Priority Queuing System with Dependent Resource Allocation for Analyzing URLLC and eMBB Transmission in Wireless Networks

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One key consideration in planning for the joint allocation of resources for enhanced mobile broadband (eMBB) and ultra-reliable low-latency communications (URLLC) services is the need to balance conflicting requirements. On the one hand, there is a need for high bitrate to support eMBB services, while on the other hand, ultra-low latency and high reliability are essential for URLLC. This balancing act becomes more complex when considering the dynamic nature of network conditions and user demands in 5G networks.

Various resource allocation strategies are being explored to accommodate both eMBB and URLLC traffic. Narrowband URLLC, aiming for sub-1 ms latency and high reliability, has priority over broadband eMBB due to its challenging requirements.

In scenarios where there is a lack of resources, the impact of narrowband traffic on broadband traffic can vary depending on the chosen approach. Three main approaches are considered: (i) Interruption of broadband sessions without subsequent resumption, where released resources are allocated to narrowband traffic. (ii) Decreasing the bitrate of broadband traffic to free up space for narrowband, with interruption if the bitrate falls below a minimum level. (iii) Delaying or possibly interrupting broadband sessions and allocating resources to narrowband, followed by resumption.

When analyzing 5G wireless networks, it's crucial to take into account their unique features. For example, in a model that includes a bit rate reduction strategy, resource allocation involves adjusting signal power adaptively to address signal attenuation problems.

In this paper, we propose models for exploring the use of joint service with priority access for narrowband traffic, based on resource queueing systems. These resources include frequency, power, and time, which are all used in a dependent manner to achieve the desired bitrate for both types of traffic.

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