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Load Balance and Mitigation of Interference Coordination in Multihop Cellular Networks

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ABSTRACT: Multihop cellular networks used to remove the limitations on the cell capacity and the coverage, dead spot, hot spot issues & to get high throughput. In the Mobile stations near cell edge the interference of cochannel problem becomes severe; it is one of the major things to affect performance of the network. So in this paper we going to address these problems and also we concentrated on the traffic congestion and quality of service. Here we present a survey on reducing these issues by implementing orthogonal frequency division multiplexing access technique and for the interference coordination, Intercell interference coordination (ICIC) had been investigated. For the analysis purpose we focused on IEEE 802.16j/m specification in the downlink of OFDMA-based MCNs with time division duplex mode & we used novel frequency reuse scheme for the reducing interference and we provide hand over mechanisms and investigation continues importantly for the coverage of more users in MCNs.

KEYWORDS: Multihop cellular networks, OFDMA/TDD, Interference coordination, ICIC, load balancing

I. INTRODUCTION

Future generation cellular networks like 3GPP, Advanced long term evolution and also IEEE 802.16m systems, will utilize orthogonal frequency division multiple access (OFDMA)[2] technology for multihop cellular networks (MCNs). OFDM is a technique which transmits large amount of digital data over radio wave, which is observed as a most promising technology for the fourth generation (4G) wireless networks. The objective is to provide the key features of OFDMA and also highlight the advantages of using OFDMA to rectify the important technical challenges in the Multihop cellular networks[2].

Orthogonal frequency-division multiplexing OFDM is a popular scheme for wideband digital communication, whether wireless or over copper wires, used in applications such as digital television and audio broadcasting[3], wireless networking and broadband internet access. OFDM was initially used for wired and stationary wireless communications. However with increasing number of applications operating in the highly cellular environment, the possibility of using OFDM for mobile environment have been increased investigated. OFDM is a frequency-division multiplexing (FDM) scheme identical to discrete multi-tone modulation (DMT) utilized as a digital multi-carrier modulation method. In OFDM large number of closely-spaced orthogonal sub-carriers is used to carry data[5]. The data is divided into several parallel data streams or channels, one for each sub-carrier and each sub-carrier is modulated with a conventional modulation scheme[3] such as quadrature amplitude modulation(QAM) or quadrature phase-shift keying (QPSK) at a low symbol rate, maintaining the total data rates similar to conventional single-carrier modulation schemes in the same bandwidth.

The primary advantage of OFDM over single-carrier schemes is its ability to cope with severe channel fading conditions without complex equalization filters. For example, attenuation of high frequencies in a long copper wire, narrowband interference and frequency-selective fading due to multipath. Channel equalization is simplified because OFDM may be viewed as using many slowly-modulated narrowband signals rather than one rapidly-varying wideband signal[8]. The low symbol rate makes use of the guard interval between symbols making it possible to handle time-spreading and eliminate intersymbol interference (ISI). This mechanism also facilitates the design of single frequency networks (SFNs), where several adjacent transmitters send the same signal simultaneously at the same frequency, as the signals from multiple distant transmitters may be combined constructively, rather than interfering.

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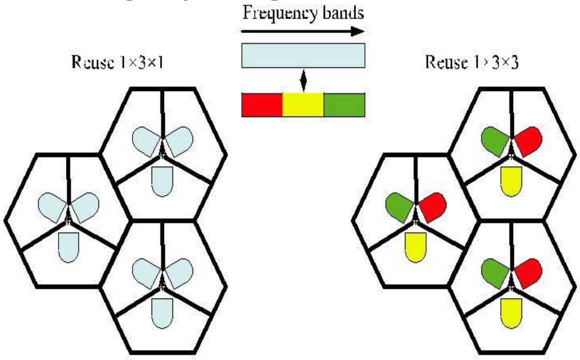
MCNs have many drawbacks, example like, it requires extra radio resource on relay links (BS-RS links). Therefore, a well-designed radio resource allocation schemes are needed for MCNs to effectively utilize the benefit of RSs, while overcoming the disadvantages.

Here RSs always utilizes same spectrum as MSs or BSs, cochannel interference (CCI) will be closely related to radio resource allocation schemes in MCNs due to intercell & intracell frequency reuse. OFDMA systems must employ the frequency planning for good cell edge performance and ease of interference management[13][14]. Traditional single-hop cellular networks (SCNs) typically utilize the frequency reuse pattern with factor of 3 or 7 to reduce CCI, which results in low spectral efficiency. As we all know, high data rate is one of desired features of the future cellular networks. It requires a highly capable utilization of the available spectrum. Frequency reuse with factor of 1 is likely to be used in LTE-Advanced and IEEE 802.16m systems, aiming at enhancing the spectral efficiency. Due to this frequency planning, it causes severe performance degradation at cell boundaries.



The worldwide interoperability for microwave access (WiMAX) Forum[1], frequency reuse pattern is given as N_S_K, which means that the networks were divided into clusters of N cells, with S sectors and K different frequency bands per cell. According to reuse patterns, all available spectrums was assigned to all sector-BSs in reuse pattern of 1_3_1, whereas each sector-BS will use only one third of total frequency bands in reuse pattern of 1_3_3. These two frequency reuse patterns are shown in above figure. The CCI level is higher in the previous pattern, whereas the spectral efficiency was lower in 1_3_3. If 1_3_3 was used in MCNs, the spectral efficiency will be lower because extra frequency resource will be allocated to relay links. If 1 _ 3 _ 1 is used in MCNs, the frequency reuse scheme is more important in a multicell scenario. Compared with BSs deployed at the cell center, RSs deployed at the cell edge cause serious interference because RSs are closer to the mobile stations (MSs) in the adjacent cells than those BSs.

II. CONCEPT OF MULTIHOP

Here we consider the MCNs consisting of 19 hexagonal cells with wrap-around model[2]. In this situation based on IEEE 802.16j/m specification, each cell has been divided into three sectors with two above the rooftop (ART) & RSs deployed in each sector. The BS-RS distance was equal to 3/8 of site-to-site distance and the angle between Relay Station location and Base Station antenna bore sight direction was 26 degree. For the sake of convenient expression below, in the jth sector of ith cell, let $N_{Rði;j;kÞ}$ be RS k, and $N_{Bði;jÞ}$ be the BS, where i ¼ 1; 2; . . . ; 19, j ¼ 1; 2; 3, k ¼ 1; 2. The first sector in the first cell, let N_M denote the MS, $N_{Bð1;1Þ}$ and $N_{Rð1;1;1Þ}$ be the candidate stations for N_M to access[2].

According to IEEE 802.16j/m specification, downlink and uplink subframes were available in each time division duplex (TDD)[12]. Every subframe was subsequently divided into two time zones denoted as relay zone (RZ) and access zone (AZ), respectively[2].

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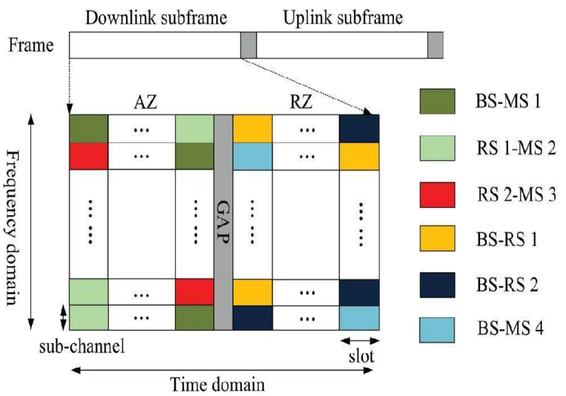

RZ was dedicated to BS transmission toward both RSs and MSs, while AZ was dedicated to the reception of MSs from the BS or two RSs. Assuming each RS receives data for relaying in RZ at the current frame, it must be scheduled to transmit the data in AZ and empty its buffer at the next frame. In each subframe, here the frequency domain consists of subchannels and time domain consists of slots. A slot in a subchannel is minimum frequency-time resource unit which is shown in the above figure is the TDD relay frame structure for MCNs.

III. SURVEY REPORT

Hongtao Zhang, Xiaoxiang Wang, Yang Liu, LZ Zheng and Thomas Michael Bohnert says in the title of Resource allocation for relay-assisted OFDMA systems using inter-cell interference coordination. In this paper Fractional Frequency Reuse (FFR) scheme is used to plan the frequency allocation and reduce the ICI in OFDMA cellular system.

Jian Liang, Hui Yin, Li Feng, Jian Zhang, Shouyin Liu says in the title Joint Opportunistic Spectrum Sharing and Dynamic Full Frequency Reuse in OFDMA Cellular Relay Networks that A dynamic full frequency reuse scheme is used, which brings an improved full frequency reuse scheme and adopts the adaptive subcarrier scheduling to obtain a better system performance than the conventional full frequency reuse scheme.

Kyuho Son, Song Chong, Gustavo de Veciana, says in the title Dynamic Association for Load Balancing and Interference Avoidance in Multi-Cell Networks that Two algorithms are proposed namely offline algorithm and practical online algorithm with less computational and feedback overheads. Concluded with better interference avoidance and provided improved load balancing.

Mohamed Salem, Abdulkareem Adinoyi, Halim Yanikomeroglu, David Falconer says in the title Opportunities and Challenges in OFDMA-Based Cellular Relay Networks: A Radio Resource Management Perspective. In this paper they discussed some fairness- implementation techniques along with some exemplary fairness metrics toward the design and performance evaluation of prospective fair RRA algorithms.

Tien-Dzung Nguyen and Youngnam Han says in the title A Proportional Fairness Algorithm with QoS Provision in Downlink OFDMA Systems has found a Downlink packet scheduling problem for proportional fairness in OFDMA system. In this paper they proposed an efficient subcarrier and power allocation algorithm based on water filling. It is shown that the proposed algorithm is slightly degraded in throughput and provides improved fairness comparing with the best schemes in throughput and perfect fairness, especially when there are large number of users.

Nassar Ksairi, Pascal Bianchi, Philippe Ciblat, Walid Hachem says in the title Resource Allocation for Downlink Cellular OFDMA Systems—Part I: Optimal Allocation and has been studied the resource allocation problem for a sectorized downlink OFDMA system in the context of a partial reuse factor. It has been proved that the solution admits a simple form and that the initial tedious problem reduces to the identification of a restricted number of parameters.

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Jemin Lee and Daesik Hong says in the title Resource Management with Limited Capability of Fixed Relay Station in Multi-hop Cellular Networks that due to the limited capability of a relay station, some mobile stations cannot transmit data in multi- hop even though they select the multi-hop transmission mode. Hence, the multi-hop user admission is provided as a way to assign the limited capability of a relay station to the mobile stations which can maximize the multi-hop gain. Through the transmission mode selection and the multi-hop user admission, the resources can be used efficiently with supporting more mobile stations with lower blocking probability.

Mahima Mehta, Osianoh Glenn Aliu, Abhay Karandikar, Muhammad Ali Imran says in the title A Self-Organized Resource Allocation using Inter-Cell Interference Coordination (ICIC) in Relay-Assisted Cellular Networks used a self-organized resource allocation scheme with intercell interference coordination to reduce the interference and also the usage of relay stations in base station provides the best quality of service near cell edges.

IV. CONCLUSION

In this paper, we have discussed a quantitative study on an adaptive resource allocation scheme based on interference coordination and load balancing for multihop cellular networks. We also surveys a novel frequency reuse scheme to mitigate interference and maintain high spectral efficiency, and present practical LB-based handover mechanisms which can evenly distribute the traffic load and guarantee users' quality of service. As we concerned, this is the first work to provide dynamic resource allocation by jointly considering interference coordination and load balancing for MCNs. We expect that our method will play a significant role in network planning and resource allocation in the future MCNs

REFERENCES

[1] IEEE P802.16j/D7, Draft Amendment to IEEE Standard for Local and Metropolitan Area Networks Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems: Multihop Relay Specification,IEEE, Oct. 2008.

[2] Yue Zhao, Student Member, IEEE, Xuming Fang, Member, IEEE, Rongsheng Huang, Member, IEEE, and Yuguang Fang, Fellow, IEEE "Joint Interference Coordination and Load Balancing for OFDMA Multihop Cellular Networks" IEEE TRANSACTIONS ON MOBILE COMPUTING, VOL. 13, NO. 1, JANUARY 2014

[3] S.S.Saravana Kumar, E.S.Karthik Kumar "Performance Improvement of MIMO OFDM Multicast Systems" Third National Conference on Recent Trends in Communication, Computation and Signal Processing, 2011 (RTCSP 2011), to be held on March 1st - 2nd, 2011.

[4] L. Wang, Y. Ji, F. Liu, and J. Li, "Performance Improvement through Relay-Channel Partitioning and Reuse in OFDMA Multihop Cellular Networks," Proc. IEEE Int'l Wireless Comm. and Mobile Computing Conf., pp. 177-182, Aug. 2008.

[5] H. Wu, C. Qiao, S. De, and O. Tonguz, "Integrated Cellular and Ad Hoc Relaying Systems: iCAR," IEEE J. Selected Areas in Comm., vol. 19, no. 10, pp. 2105-2115, Oct. 2001.

[6] Third Generation Partnership Project, "Technical Specification Group Radio Access Network; Physical Layer Aspects for Evolved Universal Terrestrial Radio Access (UTRA) (Release 7)," 3GPP Technical Report 25.814 v7.1.0, Sept. 2006.

[7] IEEE 802.16m-08/004r3, IEEE 802.16m Evaluation Methodology Document (EMD), IEEE, Oct. 2008.

[8] Y. Zhao, X. Fang, X. Hu, Z. Zhao, and Y. Long, "Fractional Frequency Reuse Schemes and Performance Evaluation for OFDMA Multi-Hop Cellular Networks," Proc. IEEE Fifth Testbeds and Research Infrastructures for the Development of Networks and Communities and Workshops, pp. 1-5, Apr. 2009.

[9] G. Boudreau, J. Panicker, N. Guo, R. Chang, N. Wang, and S. Vrzic, "Interference Coordination and Cancellation for 4G Net-works," IEEE Comm. Magazine, vol. 47, no. 4, pp. 74-81, Apr. 2009.

[10] Third Generation Partnership Project, "Technical Specification Group Radio Access Network; Requirements for Further Ad-vancements for E-UTRA (LTE-Advanced) (Release 8)," 3GPP Technical Report 36.913 V8.0.0, June 2008.

[11] Y. Wang, S. Kumar, L. Garcia, K.I. Pedersen, I.Z. Kovcs, S. Frattasi,
N. Marchetti, and P.E. Mogensen, "Fixed Frequency Reuse for LTE-Advanced Systems in Local Area Scenarios," Proc. IEEE 69th Vehicular Technology Conf., pp. 1-5, Apr. 2009.

[12] M. Salem, A. Adinoyi, H. Yanikomeroglu, and D. Falconer, "Opportunities and Challenges in OFDMA-Based Cellular Relay Networks: A Radio Resource Management Perspective," IEEE Trans. Vehicular Technology, vol. 59, no. 5, pp. 2496-2510, Jan. 2010.
N.

[13] "Mobile WiMAX - Part I: A Technical Overview and Performance Evaluation," WiMAX Forum, Aug. 2006.

[14] "WiMAX System Evaluation Methodology," WiMAX Forum, Version 2.1, July 2008.

[15] W. Lee, M. Nguyen, and J. Jeong, "An Orthogonal Resource Allocation Algorithm to Improve the Performance of OFDMA-Based Cellular Wireless Systems Using Relays," Proc. IEEE Fifth Consumer Comm. and Networking Conf., pp. 917-921, May 2008.

[16] M. Liang, F. Liu, Z. Chen, Y. Wang, and D. Yang, "A Novel Frequency Reuse Scheme for OFDMA Based Relay Enhanced Cellular Networks," Proc. IEEE 69th Vehicular Technology Conf., pp. 1-5, Apr. 2009.

[17] A. Sang, X. Wang, M. Madihian, and R.D. Gitlin, "Coordinated Load Balancing, Handoff/Cell-Site Selection, and Scheduling in Multi-Cell

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Packet Data Systems," Proc. 10th Ann. Int'l Conf. Mobile Computing and Networking, pp. 302-314, Sept. 2004.

[18] D. Amzallag, R. Bar-Yehuda, D. Raz, and G. Scalosub, "Cell Selection in 4G Cellular Networks," Proc. IEEE 27th Conf. Computer Comm., pp. 700-708, Apr. 2008.

[19] Y. Zhao, X. Fang, and Z. Zhao, "Interference Coordination in Compact Frequency Reuse for Multihop Cellular Networks," IEICE Trans. Fundamentals of Electronics, Comm. and Computer Sciences, vol. E93-A, no. 11, pp. 2312-2319, Nov. 2010.

[20] H. Zhang and S. Rangarajan, "Joint Load Balancing, Scheduling, and Interference Mitigation in Multi-Cell and Multi-Carrier Wireless Data Systems," Proc. IEEE Seventh Int'l Symp. Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks, pp. 1-10, June 2009.

[21] E. Yanmaz and O.K. Tonguz, "Dynamic Load Balancing and Sharing Performance of Integrated Wireless Networks," IEEE J. Selected Areas in Comm., vol. 22, no. 5, pp. 862-872, June 2004.

[22] L. Wang, W. Su, J. Huang, A. Chen, and C. Chang, "Optimal Relay Location in Multi-Hop Cellular Systems," Proc. IEEE Wireless Comm. and Networking Conf., pp. 1306-1310, Mar. 2008.

[23] IEEE 802.16m-08/003r7, IEEE 802.16m System Description Document (SDD), IEEE, Feb. 2009.

[24] J.M. Ku, P.K. Kim, S.J. Lee, S. Shin, and C.G. Kang, "On the Performance of Broadband Mobile Internet Access System," Proc. IEEE First Int'l Symp. Wireless Pervasive Computing, pp. 1-6, Jan. 2006.

[25] G.R. Hiertz, D. Denteneer, S. Max, R. Taori, J. Cardona, L. Berlemann, and B. Walke, "IEEE 802.11S: The WLAN MESH Standard," IEEE Wireless Comm. Magazine, vol. 17, no. 1, pp. 104-111, Feb. 2010.