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Performance Evaluation of Various Application Protocol in IoT Environment

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ABSTRACT:

The Internet of Things (IoT) is rapidly gaining popularity and is now widely applicable in various commercial sectors worldwide. It encompasses a range of technologies tailored to specific environments. However, the diversity of IoT applications, protocols, and unique requirements in each setting poses a significant challenge. To address this challenge, there is a need for support in message exchanges and communication across different protocols in implementations that aggregate multiple technologies. One of the key hurdles in the industry is enhancing the adoption of cyber-physical production systems. These systems heavily rely on new networking technologies to progress further. Thanks to the Internet of Things, even the smallest gadgets can now connect to the network and share data with the outside world. Our focus lies in facilitating communication between low-powered devices. To achieve this, we employ protocols such as 6lowpan and COAP, which are specifically designed for low-range devices. Our aim is to demonstrate the efficiency and effectiveness of these protocols in terms of communication and throughput. We utilize the cooja simulator to compare the results between the two protocols and determine which one proves more efficient.

***Keywords*: Deep Learning Techniques, CNN, Radar, Camera, Media Pipe, Sign Language.**

1. INTRODUCTION

The development of IPV6 protocols for transmission between low-power devices is a crucial focus area within the field of Internet of Things (IoT). The main objective is to enable IPV6 protocol connectivity among devices with limited power and processing capabilities, such as sensors and other IoT gadgets. One notable aspect of IPV6 is its support for low-power wireless protocols like 6LoWPAN and ZigBee, which are widely used in IoT devices.

Among these protocols, the Constrained Application Protocol (CoAP) is particularly noteworthy. It is a lightweight protocol specifically designed for constrained environments, allowing efficient communication between devices with limited resources. Additionally, the IPv6 over Low-Power Wireless Personal Area Networks (6LoWPAN) protocol enables the transmission of IPV6 packets over low-power wireless networks.

By integrating existing communication protocols like IPV6, the potential scenarios and range of use cases for wireless sensor networks can be greatly expanded. This development of communication capabilities between low-power devices using IPV6 protocols marks a critical step forward in the advancement of the Internet of Things.

The Internet of Things (IoT) refers to a network where physical objects can communicate and exchange data online. In the latest version of the Internet Protocol, IPv6, there is a vast address space available to uniquely identify devices. Low-power wireless personal area networks (LoWPANs) consist of devices with limited computing power and energy consumption. These LoWPANs can utilize IPv6 due to the existence of the 6LoWPAN protocol, which breaks down and fragments IPv6 packets into smaller frames.

To enable routing of IPv6 over LoWPANs, an adaptable protocol called RPL is employed. This allows for the efficient transmission of IPv6 packets within LoWPANs. The development of low-power device communication using IPv6 protocols aims to connect the Internet of Things (IoT) with the global internet, enabling interoperability, scalability, security, and reliability for IoT devices and systems.

2. LITERATURE SURVEY

[1] Samer Hamdani and Hassan Sbeyti "A Comparative study of COAP and MQTT communication protocol," conducted a study where two client applications were developed and implemented. The first client application was based on the Message Queue Telemetry Transport (MQTT) protocol, while the second client application utilized the Constrained Application Protocol (CoAP). The objective of the study was to monitor and evaluate the impact of these two communication protocols on the functionality of the IoT ecosystem.

The study examined various factors, including energy consumption, resource usage on devices, latency, and data bandwidth produced over the network. By comparing the performance of MQTT and CoAP in these areas, the researchers aimed to provide insights into the strengths and weaknesses of each protocol within the context of IoT applications.

[2] Nin Hayati Mohd Yusoff, Nurul Azma Zakaria, Axel Sikora, Jubin Sebastian "6LoWPAN Protocol in Fixed Environment: A Performance Assessment Analysis" When considering the protocols used in a 6LoWPAN network, RPL is often regarded as the top choice. However, its implementation in large networks can lead to high Energy Consumption (EC) and Routing Overhead (RO). To address this issue, the HRPL protocol was introduced and tested.

The results of the tests showed that HRPL outperformed RPL in terms of EC and CTO (Control Traffic Overhead) across all tested network topologies. Additionally, HRPL demonstrated improved latency specifically in the chain topology when compared to RPL.

It is worth noting that further research is needed to explore the relationship between latency and packet transmission load. This would allow for optimization of EC usage and provide a more comprehensive understanding of the performance dynamics between HRPL and RPL protocols.

[3] O.A. Gracia Osorio, Brayan S. Reyes Dazai, and Octavio J. Salcedo "Comparative Study of Performance for 804.15.4 ZigBee and 6LoWPAN Protocols" Our analysis compares the low-power mechanisms offered by the ZigBee and 6LoWPAN Protocols through various research studies. The 6LoWPAN protocol enables IPv6 communication over low-power wireless devices. We specifically examine how these low-power mechanisms impact network performance. Experimental evaluations highlight the strengths and weaknesses of both protocols when operating in low-power mode.

[4] Dinesh Thangavel, Xiaoping Ma, Alvin Valera and Hwee-Xian Tan, Colin Keng-Yan TAN "Performance Evaluation of MQTT and CoAP via a Common Middleware" In wireless sensor networks (WSNs), which involve resource-limited devices like sensor nodes and gateways, efficient application protocols are crucial for bandwidth and energy efficiency. MQTT and CoAP are two protocols proposed for such resource-constrained devices. To support both protocols and provide a unified programming interface, we have developed a middleware.

Additionally, in terms of additional traffic generated, CoAP outperforms MQTT when the message size is small, and the loss rate remains at or below 25%. This indicates that CoAP is more efficient in scenarios where minimal additional traffic is desired.

3. PROPOSED SYSTEM

The "Development of Communication between Low-Powered Devices using IPV6 Protocols" project aims to compare IPV6 protocols, specifically 6LOWPAN and COAP, for facilitating data transfer among low-power devices such as IoT devices. The system is implemented using Contiki and evaluated through extensive simulations on Cooja.

To determine the effectiveness of COAP and 6LOWPAN protocols, we analyze the performance by considering the required number of nodes. Comparative analysis provides insights into which protocol is more efficient.

Cooja Simulator, an open-source operating system, is utilized in this project. It is designed for memory-constrained systems, with a focus on low-power wireless IoT devices. Through an end-to-end IoT simulation, the Cooja emulator creates scenarios that involve adding sensors and transmitting data from the sensors to cloud services. The implementation of sensor nodes involves the utilization of relevant codes.

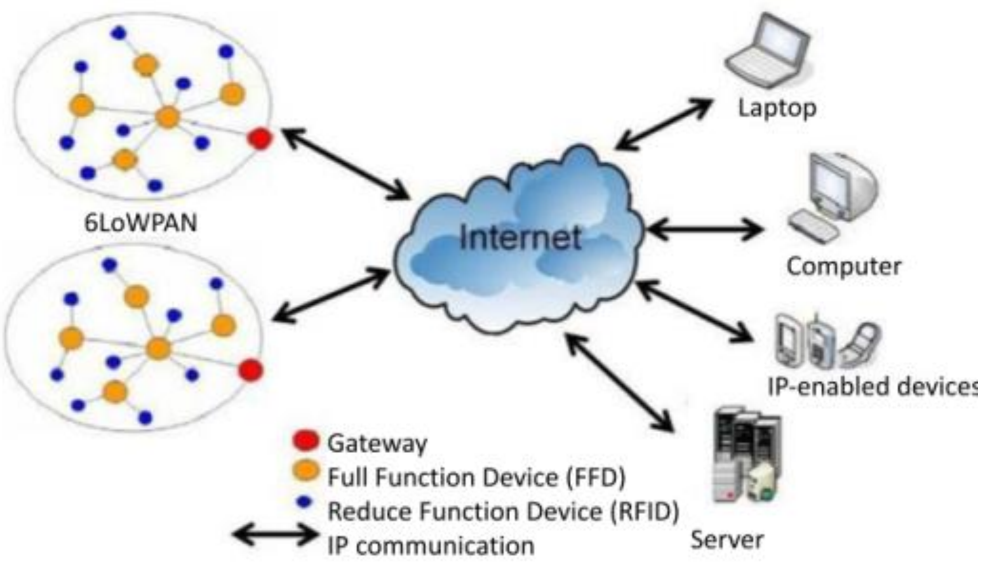

Fig. 1: 6LowPAN Architecture

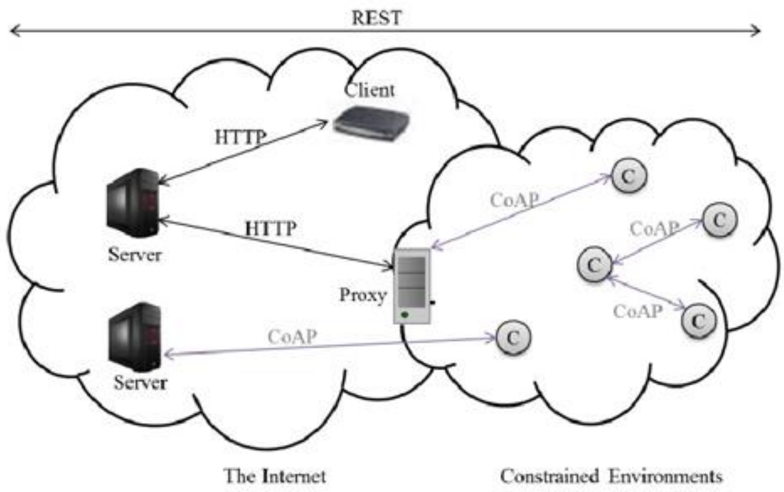

Fig. 2: COAP Architecture

4. METHODOLOGY

Contiki is an open-source operating system designed specifically for the Internet of Things (IoT). It enables the connection of small, cost-effective, and low-power microcontrollers to the Internet. Within the Contiki system, there is a network simulator called Cooja, which is capable of simulating networks composed of Contiki-compatible nodes.

In the context of IoT, the Ipv6 over Low-Power Wireless Personal Area Networks (6LoWPAN) protocol is utilized. 6LoWPAN enables low-power devices with limited processing power to participate on the Internet of Things, expanding their connectivity and capabilities.

To facilitate communication within constrained nodes and networks in the IoT, the Constrained Application Protocol (CoAP) is used. CoAP is a specialized web transfer protocol tailored for usage on the Internet of Things, particularly in scenarios where resources are limited.

ALGORITHM

Step 1: To achieve our objective, we initiate the process with a simulation using Contiki.

Step 2: Now "ant run" command is used to launch the simulation environment.

Step 3: We incorporate nodes into the network window to enable communication within the simulation.

Step 4: We integrate the mote output window to display relevant print statements for monitoring purposes.

Step 5: We utilize a timeline window to visualize the activities of the motes, such as reading, writing, or transmitting data, providing a comprehensive overview of their actions.

Step 6: To address our requirements, we initiate the process by adding a specific number of nodes, typically around 20-25, based on our needs. During this phase, we carefully observe and record the duration required to complete the procedure.

Step 7: We evaluate the efficiency and performance of both protocols under consideration. These measurements and observations allow us to assess the effectiveness and suitability of the protocols for our specific scenario.

Step 8: Now we increase the count of nodes like 75-100 for both the protocols and do the same thing we have done before.

Step 9: Finally, we compare the results of this data collection, and we demonstrate the effective one.

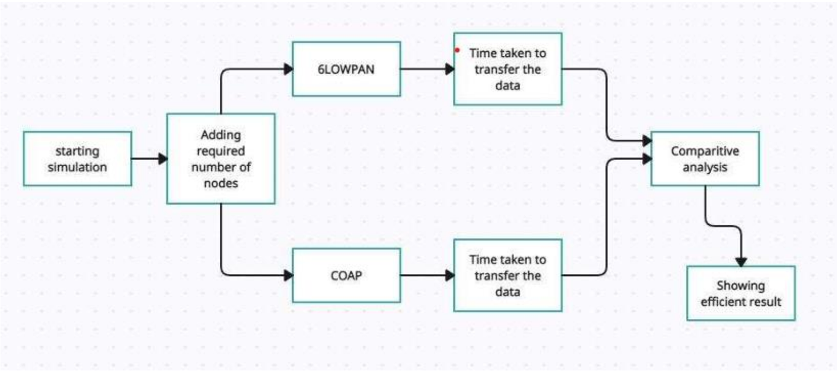

Fig. 3: Data Flow Diagram

4. RESULTS

As we compare with 6LoWPAN and COAP with 100 nodes, the results are as follows:

No. of Nodes	Protocol	Time	Speed	Mote	Serial Socket	
					Socket	Mote
100	6LOWPAN	0.425 sec	02..026%	sky	480 bytes	159 bytes
100	COAP	19.92 sec	07.81%	sky	480 bytes	159 bytes

4.1 PROCESS USING 6LOWPAN WITH 100 NODES

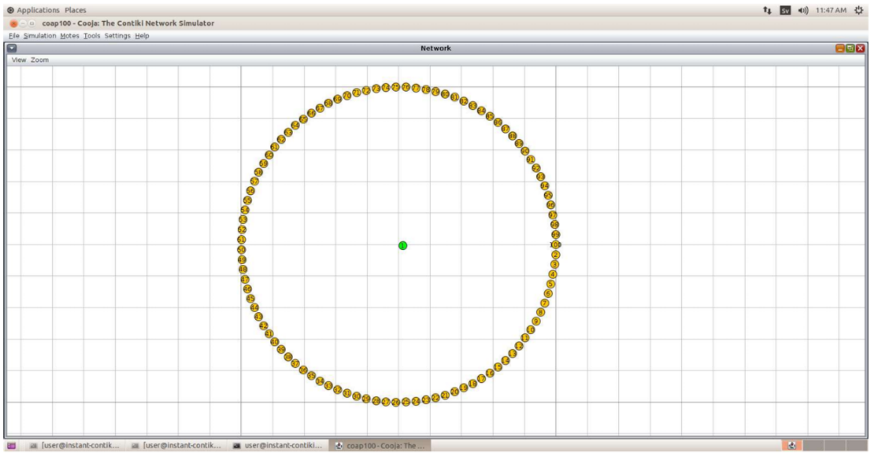

Fig. 4.1.1: Adding nodes for processing

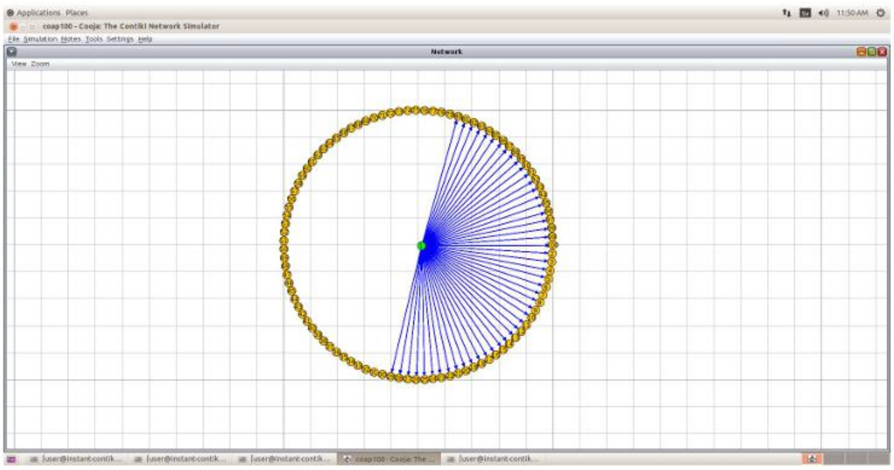

Fig. 4.1.2: Connecting with 6LOWPAN

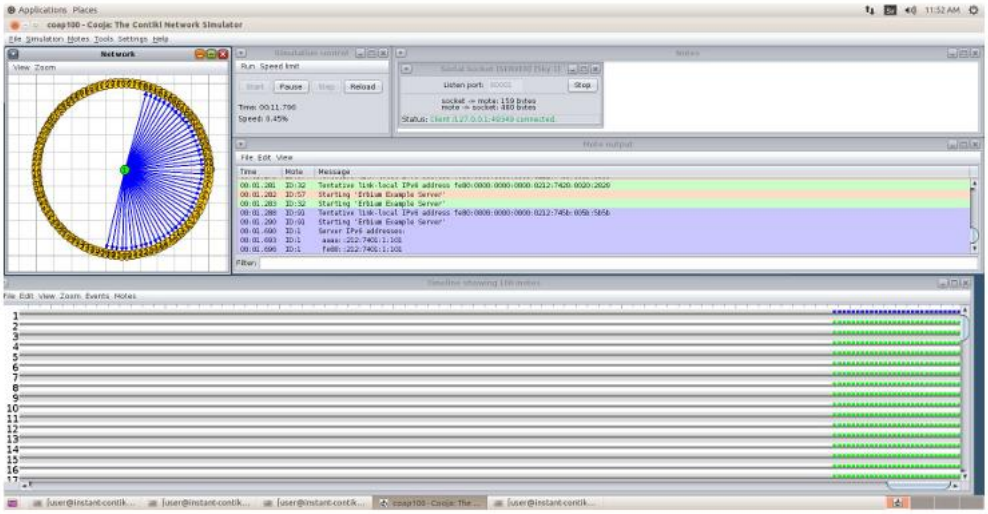

Fig. 4.1.3: Communicating through Neighbour Nodes

4.2 PROCESS USING COAP WITH 100 NODES

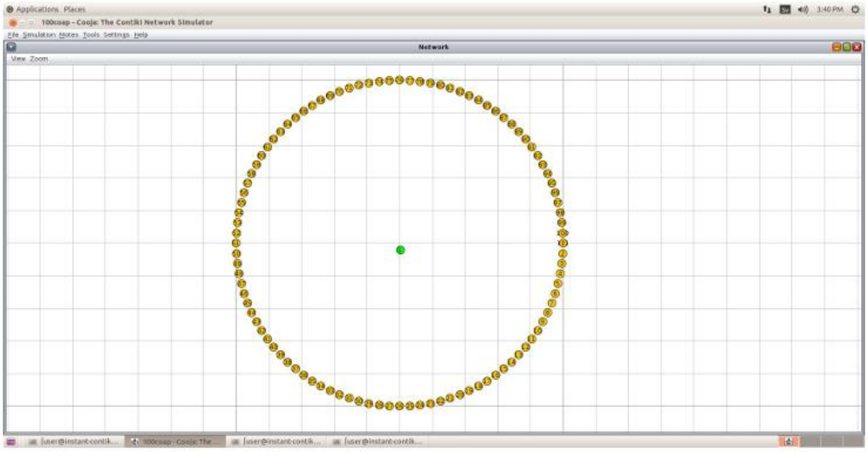

Fig. 4.2.1: Adding nodes for processing

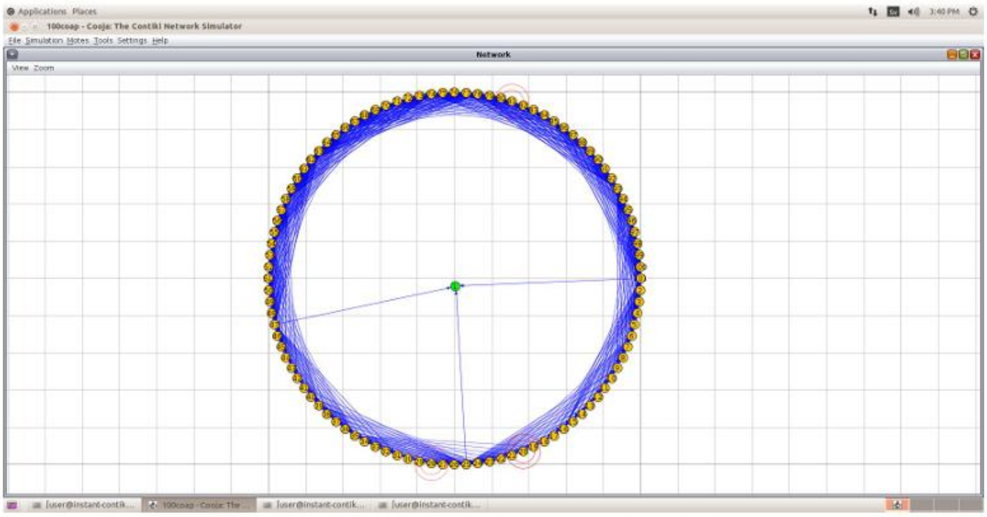

Fig. 4.2.2: Establish communication

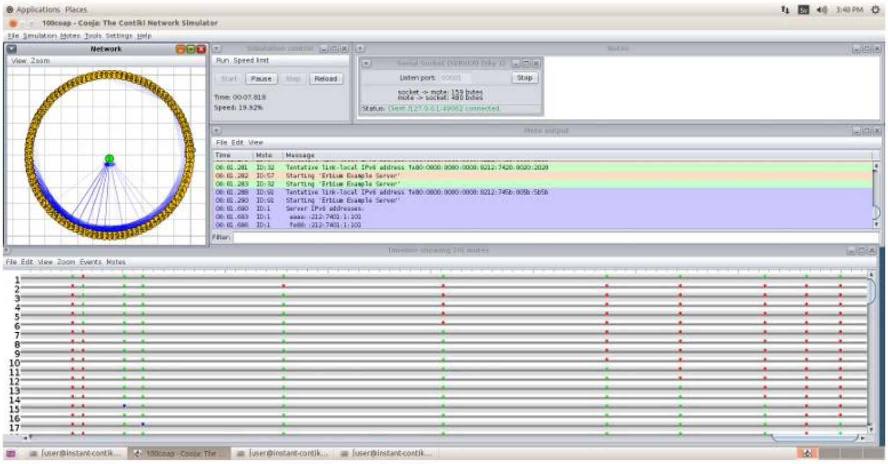

Fig. 4.2.3: Communicating through Neighbour Nodes

5. CONCLUSION

This project showcases an efficient approach to enable communication between low-powered devices using IPV6 protocols, specifically 6LOWPAN and COAP. It includes a comparative analysis to determine their effectiveness. The implementation is carried out using Contiki, and extensive simulations are performed to evaluate the performance.

To further enhance the project, additional routing protocols such as COPA and 6LOWPAN can be implemented for comparison. This would enable a comprehensive evaluation of each protocol's performance to identify the most optimal solution. The research work primarily focuses on implementing 6LowPan and CoAP using the Cooja simulator. Moreover, there are other algorithms available that can be implemented in IoT, allowing for a comparison of their performance based on various network parameters.

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