

Dynamic MBS zone configuration based on contents characteristics

Young-il Kim*, Sangseok Yun**, Lee, Kyu-Seoung ***, Won Ryu*, Ho Jin Lee*

* *Electronics and Telecommunications Research Institute, Daejeon, Korea*

** *Dept. of Electronics Engineering, Pusan National University, Busan, Korea*

*** *Dept. of Information & Communications, Korea Rail Network Authority*
yikim@etri.re.kr

Abstract— To provide high quality of multimedia service in mobile environment, mobile IPTV service technology that enables higher reliability of transmission quality and multimedia service to many subscribers has been developed. One of the important technologies for mobile IPTV is to mitigate interference. This can be done by the configuration of MBS zone. 3GPP/LTE and Mobile WiMAX support MBS technology to provide good quality of multimedia service. Nowadays multi-carrier radio resources have been considered to meet the requirement of 4G system. In this paper MBS zone selection technology based on contents characteristics to increase the service quality is suggested in multi-carrier environment.

Keywords—Mobile IPTV, MBS zone, Mobile WiMax, WiBro

I. INTRODUCTION

To increase the transmission efficiency of wireless access network, MBS technology was introduced in cellular system. The main concept of MBS is to mitigate the interference from other cells. MBS can enhance the transmission capacity of wireless system by grouping several cells into one MBS zone, meanwhile the radio resource may be wasted by allocating same radio resource to same contents in MBS region. Therefore transmission cost may be increased.

To overcome this shortcoming, dynamic MBS zone selection technology based on traffic parameters and contents characteristics is suggested in terms of satisfying the QoE(Quality of Experience) parameter. In this paper, multi-carrier radio resource allocation algorithm based on IEEE 802.16m is suggested.

II. MOBILE IPTV TECHNOLOGY

There are some challenging technologies to increase the service quality of broadcasting multimedia service considering the capacity of mobile IPTV system. One of the important technologies is the configuration of MBS zone. This technology can improve the QoS, but radio resources may be wasted by mitigating interference. Therefore the proper technology for interference mitigation should be developed. In this paper, interference mitigation technology that minimize the side effect of MBS zone configuration is suggested to increase the system capacity in multi-carrier environment based on IEEE 802.16m radio access network.

A. MBS zone configuration for mobile IPTV

To provide mobile IPTV service, 3GPP and WiMAX developed the enhanced MBS standard such as e-MBMS and E-MBS. This standard considered MBS zone configuration method, in which several BSs(Base Station) were grouped to mitigate interference from other cells as shown in Fig.1. In this MBS zone, MBS server allocates the radio resource of each BS to control interference. If same radio resources are allocated to same contents in several BSs, interference can be removed. There are several kinds of service such as unicast service and multi-cast and broadcast service in mobile IPTV system. Since the more MBS traffic, the less unicast traffic can be available in mobile IPTV system. Therefore efficient traffic scheduler should be introduced.

There are rigid requirement for transmission data rate in 4G wireless networks, that is, the BS of 4G system has to provide the peak data rate up to 1Gbps. To satisfy this requirement, 3GPP/LTE and IEEE 802.16m developed the management specification using multi-carrier frequencies.

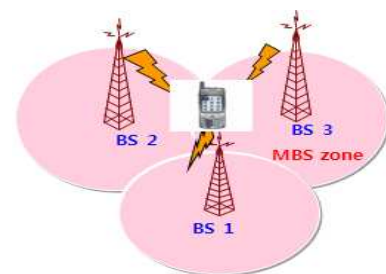


Figure 1. MBS zone configuration

III. DYNAMIC MBS ZONE BASED ON CONTENTS CHARACTERISTICS

Generally MBS zone can be configured according to the number of subscriber who requires certain programs such as real TV program. In MBS zone, unicast traffic can be allocated to the radio resource except from multicast radio resource. Also multi-carrier resources can be used for multicast traffic in mobile IPTV system. In this paper, dynamic MBS zone configuration technology is suggested to increase the service quality using contents characteristics in multi-carrier 4G system.

A. MBS zone based on frequency overlaid network

There are several kinds of characteristics in various multimedia contents. Network operator has to meet the required QoS/QoE for multimedia contents. For example, it's necessary to provide rigid QoS/QoE parameter for real time streaming contents, meanwhile flexible QoS/QoE parameter can be admitted for some contents such as VoD and data service. Therefore it's required to select proper frequency allocation(FA) to satisfy QoS/QoE parameter for subscribers who can experience various radio environments in multiple access networks.

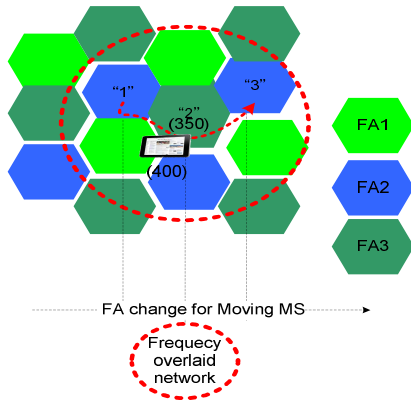


Figure 2. MBS zone based on frequency overlaid network

B. MBS zone selection criterion

As the one of the technologies to select overlaid multi-carrier frequency, a cost function is suggested as follows.

$$\text{Cost} = \text{weight} * \{(\text{Required bit rates for contents})/(\text{Available bit rates in FA})\} * (\text{Unit cost per FA/bit}) \quad \text{---(1)}$$

In equation (1), the weight parameter is introduced considering the network loading status, that is, if a certain FA overlaid network have too enough available resources, it means that it's possible to provide high quality of image service long time due to the less interference from neighbour cells. But it's not so, the interference may exceed minimum required level within short duration.

IV. PERFORMANCE EVALUATION OF DYNAMIC MBS ZONE CONFIGURATION

To evaluate the performance of dynamic MBS zone configuration technology based on contents characteristics, SLS(System Level Simulation) based on IEEE 802.16m was developed.

A. Simulation Environment

The simulation radio parameters based on IEEE 802.16m are shown in Table 1.

TABLE 1. RADIO PARAMETER

Bandwidth(MHz)		5	7	8.75	10	20
Sampling Freq.(MHz)		5.6	8	10	11.2	22.4
Sampling Factor		28/25	8/7	8/7	28/25	28/25
FFT Size		512	1024	1024	1024	2048
Carrier Space(KHz)		10.94	7.81	9.77	10.94	10.94
Effective Symbol Duration (us)		91.4	128	102.4	91.4	91.4
CP: 1/8 Symbol	Symbol Duration		102.8	144	115.2	102.8
	FDD	No. of OFDM Symbol	48	34	43	48
		Idle Time (us)	62.8	104	46.4	62.8
	TDD	No. of OFDM Symbol	47	33	42	47
		TTG+R TG(us)	165.7	248	108.8	165.7
CP: 1/16 Symbol	Symbol Duration		97.14	136	161.6	97.14
	FDD	No. of OFDM Symbol	51	36	45	51
		Idle Time (us)	45.71	104	104	45.71
	TDD	No. of OFDM Symbol	50	35	44	50
		TTG+R TG(us)	142.8	240	212.8	142.8
CP: 1/4 Symbol	Symbol Duration		114.3	160	128	114.3
	FDD	No. of OFDM Symbol	43	41	49	43
		Idle Time (us)	85.69	40	8	85.69
	TDD	No. of OFDM Symbol	42	30	37	42
		TTG+R TG(us)	199.9	200	264	199.9

19 cells configuration, in which 3 FAs are overlapped to make an overlaid MBS zone, is used to simulate the performance of suggested technology as shown Fig. 3 and Table 2. The simulation system parameters are shown in Table 2. Also 5 kinds of traffic types are used as follows.

- Class 1: 300 Kbps
- Class 2: 1 Mbps
- Class 3: 2 Mbps
- Class 4: 4 Mbps
- Class 5: 8 Mbps

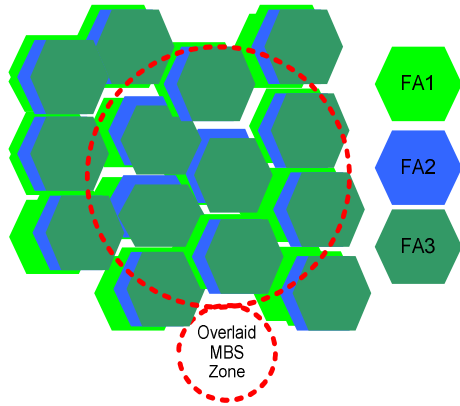


Figure 3. Simulation cell configuration

TABLE 2. SYSTEM PARAMETER

Description	Value
Center frequency	2.5 [GHz]
cell radius	866 [m]
BW	20 MHz
BS spacing	1732 [m]
configuration	2 tiers 19 cells, 3 sectors/cell
frame structure	802.16m
number of users per sector	10
Path loss type	urban, NLOS
multipath type	ITU-R Pedestrian A, B, Vehicular A, B
shadow model	spatial correlation, cross correlation
shadowing standard deviation	Type E : 8 [dB]
antenna structure	2×2 (MIMO)
noise figure	5 [dB]
scheduling / traffic model	round robin / full buffer

B. Simulation results

The geometry of MBS zone is shown in Fig.4 when MBS zone with 3 multicast frequencies is configured in 1 tier cells. There are 3 overlaid systems, which use each 1 FA in a cell. In this configuration the system capacity and unit cost per FA of 3 systems are considered as same as each other. An each cell in this MBS zone area monitors the allocated radio resources of neighbour cells for each radio frame duration time such as 5 msec. And radio resources with the least cost function are selected for multimedia service. Dynamic MBS zone configuration technology increases the system capacity in MBS zone boundary.

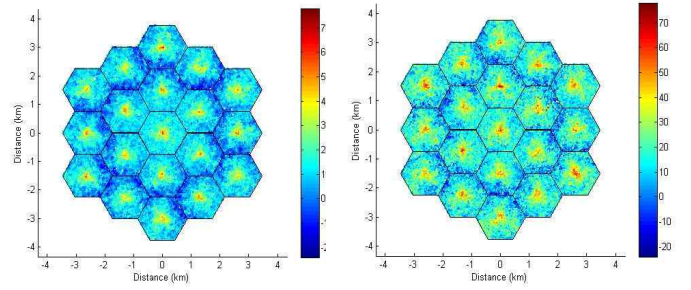


Figure 4. MBS zone Geometry according to contents characteristics

The geometry CDF of MBS zone is shown Fig. 5.

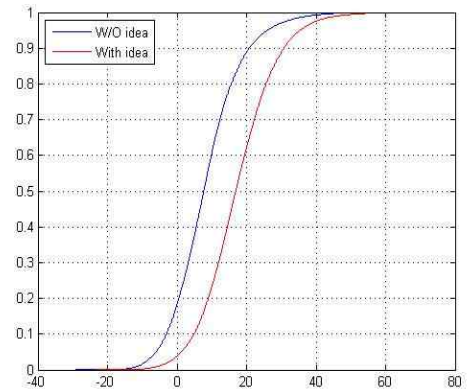


Figure 5. MBS zone Geometry CDF

An outage probability was analysed according to the dynamic MBS zone configuration based on the contents characteristics. The outage probability was decreased up to 40% by suggested algorithm

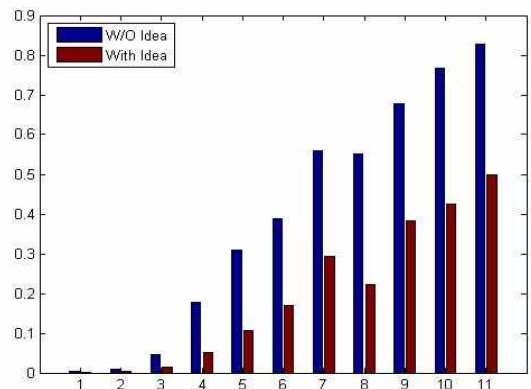
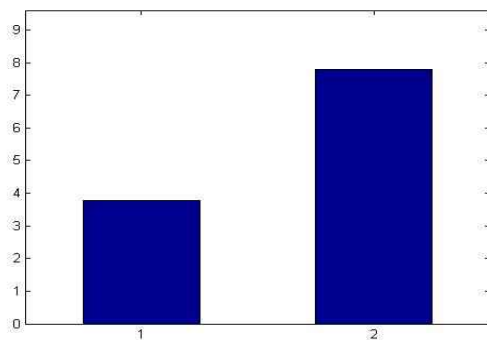


Figure 6. Outage probability

TABLE 3. OUTAGE PROBABILITY

	MCS	Fixed MBS zone	Dynamic MBS zone	Performance Enhancement
Outage Probability (%)	QPSK 1/2 x6	0.26	0.07	73%
	QPSK 1/2 x4	1.01	0.29	71%
	QPSK 1/2 x2	4.64	1.51	67%
	QPSK 1/2	17.65	5.18	71%
	QPSK 3/4	30.94	10.72	65%
	16QAM 1/2	38.75	17.09	56%
	16QAM 3/4	55.91	29.45	47%
	64QAM 1/2	55.21	22.36	60%
	64QAM 2/3	67.65	38.24	44%
	64QAM 3/4	76.73	42.41	45%
	64QAM 5/6	82.89	49.82	40%

**Figure 7.** User throughput

In terms of user throughput, the suggested technology outperforms legacy MBS technology, that is, the average user throughput of suggested technology is 7.78 Mbps, on the other hand fixed MBS technology provide 3.76Mbps.

V. CONCLUSIONS

The high quality of multimedia service is required in wireless environment to satisfy user experience acquired in wire line communication system, in which there is no limitation regarding to transmission bit rates compared to radio communication system.

In order to meet these requirements, a dynamic MBS zone configuration technology based on contents characteristics in a frequency overlaid system is suggested. To verify this algorithm, system level simulation was processed according to the IEEE 802.16m specification. According to the simulation results, this suggested technology increased the system performance as well as outage probability. Also user throughput of suggested technology is increased 2 times than fixed MBS zone configuration. Therefore it's anticipated that this suggested algorithm will be commonly used for mobile IPTV service in 4G or 5G system environment.

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