Best Effort Service in Wireless MAN

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무선 MAN에서 Best Effort 서비스

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Abstract

In the IEEE 802.16 Wireless MAN standard, the best effort service class is ranked on the lowest position in priority so that only scarce resource may be available for it. Also, the best effort service is usually assisted by a MAC scheme based on reservation ALOHA without explicit acknowledgement. However, the standard only specifies the skeleton of the MAC scheme. In this paper, we propose some rules to specify the indefinite part of the MAC scheme as well as to improve the throughput and delay performance of the MAC scheme. As generic rules for demanding and granting resource, we first propose non-gated exhaustive, gated exhaustive, non-gated limited, and gated limited demand rules, and deficient and full grant rules. Secondly, we propose grant regulation rules, identified as replacement and lifetime rules, to avoid excessive grant incurred by not giving acknowledgement. Noting the residual resource is inflated by adopting a grant regulation rule, we finally propose a rule for investing the residual resource to a subscriber station. Simulation results confirm that a combination of proposed rules improves the performance of the MAC scheme.

I. Introduction

IEEE 802.16 Wireless MAN standard specifies the air interface of fixed point-to-multipoint broadband wireless access systems providing multiple services in a metropolitan area network (MAN) [1]. Among the service classes between the base station (BS) and subscriber stations (SS's) in the wireless MAN, the best effort class is ranked on the lowest position in priority. Thus, only scarce resource may be available for it. Also, the best effort service is usually assisted by a medium access control (MAC) scheme based on a reservation ALOHA without explicit acknowledgement [1]. However, the standard only specifies the skeleton of the MAC scheme as follows: Choosing a request opportunity in an uplink subframe, an SS attempts to deliver a request for demanding the resource to send MAC protocol data units (PDU's). For the reception of the request, however, the BS gives no explicit acknowledgement to the SS. Instead, the BS grants the received request an amount of resource in the upcoming uplink subframe and notifies the SS of such a grant using the broadcast control field of a downlink subframe. Then, the SS sends MAC PDU's using the resource. Apparently, the standard does not address the details of the MAC scheme, for example, the amount of resource to demand and the amount of resource to grant. Thus, it is needed to specify the indefinite part of the MAC scheme. Since scarce resource may be available for the best effort service, it is also needed to consider the throughput and delay performance in designing the MAC scheme. As generic rules for demanding and granting resource, we first propose non-gated exhaustive, gated exhaustive, non-gated limited, and gated limited demand rules, and deficient and full grant rules. In the MAC scheme, the BS gives no explicit acknowledgement, which may incur unnecessary request and excessive grant [3][4]. To avoid excessive grant, we propose grant regulation rules, identified as replacement and lifetime rules. These grant regulation rules are known to have the side-effect of inflating the residual resource [4].

In section 2, we propose demand and grant rules. In section 3, we present grant regulation rules. In section 4, we describe rules for investing residual resource. Section 5 is devoted to illustrate the performance of a combination of proposed rules.

This work was supported by 2008 Dankook University Project of funding Internal Strategic Research Project Team.

II. Demand and Grant Rule

In this section, we propose generic rules for demanding and granting resource [2].

2.1 Demand Rule

(1) Non-gated exhaustive demand rule: An SS demands as much resource as it can send the all MAC PDU's.
(2) Gated exhaustive demand rule: If an SS succeeded in the previous request attempt, the SS demands as in the non-gated exhaustive demand rule. However, if the SS failed in the previous request attempt, the SS demands the same amount of resource as in the previous request attempt.
(3) Non-gated limited demand rule: An SS calculates the minimum of the threshold and the number of MAC PDU's stored at the SS. Then, the SS demands as much resource as it can sends the minimum number of MAC PDU's.
(4) Gated limited demand rule: If an SS succeeded in the previous request attempt, the SS demands as in the non-gated limited demand rule. However, if the SS failed in the previous request attempt, the SS demands the same amount of resource as in the previous request attempt.

2.2 Grant Rule

(1) Deficient grant rule: If the available resource is less than the resource that a request demands, the request is only granted the available resource. Then, the request is removed from the BS even if the request is deficiently granted.
(2) Full grant rule: If the available resource is less than the resource that a request demands, the request is granted the available resource. However, the request is not removed from the BS. The request is continually granted in the following frames until it is fully granted.

Ⅲ. Grant Regulation Rule

In this section, we present grant regulation rules to prevent excessive grant [3].
(1) Replacement rule: Suppose that the BS stores a request from an SS. If the BS receives another request from the same SS, the BS immediately replaces the old request with the new request.
(2) Lifetime rule: Prior to granting resource to a request, the BS examines the age of the request. If its age is higher than a prescribed lifetime, the BS grants the request no resource and discards the request.

Ⅳ. Residual Resource Investment Rule

In this section, we describe rules for investing the residual resource to a single SS [4].
(1) Heavy load rule: Using partial information, the BS estimates the number of MAC PDU's stored in each SS. Then, the BS invests the whole residual resource to the SS that the BS presumes to be most heavily loaded.
(2) Round robin rule: In each frame, the BS chooses an SS in a round robin fashion. Then, the BS invests the whole residual resource to the SS.
(3) Random choice rule: In each frame, the BS chooses an SS equally likely. Then, the BS invests the whole residual resource to the SS.

Ⅴ. Performance Evaluation

Figure 1 shows the effect of residual resource investment rule on the mean delay of MAC PDU. In this figure, non-gated exhaustive rule, deficient rule and replacement rule are chosen as demand rule, grant rule and grant regulation rule, respectively. Also, a simulation method is used to get the mean delay. We observe that the heavy load rule invokes lower mean delay than round robin and random choice rules when the traffic load is heavy.

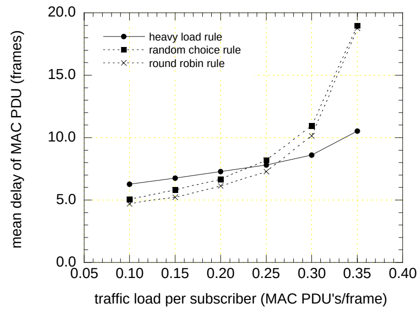

Figure 1. Mean delay of MAC PDU vs. traffic load. (the number of SS's = 10, the number of request opportunities = 3)

Ⅵ. Conclusions

In this paper, we considered the MAC scheme for the best effort service in wireless MAN. For the MAC scheme, we proposed various demand rules, grant rules, grant regulation rules, and residual resource investment rules. Simulation method was used to compare the performance of combinations of proposed rules. For example, the combination of non-gated exhaustive, deficient, replacement, and heavy load rules exhibited superior delay performance when the traffic load was heavy.

Reference

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