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PROVIDING STABLE TELECOMMUNICATION BASED ON CYBER PHYSICAL SYSTEM AND UBIQUITOUS NETWORKS IN FI-WI

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ABSTRACT

The demands of the mobile users, number has been increasing by leaps and bounds. In order to deal with such a mass user's demands, the optical network is considered to be appropriate for the backhaul network because it is capable of providing stable communication and huge bandwidth. The unstable expansion of smart devices astonishingly that requires real time communication challenging in Quality of Service like smart grid, medical, and traffic control systems, which build smart society. Require real time communication demanding Quality of Service(QoS)- centric applications for CPSs. Multiple techniques for providing service guarantees are presented, including data link layer Quality of Service schemes, network layer schemes, integrated approaches, Quality of Service routing, dynamic class adaptation. The proposed system Ubiquitous networks are capable of providing both wide bandwidth and flexibility. Problem involving Quality of Service dreadful environment in a Ubiquitous networks. A broader trend in the need to satisfy the Quality of Service requirements of Fi-Wi network users is delineated in the work. The work demonstrates how low cost and wireless mesh networks can be collective to facilitate the communication of smart power grid systems. Improve the QoS performance of the Fi-Wi access networks for CPSs.

Keywords: Fi-Wi, QoS, Ubiquitous network, CPS.

INTRODUCTION

Newly, due to the wide improvement of wireless access networks, we can use high speed wireless communication by utilize after that generation wireless access networks, such as Worldwide Interoperability for Microwave Access (WiMAX) The IEEE 802.16 standard was urbanized to transport non-line-of-sight (NLoS) connectivity between a subscriber station and base station[1]. Long Term Evolution (LTE) in cellular network, or level by with IEEE 802.11n and 802.11ac based Wireless Local Area Networks (WLANs).the improvement of smart and transportable devices (e.g., smart phones, smart sensors, and so forth), Cyber-Physical Systems (CPSs) [1]. have attracted much notice large-scale distributed CPS comprising of numerous machines, sharing radio resource efficiently with the existing wireless networks while maintaining sufficient quality of service (QoS) for machine-to machine(M2M) communications becomes an essential and challenging requirement. By utilizing the wireless networks to interact among cyber and physical components, CPSs can improve many smart systems such as smart grid, medical, and traffic control systems which construct smart society.

Although the development of wireless techniques gives us fascinatingly convenient communication facilities, the network capacity of the backhaul network will gradually, if not drastically, diminish as it is not enough to meet the demands of the mobile users, number of whom has been increasing by leaps and bounds. In order to deal with such a mass user's demands, the optical network is considered by many researchers to be suitable for the backhaul network because it is capable of providing stable communication and huge bandwidth [2].Optimal operating wireless bandwidth and number of interfaces therefore, the Fiber-Wireless (FiWi) network high-speed mobile connectivity by leveraging the speed of optical networks which integrates optical networks and wireless access networks attract more attention for supporting next generation CPSs in a future ubiquitous network.

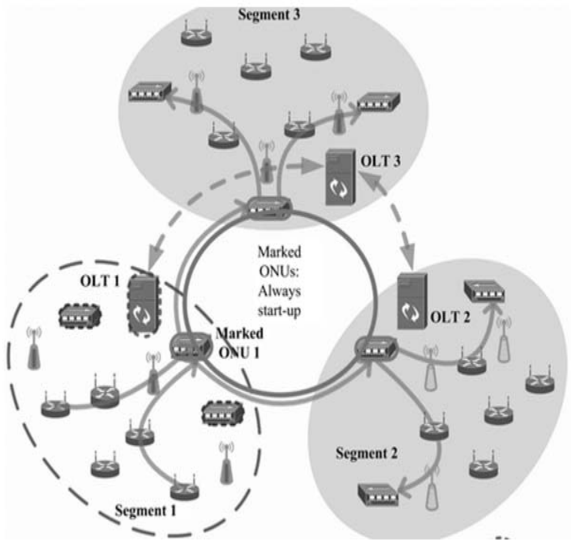

Figure 1. System architecture

A FiWi access network comprises WLAN and Passive Optical Network (PON) technology for CPSs as given away in Fig. 1. The WLAN consists of set Access Points (APs) and mobile users, sensors, or "changeable stations" (STAs). An AP manages the communications of a number of STAs, which are in the AP's treatment area. On the additional hand over, the PON consists of Optical Line Terminals (OLTs), Optical Network Units (ONUs), and a passive splitter (note that all of these devices are fixed). The OLT controls both uplinks with downlink communication of all ONU, which are linked to the OLT through the passive splitter. In this network, we can assemble a WLAN athletically since the AP can be handily set not including any complex mean such as consumption of bottom station in cellular networks[2][3]. Also, the PON provide a wide bandwidth and stable communication with low power spending since it uses passive devices prepared with control saving schemes. In adding together, the rate of construct [3] all WLAN and PON is realistically low. Suitable to these features, the FiWi may be measured to be an attractive knowledge to assemble the high bandwidth requisite of the ever growing number of mobile user and sensors for CPSs.

A FiWi access network based on WLAN and PON technology is, but, not with no its shortcoming. A grave limitation of such a FiWi network is its communication latency, which can critically shape the QoS of real time communications. As a STA start real time communication, the communiqué linking the AP and STA is illegal by IEEE 802.11e in order to promise the QoS of this communiqué. Past that, the statement packets are transmitting via OLT from side to side the ONU. For this, the packet stay put buffer in the ONU pending the OLT allows the ONU to transmit by means of Dynamic Bandwidth Allocation (DBA)

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As a consequence, transmission latency occurs in the ONU. This transmission latency causes degradation of QoS for real time communications, e.g., transmission delay, jitter, and packets drop. This problem mainly arises due to the fact that the corresponding QoS control schemes of the WLAN and PON technologies operate independently. In other words, they do not operate in a synchronized fashion, and contributes to the transmission latency, which severely degrades the QoS.

We detail discuss about the architecture in Fig 1. Inside organize to solve this problem, in our paper, we propose a cooperative QoS control scheme stuck between the WLAN and PON. The remains of this paper are controlled since follow. A rundown of current applicable workings is accessible in segment II. Division III introduces QoS control technique of in cooperation WLAN and PON [4]. Segment IV present our intended QoS control proposal. Segment V estimate the projected scheme through computer-based simulation, and present breakdown of the imitation outcome.

RELATED WORK

A of QoS provisioning technique comprise be residential newly for "Radio and Fiber" (R&F) networks. Hybrid optical wireless networks present the future-proof solution to the currently deployed copper access infrastructure. Purposing to increase the network throughput under the hybrid framework [3], we propose a scheduling scheme to deliver diverse services by taking the quality of service (QoS) requirement into consideration a new method of fabrication of helicoidally long-period fiber gratings by twisting a single mode fiber with CO_2 laser beam [2].equally federal and scattered scheduling technique be investigate for effectively combine Ethernet PON (EPON) and WiMAX technologies aim at attractive QoS necessities such as network throughput and end-to-end latency[5]. In addition, various types of bandwidth allocation scheme based on Max-Min Fairness (MMF) or Proportional Fairness (PF) criteria have been developed to increase not only system throughput but also user fairness.

A places of interest the actuality that FiWi network research on "layer 2" has started, however, not yet gain much prime of life. The work enumerate a numeral of imperative research challenge in FiWi environment, specifically incorporated channel transfer and bandwidth allocation, collective path selection, end-to-end QoS carry, and so on[1][2]. By quarrelling that an extra exhaustive study of complex QoS provisioning schemes is requisite to support multimedia application and military in R&F networks such as FiWi, it then planned an Ethernet-based "Super MAN" access-metro network with optical-wireless interface concerning EPON and WLAN-based mesh networks. It is as well exposed in that occupation that deploys hierarchical frame aggregation across EPON and WLAN-based mesh networks significantly enhance the throughput-delay presentation. Fiber-Wireless (FiWi) access networks must be able to transport video traffic in an efficient way due to the fact that video will account for the largest part of global consumer traffic. To reduce the energy consumption of FiWi networks and guarantee the performance of video applications, issues related to the energy-efficient Quality-of-Service (QoS) support for video delivery in IEEE 803.3az Energy Efficient Ethernet (EEE)-based FiWi access networks are addressed in this paper [6]. Also, a green QoS differentiated routing scheme was proposed in nature of FiWi networks and improve the QoS support for video delivery by proposing a green QoS differentiated routing strategy [3]showing that there are different ways of meeting QoS demands in FiWi networks. Furthermore, the research conducted in this purpose a mathematical formalization and an algorithm are developed also attests to the benefit of adopting FiWi access networks as they bring great prospects for energy savings in addition to cost-effective solutions. It is worth mentioning that the research in access networks because of the growing demand for digital traffic by end users highlights the following important point. The flexibility of FiWi networks in terms of energy saving becomes useful only if the QoS experienced by the users can be kept at acceptable levels [7]. For instance, more communication hops can lead to increase in delay and decrease in throughput, and this QoS degradation may be noticed particularly in the wireless segment of a FiWi network.

FIWIWAY IN NETWORK

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Inside this part, we set up the fundamental QoS provisioning method adopt with the wireless (based on IEEE 802.11e WLAN) segment as well as the fiber part (PON) of a FiWi access network. First, the QoS control modus operandi of the 802.11e is described briefly. Next [7], the DBA in work by means of the PON knowhow is delineating. Lastly, the difficulty of communication latency in the collective WLAN-PON is explained.

WLAN QoS

IEEE 802.11e offer a MAC layer protocol, which could execute QoS be in charge of in the WLAN. As a average of the unique 802.11 for MAC layer, Point Coordination Function (PCF) and Distributed Coordination Function (DCF), and Hybrid coordination Function (HCF) which combined equally DCF and PCF are particular[3][2]. inside 802.11e, QoS direct is realize by extend HCF, as well as two types of QoS direct technique, namely Enhanced Distributed Channel Access (EDCA) and HCF Controlled Channel Access (HCCA) are specified . Depending on the have two of the WLAN user (i.e., STAs), any of these QoS direct technique can be utilize. IEEE 802.11e based WLAN

When the STAs order right of way of data, EDCA can be working. An improvement of EDCA is so as to it be capable of be implement in campaign at a rationally low down rate for the reason that of its effortless direct. Excluding, QoS parameter such as bandwidth, wait and jitter cannot be sure fig 2 explain the process of data transmission.

Correctly in EDCA given that it is presently a main concern base control. In addition, when the high right of way data reside in the whole network communication [6], the right of way control accessible by EDCA may not occupation sufficiently.

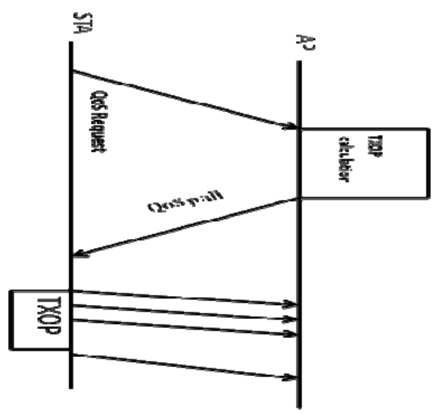

Figure 2

HCCA - The QoS control policy in the on top of the additional hand over, HCCA is base on QoS parameter, which STAs time and again want. As a result, the QoS parameter specified by a STA can be definite stringently by means of HCCA. However, in arrange to present a firm QoS Security; the figure of STAs which an AP possibly will maintain is controlled. In additional words, inside HCCA, the figure of STAs, QoS strain of which may well be content, is imperfect. The primary communication modus operandi of the HCCA QoS organize modus operandi of 802.11e is given away in Fig. 2, and momentarily describe under-

i) A STA negotiate QoS necessities to AP by distribution QoS parameter.

ii) The AP calculates communication occasion (TXOP) which is the stage so as to the STA can broadcast the data base resting on the QoS necessities.

iii) The STA start to broadcast the data when it receive the QoS-Poll frame (i.e., permission from the AP to start transmission) which the AP send if refusal other STA is at this time using the channel.

iv) The STA transmit its personal data completely for the duration of its TXOP.

To calculate the TXOP, first we need to compute the number of frames, *N*, which the STA needs to transmit as follows

$$N= [(SI\times p)/L]$$

As given away in Eq. 1, *N* container be calculate by dividing the product of the data speed in STA (denoted by ρ) and the length of the service distance *SI* by the structure length *L*. Ceiling function is functional to the splitting up result in order to make sure the upper limit number of frames, which the STA can broadcast. Now, the TXOP of the STA can be designed as follow.

$$TXOP=(N\times L) / R$$

In Eq. 2, the *TXOP* is calculating by separating the broadcast data, ($N \times L$), by the broadcast rate sandwiched between the STA and AP, denote by *R*.

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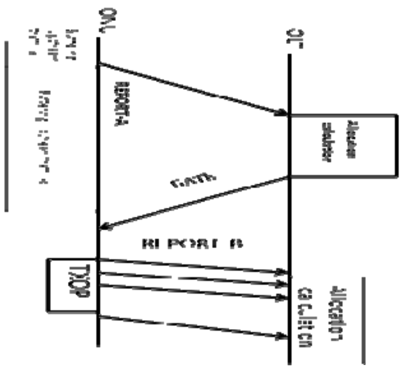

Figure 3. Concept of SR-DBA

OPERANDI OF PON

Inside the fiber side of our measure FiWi network, specifically PON, the upstream transfer is forbidden by Dynamic Bandwidth Allocation (DBA). DBA is executing with the OLT, as well as the allocated bandwidth of each ONU [7][8]associated to the OLT can be altered along with its billed buffer. There are two well recognized DBA methods, specifically standing Reporting DBA (SRDBA) and Traffic Monitoring DBA (TM-DBA) [10]. In SRDBA, the subsequent process is adopted by the OLT and both of the ONUs.

- An ONU buffers the upstream traffic.
- The ONU records the amount of traffic to a "REPORT" frame, and sends to the OLT.
- The OLT collects all the REPORT frames from the ONUs, and calculates the bandwidth to be allocated to each ONU.
- The OLT records the allocated bandwidth to the "GATE" frame and sends to each ONU.

Each ONU send upstream traffic according to the acknowledged "GATE" frame with the after that REPORT frame. Here, the GATE and REPORT frames are the direct frames of Multi Point Control Protocol (MPCP), which control the upstream broadcast. The REPORT frame gossips the amount of upstream transfer, which each ONU has buffered, in the direction of the OLT. On the additional hand, the GATE frame direct the quantity of traffic the OLT has allowable to broadcast, along with the commencement time to broadcast, to every ONU in classify to keep away from collision in the upstream transfer. Thus, the SR-DBA scheme aims at allocates the bandwidth sufficiently based on each ONU's REPORT frame. However, broadcast latency for all time happen as the SR-DBA scheme necessities to hang just in relation to for getting the REPORT frame from every ONU [7]. As an importance, the reaction on the road to the arrival traffic is low in this method.

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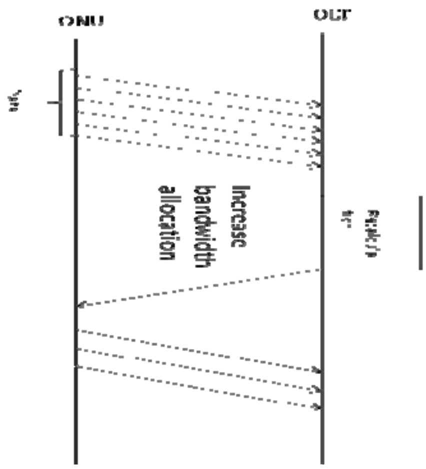
On top of the other hand over, TM-DBA allocate bandwidth based on the quantity of transfer the OLT has conventional. In TM-DBA, the OLT assign a small quantity of supplementary bandwidth to every one ONU on incessant manner. In case the ONU has no transfer to broadcast, it sends at rest frames during the overkill distribution it receive (as shown in Fig. 4(a)). When the OLT notice that an ONU is not transmitting any idler frame (as shown in Fig. 4(b)), it realizes that the ONU is currently in need of bandwidth. Consequently, the OLT increase the bandwidth distribution to that exacting ONU. Once the ONU has completed. Transferring its data, the OLT notices a significantly large number of idle frames from that ONU. Accordingly, the OLT reduces its bandwidth allocation to the ONU as [5] shown in Fig. 4(a). While it does not impose any requirement upon the ONU, the TM-DBA method does not have any provision for the OLT to know how to allocate bandwidth across several ONU that need more bandwidth. Thus, it causes transmission latency to a part of the data which is not transmitted during the allocation. Morever, also the excess



(A) In case the ONU is allocated excess bandwidth

Bandwidth allocations increase the transmission latency of the data from other ONUs [7]. Inside précis, while the consumption competence of bandwidth and sensitivity of these two schemes (i.e., SR-DBA and TM-DBA) are different, they both suffer from the communiqué latency.

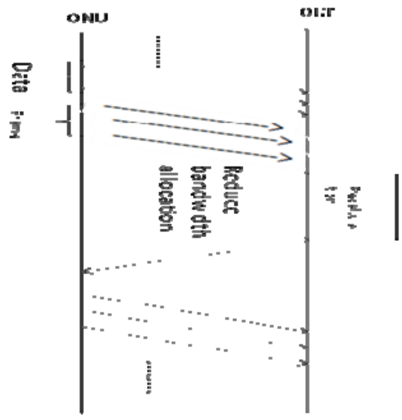


Figure 4.TM-DBA concept

(b) In case the ONU needs more bandwidth.

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CONNECTIVITY LATENCY IN FIWI

According near the actions of the IEEE 802.11e HCCA and PON's DBA, we think the network reproduction as depict in Fig. 5, and prepare the consequential communication latency of the $(j + k)th$ transmit frame $Dj+k$. In Fig. 5, *Ci, Ri, Gi* in attendance the *ith* DBA stage, statement frame, and GATE frame, in that order. In addition, *Fj* shows the *jth* frame. *Dj+k* can are spoken as a summing up of the permanent latency and variable latency. On top of the other hand, the variable latency indicates the interval connecting the arrived transfer and the report transfer

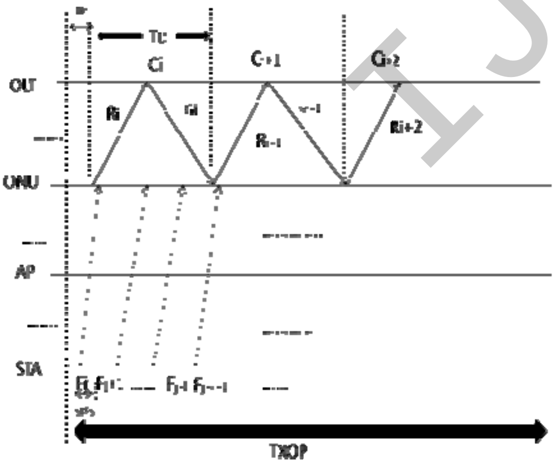

Fig.5.Network model of the considered FiWi network model

Ci=DBA period, TD=DBA-Time to one period

Fj=Frame number, Tp=Propagation delay between STA and ONU

Rj=Report in Ci, SIFS=Transmission interval defined by HCCA

Gi=GATE in Ci, TXOP=Channel duration of use

$D_{j+k}=[(k\times SIFS)/TD] . TD- k \times SIFS +TD +TP$

Now, *SIFS* represent the fixed point in time definite by the IEEE 802.11e normal for transmit a frame. *TD* refers to a DBA phase/cycle. Also, *TP* denote the broadcast delay stuck between the STA and the ONU, with may be articulated as follow.

$Tp = (d_{STA\text{-}ONU})/C$

Where dSTA–ONU and *c* represent the broadcast space connecting the STA and the ONU, and light speed, correspondingly.

The average broadcast latency of every one of frames transmit as of the STA, namely *Dave rage*, is uttered as follow

$D_{average}= (\Sigma_{k=1} D_{j+k})/N$

Eq. 5 shows feature of growing the broadcast latency is the distance end to end of DBA period (also known as the DBA cycle).

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PROPOSED SCHEME

Since explain in the previous slice, the accessible DBA methods are not proficient as these methods cannot be use mutually with the consumption competence of the bandwidth and receptiveness for declining the transmission latency in the ONU [8][9]. The main rationale why the accessible DBA methods are unproductive is that the coming traffic toward the ONU cannot be correctly predicted. So, we propose an efficient DBA scheme for decreasing the transmission latency in the ONU with high utilization efficiency of bandwidth. In order to achieve resourceful DBA system, we think about collaboration connecting the WLAN and PON in the measured FiWi network. In our future system, there are two parts to appreciate the collaboration connecting the WLAN and PON.

HCCA IN SEQUENCE OF WLAN

The performance of HCCA is alienated into two parts, namely QoS cooperation and preparation. QoS compromise means that the STA attempt to make a logical connection to the AP with several QoS requirements, i.e., the limit delay, data rate, frame length, and so on[10]. Then, the AP calculates TXOP, which is the length of broadcast time to meet the STA's QoS necessities. On the other hand, scheduling funds that the AP allows the STA, which has complete QoS compromise, to broadcast a data during TXOP. QoS negotiation and preparation are conducted in the Contention Period (CP) and Contention Free Period (CFP), and these two periods are conducted in a cycle of Service Interval (SI) periodically. When the STA tries to start its system check, it transmits in rank about QoS requirements of its network service to the AP in the QoS compromise part. The AP calculates TXOP by using Eq. 2.

After finishing the QoS negotiation, the AP begins the scheduling part. In this part, the AP confirms whether the TXOP can be scheduled in the CFP or not. Here, we refer to the TXOP which will be scheduled as the "new TXOP", and refer to a duration time of the scheduled TXOPs as the "total TXOP". If the sum of the new TXOP and the total TXOP is less than the length of CFP, the new TXOP can be scheduled in the CFP, and the STA can transmit its data during TXOP in every SI.

During the complete process of HCCA, the AP can be familiar with the accurate in sequence about the broadcast schedule of all the STAs associated to the AP. Here, we classify the in sequence as "HCCA information", and presume that each AP in the FiWi access network uses HCCA. As a result, every AP in the FiWi access network is hypothetical to possess the HCCA in order.

COOPERATIVE DATA BASE ACCESS WITH HCCA IN ORDER

The ONU collects the HCCA information from the APs connected to the ONU. The collection of HCCA scheduling information is performed for every SI of each AP because the transmission situation can be changed for every SI of each AP. After this collection, the ONU can know the arrival traffic from all the APs connected to the ONU. Here, we discuss the availability of this process from the point of view of overhead during the process. In general, the duration time of SI is significantly longer than that of the DBA period, which means that the process is not executed so frequently. Therefore, the HCCA collection is available because the effect of the overhead is quite small.

After collecting the HCCA information, the ONU calculates the amount of the traffic arrived in the DBA period, denoted by *Ci*. In the FiWi access network, every ONU has APs (*APp*) connecting STAs (*STAp, q*), which have already completed the HCCA scheduling [9]. Here, we define the *p* and *q* as the identification number of the ONU and that of the STA connecting to the ONU, respectively. Additionally, the maximum number of *p* and that of *q*, which show the total number of ONUs and STAs connecting with an ONU, is expressed as *P* and Q, respectively. Moreover, we define the *STA p, q's* transmission time in *Ci*as *TREPORT*. During *TREPORT*, the number of arrival frames, denoted by *Np, q* (*TREPORT*), is calculated as follows.

Np, q (TREPORT) =ceil((TREPORT × pp, q)⁄L)

Where *ρp, q* and *L* denote the data rate of the *STAp, q*a nd frame length.

The amount of traffic *Sp, q*is calculated as follows .*Sp,q*

Sp, q (TREPORT) =Np, q (TREPORT) .L

In order to calculate the amount of traffic from all the APs, the ONU conducts the algorithm 1. Here, *TSI, p* is the beginning time of *APp*'s HCCA scheduling, *TCi*is beginning time of the *i*th DBA cycle. In this algorithm, at first, we identify the STA, which will transmit in *App* during *Ci*by comparing *TINDEX* and *TTXOP*. *TINDEX* is computed by subtracting *TSI, p* from *TCi. TTXOP* is the sum of all *TXOP p,q*. When the value of *TINDEX* is lower than that of *TTXOP, STA p, q* will transmit during *Ci*. Then, TREPORT is temporarily set to the difference of *TTXOP* and *TINDEX*. If the value of TREPORT exceeds that of *TD*, *STAp, q* will transmit during *TD*. Therefore, we calculate *Sp, q* (*TD*) and add to *Ri*. If the value of TREPORT is lower than that of *TD*, *STA p, q*+1 will transmit after finishing *STA p, q's* transmission. Therefore, we calculate *Sp, q* (TREPORT) and *Sp, q*+1(*TD* – TREPORT), and add to *Ri*.

The arrival traffic during *Ci* is calculated by our proposed algorithm 1, and the amount of the traffic is buffered in *Ri*. The ONU can use *Ri* for the REPORT of *i*th DBA cycle, which means that the transmission latency of the arrival traffic becomes shorter than that in the existing methods, because the OLT can allocate bandwidth to the ONU accurately enough to transmit all the arrival traffic.

ENVIRONMENT PERFORMANCE

In this section, we evaluate the performance of our proposal through extensive computer simulation programmed in Ruby. The simulation parameters are summarized in Table I. In this simulation, the supposed FiWi access network is constructed by an OLT and some ONUs on the PON side, and some APs having some STAs on the WLAN side. The number of ONUs is varied from 1 to 32 and each ONU has 15 APs. The number of STAs is randomly changed and each STA generates traffic to the APs. The bandwidth of the PON side and that of the WLSN side are set to 10Gbps and 200Mbps, respectively, by reference to 10G-PON and 802.11n. We suppose that the FiWi access network has enough bandwidth for providing the requested bandwidth from the ONU because sufficient bandwidth is needed to meet the QoS demands of the real time QoS.

Algorithm 1 for QoS:

For*p* in 1 to *P* **do**

TINDEX = TCi-TSI

TTXOP = 0

For *q* in 1 to *Q* **do**

TTXOP += *TXOPp, q*

If *TTXOP* ≥ *TINDEX* **then**

TREPORT = *TTXOP* - *TINDEX*

Else if TREPORT ≥ *TD* **then**

Ri+= *Sp, q* (*TD*)

Else

Ri+= *Sp, q* (TREPORT)

Ri+= *Sp, q*+1(*TD* – TREPORT)

End if

BREAK

End for

End for

PERFORMANCE ON QOS

We set the length of DBA cycle to 0.5 m sec, and plotted the performances of each simulation parameter as demonstrated in for different numbers of ONUs. Shows that our proposal maintains its efficiency of bandwidth utilization as much as SR-DBA's for the various numbers of ONU. On the other hand, according to the size of the allocation factor, the efficiency of bandwidth utilization in TM-DBA tends to worsen. In other words, TM-DBA cannot achieve accurate bandwidth allocation because it is just a linear prediction made by the OLT. Demonstrates that our proposal constantly achieves low transmission delay in contrast with other existing methods. In smaller number of ONUsscenarios, TM-DBA performs low transmission delay proportional with the size of the allocation factor. Moreover the usage of received buffer is also improved, which shows that our proposal scheme can transmit traffic in the ONU immediately.

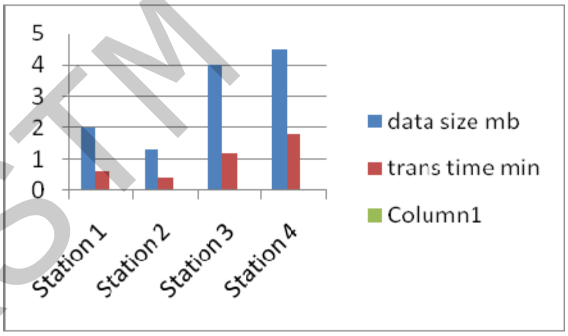

Fig.6. Existing transition time

The average values range the length of DBA cycle from 0.5 to 1.0 msec. In our proposal maintain the similar effectiveness as that of SR-DBA. In the buffer impediment and buffer occupancy of our proposal are improved up to 65% and 50%, respectively, compared with those in SR-DBA. These results show that our proposal achieve greater presentation regardless

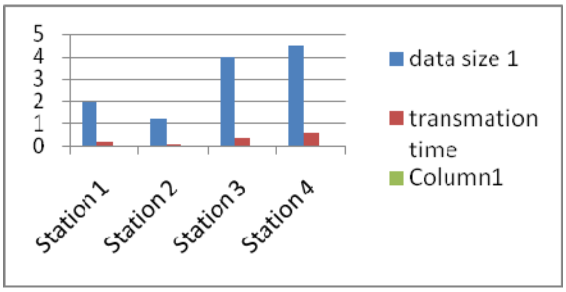

Fig.7.Proposed transition time

of the length of the DBA cycle. For that reason, QoS for real time communications for CPS is improved by our proposed method.

CONCLUSION

FiWi networks, which are made up of WLAN and PON have a possible for providing real time QoS to facilitate future CPSs. However, the transmission latency is caused by non-matching QoS control schemes used in the WLAN and PON segments of FiWi networks, and it affects the real time QoS, such as communication delay, jitter, and packets drop. In existing methods, especially DBA used by the PON, it is not possible to provide bandwidth efficiency and responsiveness at the same time when WLAN is combined with the PON technology. To solve this problem, in this paper, we proposed a QoS control scheme, which allows cooperation between the WLAN and PON in order to achieve both bandwidths efficiency and responsiveness. The results of our conducted simulations show that our proposal can significantly improve various QoS parameters for real time communications for CPSs in contrast with existing methods. Thus, our proposal can be considered to be an effective QoS control method in QoS adaptive networks for CPSs such as FiWi access networks comprising Ubiquitous network technologies.

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