Joint Load Balancing and Radio Resource Management in Cross Layer Architecture

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Abstract

We propose load balancing algorithm based on cross layer designing for MIMO OFDM system. When there are many users using data service, base station(BS) should distribute traffic. Moreover, cross layer design gives benefit managing radio resource and network bandwidth management. Proposed cross layer load balancing technique manages both BS's bandwidth allocation and MS's power control. One BS request bandwidth to other BSes and other BSes reduce each bandwidth. And BSes reduce power of sub carriers for reserving available bandwidth of backhaul. MSes that didn't get service can be served by obtaining bandwidth from other BSes. The simulation result shows more users can be served and cell throughput was increased

I. Introduction

Packet data service is widely used in 4G environment. Mobile WiMax based on 802.16e provides high data rate packet service. Data service provider introduced new Pico ACR and RAS. This architecture is the same with the conventional legacy Mobile WiMax system. We proposed Cross Layer Design for supporting real time streaming service such as VOIP or VOD.

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We named Basesation Router(BSR) that is proposed as cross layer architecture. In conventional WiMax system, RAS didn't consider both channel status and user's service class. In proposed system, user's service is served by Streaming Server in remote network. BSR has ability controlling bandwidth of wired network and changes AMC(adaptive modulation and coding) to change transmission delay. And BSR selects the scheduling policy that is the best appropriate policy for guarantee delay bounds and minimum data rate.

II. System Architecture

1. Cross Layer Design for BSR

BSR is combined type of ACR and RAS. We introduced cross layer architecture for guaranteeing Qos. This architecture gives much benefits reducing handoff delay. In legacy WiBro's ACR, Generic Routing Encapsulation(GRE) tunneling is deployed that caused long delay to forward packets from old RAS to new one. Moreover BSR gives advantage of efficient wireless resource management and scheduling. Legacy WiBro network is centralized network. On the contrary BSR is distributed network giving more network stability. By interchanging control message between BSR, BSR updates fast topology exchanged information such as adding a new BSR or deleting a BSR turned off.

2. Traffic Classification in Cross Layer Design

In Conventional WiBro system, there are 5 traffic classes in MAC layer. MAC scheduler determines which traffic should be transmitted. In Conventional WiBro system, Proportional fair scheduling is deployed for Best Effort traffic class(BE) and nrtPS.

Round robin scheduling is used for real time traffic class such as UGS, ertPS and rtPS.

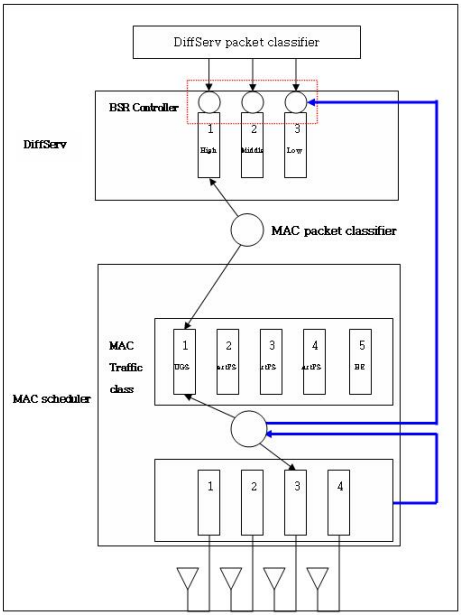

figure 1. Cross Layer Design for BSR

However, there is no consideration for IP layer' QoS. End to end delay gauranteeing is very important for commercial realtime service. When traffic load is high, conventional WiBro ACR has no capability to control traffic of wired network. Moreover, if backhaul network is full of a certain RAS's traffic, other RAS can not be serviced due to lower allocated bandwidth than required by the RAS. In this case, even wireless channel state is very good, MS can not be serviced by congestion of wired network. Therefore, we proposed collaborative resource management based on DiffServ and MAC scheduling.

3. Hybrid Traffic Load

If MSes requested various kinds of services, it would not easy to guarantee delay requirement. Because various kinds of traffic have different delay requirements respectively. In conventional WiBro system, there is no forcing way to guarantee delay requirement that users requested delay sensitive service such as VOIP. When most users requested realtime video streaming, it is not easy to ensure QoS of VOIP users.

3. Load balancing in Cross Layer Design

We proposed load balancing algorithm managing both network bandwidth and wireless resource. In conventional WiMax network, load balancing techniques is introduced in WiMax profile A and C. Load balancing techniques reduces overhead for processing traffic of ACR and service delay. When traffic is overly loaded in WiBro network, ACR distributes traffic. However, legacy WiBro ACR, Korean Mobile WiMax, does not consider radio resource management(RRM) in load balancing mechanism and scheduling policy of a RAS(Radio Access Station). Service delay is constituted of both network delay of wired network and scheduling delay of wireless access network.

4. Joint Resource Allocation and Load Balancing

Load Balancing Algorithm for BSR

(1) The BSR in high load broadcasts bandwidth requesting message to all BSRs.
(2) Each BSR checks requested bandwidth and calculates capacity of each subchannel.
(3) Each BSR calculates minimum users' service requirement.
(4) Each BSR sends response message indicating how much bandwidth it can save to the requesting BSR(RBSR).
(5) The BSR selects the who is allocated to enough subchannel power and decreases power level of subchannels.
(6) The BSR decreases the bandwidth of the user.

Ⅳ. Conclusion

Joint load balancing and radio resource manage technique is very efficient for guaranteeing enough bandwidth and reducing network delay. Moreover, Cross layer designing reduces GRE tunneling delay.

Reference

[1] T.S. Kim, H.Lee, S. Choi, "Design and implementation of a simulator based on a cross laery protocol between MAC and PHY Layers in a WiBro Compatible IEEE 802.16e OFDMA system," *IEEE Communication Magazine,* pp. 136 141, Dec. 2005.s