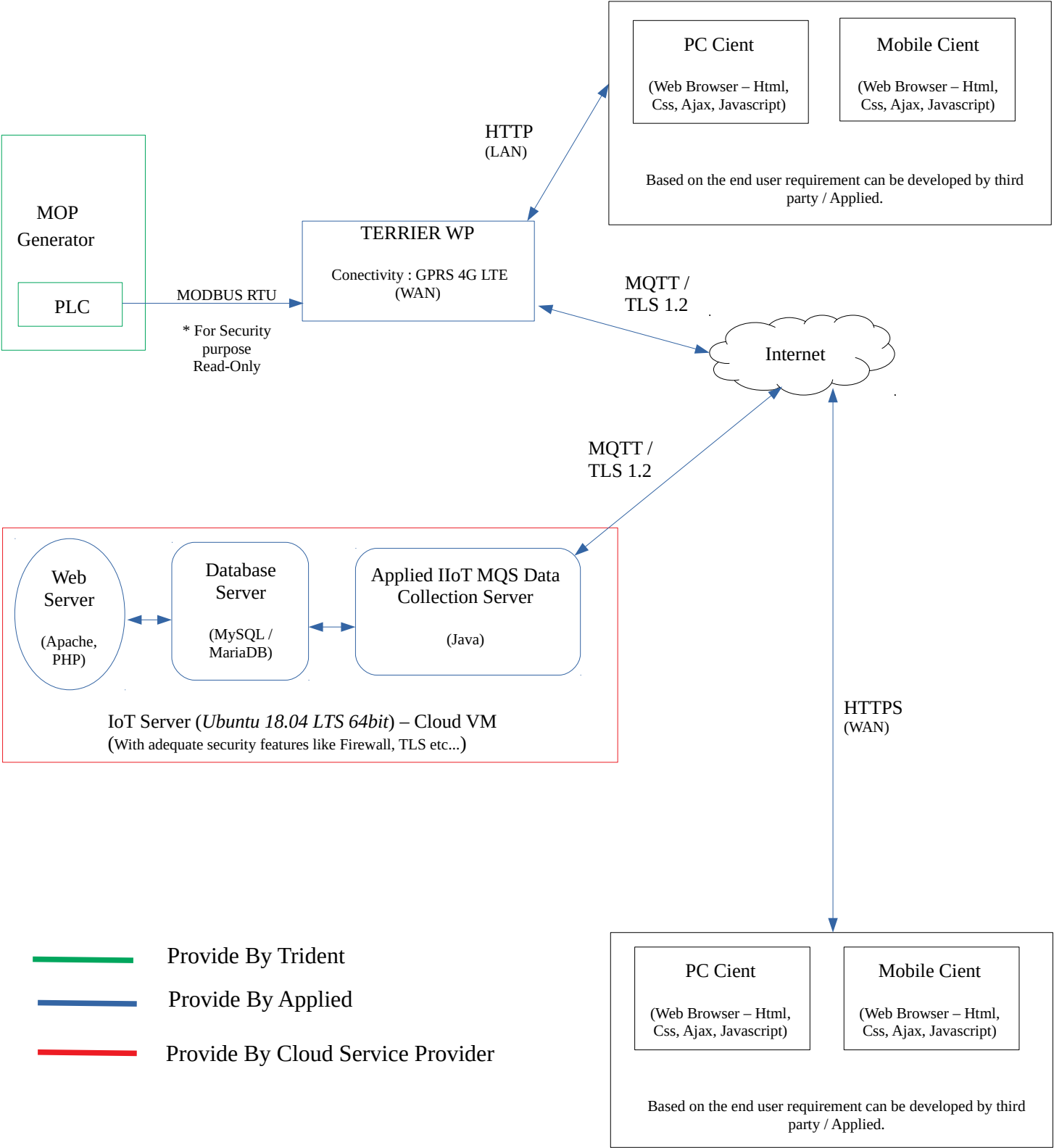


Applied IIoT MQS Server
(MOP Generator Online Data Monitoring)

Block Diagram



Applied IIoT MQS Server **Functional and Technical Requirement Document**

1. Scope

This Functional and Technical Requirements Document outlines the functional, performance, security and other system requirements identified by **Applied**. Items 2,4 are in the scope of Applied.

2. Functional Requirements and User Impacts

Applied IIoT MQS Server requires a technology based solution for from various Terrier controller implemented at the operational plant and management system whose primary functions include,

A. Terrier Controller Functions

Data Collection from Equipments @ field level

Applied Terrier-WP IIoT controller is designed and developed to connect to a PLC's over Modbus TCP/IP (or) Modbus RTU to collect data from the PLC Controllers on Equipments for which the data needs to be monitored online from a centralised infrastructure.

Process the raw data

Terrier-WP Controller process the raw data from PLC and convert it into a Applied standard protocol format in small packets suitable from reliable transfer over Internet. Terrier-WP controller connects to Applied IIoT MQS Server over MQTT protocol using TLS 1.2.

Push the data over Internet

Terrier-WP Controller then pushes these packets of processed data over the internet via MQTT protocol at specified time interval (Configured on the Controller) into the cloud server identified through a DNS Resolution pre-Configured on the Controller.

B. Applied IIoT MQS Server Functions

Receives Data

The Applied IIoT MQS Server running on the Cloud VM is listening and ready for data collection from the remote Terrier Controllers 24x7.

Stores the data

The Applied IIoT MQS Server populate the received data into a corresponding MySQL / MariaDB database tables for future access.

Data Accessibility

Stored data is available for end user access via a HTTP webserver access and it is available for user access to view the recorded data and also to configure remotely a few parameters on the Terrier Controller.

User Account and Admin Panel

Two Levels of user management options for the above data access is provided. One for admin access and other for user access. Admin user can configure the Terrier remotely besides viewing the users and error logs. General Users can access to view the data. User can signup to create their account with password. User's password can be managed by user themselves in the webpage.

Data Security

Data from Terriers to Applied IIoT MQS Server are encrypted by standard TLS algorithm and the domain can be protected by standard TLS 1.2 certificate as provided by domain service provider.

3. Hardware Requirements

Applied IIoT MQS Server has been tested on the single Cloud VM which had the following hardware specifications

- 32 GB RAM
- 16 vCPUs (hyper-threads)
- 120 GB SSD Disk
- Inbound / Outbound data transfer bandwidth 5TB per month

4. Software Requirements

Applied IIoT MQS Server has been tested on the single Cloud VM which had the following software specifications

- ◆ Ubuntu 18.04 LTS 64-bit Server Edition - Operating System
- ◆ Openjdk version 1.8 - Java Runtime Environment
- ◆ Mosquitto version 1.4.15 - MQTT Broker
- ◆ OpenSSL 1.1.1 - TLS 1.2 Certificates
- ◆ LAMP Server (**L**inux **A**pache **M**ySQL **P**hp) which includes the following software packages
 - MySQL version 5.7.29 (or) MariaDB version 10.1 - Database Server
 - PHP version 7.2.24 - General-purpose scripting language especially suited to web development

- Apache version 2.4.29 – Web Server
- ◆ CSS3 - Cascading Style Sheets; language used to describe the presentation of a document written in markup language, e.g., HTML
- ◆ HTML5 - HyperText Markup Language; the fifth and current version of the HTML standard
- ◆ Javascript - Programming language used extensively in website development
- ◆ jQuery for Javascript - Javascript library
- ◆ Any latest web browser – Google Chrome, Mozilla Firefox are recommended

5. Remote data access for Data Analysis and Information Dashboard Requirements

For further Data Analysis and Dashboard requirements to publish this data can be achieved by enabling the remote database access from this MySQL / MariaDB Database populated by the Applied IIoT MQS Server. With this data users can develop and publish user information as required. (This is not in our Scope)

6. System Redundancy and Failsafe Requirements

Applied IIoT MQS Server has to be implemented with Database Server redundancy and Web Server redundancy for scaling up and this has to be done by the cloud VM infrastructure provider.

However with our theoretical knowledge of high availability of this system can be achieved by the following steps

- Cloud VM can be configured as hardware failsafe such as RAID implementation at the hard disk level to avoid data loss
- Clustering the Apache Web Server in multiple VM helps to achieve load balance between many users with many requests and high availability of web server
- MySQL / MariaDB Database replication like master-master (or) master-client helps to enable the database server high availability
- The periodic automatic restart strategy of IIoT server provides protection against slow resource leaks.

- The periodic automatic database backup helps to quick recovery from database issues if any.

7. Current System Summary

- Each Terrier-WP controller has been configured to be connected to the internet via MQTT with TLS 1.2 or via GPRS 4G LTE technology. Once it has the successful internet access it will start sending the processed data automatically to the Applied-IIoT server in a periodic time interval configured on it.
- The data sending interval and other network parameters can be configured by the user by direct accessing of Terrier Controller web pages via Local Area Network.
- Applied IIoT MQS Server collect the data from the Terrier-WP controller continuously in a specified time interval over MQTT protocol with TLS 1.2 security and AES 256 data encryption format. This data can be collected on a pre-configured timer set on the controller with timestamp.
- Errors occurring during the data collection if any is logged into the database table for further debugging process.
- The data collection server resume back to running state automatically by the OS cron job if any unexpected software issues stall its smooth operations.
- We have a very simple GUI developed by using PHP, Html5, Css3, Javascript language to manage the data collection server processes and to make the data available for the end user on the same Cloud VM server which hosts Applied IIoT MQS Server. This GUI application has been deployed into the Apache Web Server on the same VM machine.
- We can start and stop the data collection server by the simple command on the terminal.
- The data collection server reboot automatically once in a day by the OS cron job to avoid protection against slow resource leaks and performance issues.

8. Data Traffic Estimation - Between Terrier on Equipment and Applied IIoT MQS Server

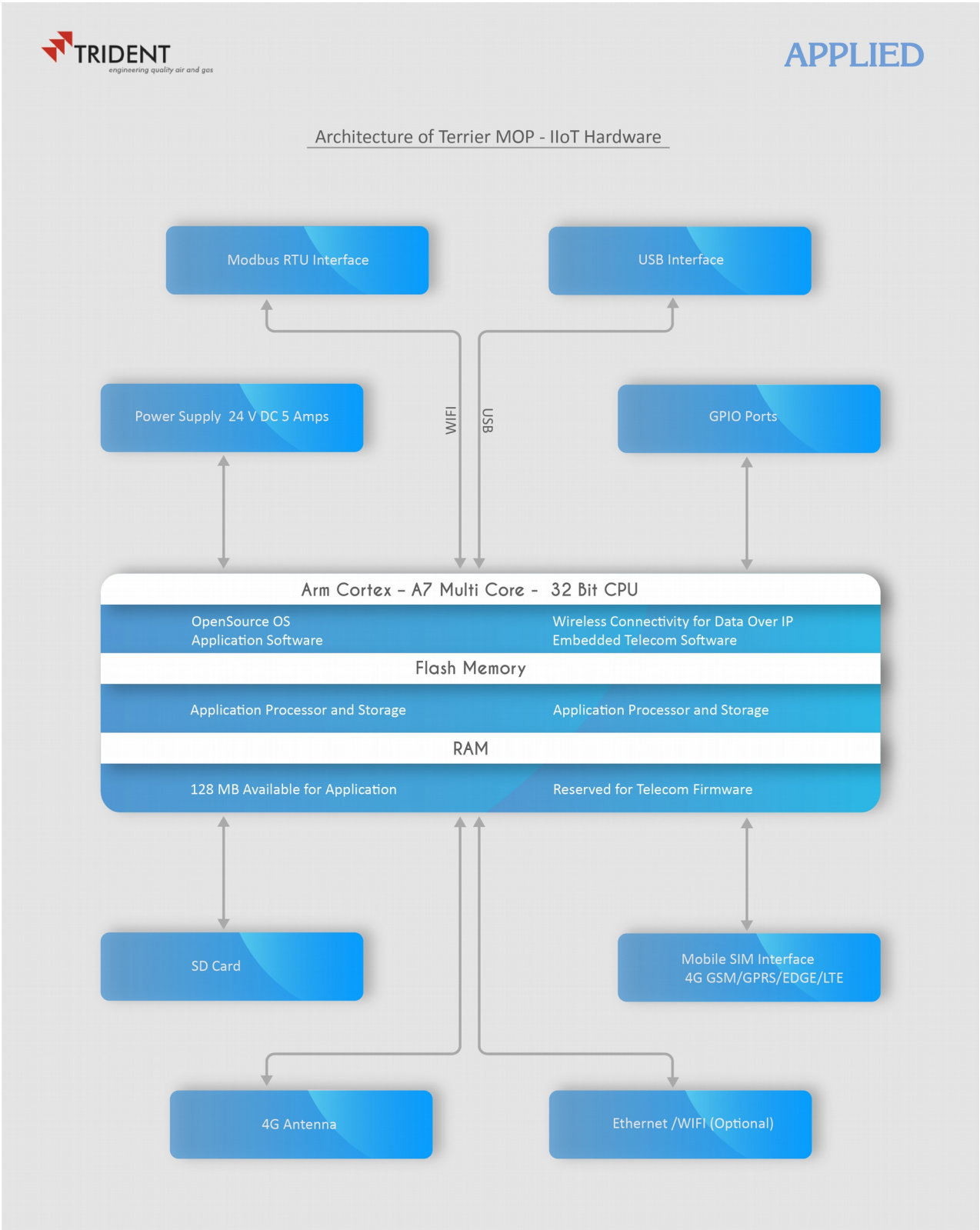
MOP - Project Data Traffic Estimation between Terrier-WP and Applied IIoT MQS Server

Inbound Data to Server

| # | Description | Unit | Value |
|---|--|-------|-------|
| 1 | Data transfer Per Controller/Per MOP (max) | Byte | 128 |
| 2 | Transfer Time Interval | Sec | 300 |
| 3 | No of Boards Connected | Nos | 500 |
| | | | |
| 4 | Data Transfer per day per board | Bytes | 36864 |
| 5 | Data Transfer per day for All Connect Boards | MB | 17.6 |
| | | | |
| 6 | Data Transfer Per Year | GB | 6.28 |

*** For Data Access to the Data base for Data Analysis and other Dashboard publishing is not part of the above and will be extra. This can be used for estimation of Data Storage requirements as well.

Terrier-WP Architecture Diagram



Applied IIoT MQS Server

Data Security and Data Flow Between Terrier-WP IIoT Controller & Applied IIoT MQS Server

26-July-2021

Data Flow Diagram

Applied IIoT MQS Server Data Flow Diagram - 26-July-2021

Cloud DCS
VM

Oxygen Plant

Public Internet

