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COMPARATIVE ANALYSIS OF LTE-M/NB-IOT TECHNOLOGIES FOR M2M DEVICES AND RESOURCE REDISTRIBUTION

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In spontaneous connections, the limited bandwidth allocated to M2M devices in LTE-M/NB-IoT networks is expected to be quickly depleted due to the high arrival demand for M2M devices to access the network. To solve the bandwidth limitation problem, bandwidth expansion is used during the period of abnormal events when many M2M devices are connected. The maximum bandwidth limitation and the resource redistribution case are calculated, which results in a significant increase in M2M traffic.

The two mains mobile IoT technologies – LTE-M and NB-IoT – are supported by large numbers of mobile operators and equipment suppliers, mobile IoT networks are carefully managed and secured by mobile operators. The growing usage of NB-IoT and LTE-M will help to counter security threats to the IoT, such as the hijacking of devices by botnets and the hacking of sensitive data belonging to individuals or organizations. LTE-M or Long-Term Evolution for Machines is a cellular connectivity technology designed to meet the long-range, low-data, low-power, and low-cost requirements of many Internet of Things (IoT) devices, LTE-M is a lower-bandwidth protocol, it enables a wide range of IoT devices to stay connected, transmitting data efficiently and reliably. Currently, there are around 20 LTE categories, where LTE Cat-M1 and Cat-M2 are more common. Many IoT devices are designed to utilize lower processing power, memory, and hardware requirements for use over long periods. They are also typically deployed in places where Wi-Fi, ethernet, or landlines are inaccessible, leaving cellular the only connectivity option. But cellular data can be pricey so data requirements must be kept low and sent intermittently. In fact, LTE-M is adapted from LTE, which means the two share many similarities in architecture and protocols. LTE-M operates within the existing LTE network infrastructure and utilizes several protocols that are consistent with the standard LTE network. NB-IoT supports very narrow bandwidth, 200 kHz, So the data rate peaks at around 250 Kbps. Also, it can be deployed even in guard-band of an LTE carrier to use the spectrum that is otherwise unused. LTE-M is considered as the second generation of LTE chips created for IoT applications. It provides low-cost LTE devices suitable for Massive Machine-Type Communications (MTC) and the Internet of Things (IoT) with enhanced coverage compared to normal LTE devices. It operates at 1.4 MHz bandwidth with higher device complexity/cost than NB-IoT. More bandwidths allows Cat-M1 to achieve data rates (up to 1 Mbps), lower latency and more accurate positioning capabilities. LTE-M supports voice calls and connected mode mobility. As an example from an operator perspective, NB-IoT can create more deployment flexibility due to guard-band deployment. If the operator's available frequency assets allow, NB-IoT can also be deployed as stand-alone access. On the other hand, for IoT applications requiring higher data rates, low latency, full mobility, and voice in typical coverage situations, LTE-M is the best LPWA technology choice. The difference between the two has to do with questions of type and degree of low power device. This is critical to entering the cellular IoT with the right equipment for design. M2M devices are expected to become one of the significant factors affecting the entire mobile network in the near future. With the rapid growth of cellular IoT devices, many challenges arise such as supporting a huge number of devices, bandwidth limitation, and emergency operation. This paper highlights and analyzes these challenges, proposes mechanisms and methods to solve them, starting with the study of random access procedures with their corresponding channel. The first bottleneck is expected at RACH as a result of a huge number of M2M requests trying to access the network at the same time, which inevitably causes congestion problems. A part of the total bandwidth is allocated for M2M traffic use, and the remaining bandwidth is allocated for H2H traffic use. High system load requires the use of queuing theory to fulfill excessive requests and minimize the number of requests that are forced to complete. To solve the bandwidth limitation problem, we have an effective solution in the form of extending the classic eNodeB in LTE-M networks or adaptive eNodeB. Adaptive bandwidth reallocation leads to the resolution of many expected M2M storms. By leasing several times, the classical LTE-M bandwidth, we can achieve a significant increase in M2M traffic - two separate bandwidths, one for M2M traffic and the other dedicated to H2H traffic by slicing network [1].

The continuous-time Markov chain (CTMC) model is proposed to be used as a stochastic process tool to characterize the H2H/M2M coexistence based on analytical equations. Unlike H2H traffic, M2M traffic is highly uniform in most cases because M2M traffic uses small chunks of low-speed data, mostly with predictable communication time and duration [2]. The simulation results show that when using the classic eNodeB, the network will experience a huge decrease in the service completion rate for M2M and H2H, reaching 8% in the worst case when the average packet arrival rate is 75. But when using our solution using bandwidth sub-allocation and leasing a maximum of 72 resource units reserved for M2M traffic from the shared network resources, the service completion rate of 96% can be achieved in the worst case.As conclusion are still given that LTE-M is more powerful than NB-IoT, that doesn't mean it's better, it's based on the use case. By renting the classic LTE-M bandwidth multiple times, we can achieve a significant increase in M2M traffic.

References:

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