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Effective Utilization of Bandwidth in IEEE 802.16 Networks Using RRSA

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Abstract : In IEEE 802.16 networks, usage of bandwidth has been rapidly increased in wireless networks. Optimal usage of bandwidth, maintenance of QoS and guaranteed services are the challenging tasks in recent years. The existing Priority Based Scheduling (PBS) Algorithm has lower bandwidth utilization. In order to address this issue, this paper proposed a modified Round Robin Scheduling Algorithm (RRSA). This research focused on enhancing the bandwidth utilization by effective utilization of the unemployed bandwidth and provided effective QoS and guaranteed services compared to existing algorithms. The bandwidth utilization has been increased from 45% to 52%. The simulation of the proposed approach is performed in NS2 and it efficiency is determined in terms of optimal utilization of the bandwidth, maintenance of QoS and guaranteed services compared to the existing traditional algorithms. The IEEE 802.16 networks reserve more bandwidth compared to its demand. The performance of this approach mainly accomplished on increasing throughput and the network without delay.

Keywords : Wireless Networks, QoS, guaranteed services, unused bandwidth, IEEE 802.16 standards.

1. INTRODUCTION

In the recent days, the need of broadband wireless access networks augmented progressively in numerous application domains [2]. However, the prevailing broadband wireless access networks are incapable to fulfill entire necessities of most of the individuals who require longer distance and higher speed broadcasting. The Worldwide Interoperability for Microwave Access (WiMAX) mesh networks depending on IEEE 802.16 standard (2004) was constructed with the aim of giving flexible, quick and cost efficient network structure, distribution and extension [1].

WiMAX permits the operations from 2 GHz to 11 GHz. Pertaining to huge accessible continuum, WiMAX is developed to expedite amenities with higher data rates for multimedia appliances [4]. Wireless broadband networks have newly attained vigorous fascination. As it has higher bandwidth range, it would augment the traffic challenges. To proficiently exploit unemployed bandwidth and provide other individual who requires further bandwidth for a specified intermission is becoming a vital constraint in wireless networking [3].

In the IEEE 802.16 frameworks two stages are defined, known as physical (PHY) stage and medium access control (MAC) stage. Numerous progressive transmission procedures are employed such as Orthogonal Frequency Division Multiplex or Orthogonal Frequency Division Multiple Access and Multiple Input Multiple Output. Therefore, it is tend to predominantly aim at IEEE 802.16 frameworks. This framework was developed to assist the bandwidth requiring appliances. In IEEE 802.16, two types of stations exists, such as Base Station (BS) and Subscriber Station (SS). The BS synchronizes entire interconnections in the network. Every network has its individual single BS. The SS can provide voice, video, and information employing single common interface. An IEEE 802.16 framework assists two functions of modes, initial one is the obligatory point-to-multipoint (PMP) approach, and the other one is the elective mesh approach. In the PMP mode, an integrated BS is proficient of

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interconnecting numerous SSs to diverse public networks connected to the BS, the traffics could merely happen amongst the BS and SSs. In the mesh mode, the SSs could likewise function as routers through cooperative access controller in a disseminated fashion. The inter relations amongst BS and SSs has two ways [5] such as uplink (from SSs to BS) and downlink (from BS to SSs).

The IEEE 802.16 network is connection-oriented. It provides the benefit of having enhanced regulation on network resource as to deliver QoS amenities that are definite. So as to assist a extensive kinds of appliances, the IEEE 802.16 framework categorizes traffics into five scheduling groups depending on diverse QoS needs: Non-Real-Time Polling Service (nrtPS), Best Effort (BE), and Extended Real-Time Polling Service (ertPS) ,Unsolicited Grant Service (UGS), Real-Time Polling Service (rtPS). Whenever working on appliances, the SS categorizes every application to one of the organized groups and constructs a relation with the BS depending on its organized groups. The BS allots an interconnection ID (CID) to every link. Whenever a link requires higher bandwidth, the SS appeals for the bandwidth depending on its CID through transferring a BR. While getting a BR, the BS could either permit or reject the appeal based on its existing resources and organized strategies.

An energetic bandwidth request-allotting approach for practical functions are suggested in [1, 6]. This approach forecast the quantity of bandwidth to be requested depending on the knowledge of the backlogged degree of traffic in the line and the rate incompatibility amongst packet arrival and service rate to enhance the bandwidth utilization. The study specified above enhanced the efficiency by forecasting the traffic occuring in the upcoming. As an alternative to forecasting, the suggested approach permits SSs to exactly recognize the part of unemployed bandwidth and offer a methodology to reprocess the unemployed bandwidth. This could enhance the utilization of bandwidth while pertaining the similar QoS assured facilities and presenting no additional interruption.

A. Organization of the paper

A brief discussion of the Wireless Network, WiMax and IEEE 802.16 networks are given in this section. The existing schemes and diverse approaches in IEEE 802.16 for bandwidth utilization is described in section 2. The proposed Round Robin Scheduling algorithm using dynamic allocation is explained in detail in section 3. The experimental results and its brief analysis of the simulation is given in section 4 followed by conclusions and references given in section 5 and in section 6.

2. RECENT ISSUES IN IEEE 802.16 NETWORK

Significant portion in carrying out the network facilities exists in prevailing techniques. The IEEE 802.16 framework was developed to aid the bandwidth needed appliances with QoS. Bandwidth is preserved for every appliance to confirm the QoS. This constant data broadcasting depend on the scheduling approaches of MAC layer in IEEE 802.16x. The initial IEEE 802.16 framework, 802.16-2001, is the native stable wireless broadband air interface description in the 10–66 GHz frequency band for LOS merely on wireless provisions. The 802.16a was finished in 2003 to outspread the strategies in 2–11 GHz for non-NLOS wireless broadband provisions [9].

An effective uplink bandwidth request-allotted approach for flexible rate practical services in IEEE 802.16 BWA networks is suggested in [6]. So as to diminish bandwidth surplus deprived of humiliating QoS, an idea of target interruption is introduced and proposed twofold feedback structure. This approach calculates the quantity of bandwidth request in such a way that the interruption is controlled round the preferred stage to diminish delay violation and delay jitter for practical operations. Its efficiency is estimated in terms of queue controller, optimum bandwidth distribution, delay controllability, and toughness to traffic attributes.

A simple single stage scheduling technique is presented in [7] which is much enhanced when compared to the hierarchical approach. It is designed since there is no time to perform the scheduling assessments. Consequently, [7] suggested a scheduling outcome depending on the round robin (RR) technique. This claimed that it is not essential to employ domains such as fair queuing (FQ) as the weights in these kind of approaches are floating numerical whereas the number of allotted slots, in 802.16 networks, need to have an integer value.

The requirement of MAC-PHY level construction is demonstrated and justified by means of initial simulation performed in [8] where it presented a cross-layer optimization architecture for WiMAX systems. The cross-layer optimizer (CLO) suggested in this study, works as an interface amongst MAC and PHY layers to attain and adjust the essential and optimal constraints.

The preliminary types of policies define the order of request bursts and allocates consecutively the position to every burst, pertaing on the features of every burst to alter its locations. Efficient Downlink Bandwidth Allocation Scheme (EDBA) [10] employed this policy. It selected and arranged the collection of requests in non-increasing sequence that could employ the maximum Modulation layer and Coding rate Scheme (MCS), depending on the approaches identical to OBBP to define the conceivable outlines of burst. In [11] and [12], the authors suggested standards to minimizes the waste, however the complete unemployed slots and over-allotted slots in their simulations still outstrips 20% of entire bandwidth reserves.

3. PROPOSED ROUND ROBIN SCHEDULING ALGORITHM USING DYNAMIC BAND WIDTH REQUEST-ALLOCATION APPROACH

So as to attain higher bandwidth utilization in an IEEE 802.16 network, in this paper a novel methodology is introduced. In this approach, the complete network is segregated into number of different region by means of using Round Robin Scheduling Algorithm (RRSA) where the Base Station is at the center and all the Subscriber Station are around the BS. The divided regions has constant bandwidth where these bandwidth is provided to the surrounded subscriber station by the Base station. The regions of bandwidths are available to the nearest nodes for its efficient and effective usage.

A Round Robin Scheduling technique is mainly employed for sequence the process in several time. The RR scheduling approach is the most extensively employed scheduling approach owing to its fairness and malnourishment free concepts. This is the best scheduling algorithm and compare to all algorithms. It is first come first server scheduling algorithm. The working of the suggested approach and the effective usage of the network is given in the below sections.

(*a*) Proposed Round Robin Scheduling Algorithm using Dynamic bandwidth request-allocation Algorithm:

The scheduler of CPU takes the process from the circular queue, put a timer to suspend it after 1 time slice and dispatches it.

1. If the best time of the process less than 1 time slice
   (*a*) Reject the process of CPU then completion
   (*b*) Circular queues of next process will be proceeded by the CPU
2. Else if the best time of the process more than 1 time Slice
   (*a*) Stopping of the timer, Because of the OS will be interrupted. The process started.
   (*b*) The process of the execution is put in the Ready Queue, then applying the process.
3. The Scheduler of CPU is proceeded, then next process will be selecting in the Ready Queue.

A. Bandwidth Utilization

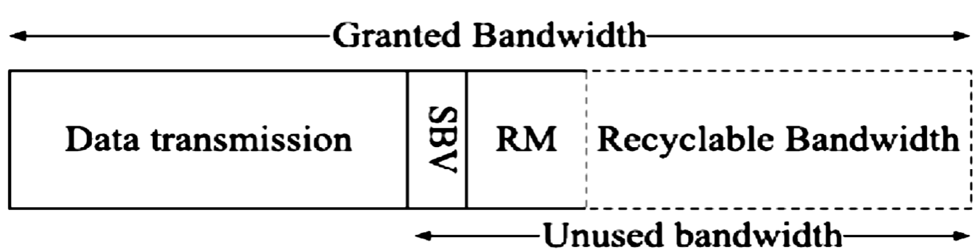

Fig. 1. Bandwidth Utilization.

These enhancements are suggested n the survey. In an energetic resource reservation technique is suggested. It could vigorously alter the quantity of reserved resources based on the authentic number of dynamic inter-connections. The study of dynamic bandwidth reservation for hybrid networks is presented here. This approach estimated the performance and efficiency for the hybrid network, and suggested proficient technique to safeguard optimal arrangement and exploitation of bandwidth while diminishing signal blocking likelihood and signaling price.

B. Packet Creation

In this section, the information is divided into N number of stable size packet with Maximal dimension of 48 letters.

C. Bandwidth Recycling

The complementary station (CS) sees for the probable chances to reprocess the unemployed bandwidth of its consistent TS in the frame. The CS data organized by the BS exist in a list known as complementary list (CL). The CL comprises of the charting connection amongst every pair of priori allotted C and TS.

D. QoS Guaranteed Services

It is dissimilar from the bandwidth alteration where the altered bandwidth is imposed as quickly as possible in the subsequent upcoming frame. Furthermore, the unemployed bandwidth is expected to be released temporarily (*i.e.*, merely in the present frame) and the prevailing bandwidth reservation do not alter. Thus, this technique enhances the whole throughput while offering the similar QoS confirmed services.

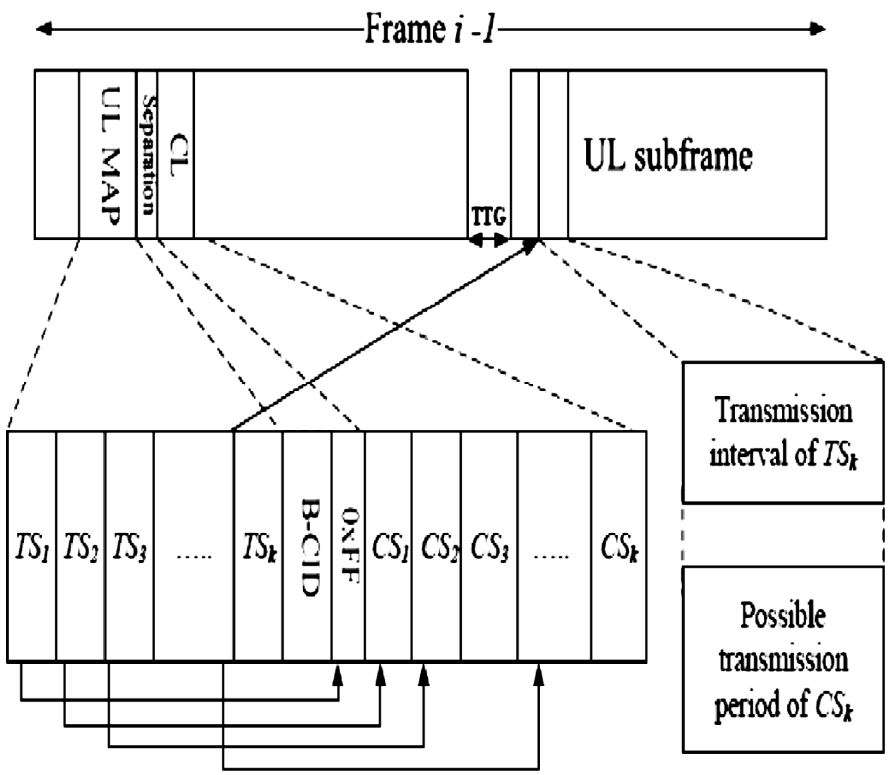

Fig. 2. Bandwidth Recycling.

E. Traffic and Packet Performance

The Packet average information rate of every appliance makes the average packet dimension arbitrarily pick from 512 to 1024 bytes. Therefore, the average packet arrival rate could be defined depending on the equivalent average packet size. As stated previously, the dimension of every packet is determined as Poisson distribution and the packet arrival rate is determined as exponential distribution. The other aspect that might influence the performance of bandwidth reprocessing is the possibility of the RM to be attained by the CS positively.

4. EXPERIMENTAL RESULTS AND ITS ANALYSIS

This paper is proposed for the effective bandwidth utilization where the bandwidth recycling is employed to reproces the unemployed bandwidth once it happens.

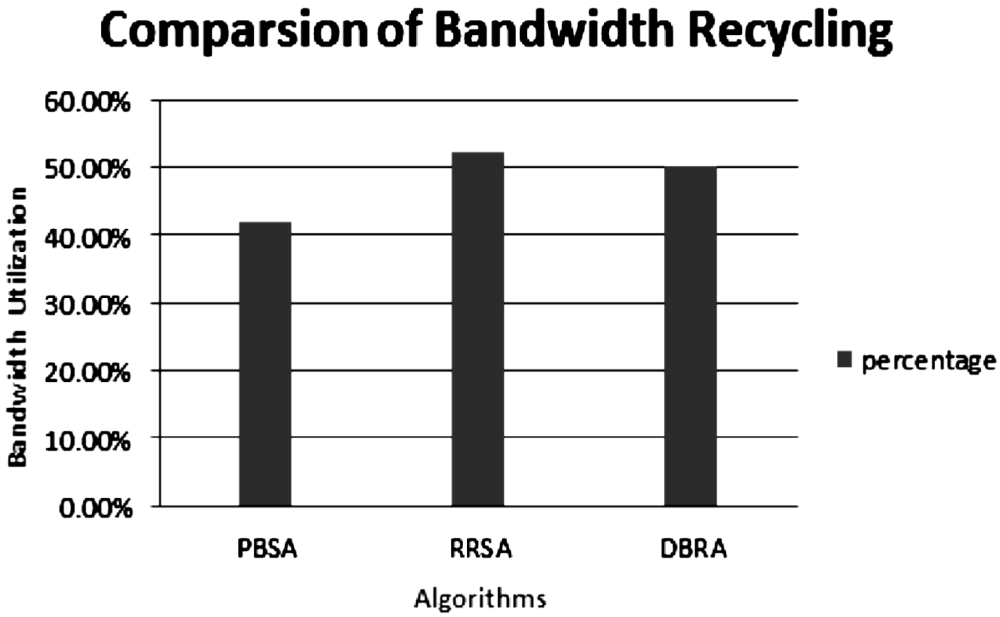

Fig. 3. Comparison of Bandwidth Recycling.

The experimental results for the proposed approach was carried out using NS2 Simulator and is compared with the existing Priority Based Scheduling Algorithm as given in Figure 3. From this figure, it is observed that the effective utilization of bandwidth is done in the Proposed Round Robin Scheduling Algorithm using Dynamic bandwidth request-allocation approach. The proposed approach outperforms in terms of effective bandwidth utilization with high throughput compared to the existing approach as demonstrated in figure 4 and figure 5.

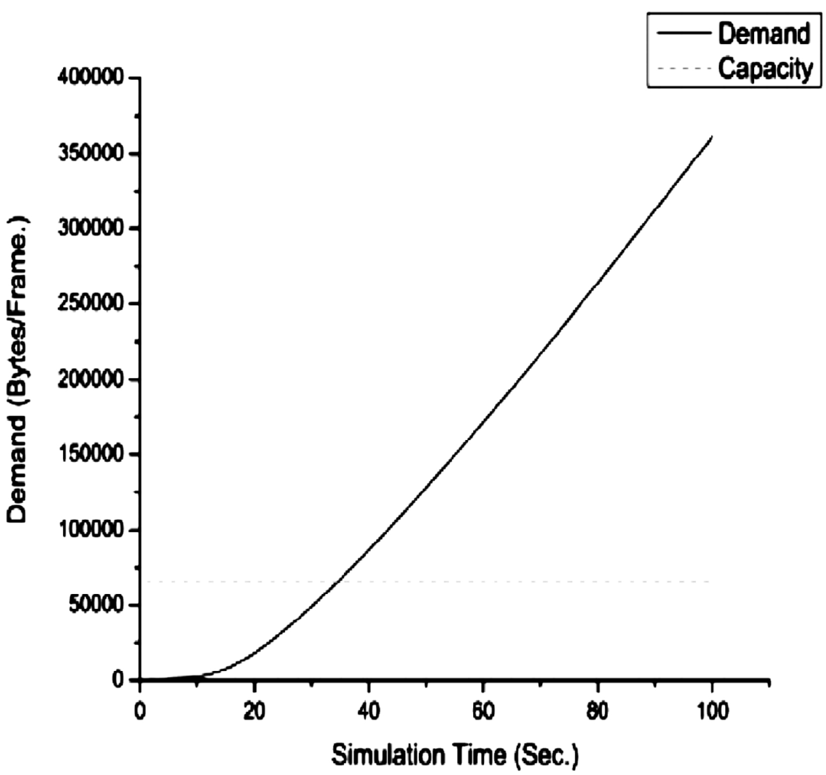

Fig. 4. Utilization of Bandwidth using RRSA.

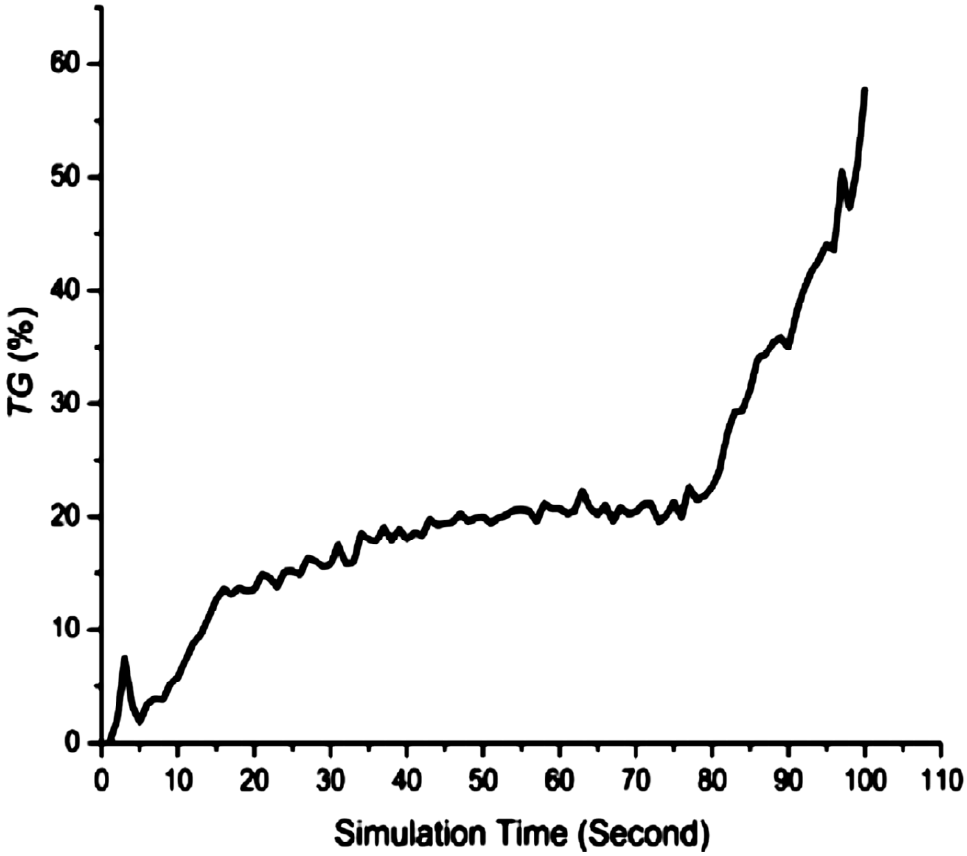

Fig. 5. Throughput of RRSA.

5. CONCLUSION

The Round Robin Scheduling Algorithm using Dynamic bandwidth request-allocation approach is suggested for the effective bandwidth utilization where the bandwidth recycling is employed to reprocess the unemployed bandwidth once it happens. It permits the BS to re-arrange a complementary station for evert broadcasting station. Every complementary station maintains the complete UL broadcasting intermission of its consistent TS and stand-in for any chances to reprocess the unemployed bandwidth. In addition to the conventional priority aided scheduling approach, a novel Round Robin Scheduling Algorithm using Dynamic bandwidth request-allocation approach is presented as to enhance the reprocessing efficiency. The scientific and simulation outcomes endorse that the Proposed Round Robin Scheduling Algorithm using Dynamic bandwidth request-allocation approach scheme not merely improved the throughput, however further reduced the delay with trivial overhead, satisfied the QoS necessities and guaranteed services.

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