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PAESSLER ROUTER TRAFFIC GRAPHER (PRTG) NETWORK MONITORING: AN IMPLEMENTATION PROCESS IN VITROX

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ABSTRACT

Network monitoring is crucial for providing network administrators with the information to ensure optimal real-time performance. The expansion of ViTrox from Campus 2.0 to Campus 3.0 requires a network monitoring system for better management and analysis of its infrastructure. Paessler Router Traffic Grapher (PRTG) Network Monitor has been selected to oversee ViTrox's network traffic using SNMP to address this need and ensure comprehensive network oversight. ViTrox can effectively manage and analyze its network traffic, ensuring optimal performance and reliability as it transitions to the new campus setup. The SNMP manager initiates communication using this communication protocol, and the agent responds. PRTG employs a sensor-based approach, defining a single metric on a device based on the required data volume, which allows for real-time monitoring and analysis. To implement PRTG, the waterfall model methodology is employed to ensure the project's step-by-step completion. Critical devices are selected for monitoring, and alarm notifications are configured to alert administrators when a sensor falls below the threshold. Utilizing this network monitoring tool allows for prompt tracking of any network downtime, providing details such as time, location, and duration. Performance metrics analysis is used as the project evaluation method to measure the key performance indicators (KPIs) such as system uptime and the accuracy of alerts. The project's significance is in providing real-time visibility, enabling proactive issue detection, and optimizing resource management. The future direction of implementing PRTG Network Monitor involves expanding its capabilities to adapt to evolving network needs and technological advancements.

Keywords: network monitoring, performance, Paessler Router Traffic Grapher (PRTG), real-time, Simple Network Management Protocol (SNMP).

INTRODUCTION

In today's digital world, businesses and organizations must ensure their networks operate efficiently (Nwakeze et al., 2024). Network management has become increasingly challenging due to the significant rise in network complexity and the growing intricacy of failures (Hu X. et al., 2021). Recent literature suggests monitoring and analyzing networks are essential for ensuring reliable and efficient performance (Akinsanya et al., 2024). When developing a scalable and effective monitoring system, the key elements to focus on are relevant metrics, precise visualization and timely alarms (Nordin, M., 2021). This article explains how implementing PRTG Network Monitor can improve network visibility and performance, helping ViTrox achieve better IT management and align with its business goals. Network monitoring software monitors and classifies system status, including factors like bandwidth utilization or system uptime. Network monitoring systems can identify and track network components, including devices and interactions while delivering real-time status updates. Network administrators depend on network monitoring systems to promptly identify device malfunctions, connectivity problems or issues like data congestion causing traffic slowdowns. These systems are equipped to notify administrators of these concerns via email or text messages and furnish comprehensive reports (Cisco, 2022). To improve the efficiency of network performance monitoring in response to the company's growth, PRTG has been chosen for its advanced capabilities and scalability. PRTG is an agentless network monitoring application developed by Paessler AG for Windows-based systems. The logo of the PRTG Network Monitoring Software is shown in Figure 1. It is suitable for monitoring the performance of networking components such as routers, switches, firewalls, and servers (ManageEngine, 2019). PRTG monitors network availability, bandwidth usage, and various other network parameters such as Quality of Service (QoS), memory load and CPU usage even on remote machines (Paessler, 2023). Following deployment, it offers a user-friendly network monitoring schema (Sathi et al., 2023).

Figure 1

Logo of the PRTG Network Monitoring Software

PRTG employs a range of industry-standard protocols like Simple Network Management Protocol (SNMP), Windows Management Instrumentation (WMI), packet sniffer, Cisco NetFlow, IPFIX, sFlow, jFlow and others (Network Interview, 2021). This software operates on a Windows-based system within the network, operating around the clock to continuously monitor and log network utilization metrics and system availability. The collected data is stored in a proprietary flat-file database, facilitating subsequent analysis (Paessler, 2020). PRTG utilizes sensors, which are individual monitoring units designed for specific tasks. These sensors encompass a variety of functions, including HTTP and SMTP/POP3 (email) application sensors, along with hardware-specific sensors tailored for switches, routers and servers. PRTG offers an extensive selection of over 200 pre-configured sensor types that actively retrieve statistics from the monitored entities, encompassing parameters like response times and usage metrics for processor, memory and bandwidth (Gilchrist, 2018).

In summary, integrating the PRTG Network Monitor is a critical step in establishing ViTrox's network infrastructure, enabling more efficient network management. The main objective of this project is to implement a network monitoring system using PRTG. The sub-objectives include 1) to gain comprehensive insight into the network performance that allows for real-time monitoring and analysis 2) to have a proactive issue detection of any network problems to minimize potential downtime and disruptions and 3) to optimize the allocation of network resources and ensure proactive Planning for future scalability.

BACKGROUND

Network monitoring software plays a crucial role in the management and upkeep of networks, irrespective of their size, as network disruptions often occur with little to no warning. PRTG can detect irregular system performance and issue early alerts for potential network issues, affording administrators valuable time to implement corrective measures and prevent potentially catastrophic network events. ViTrox encounters considerable difficulties in efficiently supervising and controlling its network infrastructure, primarily attributed to its growth. The expansion from Campus 2.0 to Campus 3.0 involves the development of additional land, which is anticipated to be finalized by the latter half of 2023 (ViTrox, 2022).

ViTrox is currently operating without the implementation of any network monitoring software. This means the organization needs a dedicated system or tool to monitor, manage and analyze its network infrastructure. Consequently, the company needs help effectively overseeing its network, including network performance, security, and scalability issues. The absence of network monitoring software can result in difficulties in identifying and addressing network issues promptly, potentially leading to operational disruptions and security vulnerabilities. To ensure the smooth and secure operation of its expanding network infrastructure, ViTrox must consider implementing a network monitoring solution to provide them with the necessary insights and tools to proactively manage their network, optimize performance, and enhance overall network reliability. Moreover, ViTrox's current network infrastructure needs comprehensive visibility with a network monitoring system, making identifying the root causes of performance issues, security threats or connectivity problems challenging. Without the ability to monitor and analyze network data in real-time, ViTrox faces operational and security challenges, as they cannot promptly detect and mitigate issues, potentially resulting in prolonged network disruptions and an increased susceptibility to security threats.

ViTrox needs to adopt a robust network monitoring solution to address these critical concerns and improve network performance. This project was conducted from October 2023 to April 2024. This timeline includes the deployment, configuration, testing and user training phases. The main goal of this software is to monitor the network traffic among the ViTrox. This prototype contains some features for the software, such as an interactive dashboard with network performance and health. This paper emphasizes the development of network monitoring software that includes software and hardware tools that can track various aspects of a network's performance, including network traffic, bandwidth utilization and uptime. Specifically, the network monitoring software encompasses the following features.

Comprehensive Mapping and Dashboard Functionality for Network Visualization Using Real-Time Maps

The project involves creating detailed and interactive network maps using the PRTG. These maps visually represent the entire network topology, including all devices, connections and their geographical locations

within ViTrox's infrastructure. This comprehensive mapping gives the network administrators a clear landscape overview (Paessler, 2023).

Distributed Monitoring in Different Locations with PRTG Remote Probes

PRTG remote probes can be installed on machines or servers to collect data and monitor network devices and systems within their respective geographical areas. The central PRTG server consolidates all the data collected by the remote probes into a single, centralized monitoring dashboard. Network administrators can access this dashboard from a central location to gain a holistic view of the entire network infrastructure, spanning multiple sites. The use of Remote Probes offers scalability, allowing ViTrox to quickly expand its monitoring capabilities without disrupting the existing network monitoring setup (Obkio, 2023).

It enhanced Alert Flexibility, such as Email Push Notifications and HTTP Request Triggering

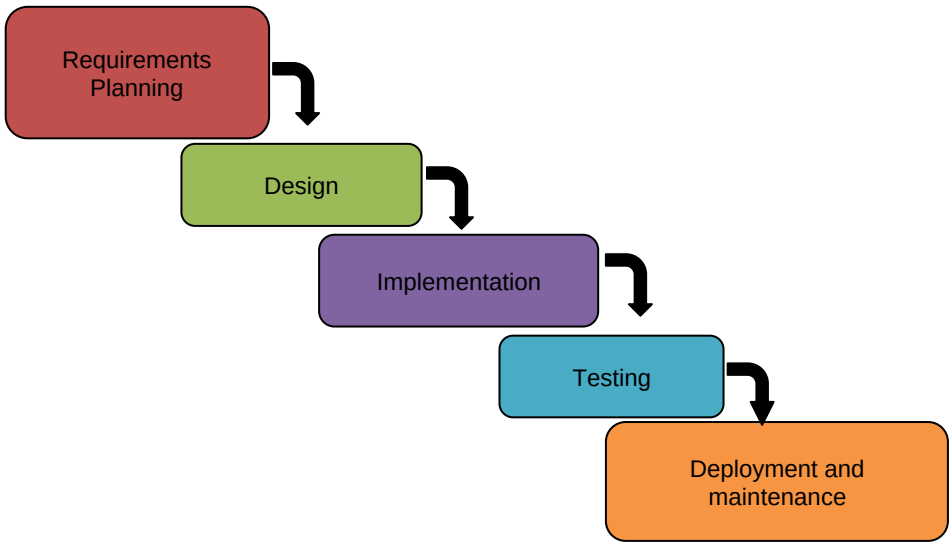
PRTG network monitor offers many alerting features that help administrators stay informed about network issues, anomalies, or performance deviations. For example, email alerts, push notifications, ticketing system integration, HTTP Request Triggering and others (Paessler, 2022). Moreover, the flexibility of PRTG's alerting features allows ViTrox to tailor their alerting strategy to match its unique requirements. Administrators can set up different alerts for various network components or specific conditions, ensuring the right personnel are alerted to address each issue.

METHODOLOGY

The Waterfall Model (figure 2) is used in this project to implement the PRTG Network Monitor. The Waterfall Model is a sequential development process that flows like a waterfall through all project phases, with one phase concluding before the next one commences (Adobe Experience Cloud, 2022).

Figure 2

The Waterfall Model of Develop PRTG Network Monitoring Software



Requirements Planning - the project implementing PRTG Network Monitor started by clearly defining the problem, objectives and scope of the project for process improvement and to guide the activities to work on the project. The main deliverable in this phase is the proposed solution.

Design - to implement PRTG Network Monitor, the system design helps to consider factors like the local probe, remote probes, number of sensors needed, and the type of alerts required, such as bandwidth usage and ping status, to define the overall system architecture. The main deliverable of this phase results in a clear definition of the network monitoring system's architecture.

Implementation - during this phase, the PRTG Network Monitor Software is built using the Google Chrome platform, following the approved architectural design endorsed by stakeholders. The main deliverable for this phase is the PRTG Network Monitor, which will monitor ViTrox's network. The monitored network components are systematically organized according to their respective blocks and floors. This structured arrangement ensures that any problems can be addressed promptly and effectively.

Testing - during this phase, the PRTG Network Monitor setup is tested to ensure it meets the defined requirements and design. For example, they verify sensor functionality, assess data accuracy, and fine-tune alert settings to ensure reliable network performance tracking. Detailed testing documentation evaluates the software thoroughly, identifying and resolving any issues before deployment. The main deliverables of the testing phase are the assurance of software quality and the identification and resolution of defects or issues.

Deployment and maintenance - in this phase, the software is deployed to the live environment to ensure proper functionality and long-term effectiveness. After installation, the focus shifts to providing ongoing support and maintenance, such as regular monitoring, applying updates, and adjusting configurations as the network needs change to ensure continuous operation. The main objective is to address any errors or defects that may arise during use. The main deliverable of this phase is to ensure that the network monitoring software remains operational and reliable.

DESIGN AND IMPLEMENTATION

The Unified Modeling Language (UML) provides a standardized language for visualizing, specifying, constructing and documenting the artefacts of a software system (Visual Paradigm, 2017). The use case diagram in Figure 3 allows for a clear representation of the communications and interactions between the actor and the use cases in the system. This visual model is a valuable blueprint for understanding and designing the network monitoring software based on the identified requirements.

Figure 3

Use Case Diagram of Network Monitoring System

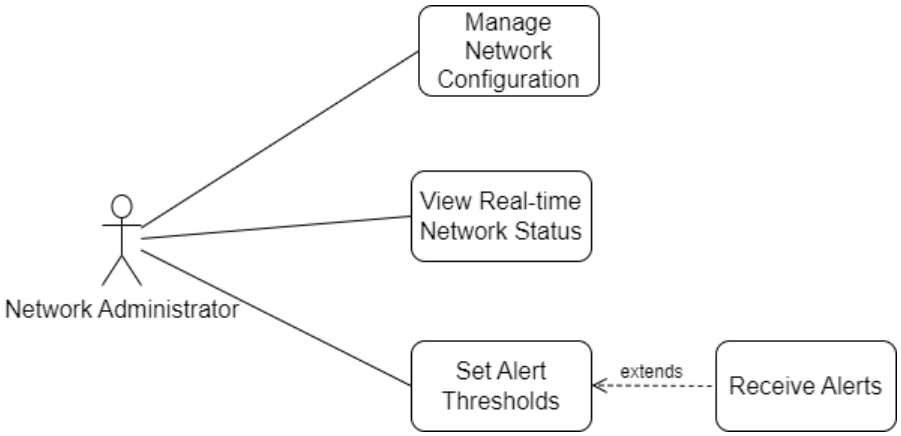


Figure 4

The Interface of the Devices' Overview

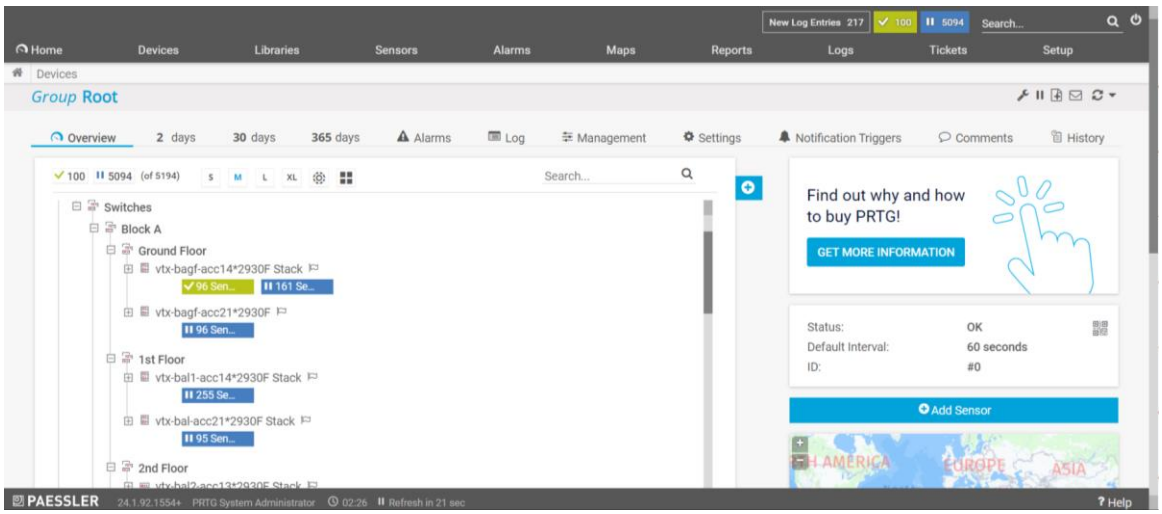
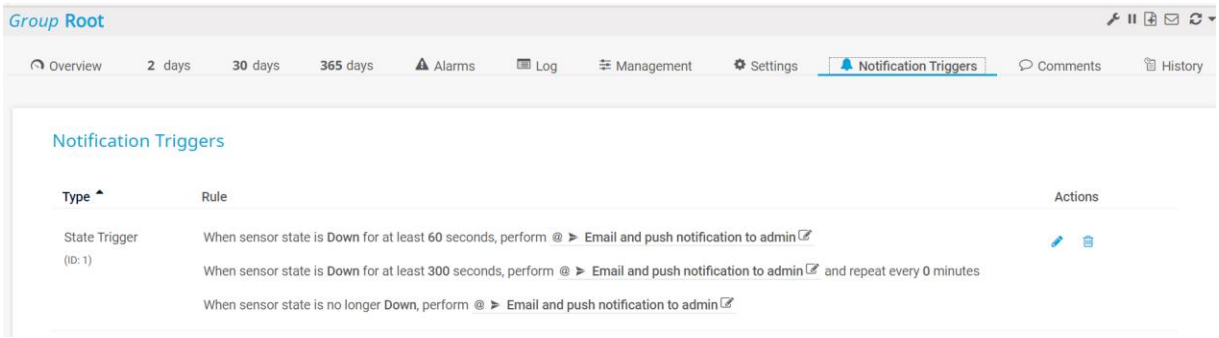


Figure 4 displays devices categorized by type, block, and floor for easy reference by administrators to identify sensors that require inspection. Google Chrome was selected as the platform for the launch of the PRTG network monitoring system. The laptop used as the local probe needs to be Google, and the company WiFi is needed to monitor the sensors, which are also connected to the company WiFi. The default interval for sensor scanning is 60 seconds. It regularly checks and collects data from sensors or devices in a network to monitor their status, performance, or other relevant metrics. We are focusing on monitoring the switches at ViTrox Campus 2 with the IP range between 10.0.10.10/24 and 10.0.10.88/24. PRTG's auto-discovery scans the network based on provided IP addresses, automatically detecting and adding relevant sensors, saving time and effort. Once sensors are added, administrators can customize settings for proactive monitoring and timely response to network issues. PRTG's auto-discovery streamlines device monitoring setup for efficient network performance and reliability.

Figure 5

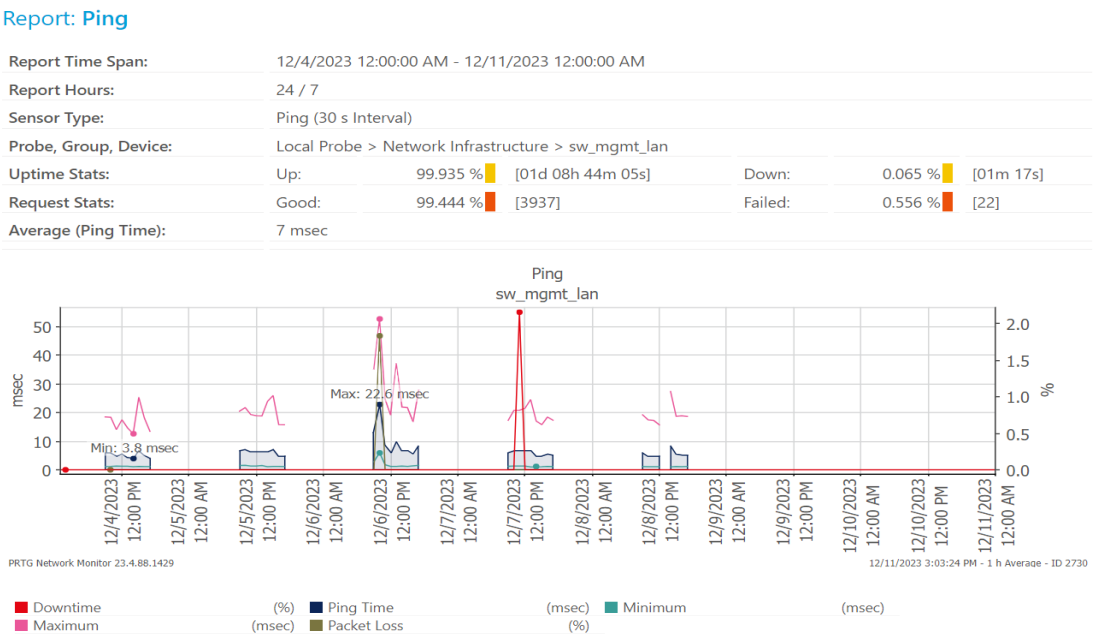
The Interface for Configuring Notifications Triggers



The graph in Figure 5 shows that the state trigger is being determined. When a sensor's state is down for either 60 seconds or at least 300 seconds, an email will be sent to notify the PRTG administrator. The notification trigger in PRTG monitors sensor data for unusual traffic patterns across the network, alerting administrators to potential issues. It includes a state trigger that detects abnormal sensor states, such as going offline or reporting abnormal data, and prompts investigation via email notification. Configured at the root level, these triggers ensure consistent monitoring across the network for proactive issue resolution. Figure 6 shows the ping report of the switch for one week—the generated report analyses historical data trends and monitors network health over time. From the figure, the switch reached the minimum value of 3.8 msec on December 4, 2023, and the maximum value of 22.6 msec on December 6, 2023. This information helps administrators to identify potential issues affecting network connectivity or responsiveness.

Figure 6

The Ping Report of a Switch



EVALUATION AND RESULTS

PRTG includes default sensors for monitoring the health of the Core Server and local probes. The 'Core Health' sensor monitors server performance, while local probes come with default sensors like 'System Health' and 'Probe Health' for overall system performance and probe-specific metrics (figure 7). Table 1 shows the two types of sensors selected to monitor switches: the switch with its IP address 10.0.10.0/24 and the server with its IP address 10.0.14.0/24. PRTG would then periodically collect data from these sensors and provide insights into the health and performance of the devices.

Figure 7

The Sensors of Core Server and Local Probe

Table 1

Type of Sensors to Monitor the Network

Sensors	Descriptions	Channels
SNMP Traffic	Monitors traffic on a device via SNMP	Downtime, traffic in, traffic out, traffic total
Uptime	A device has been running since it was restarted	System uptime

Figure 8 offers valuable insights into the performance and status of devices within the network infrastructure. They represent data collected by sensors deployed across devices, monitoring specific metrics relevant to functionality and health. The first graph shows that the traffic for port 1/10 has a minimum of 0.013 Mbit/s and a maximum of 0.600 Mbit/s. The second graph shows that the traffic port for 1/11 has a minimum of 0.013 Mbit/s and a maximum of 0.036 Mbit/s. The following graph shows that the traffic port 1/12 has a minimum of 0.0 Mbit/s and a maximum of 27.1 Mbit/s. Moreover, the fourth graph shows that the traffic port 1/13 has a minimum of 0.0 Mbit/s and a maximum of 81.5 Mbit/s. The fifth graph shows that the traffic for port 1/14 has the same data, which is 0.0 Mbit/s for both the minimum and maximum values. The last graph shows that the traffic for port 1/15 has a minimum of 0.013 Mbit/s and a maximum of 0.044 Mbit/s.

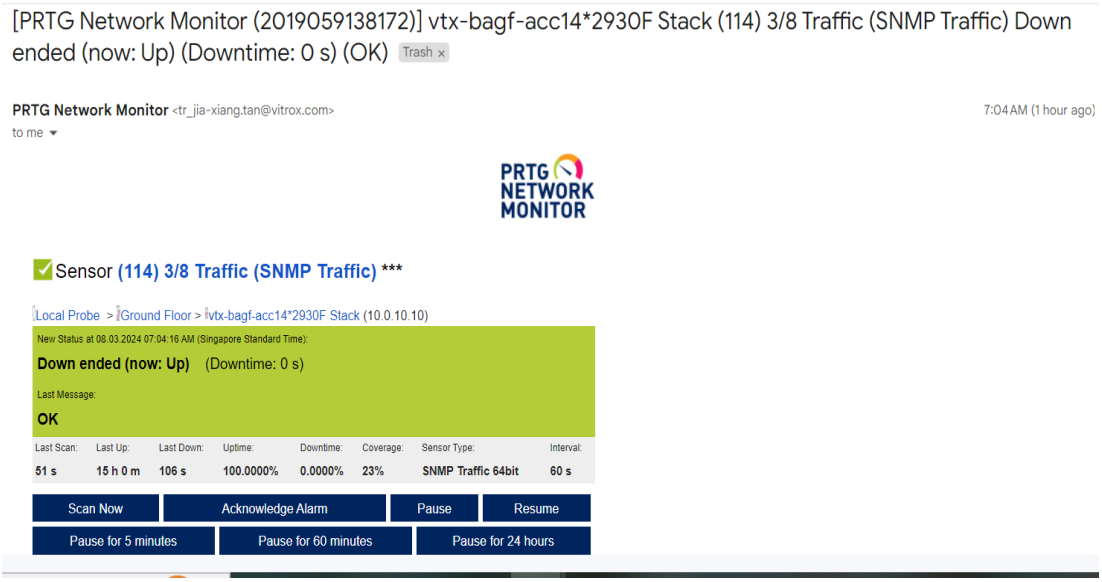
Figure 8

The Graphs of the Sensors

The graphs provide real-time and historical data, enabling administrators to track performance trends, identify anomalies, and optimize network traffic. Visual representation simplifies data interpretation, aiding in comprehensive performance analysis across devices. Standard metrics include bandwidth usage, CPU and memory utilization, system uptime, and network latency. Each graph offers a snapshot of device performance, aiding administrators in monitoring key metrics and identifying deviations from norms. These graphs are crucial for proactive network management, offering actionable insights to ensure optimal operation. Figure 9 shows the SNMP traffic for the device "vtx-bagf-acc14*2930F Stack," monitoring its downtime, traffic in, out and total. When the SNMP Traffic sensor detects an issue, an email notification is sent to the administrator for prompt action. If the issue persists beyond 300 seconds, a reminder email is automatically triggered to escalate the response. This proactive monitoring system informs administrators in real-time, allowing swift action to minimize downtime and ensure network functionality.

Figure 9

The Email Notification Received by the PRTG Administrator



DISCUSSION

As ViTrox experiences rapid growth and continuous expansion of its campus, the need for a robust network monitoring system becomes paramount to ensure seamless network connectivity. Implementing a network monitoring system enables us to closely monitor the network connection and identify any potential issues that may arise as the company expands. With PRTG selected as our network monitoring solution, we have achieved the main objective of implementing the network monitoring system. By determining the types of sensors to collect the monitoring data, we have achieved the sub-objective to gain valuable insights into the performance of our network infrastructure through real-time monitoring and analysis. PRTG lets us customize monitoring by selecting specific devices and configuring sensors to fit our needs. This flexibility ensures effective monitoring of critical network components, ensuring optimal performance and reliability.

This study has achieved the second sub-objective, PRTG's proactive issue detection feature, by completing the notification triggers for the sensors. This feature monitors network traffic, performance, and device statuses, alerting us to anomalies or potential disruptions before they become significant issues. This minimizes downtime and ensures uninterrupted operations, ultimately improving productivity and customer satisfaction. By completing the PRTG's dashboard, which offers a clear view of our network, we have achieved the third sub-objective to optimize resource allocation, identify bottlenecks, and plan for future scalability effectively. This dashboard enables informed decisions on network optimization and capacity planning, ensuring our network stays agile and responsive to business needs. In summary, implementing PRTG at ViTrox empowers us to proactively monitor and manage our network infrastructure, facilitating smooth operations and supporting the company's growth trajectory.

CONCLUSION AND FUTURE WORK

In conclusion, the primary aim of this proposal is to implement a PRTG network monitor to enhance ViTrox's network infrastructure management and monitoring capabilities. This includes achieving comprehensive network visibility, proactively detecting and addressing network issues, optimizing resource allocation and supporting scalability. Implementing the PRTG Network Monitor brings significant benefits, ranging from network optimization and security to streamlined management and cost savings, ultimately contributing to ViTrox's operational efficiency and success. Besides, the dashboard provided by PRTG makes configuration more accessible, further enhancing our ability to manage and monitor our network infrastructure effectively. However, the initial investment in PRTG may be significant due to licensing costs, especially when priced in US dollars. Furthermore, periodic upgrades to the license server may be necessary, especially when additional sensors are needed to monitor various aspects of devices. The recommendations for improvement are to maximize the benefits of PRTG and fully prioritize maximizing the utilization of its features and capabilities. Moreover, it is recommended that network security be enhanced by leveraging PRTG's monitoring capabilities to detect and mitigate potential security threats and vulnerabilities.

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