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Section III shows the numerical results. Conclusions are finally drawn in Section IV.

II. System Model

This work considers a fixed number of M devices performing random access in a multichannel slotted Aloha system.

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In this system, time is divided into fix-length ‘access cycle.’ Each access cycle contains N RAOs. A simplified group paging, which sets the backoff indicator (BI) to zero as in the fast retrial algorithm [2], is considered. That is, all of the M devices transmit their first random-access attempts at a randomly chosen RAO in the first access cycle when receiving the paging message. A device learns the success or failure of its random-access attempt immediately at the end of the access cycle. The collided devices immediately re-transmit their random-access attempts in the next access cycle. The processing delay of base station and the transmission time of the message part are ignored [1]–[3]. A total of I_{max} access cycles are reserved and thus, the random access of a device is

Note that Eqs. (1)-(3) are derived based on the assumption that M is an integer. However, the average number of contending devices, i.e. $N_{C,i}$, in each access cycle may not always an integer. A complete binomial analysis can be further derived based on the joint state probability of the number of devices that transmit their random-access attempts in each of the I_{max} access cycle. However, the computational complexity of the approach is considerably high and may not be suitable for dynamic management of random access resources for MTC. Hence, we need to find approximation formulas to derive $N_{C,i}$ and $N_{S,i}$ for the second and future access cycles, i.e. $i \geq 2$.

The system that M devices contending for N_1 RAOs in a random access slot with duration of one time unit is equivalent