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## Adaptive Data Rate Control in Low Power Wide Area Networks for Long Range IoT Services

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**Highlights**In this paper, the necessity of congestion estimation in long range IoT applications is described. Congestion Classifier using Logistic Regression and the modified adaptive data rate control scheme is designed.

- For the validation of the efficiency of the data transmission, analysis on the transmission delay is carried out. Results show that the proposed method outperforms state of the art methods.
- In this way, the proposal improves transmission efficiency in aspect of the transmission delay in wireless environment where congestion occurs.

Our proposed method predicts congestion status by learning and determines whether a node drops data rate or not. Thus, it leads to avoiding unnecessary change of data rate.

Through analysis on transmission delay, the proposed scheme has shown that it is the proper data rate control method for IoT networking in congestion environment.

### Abstract

Internet of Things (IoT) technologies can provide various intelligent services by collecting information from objects. To collect information, Wireless Sensor Networks (WSNs) are exploited. The Low Power Wide Area Network (LPWAN), one type of WSN, has been designed for long-range IoT services. It consumes low power and uses a low data rate for data transmission. The LPWAN includes several communication standards, and Long Range Wide Area Network (LoRaWAN) is the representative standard of the LPWAN. LoRaWAN provides several data rates for transmission and enables adaptive data rate control in order to maintain network connectivity. In the LoRaWAN, the wireless condition is considered by the reception status of the acknowledgement (ACK) message, and adaptive data rate

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