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Study on Reducing Communication Disruptions for Achieving High-Reliability Communication During Automobile Operation

-Implementation of a Handover Control xApp Using OpenAirInterface and Evaluation in a Digital Twin Environment-

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Advanced mobility applications such as automated driving require highly reliable, uninterrupted 5G/6G cellular networks. However, a Handover (HO) occurring under significantly degraded Reference Signal Received Power (RSRP) conditions caused by sudden blockage may lead to serious communication disruptions. This study aims to develop a method to reduce the HO interruption time during sudden signal degradation with a proactive HO control mechanism. We implemented an HO control xApp on an OpenAirInterface (OAI) based testing environment and evaluated its effect.

We constructed an HO evaluation environment based on OAI as shown in Fig. 1. To simulate sudden signal attenuation caused by blockages, we dynamically controlled the signal power in synchronization with a digital attenuator control xApp. We conducted HO experiments in the evaluation environment and confirmed that when an HO starts under conditions with severely low RSRP, the resulting HO failure forces the UE to initiate a fallback procedure to RRCSetup involving initial access, which causes a severe communication disruption of up to 1000 ms.

To prevent such disruptions, we propose a proactive HO control xApp deployed on the Near-RT RIC as shown in Fig. 1. The system utilizes predicted RSRP data derived from a mobility digital twin network simulation. When the HO control xApp detects a sudden RSRP degradation in the received predicted data, it controls the HO timing and sends an HO trigger command to the OAI RAN.

Our proposed HO control xApp successfully triggered the handover sequence before the communication link was compromised. Therefore, the UE successfully completed the HO process and avoided the RRCSetup. As shown in Fig. 2, the HO interruption time was significantly reduced from approximately 1000 ms to 100 ms.

We confirmed that our proposed prediction-based HO control xApp effectively mitigates communication disruptions during sudden signal blockages. In the future, we will enhance adaptability to complex mobility scenarios and construct a mobility digital twin environment that integrates actual communication behavior and vehicle models.

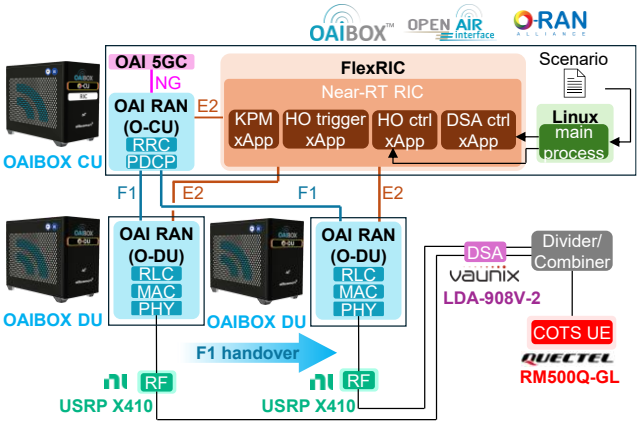

Fig. 1 HO Evaluation Environment using OAIBOX

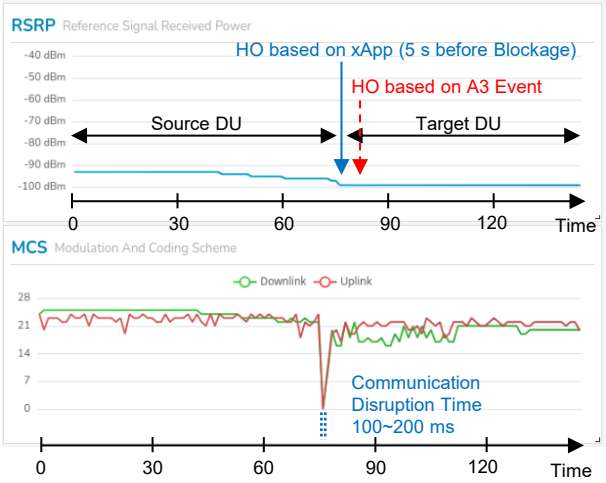

Fig. 2 HO Timing and Interruption Time with HO based on Proposed HO control xApp