

**AVAILABLE
THESIS
2024/2025
CONCEPT REPLY**



B3

THESIS DESCRIPTION [B3]

“Electricity Meter”

A solution that will allow the consumption of professional and industrial machinery to be monitored using the Electricity Meter or Water meter

The candidate will work on:

- *Embedded Development to collect data and send to the cloud*
- *Cloud Development to store data*
- *Dashboard to visualize data collected*

Technologies: SW development (C, C++), C#



B3

THESIS DESCRIPTION [B3]

“EoL control driven by AI”

A solution which will allow to verify in EoL if electronic components manufactured comply with the specifications. For this purpose, AI algorithms will be created that will identify the components made correctly from those that have errors.

The candidate will work on:

- *Embedded Development on ST*

Technologies: Embedded SW development



THESIS DESCRIPTION

Torque and Speed estimation for electric motors using AI techniques

Electric motors play a crucial role in various applications, especially in industrial and transportation systems. To ensure the efficient operation of these systems, it is essential to accurately estimate the torque and speed of the electric motor.

By processing data from various sensors, AI algorithms can learn the relationship between motor inputs and outputs, providing accurate estimates of torque and speed in different conditions. The candidate will work on:

- Adapting and improving NN-based algorithms for different motors for torque and/or speed estimation*
- Contribution to the implementation/tuning of the AI neural network to create a “sensor-less sensor” capable of self-learning and estimating torque/speed*
- Create an experimental setup on a MCU from ST with Cube.AI acceleration.*

PoC Case study: Use Case: mid-size electric motor torque sensorless sensor based on STM MCU with Cube.AI

Technologies: SW development (Python), Deep Learning , embedded programming C/C++, Open CV



THESIS DESCRIPTION [B5]

“EDGE COMPUTING PLATFORM – DATA MANAGEMENT ON THE EDGE”

Concept Reply stands at the forefront of **software, firmware** development and **data manipulation**.

We are actively working on **cutting-edge projects** that shape the future of next generation industrial edge computing platform.

This thesis has the goal of

- Enhance the current microservices architecture of Concept Reply Edge Industrial Platform (CREI) by integrating cloud orchestration mechanisms (e.g. Azure IoT Edge)
- Implement new industrial protocols drivers for the newest industrial machinery
- Develop an administrative dashboard for managing the entire platform
- Build a web portal to manage data gathered by storing, filtering, aggregating, analyzing them to present data business value on dedicated market scenario web dashboards.

Technologies: Linux, Docker, Kubernetes, Golang, Rust, Reactjs, network protocols



THESIS DESCRIPTION [B5]

“IOT CYBERSECURITY ON SMART DEVICES”

Concept Reply stands at the forefront of **software** and **firmware** development for **next-gen connected devices**, with a strong emphasis on **cybersecurity**. We collaborate with **industry leaders** across diverse sectors, actively engaging in **cutting-edge projects** that shape the future.

This thesis has the goal of

- investigating the current best practices in connected devices software and hardware security, based on current research and Common Criteria
- implement these best practices in custom Linux-based operating systems, using Yocto
- secure firmware/software development and deployment
- build a web-based application (Rust and ReactJS) to automatically track and manage vulnerabilities found in the operating system or applications dependencies after deployment

Technologies: Linux, Yocto*, computer networking, ReactJS, Rust*

*: not a requirement, learn it during the thesis!



THESIS DESCRIPTION [B5]

“EDGE COMPUTING PLATFORM – AI FOR AUTOMATIC DATA MAPPING”

Concept Reply stands at the forefront of **software, firmware** development and **data manipulation**.

We are actively working on **cutting-edge projects** that shape the future of next generation industrial edge computing platform.

This thesis has the goal of automatically mapping variables read from industrial machinery (such as PLCs) by sniffing network traffic

- Analyze the state-of-the-art of AI models to choose the most suitable for the use case
- Capture network traffic of an industrial device to be used for training (starting with Siemens S7 PLCs)
- Train the model
- Develop an administrative dashboard for managing the developed tool

Technologies: AI, Industry, Linux, Docker, PLC, network protocols



THESIS DESCRIPTION [B5]

“INDUSTRIAL COMPANION USING GENERATIVE AI”

Concept Reply stands at the forefront of **software, firmware** development and **data manipulation**.

We are actively working on **cutting-edge projects** that shape the future of next generation industrial edge computing platform.

This thesis has the goal of developing a virtual Industrial Assistant (Companion) based on GenAI that will support white and blue collars in obtaining useful information about the plant

- Analyze the state-of-the-art of AI models to choose the most suitable for the use case
- Identify the most useful information needed on a typical industrial plant (e.g. efficiency, maintenance schedule, real-time data, etc.)
- Train the model for gathering and calculating the infos, developing support APIs if needed
- Develop a suitable interface to allow plant people to utilize the Companion (e.g. mobile app, vocal commands, etc.)

Technologies: AI, Industry, Linux, Docker, PLC, network protocols



THESIS DESCRIPTION [B5]

“ENHANCE MANIPULATION CAPABILITES ON ROBOTS WITH AI”

Concept Reply provides connected robotics through tailored software solutions, enhancing functionality, security, and maintainability. Our expertise lies in leveraging **digital image processing, machine learning, NVIDIA frameworks, ROS, and MoveIt** to enable robotic arms to operate in different situations.

This thesis includes:

- investigation of the state-of-the-art for robot perception and grasping use deep learning techniques
- implement, and integrate with ROS and MoveIt, a perception pipeline able to identify and locate objects to manipulate while recognizing and avoiding obstacles
- implement, and integrate with ROS and MoveIt, a grasping pipeline able to plan pick and place tasks for objects with various shapes and materials (soft, rigid...)
- evaluate the overall solution on a real robot

Technologies: ROS*, Linux, Python, C++, computer networking, Moveit*

*: not a requirement, learn it during the thesis!



THESIS DESCRIPTION [B5]

“ENSURE INDUSTRIAL SAFETY WITH ROBOTS AND AI”

Concept Reply provides connected robotics through tailored software solutions, enhancing functionality, security, and maintainability. Our expertise lies in leveraging AI, Computer Vision to enable robots to be “security agents”.

This thesis includes

- Analysis of potentially dangerous industrial scenarios (DPI presence, shelf collapse, etc.)
- investigation of the state-of-the-art solutions for the selected scenarios
- implement a software solution able to run on an edge device
- Evaluate in a real industrial scenario

Technologies: ROS*, Gazebo*, Linux, Python, computer networking, Machine learning

*: not a requirement, learn it during the thesis!



THESIS DESCRIPTION [B5]

“ENHANCE SECURITY WITH ROBOTS AND AI”

Concept Reply provides connected robotics through tailored software solutions, enhancing functionality, security, and maintainability. Our expertise lies in leveraging **AI**, Computer Vision to enable robots to be “security agents”.

This thesis includes

- investigation of the state-of-the-art for human pose estimation and action detection models
- implement a software solution using a machine learning model able to detect actions performed by a person to discriminate potentially dangerous behaviour
- Deploy this solution on a real robot for security use cases

Technologies: ROS*, Gazebo*, Linux, Python, computer networking, Machine learning

*: not a requirement, learn it during the thesis!



THESIS DESCRIPTION [B2]

“Research study on ARC-IT (Architecture for Cooperative and Intelligent Transportation -US), FRAME-S, E-FRAME (EU): current picture”

Connected vehicles platforms are reaching crucial roles for the future of the mobility: autonomous driving level 3 and beyond, power grid networks, interoperability among different car manufacturer, support of the new actors (mobility service aggregators, mobility brokers, spare parts certifiers etc.), introduction of Ai.

This thesis is intended to try to depict in a form of study what are the current available standards that research teams have been developing. Execution of the thesis includes internet research and interviews to our engineers that are currently working on these projects.

At the beginning of the thesis, the candidate will perform preliminary study for few weeks to then agree with Reply's team the specific focus and goals of the thesis. A list of possible, but not limited goals that will be decided at the beginning of the thesis are: description of current standards/study worldwide, description of used technologies, what are the key relevant projects, architectural design of key functionalities, proof of concept of key functionalities.

Candidates will earn in-deep knowledge of architectural design of IT systems for connected vehicles.

Technologies: AWS, standards connected vehicles, back-end systems, connected functionalities, communication standards



THESIS DESCRIPTION [B2]

“Enhancing Process Efficiency in Connected Vehicle Platform Development Using AI-Driven Agile SAFe Framework”

The development of connected vehicle platforms involves complex and dynamic processes, often following the Agile SAFe (Scaled Agile Framework) methodology. Despite its structured approach, engineering teams frequently face challenges in adhering to timelines, understanding technical risks, writing epics/stories, estimation, and inter-group coordination. This thesis proposes the development of an AI-driven tool to assist Scrum Masters and Product Owners in managing these challenges effectively.

Areas of target of these thesis may include but are not limited to:

Identify Process Bottlenecks, Predictive Risk Management, Automated Writing of Epics/Stories, Accurate Estimation, Real-time Monitoring and Alerts, Inter-group Coordination, Decision Support System, Validation&Verification, Release Management.

The candidate will decide based on his/her availability and interests which area or areas to focus on and the thesis will be have the goal to develop a proof-of-concept of those focus areas. It is expected to start with a literature study that can be thought also as an independent activity for process improvement experts to pass then to a creation of Ai models (may include NLP) that requires technical knowledge also.

Candidates will earn in-deep knowledge of software development process improvements through utilization of AI.

Technologies: AI, Machine Learning, NLP, Agile SAFe, Project Management Tools, Data Analytics



THESIS DESCRIPTION [B2]

“Automated Generation of Comprehensive Project Documentation for Connected Vehicle Using AI-Powered Cloud Bot”

Manual project documentation for connected vehicle is a critical yet often neglected task, leading to inconsistent, incomplete, and outdated documentation. This results in reduced maintainability and transparency of projects. The need for a scalable solution that ensures accurate, consistent, and up-to-date documentation is paramount.

The candidate will develop a cloud-based bot leveraging artificial intelligence to automatically generate comprehensive project documentation directly from the source code. The main goal is to have a functional prototype of the chatbot capable of generating accurate and up-to-date project documentation and have a modular solution applicable to multiple projects.

Candidate will earn experience and knowledge of sw development processes and creation of AI based products

Technologies: AI, Java, Python, Cloud, AWS, Machine Learning



THESIS DESCRIPTION [B2]

“Tracking and Certifying Sustainable Connected Components for connected vehicles in Automotive Supply Chains with Catena-X”

The automotive industry faces increasing pressure to reduce its environmental impact. This requires a shift towards sustainable connected components and materials throughout the complex supply chain. However, ensuring the authenticity and traceability of these sustainable elements remains a challenge. This thesis proposes a system for tracking and certifying sustainable connected components within the automotive supply chain using Catena-X, a secure and standardized data exchange platform.

This thesis may include, depending on the candidate’s availability and interest, part or all of:

- Analyze existing sustainability certification schemes for automotive connected components and materials.
- Identify the data requirements for tracking and certifying sustainable components throughout the supply chain.
- Explore the capabilities of Catena-X for secure and transparent data exchange in the context of sustainable materials, understand inter-operability among different standards and platforms.
- Design a system architecture for tracking and certifying sustainable components using Catena-X.
- Evaluate the system's effectiveness and address potential challenges related to implementation and adoption.

Technologies: Back-end architecture, microservices, communication technologies, data storage and analysis



THESIS DESCRIPTION [B2]

“Predictive Diagnosis of Issues in Stateless Backend Systems for Connected Vehicles using Cloud Architectures”

Connected vehicles represent a rapidly evolving technology with a significant impact on the automotive industry. These vehicles collect and generate vast amounts of data that necessitate reliable and scalable backend systems for processing and analysis, with large message systems IT management tools. Predictive diagnostics can play an important role in ensuring the availability and efficiency of these systems, preventing outages, and enhancing user experience.

The objective of this thesis is to develop and implement a cloud architecture for predictive diagnosis of issues in stateless backend systems that may include sequential/non sequential and also loosely coupled processes for connected vehicles functionalities. The thesis will focus on identifying potential problems, collecting and analyzing data, and creating predictive models to prevent malfunctions.

1. Literature Research and Problem Definition: Review existing literature on connected vehicles, stateless backend systems, and predictive diagnosis. Analyze case studies and current technologies to identify best practices and existing gaps.
2. Problem Definition: Identify specific types of issues that can occur in backend systems for connected vehicles
3. Architectural Design: Design a PoC for a detailed cloud architecture including components for data ingestion, processing, predictive modeling, monitoring, and visualization.

Technologies: AWS, Back-end architecture, microservices, communication technologies, data storage and analysis



THESIS DESCRIPTION:

“TRIPS - Transport Intelligence for Safe Mobility”

Contribution to design and development of PoC focused on the data acquisition from the IoT sensors and camera positioned on drone for visual accident assessment and real time data visualization.

The thesis requires design and development of system able to provide images and video contents using 5G technology from the drone webcam to enhance the image quality of the reference satellite images and to allow real time accident assessment. Those data should contain the metadata related to drone position, network performance (throughput, latency, packet loss...). To reach this out the drone should be equipped with the following items: computing unit, battery pack, suitable multispectral web cam, sensors for distance & environment measurement, GNSS unit.

Technologies: 5G, GNSS, multimedia content elaboration



THESIS DESCRIPTION:

Powering IoT with LoRaWAN

Contribution to design and development of sensing platform and software tool for analysing and real-time monitoring of smart cities use cases. PoC development focused on the data acquisition from the IoT devices using LoRaWAN technology- for monitoring and real time data visualization.

The thesis requires design and development of IoT sensors network prototype using LoRaWAN technology for real -time monitoring of smart cities use cases.

Technologies: LoRaWAN, Micropython/C, embedded



THESIS DESCRIPTION

"Optimizing Air Safety for Indoor Spaces with IoT"

Contribution to design and development of PoC focused on the IoT components prototyping for data acquisition and data analysis for air pollution and filtering system anomaly detection;

The thesis requires design and development of IoT system able to collect environmental data from the set of sensors, analyse this data to determine the air quality problem and to detect anomaly behaviour to prevent malfunctioning for the filtering system.

Technologies: embedded development, python, C, ML



B4

THESIS DESCRIPTION

Wireless environment sensing RFID for manufacturing

Contribution to design and development of PoC focused on the IoT components prototyping for data acquisition and data analysis for air pollution and filtering system anomaly detection;

The thesis requires design and development of IoT system able to collect environmental data from the set of sensors, analyse this data to determine the air quality problem and to detect anomaly behaviour to prevent malfunctioning for the filtering system.

Technologies: embedded development, python, C, ML



THESIS DESCRIPTION

“USP agent and client implementation for IoT device”

USP (TR-369) is standardized protocol to manage, monitor, update, and control connected devices, IoT endpoints, user services and home networks. It has been developed especially for CPE as evolution of the CWMP.

Study the possibility and the advantages of extending the use of USP to IoT devices.

Find the minimal requirement for implementing a USP agent on IoT module.

Identification and Analysis of the different USP supported MTP for the specific use case (e.g. MQTT, WebSocket, STOMP)

Definition of a Cloud Architecture to perform remote access and USP based Big Data ingestion

Optional : Identification and Analysis of USP based Discovery Authentication and Authorization, for IoT devices

Device Proxy in IoT Gateway to support IoT devices with different technologies (e.g. Z-Wave, ZigBee, WiFi)}

Integration of Matter in USP agent.

PoC Case study: *Implementation of a complete IoT solution based on USP (Agent, backend, Client).*

Technologies: C/C++, Python, Android, Embedded development, Cloud, Mobile development, Backend Development



THESIS DESCRIPTION

“Internal Vacation Tracker Tool”

Design and develop a tool to request, approve and track all the vacations and absences of the members of the Concept team. Design a multi-layered approval processes and configurable permissions for the different users.

The candidate will work on:

- *Design and develop the user-interface to
 - *file new vacation/absence requests*
 - *Approve requests for PM, managers and partners of the company*
 - *List all vacation for a given user or team**
- *Design and develop the data model and backend to support the scenario*

Technologies: React / React Native, AWS services for the backend, or other technologies that could fit the scenario (both for the frontend and backend) if preferred and upon agreement



THESIS DESCRIPTION

“Android Automotive Distribution”

Android Automotive is a version of the popular smartphone OS meant to bring the ecosystem inside cars: surveys say that by 2027, 75% of the car infotainment systems will be powered by this technology.

The candidate will work on:

- *Starting from AOSP (Android source code) work to compile it to target a given board (configuration and BSP setup are required)*
- *Define best practices and processes to work on changes to the AOSP code base*
- *Customize the System UI to create a new Android distribution*
- *(and/or) work to optimize other critical part of the Android Automotive OS (e.g. Audio management, CAN-BUS management, Media base application, Phone pairing, ...)*

Technologies: C++, Java, Kotlin, C-Make and other compilation tools, repo



THESIS DESCRIPTION

“V2X and C-ITS R&D”

The C-ITS standards provides the definition of messages that "smart roads" can exchange with vehicles to inform them about the situation of the road itself, the traffic on it, and possible dangers on the way.

The candidate will need to implement an end-to-end scenario that allows the simulation of events on the road and the management of received data on an onboard unit.

Both the transmitting antenna and receiver are based on Linux and working on them requires some basis in Linux. Other business logics, as well as the creation of user interfaces to show relevant information on some sort of screen.

Technologies: C++, Kotlin/Swift/React/other frontend technology, Linux



THESIS DESCRIPTION

“Autonomous Driving & ADAS”

Autonomous vehicles are the future of transportation and Advanced Driving Assistance Systems (ADAS) are a step in that direction that is already widespread today in circulating vehicles.

The candidate will need to implement autonomous driving capabilities on a dedicated scaled down vehicle. The vehicle shall be able to autonomously detect obstacles and the space boundaries and navigate in the environment. Additionally, the vehicle will integrate some "advanced driving assistance system" to enhance the basic driving scenario.

Technologies: C++, machine learning, Python, computer vision



THESIS DESCRIPTION

“Enhancing Road Safety through V2X Communication Using CARLA”

CARLA simulator is a high-fidelity, open-source simulation environment for realistic and diverse driving scenarios, used in the development and validation of ADAS and V2X systems.

The candidate will develop and validate V2X communication protocols to enhance roads safety using the CARLA simulator. The goal is to simulate various road scenarios, and assess the system's ability to detect and respond to road actors movements.

Technologies: CARLA, Python, C++, ADAS, V2X



THESIS DESCRIPTION

“LLM based interaction in the IVI”

AI and LLM provide easy and natural interactions for the users with many systems. Integrating an LLM in the infotainment system of a vehicle can enable a huge amount of interactions with the car but also implement new functionalities that are not possible today.

The candidate will need to integrate a LLM-based speech interaction system to let the driver, or any other car occupant, interact with the car functions via voice commands. Moreover, the AI shall be able to proactively suggest actions for the user to enrich the in-car experience.

Technologies: Kotlin, machine learning, Python, computer vision

[Start Availability Date - End Availability Date]: [01-03-2024 – 31-12-2024]



THESIS DESCRIPTION

“AI-based racing coach”

AI and ML are able to learn from real-world data and propose optimal solutions. That can apply also to racing scenarios, where such a solution could provide an ultra-tailored coaching to drivers that want to improve their timing around a circuit.

The candidate will be asked to implement a system that uses AI to provide suggestions to a driver on the fastest way to drive around a circuit. Based on telemetry data collected the system shall be able to simulate the best path for that specific car on the circuit and send suggestions to the driver for the following laps.

Technologies: machine learning, python or other languages



WE'LL TOTALLY LIKE YOU IF:

- You're a fast learner, with interest in new digital technologies
- You have skills in programming
- You have knowledge of AI methodology and concepts
- We appreciate proficiency in English and interest in design of software architectures
- If interested to one of the Internships, please send an email to:
s.giaconia@reply.it

