Performance Evaluation of a proposed EPON-WiMAX Converged Network Architecture

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Abstract
For the next generation of communication networks, WIMAX and EPON (Ethernet Based Passive Optical Networks) are two potential broadband access technologies. The EPON function allows the backhaul of WiMAX Networks to achieve increased bandwidth and enhanced spectral efficiency. Some access architectures for the combination of EPON and WiMAX technologies have been proposed in this chapter. The architectures arising from this can benefit dually from the increased bandwidth of fiber optics and wireless communication's mobility. This concept was based on the proposal of an integrated architecture that reduces the design and operating expenses for the new access networks.
Keywords:
PON (Passive Optical Networks), EPON (Ethernet based Passive Optical Networks), BS (Base Station), ONU (Optical Network Unit), WIMAX (Worldwide Interoperability for Microwave Access), QoS (Quality of Services)

I. Introduction

The Internet became a fundamental element of everyday life since web browsing. The key needs of today's digital world are: VOIP, online LAN gaming, online banking, etc. Researchers & Network Engineers always endeavor to improve bandwidth, robustness and increased transmission speed access more reliable [1]. The Internet is available via wired networking, e.g. via a physical media, or via a wireless network employing smart antennas. One such project is the deployment of fiber optic technology, which has entirely replaced the standard copper wires, coaxial cables and torn pair cables for communications reasons, as the speed and bandwidth requirements of Internet users continuously increase. Applications such as HD video streaming on platforms such as YouTube, Facebook, require a100mbps internet connectivity. It is therefore necessary that our internet services should be able to provide larger bandwidth, particularly at the end of the subscriber [2].

Manuscript received November 5, 2022
Manuscript revised November 20, 2022
https://doi.org/10.22937/IJCSNS.2022.22.11.99

II. QoS in EPON & WiMAX Network

The need for internet connection is growing day after day to satisfy current needs like IPTV, VOIP, and HD Video Streaming. A promising answer in this respect is EPON [1–3], which provides low-cost broadband access deployment. Similar analogues indicate proliferation of wireless approaches because of their QoS, transmission efficiency, cell site coverage, and the support of quality of service (QoS). The next generation wireless access technology, known as WiMAX, has now been adequately standardized and deployed with the development of wireless LAN technology [4-6]. Thanks to Optical Fiber, super-high bandwidth backhauling is available in WiMAX. The cost of operating the fiber optic core network remains a major concern, however, in contrast to wireless access technology which provides not only ease of installation but also lower deployment costs. An additional advantage of the wireless technology is assistance for mobility. In addition, a wireless system usually retracts several sub-stations from a central office by an optical fiber feeder (CO). In this context, the merging of EPON and WiMAX could be a promising approach. In general, this integration has numerous reasons. EPON and WiMAX first of all offer different enhanced bandwidths. EPON provides up to 10 Gb/s of downstream and upstream bandwidth to a number of remote offices. . The usual optical network device bandwidth is approximately 100Mb/s. Second, it is possible to allocate dynamic bandwidth and programmed data packets that give greater QoS and improved network performance. Thirdly, the system can enable compatible broadband network access and mobility [7], decreasing the network's implementation and operating costs.

this research, we started by surveying the different existing teaching strategies. This survey looked at different ways and mainly focused on traditional and virtual teaching strategies. We looked at techniques of such systems and the acceptance of these strategies by job market as well as students.
The results of the survey would be important in comparing these techniques to the new technique of

III. Convergence Strategy

The best approach to merge two separate technologies, EPON and WiMAX, is to employ its equivalent independent systems where both systems are independently connected to ONU with WiMAX Base Station. Note that both devices that have connected are supported by the common standard interface (e.g., Ethernet).

Thus, the technology offers an integrated Fixed Mobile Convergence. Both the independent architecture can be connected to each other without any specific configuration in this type of interaction. As a result of the independent operation, ONU is not aware of WiMAX Base station package scheduling, and WiMAX is similarly unfamiliar with the ONU data packet scheduling mechanism. The proposed design cannot therefore fully take advantage of integration, in particular when assigning the integrated system dynamic bandwidth. In addition to it such systems require a complex integration and high deployment cost. As demonstrated in Fig.1, this architecture is an advanced integration. The full integration of devices in both H/W and S/W is supported by this configuration. The greatest benefits of this architecture are lower circuitry and cost of deployment. Because the integrated network units have full bandwidth, packet forwarding, packet re-routing, and ONU and WiMAX BS packet scheduling information, it requires simple processing procedures for upstream bandwidth allocation of the EPON network, and data packets scheduling downstream from the WiMAX network. As a result, total system performance was greatly boosted compared to independent design with respect to performance and QoS.

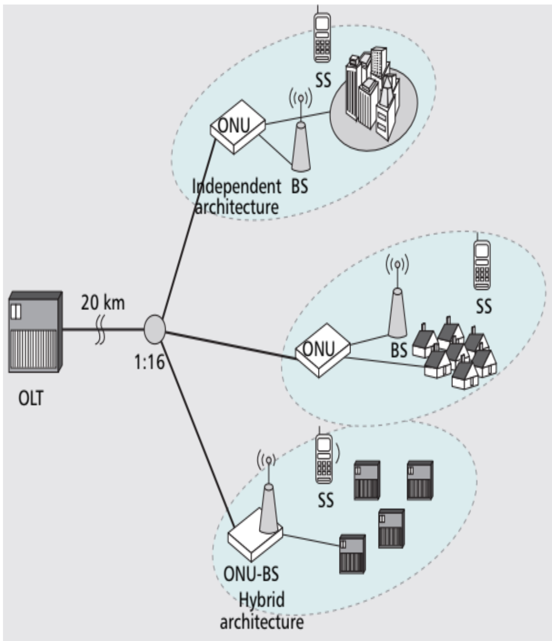

Fig. 1 Hybrid Architecture for Integration of EPON & WIMAX

IV. Handover

Handover is a key aspect in user mobility support. The hybrid designs should facilitate the transfer. As illustrated in Fig. 2, an OLT works as a coordinator to finish the entire transfer procedure. The major purpose of the transfer coordinator is to deploy the control over appropriate microcells in the transfer procedure. A dedicated channel should be created to allow the central handover controller to exchange data with the WiMAX BS in real time at each remote node in order for the mobile user to be reconnected while the new BS connects. The new design in transfer operations is more efficient than the previous integrated systems. As every user’s traffic in a central office is controlled and managed, no dedicated control channels are required for the entire system. In the case of user transfer, WiMAX Base Stations monitor the user's packets with the isotropic antenna and check the source of these data packets. If the user traffic originates from the same frequency of the subcarrier, no changeover is necessary. If the user traffic originates from another optical subcarrier, transfer operation shall be necessary.

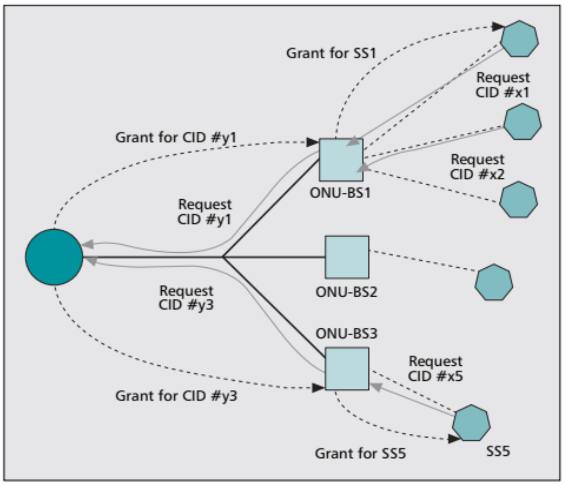

Fig.2 Bandwidth request & allocation

V. Dynamic resource allocation Algorithm

In WiMAX networks, QoS provisions are facilitated by the use of connections as well as service flows. There is a mapping of each connection in the uplink channel of a subscriber station (SS) to a base station (BS). The five services flows are defined as: *Unsolicited Grant Service* (UGS), *extended real-time Polling Service (*ertPS), *real-time Polling Service* (rtPS), *non-real-time Polling Service* (nrtPS) and *Best Effort* (BE). For real-time services with fixed packet sizes, UGS is used & ertPS is basically used for services having variable packet sizes with silence suppression. For real-time services, rtPS is deployed which allows variable bit rate transmissions with minimum rate and delay bound. Bandwidth request related queries is handled by BE.

On the basis of algorithm, a Migration based QoS scheduler has been proposed which handles the amount of Bandwidth in real time traffic. In order to support the minimum bandwidth requirement, a priority table has been maintained on the basis of decreasing order of priority. Lower the bandwidth requirement higher will be the priority values which are to be assigned for the requests of connection. The Dynamic resource allocation algorithm will guarantee that the total sum of the bandwidth allocated for a single connection should be less than or equal to the maximum traffic burst requirement. In case of violation, the scheduler is not able to allocate bandwidth for a connection against the maximum sustained traffic rate.

VII. Simulated Results

An event driven simulation has been carried out in NS-3 simulation software for the proposed resource allocation algorithm & an observation has been done in real time traffic. Table I defines the various simulation parameters taken for consideration.

TABLE I
PARAMETERS FOR SIMULATION

No. of Optical Network Units (ONU)	15
No. of Optical Network Units-Base Station (ONU-BS)	1
No. of SSs	25
Assigned data rate assigned for WiMAX	30Mbps
Assigned data rate assigned for EPON	1Gbps
Buffer size of ONU	10Mbyte
Stealing time for one cycle	5ms
WiMAX Frame Length	5ms

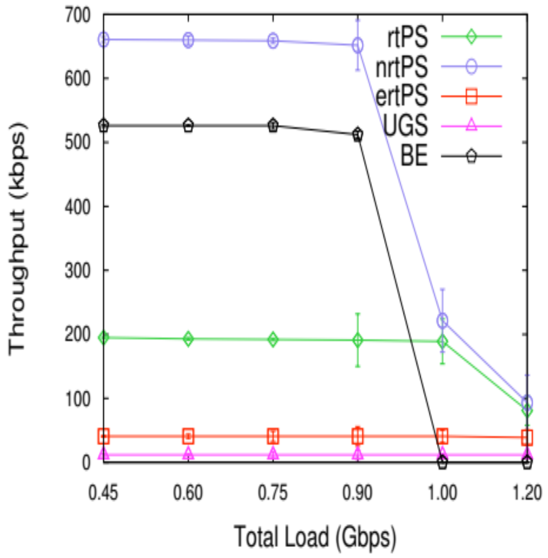

Fig.3 Throughput Vs Total Load for Hybrid EPON-WiMAX Network

VII. Conclusion & Future Scope

In this research manuscript, the performance of an integrated EPON-WiMAX network has been analyzed in real time traffic. The proposed dynamic resource allocation algorithm serves the QoS requirements for various standard services in terms of connection flows according to the channel capacity provided by the EPON network. On the basis of simulation results, it has been observed that the proposed algorithm is efficiently managing the distribution of bandwidth among various WiMAX service flows in real time traffic for all connections.

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