Prioritizing SHE Packets for Emergency Response

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Abstract. The abstract should summarize the contents of the paper and should contain at least 70 and at most 150 words. It should be written using the *abstract* environment.

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1 Introduction

Disasters like earthquakes, floods, heavy rains, and accidents often mess up communication systems, which are very important during emergencies. We really need systems that help people like first responders, firefighters, and medical teams talk quickly and effectively to help those in trouble. Sometimes, people caught up in disasters can't reach their families or call for help, so we need communication systems that can keep working no matter what happens. Making these systems better at staying up and working well is crucial for helping out during emergencies.

Nowadays, alongside the threat of terrorism, natural disasters are causing big problems. To make things better, countries need good communication networks they can rely on. These networks give top priority to important packets like security, health, and emergency messages, which helps save lives and keep the country safe. To send these urgent messages over the internet, they have to go through phone networks, and that means using lots of different up-to-date technologies.

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SHE networks can exist in two types: stationary infrastructure networks and non-stationary infrastructure networks. Stationary infrastructure networks rely on a fixed setup where data traffic is routed to a base station along predefined paths. These networks are relatively expensive and unsuitable for hostile conditions such as disaster response applications (e.g., extreme weather forecasting, earthquakes, volcanoes). In contrast, non-stationary networks do not rely on fixed network devices and include wireless networks like Ad-hoc, security, and health networks. These networks operate within a closed domain, allowing users to communicate efficiently only within this domain. If non-stationary networks fail, they can use Internet links to send information, but their data traffic does not get high priority. To address this issue, emergency data should be given the highest priority by network devices for routing during emergencies.

To get the best performance possible, this procedure needs the use of different and cutting-edge technologies in communication networks, such as Software-Defined Networking (SDN). In the event of a communication interruption, the first priority must be given to ensuring the effective data transfer of SHE networks over public Internet links.

Our contribution aims to improve packet traffic forwarding during SHE network failures using the Internet. We propose a new method for managing traffic priority by selecting specific header bits from the traffic class field instead of checking the entire header (320 bits). This method ensures that the most important SHE traffic gets the highest priority. By controlling the differentiated service and assured forwarding bits in a packet header, we can set the desired priority for specific traffic. This approach, based on selected header bits, helps prioritize traffic flows according to the levels set by the Differentiated Services Code Point (DSCP) and network administrator policies. Our traffic management method shows improvements in processing time, power consumption, and server load.

As technology gets better and faster, we need to come up with quick solutions for handling emergencies. Old ways of doing things are often too slow, unreliable, and expensive. That's why this report suggests using something called Software-Defined Networking (SDN) as a solution. This could really help out developing countries, which often suffer the most during disasters, by making their emergency response much better.

2 Background Study

2.1 Related Works

The core problems addressed across multiple research documents focus on significant challenges in wireless sensor communication, disaster management, and traffic classification in Software Defined Networks (SDN). One of the primary issues in wireless sensor communication is energy constraints, as sensor nodes often have limited power sources, necessitating efficient energy management strategies to prolong network operation. Security threats also present a critical challenge; wireless communication is inherently vulnerable to various attacks that can compromise data integrity and confidentiality. Additionally, network coverage limitations impact the effectiveness of communication, especially in large-scale deployments where ensuring reliable connectivity becomes a complex task. Addressing these challenges is crucial to advancing wireless sensor communication and maximizing its potential across diverse applications such as healthcare, agriculture, defense, and environmental monitoring.

In the context of disaster management, the increase in demand for information and communication technology (ICT) services after disasters often leads to network congestion and physical damage to ICT equipment. This results in communication systems being inaccessible when they are needed most, hindering rescue operations and coordination among relief organizations. The proposed solution involves designing a resilient network architecture that integrates existing infrastructure with cloud processing to ensure rapid deployment of ICT services during emergencies. This methodology involves studying previous major disasters to understand the key concepts necessary to enhance network reliability and availability during emergencies. By analyzing past events such as earthquakes and tsunamis, researchers aim to identify strategies to reinforce communication facilities and improve network connectivity in ad-hoc scenarios. The proposed approach focuses on deploying a three-layer network architecture that includes a connectivity layer, cloud layer, and service layer to provide robust real-time communication capabilities for victims, rescue teams, and other services in disaster-affected areas

Moreover, there is a specific need for an efficient disaster management system (DMS) for scenarios involving fire disasters. The study focuses on reducing overall delay factors by implementing a specific Named Data Networking (NDN) based Internet of Things (IoT) DMS scheme, which uses a lighter PUSH support mechanism. The challenge lies in ensuring robust and effective communication between nodes during disasters, where time-critical information dissemination is crucial. The proposed NDN-DISCA scheme includes generating Beacon Alert Messages (BAM) by producer nodes to inform nearby consumer nodes about disaster situations. Performance metrics such as Average Delay (AD), Average Throughput (ATH), and Percentage Throughput Gain (%THG) are used to assess the effectiveness of the proposed scheme. Evaluations through simulations of disaster scenarios in smart labs within the campus demonstrate that NDN-DISCA improves communication reliability and reduces delays compared to legacy NDN and existing PUSH-based schemes

In the realm of Software Defined Networks (SDN), the need for Quality of Service (QoS)-aware traffic classification is crucial due to the current SDN control mechanisms' inability to differentiate services based on diverse application QoS requirements. To address this, a framework combining Deep Packet Inspection (DPI) and machine learning techniques is proposed to classify network traffic adaptively and offer differentiated services based on application types. This involves utilizing DPI to identify flows of known applications and label them with QoS categories. A partially labeled dataset is maintained to train multi-classifiers using machine learning mechanisms, which are then used to sort different application flows into corresponding QoS categories. This enables adaptive QoS guarantees and differentiated services for various types of application flows. The framework aims to continuously update the training database information to adapt to the dynamic characteristics of network applications, ensuring accurate classification and improved network resource utilization. The results demonstrate significant improvements in performance metrics such as precision, F1 score, and Area Under the Curve (AUC), showcasing the framework's potential for enhancing network resource utilization and service differentiation.

Efficient and accurate traffic classification in SDNs is also a significant concern as traditional methods based on port numbers or payload inspection become less effective with evolving network technologies and new protocols. The challenge lies in developing robust and adaptive classification techniques that can handle abnormal network conditions, scale to process large volumes of traffic, provide fine-grained classification to understand user behavior, and adapt to the dynamic nature of network traffic for better Quality of Service (QoS) provision. Machine learning approaches are shown to be effective in achieving high classification accuracy, especially where traditional methods like DPI fall short. By combining DPI and ML methods, the MultiClassifier achieves over 85% accuracy and high classification speed, balancing accuracy and efficiency. This novel classification framework in SDN leverages both DPI and ML classifiers to enhance traffic classification, showcasing the potential of machine learning techniques in improving SDN traffic management

The importance of maintaining effective communication networks during disasters cannot be overstated. The increase in demand for ICT services after disasters often leads to network congestion and physical damage to ICT equipment, making communication systems inaccessible when they are needed most. This hinders rescue operations and coordination among relief organizations. The proposed solution involves designing a resilient network architecture that integrates existing infrastructure with layered techniques and cloud processing to ensure rapid deployment of ICT services during emergencies. By analyzing past events such as earthquakes and tsunamis, researchers aim to identify strategies to reinforce communication facilities and improve network connectivity in ad-hoc scenarios. The proposed approach focuses on deploying a three-layer network architecture that includes a connectivity layer, cloud layer, and service layer to provide robust real-time communication capabilities for victims, rescue teams, and other services in disaster-affected areas. Implementing a layer-based network infrastructure demonstrated the ability to quickly install and launch ICT services in disaster-stricken areas, reducing both installation and restoration times.

Leveraging cloud computing enhances hardware load balancing and ensures high availability of communication services, addressing the challenges of network congestion and physical damage to infrastructure.

Overall, these research efforts underscore the importance of addressing the challenges in wireless sensor communication, disaster management, and SDN traffic classification. The proposed solutions present comprehensive approaches to enhancing disaster preparedness, response, and traffic classification in SDNs. By leveraging advanced techniques such as NDN, DPI, and machine learning, these studies offer robust methods to meet the dynamic requirements of modern network environments, improving the efficiency, reliability, and scalability of communication systems in various applications.

2.2 Objectives

- Ensure the prioritized transfer of Security, Health, and Emergency (SHE) packets over the communication network.

- To provide uninterrupted communication and data exchange for effective emergency response.

- To develop an easy-to-use communication network that works even when things are really tough.

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