DVB-RCS 망에서 Soft-QoS 기반의 Borrowing 기법을 사용한 호 수락 제어

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Call Admission Control using Soft QoS-based Borrowing Scheme in DVB-RCS Networks

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요 약

본 논문에서는 DVB-RCS (Digital Video Broadcast-Return Channel via Satellite) 망에서 호 수락제어 (CAC)를 위한 Soft-QoS 기반의 borrowing 기법을 제안한다. 제안된 기법은 위성 망에서 사용 가능한 자원이 부족할 때 새로운 호를 받아들이기 위해 서비스 중인 호 중 일부에서 일시적이고 공평하게 대역폭을 가져온다각각의 호에서 가져오는 대역폭의 양은 각 사용자의 critical bandwidth ratio에 비례하며 critical bandwidth ratio는 제안된 기법에서 이용하는 QoS 파라메타 중 하나이다 시뮬레이션 결과는 제안된 기법이 호의 blocking 확률과 대역폭 효율 측면에서 성능의 향상이 있음을 보여준다

Key Words : Soft QoS, Fairness, Borrowing Scheme, CAC, DVB-RCS

ABSTRACT

We propose a soft QoS-based borrowing scheme for call admission control(CAC) in DVB-RCS(Digital Video Broadcast-Return Channel via Satellite). Some of the ongoing calls temporarily and fairly release bandwidths that can be used to accommodate a new call in an overloaded satellite network. The amount of bandwidth borrowed from each call is proportional to each user's critical bandwidth ratio, one of parameters for soft QoS mechanism. Simulation results show that the proposed scheme improves the system performance in terms of call blocking probability and bandwidth utilization.

Ⅰ. Introduction

Currently developed or planned broadband satellite systems, including low earth orbiting (LEO), medium earth orbiting(MEO) and geostationary earth orbiting(GEO) satellites, have been proposed to support interactive services. Particularly, developing DVB-RCS systems make possible providing multimedia services such as voice, video, and high-speed internet[1]. The characteristic of this system is that the capacity of the return link is less than in the forward link. Some researchers have studied about the radio resource management(RRM) in the return link. To overcome the

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limited resources and large propagation delay in DVB-RCS systems, call admission control and bandwidth reservation scheme require an effective scheme that provides adequate QoS guarantees.

Admission control become important since the amount of bandwidth requested by connections may exceed the level of bandwidth available at the time of call setup. During the duration of the connection, the network provides that the certain amount of bandwidth will be maintained. But the required bandwidth of multimedia connections varies for a session according to the user's QoS requirements. Therefore hard QoS-based resource management such as [5] reduces the utilization of network resources. On the other hands, soft QoS-based scheme is guaranteed that the waste of network resources decreases by degrading the individual QoS level of existing calls [2][3][4].

When the network has insufficient bandwidth for a new call, it borrows bandwidth from every ongoing call and allocates bandwidth to a new call. The proposed admission control and bandwidth reservation reduce the call blocking probabilities and increase the utilization of resources. However, soft QoS-based borrowing scheme decides to how it borrows from every existing call.

The rest of the paper is organized as follows. Section II presents the description of DVB-RCS. The proposed admission control concept is described in Section III. Section IV presents the simulation results. The conclusion of this work is presented in Section V.

Ⅱ. DVB-RCS network

We consider a DVB-RCS network that consists of one hub station, a GEO satellite and a number of group terminal called return channel satellite terminals(RCSTs). Fig. 1 shows the network architecture of DVB-RCS systems. In DVB-RCS systems, the multiple accesses used in the return link is multi-frequency time division multiple access(MF-TDMA) that shares time slots among RCSTs. Each frame is defined as time slots of the fixed length and the packets are encapsulated in ATM-like cell format(53 bytes) or MPEG-2 format (188 bytes).

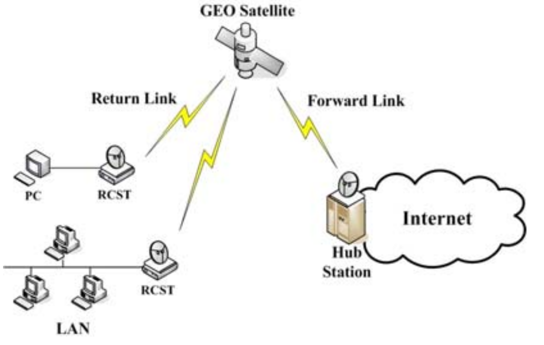

Fig 1. The network architecture of DVB-RCS

To obtain the desired number of time slots, each RCST reports hub station. Upon receiving requests, CAC function, one of RRM functions, in hub station calculates bandwidth allocated RCSTs using the proposed resource allocation scheme. And hub station broadcasts terminal burst time plan(TBTP) to RCSTs. TBTP includes each RCST's transmit time and RCSTs transmit the packets.

In DVB-RCS specification, there are four capacity requests; continuous rate assignment (CRA), rate based dynamic capacity(RBDC), volume based dynamic capacity(VBDC), free capacity assignment(FCA)[6]. When RCSTs request resource from hub station, they use one of capacity requests. But there is no method defined for optimizing the allocation of resource to RCSTs and admission control scheme in spite of describing four capacity categories specified in [6]. Hence to use the resource of satellite system efficiently, resource management such as CAC and bandwidth reservation scheme for DVB-RCS systems is needed.

Ⅲ. Call admission control based on soft QoS and borrowing scheme

A basic concept of the proposed CAC scheme allocates bandwidth released from existing calls to a new call. In borrowing scheme, it important to decide to the amount of bandwidth borrowed from each ongoing call fairly. The utilization of bandwidth decreases in the network if the borrowed bandwidth exceeds the bandwidth allocated to a new call. Therefore, this paper proposes CAC scheme using critical bandwidth ratio, ξ, proposed in [2].

The critical bandwidth ratio defines as relation between users' QoS requirements and the allocated bandwidth and calculated by soft QoS controller proposed in [2]. For example, if the network allocates 64kbps' bandwidth to the voice traffic, the critical bandwidth of its voice traffic is equal to 1. The bandwidth supported for the voice traffic is equal to 32kbps, the critical bandwidth ratio is equal to 0.5. Fig. 2 shows a basic concept of the proposed scheme.

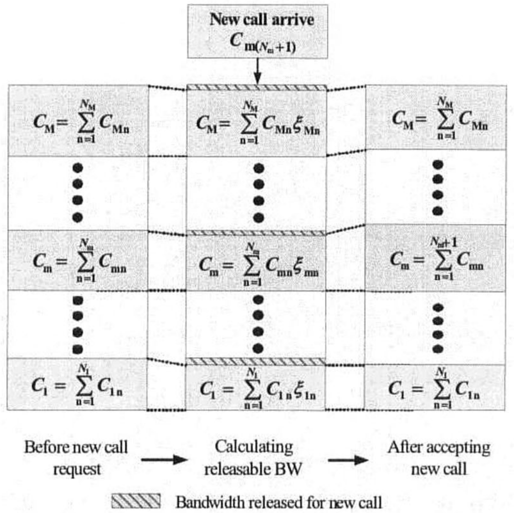

Fig 2. A basic concept of a proposed scheme

We assumed that the number of traffic class is equal to M and the number of calls of m-th class is equal to N_m. Let C_{mn} be the allocated bandwidth to n-th call with class m. The bandwidth borrowed from each existing calls presents the following equation:

$$C_{mn}(1-\xi_{mn}) \qquad (1)$$

where ξ_{mn} is the critical bandwidth ratio of n-th call with class m. Eq. (1) results in bandwidth wastes if the total amount of released bandwidth exceeds the requested bandwidth for a new call. Hence, to waste bandwidth and borrow fairly from ongoing calls, Eq. (1) may be modified.

Let $C_{m(N_m+1)}$ be the requested bandwidth from a new call which is $(N+1)$-th call with class m. And then the bandwidth released each existing calls is calculated by Eq. (2):

$$C_{mn}^{released} = \frac{C_{mn}(1-\xi_{mn})}{\sum_{m=1}^{M}\sum_{n=1}^{N_m} C_{mn}(1-\xi_{mn})} \times C_{m(N_m+1)} \qquad (2)$$

Unlikely the hard QoS concept, the proposed scheme can admit a new call even though the network does not allocated bandwidth. Hence, it reduces the call blocking probability and increases bandwidth's utilization by admitting more users.

Ⅳ. Simulation and results

Let C be the total bandwidth in the network. We assumed that C = 2Mbps, M = 3, N_1 = 6, N_2 = 2, N_3 = 2 and the value of C_{mn} and ξ_{mn} defines in Table 1. Let C_{17} be a new call with the requested bandwidth, 384kbps.

Using the traditional hard QoS schemes, this new request is rejected since the total sum of C_{mn} is equal to 1,984kbps.

But the proposed CAC using soft QoS-based borrowing scheme admits the request since the requested bandwidth is equal to the total sum of bandwidth(=384kbps) the borrowed from ongoing calls. To verify our scheme's performance, we simulate using NS-2. We assumed that the number of class is equal to 2 and the source model is on-off source. Each source is assumed to the active duration of 500 msec, the off duration of 833 msec. The peak rate of class 1 and class 2 is 32kbps and 64kbps, respectively. The basic parameters which are used in this simulation are defined as Table 2.

Table 1. The example of the proposed scheme.

traffic class, m	C_{mn}	ξ_{mn}	$C_{mn}(1-\xi_{mn})$ using Eq.(1) [kbps]	$C^{released}_{mn}$ using Eq.(2) [kbps]
m=1	C_{11}=64	ξ_{11}=1	0	0
	C_{12}=64	ξ_{12}=1	0	0
	C_{13}=64	ξ_{13}=1	0	0
	C_{14}=128	ξ_{14}=1	0	0
	C_{15}=128	ξ_{15}=1	0	0
	C_{16}=384	ξ_{16}=1	0	0
m=2	C_{21}=128	ξ_{21}=0.5	64	48
	C_{21}=384	ξ_{22}=0.5	192	144
m=3	C_{31}=256	ξ_{31}=0.6	102.4	76.8
	C_{31}=384	ξ_{31}=0.6	153.6	115.2

Table 2. Simulation parameters

Parameters	Value
Satellite range	37,500 km
Traffic model	on-off source
Uplink data slot size	53 byte
Uplink channel data rate	2 Mbps
Uplink data slot size	53 byte
Number of data slots per frame	240
Data slot time	1.766 msec
Number of Traffic class	2
Critical bandwidth ratio	0.5 ~ 1

Fig. 3 shows the call blocking probability of the proposed soft QoS scheme and traditional hard QoS scheme such as [5]. Because of soft QoS-based borrowing scheme, the proposed scheme admits a new call but the traditional scheme rejects in overloaded hub station. In this situation, our scheme temporarily allocates bandwidth borrowed from calls to a new call. Therefore the call blocking probability of our CAC scheme is lower than traditional hard QoS scheme.

Fig. 4 shows the utilization of the proposed scheme and the traditional scheme. Degrading the QoS requirements of each call, the network admits more calls. As shown in results, our proposed scheme improves the performance of network.

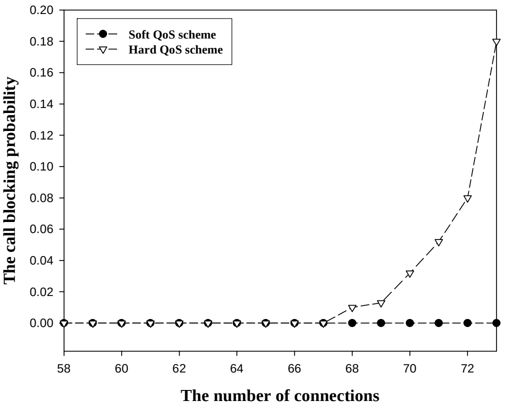

Fig 3. The call blocking probability vs. the number of connections

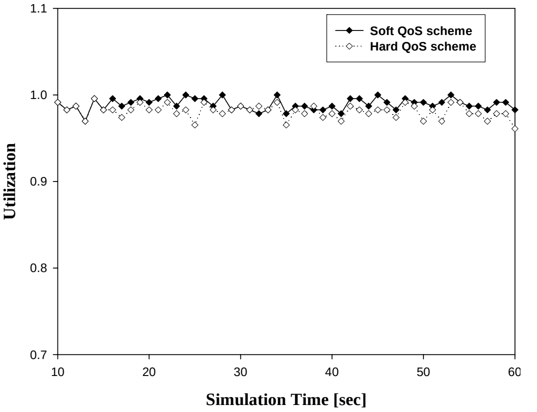

Fig 4. Utilization vs. simulation time

V. Conclusion

We proposed a call admission control and reservation scheme for multimedia satellite network. The proposed scheme using critical bandwidth ratio can increase the number of users and use the radio resource efficiently. The simulation results showed that the proposed scheme reduces call blocking probability and increases the bandwidth's utilization. Also the proposed borrowing scheme is fair.

References

[1] H. Skinnemoen, R. Leirvik, J. Hetland, H.Fanebust and V. Paxal, "Interactive IP-Network

Via Satellite DVB-RCS," *IEEE Journal on Selected Areas in Communications*, Vol. 22, April 2004

[2] D. Reininger, R. Izmailov, B. Rajagopalan, M. Ott and D. raychaudhuri, "Soft QoS Control in the WATMnet Broadband Wireless System," *IEEE Personal Communications*, Feb. 1999

[3] S. K. Das, S. K. Sen, K. Basu and H. Lin, "A Framework for Bandwidth Degradation and Call Admission Control Schemes for Multiclass Traffic in Next-Generation Wireless Networks," *IEEE Journal on Selected Areas in Communications*, Vol. 21,2003

[4] F. Alagoz, B. R. Vojcic, D. Walters, A. Alrustamani and R. L. Pickholtz, "Fixed Versus Adaptive Admission Control in Direct Broadcast Satellite Networks With Return Channel Systems,"" *IEEE Journal on Selected Areas in Communications*, Vol. 22 ,2004

[5] R. Q. Hu, J. Babbitt, H. Abu-Amara, C. Rosenberg and G. Lazarou, "Connectivity Planning and Call Admission Control in an On-board Cross-connect Based Multimedia GEO Satellite Network," *IEEE International Conference on Communications*, Vol. 1, May 2003

[6] Digital Video Broadcasting(DVB); *Interaction channel for Satellite Distribution Systems*, ETSI EN 301 790 (v1.3.1), 2003

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