Your Connection to ICT Research

Towards an On-board Personal Data Mining Framework For P4 Medicine

Dr. Mohamed Boukhebouze

Deputy Department Manager, CETIC

European Data Forum 2015, November 16-17
Luxembourg

FEDER
UNION EUROPEENNE
Wallonie
LE FONDS EUROPEEN DE DEVELOPPEMENT REGIONAL
ET LA WALLONIE INVESTISSENT DANS VOTRE AVENIR.

Centre d'Excellence en **Technologies** de l'**Information** et de la **Communication**
www.cetic.be

Agenda

- Overview of CETIC
- On-board personal data mining framework
  - Introduction
  - Objective & Challenges
  - Architecture Overview
- Use case: Epilepsy seizure
- Discussion

Agenda

- Overview of CETIC
- On-board personal data mining framework
  - Introduction
  - Objective & Challenges
  - Architecture Overview
- Use case: Epilepsy seizure
- Discussion

CETIC - Overview

cetic
Your Connection to ICT Research

Created in 2001	• Accredited Research Centre • ~40 researchers in 3 departments
Mission	• Applied Research at EU and Regional level • Technology Transfert Agent to (inter-)Regional Industry
Serving Industry	• SotA/Techno Evaluation and Coaching (HW/SW) • Trusted Third Party • Connect Industry to latest research results
International Involment	• EU: FP7 - H2020– Coordinator and Participants • EraNets and Interreg • Regional Research project (Plan Marshall 2.vert)
Regional Funding for Contract Research	• « Technological Checks » • Feasibility Studies • R&D 1-1 Projects

CETIC expertises

cetic
Your Connection to ICT Research

PROCESS & PRODUCT QUALITY

OPTIMISATION
MODELLING
SECURITY

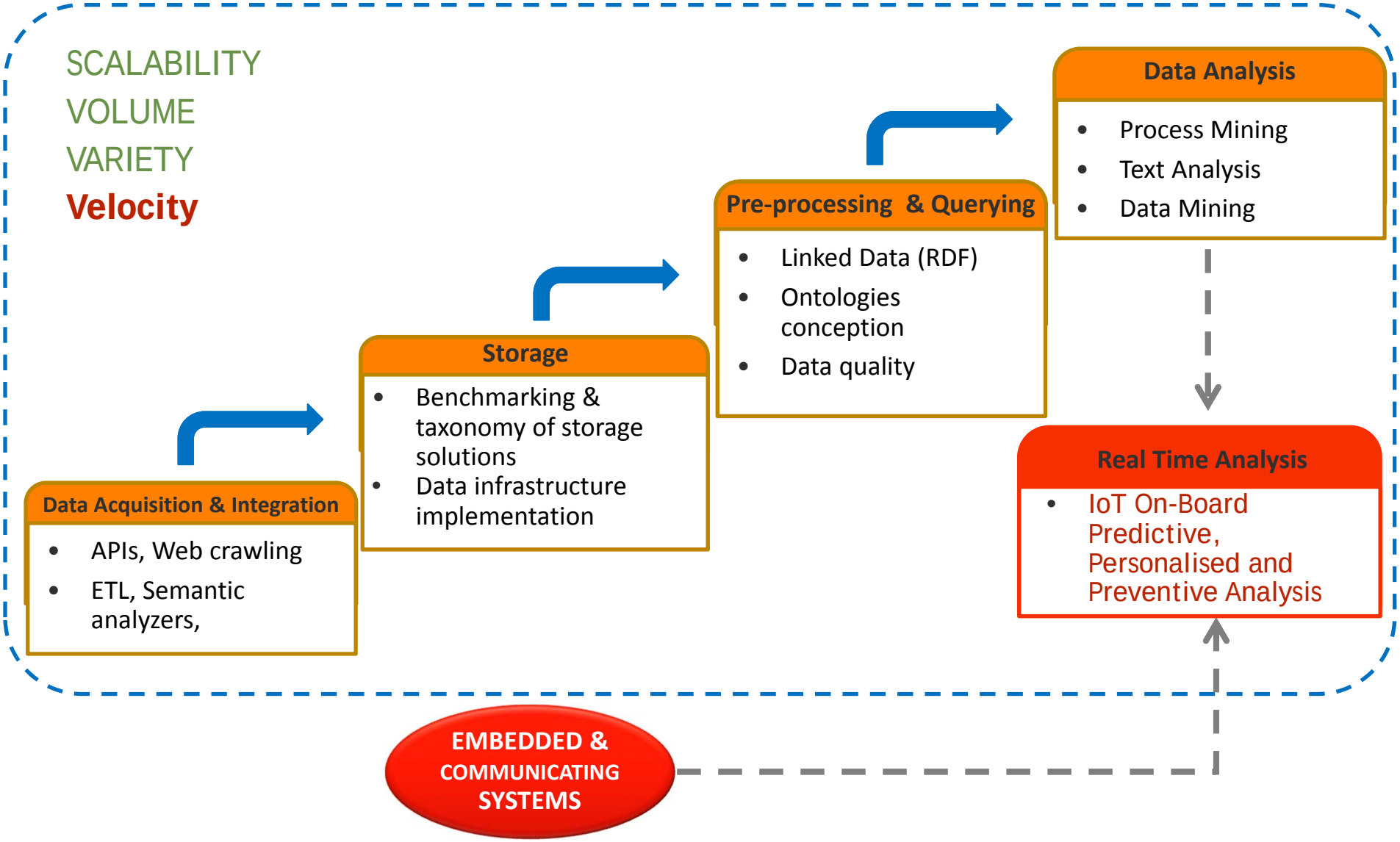
FUTURE INTERNET

CLOUD COMPUTING
SEMANTIC WEB
BIG DATA
OPEN SOURCE & OPEN DATA

INTERNET OF THINGS

PROGRAMMABLE SYSTEMS
SMART OBJECTS
WIRELESS SENSOR NETWORK

CETIC Experience in Big Data



Agenda

- Overview of CETIC
- On-board personal data mining framework
  - Introduction
  - Objective & Challenges
  - Architecture Overview
- Use case: Epilepsy seizure
- Discussion

On-board data mining framework: Introduction

- Wearable devices can play a major role in the ubiquitous collection of a large subset of personal data
  - Physiological sensors (e.g. EEG, ECG),
  - Environmental sensors (e.g. temperature monitor),
  - Location sensors (e.g. GPS)
- Wearable devices are used as interface of data mining algorithms
  - Execution on a high performance computational facility (remote processing)
    - Like: a cloud-based infrastructure
- Issue
  - In several scenarios, ubiquitous and offline data stream mining is required
    - So that, a continuous monitoring and real-time processing can be done

→ Use wearable devices not only to collect personal data, but also to on-board execute the personal data mining algorithms (local processing)

On-board data mining framework: Objective

- Development of an on-board personal data-mining framework for P4 medicine:
  - **Prediction**
    - Predicting the risk of developing diseases or faintness
  - **Prevention (Prescription)**
    - Providing recommendations that help to avoid or reduce the risk of developing certain diseases or faintness
  - **Personalisation**
    - Personalising the prediction and prevention recommendation by taking into account the patient's context
  - **Participation**
    - Participation of the patients in the learning and tuning of the prediction and prevention models by providing feedback about issued notifications and recommendations.

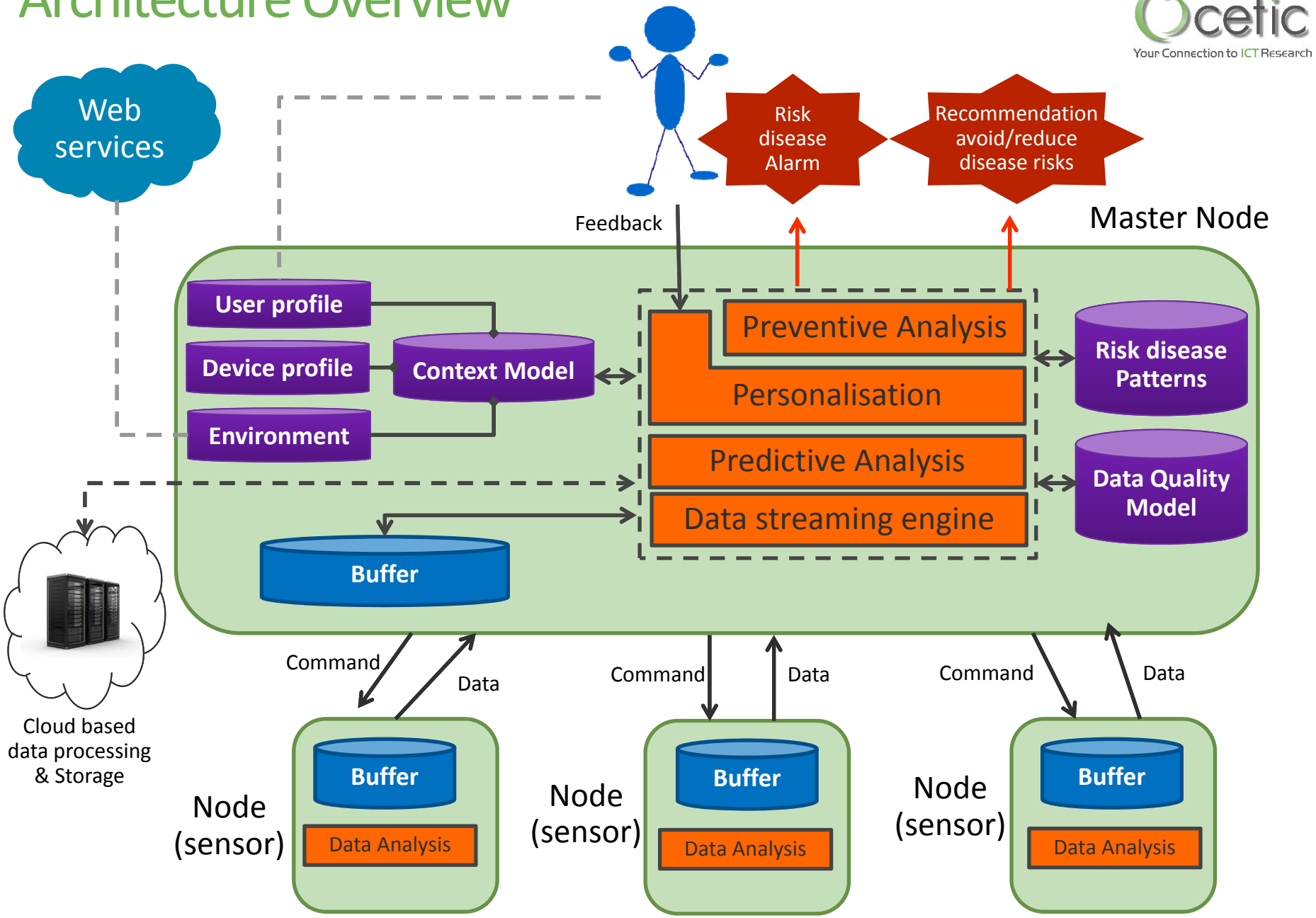
On-board data mining framework: Challenges

- **Resources limitation**
  - Wearable devices are limited in terms of computational power, energy consumption, storage / memory capacities and bandwidth
- **Context and resources changes**
  - The ubiquitous data stream mining is faced with the problem of patient situation changes and devices disconnection
- **Data quality**
  - Despite the fact that current sensors are becoming more sophisticated, accuracy of gathered data is not always ensured

On-board data mining framework: Solutions

- The framework deals with on-board processing challenges by combining three approaches:
  - **A distributed data mining approach**
    - Execute data mining algorithms concurrently over the devices network
  - **A context-aware and resource-aware adaptation approach**
    - Detect changes of user situation or devices and adjust automatically parameters of data mining algorithms
    - Adjust dynamically load distribution of the data mining algorithms based on resources availability
  - **A probabilistic data mining approach**
    - Compute the data variation and uncertainty based on a data quality model
    - Define a mechanism that allows marking the data as "uncertain" to prevent its further analytical usage

Architecture Overview



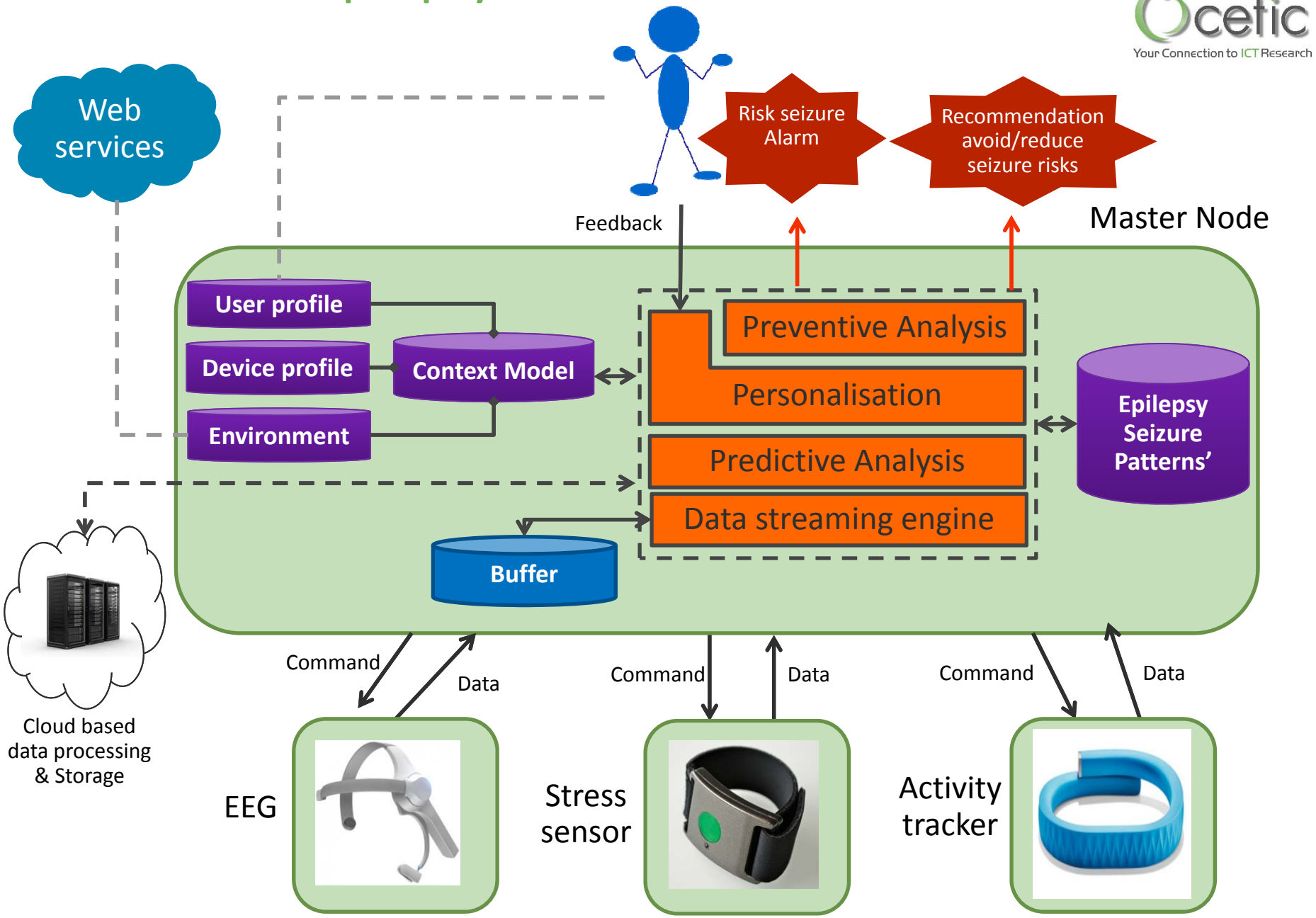
Agenda

- Overview of CETIC
- On-board personal data mining framework
  - Introduction
  - Objective & Challenges
  - Architecture Overview
- Use case: Epilepsy seizure
- Discussion

Use Cases: Refractory Epilepsy (Introduction)

- The refractory epilepsy patients do not respond to conventional treatments (30% of all patients)
  - It has a strong impact on quality of life since the seizures are random and not controlled with medications
- The proposed framework can be used to continuously monitor refractory epilepsy patients:
  - Early predicting seizures based on the patterns that are developed by our partner ULB, Belgium
  - Refining the prediction pattern based on the context of the patient
  - Providing context-aware based recommendations to avoid the seizures risk by analysing the factors that favour their appearance (e.g. stress level)

Architecture: Epilepsy Seizure Use Case

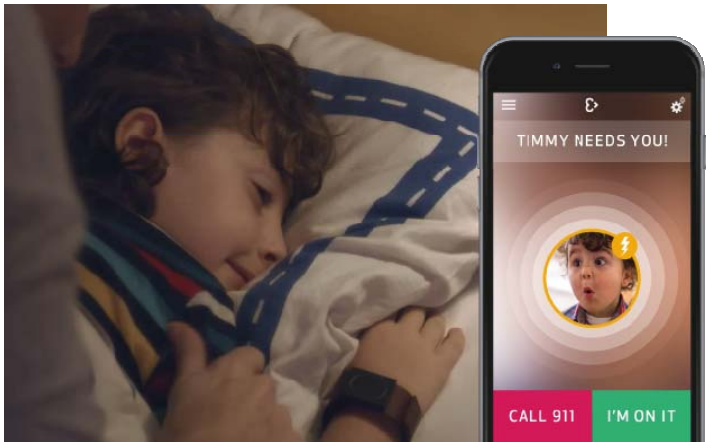


Use Cases: Refractory Epilepsy (Related Work)

- Embrace Watch (from Empatica, Italy)
  - Seizure monitoring (detection and notification)
  - Activity Tracking
  - Stress Management
  - Sleep Monitoring

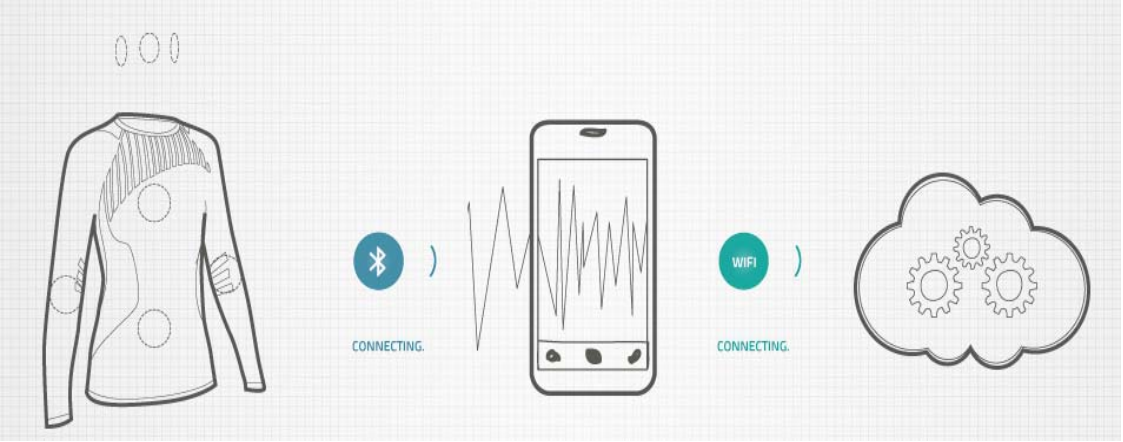
Weakness

- No seizure prediction
- No seizure prevention



Use Cases: Refractory Epilepsy (Related Work)

- BioSerenity



Weakness

- No seizure prediction
- No seizure prevention

Use Cases: Refractory Epilepsy (Related Work)

- NeuroPro (Swiss-based medical technology company)
  - Development of user-friendly and wireless EEG headset
  - The EEG data is then processed in real-time in a server
  - A mobile application can report and alert the user with the results in real-time

<u>Weakness</u>

- No seizure prevention

Agenda

- Overview of CETIC
- On-board personal data mining framework
  - Introduction
  - Objective & Challenges
  - Architecture Overview
- Use case: Epilepsy seizure
- Discussion

Discussion

- The proposed framework can be applied in many others uses cases
  - e.g. Heart attack, Human Falls, …
- The collected data can be used to improve the disease patterns as well as the healing treatment
- Open issues
  - What about acceptance of the wearable devices by the patients?
  - What about precision of the disease patterns?
  - What about data privacy?

Your Connection to ICT Research

Aéropole de Charleroi-Gosselies

Bâtiment Éole

Rue des Frères Wright, 29/3

B-6041 Charleroi

Tel: +32.71.490.700

Fax: +32.71.490.799

www.cetic.be

info@cetic.be

linkedin.com/company/cetic

twitter.com/@CETIC

Thank you for your attention

Dr. Mohamed Boukhebouze

Mohamed.boukhebouze@cetic.be