International Civil Aviation Organization

The Second Meeting of the Asia/Pacific Air Traffic Management Automation System Task Force (APAC ATMAS TF/2)

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Agenda Item 4: ATM Automation System Implementation by States

4.5 Emerging Technology Adaptations and Cybersecurity

THE IMPLEMENTATION OF VIRTUALIZATION TECHNOLOGY IN ATMAS TEST AND VALIDATE SYSTEM

(Presented by China)

SUMMARY

This paper presents the implementation of virtualization technology in ATMAS Test and Validate System (TVS), and analyzes and compares the two implementation methods of vSphere and docker.

1. INTRODUCTION

1.1 With the rapid development of computer technology, superfluous computer hardware performance and configuration provide capability to implement ATM automation system virtualization. Since automation system is the core system in ATM operations, the implementation of virtualization technology needs to be fully verified. Recently, ATMB has carried out the verification of virtualization technology in ATMAS Test and Validate System (TVS）.

1.2 TVS is generally used for new version software testing, fault investigation, system parameter adjustment, and technical training, etc. Adopting virtual machine technology, container technology and virtual network technology, which has been widely used in the field of cloud computing, the servers of TVS can achieve virtualization. The TVS with virtualization technology can reduce the hardware cost and improve the server utilization. At the same time, it can also complete the test task with full function and performance equivalent to the running platform.

2. DISCUSSION

2.1 Introduction of Virtualization Technology

2.1.1 Virtualization has a broad meaning, abstracting any form of resource into another form can also be regarded as virtualization technology. For server virtualization, there are two mainstream technical routes, virtual machine and container technology.

2.1.2 Virtual Machine Technology abstracts one server into multiple servers to achieve server reuse. Virtual machine software can simulate a complete computer system with complete hardware functions and running in a completely isolated environment. Common virtual machine solutions include VMware's vSphere, RedHat's KVM, Microsoft's Hyper-V, Oracle's VirtualBox, etc.

2.1.3 Container Technology is a virtualization technology on application layer, which can encapsulate some applications with specific functions in a customized container. It can be regarded as a lightweight virtual machine technology. Docker is currently the most successful open source container technology. Compared with virtual machine, its biggest advantage is lightweight, which is embodied in small file volume, fast startup speed, less resource occupation and so on.

2.1.4 Figure 1 shows the architecture comparison of two virtualization technology routes: virtual machine and container.

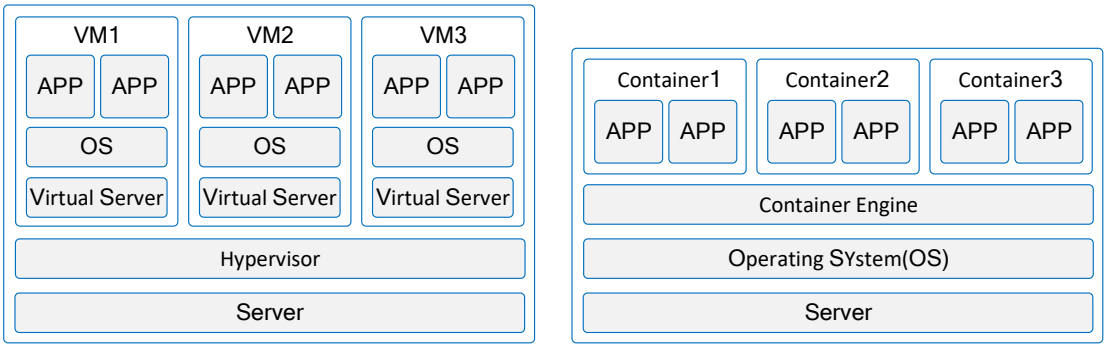

Figure1. Comparison of virtual machine and container architecture

2.2 Implementation of TVS based on Virtual Machine Technology

2.2.1 Figure 2 shows the architecture of TVS based on vSphere virtual machine.

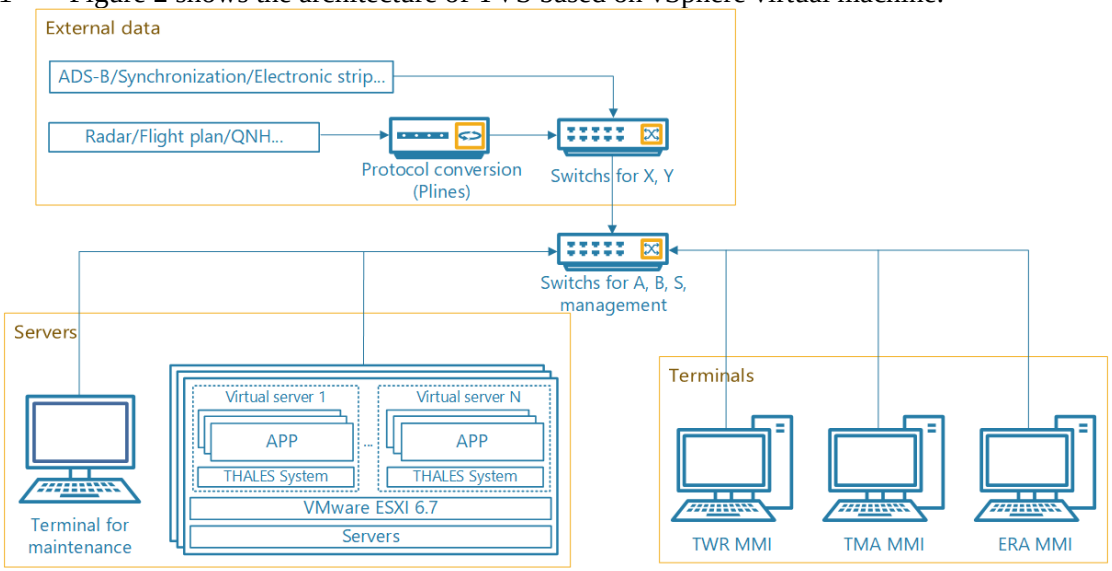

Figure 2 the architecture of TVS based on vSphere virtual machine.

2.2.2 To virtualize the ATM automation system's server with vSphere virtual machine software, it needs to complete disk array configuration, system and software integration, virtual network configuration, etc. Using two servers can cart the workload of the original 10 servers. While greatly reducing the number of servers, the TVS is realized to simulate the same running environment as the running system.

2.3 Implementation of TVS based on Container Technology

2.3.1 Figure 3 shows the architecture of TVS based on Docker container technology.

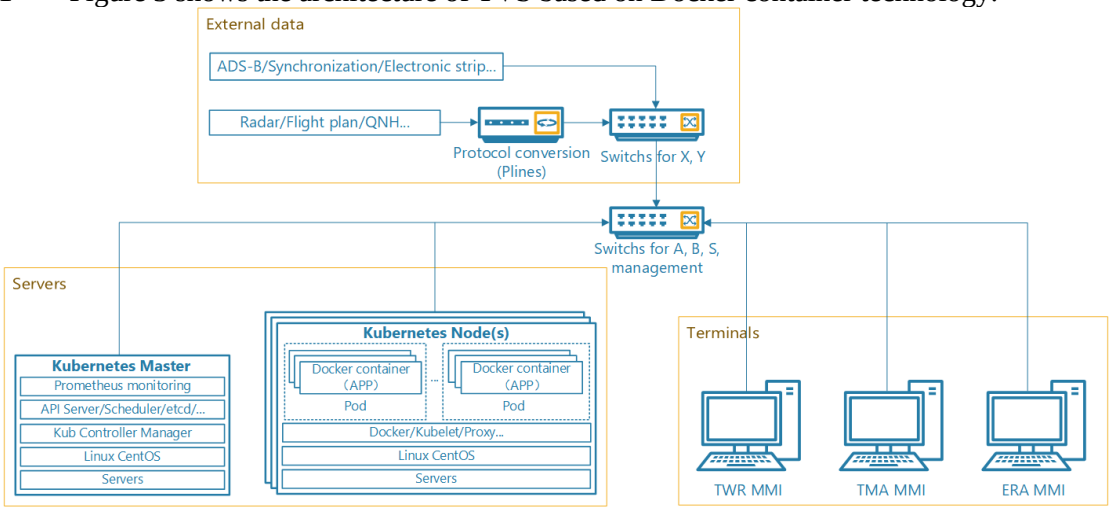

Figure 3 the architecture of TVS based on docker container technology.

2.3.2 The docker container engine can be used to virtualize the Redhat 7 operating system. First, install the Redhat 7 operating system on the server and deploy the docker container engine on it. Then, encapsulate the file system of each server of the TVS into docker image, completing the startup file, configuring the virtual network between containers. Finally, the services and applications of TVS can start in the form of containers. The test results show that comparing with virtual machines, servers of the same configuration can host more than three times of containers

2.4 Summary and Prospect

2.4.1 No matter what kind of virtualization technology, its purpose is to divide the server into smaller computing units to achieve better efficiency and more flexible deployment. Table 1 shows the comparisons of technical indicators between virtual machine and container virtualization technology. It can be concluded that compared with traditional virtual machine solutions such as physical environment, VMware or vSphere, docker container engine has the advantages of fast start-up and deployment, strong portability and strong scalability. However, Docker cannot replace traditional virtual machine technology in all application scenarios, compared with the vSphere or KVM, continuous improvement is needed in terms of system isolation, application and maintenance.

2.4.2 Table 1 Comparison of main indicators of three technical routes

Index	Server	Virtual machine	Container
The number of hardware	More	Less	least
The resources of system	100%	5%--15%	1%--5%
The time of start-up	Minute level	Minute level	Second level
Cost	High	Low	Very low
Portability	Not bad	Good	Good
Scale	Hardware	Operating system	Process

2.4.3 Using virtualization technology to build TVS, the complete ATM automation system can be achieved with less hardware. In addition, the same server cluster can even provide services for multiple systems at the same time which can not only reduce the coupling relationship between the system and hardware but also improve the flexibility and portability of deployment.

2.4.4 The implementation of virtualization technology in TVS can lay a solid foundation for further implementing in ATM automation system.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper; and

b) discuss any relevant matter as appropriate.

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