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REPUBLIC OF CAMEROON
PEACE-WORK-FATHERLAND

MINISTER OF HIGHER
EDUCATION

UNIVERSITY OF BUEA

DEPARTMENT OF COMPUTER
ENGINEERING

Course Code: CEF440

Course name – Internet Programming And Mobile Programming

Course Instructor – Dr Nkemeni Valery

Requirements Gathering

Task 2

Project 1

Task Report

Prepared by :

GROUP 6

Prepared on:

Sunday 13th April 2025

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INTRODUCTION

As mobile networks evolve, user expectations for service quality and performance have significantly increased. In developing countries like Cameroon, subscribers frequently encounter fluctuations in network quality, service delays, and outages. This project aims to develop a mobile application that gathers real-time data on the Quality of Experience (QoE) from mobile network subscribers, integrating both subjective feedback and objective performance metrics.

PROBLEM STATEMENT

Current methods for monitoring network performance often rely on traditional, network-centric metrics that fail to capture the real-time, location-specific user experience. This gap leads to an incomplete understanding of service quality and limits the ability of mobile operators to proactively address network issues.

The primary goal of this project is to design and implement a mobile application with the following features:

- ❖ Continuous background operation.
- ❖ Periodic prompts for user satisfaction ratings and feedback.
- ❖ Automatic logging of device and network parameters.

IDENTIFIED STAKEHOLDERS

1. End Users (Subscribers)

Using **Google Forms [1], interviews and questionnaires**, this genre of audience was approached to get quantitative data on:

- ✓ User Experience.
- ✓ Feedback mechanism.
- ✓ App Features.
- ✓ Privacy Concerns.

It was a productive exercise as we succeeded to reach over a hundred subscribers.

2. Mobile Network Operators

Through **Google Forms [2]** and **interviews and questionnaires**, personnels of Network Operators such as Orange, MTN and CAMTEL were approached to get insights on:

- ✓ Their current challenges.
- ✓ The data requirements.
- ✓ Their strategies in engaging users for feedback.
- ✓ Tools needed to integrate with the proposed system.

Unfortunately, throughout the week we weren't received at both MTN and Orange. As for CAMTEL, we were chanced to interview senior technicians. However, none could answer our questions as their area of expertise is to establish and maintain the backhaul of the network of the country.

3. Developers and Technical Teams

We **interviewed** UI/UX designers, software developers, QA testers, and telecommunications consultants, on:

- ✓ Best practices we should adopt (especially when collecting user experience data).
- ✓ Technical feasibility (foreseen challenges and possible solutions).
- ✓ What metrics to track during the app's deployment.

REQUIREMENTS GATHERING TECHNIQUES

To accurately define the functional and non-functional requirements of the mobile app, multiple techniques were employed:

1. Surveys [1]

Surveys were used to collect quantitative data from potential users about their network experience, preferred user interfaces, and willingness to provide feedback.

2. Interviews [2]

Semi-structured interviews were conducted with telecom engineers and customer support teams to understand the types of metrics needed and user pain points.

3. Brainstorming Sessions

Conducted with developers and UI/UX designers to outline the app's architecture, including its feedback mechanisms and background data collection modules.

4. Observation

Key users (such as gamers and remote workers) were observed to understand the flaws they may encounter when using network services. It was observed that many of them make use of StarLink.

5. Reverse Engineering

Reverse engineering of similar applications like **nPerf** and **OpenSignal** was done to understand feature sets, data handling, and performance monitoring. We further studied what can be added or improved to distinguish our application and why users would prefer it over existing solutions. This spans the introduction of offline services and the inclusion of AI-based analytics.

A. NPerf

It is a mobile application that allows users to:

- ✓ Test download and upload speed.
- ✓ Measure latency and browsing/video streaming performance.
- ✓ Visualize signal coverage on a map.
- ✓ Share results to the cloud for aggregation.

B. OpenSignal

OpenSignal provides:

- ✓ Signal strength visualization with tower direction.
- ✓ Speed testing and latency measurement.

✓ Network coverage heatmaps.
✓ Historical signal quality trends.

Insights Gotten From nPerf And OpenSignal

User Interface and Experience
✓ Clean, intuitive dashboards for network performance.
✓ Easy-to-read graphs and maps.
✓ Customizable testing intervals (nPerf).
✓ Real-time feedback with progress indicators.

Data Collection and Reporting
✓ Use of background data collection.
✓ Anonymized crowdsourced reports.
✓ Exportable CSV and JSON formats.

Network Visualization
✓ Signal heatmaps per operator and technology.
✓ Cell tower location approximation.
✓ Map-based reporting and history timeline.

What More Will The Proposed App Have To Offer ?

Offline Functionality

✓ Unlike nPerf/OpenSignal which require internet connectivity, our app will store user data locally when offline.
✓ Data is synced to cloud storage only when a connection is available.
✓ Offline logging includes timestamps, coordinates, and user feedback.

AI-Based Analytics

✓ AI models can detect patterns in user feedback and signal strength over time.
✓ Predict network downtimes and suggest alternate usage times.
✓ Personalized user notifications based on historical data.

QoE-Focused Feedback System

✓ OpenSignal and nPerf focus on objective metrics.
✓ Our app collects both objective (network metrics) and subjective (user experience) data.
✓ Prompts include usability ratings, service complaints, and satisfaction levels.

Offline Services

✓ Store all collected data offline.
✓ Provide summary of performance trends while offline.
✓ Only request connection for uploads and model updates.

Gamification and Rewards

- ✓ Users receive points for submitting data.
- ✓ Points can be exchanged for mobile data bundles (partnered with network providers).

AI-Powered Dashboard

- ✓ Displays real-time analytics driven by user history.
- ✓ Recommends networks for optimal usage in certain areas.
- ✓ Flags poor-performing regions automatically.

Customizable Data Privacy Controls

- ✓ Users select what data is stored (location, signal, feedback).
- ✓ Option to enable/disable background services.

Comparison Table
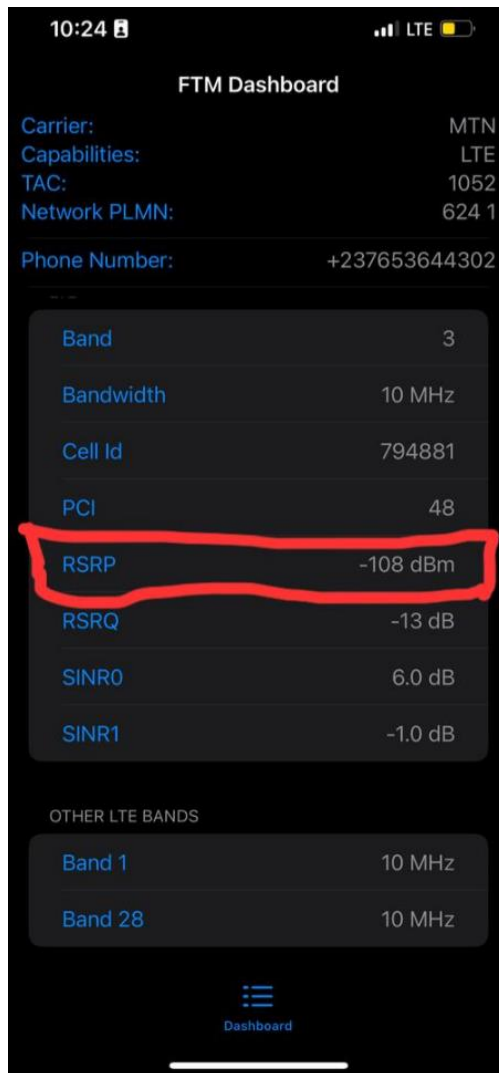
Feature	nPerf	OpenSignal	Our App
QoE Feedback Collection	No	No	Yes
Offline Operation	No	No	Yes
AI-Based Analysis	No	No	Yes
Gamification	No	No	Yes
Network Visualization	Yes	Yes	Planned
Background Monitoring	Yes	Yes	Yes
Custom Feedback Prompts	No	No	Yes

DATA GATHERING

Insights on Data Gathered

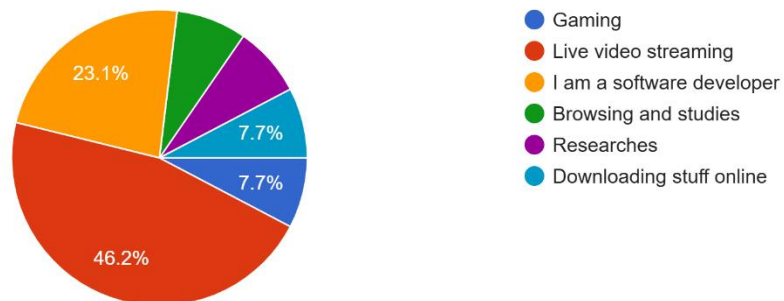1. Signal strength (in dBm) using interviews

   ➢ *MTN*

   ➢ *ORANGE*

2. Network type of all users spans from **2G** to **4G**.

3. **46.2%** of Subscribers who answered the form mostly use the network services to stream videos online

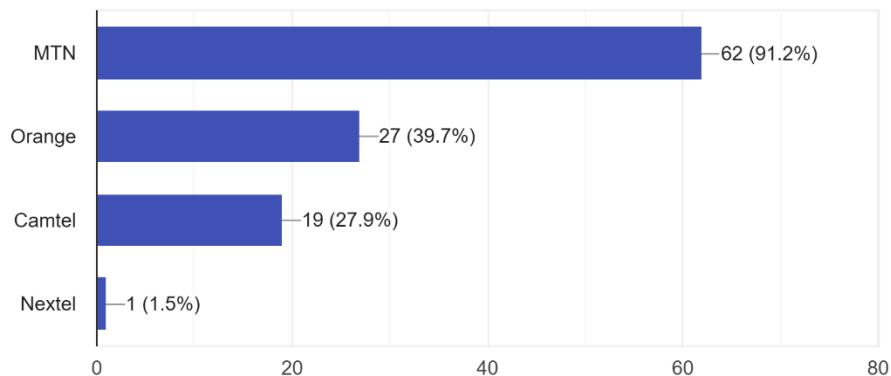What do you mostly use the network for?
13 responses

- Gaming
- Live video streaming
- I am a software developer
- Browsing and studies
- Researches
- Downloading stuff online

4. Most of these subscribers are subscribed to MTN and least to Nextel

Which mobile network(s) do you currently use?

68 responses

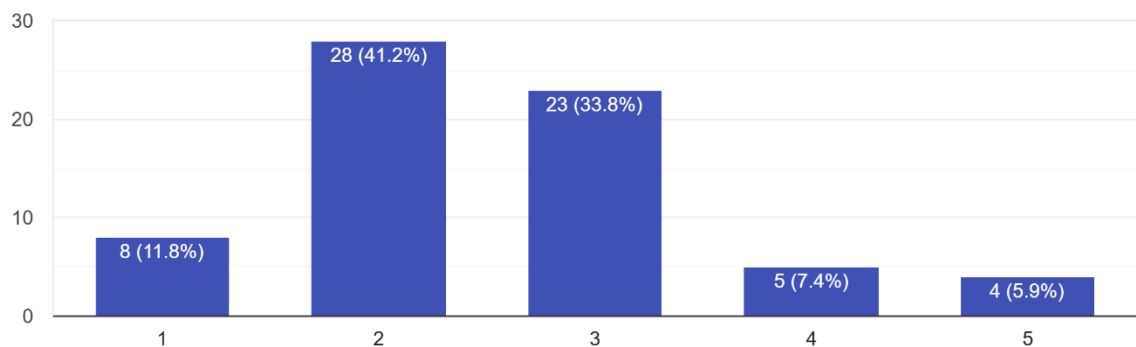| Network	Value
MTN	62 (91.2%)
Orange	27 (39.7%)
Camtel	19 (27.9%)
Nextel	1 (1.5%)

5. The average ratings of these subscribers regarding the QoS they receive from network operators is **2.5/5**, with **41.2%** rating **2/5**

How would you rate your overall mobile network experience?

68 responses

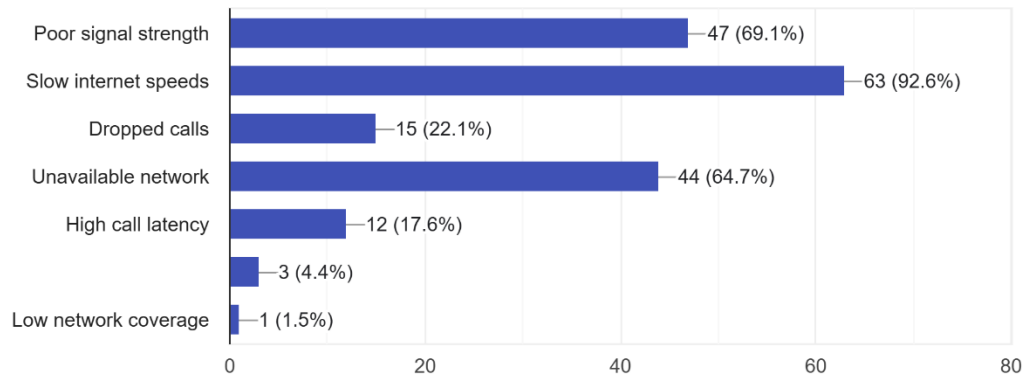| Rating	Count
1	8 (11.8%)
2	28 (41.2%)
3	23 (33.8%)
4	5 (7.4%)
5	4 (5.9%)

6. The three leading network issues experienced by these subscribers is
   - Slow internet speed
   - Poor signal strength
   - Unavailable network

   Where slow internet speed is the most experienced.

Which of the following issues do you frequently experience? (Select all that apply)
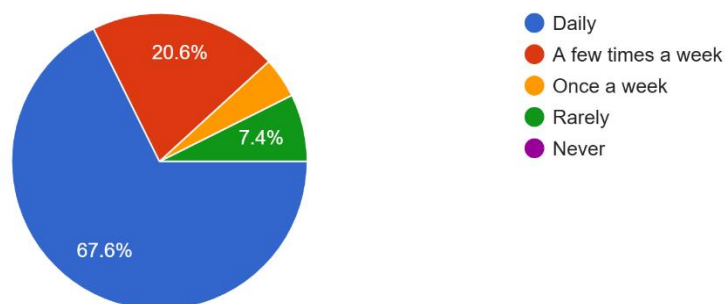68 responses

7. According to the chart below, network issues are experienced daily by most subscribers.

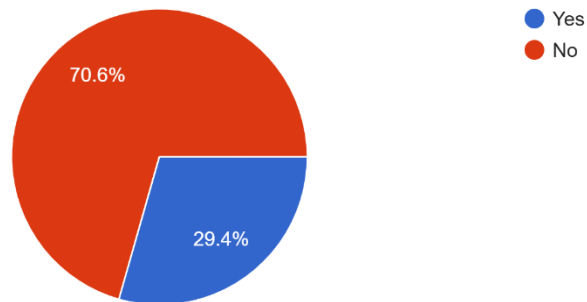How often do you face these issues?
68 responses

8. As shocking as it sounds, it was also studied that a good number of these subscribers don't make known their complaints to their service providers.

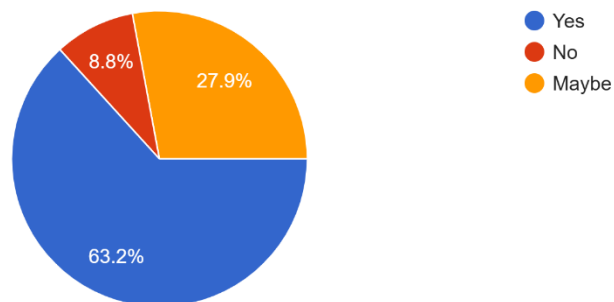Have you ever reported a network issue to your service provider?
68 responses

9. **63.2%** of these subscribers mentioned that they'll be eager to use an application to communicate their challenges with much ease to their service providers.

Would you be willing to rate your network experience regularly using a mobile app?
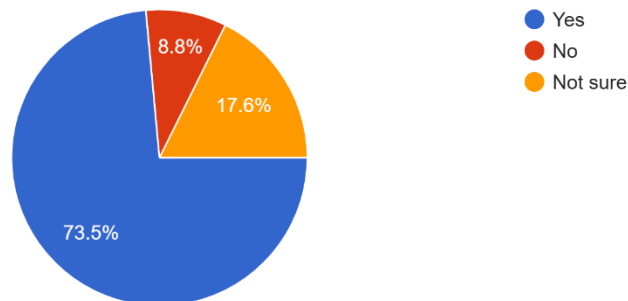68 responses

10. A higher percentage of these subscribers admitted that they'll be comfortable with an application running in the background to measure network performance.

Would you be comfortable with an app running in the background to measure network performance?
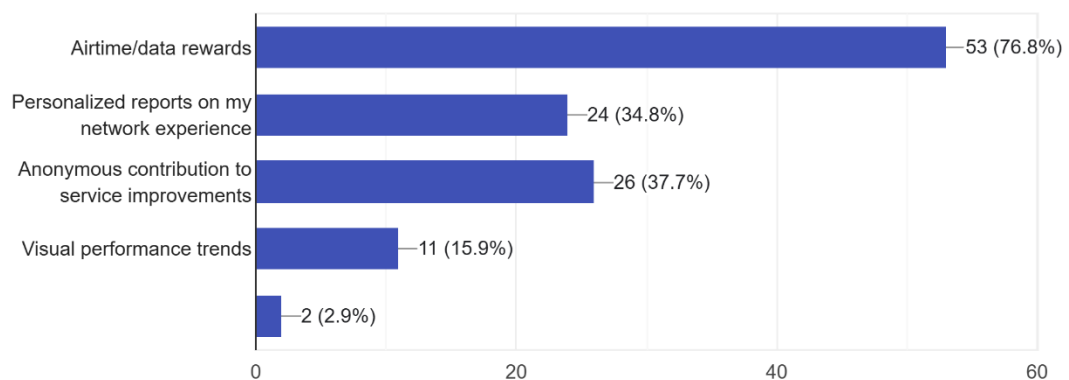
68 responses

- Yes
- No
- Not sure

8.8%

17.6%

73.5%

11.   The percentage of subscribers who'll want to use such an application increased to **77.9% (by 4.4%)**

12.   Subscribers care most about their airtime and data bundle. It can be confirmed studying the chart below

What features would encourage you to use such an app? (Select all that apply)
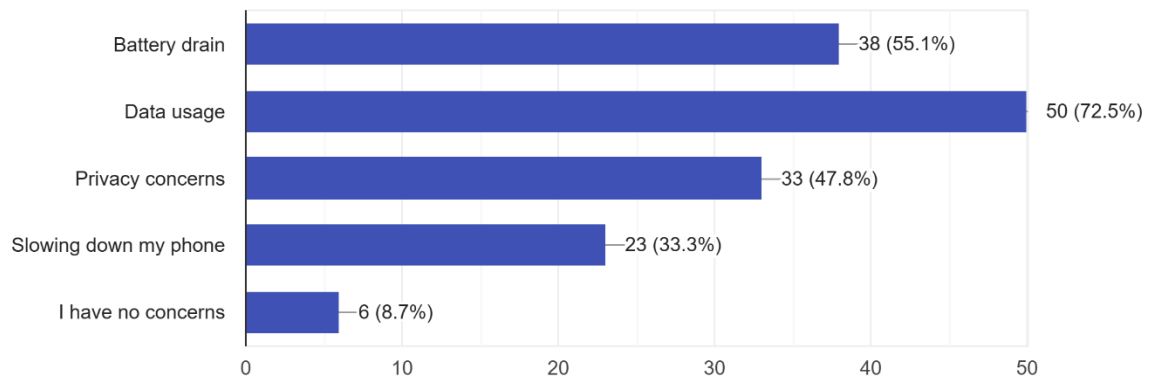
69 responses

Feature	Value
Airtime/data rewards	53 (76.8%)
Personalized reports on my network experience	24 (34.8%)
Anonymous contribution to service improvements	26 (37.7%)
Visual performance trends	11 (15.9%)
	2 (2.9%)

USER RELUCTANCE ASSESSMENT

On approaching end users, it was noticed that they:

✓ Have concerns about battery drain from background services.

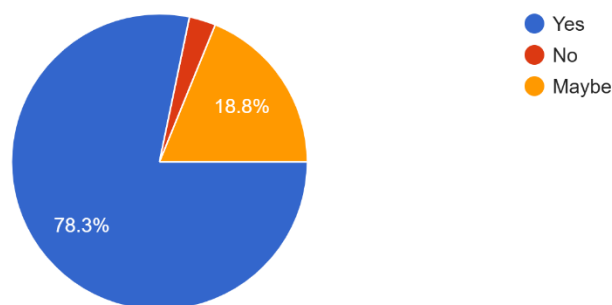What concerns would you have using such an app? (Select all that apply)
69 responses

✓ Have concerns about granting App permissions to personal data such as location.

Would you be more willing to use the app if your data was anonymized and secured?
69 responses

✓ Are reluctant to provide frequent feedback. A large proportion of subscribers are comfortable in providing feedbacks only when they encounter a problem.

How frequently would you be willing to provide feedback via short in-app questions?
69 responses

- ● Once a day
- ● Once a week
- ● Once a month
- ● Only when I experience a problem
- ● Never
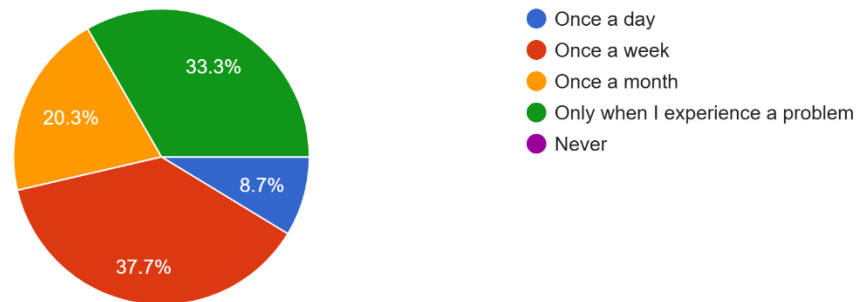
CONCLUSION

The survey indicates that users are more likely to adopt the app if it ensures data anonymity and offers incentives like airtime rewards. By integrating both objective metrics and subjective feedback, the proposed app provides a comprehensive view of user experiences. Key features such as offline functionality and AI-based analytics will help address user concerns and encourage adoption.

In summary, this project aims to bridge the gap in current monitoring methods, empowering users to voice their experiences and enabling mobile operators to improve services and customer satisfaction.

REFERENCES

1. Google Form for subscribers,
   https://docs.google.com/forms/d/e/1FAIpQLSd3j-2kOmayUbwuEoCFvejdOmRhMLfK_cM79gquMvpPAUOm4w/viewform?usp=header
2. Google Form for technical teams (telecommunication engineer, developer etc.),
   https://docs.google.com/forms/d/e/1FAIpQLSctqzLQS0AOSuQ0AuMn_3fpD-jEw8DAerzpMC9EOnEexypn0w/viewform?usp=header