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基於微服務之可信任邊緣運算裝置管理系統

Trusted Edge Computing Device Management System Based on Microservices

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作品摘要

現今邊緣運算裝置的數量大量增加，相應的邊緣運算裝置運行的穩定性和可靠性也愈來愈要求，對裝置狀態監測與信息管理技術也變得更加複雜。此外，面對多樣的硬體平台及應用情境，遠端邊緣運算裝置管理系統因相容性問題，開發複雜度提升許多。

許多廠商在產品部署出去後，在管理上面臨許多問題，如邊緣運算裝置故障死機，如何故障排除檢修與重新開機，減少人員到事發點維修的人力成本與時間耗費是問題之一。因此，本團隊擬掌握這個契機，設計與實作一個基於微服務之可信任邊緣運算裝置管理系統與隨插即用裝置，實現邊緣運裝置快速部署與汰換機制、資料安全傳輸、遠端監控管理、遠端故障排除，預警管理等高彈性化管理服務，有效管理、控制、部署與應用邊緣運算裝置，達成智慧物聯網落地實現。

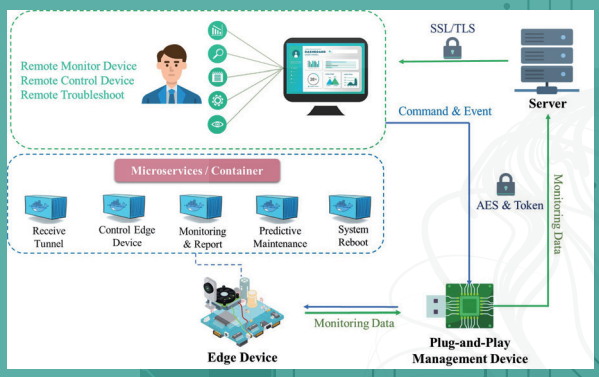
基於微服務之可信任邊緣運算裝置管理系統的架構主要分為三個部分：隨插即用硬體管理裝置、容器虛擬化部署技術結合微服務、雲端管理平台。

1.隨插即用硬體管理裝置：該裝置具備有效監控、遠端控制和自動回報邊緣運算設備的運行狀況，以減少維護成本。而在資料傳輸的過程中，需要確保資料傳輸的安全性與可靠度。因此，引入可信任平台模組（Trusted Platform Module，TPM）的設計概念，由硬體端直接提供加密功能，增加其可信度與使用性。

2.容器虛擬化部署技術結合微服務：在邊緣運算裝置上的部署與雲端管理平台的設計，本團隊採用Docker虛擬化技術和微服務架構結合，將複雜的應用程式分離為輕量級且每個元件獨立執行，最大程度地減少了不同組件之間的相互依賴性，單一服務的故障並不會影響整個系統運作，從而使其操作具有高彈性和安全性。

3.雲端管理平台：透過直覺式的方式呈現，幫助管理者可以在遠端監控和管理邊緣運算裝置，平台功能包含：即時性資訊，歷史數據查詢，遠端控制、遠端系統重啟以及系統健康檢查。

由於現今邊緣運算管理裝置需執行龐大的運算，管理服務的性能開銷必須要減少，因此本團隊針對CPU、磁盤I / O和內存和功耗進行數據收集並分析，結果顯示部署本團隊開發的邊緣運算裝置管理服務的性能消耗幾乎可以忽略不計。



▲圖一 系統架構圖

指導教授

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成功大學電腦與通信工程博士，現為高雄科技大學智慧商務系助理教授。曾任圓剛科技公司遠見實驗室主管，開發內容為嵌入式系統研發、Linux 影音擷取卡驅動程式研發、人工智慧嵌入式系統整合應用、人工智慧深度學習演算法研發及客戶技術服務。目前著重於微控制器、嵌入式系統與人工智慧演算法之間的整合應用議題。

研究領域

物聯網、機器學習、深度學習、電腦視覺

Abstract

Nowadays, the number of edge computing devices has greatly increased, and the stability and reliability of the corresponding edge computing devices have been than even, and the device status monitoring and information management technologies have become more complicated. In addition, in the face of diverse hardware platforms and application scenarios, the development complexity of the remote edge computing device management system has increased a lot due to compatibility issues.

Many manufacturers face many problems in management after the product is deployed. For example, the edge computing device fails and crashes. One of the problems is how to troubleshoot, repair, and restart to reduce the labor cost and time consumption of personnel to the point of the incident. Therefore, the team intends to grasp this opportunity to design and implement a trusted edge computing device management system based on microservices and plug-and-play devices to achieve rapid deployment and replacement of edge devices, secure data transmission, and remote monitoring management, remote troubleshooting, early warning management and other highly flexible management services. Through this device, you can effectively manage, control, develop, and apply the connected operating device to realize the intelligent Internet of Things.

The architecture of the trusted edge computing device management system based on microservices is mainly divided into three parts: “plug and play hardware management device”, “container virtualization deployment technology combined with microservices”, and “cloud management platform”.

1. Plug and Play Hardware Management Device: There are equipped with effective monitoring, remote control and automatic reporting of the operating status of edge computing equipment on the device to reduce maintenance costs. In the process of data transmission, it is necessary to ensure the safety and reliability of data transmission. Therefore, the design concept of Trusted Platform Module (TPM) is introduced, and the encryption function is directly provided by the hardware side to increase its reliability and usability.

2. Container virtualization deployment technology combined with microservices: On the deployment on the edge computing device and the design of the cloud management platform, we use the combination of Docker virtualization technology and microservice architecture to separate complex applications into lightweight, and each component executes independently. It can sufficiently reduce the interdependence between different components. The failure of a single service will not affect the operation of the entire system. Instead, the operation is highly flexible and safe.

3. Cloud Management Platform: Presented in an intuitive way, it helps managers to remotely monitor and manage edge computing devices. Platform functions include: real-time information, historical data query, remote control, remote system reboot and system health examination.

Since today’s edge computing management devices need to perform huge operations, the performance overhead of management services must be reduced. Therefore, we collected and analyzed data for CPU, disk I/O, memory and power consumption. The results showed that the performance consumption of edge computing devices developed by us is almost negligible.