

Mobile IPTV Performance Enhancement based on WiBro MMR Technology

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Abstract— It's necessary to enhance the capacity of wireless access network to provide mobile IPTV service. In this paper MMR(Mobile Multi-hop Relay) system is introduced to increase the performance of mobile system based on IEEE 802.16m which introduced network coding technology to increase the performance of radio link. Radio link quality and mobile terminal throughput are analysed by simulation when RS(Relay Station) is installed in sector cell and MBS(Multicasting and Broadcasting Service) is applied.

Keywords— Mobile IPTV, MMR, RS(Relay Station), Mobile WiMax, WiBro

I. INTRODUCTION

Mobile IPTV is promising multimedia service to increase the revenue of communication industry. Currently there are two approaches to introduce mobile IPTV service. The one is to introduce IP addressing technology to mobile TV such as DMB. The other is to support mobility to a fixed STB(Set Top Box).

Mobile IPTV service based on mobile TV has to integrate wireless network with mobile TV to provide return channel. Since the cell coverage is larger than mobile communication system in this approach, linear TV service is more preferable than VoD service to operator.

Mobile IPTV technology based on wireless communication system to support mobility to a STB can support IPTV services such as linear TV service and VoD service up to large number of subscribers.

Generally the QoS of mobile IPTV can be determined according to the poorest quality of MS located in cell boundary. To overcome this problem, MBS concept was introduced. Already 3GPP and WiMAX announced MBS specification. But right now mobile IPTV service is not available to the market due to limited frequency resource and low throughput in access network. Currently 3GPP/LTE and IEEE 802.16m has been developed the enhanced MBS standard such as e-MBMS and E-MBS. But performance enhancement in wireless access network is hot issues due to interference in cell boundary. To improve cell throughput

and cell coverage extension MMR(Mobile Multi-hop Relay) technology was introduced in mobile communications.

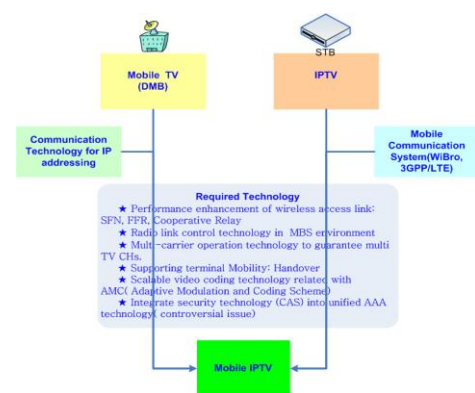


Figure 1. The development of mobile IPTV.

But there are no activities to introduce RS(Relay Station) in MBS environment. Therefore in this paper, we suggest the RS application in MBS zone to increase the performance of wireless access network. We focus on the introduction of RS in IEEE 802.16m system. Also performance enhancement in MBS environment will be evaluated

II. MOBILE IPTV SYSTEM

In this chapter MBS and MMR concept for mobile IPTV service will be described.

A. Multicast Broadcast Service

MBS is point-to-multipoint communication technology where data packets are transmitted simultaneously from a single source to multiple destinations. There are two types of MBS structure. The one is to provide MBS within single cell. The other is to provide MBS over multi-cell. Single-BS(Base Station) access does not support macro diversity since its transport connection is configured within one BS, while multi-BS access supports macro diversity. Both single-BS and multi-BS type are not applicable ARQ. In case of multi-BS access, MBS zone may be configured for getting diversity gain.

MBS zone may work with single frequency network (SFN). SFN operation can be realized for broadcast traffic transmitted using OFDMA form in multiple cells with timing errors within the cyclic prefix length. The number of base stations can belong to an MBS zone, and a number of MBS zones in macro cell can be exist.

BS has to transmit MBS content even though there are not users who want to receive MBS if there exist a user who want to receive MBS located the same MBS zone. It brings out waste of power to BS. Hence, the size of MBS zone is important factor of the performance of MBS. The SFN concept is depicted in Figure 2.

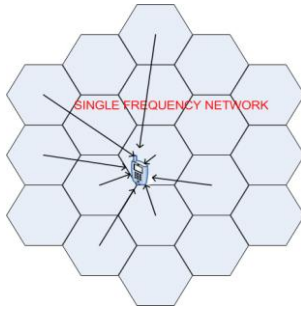


Figure 2. Macro diversity in SFN environment.

B. Macro diversity in MBS zone

MBS transmission within same MBS zone should be synchronized to increase the performance. It means that each BS shall transmit the same transmission mechanism (symbol, sub-channel, modulation). The effect of macro diversity gain is varied to size of MBS zone. MBS zone is the group of BS which transmitting the same data in SFN environment for getting macro diversity gain. The larger MBS zone is deservedly better performance but leads to waste of resources because BSs in same MBS zone should be transmit the data regardless of the number of users with dissipating power.

III. MMR SYSTEM FOR MOBILE IPTV

In this chapter, MMR concept based on IEEE 802.16m is described, and MMR technology is suggested to enhance the performance of wireless access network.

A. IEEE 802.16m MMR

IEEE 802.16m standard has been developing to satisfy the requirement of ITU-R Advanced technology. There are MMR technology to increase cell throughput and to extend cell coverage in IEEE 802.16m.

The relay frame structure is illustrated in figure 3. Especially network coding zone was specified in IEEE 802.16m to decrease interference and delay latency in service area.

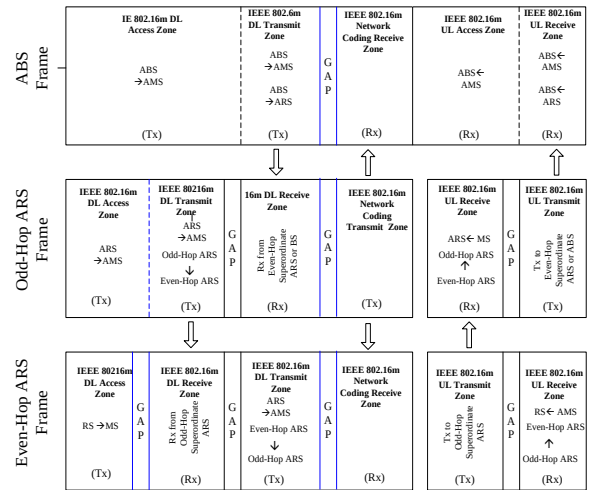


Figure 3. Relay frame structure

B. Suggestion of RS installation for Mobile IPTV service

The purposes of RS installation are to increase the throughput of MS(Mobile Station) and the extension of cell coverage. We suggest the introduction of RS in MBS zone boundary in order to enhance MBS performance. MBS zone can be configured as dynamically according to the MBS traffic character. When there are no MSs that moves to MBS zone boundary, RS will not be operated to decrease interference. In case of MS movement to other MBS zone, RS will be operated to support QoS of MBS data.

IV. PERFORM EVALUATION OF MOBILE IPTV BASED ON MMR

The performance evaluation result of wireless access network for mobile IPTV service when RS is deployed in MBS zone will be presented.

A. Simulation parameter

To evaluate the performance of wireless access network with RS based on IEEE 802.16m, 6 cell MBS zone and 7 cell MBS zone are considered.

The simulation parameter to evaluate the performance of mobile IPTV service based on IEEE 802.16m are as follows.

- Cell planning : 3 MBS zone(6 cells, 6 cells, 7cells)
- Path-loss, Shadow fading : WINNER 2 C2 Urban Macro, (sigma = 8dB, correlation distance = 50m)
- Multipath model: ITU-R Ped B(3km), Veh A (30km, 60km, 120km)
- Link to System Mapping : EESM
- Relay : ART, site to site distance 1.5km (cell radius: 0.866 km), 2RS/Sector
- The ratio of DL to UL= 29:18 (47 Symbol)
- The ratio of uni-cast region to multicast region=4:1
- Network coding region: 15 symbol

Frame structure be modified to consider 2 hop environment such as BS and one-tier RS and MS as figure 5.

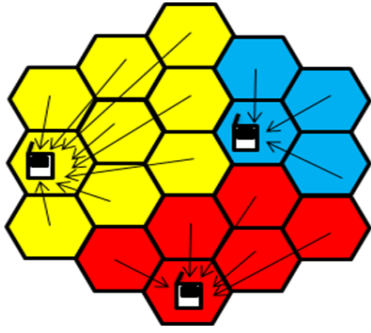


Figure 4. Cell planning for MBS simulation(example)

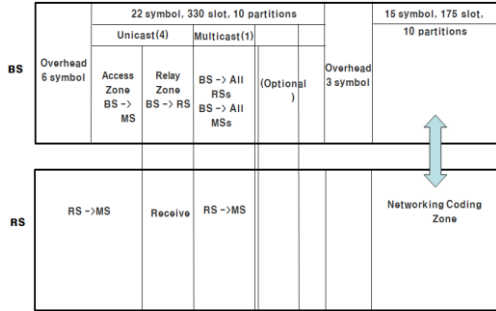


Figure 5. Frame structure for simulation

B. Simulation results

The performance comparison between uni-casting and multicasting method is presented in terms of geometry as figure 6 and figure 7.

The performance of DL multicasting service is superior to DL uni-casting service due to diversity and interference avoidance, meanwhile UL performance is similar to each other both uni-cast and multicasting service due to similar transmission procedure.

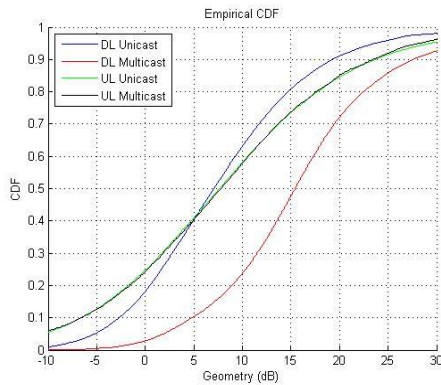


Figure 6. Geometry CDF

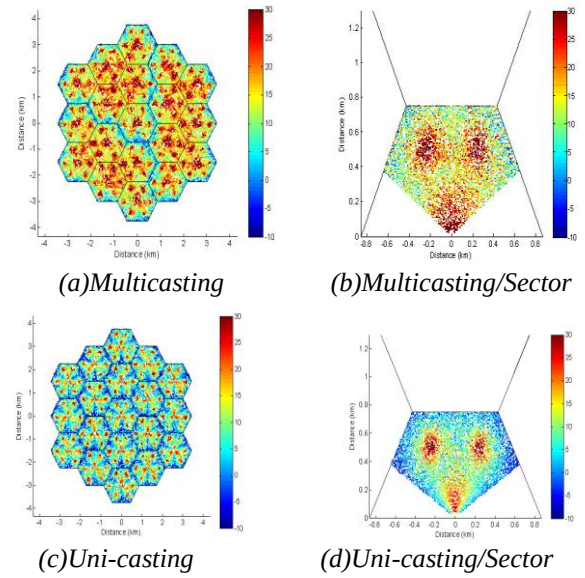


Figure 7. Geometry

The MCS distribution result is depicted in figure 8. We fixed MCS level as 16QAM 1/2 for multicasting service which support 10% outage probability. In this simulation UL uni-casting performance is superior to DL uni-casting due to radio resource allocation method, that is UL link traffic is allocated as frequency division method which resulted in decrease the interference.

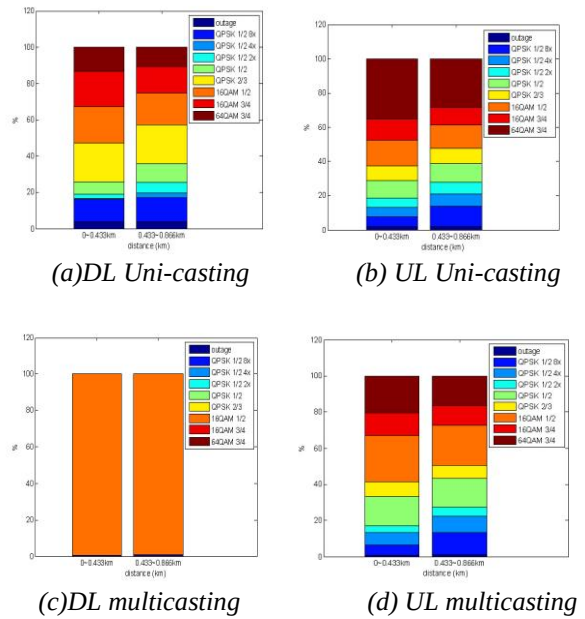
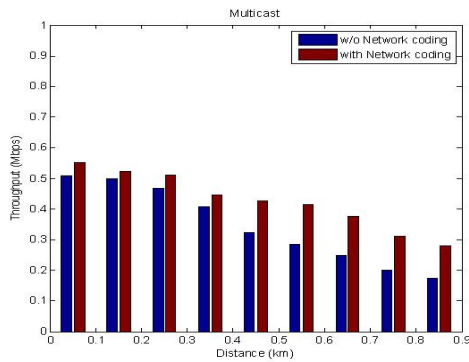


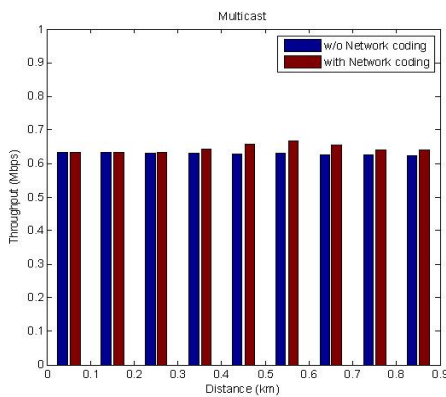
Figure 8. The distribution of MCS level

The throughput of mobile terminal is appeared in Fig 9. When network coding is introduced, the performance of uni-casting service is superior than multicasting in the RS region

because uni-casting region is 4 times greater than multicasting region. In multicasting case, the performance of DL is similar to UL. It's due to the good channel condition of DL and the ratio of DL and UL.



(a) Uni-casting throughput



(b) Multicasting throughput

Figure 9. The comparison of throughput between unicasting and multicasting.

V. CONCLUSIONS

In this paper, we suggested the introduction of MMR technology to support mobile IPTV service. The simulation result of MMR deployment was presented. According to the simulation results, we can enhance the throughput of uni-casting service by introducing network coding technology.

In this simulation to evaluate networking coding technology, we only focused on the interference effect. We'll consider network coding methodology and delay latency effect in future.

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