

category. Meanwhile, throughput download with yellow, pink, and red indicators is classified as a bad category. Before being optimized, the throughput download in a good category is 18.94%, and after optimization is 63.68%. There is an increase in throughput download in the good category, namely 44.74%.



Fig. 14 Percentage of SINR before and after the optimization



Fig. 15 Percentage of throughput download before and after the optimization.

IV. CONCLUSION

Regarding the activities of PCI modulo interference optimization that have been carried out, the following conclusions can be taken as follows: PCI modulo interference occurred in the XX Nan Pampangan area, Sub-district. Lubuk Begalung, Padang city between site 30107 sectors 2, and site 32051 sectors 2. PCI modulo interference can be identified by checking the adjacent PCI modulo sites, and the optimization was taken in the case of PCI modulo interference in this study, namely rotating the PCI on-site 30107 from 192/193/194 to 193/192/194, then rotating the PCI on-site of 31060 from 261/262/263 to 263/261/262, and then changing the azimuth sector 2 of site 32051 from 260o to 220o. Based on the optimization process of PCI modulo interference with the driving test method, it was found that RSRP, SINR, and download throughput with good categories increased compared to the one before the optimization. RSRP in the good category was from 81.58% to 92.09%. SINR with good category was from 9.47% to 19.47%, and throughput download in the good category was from 18.94% to 63.68%.

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REFERENCES

- [1] A. P. Lestari, "Metode Collision dan Confusion Free pada alokasi Physical Cell Identity (PCI), Studi Kasus: Jaringan 4G LTE-Advanced 1800MHz Area Kotamadya Jakarta Timur," *Telecommun. - Eng.*, 2018.
- [2] M. Ulfah, "Perfomansi Parameter Carrier to Noise Interference Ratio (C/N+I) terhadap Penggunaan Metode Physical Cell Identitiy (PCI) Teknologi 4G LTE 1800 MHz," *JST (Jurnal Sains Ter.*, 2019, doi: 10.32487/jst.v5i1.633.
- [3] P. T. Lelepadang, E. Y. D. Utami, and A. A. Febrianto, "Analisis Coverage Planning dan Coverage Prediction di Existing Network eNodeB Jaringan 4G di Daerah Operasional Yogyakarta dan Magelang," *Techné J. Ilm. Elektrotek.*, 2018, doi: 10.31358/techné.v17i02.173.
- [4] J. Gui, W. Yang, S. Gao, and Z. Jiang, "A robust power optimization algorithm to balance base stations' load in LTE-A network," 2018, doi: 10.1007/978-3-030-04618-7_15.
- [5] A. P. Lestari, A. N. Mufti, and U. K. Usman, "Optimization of PCI conflict detection in LTE-advanced using collision and confusion methods considering reuse distance algorithm," 2018, doi: 10.1109/ICSIGSYS.2018.8372665.
- [6] Z. Lv *et al.*, "Neighbor cell list optimization of LTE based on MR," 2019, doi: 10.1007/978-981-13-1733-0_35.
- [7] A. Shen *et al.*, "A Novel PCI Optimization Method in LTE System Based on Intelligent Genetic Algorithm," 2018, doi: 10.1007/978-981-10-7521-6_42.
- [8] A. Bazzi, B. M. Masini, A. Zanella, and I. Thibault, "On the performance of IEEE 802.11p and LTE-V2V for the cooperative awareness of connected vehicles," 2017, doi: 10.1109/TVT.2017.2750803.
- [9] Z. Xu, X. Li, X. Zhao, M. H. Zhang, and Z. Wang, "DSRC versus 4G-LTE for connected vehicle applications: A study on field experiments of vehicular communication performance," *J. Adv. Transp.*, 2017, doi: 10.1155/2017/2750452.
- [10] M. M. Abdulkareem, S. A. Yaseen, and L. M. Abdullah, "Matrix based graph coloring algorithm for LTE-PCI assignment and reassignment reduction," 2017, doi: 10.1109/ICSGRC.2017.8070565.
- [11] R. Acedo-Hernández, M. Toril, S. Luna-Ramirez, J. A. Fernández-Segovia, and C. Úbeda, "Analysis of the Influence of PCI Planning on the Physical Uplink Control Channel in LTE," *Wirel. Pers. Commun.*, 2018, doi: 10.1007/s11277-017-4887-7.
- [12] S. S. Mwanje and J. Ali-Tolppa, "Layer-independent PCI assignment method for Ultra-Dense multi-layer co-channel mobile Networks," 2017, doi: 10.23919/INM.2017.7987298.
- [13] N. Li, H. Chengti, and Z. Mingjie, "Performance optimization and simulation verification of LTE network planning based on micro coverage," 2017, doi: 10.1109/ICASID.2016.7873932.
- [14] R. Verissimo, P. Vieira, A. Rodrigues, and M. P. Queluz, "PCI and RSI Conflict Detection in a Real LTE Network Using Supervised Learning," 2018.
- [15] A. Mubarok and H. Putri, "Analisis Dampak Inter-Band Carrier Aggregation pada Perencanaan Jaringan LTE-Advanced," *ELKOMIKA J. Tek. Energi Elektr. Tek. Telekomun. Tek. Elektron.*, 2019, doi: 10.26760/elkomika.v7i2.363.
- [16] A. Nshimiyimana, D. Agrawal, and W. Arif, "Comprehensive survey of V2V communication for 4G mobile and wireless technology," 2016, doi: 10.1109/WiSPNET.2016.7566433.
- [17] F. Morvari and A. Ghasemi, "Two-Stage Resource Allocation for Random Access M2M Communications in LTE Network," *IEEE Commun. Lett.*, 2016, doi: 10.1109/LCOMM.2016.2539159.
- [18] M. Ulfah and A. S. Irtawaty, "Optimasi Jaringan 4G LTE (Long Term Evolution) pada Kota Balikpapan," *J. ECOTIPE*, 2018, doi: 10.33019/ecotipe.v5i2.645.
- [19] V. Kusumo, P. Sudiarta, and I. Ardana, "Analisis Performansi Dan Optimalisasi Coverage Layanan Lte Telkomsel di Denpasar Bali," *J. Ilm. SPEKTRUM*, 2015.
- [20] W. Yi, J. Hai, W. Ye, and D. Zhang, "Physical cell identity self-organization for home eNodeB deployment in LTE," 2010, doi: 10.1109/WICOM.2010.5600778.
- [21] J. Yu, M. Peng, and Y. Li, "A physical cell identity self-organization algorithm in LTE-advanced systems," 2012, doi: 10.1109/ChinaCom.2012.6417549.