Eighth SG13 Regional Workshop on "Standardization and Future Networks: Opportunities for Africa Beyond 2020"

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Applications for future networks in emerging markets.

Guda Blessed gudablessed@gmail.com
Abdullahi Sani Shuaibu sanishuaibsp@gmail.com
Ibrahim Aliyu ibal2010@yahoo.com
Mohammed mohammed Pinto_ditto@Yahoo.com
Emmanuel Othniel Eggah Emmanueleggah@gmail.com
Ibrahim Muhammad muhammadulimaj@gmail.com

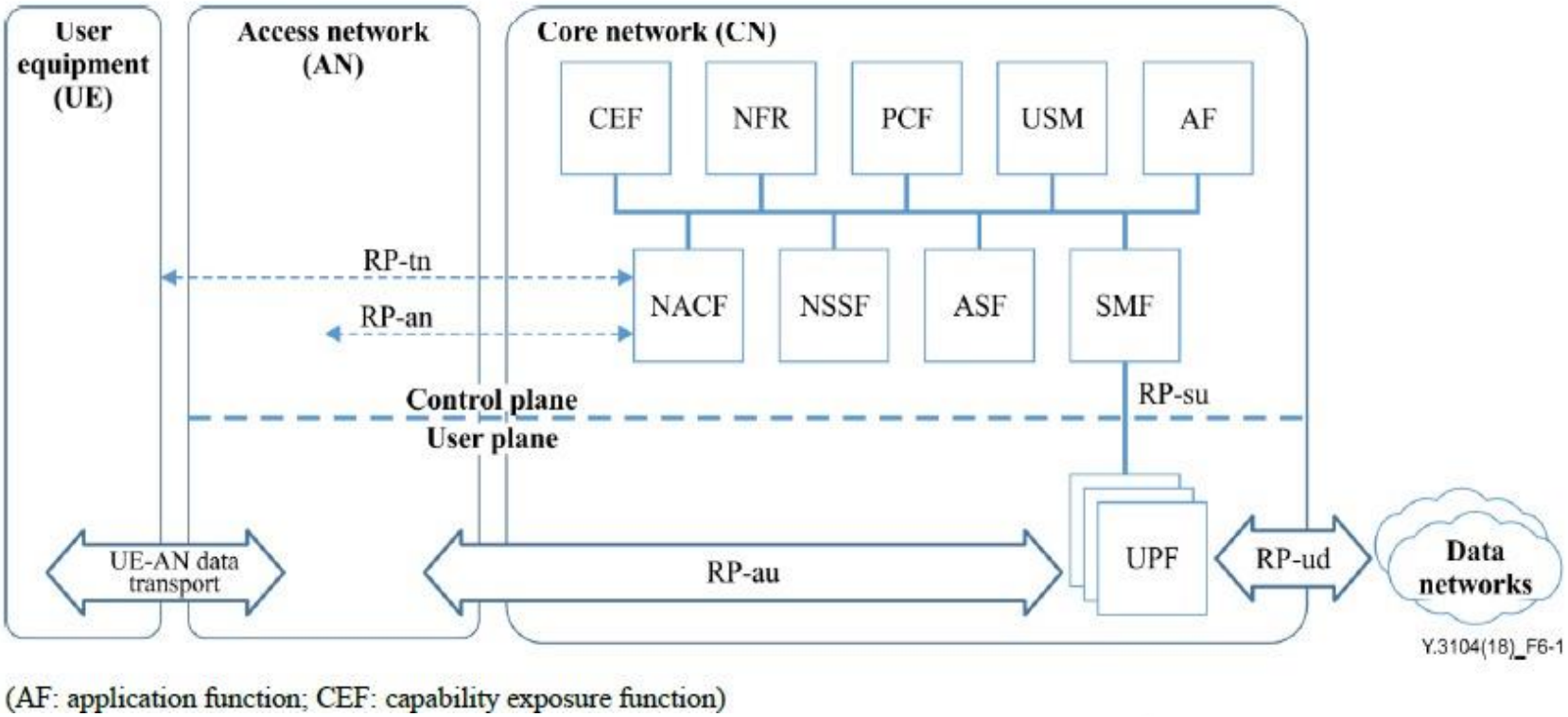
This work is done under the guidance of:
Dr James Agajo james.agajo@futminna.edu.ng
Vishnu Ram vishnu.n@ieee.org

Federal University of Technology Minna, Nigeria.

Introduction

- Three applications for future networks are to be discussed
  - Pandemic Tracing Application
  - AI-Based ClassRoom
  - Wazobia open speech

Background - IMT-2020 Architecture



(AF: application function; CEF: capability exposure function)

Figure from ITU-T Y.3104

Pandemic Tracing Application

- Effective contact tracing is very important in reducing the spread of Covid-19. (WHO)
- The manual approaches are dependent on the memory of the people involved.
- Mobile applications based on Bluetooth proximity and/or GPS locations have been developed.

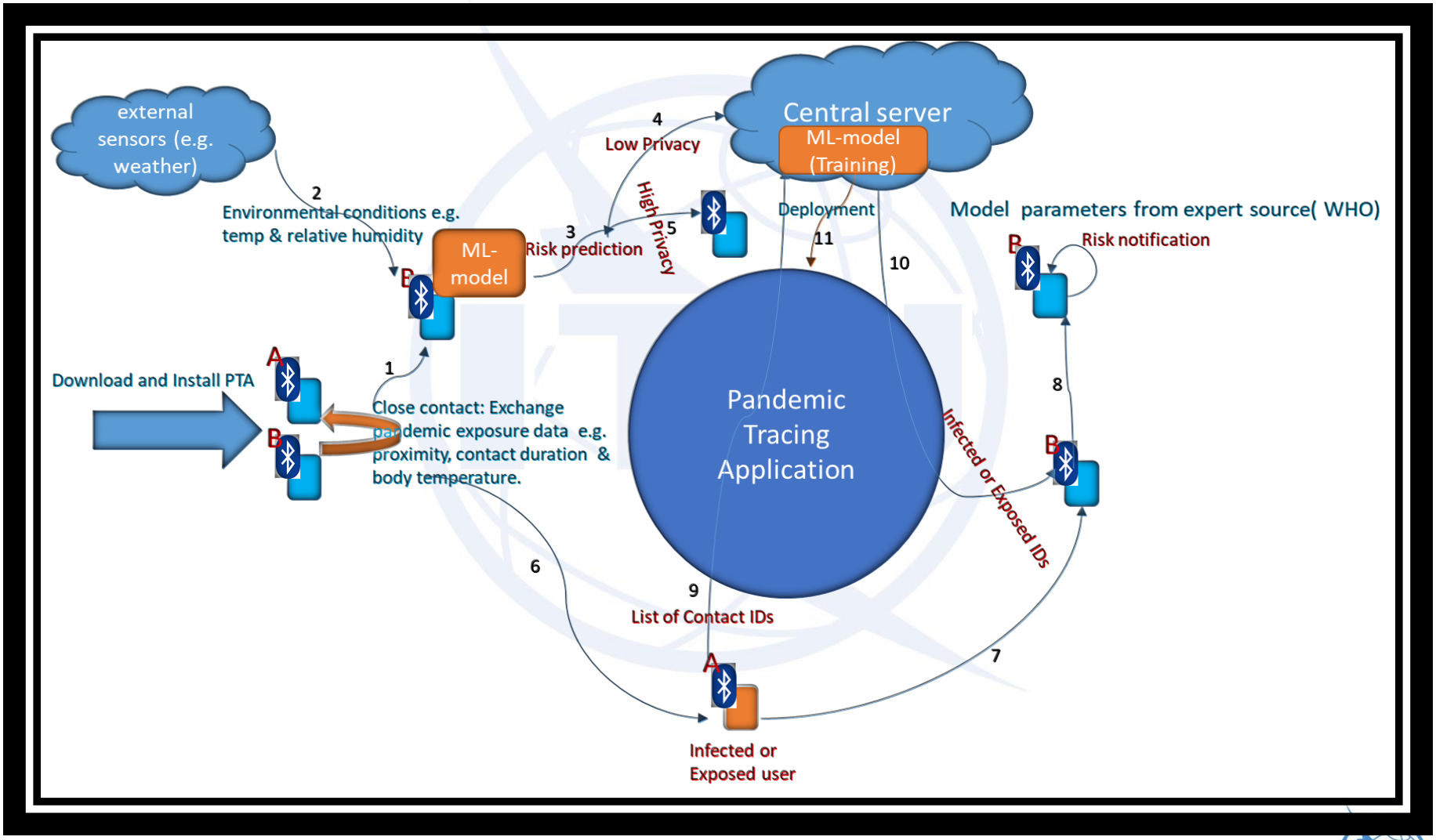
Contact tracing apps and challenges

Name of App	Approach	Limitations
TraceTogether [Singapore]	Centralized	1. Only about one-fifth of the population are using the app. 2. Large number of false positives.
Aarogya Setu [India]	Centralized	1. Large number of false positives. 2. Lots of citizens (Indians) are worried about violation of their privacy [location data is used]. 3. High battery consumption
Covid Watch [Australia]	deCentralized	1 Large number of false positives—general problem with Bluetooth solutions. 2 Not yet deployed.
GH COVID-19 TRACKER [Ghana]	Centralized	1. The app has no means to trace contacts, It is just a static form. 2. A lot of private information is collected from the users and stored with the ministry of health.5 It is difficult if not impossible for a user to know whether or not a person he/she has come in contact with is a covid-19 suspect or had been infected.

Guiding principles for Pandemic Tracing Application

- **PRINCIPLE-001:** The framework for tracing will be generic, but flexible enough with configurable parameters (which are monitored for tracing) to accommodate future pandemics.
- **PRINCIPLE-002:** The framework for tracing will be reuse any relevant aspects from existing global frameworks but customize for application in Nigeria and other emerging countries.
- **PRINCIPLE-003:** The framework for tracing will be open and will be reviewed with experts in ITU and WHO.
- **PRINCIPLE-004:** The framework for tracing will be flexible to allow different implementation options using smart phones, wearables, sensors and other kinds of tracking devices.
- **PRINCIPLE-005:** The framework for tracing will provide value-added features like risk detection, information and awareness about valid management mechanisms for the pandemic.
- **PRINCIPLE-006:** The framework for tracing will be designed with privacy preserving mechanisms as a core requirement.

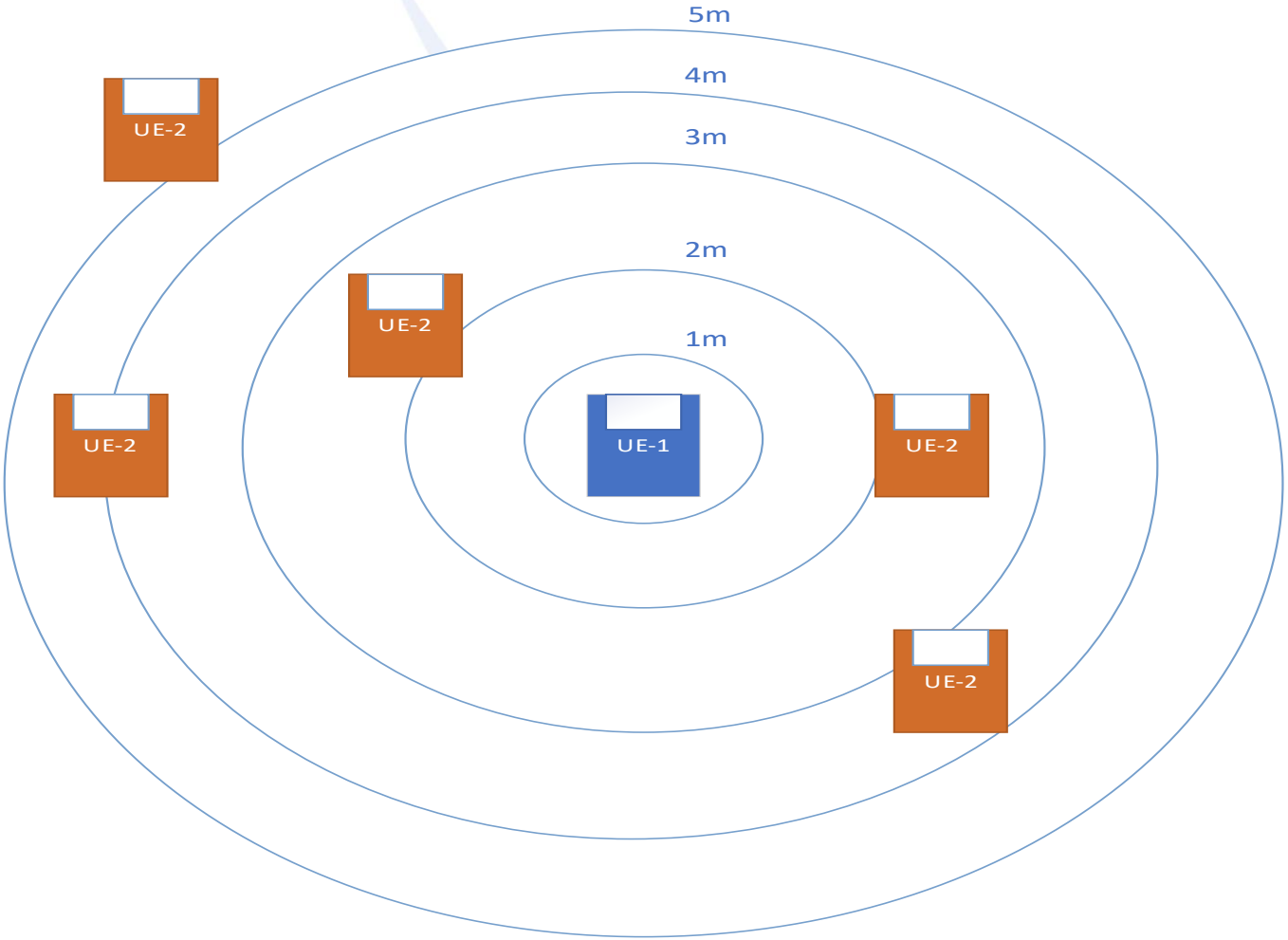
Pandemic Tracing Application



PoC: AI- Bluetooth based Contact Detection [Distance Estimation]

Feature	Data Collected
Environment Setting	Ambient light intensity
Proximity between contacts	Bluetooth RSSI
Density of people	Count of number discovered wifi/bluetooth interference signal.
Bluetooth RSSI variations	OS version UE model Battery Charging status Battery temperature Orientation of device CPU utilization over the past 40s orientation of device (pitch, azimuth and roll)
Label	Ground truth distance (1-5m)

PoC: Data Collection Setup



AI- Bluetooth based Contact Detection

- A total of 272 samples were collected in Ngeria.
- ANN and SVM distance prediction models were trained on the data.
- Link to Dataset, Codes and Benchmark Results: https://github.com/gblessed/covid-19-bluetooth-distance-estimator

References

- Jason, B., Joel, K., Alvin, T., Chai, S. H., Lai, Y., Janice, T., & Tang, A. Q. (2020, May 1). *BlueTrace: A privacy-preserving protocol for community-driven contact tracing across borders.* Retrieved from BlueTrace: https://bluetrace.io/static/bluetrace_whitepaper-938063656596c104632def383eb33b3c.pdf
- [Covid Watch] https://covid-watch.org/
- https://gdprhub.eu/index.php?title=Projects_using_personal_data_to_combat_SARS-CoV-2

AI-Based Class Room

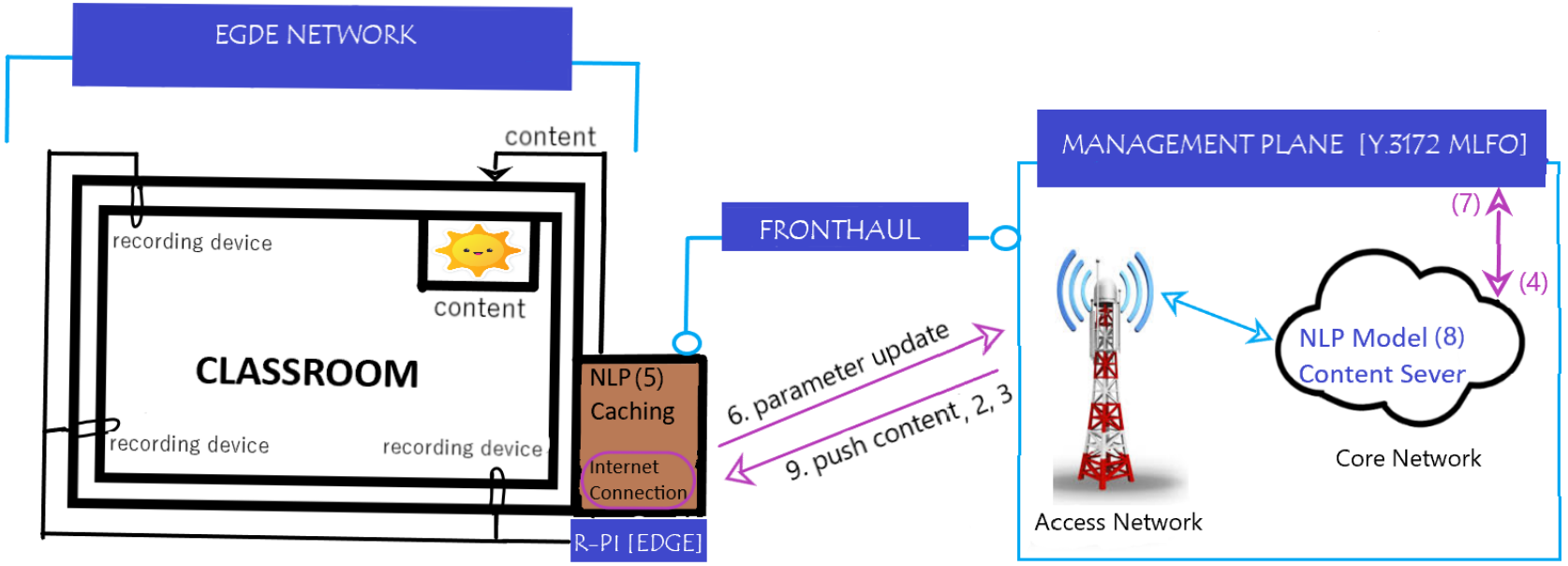
AI based classroom is a smart classroom that leverages the power of ML to facilitate the learning process for younger pupils.

AI-Based Class Room Contd

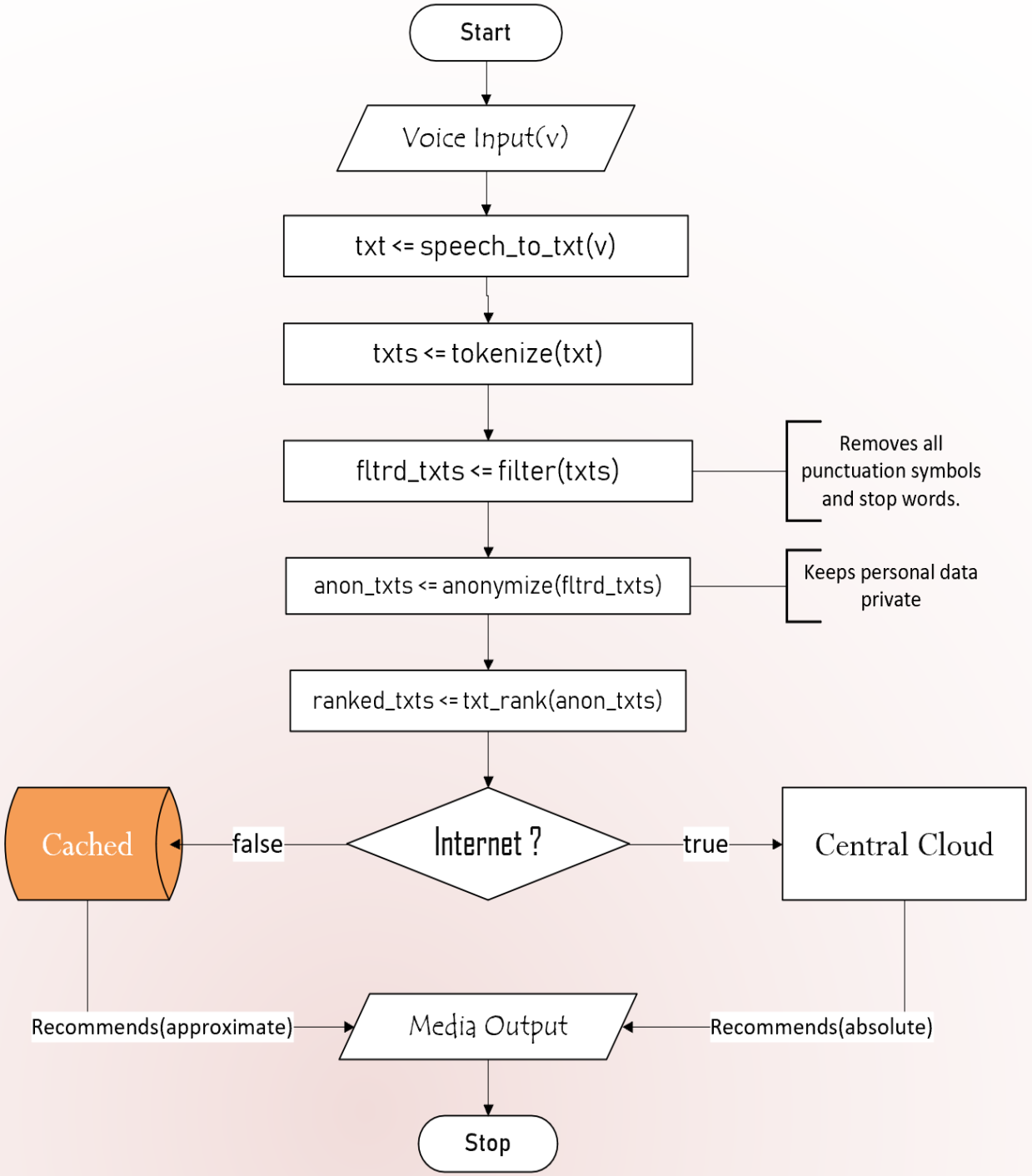
It consists of the following:

- Data collection – Listening devices, record pupils & teacher.
- Data processing – NLP model processes voices at the edge.
- Distributed ML – Periodic reports sent to the cc while keeping personal data private.
- Content output – CC recommends appropriate media based on model predictions.

AI-Class Overview



AI-C Flow Chart



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- Veton, K., & Gamal, B. (2017). Comparing Speech Recognition Systems (Microsoft API, Google. *International Journal of Engineering Research and Application*, 20-24.
- Guangming, L., Yule, X., Jiamei, W., & Zhenling, Y. (2016). Research on Text Classification Based on TextRank. *International Conference on Communications, Information Management and Network Security*.

Link to video

https://mega.nz/#!EQBkTKjA!XgmcH6RJQjZKr9P3maWNhC3zqQ7hntLQr2YBw5fDTo

Open Problems And Suggestions

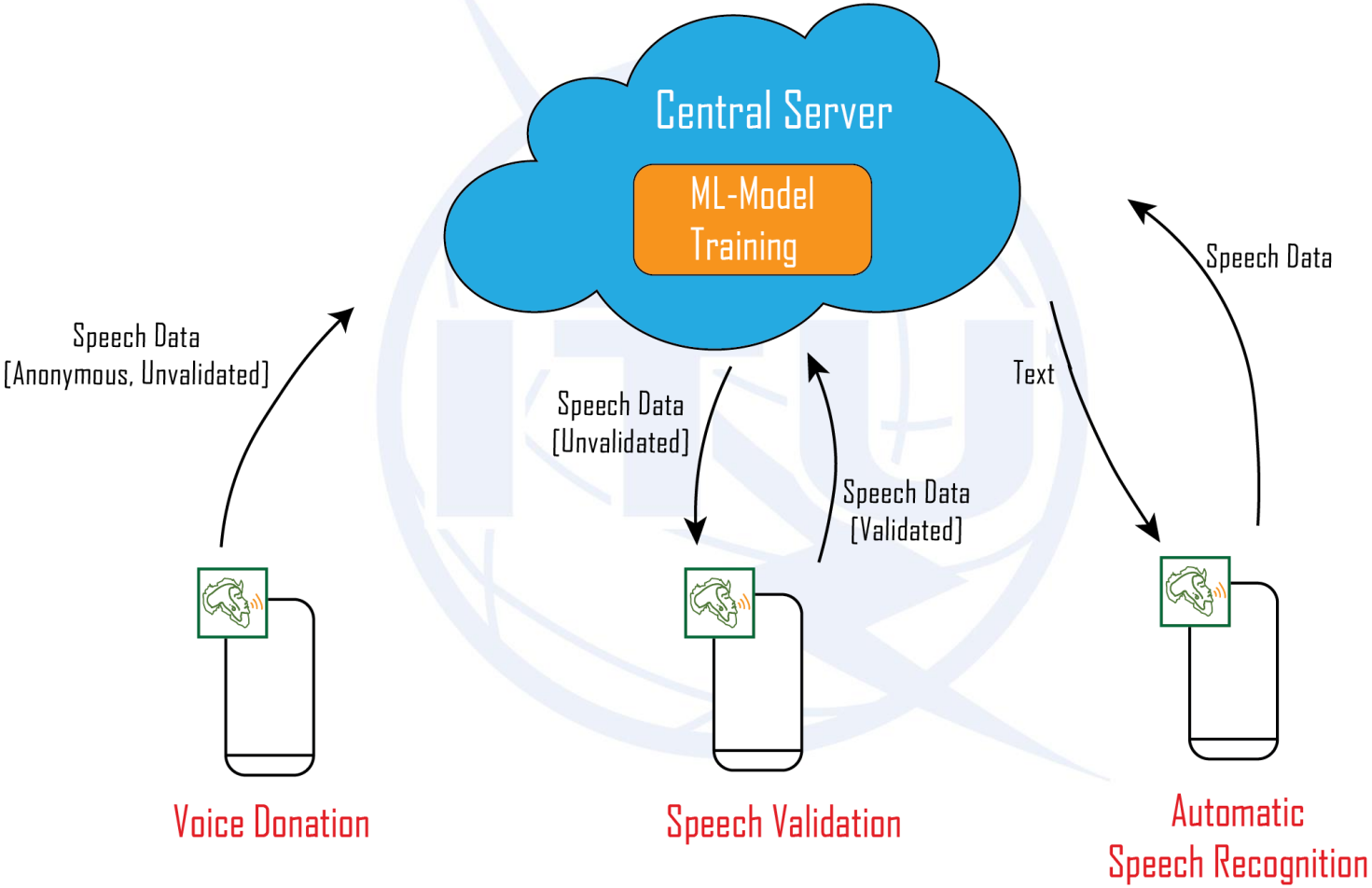
Problems

- For confidentiality speech recognition should be done locally.
- The Carnegie Mellon University, CMUsphinx offline Speech Recongition engine performs poorly on Africans accents.
- This has led us to building Wazobia Open Speech.

Wazobia open speech

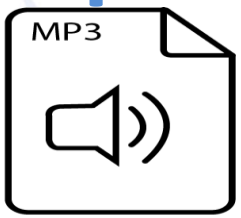
Wazobia open speech is an automatic speech recognition system that can understand english accents spoken by native Africans. Wazobia open speech is built on top of Mozilla's DeepSpeech engine.

Wazobia open speech



Wazobia open speech (Implementation)

Audio file
(16kHz, MP3)



Segmentation

- Audio reduced into a colleaction of clips. Usually sentences
- Clips are mapped to their corresponding transcripts

DeepSpeech
ASR Engine

- Pre-existing acoustic model and decoder
- Simple API
- Offers performance optimization

Training → Model

Speech Input

Text Output

Wazobia open speech

- Hours of audio collected: 3.58
- Female donors: 37%
- Male donors: 63%

Links to Implementation

- Link to Dataset, Codes and Benchmark Results: https://github.com/Heatwave114/wazobia-open-speech
- Link to Android Data collection application: https://play.google.com/store/apps/details?id=com.fgml5g.wazobia

Acknowledgements

We would love to express immense gratitude to our teacher and HOD Dr James Agajo for his relentless mentorship as well as for introducing us to ITU Contributing under ITU student project has drastically increased us in practical knowledge that pertains to our course of study and has also improved our research skills in general.

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Thank you for listening