Conceptual Model of Real Time Infrastructure Within Cloud Computing Environment

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Abstract

Cloud computing is a new and most demandable technology in communication environment. Where computing resources such as hardware or/and software are processed as service over networks. SCADA implementation within cloud environment is relatively new and demandable over real time infrastructure (industrial infrastructure).The shifting (moving) of SCADA system (applications and resources) within cloud based infrastructure,meanfully overcome the cost and improve the reliability and performance of whole system. Cloud computing provides on-demand network access and batch of computing services for SCADA system. The current research paper takes two conceptual ideas to implement SCADA system within cloud computing (Hybrid Cloud) environment. In the first phase, SCADA applications are processed entirely inside the hybrid cloud. In the second phase, SCADA applications are running in separate application server directly connected to devices in a SCADA network and rest of paper discusses the security related to SCADA and cloud computing communication.

Keywords: Cloud Computing, SCADA (Supervisory Control and Data Acquisition), Prevention and Detecteion System,Security attack/issues.

1. INTRODUCTION

"Supervisory control and data acquisition (SCADA) system has been deployed/implemented over several real time infrastructures and the field devices that are connected within network(LAN/WAN) are control and monitor from central location (SCADA master station). Supervisory control and data acquisition (SCADA) system architecture has five main components such as master station, remote station, user interface/human machine interface (HMI), Historian/database, and communication media (network), these are used to provide communication within SACDA system" [8],[11].

Information Technology industry is becoming broader and used in many areas of daily life activities. Cloud computing as one of new IT Models is widely used in different area including software and hardware delivery model. Cloud computing provides end users with fixable and scalable sharable computing services. In study [1], for application development process, the developers no need to own all requirements of application building. Instead of that they can use well established development environment available in the cloud (PaaS) platform as service [2]. GAE, Microsoft Azure are some PaaS example .Similarly, several tenants are able to share same application software simultaneously based on payment as usage agreement [3], which called (SaaS) software as a service [4]. In addition to that, using computing Infrastructure resources is available on cloud Infrastructure as a service (IaaS)[3]. This can provide end users with latest computing technologies based on client and provider agreement .PaaS provider such as GoGrid, Flexiscale, and Layered Technologies etc. Cloud deployment model is divided into four models, public, private, community and hybrid. In public the cloud services offered by third-party provider who own the cloud infrastructures. Moreover, end users are able to utilize cloud services located in Off-premise location. The main disadvantage (drawback) in public cloud model is weakness of access security model[5].In private and hydride cloud, cloud services can offered by the origination or by third party and the same thing for cloud Infrastructure ownership. Cloud services can be Off-premise or On-premise. The main advantage in this model; resources access and consumption are more trustable than public[5].

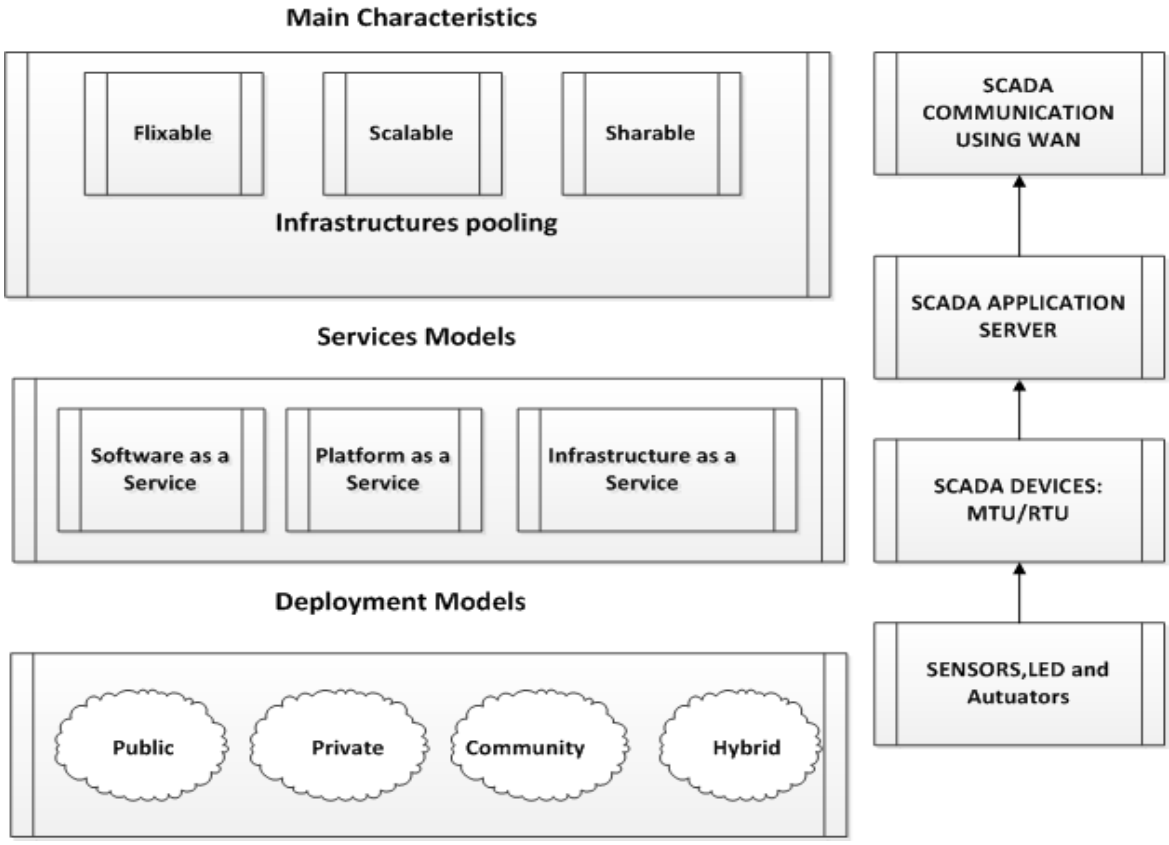

FIGURE 1: SCADA and Cloud Architecture.

2. LITERATURE REVIEW

"Greenville Utilities Commission (GUC)" [1], they suggest integration of SCADA with open cloud technology which give a new opportunity to current business to add new value to their investments and increase their productivity . They can get more benefit from historical data

existed in cloud to make their business more successful and more concurrent about OS and platform SCADA (in cloud).This also help GIS to get real time SCADA map, and help also LIMS to obtain real time report to their laboratory data and SCADA process and help also CMMS systems to organize maintenance works based on real time data and end customers can get their SCADA invoice easily using cloud. When several of SCADA system is sharing infrastructure on cloud that can reduce the cost of all single system infrastructures. SCADA in cloud give a Decision-makers vision about computation of real time data weather forecasting and electrical usage rate to make decisions and thus reducing the cost.

In [2], Smart grid is kind smart electrical networks, it use IS (Information system) to enhance its effectiveness. It give consumers kind of connectivity. Using smart grid applications in cloud is discussed. The security is one of challenges to involve smart grid in cloud so, paper has proposed a frame work to handle this problem.

In[3] , the paper argue that there is an urgent need to scalability features in Smart Grid management . The cloud computing paradigm is able to offer this feature but it still suffers from some shortages. The most important one is security obstacles. Moreover, the paper also argues that when this problem is solved smart grid management system in the cloud can be more effective.

“VS-Cloud” has been proposed to shift SCADA system within cloud computing environment for SCADA efficiency enhancement and for the purpose of reliability, but security is the major problem consider within communication [4]. The results have been captured, based on power consumption and cloud architecture performance in power system within grids network communication [5].

In [6], SCADA applications(softwraes) are completely install within cloud computing environment rather than traditional computer system.No longer need to update computing resources in case of needs instead cloud infrastructure can be used. In addition, with cloud cost of IT staff can be reduces as well. SCADA Staff collaboration can be easily done in cloud regardless of the time and location of communicating. However, some of obstacles is still in cloud which make many reluctant to use SCADA in cloud such as reliability, security, performance challenges. Some of security risk such as lack in privacy and weakness in performance such as bandwidth overload and latency cased by losing internet connection.

In [7], Microsoft has proposed to oil and gas company using a new cloud based SCADA system. This system connected with HMI station and RTU terminal. It also includes online cloud based SCADA system offering end user with historical data. End can user just kind of thin client station to get a required report in easy way. This system offer high reliability through databases redundancy and synchronously.

Cryptography solution has been successfully implemented “between master terminal unit (MTU) and remote terminal units (RTUs) and/or remote terminal units (RTUs) and master terminal unit (MTU)”. The implementation successfully achieved the security services and overcomes the attacks related with SCADA communication [9]. Another research also successfully implemented the cryptography solution within the layers (application layer and data link layer) of distributed network protocol (DNP3). The implementation within DNP3 layers successfully enhance the SCADA security, achieved the security services and minimized the attacks ratio of DNP3 as part of SCADA system [11].

3. CONCEPTUAL IMPLEMENTATION

A proposed conceptual idea, used to connect Malaysian eight states ports such as Johor, Kedah, Kelantan, Malacca, Pahang, Perak, Penang and Terengganu together connected with head quarter which is located in Kuala using hybrid cloud computing infrastructure. These ports are based on SCADA implementation using TCP/IP connectivity with WAN or Internet.

Each port has an own private cloud and every cloud is connected with headquarter cloud (public cloud) in Kuala Lumpur, same as distributed SCADA application in cloud infrastructure. In first phase illustrated in figure 2; all SCADA applications (such as HMI software, reporting, monitoring, visualization and execution etc) are processed entirely inside cloud and simultaneously all processing will save in headquarter (Kuala Lumpur) for monitoring and backup storage using WAN and allow remote user to interact with SCADA. Each time when communication will occur between Master Terminal Unit and Remote Terminal Unit are preceding using cloud [10]. In the second phase illustrated in figure 5, SCADA applications are running in separate application server directly connected to devices in SCADA network [10], and send Information to cloud for monitoring and storage and simultaneously all processing will save in headquarters (Kuala Lumpur). SCADA implementation within cloud computing is new technology and processing is quite different from traditional networks. SCADA solution providers and users have adopted this

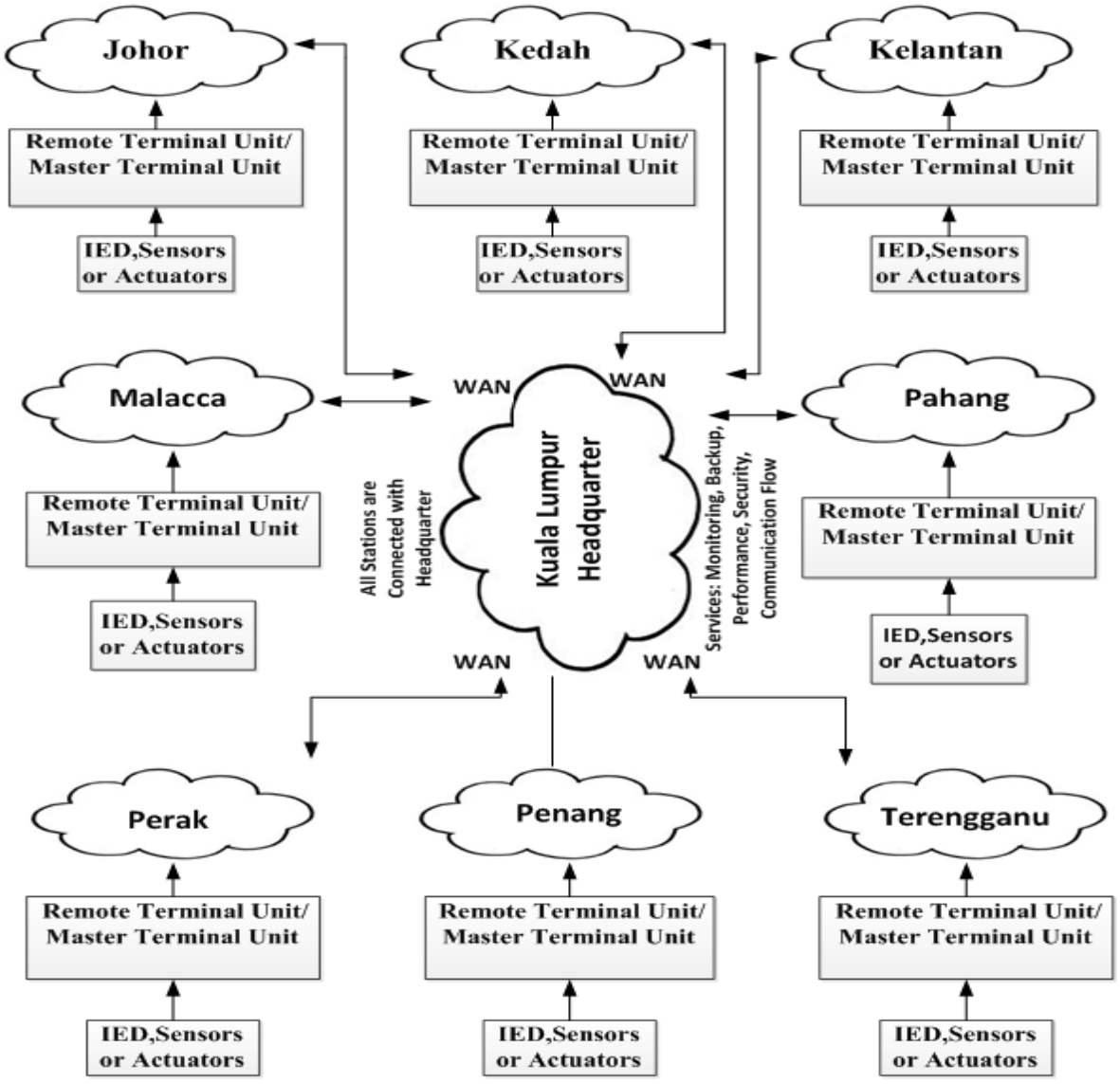

FIGURE 2: Cloud Base SCADA System (Phase 1).

technology to save costs, scalability, reliability, and enhance performance results. Security is a big issue in SCADA within the cloud as compared with traditional networks because of SCADA

systems are based on real time delivery of message/data but the TCP / IP protocol doesn't provide functionality related to real time Message delivery such as DNP3, Modbus, Field bus and other SCADA protocols.

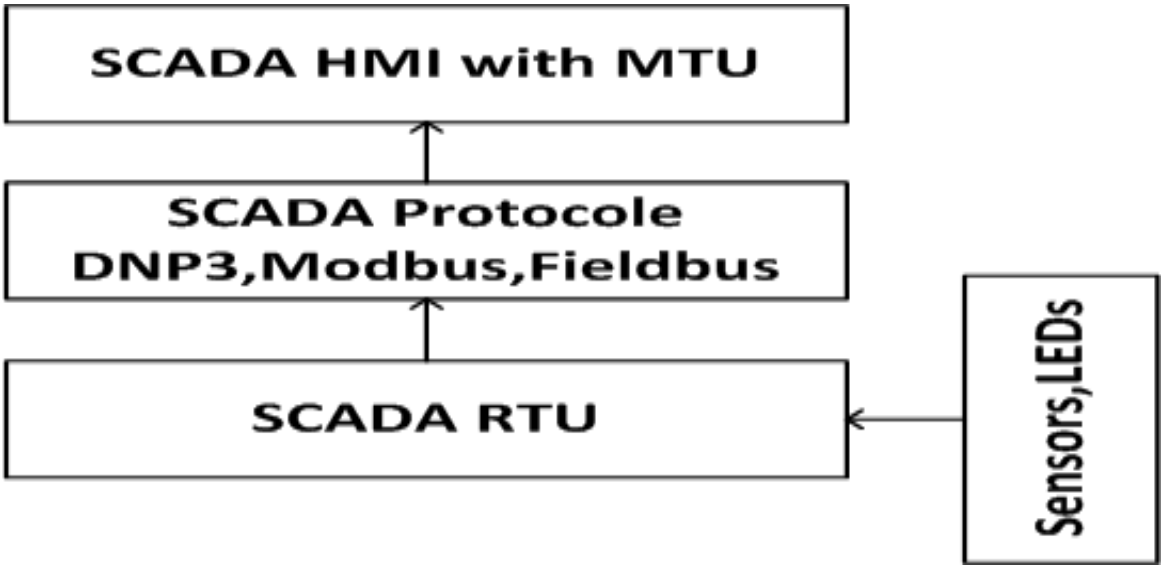

FIGURE 3: SCADA Communication.

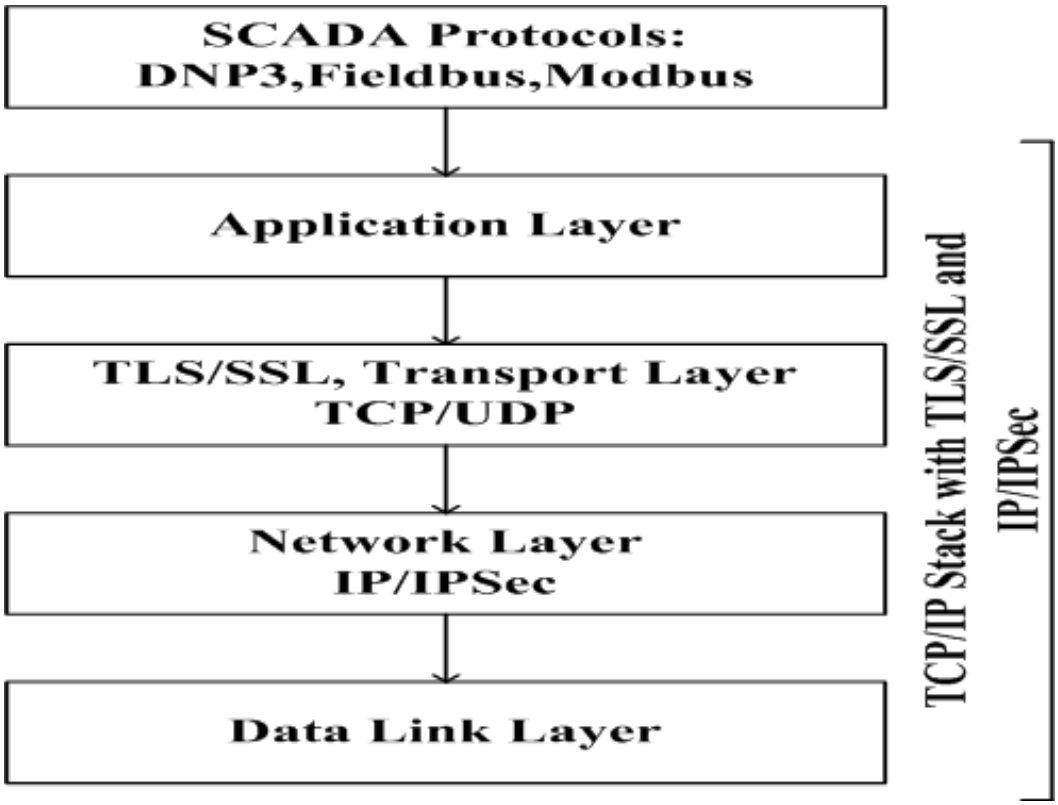

FIGURE 4: SCADA Communication with TCP/IP Stack.

Each private cloud and headquarter cloud (public cloud) Uses SSL/TLS in their communication (Illustrated inFigure 4). However, the SSL / TLS protocol has limitations because the SSL / TLS protocol relies on transport protocols such as TCP/IP, and cryptography and signature algorithms for security purposes. So, the best solution / approach is to be used Cryptography or signature algorithms to secure SCADA communication within the cloud. Figure 3 illustrated the simple SCADA architecture connected with the MTU / RTU

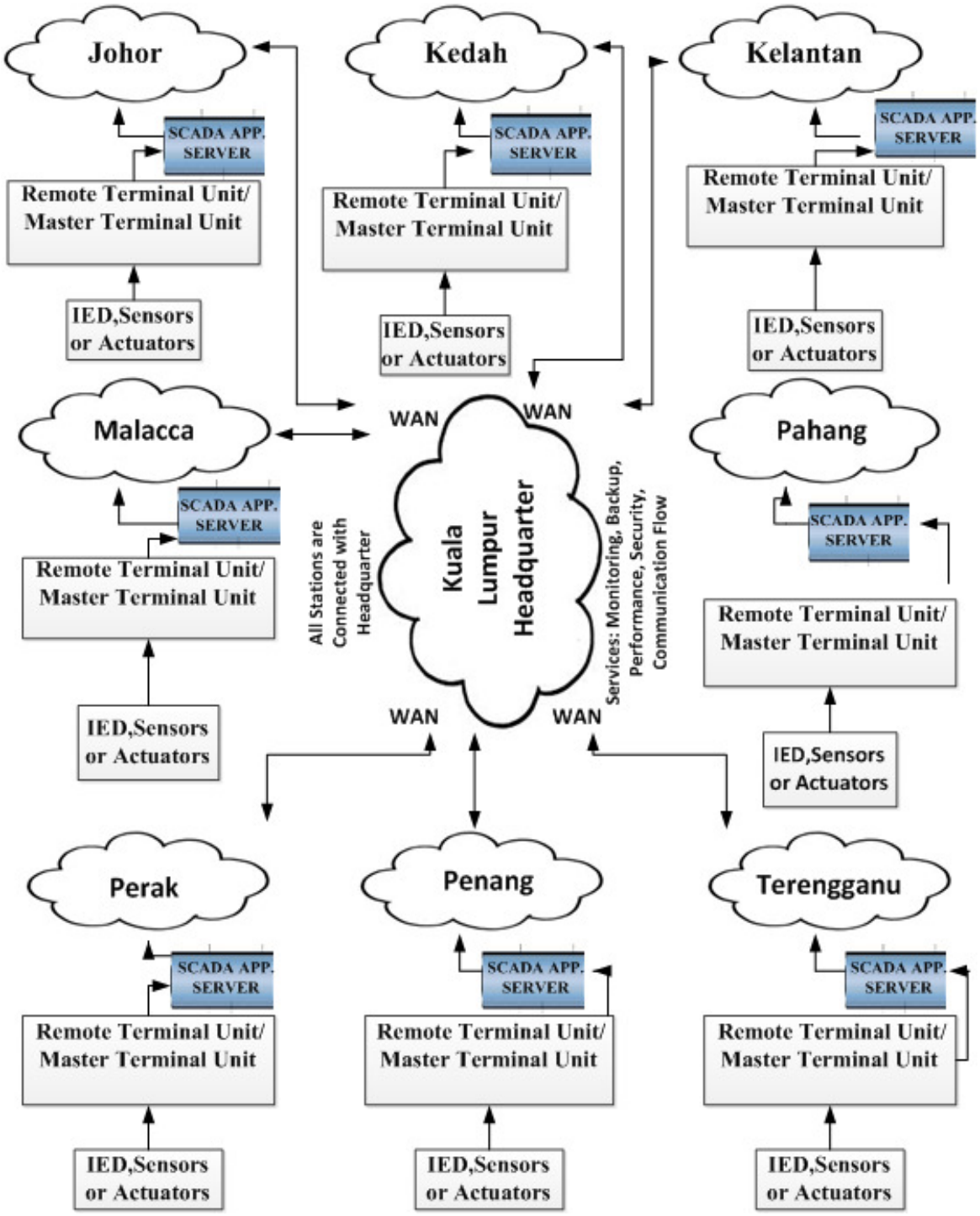

FIGURE 5: Cloud Base SCADA System (Phase 2).

4. CONCLUSION and FUTURE WORK

The implementation within cloud computing is new and demandable over real time infrastructure. Using cloud environment, SCADA overcomes the cost and improve the reliability and performance but the same time current platform has a lot of risks and security issues related to detection and prevention inside communication. Current research using SCADA within cloud environment ;gives new research direction for implementation of our proposed framework in real environment and directions to secure SCADA communication within cloud using TLS/SSL and more advance to apply cryptography and covariance mathematical model .

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