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High Availability Layers and Failure Recovery Timers for Virtualized Systems and Services

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Abstract

Highly available virtualized systems and services are required for applications that are sensitive to down time. The availability of virtualized systems and services needs to be on par with that for non-virtualized systems and services. However, high availability (HA) designs for virtualized systems and services are much more complicated than those for their non-virtualized counterparts due to the existence of independent multiple layers where each layer may have its own failure recovery mechanism.

This paper defines a novel approach to the design of highly available virtualized systems and services. The recovery from failures is self-coordinated. There are no race conditions among layers.

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Keywords: Availability; Timer; Failure; Recovery; Virtualized; Systems; Services

1. Introduction

High Availability (HA) is necessary for virtualized systems and services to minimize their down time. The availability of virtualized systems and services needs to be on par with that for non-virtualized systems and services. However, high availability (HA) designs for virtualized systems and services are much more complicated than their non-virtualized counterparts due to the existence of independent multiple layers where each layer may have its own failure recovery mechanism [3-7].

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High Availability designs that are focused on one or two layers such as only applications, servers, or their combinations are inadequate addressing high availability of Virtualized Systems and Services. HA designs need to address all layers, end-to-end service level, and coordination among layers.

In this paper, for the first time we define High Availability Layers for Virtualized Systems and Services, and associated failure recovery timers. Furthermore, for the first time we define guidelines for the relationships among these timers to ensure that the failure recoveries of one or more layers are self-coordinated and there are no race conditions among layers. When there is a race condition, incomplete switchover and fluctuations (i.e. back and forth between Primary and Secondary units) are highly likely.

2. Layering of Virtualized Systems

Layers of a virtualized system supporting virtual services (i.e. cloud services [2]) riding over connections are depicted in Figure 1. Virtual Machines (VMs) are created on top of a virtualization layer, which is formed of a hypervisor, providing a virtual representation of hardware and operating system underneath. Applications in the form of VNFs (Virtual Network Functions) built on top of VMs terminate connections between the user and the application or between applications in a service chain of multiple VNFs.

Hardware and Operating System Layers are considered as one layer, INF-L.

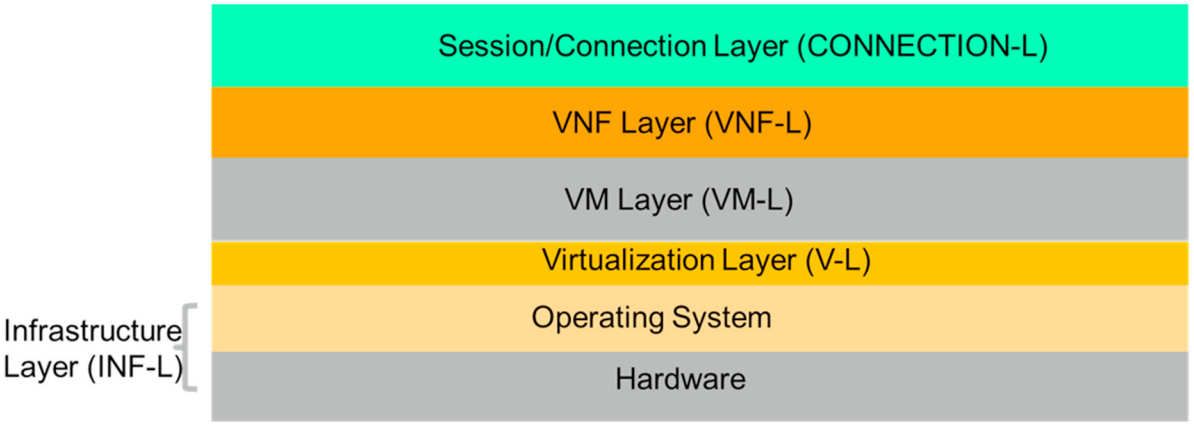

Figure 1: Virtualized System Layers [1]

The functionalities of each layer for high availability are as follows [1]:

- **Hardware Layer (INF-L):** This layer is responsible for detecting failures in hardware such as CPU, memory, physical interfaces, Small Form-factor Pluggables (SFPs), etc.; generating traps/messages and forwarding them to the Controller or Orchestrator; and switchover from failed Primary to Secondary or vice-versa.

- **Operating System Layer (INF-L):** This layer is responsible for detecting failures in Operating System (OS), generating traps/messages and forwarding them to the Controller or Orchestrator; and switchover from failed Primary to Secondary or vice-versa.

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