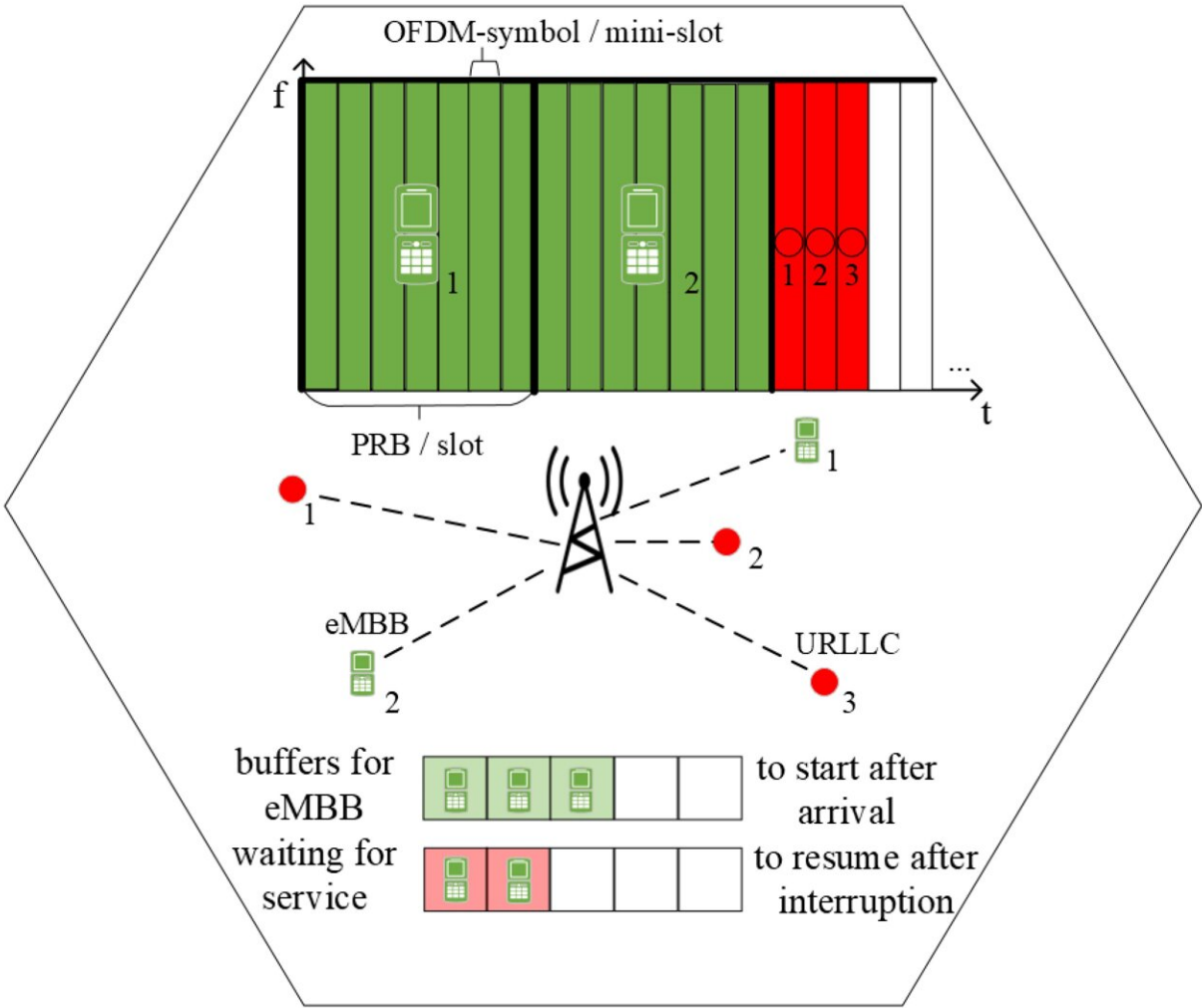


Mathematicians make 5G network scheme more efficient and reliable

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Scheme representing the system under consideration. At the center of the figure is the base station. The upper portion of the figure displays a segment of the channel as a sequence of PRBs, highlighting the resources allocated for eMBB sessions in green and the resources allocated for URLLC sessions in red. Toward

the lower section of the diagram, two base station buffers are shown, with the upper buffer designated for new eMBB sessions and the lower buffer designated for interrupted eMBB sessions. Credit: *Mathematics* (2023). DOI: 10.3390/math11183925

Mathematicians from RUDN University have proposed a new scheme for 5G networks that optimizes access to different network segments. The number of non-priority tasks awaiting the start of execution or interruption has halved, while the probability of disconnection for them does not exceed 0.1%. The results are [published](#) in the journal *Mathematics*.

Two key scenarios of 5G networks are Enhanced Mobile Broadband (eMBB) and Ultra Reliable Low Latency Communications (URLLC). eMBB first appeared in 4G networks providing a large data bandwidth and low latency. The innovation of 5G is URLLC. This slice of the [network](#) transmits data very quickly. It allows implementing applications of the Internet of Things, tactile Internet, and other latest technologies.

Therefore, in cases where URLLC and eMBB intersect, priority is given to the former. It reduces the quality of applications that use eMBB.

RUDN University mathematicians proposed a new scheme for allocating network resources to have URLLC in priority not losing eMBB.

"New usage scenarios require very high speeds, a large number of connected devices, and applications with ultra-low latency and high reliability. eMBB scenarios are people-oriented and involve access to multimedia content, services, and data. They require wide coverage, high user density, and high data transfer rates.

"For several scenarios to coexist, it is necessary to simultaneously provide services with different quality of service requirements. Therefore, the question arises of how to divide the frequency channel between URLLC and eMBB sessions," Irina Kochetkova, Ph.D., Associate Professor at the Institute of Computer Science and Telecommunications of the RUDN University said.

Mathematicians used the classical scheme when sessions on eMBB are interrupted if there is no resource left for URLLC. New eMBB sessions are then sent to the queue. Deferred and interrupted sessions constantly check whether resources have been released.

The authors have improved this approach—the verification does not happen constantly, but periodically. Plus, the "affected" eMBB sessions are waiting for their turn in more than one place. The new scheme, unlike the classic one, consists of two "orbits"—separate buffers for deferred and interrupted sessions.

RUDN mathematicians conducted a numerical experiment to verify the effectiveness of the new scheme. Two separate buffers have almost doubled the number of active eMBB sessions. At the same time, the probability of connection failure is low—only 0.1%.

"This model guarantees a successful start and end and an uninterrupted eMBB session. The scheme practically doubles the average number of active eMBB applications, while keeping the probability of interruption below one-tenth of a percent," Irina Kochetkova, Ph.D., Associate Professor at the Institute of Computer Science and Telecommunications of the RUDN University said.

More information: Elena Makeeva et al, Retrial Queueing System for Analyzing Impact of Priority Ultra-Reliable Low-Latency Communication Transmission on Enhanced Mobile Broadband Quality

of Service Degradation in 5G Networks, *Mathematics* (2023). [DOI: 10.3390/math11183925](https://doi.org/10.3390/math11183925)

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