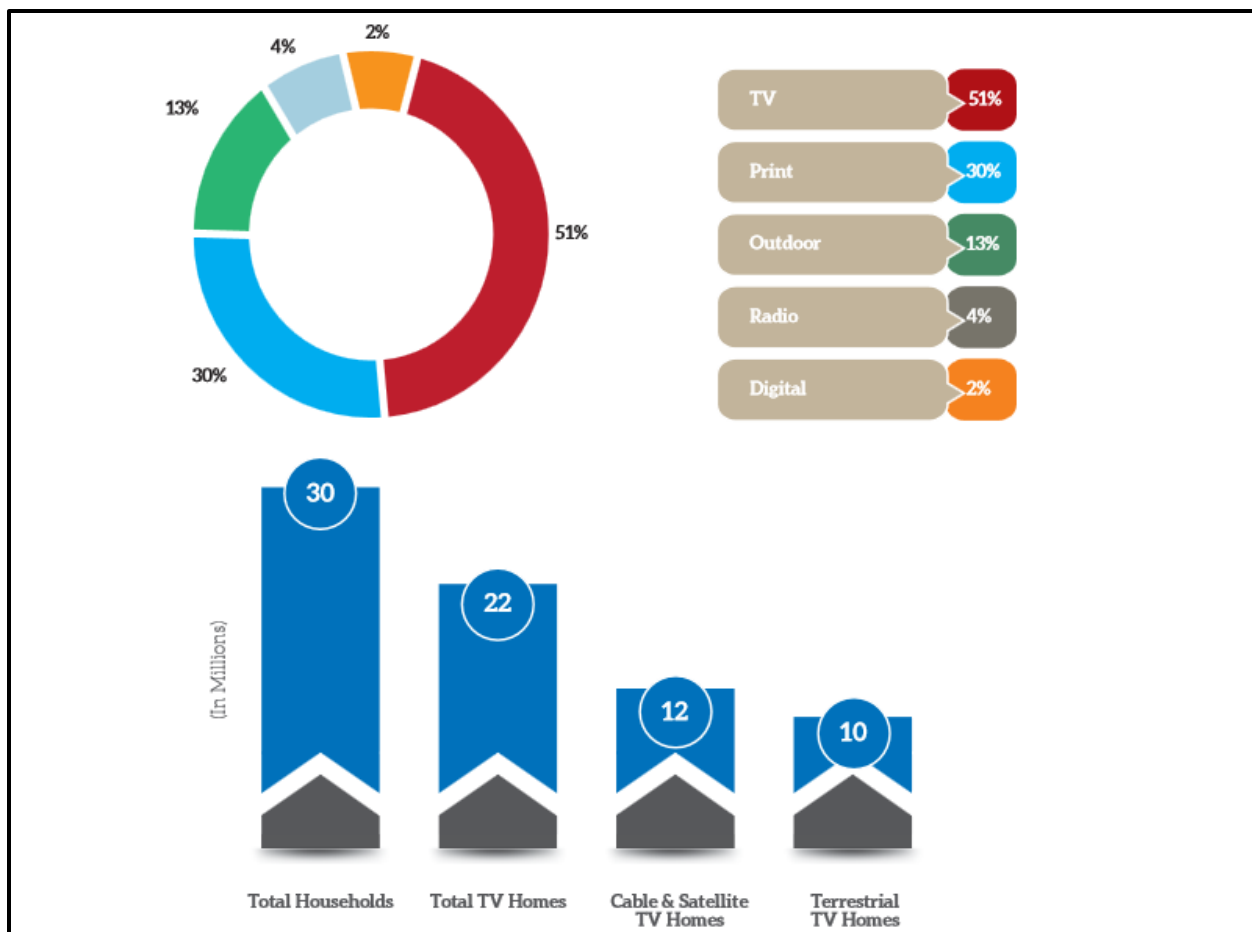|	
Total Population	180 million (As per last Census Report)
Total Area	796,095 sq. Kms
Per capita income	US$ 1,200/-
Total Advertisement Market	PKR 47 bllion

Figure 1

Table 2

Total TV Viewers (Cable,Satellite& Terrestrial)	135 million (75% of total population)
Total Cable & Satellite Viewership	74 million (55% of total viewership)
Total Terrestrial Viewership	61 million (45% of total viewership)
Cable TV Penetration (In %age)	70% aprox
Analogue cable TV penetration	97% (total cable TV homes)
Digital cable TV penetration	03% (total cable TV homes)
Cable TV penetration in Urban areas	85% (of TV homes)
Cable TV penetration in Rural areas	60% (of TV homes)

The Cable TV licenses issued by PEMRA from 2002 to 2014 are given in the following Figure 2 [5].
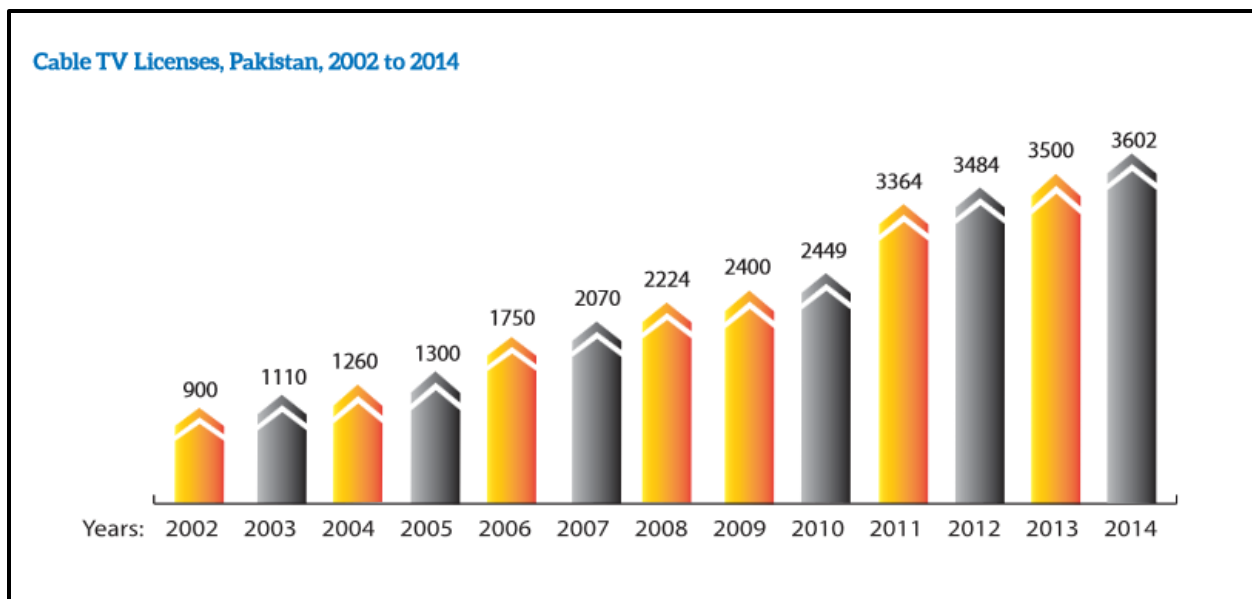
Figure 2

From the above Figure 2 PEMRA has issued 3602 cable TV licenses. Most of cable TV service providers in Pakistan deliver TV channels on analogue mode. They are using bandwidth of 860MHz in which the maximum numbers of TV channels are 106. In future this bandwidth could get enhanced to 1000MHz.

As per above statistics the Cable TV penetration in urban areas is 85%. In these areas broadband services are transported to customer end via DSL, 3G, EVDO, LTE and WIMAX technologies. But still there is a big market of broadband services in rural and semi urban areas where these broadband services cannotaccess by the customers due to absence of IP network infrastructure. In these areas according to PEMRA the Cable TV penetration is about 60%. To capture this market I develop a solution in which we can use this existing CATV Cable TV network as last mile to transport triple play (Voip, Internet & TV) [6] services to customer door over the coaxial cable.
There are two types of CATV networks in Pakistan are providing TV services. One is analogue CATV network and another is digital CATV network [4].

Architechure of catv network:-
The current architecture of CATV network in Pakistan is shown in the Figure 3. The major components of the network are:
- Headend (Analogue/Digital)
- Combiner
- Transmitter (1310nm/1550nm)
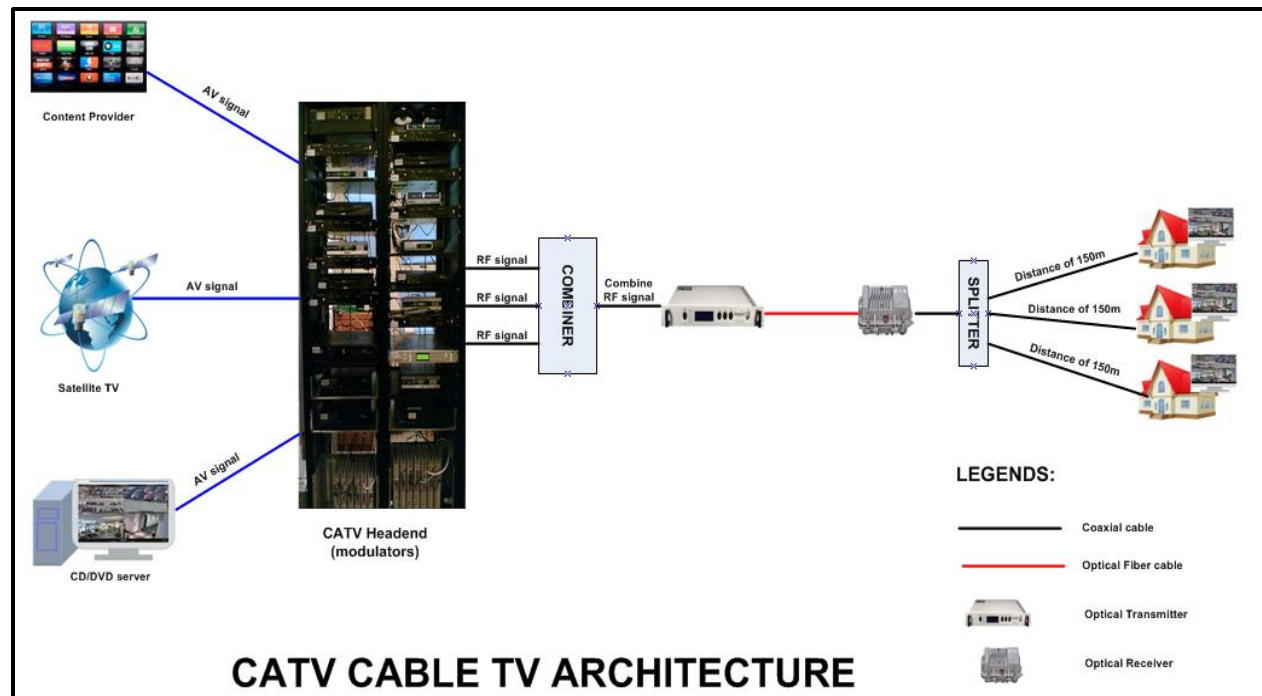- Receiver
- Splitter
- Amplifier

Figure 3

Solution to transport triple play services over catv cable tv network:-

In this solution we place an OLT node at core site to transport IP signal over the optical fiber in the hybrid CATV Cable TV network. The OLT is connected with the internet cloud for internet , VOIP server for phone and video server for NVOD (narrow video on demand), gaming server to play network sharing games via uplink optical/GE (giga Ethernet electrical) ports through respective VLANs (virtual local area networks). These VLANs are then transported along with their respective services to end users via downlink PON (passive optical network) ports. The trans receive wavelengths of OTL is 1310nm/1460nm whereas the wavelength of CATV transmitter is 1550nm. Therefore in order to transport two different wavelengths (RF TV signal ,IP signal) over a single fiber we use a passive device WDM (wavelength division multiplexer) as shown in the Figure 4. Before the receiver node we use again WDM to separate the RF TV and IP signal. After separation RF TV fiber single mode interface is input into the CATV receiver and IP optical signal is input into the modulator. This modulator has two input ports one is coaxial RF and another is IP optical port. This modulator is based on IEEE 1901 [7] and compatible with home plug AV protocol [8]. This can transmit/receive Ethernet signals over the CATV coaxial cable, occupy low frequency band outside the frequency range of the existing CATV. This modulator consists of following basic units:

- Uplink optical data module
- Downlink optical reception module
- EOC (Ethernet over cable) module

The uplink optical data module receives different VLANs from OTL for respective IP services. Whereas downlink optical module is used to deliver the required bandwidth as per user requirement over the EOC module. The capacity of EOC module depends on manufacturer that plan according to customer requirement based on quality of service (QoS) parameter. It can support i.e, 30, 60 , 120 users and so one . This modulator has functionality of mixing the RF TV and IP signal and transport it upto a radius of approximately 500m viaits output coaxial port with good power level signal without any amplifier.
At the user end we use a modem including two RF ports one for cable and other for TV along with fast Ethernet ports (FE). Inside the modem there is circuit of filter that separate the signal of RF TV and IP with respect to their frequencies. It deviate the low frequency signal towards FE ports and high frequencies towards TV RF port.The user can easily experience a broadband of 8Mbps over its existing coaxial cable with a very low cost.
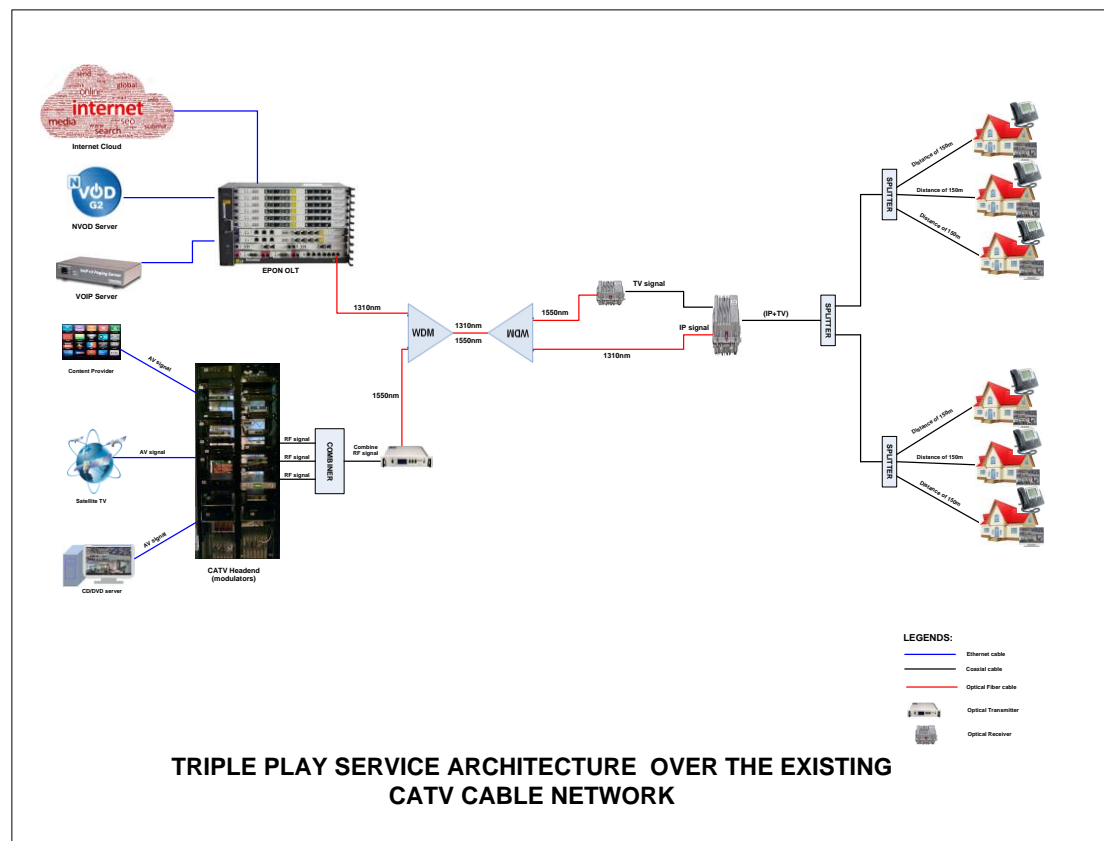
TRIPLE PLAY SERVICE ARCHITECTURE OVER THE EXISTING CATV CABLE NETWORK

Figure 4

The deployment of such solution not only save the huge cost ($100000) of cellular mobile operators by installing their per BTS site, spectrum utilization ,OPEX (operational expenditure) in semi urban and rural areas but also save the cost of expensive copper deployment of fixed line telecommunication operator. It gives them an opportunity to share the infrastructure of these cable TV network service providers as a joint venture to extend IP services to end users as a partner. It will not only increase their revenue but also reduce the OPEX (operational expenditure) cost. The cellular mobile operators can expand their coverage using FEMTO CELL [8] concept by backhauling the IP bandwidth over these coaxial cable networks.

References:-
1. Characteristics of Wide-Area TCP/IP Conversations by Ramon Caceres, Peter Danzig, Sugih Jamin, and Danny Mitzel.In *ACM SIGCOMM,* 1991.
2. M2M Communications in the Smart Grid: Applications, Standards, Enabling Technologies, and Research Challenges by Siok Kheng Tan, Mahesh Sooriyabandara, and Zhong Fan. Telecommunications Research Laboratory, Toshiba Research Europe Ltd., 32 Queen Square, Bristol BS1 4ND, UK.
3. http://people.seas.harvard.edu/~jones/cscie129/nu_lectures/lecture13/CATV/CATV.html
4. Cable TV & Direct to Home Television Scope in Pakistan (ISBN: 978-969-9368-06-6)
5. http://www.pemra.gov.pk/pemra/images/docs/pub-rep/PEMRA_REPORT_2014.pdf
6. Implementation and Analysis of SOFTSWITCH for Triple Play Services,Malik Salahuddin Nasir, Muhammad Usama, Kamran Saeed, Sabir Hussain, Syed Baqar HussainCS&IT Department, Superior University,17-km off Rawind Road Lahore PakistanElectronics Department, The University of Lahore, 1-km Raiwind Road Lahore
7. https://standards.ieee.org/news/2011/bpl.html. FINAL IEEE 1901 BROADBAND OVER POWER LINE STANDARD NOW PUBLISHED. **PISCATAWAY, N.J., USA,** 1 February 2011 — IEEE, the world's largest professional association advancing technology for humanity, today announced that the final IEEE 1901™ Broadband over Power Line (BPL) standard was finalized in December 2010 and is now published and available for purchase or through the IEEE Xplore Digital Library.
8. https://www.qualcomm.com/products/small-cells/technology