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Analysis of Interference to S-Band Geo-Mobile Satellite Services from 4G LTE Systems

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To cater to the exponential growth of terrestrial mobile services, several frequency bands have been included for use in International Mobile Telecommunications (IMT). Consequently, the 2500-2690 MHz frequency band is now being shared between Band 41 of 4G-LTE (Long Term Evolution) and regional Geo-Mobile Satellite Services (MSS) [1]. Within a country the inter-system interference is minimized through its national-level coordination, which ensures that the frequencies used for both systems are mutually exclusive. However, other countries (including neighbouring) can independently choose to use this band for either LTE or MSS, resulting in interference to systems of both countries. This paper proposes a novel method to estimate aggregate interference from LTE terrestrial services on S band Geo-MSS return (user to satellite) and forward (satellite to user) links. The results of interference analysis are presented and it is shown that MSS forward and return links of a particular country are severely affected by co-frequency LTE services of other countries.

1 MSS Return Link Interference Analysis

In S band return link, on-board antenna coverage is desired to be limited within national boundaries i.e. over desired coverage area. Practical onboard antenna designs can only provide finite gain roll-off over countries using LTE services. On the other hand, although LTE base station (BS) antenna is tilted 5° below horizon, antenna gain pattern is wide enough to radiate power in the direction of GEO satellite. Hence, on-board antenna receives aggregate interference from LTE FDD downlink (LTE Band 41) signals from large number of BS across multiple countries, degrading MSS return link performance. Since the interference is wideband, from large number of sources, the degradation will appear as an increase in noise floor, which will be observed at the MSS hub. The proposed methodology for estimating aggregate interference is shown in Figure 1.

As a case study, interference is evaluated for a multibeam satellite located at 83°E. The on-board antenna user beam has a radius of 600 km and is pointed at Eastern India. The interfering LTE BS are assumed to be located in Japan. It is seen that interference from 30000 LTE BS will raise the noise floor by ~ 3 dB. Hence, it is concluded that frequency sharing of LTE services with MSS will result in significant degradation of MSS return link performance.

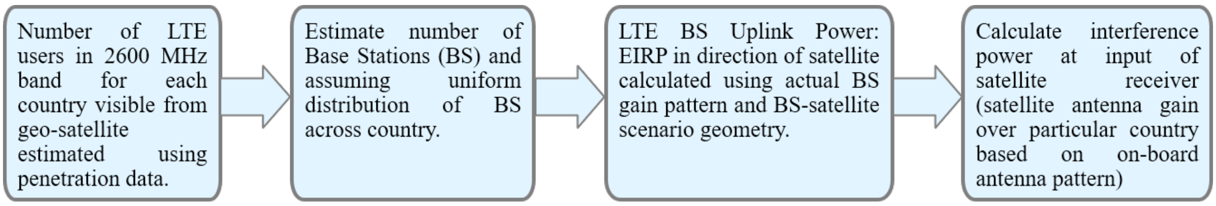

Figure 1. Proposed Method for Estimating Aggregate LTE Interference in MSS Return Link

2 MSS Forward Link Interference Analysis

MSS user terminals will not face interference in forward link as long as the same frequencies are not being used by terrestrial services in near vicinity. However, neighbouring countries may use same frequency for LTE. Thus MSS terminals near international boundaries may receive interference from LTE BS of neighbouring country. Assuming that the LTE BS is 30 km from MSS user terminals, the path loss of BS signals at MSS user is nearly 60 dB lesser than satellite signals. In contrast, the EIRP of satellite is only 20 dB higher than that of a BS and the wide beam-width MSS user antenna provides no spatial isolation. Thus, MSS terminals operating within 30 km of international boundaries can face significant interference.

References

[1] International Telecommunications Union (ITU), “Final acts of world radiocommunication conference,” *WRC-07*, Geneva, 2007.