

# QoE Analysis of DASH in Single-RAT and Multi-RAT Networks

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## ABSTRACT

The rapid adoption and growing traffic volume over cellular Long Term Evolution (LTE) networks have been mounting concerns for network operators, majorly due to the limited capacity and bandwidth of the available spectrum. In recent years, offloading of cellular traffic over unlicensed spectrum has been the focus of many studies and has even led to many commercial deployments. The LTE-WLAN Aggregation (LWA) is a multi-RAT (Radio Access Technology) implementation which allows LTE traffic to utilise Wireless Large Area Network (WLAN) for its traffic flow without significant impact to the existing deployments. LWA can be an attractive investment for operators having well-established deployments in WiFi and LTE markets. Also, with the rising popularity of video-based content, streaming services have emerged to be the largest contributors to the total traffic volume. Providing a high-quality experience to the users has been a significant focus not only for video service providers but also for network operators.

Dynamic Adaptive Streaming over HTTP (DASH) is a standard implementation for adaptive video streaming over HTTP, widely used by many video service providers. In this study, we use an open-source simulation framework, Network Simulator 3 (ns-3) for implementing LTE and LWA networks. Then, by streaming a DASH video over these networks, we analyse the Quality of Experience (QoE) for the users. A set of experiments are performed to understand the impact of different network configurations on a user's QoE. Our findings suggest an improved bitrate performance of video streaming in LWA networks, subject to WiFi contention. Our simulator implementation is further extensible for analysis of multi-cast scenarios and other aggregation solutions like LTE-DC (Dual Connectivity), LTE-NR (New Radio).

**Keywords:** LTE, LWA, Multi-RAT networks, DASH, ns-3