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***Software Requirements Specification***

***(SRS) Document***

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## **1. Introduction**

This document outlines the design, functionality, and operational details of the **Proxmox Virtual Environment (PVE)** hosted locally on **jw.cybersentinel.net (192.168.56.60)**. The system is built to leverage **high-performance computing** for virtualization, AI workloads, and cybersecurity testing.

## **2. General Description**

Proxmox VE is an **open-source hypervisor** combining **KVM (Kernel-based Virtual Machines)** and **LXC (Linux Containers)** with storage, networking, and security features. It is deployed on **high-end hardware** to support intensive workloads, including:

* **Virtualization using KVM and LXC**
* **GPU passthrough for AI, ML, and cybersecurity applications**
* **Enterprise-grade network and storage configurations**
* **Integrated web-based management interface**
* **Role-based access control (RBAC)**
* **Snapshot and backup management**

## **3. System Requirements**

### **3.1 Hardware Specifications**

Your **Proxmox environment** is running on a **high-performance workstation** with the following specs:

* **Processor:** AMD Ryzen 9 5950X (16 cores, 32 threads)
* **RAM:** 96GB DDR4
* **Storage:** 20TB (NVMe SSDs + HDDs)
* **GPU:** NVIDIA RTX 3090 Ti (for GPU passthrough & AI workloads)
* **Network:** 10GbE capable

### **3.2 Software Stack**

#### **Linux VMs**

* **Ubuntu 24.04.2 Desktop** (ubuntu-24.04.2-desktop-amd64.iso)
* **Kali Linux 2024.4** (kali-linux-2024.4-installer-amd64.iso)
* **pfSense** (pfsense\_installer.iso)
* **CentOS 7 Minimal** (CentOS-7-x86\_64-Minimal-2009.iso)

#### **Windows VMs**

* **Windows 10 Workstation Enterprise** (Windows10\_WorkStation\_Enterprise.iso)
* **Windows Server 2019 (Domain Controller)** (Domain\_Controller\_2019.iso)

### **Potential Use Cases for Your Proxmox Setup**

* **AI/ML Workloads:**
  + Set up **Ubuntu 24.04 LTS** with **CUDA, cuDNN, and TensorFlow/PyTorch** for **AI model training**
* **Network Security & Pentesting:**
  + Use **Kali Linux + pfSense** to simulate **real-world attack/defense scenarios**
* **Windows Domain Testing:**
  + Set up **Windows Server 2019 as a Domain Controller** and connect **Windows 10 Workstation** for **Active Directory la**

## **4. Functional Requirements**

* Create and manage multiple VMs and containers efficiently
* Enable GPU passthrough for AI and machine learning workloads
* Configure network isolation and VLANs for cybersecurity testing
* Automate backup and disaster recovery solutions
* Monitor resource usage dynamically

## **5. Proxmox Environment Overview**

### **5.1 Virtual Machines and Containers**

* **VMs:** Used for Windows/Linux-based services, AI training, cybersecurity tools
* **LXC Containers:** Lightweight applications, firewalls, and network services

### **5.2 Networking Configuration**

* Bridged networking (vmbr0) for LAN connectivity
* VLANs for network segmentation
* pfSense firewall for routing and security management
* 10GbE networking for high-speed data transfer

### **5.3 Storage and Backup Solutions**

* ZFS for redundancy and performance optimization
* NVMe SSDs for AI/ML workloads
* HDDs for archival and long-term storage
* Automated vzdump-based backups with offsite storage support

### **5.4 Security and Access Control**

* RBAC implemented for multiple user roles
* Two-Factor Authentication (2FA) for admin access
* Proxmox firewall rules for VM protection
* Isolated lab environment for cybersecurity testing

## **6. Performance Requirements**

* Optimized CPU threading for VM workloads
* Dynamic memory allocation using ballooning
* Disk I/O monitoring and optimization via ZFS ARC caching
* GPU passthrough for AI workloads and high-performance computing

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## **7. Non-Functional Attributes**

### **7.1 Security Considerations**

* Strict authentication policies for remote access
* Encrypted backups for data security

### **7.2 Reliability and Maintainability**

* Proxmox updates and patching scheduled
* RAID and ZFS snapshots for fault tolerance

### **7.3 Resource Utilization**

* 96GB RAM allows high-performance VM operations
* Proxmox dashboard for real-time monitoring

### **7.4 Portability and Scalability**

* Expandable storage up to 100TB
* Proxmox clustering support for multiple nodes

### **7.5 Serviceability and Support**

* Community and enterprise support available
* Automated system monitoring via Proxmox API

## **8. Operational Scenarios**

### **Scenario 1: Deploying a New VM**

1. Create VM in the Proxmox GUI
2. Assign CPU, RAM, and GPU passthrough settings
3. Configure VLAN-based networking
4. Install OS and optimize settings

### **Scenario 2: Configuring a Virtualized Firewall (pfSense)**

1. Deploy pfSense as a VM
2. Set up VLANs and network segmentation
3. Configure firewall rules for security isolation

### **Scenario 3: AI/ML Workload with GPU Passthrough**

1. Deploy Ubuntu VM with CUDA support
2. Pass RTX 3090 Ti GPU to the VM
3. Optimize drivers and allocate compute resources
4. Run AI training workloads

## **9. Use Case Models and Diagrams**

### **9.1 Use Case Model**

**Actors:** System Administrator, Data Scientists, Cybersecurity Engineers  
 **Use Cases:**

* Create VMs and containers
* Assign GPU resources
* Configure network isolation
* Backup and restore VMs

### **9.2 Sequence Diagrams**

(Include a visual diagram for VM deployment and resource allocation)

## **10. Deployment and Network Setup**

* Bridged networking (vmbr0) for external connectivity
* pfSense manages internal firewall and VLAN segmentation
* ZFS-backed storage for VM disks and snapshots
* GPU passthrough for AI/ML VMs

## **11. Updated Schedule**

The updated **PERT/GANTT chart** is attached at the end of the document.

## **12. Updated Budget**

|  | Component | Price | Current |
| --- | --- | --- | --- |
| 1 | Motherboard - ASUS Prime X570-Pro | $630.99 | YES |
| 2 | GPU - ASUS ROG STRIX RTX 3090 TI White OC | $1999.99 | YES |
| 3 | RAM - Timetec Pinnacle Konduit RGB 64GB (4x32GB) | $220.99 | YES |
| 4 | Power Supply - Corsair HX1200 1200W 80+ Platinum | $340.99 | YES |
| 5 | SSD - WD\_BLACK 2TB SN7100 NVMe | $139.99 | YES |
| 6 | SSD - WD\_BLACK 4TB SN7100 NVMe | $345.99 | YES |
| 7 | CPU Cooler - Corsair iCUE H150i Elite LCD XT - AIO | $438.99 | YES |
| 8 | CPU Cooler - NZXT Kraken X73 RGB 360mm - RL-KRX73-RW - AIO | $234.99 | NO |
| 9 | Case Fans - Lian Li UNI Fan SL120 V2 RGB White (Triple Pack) x2 | $230.99 | YES |
| 10 | Case Fans - Thermaltake SWAFAN EX 12 | $109.99 | NO |
| 11 | Hard drive - Seagate Desktop Drive 8000 GB 8TB external Hard Drive | 169.99 | YES |
| 12 | PC case - Lian Li PC-O11DW 001 | $120.99 | YES |
| 13 | CPU - AMD Ryzen 5950X 16-core, 32-thread | $348.00 | YES |
| 14 | Motherboard - ASUS Prime X670E-Pro | $259.99 | NO |
| 15 | TOTAL | $5,592.87 | YES |

## **13. Appendices**

### **13.1 Definitions, Acronyms, Abbreviations**

* **PVE:** Proxmox Virtual Environment
* **LXC:** Linux Containers
* **KVM:** Kernel-based Virtual Machine
* **IDANRV:** Intellectual Disabilities Agency of the New River Valley
* **RBAC:** Role-Based Access Control
* **GPU Passthrough:** Direct assignment of GPU resources to a VM for high-performance workloads