International Journal of Emerging Engineering Research and Technology
Volume 3, Issue 7, July 2015, PP 53-60
ISSN 2349-4395 (Print) & ISSN 2349-4409 (Online)

QoS Control in FiWi Access Network

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ABSTRACT

A definitive objective of Fiber-Wireless (FiWi) systems is the meeting of different optical and wireless advances under a solitary foundation to exploit their correlative peculiarities and hence give a system equipped for supporting bandwidth hungry rising applications in a consistent manner for both fixed and portable customers. Wireless LAN (WLAN) uses HCF Controlled Channel Access (HCCA) and Enhanced Distributed Channel Access (EDCA) for QoS control and Passive Optical Network (PON) use Dynamic Bandwidth Allocation (DBA). Proposed DBA concentrated on link between Access Point (AP) and Optical Network Unit (ONU). Same as ONU to Optical Line Terminal (OLT) operation AP collect information from end Station STA send in single report frame to the ONU. ONU forwards that with own calculation of other AP's frames to the OLT.

Keywords: FiWi; PON; WLAN; HCCA; DBA.

INTRODUCTION

Generally, wireless and optical fiber systems have been framed independently from one another. Wireless systems gone for gathering particular administration necessities while adapting with specific transmission weaknesses and improving the usage of the framework assets to guarantee cost-adequacy what's more fulfilment for the client. In optical systems, on the other hand, research endeavours fairly centred on expense lessening, effortlessness, and future proofness against legacy and rising administrations and applications by method for optical straightforwardness. Wireless and optical access systems can be considered corresponding. Optical fiber does not go all over, yet where it does go; it gives a colossal measure of accessible data transmission. Wireless access systems, then again, conceivably go very nearly all over however give an exceedingly bandwidth obliged transmission channel powerless to a mixed bag of debilitations.

Future broadband access organizes not just need to give access to data when we require it, where we require it, and in whatever configuration we require it, additionally, and apparently all the more critically, need to scaffold the computerized gap and offer straightforwardness and ease of use focused around open models keeping in mind the end goal to fortify the frame of new applications and administrations. To this end, future broadband access systems must influence on both optical and wireless innovations and unite them flawlessly, offering climb to FiWi access systems. FiWi access systems are instrumental in reinforcing our data society while staying away from its computerized gap. By joining the limit of optical fiber systems with the universality and portability of wireless systems, FiWi systems structure an effective stage for the backing and formation of rising and also future unforeseen applications and administrations. FiWi systems hold extraordinary guarantee to change the way we live and work by supplanting driving with teleworking. This not just gives of a chance time to expert and individual exercises for corporate and our own individual advantage additionally helps decrease fuel utilization and secure the earth; issues that are getting to be progressively vital in our lives.

FiWi access systems may send both RoF and R&F innovations. By at the same time giving wired and wireless administrations over the same foundation, FiWi access systems have the capacity combine optical and wireless access arranges that are normally run autonomously of one another, accordingly possibly prompting significant expense reserve funds.

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Fiber-Wireless (FiWi) systems are an alluring arrangement that can give high throughput. FiWi systems are the merging of both wireless systems and optical systems. They can convey the focal points of both wireless and optical systems, i.e., the versatility backing of wireless systems and the high transmission capacity of optical systems. Concerning the optical system part, Passive Optical Networks (Pons) are prevalent because of their low set up expense, high transmission capacity, and low postpone. Concerning the wireless system part, numerous sorts of wireless systems can be associated with the optical system part. These incorporate Wireless Area Networks (WLANs), Wireless Mesh Networks (WMNs), Worldwide Interoperability for Microwave Access (WiMAX) and third era (3g) systems. Here, WMNs in the FiWi systems comprise of numerous Access Points (APs) joined together with one AP going about as a portal to the Optical Network Unit (ONU). The Stations (STAs) are joined with the system through these APs. In this paper, we concentrate on FiWi systems made out of Pons and WLANs, as indicated in Fig. 1, since WLANs have seen wide organization in homes, work places, et cetera. In this structure, the PON, which has abundant transmission capacity, obliges the upstream activity created by the clients in the WLANs. In any case, because of the improvement of the wireless gadgets and the increment in the quantity of clients who have different terminal gadgets, for example, portable computer, cell phone, and tablet PC, activity in the FiWi system is expanding. Particularly, the appearance of uses, for example, Social Network Service (SNS) brings about the increment of upstream activity from WLANs that the PON needs to exchange, which prompts the expanded, postpone in the PON. Traditional instruments that minimize the lining defer as of now exist in Pons. Case in point, numerous sorts of Dynamic Bandwidth Allocation (DBA) components, is proposed as such. Be that as it may, these systems just work in Pons, so a PON can't control the upstream movement that is produced in the WLANs. Thusly, new strategies are obliged that work in the whole FiWi system to reduction the lining postpone in the PON.

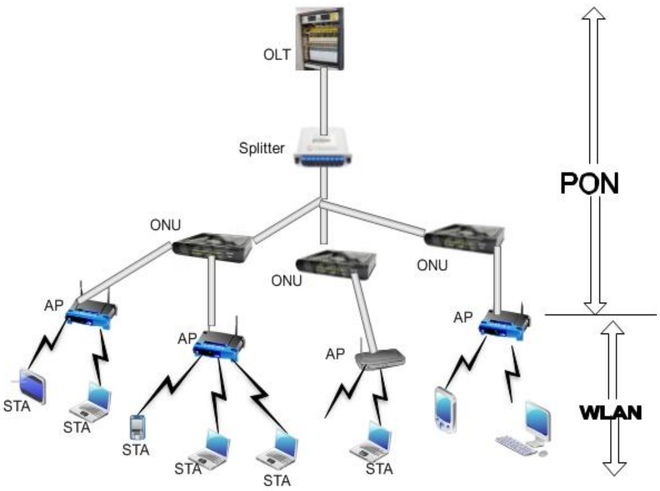

Figure1. *FiWi Access Network*

RELATED WORK

A FiWi access system focused around WLAN and PON advances is, in any case, not without its inadequacies. A discriminating weakness of such a FiWi system is its transmission Latency, which can genuinely influence the QoS of ongoing correspondences. At the point when a STA begins continuous correspondence, the correspondence between the AP and STA is controlled by IEEE 802.11e [11] so as to ensure the QoS of this correspondence. After that, the correspondence packets are transmitted to the OLT through the ONU. For this, the packets stay supported in the ONU until the OLT permits the ONU to transmit by method for Dynamic Bandwidth Allocation (DBA) [8]. As an outcome, transmission latency happens in the ONU. This transmission idleness causes debasement of QoS for ongoing interchanges, e.g., transmission Delay, packets drop, and jitter. This issue primarily emerges because of the way that the comparing QoS control plans of the WLAN and PON advances work autonomously. At the end of the day, they don't work in a synchronized manner, and helps the transmission latency, which extremely corrupts the QoS.

Various QoS provisioning systems have been created as of late for ``radio and Fiber'' (R&F) systems. In the work in[6], both unified and conveyed scheduling methods were explored for adequately joining Ethernet PON (EPON) and WiMAX innovations pointing at upgrading QoS prerequisites, for example, system throughput and end-to-end latency.

FiWi networks, which are made up of WLAN and PON have a potential for providing real time QoS to facilitate future CPSs [10]. Shao-Yu Lien et al. resolve the most discriminating test of self-governing radio asset administration to give QoS ensures for the swarm in CPS by applying the cognitive radio innovation and the appropriated radio asset checking, which is empowered by the compressive sensing range map[10].

An intriguing work led in [2] highlights the way that FiWi systems administration investigates on ``layer 2" has begun, then again, not yet increased much development. The work identifies various essential examination challenges in FiWi situations, in particular incorporated channel task and data transmission designation, joined way choice, end-to-end QoS backing, etc. By belligerence that a more concentrated investigation of cutting frame QoS provisioning plans is obliged to help mixed media applications and administrations in R&F systems, for example, FiWi, it then proposed an Ethernet-based ``superman" access-metro system with optical-wireless interfaces including EPON and WLAN-based lattice systems. It was additionally demonstrated in that work that sending various leveled frame accumulation crosswise over EPON and WLAN-based cross section arranges considerably upgrades the throughput-delay execution. Navid Ghazisaidi et al. conclude critical exploration difficulties incorporate incorporated channel task and data transfer capacity allotment, coordinated way determination, various leveled optical blast get together and stream and congestion control, and in addition end-to-end QoS help[2].

FIBER WIRELESS ACCESS NETWORK

Before In this area, we present the fundamental QoS provisioning routines embraced by the wireless section and the fiber part PON of a FiWi access system. To start with, the QoS control strategy of the 802.11e is depicted brief. Second, the DBA utilized by the PON engineering is portrayed. At last, the issue of transmission inactivity in the consolidated WLAN-PON is clarified.

WLAN QoS Control Technique

In Distributed Coordination Function (DCF), STAs access the AP as indicated by their coveted time and every STA contends to get the transmission right. In this manner, the DCF is conflict based access control, so crashes among STAs may happen in this methodology. To evade crashes, the medium access control system of Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) is received in the DCF. CSMA/CA characterizes two crash evasion instruments, specifically, the transporter sense and the conflict window components. At the point when a STA wishes to start a transmission, the STA faculties in the event that others STAs are transmitting or not, and begins transmission if no other STA is transmitting. This sensing is the bearer sense instrument, on the other hand, impacts still happens in DCF when a few STAs are doing transporter sensing and begin to transmit in the same time. The controversy window component stays away from this circumstance. The conflict window instrument holds up an arbitrary measure of time to stay away from crash when a STA wishes to transmit and an impact happens. These components are exceptionally successful to lessening the likelihood of impacts. Be that as it may, if the quantity of STAs associated with an AP expands, the likelihood of impact will likewise increment.

To help time-limited administrations, the IEEE 802.11 standard characterizes the Point Coordination Function (PCF) to let stations have need access to the wireless medium, composed by a station called Point Coordinator (PC). The PCF has higher need than the DCF, in light of the fact that it may begin transmissions after a shorter term than DIFS; this time space is called PCF Interframe Space (PIFS), which is 25 us for 802.11a and more than SIFS, i.e., the most limited between frame space. Time is constantly partitioned into rehashed periods, called superframes. With PCF, a Contention Free Period (CFP) and a Contention Period (CP) exchange over the long run, in which a CFP and the accompanying CP structure a superframe. Amid the CFP, the PCF is utilized for getting to the medium, while the DCF is utilized amid the CP.

EDCA is intended to give organized QoS by improving the controversy based DCF. It gives separated, circulated access to the wireless medium for QoS stations (QSTAs) utilizing 8 distinctive User Priorities (UPs).before entering the MAC layer, every information packet got from the higher layer is relegated a particular client need quality. The most effective method to label a need worth for every bundle is an execution issue[9]. The EDCA instrument characterizes four diverse first-in first-out (FIFO) lines, called access categories (ACs) that give backing to the conveyance of movement with Ups at the QSTAs. TXOP-Transmission opportunity is characterized in IEEE 802.11e as the interim of time when a specific QSTA has the privilege to start transmissions. There are two modes of

EDCA TXOP characterized, the start of the EDCA TXOP and the different frame transmission inside an EDCA TXOP [9]. A start of the TXOP happens when the EDCA guidelines license access to the medium.

The HCF controlled channel access (HCCA) meets expectations a great deal like PCF. Then again, rather than PCF, in which the interim between two signal frames is isolated into two times of CFP and CP, the HCCA considers CFPs being launched at just about whenever amid a CP. This sort of CFP is known as a Controlled Access Phase (CAP) in 802.11e. A CAP is started by the AP at whatever point it needs to send an frame to a station or get a frame from a station in a dispute freeway. Indeed, the CFP is a CAP as well. Amid a CAP, the Hybrid Coordinator (HC)—this is likewise the AP—controls the right to gain entrance to the medium. Amid the CP, all stations work in EDCA. The other distinction with the PCF is that Traffic Class (TC) and Traffic Streams (TS) are characterized. This implies that the HC is not constrained to every station lining and can give a sort of every session administration. Additionally, the HC can organize these streams or sessions in any manner it picks (not simply round-robin). In addition, the stations give insight about the lengths of their lines for each one Traffic Class (TC). The HC can utilize this insight to offer need to one station over an alternate, or better alter its planning component. An alternate contrast is that stations are given a TXOP: they may send numerous packets consecutively, for a given time period chose by the HC. Amid the CFP, the HC permits stations to send information by sending CF-Poll frames. HCCA is by and large considered the most progressive (and complex) coordination capacity. With the HCCA, QoS can be arranged with extraordinary accuracy. QoS-empowered stations can ask for particular transmission parameters (information rate, jitter, and so forth.) which ought to permit propelled applications like VoIP and feature streaming to work all the more successfully on a Wi-Fi.

The major correspondence strategy of the HCCA QoS control procedure of 802.11e is as per the following. A STA arranges QoS necessities to AP by sending QoS parameters. The AP computes transmission opportunity (TXOP) which is the period that the STA can transmit the information focused around the QoS prerequisites [9]. The STA begins to transmit the information when it gets the QoS-Poll frame which the AP sends if no other STA is as of now utilizing the channel. The STA transmits its own particular information solely amid its TXOP.

Frame Aggregation [11]: There are two routines accessible to perform frame Aggregation: Aggregate MAC Protocol Service Unit (A-MSDU) and Aggregate MAC Protocol Data Unit (A-MPDU). The principle qualification between a MSDU and a MPDU is that the previous compares to the data that is foreign to or sent out from the upper piece of the MAC sublayer from or to the higher layers, individually, while the later identifies with the data that is traded from or to the PHY by the lower piece of the MAC.

A-MSDU: The guideline of the A-MSDU (or MSDU Aggregation) is to permit various MSDUs to be sent to the same collector linked in a solitary MPDU. This doubtlessly enhances the effectiveness of the MAC layer, particularly when there are numerous little MSDUs, for example, TCP affirmations. For an A-MSDU to be framed, a layer at the highest point of the MAC gets and buffers numerous packets (MSDUs).

A-MPDU: The idea of A-MPDU aggregation is to join different MPDU subframes with a solitary driving PHY header. A key distinction from A-MSDU aggregation is that A-MPDU capacities after the MAC header exemplification process. Therefore, the A-MSDU limitation of aggregating frames with matching TIDs is not a component with A-MPDUs. Then again, all the MPDUs inside an A-MPDU must be tended to the same collector address. There is no holding up/ holding time to structure an A-MPDU so the quantity of MPDUs to be collected completely relies on upon the quantity of packets effectively in the transmission line.

PON QoS Control and DBA

Dynamic Bandwidth Allocation (DBA) in gigabit-competent Passive optical systems (G-PON) is the methodology by which the optical line end (OLT) reallocates the upstream transmission chances to the movement bearing substances inside Optical Network Units (ONUs) based on the element evidence of their action status and their arranged activity contracts. The movement status evidence can be either unequivocal through support status reporting, or implied through transmission of unmoving GEM frames set up of conceded upstream transmission open doors.

In examination with static data transmission task, the DBA instrument enhances the G-PON upstream transfer speed use by responding adaptively to the ONUs bursty movement designs. The down to earth advantages of DBA are twofold. First and foremost, the system administrators can add more supporters of the PON because of more productive bandwidth utilization. Second, the endorsers can appreciate improved administrations, for example, those obliging variable rate with the crests developing past the levels that can sensibly be designated in a static manner.

The two techniques for DBA are alluded to as status reporting DBA (SR-DBA) and Traffic Monitoring DBA (TM-DBA)[8]. An OLT can actualize one or both of these techniques.

SR-DBA: 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 sends upstream traffic according to the received ``GATE'' frame with the next REPORT frame.

Here, the GATE and REPORT frames are the control frames of Multi Point Control Protocol (MPCP), which controls the upstream transmission. The REPORT frame reports the amount of upstream traffic, which each ONU has buffered, to the OLT. On the other hand, the GATE frame directs the amount of traffic the OLT has allowed to transmit, along with the beginning time to transmit, to every ONU in order to avoid collision in the upstream traffic.

TM-DBA: TM-DBA apportions bandwidth focused around the measure of traffic the OLT has gotten. In TM-DBA, the OLT allocates a little measure of extra bandwidth to every ONU on a constant way. In the event that the ONU has no traffic to transmit, it sends idle frames amid the overabundance assignment it gets. At the point when the OLT recognizes that an ONU is not transmitting any more idle frames it understands that the ONU is as of now in need of bandwidth. Thusly, the OLT expands the bandwidth allotment to that specific ONU. Once the ONU has finished exchanging its information, the OLT notices a significantly vast number of idle frames from that ONU. Appropriately, the OLT lessens its bandwidth portion to the ONU. While it doesn't force any necessity upon the ONU, the TM-DBA technique does not have any procurement for the OLT to know how to assign bandwidth over a few ONUs that need more bandwidth. Hence, it causes transmission inactivity to a piece of the information which is not transmitted amid the distribution. Additionally, likewise the abundance bandwidth allotment expands the transmission latency of the information from different ONUs.

PROPOSED WORK

Problem Statement

To improve bandwidth allocation efficiency of FiWi access network by reducing no. of report frames.

Proposed System

Here we propose a system to reduce no. of frames overhead between AP and ONU. Proposed DBA concentrated on link between AP and ONU. Same as ONU to OLT operation AP collect information from STA send in single report frame to the ONU. ONU forwards that with own calculation of other AP's frames to the OLT.

The conduct of HCCA is separated into two sections, specifically QoS arrangement and scheduling [1]. QoS negotiation implies that the STA endeavors to make a sensible association with the AP with a few QoS necessities. At that point, the AP figures TXOP, which is the length of transmission time to meet the STA's QoS necessities. Scheduling implies that the AP permits the STA, which has finished QoS transaction, to transmit information amid TXOP [1].

Before sending report frame, AP does QoS negotiation and scheduling with every connected STA. Then STAs send their required bandwidth request to AP within given time threshold nothing but the service interval. After given time threshold AP calculate Total require bandwidth and send only one report frame for given STAs.

Now,

$N(T_{REPORT})$ From AP to ONU = 1 (1)

This system will also do the frame aggregation mention above for bulk of data with same source and destination address. Focus to do the aggregation of QoS requirement frames from various APs aggregate together and make report frame of that. In this technique aggregation does with different source and same destination address.

For Single (k)th frame after (j)th frame summation of fixed and variable latency is

$$D_{j+k} = \left\lceil \frac{k * SIFS}{T_D} \right\rceil T_D - k * SIFS + T_D + T_P \quad (2)$$

SIFS represents the fixed time defined by the IEEE 802.11e standard for transmitting a frame.

T_D refers to a DBA period/cycle.

T_P denotes the propagation delay between the STA and the ONU.

$$D_{average} = \frac{\sum_{k=1}^{N} D_{j+k} * T_T}{N} \quad (3)$$

$D_{average}$ average transmission latency of all frames transmitted from the STA,

T_T Threshold time at AP.

$$N_{(p,q)}(T_{Report}) = 1 \quad (4)$$

$N_{(p,q)}(T_{Report})$ No of frames from AP to ONU

p and *q* as the identification number of the ONU and that of the STA connecting to the ONU.

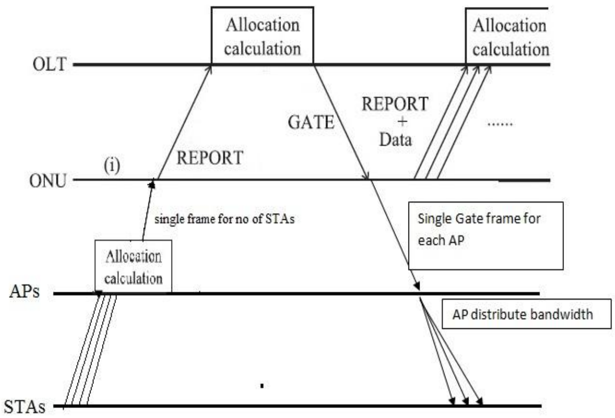

Figure 2. *Single Frame from AP to ONU for no of STAs within single SI.*

RESULT

This proposed system reduces the burden on ONU. ONU can make REPORT frame on the basis of report frames collected from APs. In previous system ONU had problem of buffer overflow and packet drop due to overflow. Now, ONU has no need to buffer actual traffic instead of that it buffers the report frames from APs. ONU calculates upstream traffic from APs report frame and make REPORT frame faster than current. This achieve reduced overhead of every STAs frame on AP to ONU link.

Resultant Formulae

$N(T_{REPORT})$ From AP to ONU = 1

From above equation,

$$D_{average} = D_{j+k} + T_T \quad (5)$$

$D_{average}$ average transmission latency of all frames transmitted from the STA.

$$S(T_{Report}) = N(T_{Report}) * L \quad (6)$$

From equation (4)

$S(T_{Report})=L$ (7)

$S(T_{Report})$ Ammount of traffic on AP-ONU.

L Length of frame.

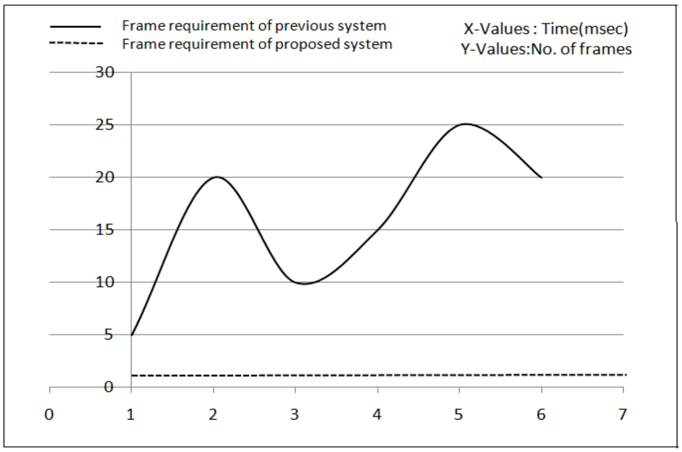

Figure3. *Number of bandwidth requesting report frame from AP to ONU*

CONCLUSION

From above discussion we can conclude that use of single report frame from AP to ONU reduce the overhead of every STA,s report frame. 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.

Frame Aggregation with cooperative DBA will improves the performance of overall network. HCCA is for WLAN and DBA for PON used for QoS control in bandwidth allocation for upstream traffic. But need to work on in between PON and WLAN. This require more attention which actual integration of Fiber optical network with wireless network like WLAN, WiMAX or LTE.

ACKNOWLEDGMENT

I thank my guide Prof. Vivek V. Jog. for his valuable guidance and support. I would like to thank all staff members who have assuredly helped me a lot and my friends and parents for their motivated support in this work.

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