Software Engineering in Industrial

IIoT 工業物聯網實戰

2024/05/09

Zack YL Shih, Team Lead, SW

Who am I

Zack Shih, Team Lead of Cloud Team

Graduated from Taipei Tech 2013, joined Moxa as a software engineer since then. Most of my works are focusing on IIoT, Device Management related topics.

6 Years of RD role,
2 Years of FAE role @ Moxa Americas,
2 Years of Team Lead role.

3 Takeaways

1 裝置管理基礎應用

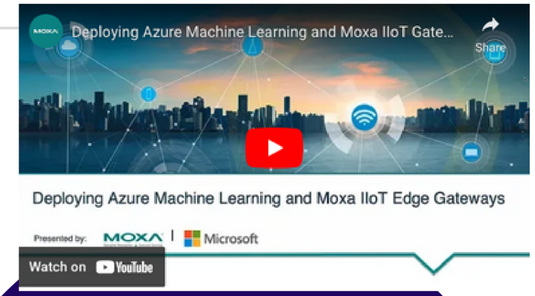
當應用離開實驗場域，進入實際部署環境時，挑戰隨之而來。裝置生命週期管理成為一個**重要卻常被忽視的議題**。透過公有雲及設備製造商提供的服務與軟體，使用者能夠釋放雙手，專注於實際應用的開發與運營。

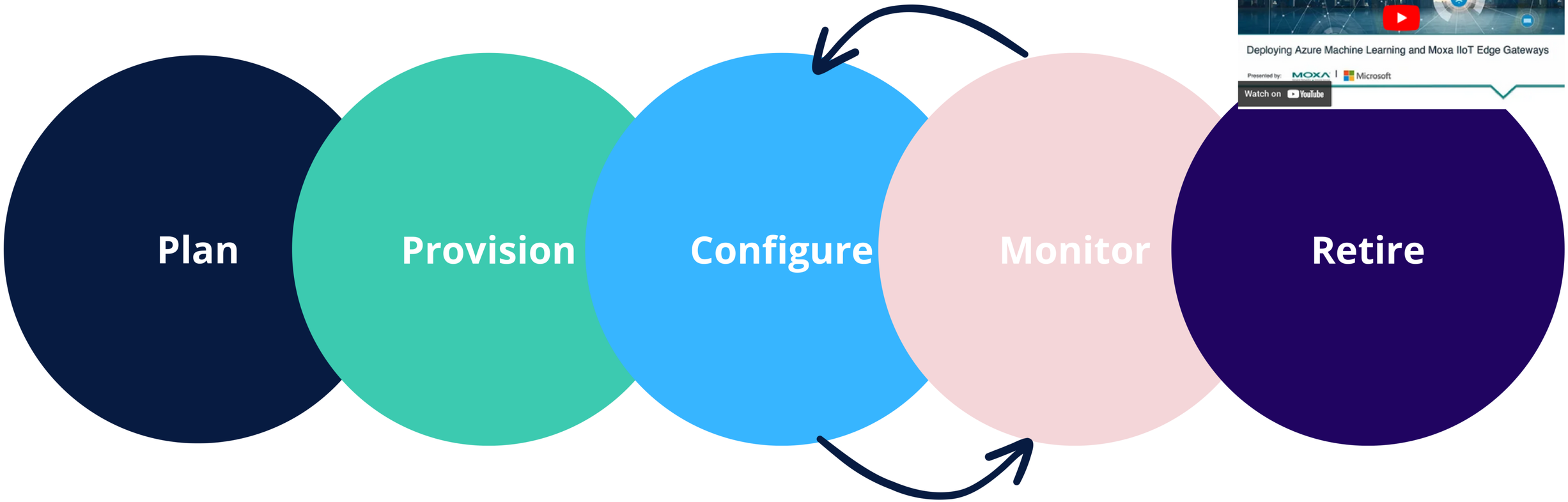
2 場域常見通訊協議

在應用場域中，會經常遇到像 **MQTT** 這樣的通訊協議，用來傳輸感測資訊甚至是遠端控制機器的指令；同時，也會看到像 **OpenVPN/WireGuard** 這樣的協議，**搭配網路加速架構**，用來進行進階操作和遠端登入機器進行故障排除。

3 實際案例分享

透過一個再生能源應用的案例，我們將一窺**部署上萬台裝置所面臨的挑戰**。這將包括從裝置製造到部署以及後續維運過程中實際遭遇到的各種問題。





裝置管理基礎應用

裝置管理是工業物聯網中不可或缺的一環，尤重於裝置生命週期管理

Device Lifecycle Management

這包括：計劃、註冊、配置、監控和退役等關鍵階段。從裝置導入系統、設置基本參數，到監控運行狀態和即時解決問題，再到安全地退役裝置和處理相關資源，這些步驟都是確保工業物聯網系統持續運行並發揮最大價值的重要環節。

DM Solutions

使用現成的裝置管理解決方案能夠節省時間和成本，提高效率並增強安全性。

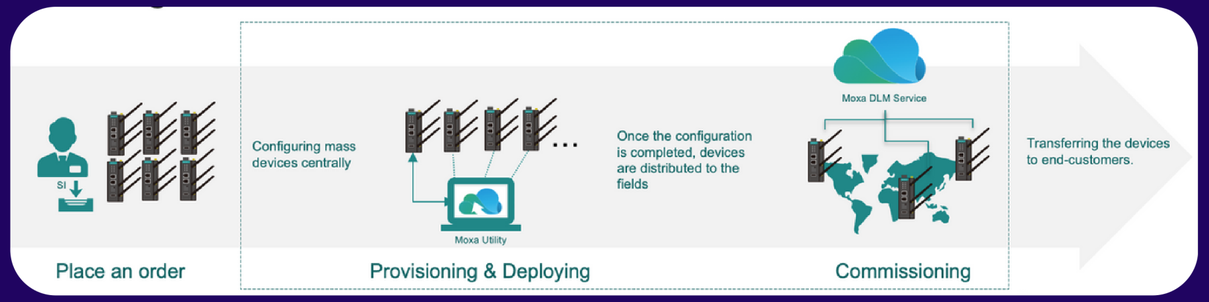
這些方案通常伴隨著自動化、排程和安全功能 (e.g., OTA SW)，能快速部署、配置和管理大量裝置。同時，提供完善的監控和遠端管理功能，使用者能隨時監控裝置狀態並執行遠端操作。

最後，這些解決方案可建立在雲端平台上，具有良好的**擴展性**、**可用性**和安全性，讓企業能夠放心地擴展其 IIoT 應用並確保資料安全性。

OUT OF THE BOX: DM

Moxa DLM Service

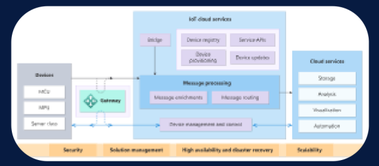
由 Moxa (設備製造商) 提供的設備雲端管理系統，能有效管理設備之設定、進行部署與後續的除錯；透過導入裝置管理服務，可以降低營運成本，特別是在初期測試階段



AWS IoT

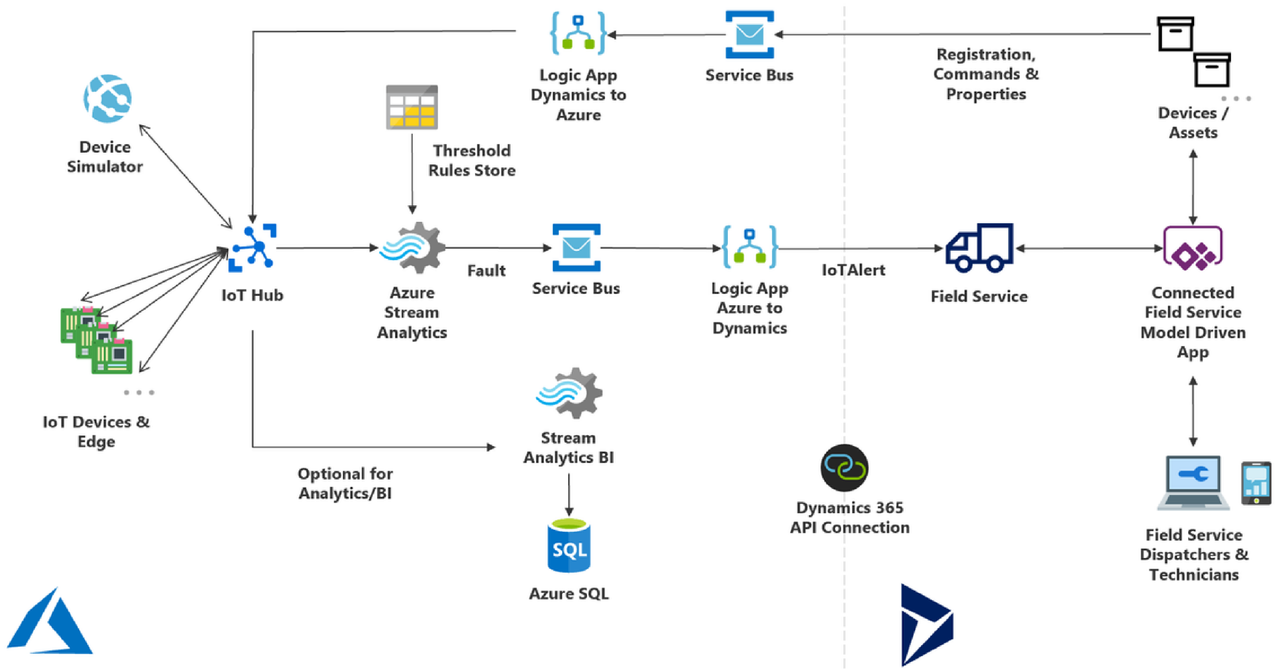
AWS IoT 提供將 IoT 裝置連接至其他裝置和 AWS 雲端服務的雲端服務。 AWS IoT 提供可協助您將 IoT 裝置整合至 AWS IoT基礎解決方案的裝置軟體。如果您的設備可以連接到 AWS IoT，則 AWS IoT 可以將它們連接到 AWS 提供的雲服務。

Azure IoT



Azure 物聯網 （IoT） 是 Microsoft 管理的雲端服務、邊緣元件和 SDK 的集合，可讓您大規模連線、監視及控制 IoT 資產。 簡單來說，IoT 解決方案是由與雲端服務通訊的IoT裝置所組成。

IoT SaaS: Focus on Data

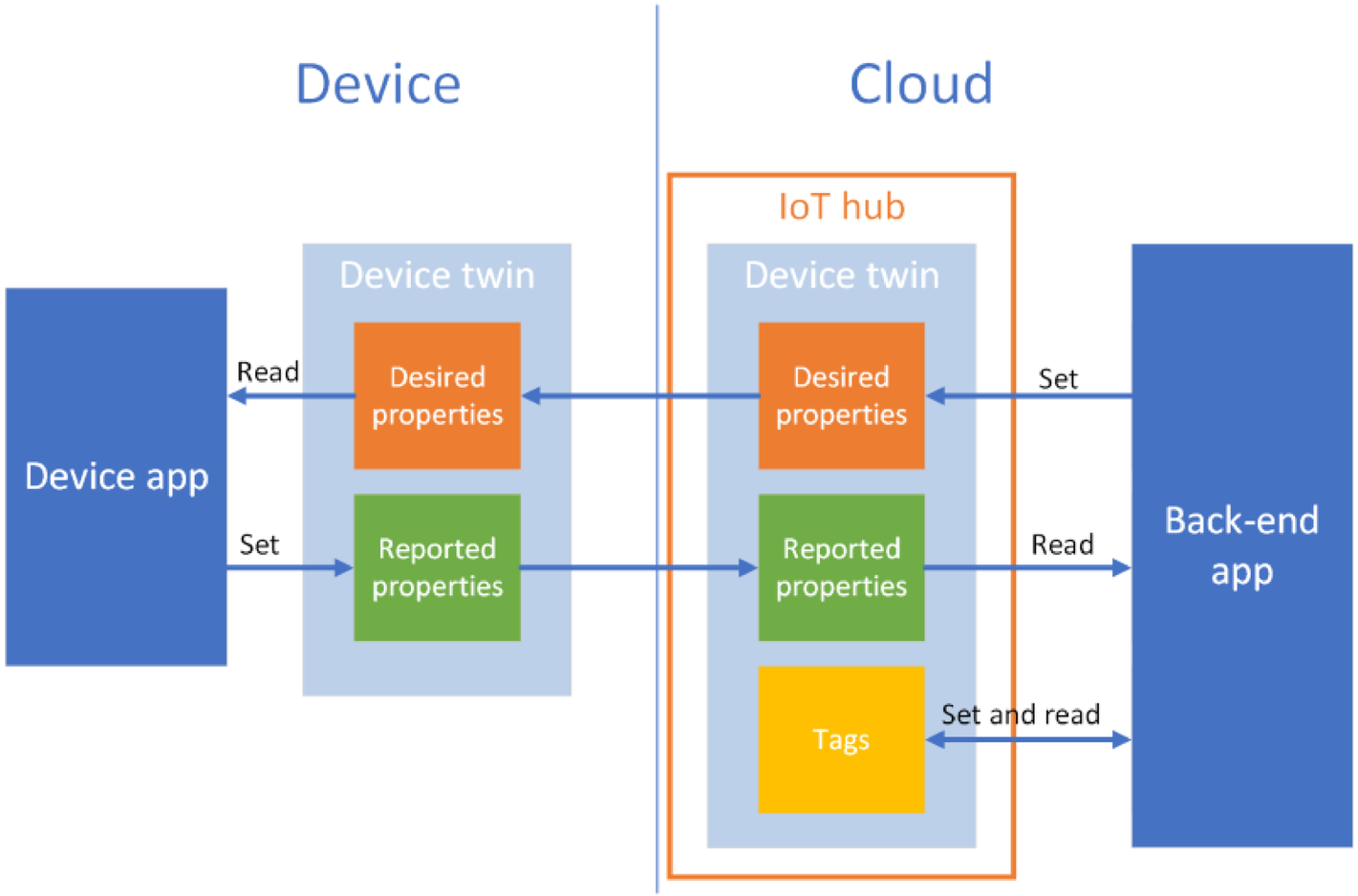


IoT Core / Hub

Azure IoT: Twin (async) / Direct Method (sync)

AWS: Shadow (async) + Job

Azure IoT - Device Twin



https://learn.microsoft.com/en-us/dynamics365/field-service/connected-field-service-architecture

AWS IoT - Shadow (Report)

Device Shadow document Info

The Device Shadow document contains the reported, desired, and delta values of the device's state. You can edit the state values here or programmatically. Your de

Device Shadow state

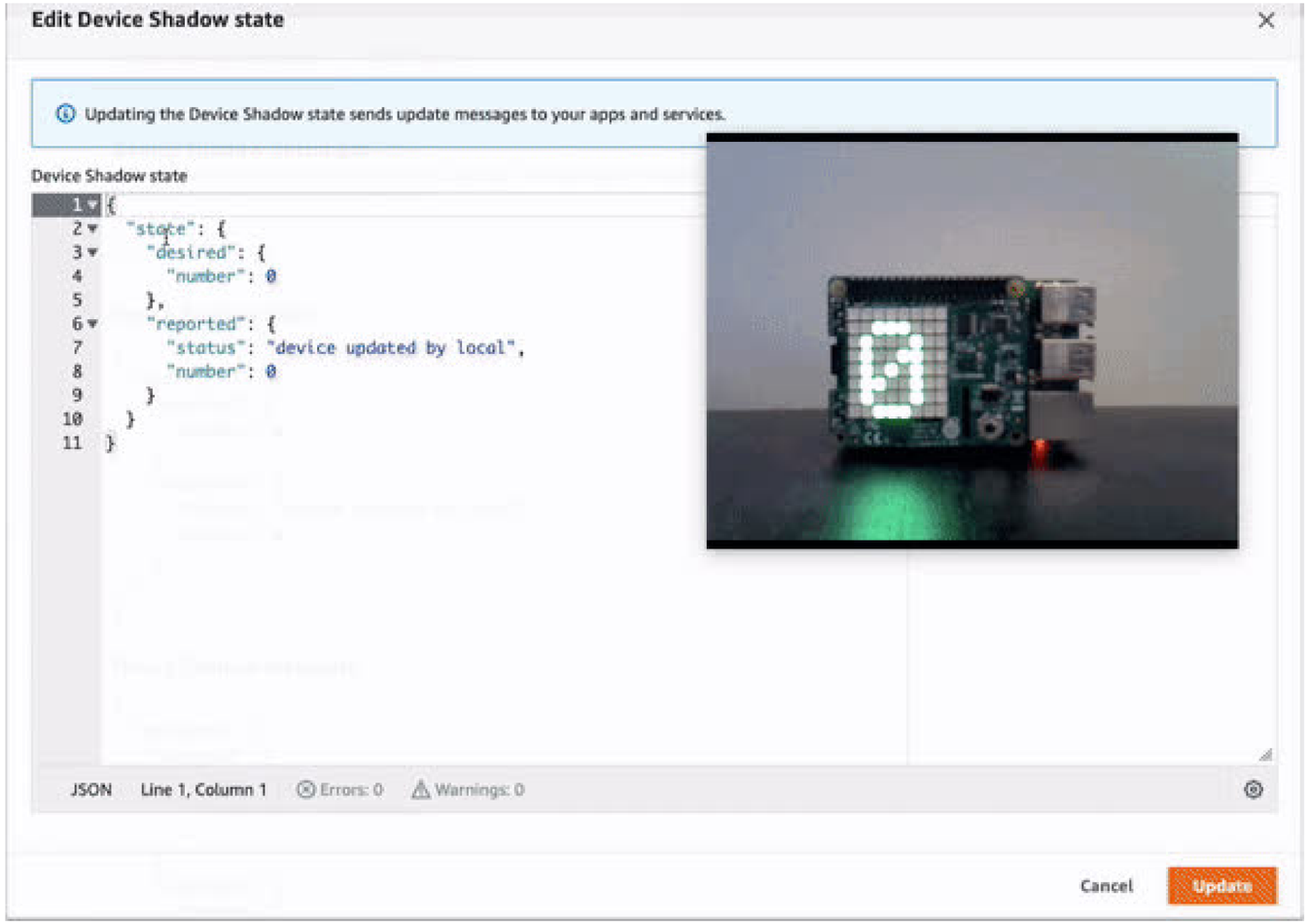

```
{
  "state": {
    "desired": {
      "number": 3
    },
    "reported": {
      "status": "device updated by local",
      "number": 3
    }
  }
}
```


Device Shadow metadata


```
{
  "metadata": {
    "desired": {
```

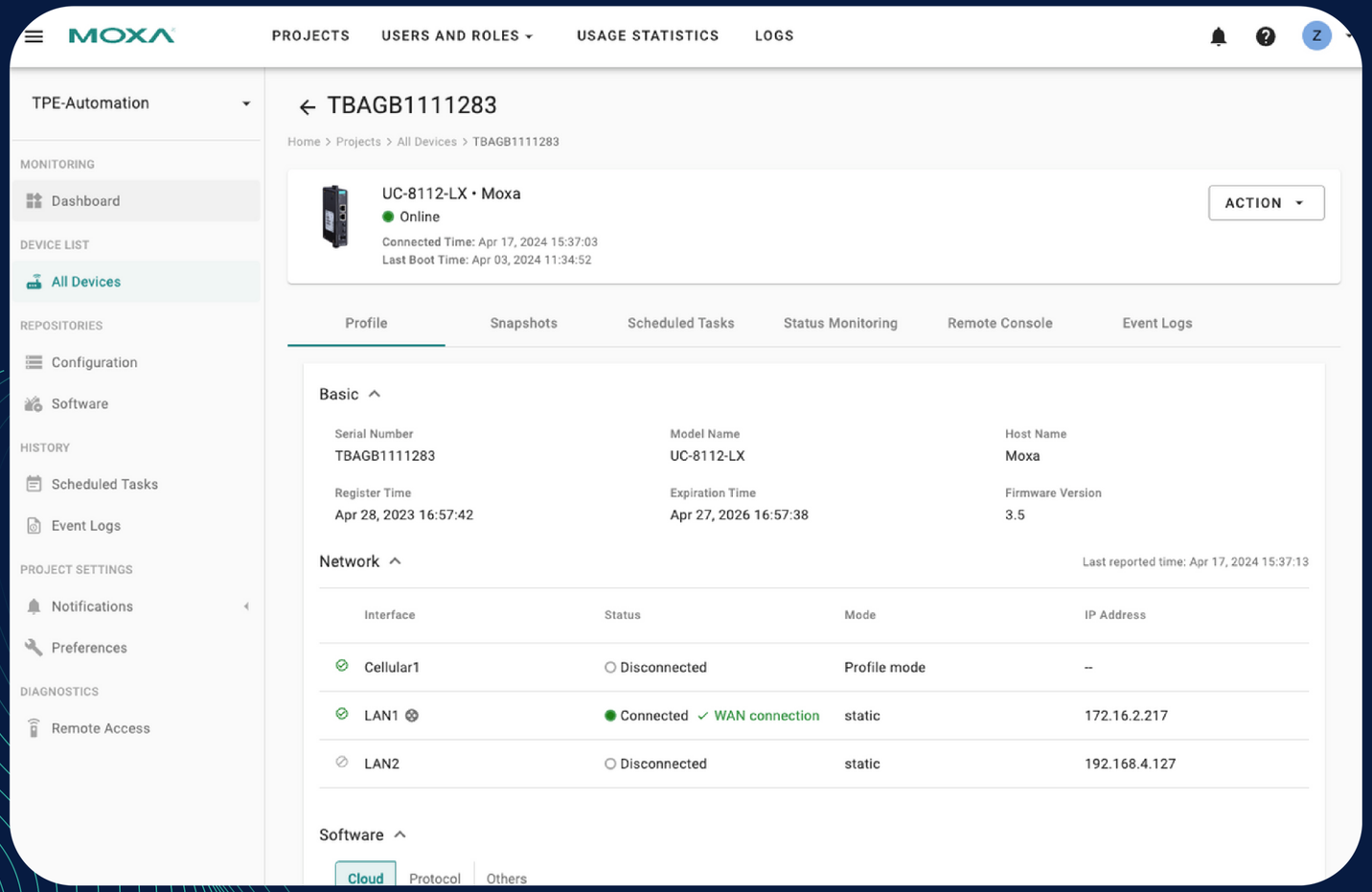

https://feng.lu/2023/05/23/Manage-IoT-device-state-anywhere-using-AWS-IoT-services/

AWS IoT - Shadow (Desire)



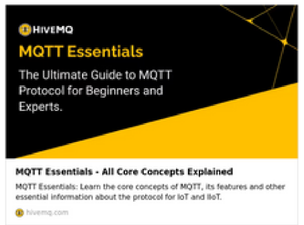
https://feng.lu/2023/05/23/Manage-IoT-device-state-anywhere-using-AWS-IoT-services/

DEMO – DM in Action



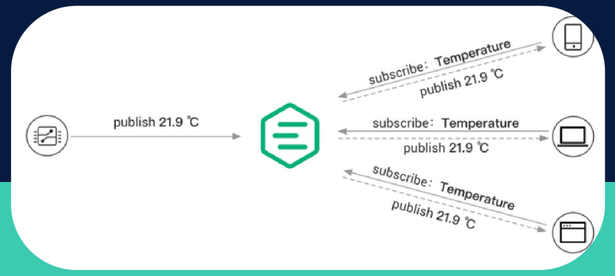
MQTT: Telemetry Data

The MQTT protocol is the de-facto standard for IoT messaging. Standardized by OASIS and ISO, MQTT publish/subscribe protocol provides a scalable and reliable way to connect devices over the Internet. Today, MQTT is used by many companies to connect millions of devices to the Internet.



Lightweight and Efficient

Small code footprint, and low overhead, making it suitable for resource-constrained devices and low-bandwidth environments.



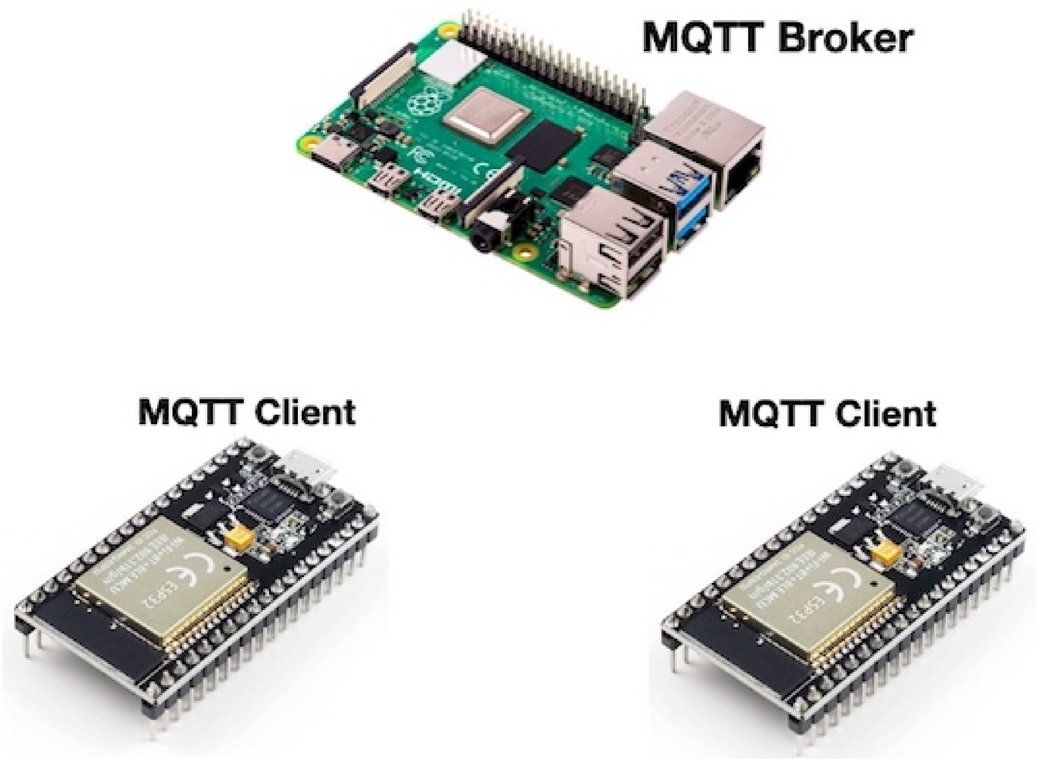
Publish/Subscribe Model

Follows a publish/subscribe messaging pattern, where clients can publish messages to **topics** and subscribe to topics to receive relevant messages. This **decoupling of producers and consumers** allows for flexible and scalable communication.

QoS levels

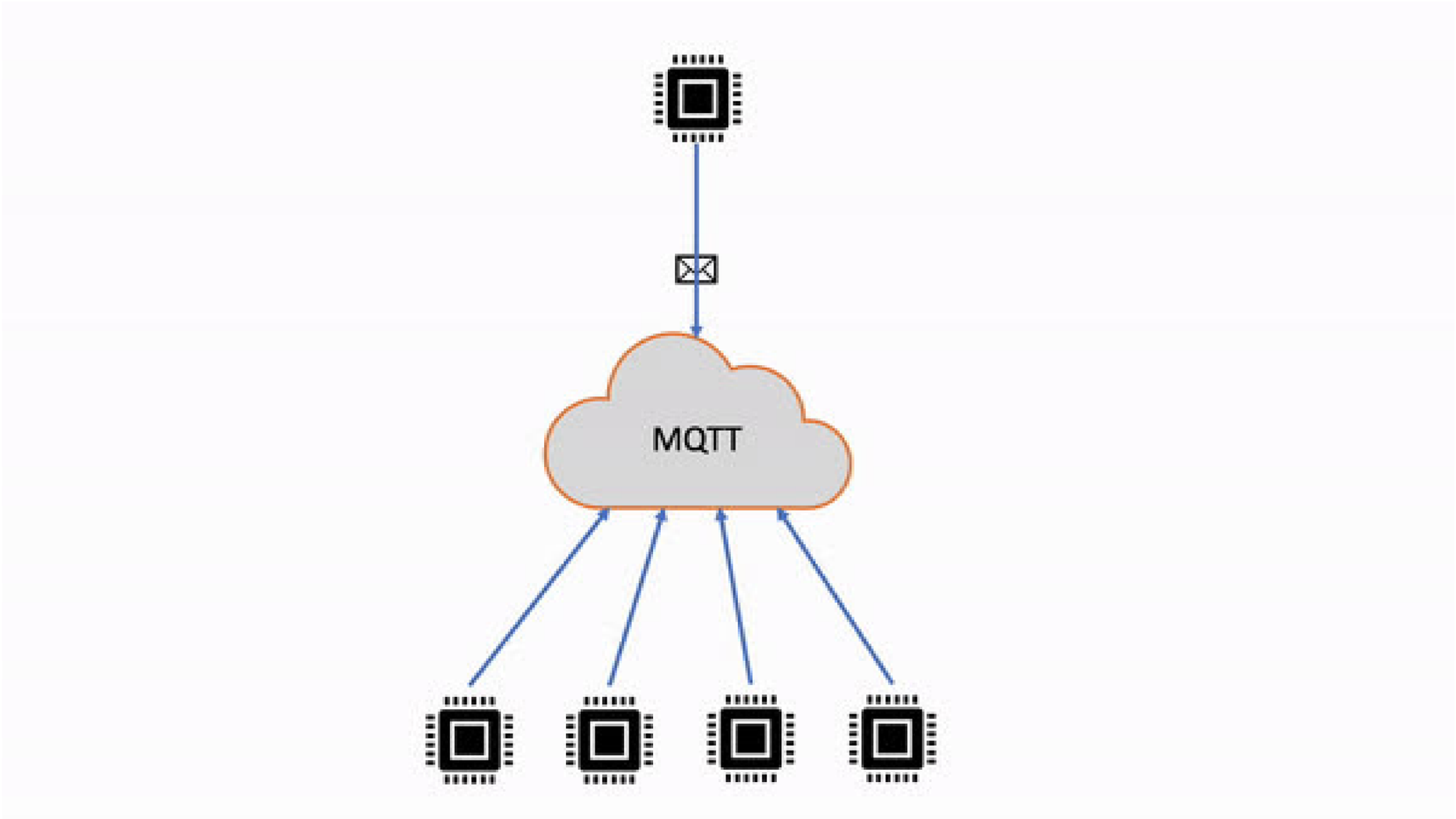
At most once (0): Message delivery is not guaranteed, and messages may be lost or duplicated.
At least once (1): Message delivery is guaranteed, but messages may be duplicated.
Exactly once (2): Message delivery is guaranteed, and messages are not duplicated.

MQTT - Lightweight



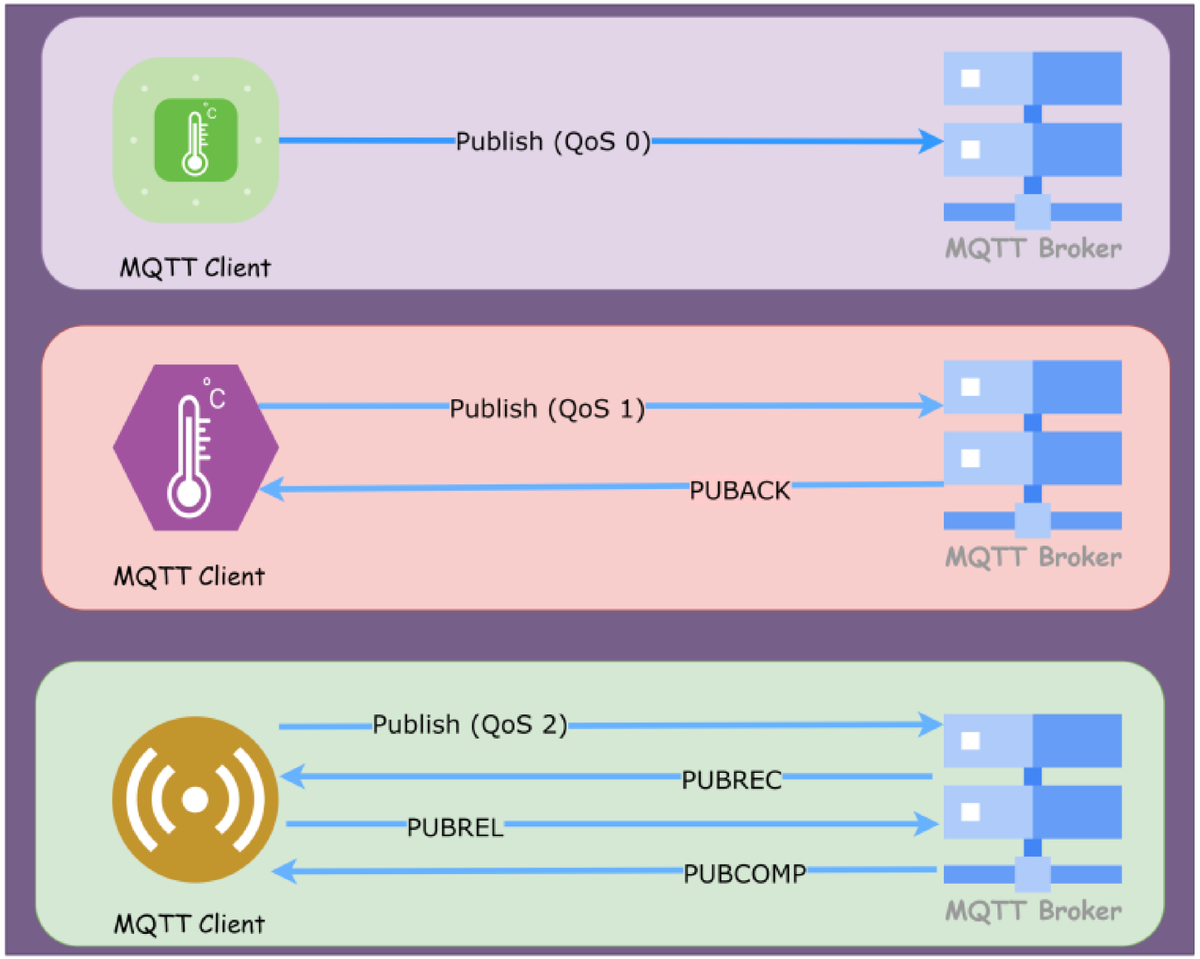
https://helloworld.co.in/article/mqtt-raspberry-pi-esp32

MQTT - Pub/Sub

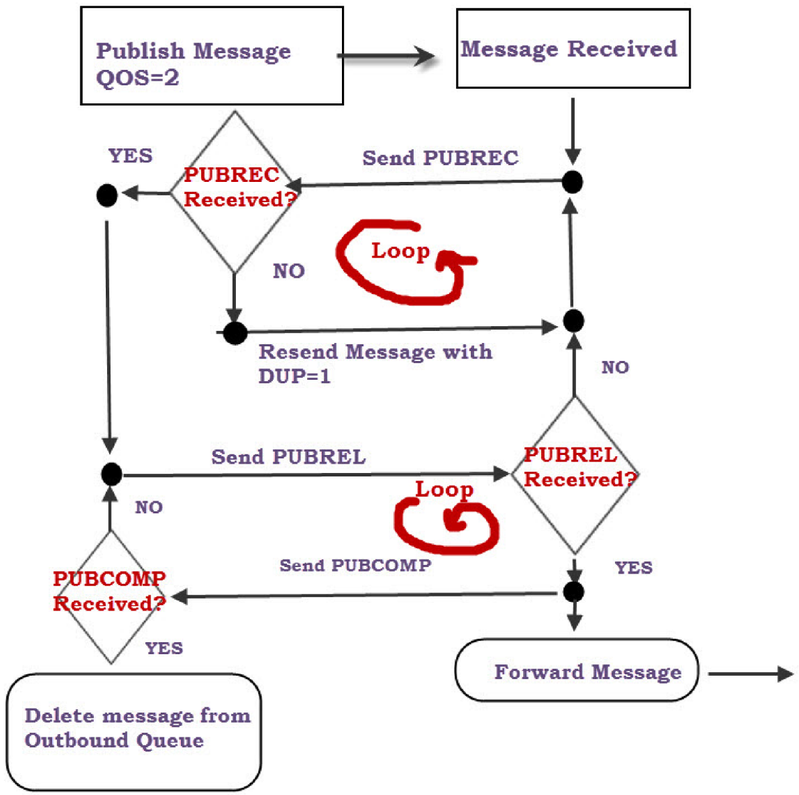


https://docs.aws.amazon.com/iot/latest/developerguide/mqtt.html

MQTT - QoS



https://takethenotes.com/mqtt-qos/



MQTT QOS 2 Message Flow Diagram

http://www.steves-internet-guide.com/understanding-mqtt-qos-2/

Remote Access

故障排除

當系統出現問題時，管理者需要進行故障排除。透過遠端存取，可以立即登入到遠端伺服器/設備，檢查日誌、執行指令和進行測試，快速找到問題並解決。

遠端設定

在設定管理方面，遠端存取同樣扮演重要的角色。當需要更新設定、安裝軟體或調整參數時，管理者可以通過遠端存取直接登入到目標設備，而無需實體接觸，從而節省了時間和成本。

Without AWS Global Accelerator

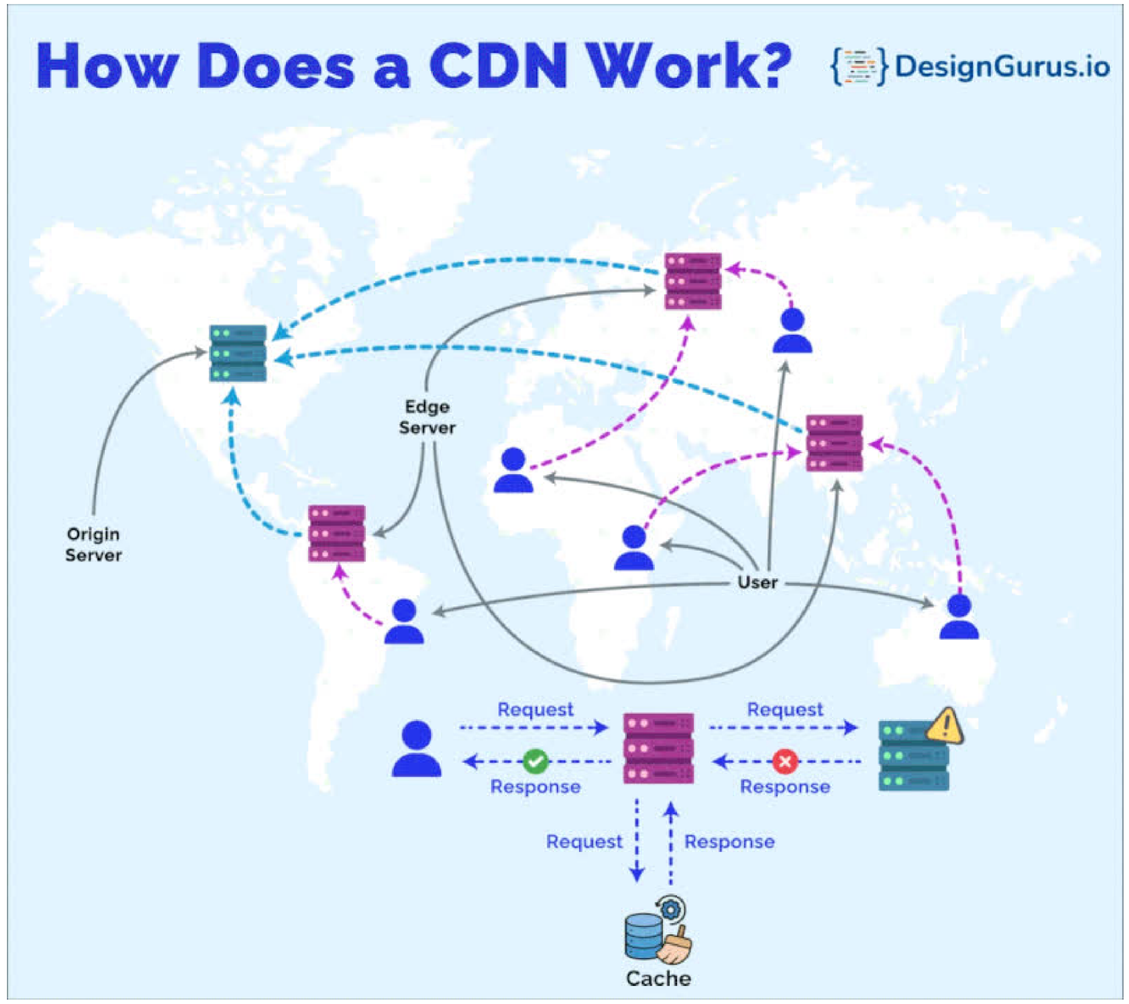
It can take many networks to reach the application. Paths to and from the application may differ. Each hop impacts performance and can introduce risks.

With AWS Global Accelerator

Adding AWS Global Accelerator removes these inefficiencies. It leverages the Global AWS Network, resulting in improved performance.

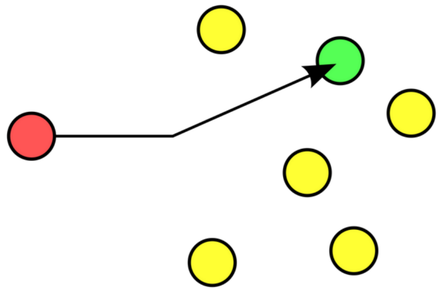
GA (**Anycast**) + CloudFront (**DNS**)

CDN: Content Delivery Network

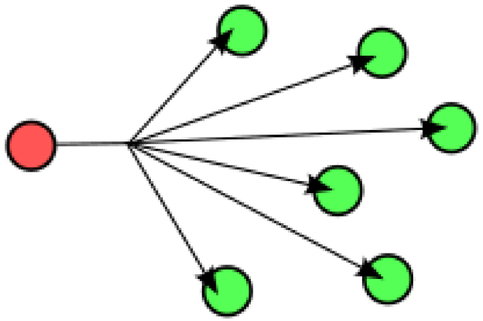


DesignGurus.io

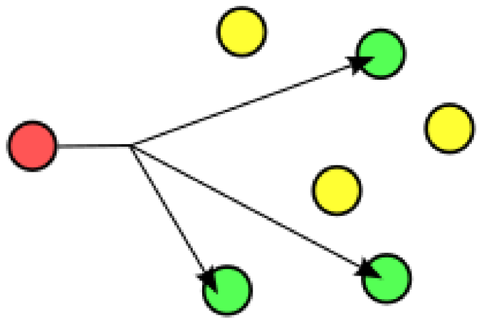
Routing Scheme



unicast



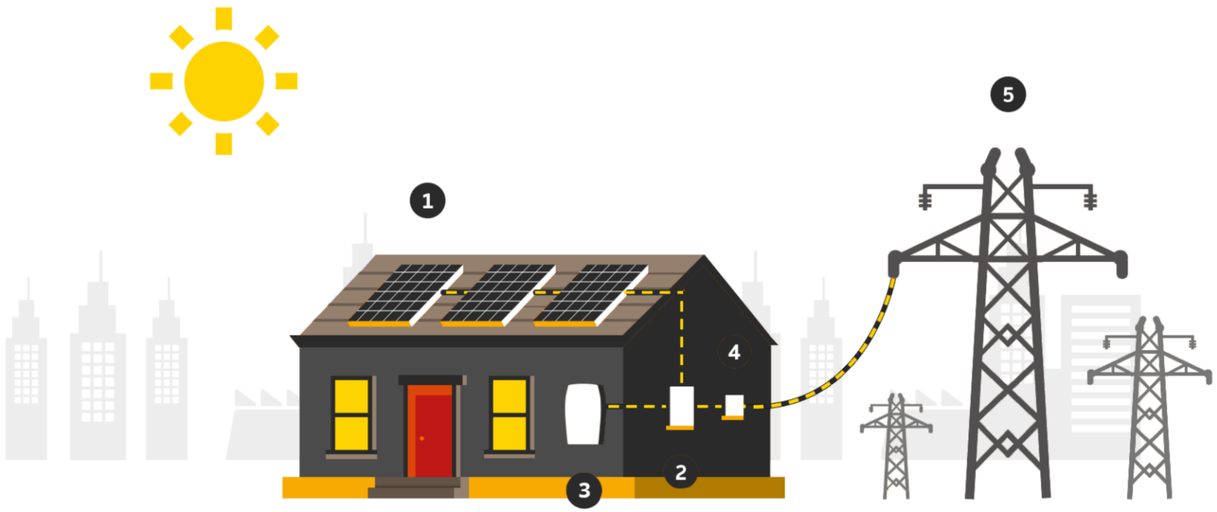
broadcast



multicast

Wikipedia

實際案例分享：家用再生能源系統



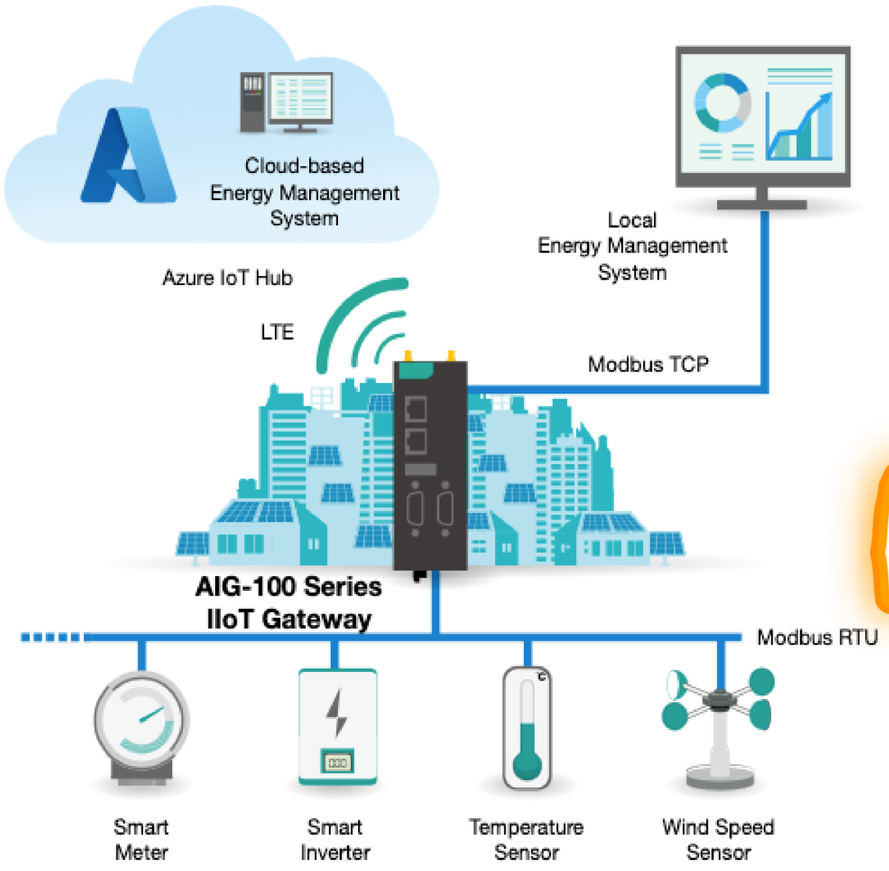
太陽能板需要很多錢建置和維護。這時候，有些太陽能公司會提出幫助，他們會說：「我們先幫你買和安裝太陽能板，你不需要一次付很多錢。然後，你只需要按月付錢給我們，就像你平常付電費一樣。」

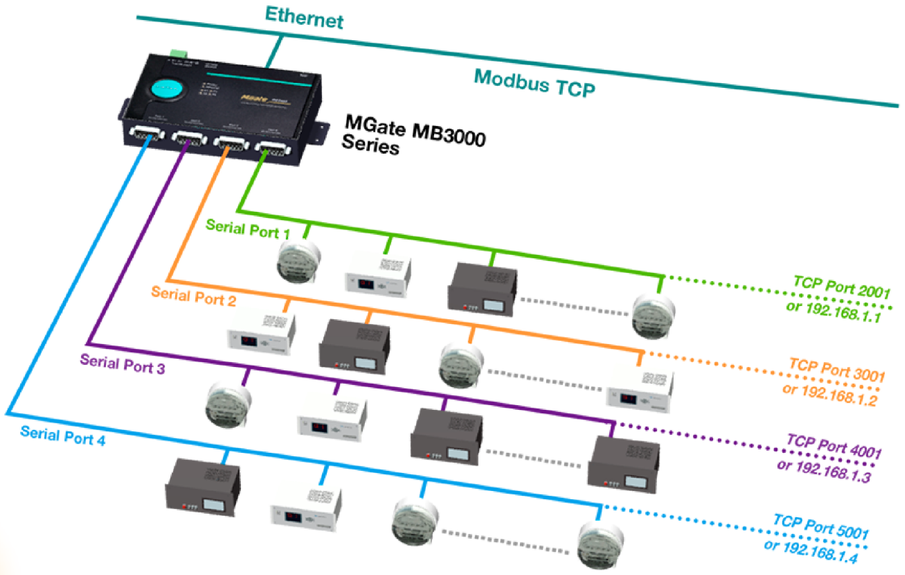
常見的方案如：

Power Purchase Agreement, PPA

https://voltstarsolar.com

Architecture





透過使用傳統的 **Modbus RTU 協議**，使用者可以無需購買昂貴的智慧裝置，繼續使用穩定、簡單、便宜的設備。同時也免除廠商綁定 (vendor lock-in) 的風險，透過額外的工業電腦，將資料擷取、處理後，傳送到雲端。

FAQ

Email Adress

zackyl.shih@moxa.com