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INTERFERENCE LIMITED UNDERLAY CR-NOMA NETWORKS

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Abstract— **In this paper we consider downlink underlay cognitive radio non-orthogonal mutliple access (CR-NOMA) system. CR and NOMA are both efficient spectrum utilization techniques. The major challenge in combining both CR and NOMA is to address effect of interferences caused by both. Underlay CR-NOMA network is interference limited system due to the fact that both the primary and secondary transmits simultaneously to its corresponding users. The effect of intra-network interference and inter-user interference is analysed and new architecture is proposed for underlay CR-NOMA to combat the intra-network interference. It is shown that proposed architecture provides greater system throughput than the traditional underlay CR-NOMA network.**

Keywords—**CR, NOMA, spectrum utilizations, interferences**

I. INTRODUCTION

Non-orthogonal Multiple Access (NOMA) has been identified as one of the promising techniques for the upcoming fifth generation (5G) mobile networks [1]. In NOMA multiple signal are superimposed the base station transmitter side and successive interference cancellation is employed at the receiver to decode its corresponding signal. Users near to the transmitter are allocated less power and cell edge users with power. The power allocation for the users are based channel quality between the transmitter and user. NOMA has been recently been incorporated into various standardizations for example, multi-user superposition transmission (MUST) in 3rd-generation partnership project long-term evolution (3GPP-LTE) and layered division multiplexing (LDM) in digital TV standard ATSC 3.0 [2]. Advantages of NOMA over orthogonal multiple access (OMA) schemes are discussed in [3,4].

Cognitive Radio (CR) has been known for more efficient use of wireless spectrum. In CR, secondary users (SUs) try to adapt their operations to access band which has been already occupied by the primary users (PUs) either in an opportunistic or collaborative manner [5,6]. Research activities so far have exploited CR technology to support other emerging applications such as CR based full-duplex, device-to-device and multiple-input multiple-output (MIMO) to further increase spectrum efficiency. Existing research om the combination of CR and NOMA [7-11] has shown the possibility to meet the 5G requirements such as massive connectivity, low latency and high throughput. Three CR architecture is present up-to-date [5].

1. Underlay: Primary and secondary transmission occur simultaneously under the condition that interference from secondary network to primary network should be lower than the controllable level.
2. Overlay: A Secondary user (SU) acts as relay to the primary network while transmitting its own signal.
3. Interweave: A SU transmits only in the absence of PU in the licensed spectrum.

CR and NOMA aims to achieve efficient spectrum utilization from different perspectives. In CR the secondary users performs operations in an opportunistic manner i.e., underlay mode or overlay mode or collaborative mode. On the other hand NOMA enables simultaneous multiple users transmission by differentiating users power levels. Thus, the combination of CR and NOMA aims to provide more intelligent spectrum utilization in a constructive way. CR NOMA provides improved spectrum efficiency, massive connectivity [9], low latency [2] and better quality of service [9]. Considering the merits of these two technologies, incorporating CR with NOMA needs to address the challenging issues in practice, because both CR