Abstract

IEEE 802.16 Standard leaves the minislot allocation in mesh mode for further study. The minislot is the basic unit for resource allocation. The simple minislot allocation scheme (SMAS) is proposed to allocate minislots according to the request from the requester node. However, SMAS is an inflexible scheme, because it cannot adjust the request according to the available minislots. We proposed a dynamic minislot allocation scheme (DMAS) to improve the flexibility of SMAS with minimum change in MSH-DSCH request IE field. The DMAS adjusts the Demand Persistence specified in MSDH-DSCH Request IE to reduce the end-to-end delay, and get better throughput compared to SMAS. This paper introduces a new minislot allocation scheme (i.e. DMAS) and discusses the simulation results.

Keywords: WiMAX · Mesh · 802.16 · Minislot

1. Introduction

The minislot is the basic unit for resource allocation in IEEE 802.16 that is also known as WiMAX. IEEE 802.16 Standard [1·2] leaves the minislot allocation in mesh mode for further study. The simple minislot allocation scheme (SMAS) [3·8] is proposed to allocate minislots according to the node’s request. However, SMAS is an inflexible scheme, because it cannot adjust the request according to the status of the available minislots. We proposed a dynamic minislot allocation scheme (DMAS) to improve the flexibility of SMAS with minimum change in MSH-DSCH Request Information Element (IE) field. The DMAS adjusts the Demand Persistence specified in MSDH-DSCH request IE to reduce the end-to-end delay, and get better throughput compared to SMAS.
Take figure 1 as an example, nodes A and B send requests to the same granter node. For the case that the request of the node B is conflict to that of the node A or others node, then the granter nodes sends a reject message to the node B. Assume that node A’s request contain the Demand Level = 256, and Demand Persistence = 128, node B’s request contain the Demand Level = 2 and Demand Persistence = 1 shown in figure 2, and the granter node get node A’s request first. Because the limitation of Demand Persistence is 128 in IEEE 802.16 standard, node B will be rejected at first time of request. If the granter node can adjust the Demand Persistence of node B’s request to equal 2, then the granter node can grant minislot resource to node B as shown in figure 3.

Assume that node A has reserved one minislot in frame i at the pervious grant where node A’s request contains the Demand Level = 256 and Demand Persistence = 128. Node B’s request contains the Demand Level = 4 and Demand Persistence = 2 in figure 2. Assume that the granter node received node A’s request first. Node B will get reject message from the granter node because granter node cannot accept the Demand Persistence of node B’s request. If the granter node can adjust the Demand Persistence of node B’s request to equal 4, then the granter node can grant minislot resource to node B as show in figure 5.

This paper focuses on how to get better performance in minislot allocation based on mesh mode distributed scheduling. The paper is organized as follows. We will describe our proposed scheme dynamic minislot allocation scheme (DMAS) in section 2. In section 3, we described the WiMAX mesh environment and our simulation parameters. Section 4 shows simulation results were simulated by ns-2 simulator, and compare the performance with simple minislot allocation scheme (SMAS). The conclusion and future work are described in section 5.

**Figure 1: Example for the flow chart where node B’s request is rejected**

**Figure 2: Example 1 of node B’s request is rejected in the granter node’s resource map**

**Figure 3: Example 1 of node B’s request is successful in the granter node’s resource map**

**Figure 4: Example 2 of node B’s request is rejected in the granter node’s resource map**

**Figure 5: Example 2 of node B’s request is successful in the granter node’s resource map**

2. Dynamic Minislot Allocation Scheme

In session 1, there have two examples in figure 2 and figure 4 to show that if granter node can adjust the request from node B, then node B won’t need to resend the request again. Based on this concept, we propose a dynamic minislot allocation scheme (DMAS) to solve this minislot allocation issue. Before we introduce DMAS, we need to introduce simple minislot
allocating scheme (SMAS) first. SMAS [3, 8] is an allocation scheme used in IEEE 802.16 Mesh mode to allocate minislots, and the basic concept of SMAS is to find the continuous minislots in persistence frames, and according to the IEEE 802.16 Mesh mode grant message, the start position and end position of continuous minislots in persistence frames need be the same as each persistence frame. The granter node rejected node B’s request in figure 2 and figure 4, because SMAS can not let granter node adjust the request to meet the available minislot resource. The node B needs to re-compete to reserve the minislot resource. But let us remain that, node B may not win the competition, and get resource so smoothly at frame i+128 in figure 2. In [3] had proposed an analysis model to analysis the three-way handshaking procedure, and the average three-way handshaking time is about 150 time slots in 100 nodes topology.

To reduce the delay of node B need to re-compete and process three-way handshaking again and again, we proposed a dynamic minislot allocation scheme (DMAS). In IEEE 802.16 standard [1, 2], three-way handshaking composed by composed by request (MSH-DSCH Request IE), grant (MSH-DSCH Grant IE, direction = 1), and confirm (MSH-DSCH Grant IE, direction = 0) among the nodes sending request. We notice that there has one bit reserved in MSH-DSCH Request IE, and the bit shall be zero in the standard. To let granter node can adjust requester node’s request, we need to modify the MSH-DSCH Request IE to enable DMAS, because SMAS can’t satisfy this request. So we give the reserved bit a new name call “Dynamic bit”, and use it to let granter node know that this request can be dynamic allocate if the available minislots can’t satisfy this request when dynamic bit be set equal 1.

MSH-DSCH Request IE contains 8bits Link ID, 8bits Demand Level, 3bits Demand Persistence, and 1bit reserved. After got MSH-DSCH Request IE, the granter node gets minislot range information according to Demand Level divide Demand Persistence. Minislot range means how many minislots in a single frame. DMAS collects this information include Dynamic bit set equal 1 or not, if Dynamic bit equals zero, then do not thing with minislot allocation. If Dynamic bit equals 1, then first step will try to find out the available minislot resource can satisfy the Demand Level and Demand Persistence or not. If the available minislot resource can’t satisfy the request, then DMAS will extension the Demand Persistence, and clip minislot range then find out the available minislot resource can satisfy the modified Demand Persistence and minislot range or not. DMAS will repeat these steps until granter node can find out an allocation way of modified demand persistence and minislot range or the Demand Persistence equals 128 which is the limitation of IEEE 802.16 standard Demand Persistence maximum value.

Figure 6 Example: Flow chart of node B’s request was adjusted by granter node

Also according to the examples we gave in chapter 1, Figure 6 apply DMAS in three-way handshaking. We assume that node A’s request contain the Demand Level = 256, and Demand Persistence = 128, node B’s request contain the Demand Level = 2 and Demand Persistence = 1 in figure 2, and the granter node got node A’s request first. The main difference between node A and node B is the node B’s Dynamic bit equals 1, that means node B’s request can be adjust by the granter node. In figure 2, we can see if the granter node can’t dynamically adjust node B’s request, node B will need to re-compete again. And after apply DMAS, granter can dynamically adjust node B’s request from Demand Level equals 1 to Demand Level equals 2 according to the available minislot resource as show in figure 3. Then we can see the granter node accept the modified request of node B, and return the Grant message which contains allocation information, the clipped minislot range, and the extended Demand Persistence.

In figure 4, the reason why the node B’s request been rejected by the granter node is the granter node can’t guarantee the persistence of the node B’s request. After apply DMAS in figure 5, the granter node also can dynamically extend the persistence of node B’s request, and clips the minislot range in a frame to satisfy the Demand Level of node B’s request, but