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INCREASING FAULT TOLERANCE IN IOT AND ADHOC NETWORKS FOR RISK REDUCTION IN DISASTER RECOVERY MODE

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ABSTRACT

This work introduces three case studies of an IoT network that is simulated using discrete-event model. In the first case, the network operates without resource redundancy. The second case introduces link redundancy with an emergency gateway, and the third case extends the first with macro-cells. The main performance parameters under analysis are the processor utilization and the network global delay. The model and its implementation may be used to plan, configure and dimensioning of the network in the face of possible catastrophic events where key network resources may be lost.

1 INTRODUCTION

The Internet of Things (IoT) accomplishes a new digital transformation by connecting devices, enhancing business values, redefining organizations and generating new opportunities. Figure 1 (Leite et al. 2018) presents an IoT Network Simulation Model with Sensors, Actuators, RFIDs, AdHoc Networks, and Applications. It can be used in the study of network planning, development, deployment, and evolution phases. A number of cluster nodes (CLT, CLR, GW) are connected via wired (or wireless) links to a mediator (MD) where the traffic converges. The 2G / 3G / 4G (LTE)/ 5G mobile networks, which are part of the proposed model, are the most widely used in disaster warning to access the immediate escape route and general information collected from the network.

2 CASE STUDIES

In disaster environments, it is desirable to have many types of redundancies, including telecommunications networks such as AdHocs, RFID Networks, IoT, Cellular Networks (2G, 3G, 4G, and 5G), and Satellite Networks. This redundancy is necessary due to the potential loss of resources in the face of environmental disasters Kishorbhai and Vassanthai (2017). This work introduces three case studies regarding catastrophic scenarios:

1. *Case 1: Normal AdHoc and IoT Networks without Catastrophe*: This case deals with a normal AdHoc Network within the cluster without catastrophe and without packet loss in the cluster; the clusters are interconnected by wired and wireless links forming a mesh network.
2. *Case 2: AdHoc Network with Link Redundancy for the Emergency Node*: In this case, the Emergency Gateway (GW3) receives all the traffic from CLT1 to CLT7 clusters (due to link failure) and its processing must be scaled to the mediator's performance levels.
3. *Case 3: AdHoc Network with Wireless Access Redundancy within the Cluster*. In the case of failure, the packets are routed to a macrocell (WiMax, LTE/4G, and 5G). In this case, if the fault probability

is above zero, the packets are diverted to a WiMax or to an LTE macrocell. These redundancies ensure that there will be no communication faults during the catastrophe and its recovery.

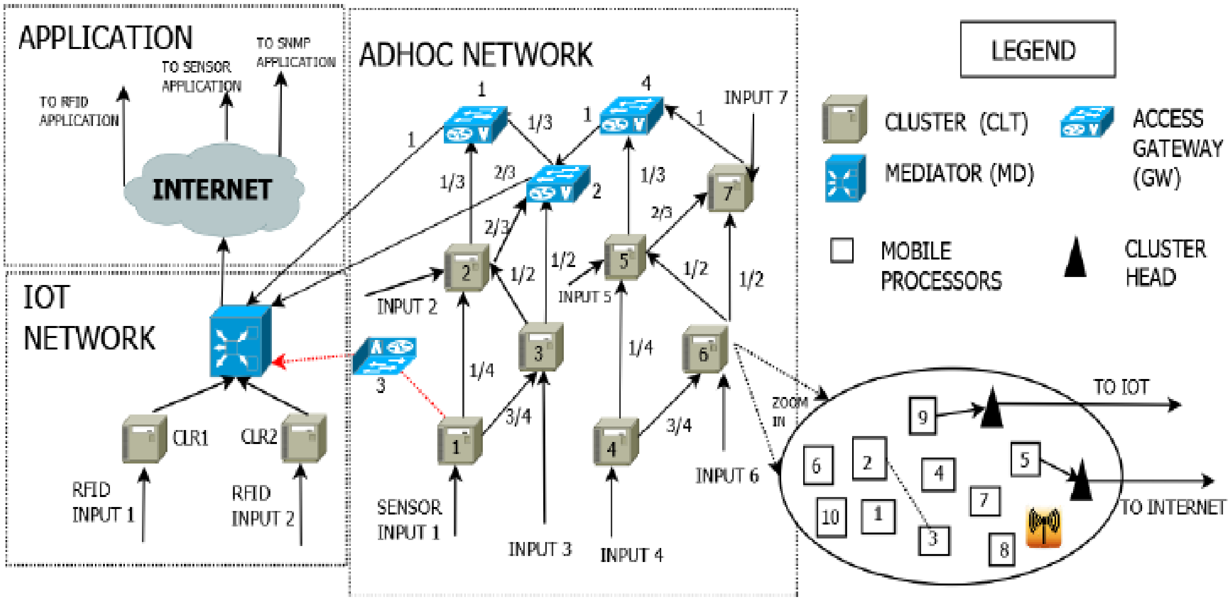

Figure 1: IOT network model.

The parameters under analysis are the mean queue time and the CPU usage in all cases. The simulation shows that the model may be used to estimate the level of redundancy that is required for networks that are subject to abnormal modes of operation (and in particular catastrophic scenarios) with increased traffic and reduced network topologies.

3 CONCLUSION

The technologies selected by IoT are established in the telecommunications market and can greatly reduce the risk of death from environmental disasters. This requires the investment in the construction of new networks and the use of discrete event simulation tools, which may be combined or extended with algorithms to enhance their applicability and turn them more realistic.

REFERENCES

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