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**MASENO UNIVERSITY**

**SCHOOL OF COMPUTING AND INFORMATICS**

**DEPARTMENT OF IT**

**CIT 309: INDIVIDUAL PROJECT PROPOSAL**

**TITLE: NETBIL, INTELLIGENT NETWORK MONITORING AND DYNAMIC BILLING SYSTEM FOR ISPS**

**CIT/00094/020**

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**PROJECT PROPOSAL FOR NETBIL: INTELLIGENT NETWORK MONITORING AND DYNAMIC BILLING SYSTEM FOR ISPS**

TITLE: **NETBIL:** **INTELLIGENT NETWORK MONITORING AND DYNAMIC BILLING SYSTEM FOR ISPS**

# **Declaration**

I hereby declare that this project titled "NetBil: Intelligent Network Monitoring and Dynamic Billing System for ISPs" is my original work and has not been submitted for any other degree or examination. All sources of information and references used in this proposal have been duly acknowledged.

Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

# **Abstract**

The **NetBil: Intelligent Network Monitoring and Dynamic Billing System for ISPs** project proposes a transformative approach to addressing the operational and customer service challenges faced by Internet Service Providers (ISPs) in Kenya. With the rapid expansion of internet users and devices, ISPs grapple with real-time monitoring, accurate billing, and transparent customer communication.

This project aims to develop an intelligent system that integrates real-time network monitoring, dynamic billing models, and user-centric dashboards. The system will track network metrics like bandwidth, latency, and uptime, enabling ISPs to optimize resource allocation. It will also implement flexible billing models, such as pay-per-use and tiered pricing, ensuring fair charges aligned with actual service delivery.

By enhancing transparency and service quality, NetBil will empower ISPs to improve customer satisfaction and operational efficiency while fostering trust. Ultimately, the project envisions a robust and scalable solution that aligns with the evolving demands of Kenya’s dynamic internet landscape.

# **Acknowledgment**

I would like to extend my sincere gratitude to my supervisor, Mr. Chamwama, for their valuable guidance, support, and expertise throughout the development of this project. Their insights have been instrumental in shaping the direction of this research.

I also wish to acknowledge the ***local ISPs*** who participated in the interviews and provided valuable input on the challenges they face in network monitoring and billing. Their contributions were critical in identifying the core requirements of the system.

Finally, I would like to thank my family and friends for their unwavering support and encouragement during the course of this project.

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# **List of Abbreviations**

|  |  |
| --- | --- |
| **ABBREVIATION** | **MEANING** |
| **ISP** | Internet Service Provider |
| **SNMP** | Simple Network Management Protocol |
| **UAT** | User Acceptance Testing |
| **AWS** | Amazon Web Services |
| **API** | Application Programming Interface |
| **DB** | Database |
| **TTL** | Time to Live |

# **Definition of Terms**

- **Network Monitoring**: The process of continuously tracking the performance and status of a network to ensure its optimal operation.

- **Dynamic Billing:** A billing method that adjusts charges based on actual usage and service quality, rather than relying on fixed rates.

- **Tiered Pricing:** A pricing model where customers pay different rates based on the amount of data used or the level of service required.

- **Real-Time Tracking:** The ability to monitor and measure network usage and performance as it happens, without delays.

- **Dashboard:** A user interface that presents key metrics and statistics related to network usage, billing, and service quality.

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CHAPTER ONE: INTRODUCTION

# **Background**

In Kenya, the **telecommunications** and **internet service** sector has witnessed rapid growth in recent years. With the rise of mobile internet services, affordable broadband plans, and the government’s push for digital transformation, **Internet Service Providers (ISPs)** have become critical players in driving economic growth. However, ISPs in Kenya face several challenges, including:

- ***Inefficient billing systems:*** Many ISPs still rely on outdated billing methods that do not accommodate real-time usage tracking or dynamic pricing.

- ***Poor network performance:*** With increasing numbers of users and devices, network congestion, slow speeds, and high latencies have become common issues.

- ***Lack of transparency:*** Customers often face challenges with understanding their bills, usage patterns, and how performance issues impact their costs.

In response to these challenges, this project seeks to develop **"NetBil"—**an **Intelligent Network Monitoring and Dynamic Billing System for ISPs** that will enable real-time tracking of network usage, dynamic billing based on usage patterns and service quality, and transparency for both ISPs and their customers.

**The system will address key issues such as:**

- ***Real-time data usage monitoring***: Allowing ISPs to track user consumption accurately and in real-time.

- ***Dynamic billing system***: Providing billing adjustments based on data usage, service quality, and network performance.

- ***Improved customer satisfaction***: Offering users transparency in their usage and billing, while also enabling ISPs to offer customized plans and services.

# **Problem Statement**

The current state of network monitoring and billing among ISPs in Kenya reveals significant inefficiencies:

1. **Lack of Real-Time Monitoring**  
   ISPs struggle to track bandwidth usage, latency, and service uptime in real time, which limits their ability to proactively address performance issues.
2. **Static Billing Systems**  
   Traditional billing methods rely on fixed-rate pricing, leading to inaccurate charges. Customers often face overcharges or undercharges due to the lack of a dynamic model that adjusts based on real-time data usage and service quality.
3. **Customer Dissatisfaction**  
   The absence of transparent billing systems contributes to low trust and satisfaction among customers. Without detailed insights into their usage, customers cannot make informed decisions about their internet consumption.

This project proposes a solution that integrates **real-time monitoring** with **dynamic billing**, addressing these issues and laying the foundation for improved ISP performance and customer relationships

# **Overall Objective**

The main objective of this project is to design and implement an **Intelligent Network Monitoring and Dynamic Billing System** for ISPs in Kenya. The system will enable ISPs to monitor network usage in real-time, optimize resource allocation, and provide dynamic billing based on actual consumption and service quality. It will also empower customers with tools to track their usage and billing, improving transparency and customer satisfaction.

# **Specific Objectives**

The specific objectives of the project are as follows:

1. ***To develop a real-time network monitoring system*** that allows ISPs to track bandwidth, latency, uptime, and user data consumption.

2. ***To implement a dynamic billing system*** that adjusts charges based on real-time usage data, service quality, and predefined pricing models such as pay-per-use and tiered pricing.

3. ***To design user-friendly dashboards*** for both ISPs and customers, providing visibility into network performance, data consumption, and billing details.

4. ***To integrate alert and notification mechanisms*** that notify users when they approach their data limits or experience service issues.

5. ***To ensure scalability and flexibility*** in the system to accommodate the growing number of internet users and devices in Kenya.

# **Scope and Limitations**

- **Scope:**

  - The project will focus on monitoring network performance, including bandwidth usage, latency, and uptime.

  - The billing system will support dynamic pricing models based on real-time data usage and service performance.

  - The project will create dashboards for admin users (ISPs) and end-users (customers) to manage their accounts, view usage statistics, and track billing.

- **Limitations:**

The system will not address advanced network security concerns such as intrusion detection or denial-of-service attacks.

  - The system will not support highly complex pricing models or advanced analytics, focusing instead on core features like real-time tracking and basic dynamic billing.

  - The system will initially be designed to work for broadband ISPs and may not fully support mobile ISPs or mobile data networks.

## **Significance of the Project**

The **NetBil** system will revolutionize network management and billing for Kenyan ISPs by:

1. **Enhancing Operational Efficiency**:
   * Real-time monitoring and dynamic billing will enable ISPs to optimize network resource allocation and improve revenue accuracy.
2. **Increasing Customer Trust and Satisfaction**:
   * Transparent billing practices and user-friendly dashboards will empower customers to understand and control their internet usage, fostering trust.
3. **Driving Innovation in ISP Practices**:
   * By adopting flexible billing models, ISPs can cater to diverse customer needs and improve market competitiveness.
4. **Supporting Industry Growth**:
   * As ISPs overcome operational challenges, they will be better positioned to meet the increasing demand for reliable and affordable internet services in Kenya

CHAPTER TWO: LITERATURE REVIEW

# **Organization & Flow**

The literature review will begin with an overview of current network management and billing systems used by ISPs in Kenya and globally. It will then cover existing ***technologies and tools*** used for ***network monitoring*** (e.g., SNMP, NetFlow) and ***dynamic billing systems*** (e.g., pay-per-use, subscription-based models). Finally, the review will discuss the **gap** in existing systems and how the proposed project aims to fill that gap.

# **Review of Related Works**

* **Network Monitoring**:  
  Several studies have explored network monitoring technologies to improve the performance and reliability of network infrastructure. Tools such as **SNMP (Simple Network Management Protocol)** are widely used for tracking network devices and monitoring traffic. These tools provide basic insights into bandwidth usage, latency, and uptime. Advanced tools like **Zabbix** and **Nagios** extend this functionality, allowing ISPs to monitor performance metrics and generate alerts for anomalies. However, these solutions often lack seamless integration with billing systems, which limits their effectiveness in providing end-to-end solutions for ISPs.
* **Dynamic Billing Systems**:  
  Research has shown a global trend toward **usage-based billing models**, particularly in response to the increasing demand for mobile internet and data-intensive services like streaming. These billing systems dynamically adjust charges based on actual usage and service quality, offering customers fairer pricing structures. Despite this innovation, Kenyan ISPs face challenges in adopting such systems due to limited infrastructure, manual processes, and high initial costs of implementing dynamic billing solutions.

#### **Reviewed Systems**

###### **PhpRadius:**

* + **Strengths**:  
    PhpRadius has a large user base and is widely adopted by ISPs due to its scalability and compatibility with various network monitoring tools.
  + **Weaknesses**:  
    Its capacity often falls short of the demand, leading to network buffering, delays, and high latencies during peak usage times. This limits its reliability for ISPs managing heavy traffic loads and impacts the overall customer experience.

###### **ASTRANet:**

* + **Strengths**:  
    This system supports advanced features, including detailed usage analytics and integration with third-party billing tools.
  + **Weaknesses**:  
    It suffers from a complicated and unfriendly user interface, making it difficult for customers to navigate and understand their billing and usage details. This complexity often leads to user dissatisfaction and a steep learning curve for new customers.

###### **nuXbill:**

* + **Strengths**:  
    Being open-source, nuXbill offers cost advantages and flexibility for ISPs to customize the system to their needs. It also supports a wide range of network monitoring functionalities.
  + **Weaknesses**:  
    There is no dedicated support team or quick reference in case of downtime. ISPs relying on this system face challenges with prolonged service interruptions and delays in resolving technical issues, which negatively affect customer satisfaction and trust.

#### **Analysis**

While existing systems like **PhpRadius**, **ASTRANet**, and **nuXbill** provide valuable features, they fail to address the core requirements of Kenyan ISPs effectively. **PhpRadius** cannot handle high-capacity demands, **ASTRANet** complicates user interactions, and **nuXbill** lacks reliable support. The gaps in these systems highlight the need for an integrated solution like **NetBil**, which combines scalability, user-friendly interfaces, and robust support mechanisms to meet the specific demands of ISPs in Kenya.

**Gap Analysis:** While many ISPs in Kenya have implemented basic billing systems, they lack real-time monitoring and dynamic adjustment capabilities. This project aims to bridge this gap by integrating real-time network monitoring with flexible, usage-based billing.

## **Clarity of Gap**

The key gap identified is the lack of real-time data usage tracking and dynamic billing in Kenyan ISPs. Existing billing systems are static, and customers often face issues related to inaccurate billing or service quality not being reflected in the charges.

CHAPTER THREE: PROJECT METHODOLOGY

# **Requirements (Gathering & Analysis)**

Requirements will be gathered through interviews with local ISPs in Kenya to understand their current network management challenges and billing practices. Additionally, user surveys will be conducted to gather feedback on what features customers expect from a network monitoring and billing system.

### **1. Functional Requirements**

The core functionalities that the NetBil system must fulfill are as follows:

#### 1.1 Real-Time Network Monitoring

* Ability to monitor bandwidth usage, latency, uptime, and other network performance metrics.
* Track individual user data consumption on a real-time basis.
* Integration of SNMP (Simple Network Management Protocol) for device and traffic tracking.

#### 1.2 Dynamic Billing System

* Implementation of a billing module capable of calculating charges based on:
  + Actual data usage.
  + Service quality (latency, downtime).
  + Pricing models like pay-per-use, tiered pricing, and flat rates.
* Support for automated invoice generation and payment reminders.

#### 1.3 User Dashboards

* Develop intuitive dashboards with the following features:
  + ISP dashboard: Overview of all network statistics, customer data, and billing details.
  + Customer dashboard: Insights into individual data usage, billing history, and notifications.

#### 1.4 Notification and Alert System

* Real-time notifications for customers about:
  + Nearing data limits.
  + Service outages or network performance issues.
  + Billing due dates and payment confirmations.

#### 1.5 User Role Management

* Admin roles for ISPs to manage customer accounts, monitor usage, and control billing.
* Customer roles for end-users to view their usage and billing information.

#### 1.6 Scalability

* System must support growth in users and network devices without performance degradation.

#### 1.7 API Integration

* Integration with external APIs for:
  + Payment gateways for billing and transactions.
  + Cloud hosting services for scalable and reliable operations.

### **2. Non-Functional Requirements**

These define the quality attributes and constraints for the system:

#### 2.1 Performance

* The system should be able to handle at least 1,000 concurrent users in the initial phase.
* Real-time updates for network statistics and billing information should occur within a delay of no more than 1 second.

#### 2.2 Reliability

* Ensure 99.9% uptime for the system using cloud-hosted architecture (e.g., AWS or similar platforms).
* Implement fault-tolerant mechanisms to recover from network or server outages.

#### 2.3 Usability

* Dashboards must feature a clean, user-friendly interface with intuitive navigation.
* The customer dashboard should support both desktop and mobile platforms.

#### 2.4 Security

* Secure user data and transactions using encryption protocols (e.g., TLS/SSL).
* Implement authentication and authorization features, such as two-factor authentication for ISP admin roles.

#### 2.5 Scalability

* Ensure the system can expand to accommodate up to 10,000 users with minimal configuration changes.

#### 2.6 Maintainability

* Modular architecture to facilitate updates and debugging.
* Use industry-standard development tools and frameworks to ensure long-term maintainability.

### **3. Resource Requirements**

#### 3.1 Human Resources

* **Software Developers**:
  + Backend development (e.g., PHP, Node.js).
  + Frontend development (e.g., React.js, HTML, CSS, JavaScript).
* **Database Administrators**:
  + Responsible for database design and maintenance (e.g., MySQL or PostgreSQL).
* **System Architects**:
  + Design the overall system architecture, including cloud and network integrations.
* **UI/UX Designers**:
  + Create the dashboards and ensure a seamless user experience.
* **Project Manager**:
  + Oversee the development process, manage timelines, and communicate with stakeholders.

#### 3.2 Software and Tools

* **Backend**: PHP or Node.js for the server-side application.
* **Frontend**: React.js for dashboards.
* **Database**: MySQL or PostgreSQL for storing user data, billing records, and network usage logs.
* **Monitoring Tools**: Integration with tools like Zabbix or Nagios for network performance tracking.
* **APIs**: Payment gateways, such as PayPal or M-Pesa, and cloud hosting APIs like AWS.
* **Version Control**: GitHub or GitLab for source code management.
* **Development Environment**: IDEs like Visual Studio Code or IntelliJ IDEA.

#### 3.3 Hardware Resources

* **Network Equipment**:
  + MikroTik routers for SNMP-based monitoring.
  + High-performance servers for hosting the application.
  + Backup hardware for failover and redundancy.
* **Testing Devices**:
  + Access points, cables, and other testing equipment for system validation.

#### 3.4 Budgetary Requirements

* Development tools and licenses: **Ksh 500**.
* Cloud hosting (e.g., AWS): **Ksh 1,200 per month**.
* Testing and deployment equipment:
  + MikroTik: **Ksh 3,000**.
  + Access point: **Ksh 2,500**.
  + Cables: **Ksh 150**.
* Miscellaneous costs: **Ksh 1,000**.
* Total estimated budget: **Ksh 8,350**.

#### 3.5 Time Requirements

* Estimated timeline: 6 months.
  + Requirements gathering and analysis: 1 month.
  + System design: 1 month.
  + Development: 3 months.
  + Testing and deployment: 1 month.

## **Approach to Analysis of Requirements**

The ***Agile methodology*** will be used for the development of this project, allowing flexibility and iterative progress. Requirements will be prioritized based on their importance and feasibility, and will guide the development of both the network monitoring system and the dynamic billing system.

# **Design Tools & Process**

**Database Design:** The database will be designed using **MySQL** **or PostgreSQL** to store user data, billing records, and network usage logs.

- **System Architecture:** The system will be designed using a **client-server model**. The backend will be built using PHP or Node.js, while the frontend will be designed using React.js or html+php+js.

**CHAPTER FOUR: SOLUTION ANALYSIS & SPECIFICATION**

# **Requirements Determination**

The key requirements for the project include:

- Real-time tracking of data usage and network performance.

- Integration of a dynamic billing model based on usage.

- Dashboards for both end-users and administrators to view network statistics and billing details.

**Requirements Analysis**

Solution models such as (DFDs) and Use Cases will be created to model the system’s interactions. These models will ensure that both the monitoring and billing components are aligned with user needs and business goals.

**Formulate & Document Solution Specifications**

Specifications will include the technical stack, user interface design, and database schema. These will be documented in detail to ensure a clear path from development to deployment.

**REFERENCES**

# **- Books:**

  - "Network Management and Monitoring" by R. Brooks

  - "Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl

## **- Research Papers:**

  - "Dynamic Network Billing" – IEEE Xplore

  - "Real-Time Network Monitoring for ISPs" – Springer Link

- **Websites:**

  - MikroTik RouterOS documentation

  - AWS Documentation for Cloud Hosting and Monitoring

**APPENDICES**

## **Gantt Chart**

A Gantt chart will outline the project timeline, breaking down major milestones such as requirement gathering, system design, development, testing, and deployment.

# **Budget**

- Development Tools: 500

- Cloud Hosting:1200/month

- Testing & Deployment:

- Mikrotik 3,000

- Access point 2,500

- Cable 150

- Miscellaneous (Software, Licenses):1000

- Total: Ksh 8,350 /=

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