**KYAMBOGO UNIVERSITY**

**FACULTY OF ENGINEERING**

**DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING**

**ASSESSING UGANDA’S PREPAREDNESS FOR EMBEDDED SIMCARD EVOLUTION: PROSPECTS AND CHALLENGES**

**TETE 4101: FINAL YEAR PROJECT**

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**PROJECT REPORT SUBMITTED TO THE FACULTY OF ENGINEERING IN PARTIAL FULFILLMENT OF REQUIREMENT FOR THE AWARD OF BACHELORS OF ENGINEERING IN TELECOMMUNICATIONS ENGINEERING**

# 

# DECLARATION

I ABIGABA LORNA MARIA hereby declare that this report “assessing Uganda’s preparedness for embedded sim-card evolution: prospects and challenges” is my own original work and that has not been presented to anywhere.

Signature: ………………………… Date: …………………….

ABIGABA LORNA MARIA

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# APPROVAL

I confirm that the project was done by ABIGABA LORNA MARIA under my supervision. This has been submitted for review with my approval to the University.

……………………………

MR. SSEMUJU MARK

PROJECT SUPERVISOR

# DEDICATION

This project report is dedicated to my lovely parents Mr. Mucunguzi David and Mrs. Namusisi Hope who have financially and emotionally supported and encouraged me all the time in the course of my study. I could not have made it without your support, thank you.

# ACKNOWLEDGEMENT

I give glory to God Almighty for his Grace throughout this period. None of this would have been accomplished without Him.

I thank my lovely parents Mr. Mucunguzi David and Mrs. Namusisi Hope for their financial and emotional support during my study period.

I am greatly indebted to my classmates who have shown maximum cooperation and willingness to help in different areas throughout the course of study.

I am grateful to my supervisor Mr. Ssemuju Mark for sparing his time to advise me in this project process.

Thank you so much.

# ABSTRACT

This research project titled "Assessing Uganda's Preparedness for Embedded SIM Card Evolution: Prospects and Challenges" aims to examine Uganda's readiness for the transition from traditional SIM cards to embedded SIM cards (s) and identify the prospects and challenges associated with this evolution. The study employed a mixed-methods research design that included stakeholder consultations, a literature survey, and data entry and analysis. The stakeholder consultations involved key players in the telecommunications industry, including mobile network operators, regulatory authorities, and device manufacturers. The literature survey covered existing literature on technology, regulatory frameworks, and policy guidelines. Data entry and analysis involved the use of statistical software to analyze the data collected from the stakeholder consultations and literature survey. The findings indicate that Uganda's regulatory environment is not yet fully prepared to accommodate the transition to technology. The lack of a clear legal and regulatory framework and the limited technical capacity of regulatory authorities were identified as the major challenges. The study recommends the need for a robust legal and regulatory framework that addresses the specific challenges associated with technology, including security concerns and the need for interoperability between network operators. The study also suggests the need for capacity building programs to enhance the technical capacity of regulatory authorities and other key stakeholders. Overall, this study provides valuable insights into the prospects and challenges associated with the transition from traditional SIM cards to technology in Uganda and provide recommendations for policymakers, regulators, and industry players.

# LIST OF ABBREVIATIONS

: embedded SIM

**SIM** : subscriber identity module

**IoT** : Internet of Things

**MNO** : mobile network operator

**MVNO** : mobile virtual network operator

**SM-DP+ :** Subscription Manager Data Preparation

**OTA** : over-the-air

**API** : application programming interface

**GDP** : Gross Domestic Product

**MoICT** : Ministry of Information and Communications Technology

**UCC** : Uganda Communications Commission

**NIRA** : National Identification and Registration Authority

**SIMO** : SIM Box fraud Operations

**TMSI** : Temporary Mobile Subscriber Identity

**IMSI** : International Mobile Subscriber Identity

**MCC** : Mobile Country Code

**MNC** : Mobile Network Code

**PUK**  : Personal Unlocking Key

**PIN** : Personal Identification Number

**ICCID** : Integrated Circuit Card Identifier

**NFC** : Near Field Communication

**GUI** : graphical user interface

**SP** : service provider

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# CHAPTER 1 : INTRODUCTION

## BACKGROUND

The traditional physical SIM cards have been used for several years to identify mobile network subscribers and provide access to mobile networks. With the advancement in technology and the Internet of Things (IOT) devices, there is a need for a more flexible, secure, and remote way to provision mobile network services. This has led to the development of s, which are embedded SIM cards that can be provisioned over the air.

Figure E-sim

An is a chip soldered onto the device's motherboard or embedded in the device's hardware, and it allows users to switch between networks without having to physically change the SIM card. The is remotely provisioned by an SM-DP+ (Subscription Manager Data Preparation) server, and the subscription profile is securely downloaded onto the . There are several architectures, including the integrated, removable, and soft SIMs, with each having different implementation methods and advantages.

The activation and provisioning of s differ from traditional SIM cards. The activation process of an involves scanning a QR code, which contains the subscription profile, with a compatible device. The device then downloads the profile to the , and the user can start using the network services. In addition, the remote provisioning of s provides several benefits, including the ability to provision multiple devices at once, making it ideal for IOT applications.

The adoption of s in Uganda is still in its early stages. The Uganda Communications Commission (UCC) is working on the necessary regulations to govern the implementation of sin the country.The rules and regulations concerning SIM cards are essential to ensure smooth transition and adoption of s. In Uganda, the Uganda Communications Commission (UCC) is the regulatory body responsible for overseeing the telecommunications sector. The UCC has developed policies and regulations for the telecommunications sector, which also apply to SIM cards. These regulations include the need for a valid identification card to register for SIM cards, and adherence to data protection laws to ensure the privacy and security of user information. Mobile network operators must also comply with the UCC's technical and quality standards for their networks, including networks.

The implementation of s in Uganda has the potential to improve the connectivity and provide a more flexible and secure method for provisioning mobile network services. It can also enhance the adoption of IOT devices and support the growth of the digital economy in the country. However, there is a need for stakeholder consultations, legal and regulatory frameworks, and infrastructure development to facilitate the smooth transition from traditional SIMs to s in Uganda.

## PROBLEM STATEMENT

The advent of embedded SIM cards (s) is poised to change the telecommunications industry in unprecedented ways, and Uganda is not an exception. The transition from traditional SIM cards to s is likely to cause a significant disruption to the current regulatory and policy framework of Uganda. As such, it is important to assess the preparedness of frequency licensing, regulatory, policy levels, quality of service compliance, frequency allocation, and network planning for this transition. The frequency spectrum is a valuable and limited resource, and as such, it is necessary to ensure that s are effectively integrated into the existing frequency allocation plans. This integration will require a collaborative effort from all stakeholders, including the Uganda Communications Commission (UCC), telecommunications operators, and other relevant regulatory bodies. Additionally, the implementation of s will necessitate a review of the current licensing regime to ensure that it can accommodate the new technology. Regulatory and policy frameworks will also need to be updated to reflect the changes brought about by s. Quality of service compliance is another crucial consideration, as s may require additional measures to ensure that customers receive reliable and high-quality services. The transition to s will also necessitate a review of network planning to ensure that it can accommodate the new technology. In summary, the transition to s is a complex and multifaceted process that requires careful planning and collaboration from all stakeholders. The preparedness of frequency licensing, regulatory, policy levels, quality of service compliance, frequency allocation, and network planning is critical to the successful implementation of s in Uganda.

## OBJECTIVES

The objectives of this research project are multifaceted, and each is crucial to achieving a comprehensive understanding of Uganda's preparedness for the transition to s.

### MAIN OBJECTIVE

* To conduct an assessment of the feasibility and readiness of Uganda for E-simcard evolution: prospects and challenges.

### SPECIFIC OBJECTIVE

* To identify the legal and regulatory pre-requisites to facilitate E-simcard transition
* To assess network infrastructure and other technical prerequisites for the introduction of E-simcard
* To evaluate a reliable mechanism for provisioning that allows users to activate and manage s in IOT platforms

## RESEARCH QUESTIONS

1. What is the current state of adoption and deployment in Uganda?
2. What are the legal and regulatory requirements for the successful transition to technology in Uganda?
3. What are the technical requirements for activating and provisioning embedded SIM cards in a mobile network?
4. What are the potential benefits of technology adoption in Uganda, and how can they be realized?
5. What are the challenges and prospects for reliable provisioning and management in IoT platforms in Uganda?
6. What is the readiness of telecom operators in Uganda to implement technology?

## S**IGNIFICANCE**

The transition to embedded SIM cards (s) is a crucial step in the evolution of the mobile telecommunications industry. The introduction of s is projected to disrupt the traditional SIM card market and bring significant changes to the regulatory, technical, and policy framework of the telecommunications industry. Uganda is one of the countries that will be affected by this transition, and as such, it is essential to assess the country's readiness for this change. This study seeks to identify the prospects and challenges that Uganda may face in the transition to s and provide recommendations on how to address these challenges.

One significant challenge that this study seeks to address is the legal and regulatory framework. With the introduction of s, the traditional regulatory framework may not be adequate to govern the new technology. Therefore, it is crucial to identify the legal and regulatory pre-requisites necessary to facilitate the transition to s. Additionally, the study will assess the technical infrastructure required to support s, such as network infrastructure and other technical prerequisites. This will enable policymakers and stakeholders to understand the infrastructure changes that may be necessary for the successful introduction of s in Uganda.

In conclusion, this study is significant because it seeks to identify the prospects and challenges that Uganda may face in the transition to s. By identifying the necessary legal and regulatory pre-requisites, technical infrastructure requirements, and provisioning mechanisms, the study will provide valuable insights into how Uganda can prepare for this technological transition. The recommendations from this study will be useful to policymakers, regulators, and stakeholders in the telecommunications industry in Uganda, ensuring that the country is ready for the evolution of SIM cards.

## JUSTIFICATION

The adoption of embedded SIM () technology has been on the rise in recent years, and is expected to continue growing in the coming years. This technology is seen as a game changer in the telecommunications industry, offering benefits such as improved security, enhanced flexibility, and reduced operational costs. Uganda, like many other countries, is currently in the process of transitioning from traditional SIM cards to s. However, this transition is expected to disrupt the current regulatory and policy framework of Uganda, and could potentially create challenges in frequency licensing, regulatory policy, quality of service compliance, frequency allocation, and network planning. As such, it is timely to interrogate the preparedness of Uganda for the adoption of s. This research project aims to assess Uganda's preparedness for the evolution of embedded SIM cards by identifying the prospects and challenges associated with this transition, and exploring possible solutions to any identified issues. Through this research, we hope to provide valuable insights into the transition to technology, and inform policy makers and industry players on the best strategies for managing this transition effectively. Ultimately, this research project will contribute to the advancement of the telecommunications industry in Uganda, and support the country's broader economic and social development goals.

## SCOPE OF THE STUDY

The study focuses on assessing the feasibility and readiness of Uganda for the e-SIM card evolution, with particular emphasis on the physical and technical boundaries of the research project. The physical boundaries of the study will cover the entire territory of Uganda, with a focus on urban and semi-urban areas. The study will also cover the technical boundaries of the research project, including the technical capabilities of the mobile network operators, the availability of the necessary infrastructure, and the regulatory framework governing the e-SIM card transition.

**Key areas of interest in the physical boundaries:**

* Accessibility of e-SIM card services in urban and semi-urban areas.
* Consumer adoption and usage of e-SIM cards in different regions of Uganda.
* Physical infrastructure requirements for the provision of e-SIM card services in different regions of Uganda.

**Key areas of interest in the technical boundaries:**

* Technical capabilities of mobile network operators to provide e-SIM card services.
* Technical requirements for the provision of e-SIM card services, including network infrastructure and security considerations.
* Regulatory framework governing the e-SIM card transition, including frequency licensing, policy level, quality of service compliance, frequency allocation, and network planning.

## THEORETICAL FRAMEWORK

The theoretical framework of the input-process-output (IPO) model provides a comprehensive approach to analyzing the adoption of embedded SIM card () technology in the telecommunications industry. The IPO framework examines the input factors that shape adoption, such as legal and regulatory landscape, infrastructure, and consumer preferences. It also considers the processes involved, including legal evaluations, technical assessments, and consumer awareness campaigns. Additionally, the framework assesses the outputs and outcomes, such as regulatory modifications, infrastructure improvements, and consumer acceptance. By utilizing the IPO framework, this research project aims to assess Uganda's readiness for evolution and provide valuable insights for stakeholders to effectively integrate technology in the country's telecommunications industry.

**Input:** The input component of the IPO framework focuses on the factors that contribute to the adoption and implementation of embedded SIM card technology in Uganda. This includes the legal and regulatory landscape, existing telecommunication infrastructure, consumer preferences, and technological advancements. The input factors also encompass the stakeholders involved, such as telecommunication operators, regulatory bodies, device manufacturers, and consumers. Understanding these input factors is crucial for assessing Uganda's preparedness for embedded SIM card evolution.

**Process:** The process component of the IPO framework examines the actions and activities involved in the adoption and implementation of embedded SIM cards. This includes the evaluation of legal and regulatory pre-requisites, technical assessments of network infrastructure, and the establishment of reliable mechanisms for provisioning. The process component also encompasses consumer awareness campaigns, industry collaborations, and the development of industry standards. Analyzing the process component allows for a deeper understanding of the steps and initiatives necessary to facilitate the successful adoption of embedded SIM card technology in Uganda.

**Output:** The output component of the IPO framework focuses on the outcomes and impacts resulting from the adoption of embedded SIM cards in Uganda. This includes assessing the effectiveness of legal and regulatory modifications, improvements in network infrastructure, increased consumer awareness and acceptance, and the overall enhancement of the telecommunications industry. The output component also considers the long-term implications, such as improved connectivity, enhanced user experiences, and the potential for economic growth and digital transformation. Evaluating the output component provides insights into the overall success and effectiveness of Uganda's preparedness for embedded SIM card evolution.

By utilizing the IPO framework, you can analyze the input factors that influence the adoption of embedded SIM cards, examine the processes involved in their implementation, and evaluate the outputs and outcomes resulting from their adoption. This framework helps provide a structured approach to understand and assess Uganda's readiness for embedded SIM card technology, by considering the various factors and stages involved in the adoption process.

# CHAPTER 2 : LITERATURE REVIEW

The evolution of SIM cards from traditional SIMs to embedded SIMs (s) has been a significant development in the telecommunications industry s are embedded in devices, which enables users to activate and manage their SIM profiles remotely, making it easier to switch between networks and devices. This technology has the potential to revolutionize the mobile telecommunications industry, with a significant impact on the way users buy and use mobile devices, and how operators manage their networks.

The literature review will explore the following areas: the definition and history of s, the benefits and challenges associated with s, adoption and implementation globally, and the status of adoption in Uganda.

### DEFINITION AND HISTORY OF S:

The is a new type of SIM card that is integrated into a device and is capable of being programmed and reprogrammed over-the-air. The concept of s has been around for a while, but the standard was officially released in 2016 by the GSMA (Global System for Mobile Communications Association). The GSMA is a trade association representing the interests of mobile network operators worldwide.

**UNLOCKING THE POTENTIAL: ADVANTAGES AND OPPORTUNITIES OF CARDS FOR UGANDA'S MOBILE INDUSTRY**

* Increased convenience: cards can be remotely activated and managed, eliminating the need for physical SIM cards and visits to mobile network operators.
* Enhanced security: s use encryption and other security measures to protect user data and prevent unauthorized access.
* Greater flexibility: cards can store multiple network profiles, allowing users to switch between carriers without physically swapping SIM cards.
* Improved reliability: s are less susceptible to physical damage and wear-and-tear compared to traditional SIM cards.
* Increased device compatibility: s can be used with a wider range of devices, including IoT devices, wearables, and other non-phone devices.
* More efficient network management: s can enable carriers to more easily manage network resources and optimize capacity.
* Reduced costs: s can reduce costs associated with physical SIM card production and distribution.
* Reduced waste: s can reduce electronic waste generated by traditional SIM cards
* .Enhanced tracking and monitoring: s can be used for location tracking and other monitoring applications.
* Improved access to mobile services: s can enable more people to access mobile services in remote or under-served areas
* .Increased competition: s can lower barriers to entry for new mobile network operators, increasing competition in the market.
* Greater personalization: s can enable carriers to offer more personalized plans and services to individual users.
* Improved privacy: s can enable users to control and restrict data sharing more easily than traditional SIM cards.
* Enhanced data security: s can enable secure storage and transmission of sensitive data, such as medical records or financial information.
* Simplified international travel: s can enable users to easily switch between carriers and plans when traveling internationally.
* Improved customer service: s can enable carriers to more quickly and easily troubleshoot customer issues remotely.
* Increased revenue opportunities: s can enable carriers to offer new services and generate new revenue streams.
* Simplified device activation: s can simplify the device activation process and reduce the time needed for users to start using new devices.
* Improved resource efficiency: s can reduce the resources needed for SIM card production, distribution, and disposal.
* Enhanced disaster response: s can enable more efficient communication during natural disasters or other emergencies.

While s offer many benefits, they also come with some disadvantages. Here are some of the potential drawbacks of technology:

* Limited availability: Not all carriers support s, and some countries may not have support at all. This can make it difficult for users to switch carriers or use -enabled devices in certain locations.
* Device compatibility: technology is still relatively new, so not all devices support it. This means that users may need to purchase a new device in order to take advantage of technology.
* Activation process: Activating an can be more complicated than simply inserting a physical SIM card. Users may need to scan a QR code or manually enter activation codes, which can be confusing for some users.
* Potential for security issues: Because s are built into the device, they could potentially be more vulnerable to security breaches than traditional SIM cards. Additionally, because s can be remotely activated, there is a risk that someone could activate an without the user's knowledge or consent.
* Lack of physical access: Unlike traditional SIM cards, s cannot be physically removed or replaced. This means that if there is an issue with the , it may be more difficult to resolve.
* Limited carrier options: While s offer the flexibility to switch carriers without changing SIM cards, the number of carriers that support s may be limited. This could restrict users' ability to take advantage of the benefits of technology.

Overall, while s offer many benefits, users should also consider the potential drawbacks before deciding whether or not to use technology.

## HOW S WORK IN GENERAL

s, or embedded SIMs, are a newer type of SIM card that are built into devices rather than being removable like traditional SIM cards. Here's a brief overview of how s work:

s store the same information as traditional SIM cards, such as your mobile number, carrier information, and other identifying details.

Instead of being a physical card, the information is stored electronically on the device's chip.

When you want to activate a new device with an , you can either scan a QR code provided by your carrier or download the profile directly from the carrier's website.

The device will then automatically download the profile and connect to the carrier's network, allowing you to make calls, send texts, and use mobile data.

s can be switched between carriers without needing to physically swap out a SIM card, making it more convenient for users to switch carriers when traveling or when they find a better deal.

s are also beneficial for manufacturers as they don't need to include a physical SIM card slot in the device, which saves space and makes devices more water-resistant.

**TYPES OF CARDS SUITABLE FOR UGANDAN MARKET**

There are several types of s available on the market, but the availability of each type of can vary depending on the country and carrier. Here are some of the types of s that may be available for use in Uganda:

**CONSUMER S:**

These s are designed for individual consumers and are typically used in smartphones, tablets, and other mobile devices. They can be used to switch carriers without needing to physically swap out a SIM card, making them a convenient option for users who travel frequently or want to switch carriers.

1. **Architecture:**

Consumer s are built into the device's chip and store the same information as a traditional SIM card, including the mobile number, carrier information, and other identifying details. However, unlike traditional SIM cards, the information on the can be remotely updated or changed, allowing for greater flexibility in managing carrier profiles.

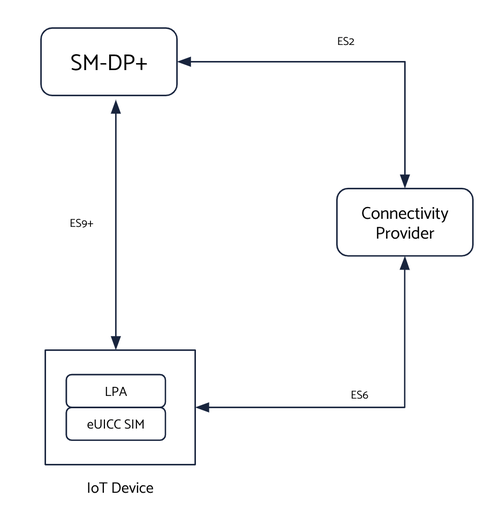


Figure 2E-sim architecture

**Functions of each part above**

The full form of SM-DP+ in is Subscription Management Data Preparation Plus

The SM-DP+ is a key component in the ecosystem and is responsible for securely managing and preparing the subscription data that is stored on the .

* The function of the SM-DP+ is to securely manage and prepare the profiles that are used to identify and authenticate the user on the mobile network. This includes securely storing and managing the cryptographic keys and other sensitive information that is used to authenticate the user and ensure the integrity of the network.

In addition to its role in managing and preparing the profile, the SM-DP+ also provides a range of other functions, including:

* Managing the life cycle of the profile, including updates and revocations
* Enabling remote provisioning and management of profiles
* Ensuring the security and privacy of user data stored on the
* Providing a platform for testing and certification of devices and profiles

LPA in is Local Profile Assistant. The LPA is responsible for managing the profiles on the device and ensuring that they are properly installed and activated.

The function of the LPA is to provide a user-friendly interface for managing profiles on the device. This includes the ability to download, install, and activate profiles from various mobile network operators (MNOs).

The LPA acts as a local repository for profiles, providing a centralized location for managing and switching between different carrier profiles. This makes it easier for users to switch between carriers without needing to physically swap out a SIM card.

In addition to its role in managing profiles, the LPA also provides a range of other functions, including:

1. **Activation:**

* QR code activation: This is one of the most common ways to activate an . The user is provided with a QR code that contains all the necessary details to activate the . The user simply needs to scan the code using their device's camera, and the will be activated automatically.
* App-based activation: Some service providers offer an app that can be used to activate the . The user simply needs to download the app and follow the on-screen instructions to activate the .
* Over-the-air activation: In some cases, the can be activated over-the-air, without the need for a physical SIM card. This is typically done by sending an activation code or profile to the device.
* Built-in activation: Some devices come with built-in s that are pre-activated by the manufacturer. These devices are typically sold by service providers who have partnered with the manufacturer.
* Manual activation: In some cases, the can be activated manually by entering the necessary details, such as the activation code or profile, into the device's settings.

**Steps on how to activate an e-sim using a QR code:**

* Make sure that your device is connected to a Wi-Fi network.
* Open the Camera app on your device.
* Point the camera at the QR code provided by your carrier.
* Once the QR code is scanned, a notification will appear on your screen.
* Tap on the notification to begin the activation process.
* Follow the on-screen instructions to complete the activation process.

**Steps on how to activate an e-sim using a website or app:**

* Go to your carrier's website or open their mobile app.
* Log in to your account.
* Click on the "Activate " button.
* Enter your device's IMEI number.
* Enter your carrier's information.
* Click on the "Activate" button.

**Steps on how to activate an by calling customer service:**

* Call your carrier's customer service line.
* Provide the customer service representative with your device's IMEI number.
* Provide the customer service representative with your carrier's information.
* The customer service representative will activate your over the phone.

1. **Usage:**

Consumer s can be used in the same way as traditional SIM cards, allowing users to make calls, send texts, and use mobile data. However, s offer greater flexibility in terms of switching carriers or activating new devices. For example, users can switch carriers without needing to physically swap out a SIM card, making it easier to take advantage of promotional deals or better coverage in certain areas.

Consumer s can also be particularly useful for users who travel frequently, as they can activate local carrier profiles without needing to purchase a physical SIM card in each location. Additionally, s can make it easier to manage multiple devices, as users can activate the same carrier profile on multiple devices without needing to purchase additional SIM cards.

**M2M s: Machine-to-machine (M2M) s**

These are designed for use in connected devices, such as IoT sensors, wearables, and other smart devices. These s allow for seamless connectivity between devices and can be remotely activated and managed.

1. **Architecture of M2M s**

M2M shave a similar architecture to traditional SIM cards, with a few differences. The key difference is that M2M s are designed for embedded devices that require a high level of reliability and security. This is because M2M s are used in critical applications such as industrial automation, smart grid, and healthcare

M2M s have the following components:

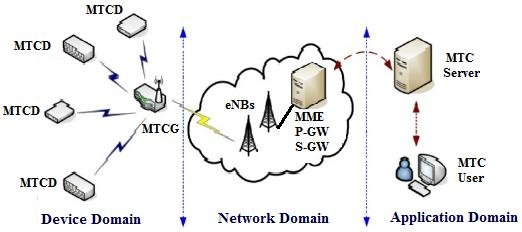
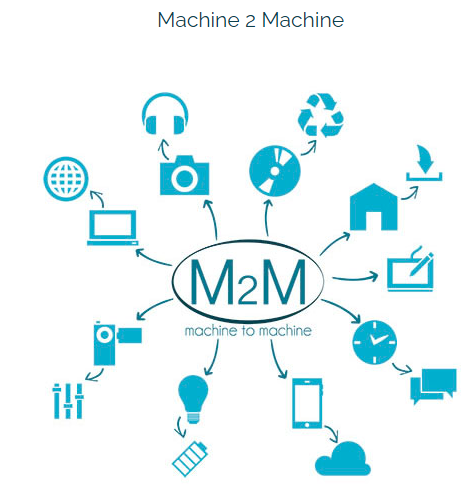


Figure 1.Architecture of M2M

Secure element: This is the hardware component that stores the cryptographic keys used for authentication and encryption. The secure element can be a physical chip or a virtual component that is integrated into the device's processor.

Operating system: The operating system on the M2M controls the functions of the and manages the communication between the device and the network. The operating system is designed to be lightweight and efficient to reduce the processing load on the device.

M2M application: The M2M application on the is responsible for managing the device's connection to the network and handling data transmission.

Remote management platform: This is the platform used to remotely manage the M2M s. It allows network operators to provision and manage the s over-the-air.

Embedded universal integrated circuit card (eUICC) s: These s are built into devices and can be remotely provisioned with different carrier profiles. This allows for greater flexibility and easier management of carrier profiles, making it easier to switch carriers without needing to physically swap out a SIM card.

Soft SIMs: Soft SIMs is a newer type of that are software-based and do not require a physical SIM card. Instead, the SIM information is stored in software on the device's chip, allowing for even greater flexibility and ease of use.

**Adoption and Implementation Globally**:

The adoption of s has been steadily increasing globally, with many countries already implementing the technology. In Europe, s have been widely adopted, with countries such as Germany, Spain, and the UK leading the way. The United States, China, and Japan are also seeing a growing adoption of s.

**The Status of Adoption in Uganda:**

Uganda is yet to fully adopt technology. However, the Uganda Communications Commission (UCC) has taken steps towards the adoption of s by starting a consultation process to develop guidelines for registration and activation. The guidelines will cover issues such as the registration process, the security of s, and the provision of support services for users.

In conclusion, the adoption of s is a significant development in the telecommunications industry, with the potential to revolutionize the way users buy and use mobile devices, and how operators manage their networks. While there are many benefits associated with s, there are also some challenges that need to be addressed. The literature review has provided a broad overview of s, including their definition and history, benefits and challenges, global adoption, and the status of adoption in Uganda.

**GLOBAL ADOPTION AND TRENDS OF EMBEDDED SIM CARDS**

Review of the adoption status and trends of embedded SIM card technology in various countries

The adoption status and trends of embedded SIM card technology have been observed in several countries worldwide. These countries have implemented embedded SIM cards to varying degrees, showcasing the potential benefits and challenges associated with this technology.

1. **European Union (EU)**

The EU has been at the forefront of embedded SIM card adoption, with the introduction of the eUICC (embedded Universal Integrated Circuit Card) standard.

Countries within the EU, such as Germany, France, and the United Kingdom, have witnessed significant growth in the use of embedded SIM cards across different sectors, including automotive, healthcare, and consumer electronics.

The adoption of embedded SIM cards in the EU has been driven by the aim to enhance connectivity, enable remote provisioning, and facilitate the Internet of Things (IoT) applications.

1. **United States**

The United States has seen a gradual increase in the adoption of embedded SIM card technology, primarily in the cellular-enabled consumer electronics market.

Mobile network operators and device manufacturers have collaborated to offer embedded SIM cards in devices like tablets, smartwatches, and laptops, enabling cellular connectivity without the need for physical SIM cards.

The introduction of (embedded SIM) technology has provided consumers with more flexibility in choosing their network providers and switching between them easily.

1. **Asian countries**

Asian countries, including China, Japan, and South Korea, have been active in adopting embedded SIM card technology, particularly in the automotive industry.

Embedded SIM cards are being integrated into vehicles, allowing for remote management of connectivity, software updates, and providing various connected services.

The growth of embedded SIM cards in these countries has been driven by the increasing demand for connected cars and intelligent transportation systems.

1. **African countries**

In Africa, the adoption of embedded SIM cards is gradually gaining momentum, with some countries exploring its potential applications.

Countries like South Africa, Nigeria, Kenya have witnessed limited implementation of embedded SIM card technology, primarily in the IoT and machine-to-machine (M2M) communication sectors.

In Uganda as of just now airtel Uganda has just introduced cards.

## EMBEDDED SIM CARD TECHNOLOGY IN AFRICA

Embedded SIM card technology, also known as , is gradually gaining traction in Africa, albeit at a slower pace compared to other regions. African countries are exploring the potential applications of embedded SIM cards in various sectors, including telecommunications, IoT, and machine-to-machine (M2M) communication.

1. **Current Adoption Status**

Limited Implementation: The implementation of embedded SIM card technology in Africa is still relatively limited compared to other regions. Several African countries, such as South Africa, Nigeria, Kenya, and Ghana, have witnessed some adoption of embedded SIM cards, primarily in specific use cases and industries.

Focus on IoT and M2M Communication: The adoption of embedded SIM cards in Africa has been driven largely by the demand for IoT and M2M communication solutions. Industries such as agriculture, transportation, energy, and healthcare are exploring the benefits of connected devices enabled by embedded SIM cards.

1. **Key Drivers of Adoption**

IoT Development: The increasing development of IoT solutions in Africa has created opportunities for embedded SIM card technology. Connected devices and applications require seamless connectivity, and embedded SIM cards provide the flexibility and remote provisioning capabilities necessary for IoT deployments.

Enhanced Connectivity: Embedded SIM cards offer the advantage of easy connectivity for devices across networks, eliminating the need for physical SIM card swapping. This feature is particularly useful for industries that rely on widespread connectivity, such as logistics and fleet management.

1. **Challenges and Considerations**

Network Infrastructure: Limited network infrastructure in some regions of Africa poses a challenge for the widespread adoption of embedded SIM cards. Adequate network coverage and capacity are crucial for seamless connectivity and remote provisioning.

Regulatory Environment: The regulatory framework surrounding embedded SIM cards varies across African countries. Clear and supportive regulations are necessary to facilitate the implementation and interoperability of embedded SIM card technology.

Cost Considerations: Affordability remains a significant consideration in the adoption of embedded SIM cards in Africa. The cost of compatible devices and associated services, along with considerations of data plans and tariffs, can impact the adoption rate.

1. **Future Prospects**

Growing Interest: There is an increasing interest in embedded SIM card technology in Africa as awareness and understanding of its benefits continue to spread. African mobile network operators, device manufacturers, and IoT solution providers are actively exploring opportunities for collaboration and development.

Potential Applications: Embedded SIM cards have the potential to drive innovation and connectivity across various sectors in Africa. These include agriculture, smart cities, healthcare, transportation, and energy management, where the benefits of remote management, improved efficiency, and enhanced services can be realized.

**EXAMINATION OF SUCCESSFUL CASE STUDIES HIGHLIGHTING THE IMPLEMENTATION AND OUTCOMES OF EMBEDDED SIM CARD TECHNOLOGY IN DIFFERENT REGIONS.**

|  |  |  |  |
| --- | --- | --- | --- |
| **COUNTRY** | **CASE STUDY** | **IMPLEMANATION** | **OUTCOME** |
| South Africa | Discovery Insure Vitality Drive Program | Embedded SIM cards in telematics devices for safe driving | Improved driving behavior and reduced accidents  Lower insurance premiums for safe drivers |
| Nigeria | Pay-As-You-Go Solar Systems | Embedded SIM cards in solar systems for remote monitoring | Increased access to affordable clean energy  Remote activation, monitoring, and payment |
| Kenya | M-KOPA Solar | Embedded SIM cards in solar systems for remote monitoring | Expanded access to clean energy for low-income households  Improved quality of life |
| Ghana | Telemetry Systems for Water Management | Embedded SIM cards in telemetry systems for water monitoring | Enhanced water resource management  Reduced leakages and improved access to clean water |

In this table, the four case studies are listed along with the respective countries, the specific implementation of embedded SIM card technology, and the outcomes achieved in each case.

This tabular format provides a clear overview of the different regions, case studies, and the positive impacts of embedded SIM card technology implementation in Africa.

**ANALYSIS OF THE PROSPECTS AND POTENTIAL ADVANTAGES OF EMBEDDED SIM CARDS IN THE GLOBAL TELECOMMUNICATIONS INDUSTRY**

Enhanced Connectivity:

* Embedded SIM cards offer seamless connectivity for devices across different networks, enabling a more efficient and flexible user experience.
* Users can switch between network providers without physically changing SIM cards, simplifying the process and reducing downtime.
* This enhanced connectivity is particularly beneficial for international travelers, IoT devices, and connected vehicles that require constant and reliable network access.

Remote Provisioning and Over-the-Air Updates:

* Embedded SIM cards enable remote provisioning and management of network profiles, eliminating the need for physical SIM card swaps.
* Network operators can remotely activate, deactivate, or modify SIM cards, enhancing operational efficiency and reducing logistical challenges.
* Over-the-air updates can be performed to update network settings, security features, and other SIM card parameters without physical access to the device, ensuring seamless and secure connectivity.

Flexibility and Scalability:

* Embedded SIM cards provide flexibility in device connectivity, allowing users to choose network providers based on their preferences and needs.
* The technology enables the dynamic allocation of network resources, facilitating efficient use of available network capacity.
* Network operators can offer tailored data plans and tariffs, allowing users to select the most suitable options for their usage patterns.

Security and Authentication:

* Embedded SIM cards offer enhanced security features compared to traditional SIM cards, reducing the risk of SIM card cloning or unauthorized access.
* Robust authentication mechanisms, such as cryptographic algorithms, are utilized to ensure secure communication between the device and the network.
* This increased security is particularly relevant for applications requiring secure connections, such as financial transactions, IoT deployments, and critical infrastructure systems.

Internet of Things (IoT) Enablement:

* Embedded SIM cards play a crucial role in enabling IoT applications by providing seamless connectivity for a wide range of connected devices.
* IoT devices with embedded SIM cards can transmit data, receive updates, and interact with other devices or cloud platforms, enabling efficient data collection and analysis.
* The scalability and remote provisioning capabilities of embedded SIM cards make them well-suited for large-scale IoT deployments, facilitating the growth of smart cities, industrial automation, and other IoT-driven initiatives.

Cost Efficiency:

* The adoption of embedded SIM cards can lead to cost savings for network operators and device manufacturers.
* Embedded SIM cards eliminate the need for physical SIM card distribution, reducing logistics and associated costs.
* The remote management capabilities of embedded SIM cards result in efficient use of network resources, reducing operational expenses and improving overall cost efficiency.

**REGULATORY FRAMEWORKS AND POLICIES**

In Uganda, the regulatory frameworks and policies related to SIM cards and telecommunications are established and enforced by the Uganda Communications Commission (UCC). Here is an overview of the existing regulatory frameworks and policies in Uganda:

1. **SIM Card Registration**

The Ugandan government implemented mandatory SIM card registration to enhance security and combat criminal activities.

The SIM card registration process requires individuals to provide their biometric information, including fingerprints, and personal details such as name, address, and identification documents.

The UCC collaborates with telecommunication service providers to ensure compliance with SIM card registration requirements and maintain a database of registered SIM card owners.

1. **Mobile Number Portability (MNP)**

The UCC has implemented Mobile Number Portability, allowing mobile subscribers to switch network operators while retaining their phone numbers.

The MNP regulations aim to promote competition in the telecommunications market and offer users the freedom to choose their preferred service provider without changing their phone numbers.

1. **Quality of Service Regulations**

The UCC has established Quality of Service (QoS) regulations to ensure that telecommunication service providers maintain acceptable standards of service delivery.

These regulations define benchmarks for network availability, call success rates, call drop rates, and other key performance indicators.

The UCC regularly conducts QoS assessments and enforces penalties or corrective measures for non-compliant service providers.

1. **Spectrum Management**

The UCC is responsible for managing and allocating radio frequency spectrum resources to telecommunication service providers in Uganda.

Spectrum allocation follows a transparent and competitive process to ensure efficient utilization and fair access to spectrum resources.

The UCC sets guidelines and regulations for spectrum use, interference management, and radio equipment standards to maintain the integrity of telecommunication networks.

1. **Licensing and Regulation of Service Providers**

The UCC issues licenses to telecommunication service providers, ensuring compliance with technical, financial, and operational requirements.

The licensing process promotes fair competition, protects consumers' interests, and maintains the stability and growth of the telecommunications sector.

The UCC also monitors and regulates service providers to ensure compliance with licensing conditions, consumer protection, and adherence to industry standards.

1. **Consumer Protection:**

The UCC has established regulations and policies to protect the rights and interests of telecommunication service consumers in Uganda.

These regulations address issues such as billing transparency, quality of service, dispute resolution, and protection against fraudulent activities.

The UCC promotes consumer awareness through public education campaigns, complaint mechanisms, and the enforcement of fair business practices by service providers.

**ANALYSIS OF THE COMPATIBILITY OF CURRENT REGULATIONS WITH EMBEDDED SIM CARD TECHNOLOGY**

1. **SIM Card Registration**

The existing SIM card registration regulations in Uganda primarily focus on traditional physical SIM cards and their registration requirements.

The regulations may need to be updated or expanded to incorporate provisions specifically addressing the registration and management of embedded SIM cards.

Considerations should be made to ensure that the registration process adequately captures the unique identifiers and authentication mechanisms associated with embedded SIM cards.

1. **Mobile Number Portability (MNP)**

The regulations governing Mobile Number Portability in Uganda are generally technology-neutral and applicable to both traditional SIM cards and embedded SIM cards.

The existing framework should support the seamless portability of numbers between different network operators, irrespective of the type of SIM card technology used.

Any updates to MNP regulations should ensure that embedded SIM cards are included and that the necessary processes and procedures are in place to facilitate number porting.

1. **Quality of Service Regulations**

The Quality of Service (QoS) regulations in Uganda may require amendments to include specific parameters and benchmarks for assessing the performance and compliance of embedded SIM card technology.

As embedded SIM cards enable remote management and provisioning, additional metrics related to the remote connectivity and over-the-air functionality may need to be considered for QoS assessments.

The regulations should account for the impact of embedded SIM cards on network availability, call success rates, data speeds, and other relevant performance indicators.

1. **Spectrum Management**

The existing spectrum management regulations should consider the implications of embedded SIM card technology on spectrum allocation and utilization.

The regulations should ensure that service providers deploying embedded SIM card-based services have fair access to the required spectrum resources.

Compatibility with existing regulations can be achieved by considering embedded SIM card technology as part of the broader spectrum management framework, including aspects of interference management and compliance with radio equipment standards.

1. **Licensing and Regulation of Service Providers**

The licensing framework for telecommunication service providers may need updates to explicitly include provisions related to embedded SIM card technology.

The regulations should address the technical, operational, and security requirements specific to embedded SIM cards, such as remote provisioning, secure authentication, and device management capabilities.

Licensing conditions should also account for compliance with international standards and interoperability requirements for embedded SIM card technology.

1. **Consumer Protection**

Consumer protection regulations should be updated to ensure the rights and interests of consumers using embedded SIM card-based services are adequately addressed.

Provisions related to billing transparency, service quality, data privacy, and dispute resolution should explicitly cover embedded SIM card technology.

The regulations should consider the unique features and potential risks associated with embedded SIM cards, such as remote SIM card management and the security of personal data.

**IDENTIFICATION OF ANY GAPS OR MODIFICATIONS NEEDED TO FACILITATE THE ADOPTION OF EMBEDDED SIM CARDS IN UGANDA**

1. **Regulatory Framework Updates**

The existing regulatory framework may need updates to explicitly address the requirements and considerations specific to embedded SIM card technology.

This includes amending regulations related to SIM card registration, mobile number portability, quality of service, spectrum management, licensing, and consumer protection.

The updates should ensure that embedded SIM cards are explicitly recognized, and the necessary provisions are in place to support their adoption and operation.

1. **SIM Card Registration**

The SIM card registration process may need modification to accommodate the unique identifiers and registration requirements associated with embedded SIM cards.

The registration framework should include provisions for capturing the necessary information, such as the device's unique identifiers, serial numbers, and manufacturer details.

The registration process should also consider remote registration capabilities for embedded SIM cards, enabling efficient registration and management of these devices.

1. **Mobile Number Portability (MNP)**

The MNP regulations should explicitly include provisions for the portability of numbers associated with embedded SIM cards.

Updates should ensure a seamless process for consumers to switch between network operators while retaining their embedded SIM card and associated phone numbers.

The regulatory framework should address the technical and procedural aspects of embedded SIM card number porting, including coordination between service providers and the necessary authentication mechanisms.

1. **Security and Authentication**

The existing regulations may require enhancements to address the specific security and authentication requirements associated with embedded SIM card technology.

The regulatory framework should ensure the implementation of robust security measures, including encryption, authentication protocols, and protection against SIM card cloning or tampering.

Guidelines should be established to address the secure provisioning and management of embedded SIM cards, as well as the protection of personal data associated with these devices.

1. **Technical Standards and Interoperability**

To facilitate the adoption of embedded SIM cards, it is essential to establish technical standards and guidelines for interoperability among different devices and network operators.

The regulatory framework should promote adherence to international standards, ensuring compatibility and seamless operation of embedded SIM cards across networks and devices.

Considerations should be made to enable interoperability between different embedded SIM card platforms and ensure that service providers can effectively manage and provision embedded SIM cards from various manufacturers.

1. **Consumer Awareness and Education**

The regulatory framework should emphasize consumer awareness and education programs to ensure that users understand the benefits, functionalities, and potential risks associated with embedded SIM cards.

Information campaigns should be conducted to educate consumers on topics such as remote management, data privacy, secure transactions, and the proper use of embedded SIM card-based services.

The regulatory body should collaborate with telecommunication service providers and other relevant stakeholders to develop informative materials and conduct outreach programs.

**TECHNICAL INFRASTRUCTURE READINESS**

**EVALUATION OF UGANDA'S MOBILE TELECOMMUNICATIONS INFRASTRUCTURE AND ITS READINESS FOR SUPPORTING EMBEDDED SIM CARDS**

1. **Network Coverage and Connectivity**

The evaluation should assess the extent and quality of mobile network coverage across different regions of Uganda.

It should consider factors such as network availability, signal strength, and data speeds to determine if the infrastructure can support reliable connectivity for embedded SIM cards.

The evaluation should also identify any areas with weak or no coverage that may require infrastructure improvements to ensure widespread access to embedded SIM card services.

1. **Network Capacity and Scalability**

The evaluation should assess the capacity of the existing mobile telecommunications infrastructure in Uganda to handle the increased data traffic and connectivity demands associated with embedded SIM card technology.

It should consider the projected growth in the number of connected devices and the corresponding impact on network capacity.

The evaluation should identify any areas where network upgrades or expansions may be required to accommodate the anticipated increase in embedded SIM card deployments.

1. **Technical Compatibility**

The evaluation should examine the technical compatibility between the existing mobile telecommunications infrastructure and embedded SIM card technology. It should assess the compatibility of network equipment, base stations, and core network systems with embedded SIM card functionality.

Any gaps or modifications needed to enable seamless integration of embedded SIM cards within the existing infrastructure should be identified.

1. **Remote Provisioning and Management Capabilities**

The evaluation should assess the readiness of Uganda's mobile telecommunications infrastructure to support remote provisioning and management of embedded SIM cards.

It should consider the capabilities of network operators to remotely activate, deactivate, and update embedded SIM cards over-the-air.

The evaluation should also examine the existing systems and processes for remote SIM card management and identify any necessary improvements or updates.

1. **Security and Authentication**

The evaluation should examine the security measures and authentication mechanisms in place within Uganda's mobile telecommunications infrastructure to support embedded SIM cards.

It should assess the existing protocols and procedures for secure provisioning, authentication, and encryption of embedded SIM cards.

Any gaps in security or areas where enhancements are needed to ensure the safe and reliable operation of embedded SIM card technology should be identified.

1. **Regulatory Compliance**

The evaluation should assess the compliance of Uganda's mobile telecommunications infrastructure with relevant regulatory frameworks and policies related to embedded SIM cards.

It should examine whether the infrastructure meets the requirements outlined by the Uganda Communications Commission (UCC) and other regulatory authorities.

Any areas of non-compliance or regulatory gaps that need to be addressed to ensure the seamless integration of embedded SIM cards should be identified.

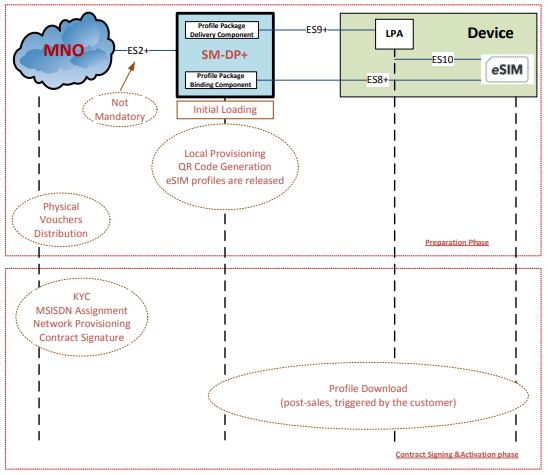
# CHAPTER 3 : METHODOLOGY

## INTRODUCTION

For this study, a qualitative research design was adopted to explore and understand the prospects and challenges related to Uganda's preparedness for embedded SIM card evolution. Qualitative research provides an in-depth understanding of individuals' perspectives, experiences, and attitudes, allowing for rich insights into complex phenomena.

**TOOLS AND EQUIPMENT USED TO ACCOMPLISH THE PROJECT**

1. Computer and Internet Access: A computer with reliable internet access is essential for conducting literature reviews, accessing online databases, and communicating with stakeholders.
2. Documentation Tools: Efficient documentation of your research findings is crucial. Tools like Microsoft Word or LaTeX were used for writing the research report, while presentation software like Microsoft PowerPoint assisted in creating engaging visual presentations of Pre-Configured Token as shown below



1. Research Software: You may use research software applications such as Microsoft Excel or SPSS for data analysis and statistical calculations. These tools helped to organize and analyze large datasets efficiently.
2. Survey Tools: To gather primary data, you may employ online survey tools such as Google Forms. This platform allowed designing, distributing surveys, collecting responses, and analyzing the results.
3. Communication Tools: Effective communication is crucial for stakeholder consultations and interviews. Tools such as email, video conferencing platforms (e.g., Zoom or Skype), and instant messaging apps (e.g., Slack or Microsoft Teams) where used to facilitate communication with relevant stakeholders.
4. Data Analysis Tools: In addition to research software mentioned earlier, you may also utilize qualitative analysis software like NVivo or Atlas.ti to analyze qualitative data such as interview transcripts or open-ended survey responses.
5. Reference Management Software: To organize and manage references, citation management tools like EndNote or Zoterowhere used. These tools help you store and cite references in the required format.

**METHODS**

The choice of the qualitative research design aligned well with the research objectives and the nature of the research questions in thestudy as followed:

*To identify the legal and regulatory pre-requisites to facilitate E-simcard transition*

* Qualitative research was well-suited for exploring and understanding the legal and regulatory landscape surrounding E-simcard transition.
* This approach allowed for in-depth exploration of the existing legal frameworks, policies, and regulations pertaining to E-simcards.
* By conducting interviews and analyzing relevant documents, the qualitative research providednuanced insights into the legal and regulatory requirements and their implications for the transition to E-simcards.

*To assess network infrastructure and other technical prerequisites for the introduction of E-simcard*

* Qualitative research enabled a comprehensive exploration of the network infrastructure and technical requirements necessary for the successful introduction of E-simcards.
* Through interviews with telecommunications experts, network operators, and technology providers, the qualitative research was used to gather detailed information on the current infrastructure, its compatibility with E-simcards, and any required modifications or upgrades.
* It allowed for a deeper understanding of technical challenges, potential barriers, and feasible solutions related to network infrastructure and technical prerequisites.

*To evaluate a reliable mechanism for provisioning that allows users to activate and manage s in IoT platforms*

* Qualitative research was particularly well-suited for evaluating and understanding user experiences, perspectives, and preferences.
* Through interviews, focus groups, or user observations, qualitative research was used to gather rich insights into users' experiences with provisioning mechanisms in IoT platforms.
* It allowed for exploring user satisfaction, challenges, and recommendations regarding the reliability, ease of use, and effectiveness of existing e-SIM provisioning mechanisms.
* Qualitative research also captured contextual factors and individual perspectives that influenced user acceptance and adoption of e-SIM provisioning mechanisms.

The nature of the research questions in our study required an in-depth exploration of the experiences, perspectives, and contexts of key stakeholders involved in E-simcard transition. A qualitative research design provided the flexibility to gather rich and detailed data, enabling a comprehensive understanding of the legal and regulatory pre-requisites, network infrastructure and technical prerequisites, and user experiences with e-SIM provisioning mechanisms.

## DATA COLLECTION METHODS

PRIMARY DATA COLLECTION

**INTERVIEWS**

This was valuable qualitative data collection method that allowed for in-depth exploration and understanding of the perspectives, experiences, and insights of key stakeholders

Here are some of the key considerations and details used

|  |  |
| --- | --- |
| **STEP** | **DESCRIPTION** |
| Determining the key stakeholders | Identification of individuals or groups with relevant knowledge or expertise related to the research topic. |
| Selection of interview type | We Choose the appropriate interview type: structured. |
| Developing interview guide | We created a set of questions that aligned with the research objectives and encouraged detailed responses. |
| Piloting the interview guide | Tested the interview guide with a small sample to ensure clarity and relevance of the questions. |
| Determining sampling strategy | Decided on the sampling approach to select participants who provided valuable insights and perspectives. |
| Conducting interviews with participants | Scheduled and conducted interviews with the selected stakeholders, using the chosen interview type. |
| Establishing rapport and obtaining consent | Built a rapport with participants, explained the purpose of the study, and obtained their informed consent. |
| Following interview guide | Asked the interview questions, allowing participants to share their perspectives, experiences, and insights. |
| Taking detailed notes or record interviews | Document the responses through detailed note-taking or recording, ensuring accuracy and capturing key information. |
| End of Interviews | Conclude the data collection process after conducting all the planned interviews. |
| Transcribe or review interview recordings | Transcribe the recorded interviews or review the notes taken during the interviews for further analysis. |
| Perform thematic analysis | Analyze the interview data to identify recurring themes, patterns, and key insights. |
| Extract quotes and examples for support | Select quotes or examples from the interviews that illustrate and support the analysis and findings. |
| Present findings in the report | Incorporate the interview findings into the research report, presenting them in a coherent and informative manner. |
| End | Completion of the data collection and analysis process. |

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# CHAPTER 4 : RESULTS AND DISCUSSIONS

## RESULTS

This chapter presents the findings and analysis of the research project on assessing Uganda's preparedness for embedded SIM card evolution. It aims to provide a comprehensive overview of the data collected, analyze the results, and engage in a detailed discussion of the key findings. The research objectives, research questions, and methodology adopted in the study have guided the analysis, ensuring alignment with the research's purpose. This chapter delves into the outcomes of the research, highlighting important insights and implications for Uganda's telecommunications industry.

**KEY FINDINGS**

1. Legal and Regulatory Pre-requisites: The research findings indicate that the current legal and regulatory frameworks in Uganda require revisions and updates to effectively accommodate the introduction of embedded SIM card technology. Key recommendations include the development of specific provisions addressing adoption, ensuring compliance with international standards, and fostering an enabling environment for innovation and competition.
2. Network Infrastructure Readiness: The analysis reveals that Uganda's mobile telecommunications infrastructure shows promising readiness for supporting embedded SIM cards. However, certain areas require improvement, including network capacity, coverage, and reliability. Recommendations include targeted infrastructure upgrades, increased investments, and collaboration between telecommunication operators and infrastructure providers to ensure optimal performance and seamless integration.
3. Mechanisms for Provisioning: The research findings highlight the need for establishing reliable mechanisms for provisioning that allow users to activate and manage their s effectively, particularly in the context of IoT platforms. In Pre-Configured Token, operators get profiles pre-provisioned on the SM-DP+, associated QR codes, PIN (personal identification number) and PUK (personal unblocking number) pre-printed on paper or plastic cards. Each card (or more precisely QR code) is pre-linked to a downloadable profile on SM-DP+ and is made available in operators’ sales stores. With the purchase process, those profiles get associated to MSISDNs in a way that’s quite similar to what’s happening now with physical SIMs; the voucher is given to the customer who connects the device to internet–typically through WiFi- and proceeds with installation by scanning the QR code. In this technique, the three ES2+ interface commands (Download\_Order, Confirm\_Order and Release\_Profile) are effectively preexecuted locally on the SM-DP+ in an offline mode prior to issuing the QR codes. This way does not necessarily need integration between the operator’s fulfillment system and SM-DP+, does not need major changes to existing processes, and can work with the standard capabilities of any enabled device; therefore, it presents the fastest way for MNOs and MVNOs to launch the service. It has the drawbacks of not being that digital as it does maintain the existing SIM logistics practice including paper work and distribution.

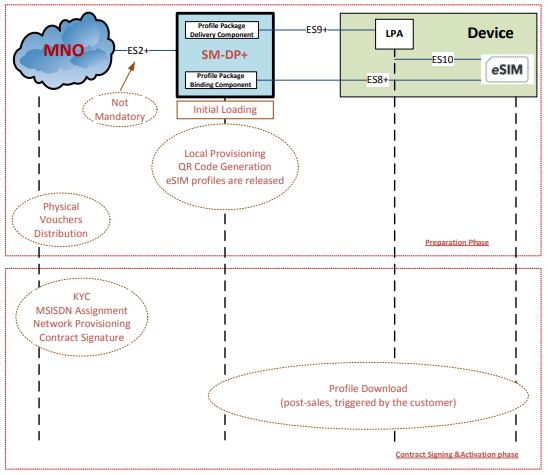


Figure Pre-Configured Token

1. Consumer Acceptance and Awareness: The research findings shed light on the level of awareness and acceptance of embedded SIM cards among Ugandan consumers and businesses. It is observed that while awareness levels are relatively low, there is potential for adoption with proper education and awareness campaigns. Recommendations include targeted consumer education initiatives, comprehensive awareness campaigns, and user-friendly interfaces to promote the benefits and convenience of technology.
2. Collaboration and Industry Standards: The analysis emphasizes the importance of collaboration among telecom operators, regulatory bodies, device manufacturers, and technology providers to establish industry standards and best practices

**DISCUSSIONS**

1. Legal and Regulatory Implications: The discussion reveals that the current legal and regulatory framework in Uganda poses certain challenges for the smooth adoption of embedded SIM card technology. Key findings suggest the need for revisions to address issues such as data protection, privacy concerns, and interoperability standards. Recommendations include the development of specific guidelines and regulations that promote transparency, security, and collaboration among telecommunication operators, regulatory bodies, and other stakeholders.
2. Infrastructure and Technical Considerations: The analysis highlights the importance of robust network infrastructure to support the introduction of embedded SIM cards. Findings indicate that while Uganda's telecommunications infrastructure shows promise, certain areas require attention, such as network capacity and coverage in rural areas. It is recommended that telecommunication operators invest in infrastructure upgrades, including expanding network coverage, enhancing data speeds, and ensuring network reliability to meet the increasing demands of technology.
3. Consumer Perception and Adoption: The discussion identifies consumer awareness and acceptance as crucial factors for the successful implementation of embedded SIM cards. Key findings indicate a relatively low level of awareness among Ugandan consumers regarding technology. However, there is a positive perception of the benefits associated with s, including flexibility and convenience. To drive adoption, recommendations include comprehensive consumer education campaigns, focused on highlighting the advantages of s, addressing concerns, and providing step-by-step guidance on activation and management.
4. Industry Collaboration and Standards: The analysis emphasizes the importance of industry collaboration in establishing standards and best practices for the implementation of embedded SIM card technology. Findings suggest the need for telecommunication operators, device manufacturers, and technology providers to work together to ensure interoperability, compatibility, and seamless user experiences across different devices and platforms.
5. Challenges and Opportunities: The discussion highlights various challenges that may arise during the transition to embedded SIM cards, including infrastructure constraints, regulatory complexities, and consumer adoption barriers. However, it also presents opportunities for the telecommunications industry, such as improved customer experiences, new revenue streams, and enhanced competitiveness. Key findings suggest that addressing the identified challenges through collaborative efforts and proactive measures can unlock the potential benefits of embedded SIM cards in Uganda

# CHAPTER 5 : CONCLUSIONS AND RECOMMENDATIONS

## CONCLUSION

* By evaluating Uganda's existing regulatory frameworks and policies, this research project identified areas where modifications and enhancements are needed to facilitate the smooth transition to embedded SIM card technology. It became evident that aligning the regulatory environment with technological advancements is crucial to foster innovation, protect user interests, and ensure a competitive telecommunications landscape.
* The evaluation of Uganda's mobile telecommunications infrastructure revealed both strengths and areas requiring improvement. The analysis emphasized the need for robust network infrastructure capable of supporting the increased demands associated with embedded SIM card technology. Additionally, considerations were made for reliable provisioning mechanisms and integration with emerging technologies like the Internet of Things (IoT).
* The research project also investigated consumer and industry perspectives, shedding light on the level of awareness and acceptance of embedded SIM cards among Ugandan consumers and businesses. Understanding their preferences, concerns, and expectations is essential for developing targeted strategies to promote adoption and address potential barriers. It was evident that comprehensive education and awareness campaigns, along with providing user-friendly interfaces and seamless experiences, are key to fostering trust and widespread adoption.
* The literature review provided a solid foundation by examining the global adoption and trends of embedded SIM cards, showcasing successful case studies from various regions. This review highlighted the potential advantages of embedded SIM card technology, such as enhanced security, flexibility, and scalability. However, it also underscored the challenges related to regulatory compliance, infrastructure upgrades, and consumer acceptance.
* In conclusion Airtel Uganda's recent launch of services in May 2023 signifies a remarkable milestone in Uganda's journey towards embracing embedded SIM card technology. This strategic move by Airtel Uganda showcases their commitment to innovation and meeting the changing needs of consumers. The introduction of s provides customers with the convenience of remotely activating and managing their mobile connections, eliminating the requirement for physical SIM cards. This development aligns with the research project's findings, highlighting the potential advantages of embedded SIM cards. Airtel Uganda's initiative sets a positive precedent for other telecom operators in Uganda to adopt technology, driving further industry innovation and enhancing the overall telecommunications landscape in the country

## RECOMMENDATIONS

* The implementation of technology in Uganda should be supported by a clear regulatory framework that outlines policies and regulations. This will ensure that the technology is deployed in a manner that benefits all stakeholders, including consumers, telecom operators, and the government.
* Consider the scalability and flexibility of the Pre-Configured Token architecture to accommodate future growth and changes in your IoT platform and application.
* Digitize the KYC to eliminate existing SIM logistics

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