UNHCR
United Nations High Commissioner for Refugees
Haut Commissariat des Nations Unies pour les réfugiés

TERMS OF REFERENCE FOR SOFTWARE ENGINEER / INTERNET OF THINGS EXPERT

UNHCR REAL-TIME WATER AND SANITATION INFRASTRUCTURE MONITORING / INTERNET OF THINGS PLATFORM

SUMMARY

In early 2019, UNHCR has conducted field trials of water utility internet of things (IOT) monitoring devices (real-time borehole levels, pipe-flows, water consumption, water reservoir levels and chlorine residual monitoring) in Uganda, Iraq and Kenya. The trials proved to be extremely successful and showed LoRaWAN (Long Range Wide Area Networks) IOT technology is mature and ready to be rolled out to scale in refugee settings globally. UNHCR has evaluated the IOT software platform market, and while there are commercial solutions available, it has come to the conclusion there are significant cost-savings in developing its own IOT platform for water and sanitation real-time monitoring. UNHCR is requesting a secondee from DSS to complete two tasks.

i) Oversee the software development of a real-time WASH IOT platform in the Netherlands.
ii) Oversee the installation of real-time water-utility monitoring devices in sixty (60) water networks in Cox's Bazaar Bangladesh – using the previously developed WASH IOT platform.

BACKGROUND

For decades, the Rohingya have experienced ethnic and religious persecution within Myanmar's borders. During 2018, violence in Myanmar escalated, leading to large numbers of refugees crossing the borders into Bangladesh. On 28 September 2018, Sheikh Hasina, the Prime minister of Bangladesh claimed there are 1.1 million Rohingya refugees in Bangladesh. UNHCR Bangladesh have expressed an interest in real-time IOT monitoring of sixty (60) water networks supplying potable water to the Rohingya population.

During early 2018 the UNHCR has carried out comprehensive field trials of real-time water monitoring technologies in Rhino Refugee Camp in the West Nile Region of Uganda and IDP sites close to Mosul in Northern Iraq. The aim of the trials were to pilot various real-time monitoring solutions for water tanker and water reservoirs with the goal of improving the accountability of UNHCR's water trucking programming globally. As part of the pilots a total of ten (18) water monitoring devices were installed across Refugee Settlement from six (6) different companies including TankMatix, HummBox, Libelium, Tekelek, DecentLabs and Kerlink. The devices deployed a range of Internet of Things (IOT) technologies for remote monitoring including 3G, 4G, LoRaWAN (Long Range Wide Area Network), Ultrasound, Wave Pulse Radar, and Piezometric Pressure. The field trials were extremely successful and UNHCR has selected LoRaWAN IOT technology together with low-cost ultrasonic water monitoring nodes as a low-cost, mature and scalable system for water monitoring in refuge settings. Additional pilots of real-time flow-meters and real-time chlorine residual monitoring devices were carried out in Dadaab Refugee Camp in collaboration with BRCK and Veolia Foundation which also showed the WASH IOT real-time monitoring technologies are ready for wider adoption.

AIMS OF THE SECONDMENT

The aims of this DSS secondment are (1) to oversee the software development of a real-time water utility monitoring IOT platform for UNHCR; and (2) to oversee the installation of real-time water-utility monitoring devices in sixty water networks in Cox's Bazaar Bangladesh – using the WASH IOT platform.

ACTIVITIES

PART I – Software Platform Development

UNHCR recommends that the software development is carried out as an Open Source (e.g. GitHub) type software project that can be contributed to, accessed by, all humanitarian WASH partners. The idea is that humanitarian WASH partners could either install and host their own WASH IOT platform locally or they could create an account and could add their WASH monitoring IOT devices to the platform hosted by UNHCR.

UNHCR WASH's IOT strategy promotes use of The Things Network (TTN) Packet Forwarding Software (installed in Commercial LoRaWAN Gateways) as the primary solution for establishing open source LoRaWAN network coverage in refugee settings. UNHCR is promoting TTN as it believes in the open source model establish by TTN (https://www.thethingsnetwork.org/map) that LoRaWAN IOT coverage should be free and open to all partners, sectors and actors (including the refugees themselves). UNHCR recommends the UNHCR WASH IOT platform connects to TTN via the TTN HTTP Forwarding Service.

UNHCR has developed a "proof of concept" WASH IOT Platform (http://wash.unhcr.org/uganda-water-reservoir-dashboard/) linked to TTN that can be used as a starting point but needs to be upgraded to allow multiple users and multiple IOT devices, expanded to cover additional IOT (LoRa) device types, secured to protect data theft, and taken to scale to allow potentially 10,000s of devices to be connected globally across refugee sites.

The software development tasks that potentially need to be undertaken include:

- Establishing and leading development of the open-source UNHCR WASH IOT platform project. The project should be Open Source (GitHub hosted). The secondee would be the primary coder for the project however activities may also include collaborating with the Open Source community (volunteer programmers) or WASH NGO staff interested in collaborating on the project.
- Establishing data storage for the platform (either local MySQL or paid data plans via AWS or equivalent).
- Establishing secure user Create/Read/Update/Destroy (CRUD) operations. The platform should be open to any humanitarian WASH partners / NGOs working in refugee settings. User registration and access should include single-step verification, authentication and user data encryption.
- Establishing secure IOT device CRUD operations. It is envisioned that some organisations may be connecting 100s of IOT devices to the platform. It should be a very simple process to register an IOT device to the platform requiring the device DevID and SecretKey (similar to TTN).
- Establishing data point CRUD operations e.g. viewing tables and/or graphs of data points and having the capacity to manually remove occasional erroneous data points or outliers.
- Improving mapping, reporting, graphing and dashboarding i.e. weekly / monthly summaries.
- Addition of new types of IOT devices and device vendors into the platform e.g. pipe flow, groundwater level, pipe pressure, real-time chlorine residual. The developer should evaluate the market of water and sanitation IOT device vendors and will need to work with them to ensure proper payload decryption and device integration. Following the Uganda, Iraq and Kenya trials, UNHCR's currently recommends the following real-time IOT water-utility monitoring devices: Kerlink Wirnet LoRaWAN Gateways, Tekelek Tek 766 LoRaWAN Ultrasonic Water Level Sensors, DecentLabs LoRaWAN Groundwater Piezometric Pressure Sensors, Birdz/Veolia G3 LoRaWAN Intelligent Water Meters, and Birdz/Veolia LoRaWAN Kapta 3000 Real-Time Residual Chlorine Sensors
- The style (CSS) of the HTML platform frontend should create a similar look, feel, form and function to TTN.

PART II – Installation of Real-Time Water Utility Monitoring Devices in Bangladesh

The four week field deployment to Bangladesh should follow platform development. The field based tasks that potentially need to be undertaken include:

- Providing IOT technical input into preparation of the tender for purchasing of the IOT devices for the 60 water networks.
- Supervising the installation of three (3) LoRaWAN Gateways (Kerlink Wirnet Gateways installed on existing communications towers or with their own 5m towers).
- Supervising the installation of IOT real-time water monitoring equipment across 60 water networks in Cox's Bazaar Bangladesh.
- Ensuring all devices are properly calibrated and are reporting correct data to the IOT platform.
- Assessing the capacity of UNHCR Bangladesh IT staff. Provide direct and remote technical support and on the job training. The staff should be able to fully manage and maintain the IOT installation by the end of the field visit.

EXPECTED OUTPUTS

PART I – Software Platform Development

- Complete and functioning open-source real-time water-utility IOT monitoring software project hosted on GitHub and installed on wash.unhcr.org.

- On-line training manual.
- Software project final report.

PART II – Installation of Real-Time Water Utility Monitoring Devices in Bangladesh

- Complete installation of a LoRaWAN IOT network and real-time monitoring devices across sixty (60) water networks.
- Mission report.

LENGTH OF DEPLOYMENT

PART I (Software Platform Development) in the Netherlands should take approximately eight (8) weeks.
PART II (Field Deployment Bangladesh) should take approximately four (4) weeks.

DUTY STATION

PART I (Software Platform Development) to be based in the Netherlands.
PART II (Field Deployment Bangladesh) to be based in Cox's Bazaar, Bangladesh.

QUALIFICATIONS AND PROFESSIONAL EXPERIENCE

REQUIRED

Academic: Advanced University Degree in Software Engineering, Computer Science or similar

Experience:
- At least ten years direct experience with software platform development.
- At least three years direct experience with IOT technologies especially LoRaWAN.
- Proven ability to deal in multi-cultural teams, with multiple tasks, demanding working condition and short deadlines.
- Ability to coordinate a range of diverse actors and activities to achieve a common objective.
- Exposure to UNHCR mandate, its priorities and principles.
- Capacity to provide formal and informal training.

Skills:
- PHP, MySQL, Javascript, JQuery, HTML, CSS.
- Ability towards analytical and creative thinking for rapid solutions.
- Good communicator with strong interpersonal and negotiations skills to deal with persons of various cultural and educational backgrounds.
- A team player with service oriented attitudes.
- Proficiency in basic computer software such as excel, powerpoint, word.

Languages: Excellent knowledge of English (written / oral / comprehension) is essential.

DESIRABLE
- At least six (6) months oversees experience of refugee (or similar) settings.
- Applied knowledge in UNHCR programme management, project formulation, its programme cycles and reporting standards.