

An Advanced Resource Allocation Algorithm for PON-LTE Converged Networks

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Abstract

Enhanced radio access technologies (RAT) are deployed in Next Generation Convergence Networks by the service providers so as to satisfy the basic requirements of end-users for e.g.-QoS. Whenever the available resources are being shared simultaneously & dynamically by multiple users or distribution of allocated channels randomly, the deficiency of spectral resources and dynamic behavior of Network traffic in real time Networking, we may have problem. In order to evaluate the performance of our proposed algorithm, computer simulation has been performed on NS-2 simulator and a comparison with the existing algorithms has been made.

Keywords:

PON (Passive Optical Networks), LTE (Long Term Evolution), LTE-A (Long Term Evolution-Advanced), DBA (Dynamic Bandwidth Allocation), QoS (Quality of Service), Mobile speed (MS), latency (L), packet size (PS), packet loss (PL), and jitter (J), Medium Access Control (MAC)

1. Introduction

In the last developing years of Networking, a rapid development in the field of converged networks has been observed.

Typical converged network architecture is shown in Fig. 1. represents a typical converged architecture. UMTS, LTE, LTE Advanced, PON, RATs all are typical subsystems of 5th generation cellular mobile systems. In converged networks, basically integration of two or more different access technologies have been done for providing an enhanced version of mobility, better coverage, improved bandwidth & lesser delay while using various kinds of multimedia services over the communication channel. By using RATs, end users are able to transmit their data simultaneously.

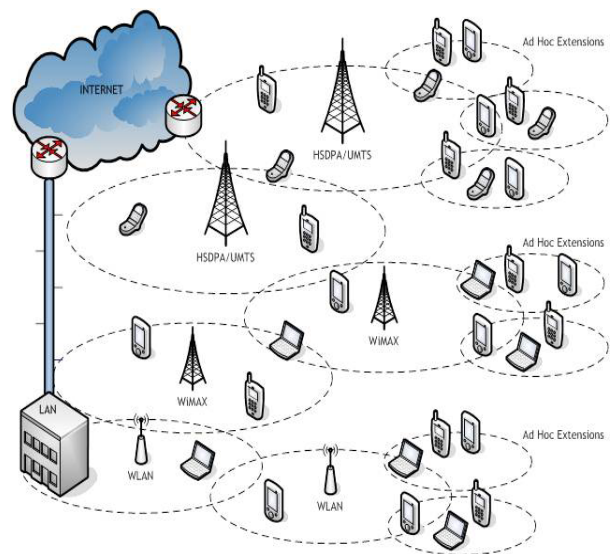


Fig. 1. Typical Converged Network

2. Literature Survey

We have observed a massive development over the past years in the field of wireless communication & its related entity. [1–41]. Real-time & non-real time allocation of resources due to random distribution of channels have caused congestion problem in network. Traffic [1–12, 17–41]. When large no. of users tries to share the available resources simultaneously, it may cause the problem in the system. We already have three existing resource allocation algorithms viz., dynamic bandwidth allocation (DBA) algorithm, static bandwidth allocation algorithm, and joint

power band-width allocation (JPBA) algorithm which had been proposed for Converged wireless Networks [25–41]. The schemes were more focused on resource allocation and they have ignored the traffic management in their implementation which leads to end-to-end delay, data packets loss and an overall poor network throughput in converged networks [25–41]. Hence, these existing schemes are not so efficient for dynamic allocation of data. In order to overcome this limitation of existing resource allocation algorithms we have proposed a modified & enhanced resource allocation (ERA) algorithm with traffic diversifying feature & improved throughput characteristics.

3. Proposed resource allocation algorithm

In order to improve Network Performance in Converged Networks the resource allocation is done as per the traffic load & QoS Criteria. In order to design, the proposed ERA Algorithm, a wavelet based Neural Network prediction model has been used & this algorithm uses Latency, Packet Size, Packet loss, Mobile speed & Jitter as input parameters for efficient allocation of bandwidth in converged networks. By doing so, it is observed that this minimizes end to end delay & packet losses resulting in improved throughput performance and QoS in converged networks. A flowchart has been presented for the proposed Enhanced-Resource Allocation algorithm in Fig. 2.

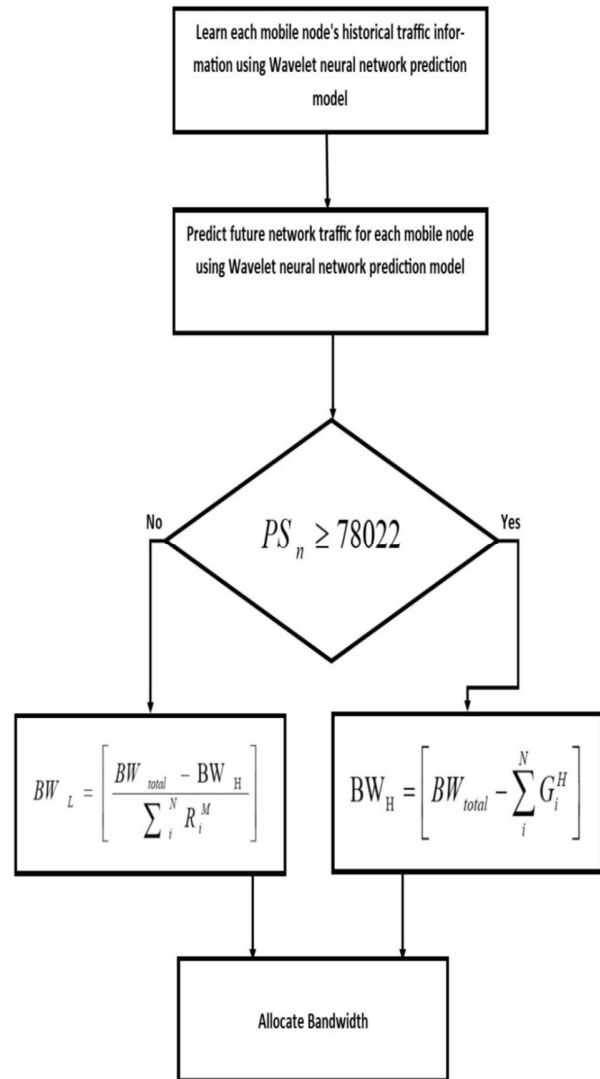


Fig.2. Proposed ERA Algorithm Flowchart

4. Simulation based Performance Evaluation

A real time simulation has been done for testing the efficiency of the proposed algorithm. For this purpose, an Open Source Software viz., Network Simulator (NS-2) has been used since it is an open source software which is widely used for developing real time simulation environment in applications like Network Traffic Models & Networking Protocols [13–24]. In the simulation, the simulated radius for each base station is assumed within a radius of

250 m. IEEE 802.11 standard has been considered with a data transmission rate of 2Mbps with a bandwidth of 2.4 GHz. The simulation parameters are listed in Table 1. A comparison has been made between the proposed ERA algorithm along with that of JPBA and DBA algorithms. The JPBA and DBA algorithms are conventional algorithms which has already been tested previously[25–41].

Table 1. Parameters for Experimental Simulation

Simulation Parameters	
Routing Algorithm	Link State Vector Routing
Standard Protocol used	IEEE 802.11 (MAC Protocol)
Propagation Model	Rayleigh Fading
Queuing Model	Drop Tail
Total No. of participatingNodes	10
Allocated Bandwidth of the Network	10 Gbps
Area chosen for simulation	250m X 250m

5. Analysis based on simulated results

I. Average Bandwidth Allocation

It is observed that simulation results shown above depicts that the proposed algorithm utilizes 98.2% of the allocated bandwidth whereas it is observed that JPBA utilizes 82% of the allocated bandwidth and DBA algorithm utilizes only 79% of the allocated bandwidth.

The reason behind it is that the proposed algorithm is using wavelet-based prediction model for analyzing the bandwidth requirement & forecasting the traffic where DBA & JPBA algorithms do not have any such mechanism as

a result of which both of them are failed to analyze and predict the bandwidth requirement & forecasting the real time Network Traffic.

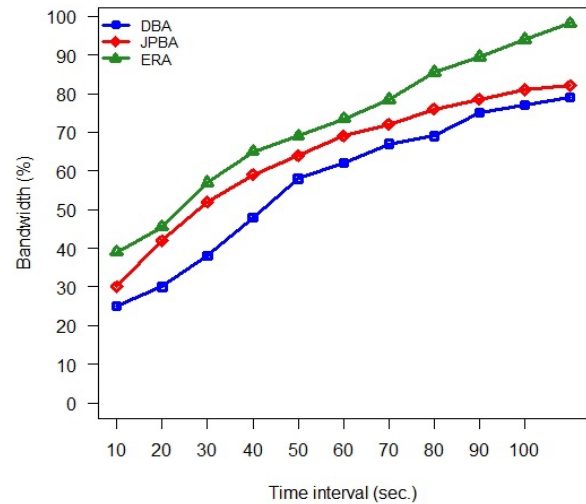


Fig. 3. Average Bandwidth Allocation

II. Average End-End delay

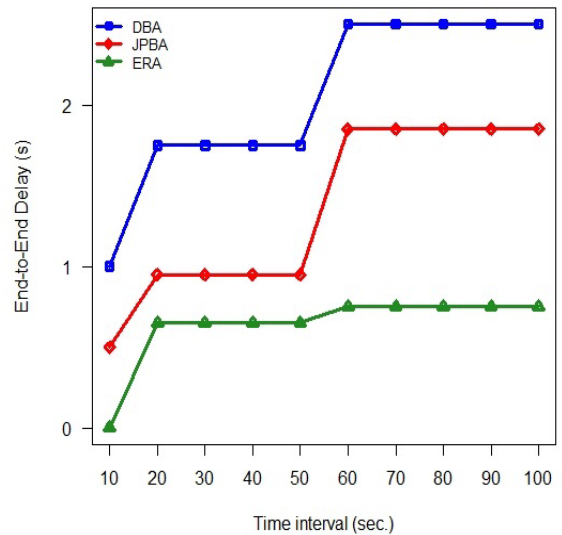


Fig. 4. Average End-End delay

The average time taken by the data packets to reach its destination from its source is termed as average end to end delay. From the simulation results, it is observed that ERA

algorithm with minimum average end to end delay performs better than JPBA and DBA algorithms with a value of 0.75 as compared to JPBA and DBA algorithms with a value of 1.6 and 2.2 respectively for a time interval of 100 seconds. The reason behind it is that the ERA algorithm has historical information about the traffic intensity of each participating nodes since it is based on prediction model whereas other two algorithms are completely failed for real time analysis of traffic intensity in the network.

III. Average Packet loss

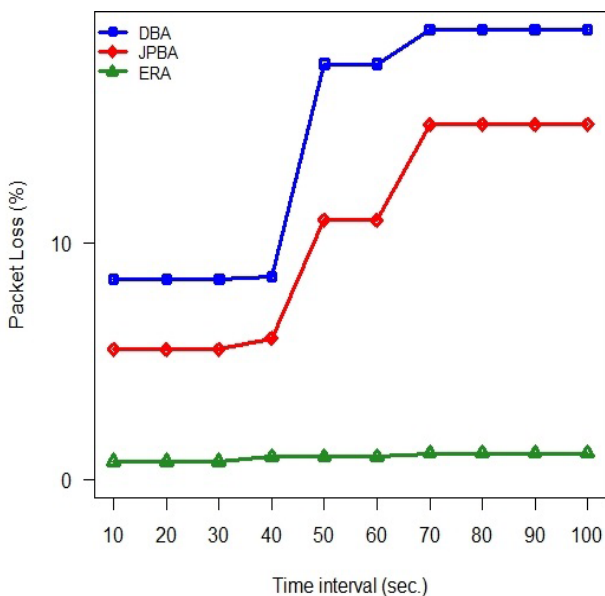


Fig. 5. Average Packet loss

Packet loss refers to a phenomenon when or more data packets are failed to reach its destination. The possible reason behind the loss of data packet is slow transmission speed, network disruption due to failure of any intermediate networking device like switch, router, etc., & loss of network connectivity. From the above simulated result, it has been clearly observed that the ERA algorithm

experiences comparatively a lesser average packet loss of approximately 1.1% whereas the other algorithms viz. JPBA & DBA experiences the average packet loss of around 15% and 19% respectively. The higher average packet loss of JPBA & DBA is due to the inefficient allocation of bandwidth as discussed in first simulated result.

IV. Average Throughput

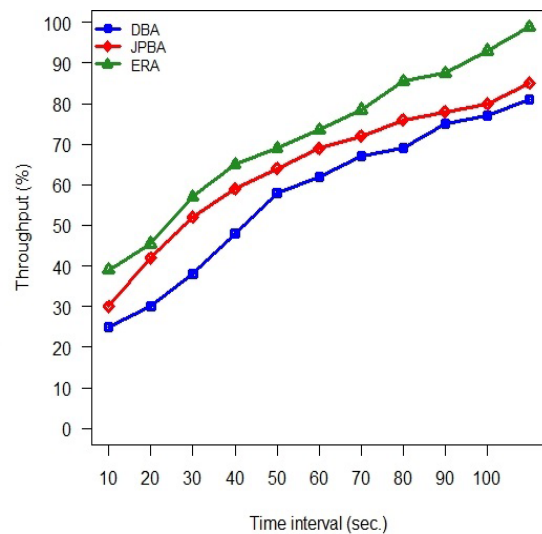


Fig.6. Average Throughput

With an efficient bandwidth allocation, the proposed algorithm results in 98.9% throughput performance in overall networking. The improved and better throughput is also contributed by lesser end-end delay & minimized packet losses in the proposed algorithm. The average throughput performance of the proposed algorithm outperforms the throughput performance of JPBA & DBA as indicated in Fig. 6 with 85% & 81% respectively.

6. Conclusion & Future Work

Exploiting the wavelet based Network Predication Model for forecasting and analyzing the real time traffic and Bandwidth

requirement of each participating node, an ERA algorithm has been proposed.

As a further scope of study, the performance of the proposed algorithm may be evaluated in more complex network environment with larger no. of nodes & greater coverage radius in information systems.

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