

Technology Stack Specification – LVHN eKVM Remote Update

Document Control - Version: 1.0 - **Date:** 2025-11-11 - **Classification:** Internal – Technical Specification - **Owner:** Ionic Engineering Team - **Platform:** Microsoft Windows

Configuration Custody Notice

Ionic Health engineering exclusively manages all eKVM configuration, firmware, and software changes, including patching operations executed via the jumper server. LVHN operations is solely responsible for provisioning, hardening, and maintaining the Windows jumper server in line with the requirements defined in this specification. Any cross-domain action demands documented approval from both organizations.

Network Visibility Scope

The specification assumes Ionic Health requires no access to LVHN's internal network beyond the jumper server footprint and its controlled outbound route to Ionic eKVM devices hosted on public IP.

1. Executive Summary

This document defines the complete Microsoft Windows-based technology stack for the LVHN eKVM Remote Update project. All components are based on native Windows technologies to leverage existing LVHN infrastructure, minimize licensing costs, and align with LVHN IT expertise.

Core Principles: - **Native Windows:** Prefer built-in Windows features over third-party tools - **Zero New Agents:** No additional software installed on eKVM devices - **Enterprise-Ready:** Proven Microsoft technologies with long-term support - **Compliance-First:** FIPS 140-2, HIPAA, NIST SP 800-53 aligned - **Cost-Effective:** Leverage existing Windows Server licenses

1.1 Critical Infrastructure Ownership

IMPORTANT: Infrastructure Components are LVHN Responsibility

This document provides **RECOMMENDATIONS ONLY** for the following components. Final technology selection, procurement, configuration, and maintenance are **LVHN's sole responsibility**:

- **SSL VPN Solution** (e.g., Palo Alto, Cisco, Fortinet) – LVHN selects and manages

- **Privileged Access Management (PAM)** (e.g., CyberArk, BeyondTrust) – LVHN selects and manages
- **SIEM Platform** (e.g., Microsoft Sentinel, Splunk, QRadar) – LVHN selects and manages
- **Firewall** (e.g., Palo Alto, Cisco, Fortinet) – LVHN existing infrastructure
- **Active Directory** – LVHN existing infrastructure
- **DNS/DHCP** – LVHN existing infrastructure
- **Network Infrastructure** – LVHN existing infrastructure

Ionic Responsibilities: - Provide technical requirements and recommendations - Ensure eKVM devices are compatible with standard Windows protocols - Provide implementation guidance and best practices - Support eKVM device configuration within LVHN infrastructure

LVHN Responsibilities: - Select, procure, and deploy all infrastructure components - Configure and harden jumper server - Manage VPN, firewall, PAM, SIEM - Maintain compliance and security of infrastructure - Operational support and monitoring

2. Operating Systems

2.1 Windows Jumper Server

Recommended OS: Windows Server 2022 Standard Edition

| Component | Version | Justification |
|--------------------------|---|---|
| OS Edition | Windows Server 2022 Standard | Latest LTS release (support until 2031); includes all required features |
| Alternative | Windows Server 2019 Standard | If 2022 not available; support until 2029 |
| Build | 20348.x or later | Latest cumulative updates applied |
| Installation Type | Server Core (preferred) or Desktop Experience | Server Core reduces attack surface; Desktop Experience for GUI management |

Key Features Enabled: - Remote Desktop Services (RDP) - Windows Remote Management (WinRM) - File and Storage Services (SMB 3.1.1) - Windows Defender / Microsoft Defender for Endpoint - PowerShell 7.x - Event Log Forwarding

Hardening Baseline: - CIS Benchmark for Windows Server 2022 Level 1 (minimum) - Microsoft Security Compliance Toolkit (SCT) applied - STIG (Security Technical Implementation Guide) if DoD compliance required

2.2 eKVM Device OS

CRITICAL: eKVM OS is FIXED and NOT MODIFI- ABLE

The eKVM device operating system is pre-configured by Ionic and **cannot be changed** by LVHN. All configurations must work with the existing OS.

Fixed OS Specification (Provided by Ionic):

| Component | Specification | Notes |
|--------------------------|------------------------------|---|
| OS Edition | Windows 11 Pro | FIXED – Cannot be changed |
| Architecture | 64-bit | x64 processor architecture |
| Version | 24H2 | Latest Windows 11 feature update (October 2024) |
| OS Build | 26100.4202 | Current build as of 2025-11-11 |
| Installation Type | Full Desktop Experience | Required for nCommand Lite GUI |
| Update Channel | General Availability Channel | Receives monthly cumulative updates |

Pre-Installed Windows Features (Cannot Modify): - Remote Desktop (RDP) – **CAN be enabled/disabled via configuration** - Windows Remote Management (WinRM) – **CAN be enabled/disabled via configuration** - SMB Client – Built-in, available for file transfer - Windows Defender Antivirus – Built-in, active by default

Important Constraints: - Cannot reinstall or change Windows edition - Cannot downgrade to Windows 10 - Cannot switch to IoT Enterprise or

LTSC - CAN enable/disable RDP, WinRM during maintenance windows -
CAN apply Windows Updates (monthly cumulative updates) - CAN configure
security settings (GPO, registry, firewall)

Compatibility Notes: - Windows 11 Pro includes all features required for this
project - RDP 10.12+ (native to Windows 11 24H2) - WinRM 3.0 (PowerShell
5.1 built-in) - SMB 3.1.1 with encryption support - TLS 1.3 support (native) -
FIPS 140-2 validated cryptographic modules

3. Remote Access Technologies

3.1 Remote Desktop Protocol (RDP)

Version: RDP 10.x (Windows Server 2022) / RDP 8.x (Windows Server 2019)

Protocol Stack:

| | |
|--------------------|--|
| Application Layer: | Remote Desktop Services (TermSvcs) |
| Security Layer: | TLS 1.2 / TLS 1.3 |
| Authentication: | Network Level Authentication (NLA) with Kerberos or NTLM |
| Encryption: | 128-bit AES (minimum), 256-bit AES (preferred) |
| Port: | TCP 3389 (default, can be changed) |

Configuration Parameters:

```
# Registry: HKLM\SYSTEM\CurrentControlSet\Control\Terminal Server\WinStations\RDP-Tcp
SecurityLayer = 2           # TLS
UserAuthentication = 1      # NLA required
MinEncryptionLevel = 3     # High (128-bit minimum)
fEnableWinStation = 1      # RDP enabled
```

Client Requirements: - Windows Remote Desktop Connection (mstsc.exe)
6.0 or later - Supports NLA (CredSSP or Kerberos) - TLS 1.2+ capable

Supported Operating Systems (Client): - Windows 10/11 Pro/Enterprise
(built-in) - Windows Server 2016/2019/2022 (built-in) - macOS: Microsoft Re-
mote Desktop (App Store) - Linux: Remmina, FreeRDP (with NLA support)

3.2 Windows Remote Management (WinRM)

Version: WinRM 3.0 (PowerShell 5.1+) / WinRM 5.1 (PowerShell 7.x)

Protocol Stack:

| | |
|--------------------|---|
| Application Layer: | WS-Management (SOAP-based) |
| Transport: | HTTP (port 5985) or HTTPS (port 5986) |
| Security: | Kerberos, NTLM, or CredSSP authentication |
| Encryption: | TLS 1.2+ for HTTPS transport |

Configuration:

```
# Enable WinRM with HTTPS
```

```
Enable-PSRemoting -Force
```

```
New-SelfSignedCertificate -DnsName "jumper-server-01.lvh.n.local" -CertStoreLocation Cert:\L
```

```
New-Item -Path WSMAN:\localhost\Listener -Transport HTTPS -Address * -CertificateThumbprint
```

Firewall Rules: - Port 5985 (HTTP) – Allow from jumper server IP only -
Port 5986 (HTTPS) – Preferred; allow from jumper server IP only

PowerShell Remoting: - New-PSSession, Enter-PSSession, Invoke-Command
- Copy-Item -ToSession / -FromSession for file transfers

3.3 Server Message Block (SMB)

Version: SMB 3.1.1 (Windows Server 2022) / SMB 3.0.2 (Windows Server 2019)

Protocol Features:

| | |
|---------------|------------------------------------|
| Version: | SMB 3.1.1 (dialect 311) |
| Encryption: | AES-128-CCM or AES-128-GCM |
| Signing: | Required for all connections |
| Port: | TCP 445 |
| Multichannel: | Enabled (for high-speed transfers) |

Security Configuration:

```
# Enforce SMB encryption
```

```
Set-SmbServerConfiguration -EncryptData $true -RequireSecuritySignature $true
```

```
# Disable SMB 1.0 (security risk)
```

```
Set-SmbServerConfiguration -EnableSMB1Protocol $false
```

Use Case: Alternate file transfer method when WinRM unavailable

4. File Transfer Technologies

4.1 HTTPS (Direct Download)

Technology: PowerShell Invoke-WebRequest / Invoke-RestMethod

Configuration:

```
# Download with TLS 1.2
```

```
[Net.ServicePointManager]::SecurityProtocol = [Net.SecurityProtocolType]::Tls12
```

```
Invoke-WebRequest -Uri "https://downloads.ionic.com/ekvm/firmware.exe" -OutFile "C:\Staging\
```

Requirements: - TLS 1.2 or TLS 1.3 support - Firewall allows HTTPS egress (port 443) to allowlisted domains - Proxy support (if required): -Proxy parameter

Allowlisted Domains: - downloads.ionic.com - cdn.ionic.com - updates.ionic.com

4.2 RDP Drive Mapping

Technology: Remote Desktop Services Client Drive Redirection

Configuration:

Group Policy: Computer Configuration

Administrative Templates

Windows Components

Remote Desktop Services

Remote Desktop Session Host

Device and Resource Redirection

Do not allow drive redirection = Disabled (during window)

Access Pattern:

\\tsclient\<drive-letter>\<path>

Example: \\tsclient\C\Downloads\firmware.exe

Security Controls: - Enable drive mapping only during maintenance window (GPO scheduled task) - Revert to “Do not allow drive redirection = Enabled” post-window - SIEM alert on any \\tsclient access outside approved operators

4.3 WinRM File Copy

Technology: PowerShell Remoting Copy-Item cmdlet

Syntax:

```
$session = New-PSSession -ComputerName ekvm-01 -Credential $cred
Copy-Item -Path "C:\Staging\firmware.exe" -Destination "C:\Temp\" -ToSession $session
Remove-PSSession $session
```

Performance: - Transfer speed: ~50-100 MB/s (depends on network) - Max file size: Limited by available memory (MaxMemoryPerShellMB) - Optimal for files: 10 MB - 500 MB

4.4 SMB File Share

Technology: Windows File Sharing (SMB 3.1.1)

Setup:

On eKVM (temporary share)

```
New-SmbShare -Name "eKVMUpdate$" -Path "C:\Temp\Update" -FullAccess "LVHN\admin" -EncryptData $true
```

On jumper server

```
Copy-Item -Path "C:\Staging\firmware.exe" -Destination "\\ekvm-01\eKVMUpdate$\\"
```

Cleanup

```
Remove-SmbShare -Name "eKVMUpdate$" -Force
```

Security: - Hidden share name (trailing \$) - SMB encryption enforced (-EncryptData \$true) - Temporary share (create/remove per device) - Least privilege access (specific user only)

5. Security Technologies

5.1 Encryption

| Component | Technology | Standard | Key Length |
|---------------------------------------|---------------------------------|----------------------|--|
| Transport Encryption (RDP) | TLS 1.2 / TLS 1.3 | IETF RFC 5246, 8446 | 128-bit AES (min), 256-bit AES (preferred) |
| Transport Encryption (WinRM) | TLS 1.2 / TLS 1.3 | IETF RFC 5246, 8446 | 128-bit AES (min), 256-bit AES (preferred) |
| File Transfer Encryption (SMB) | AES-128-GCM | SMB 3.1.1 spec | 128-bit AES |
| Hash Algorithm | SHA-256 | NIST FIPS 180-4 | 256-bit |
| Data at Rest (Jumper Server) | BitLocker | FIPS 140-2 validated | 128-bit or 256-bit AES |
| Data at Rest (eKVM) | BitLocker (if enabled by Ionic) | FIPS 140-2 validated | 128-bit or 256-bit AES |

PowerShell Hash Verification:

```
Get-FileHash -Path "firmware.exe" -Algorithm SHA256
```

5.2 Anti-Malware / Endpoint Detection and Response (EDR)

Primary Solution: Microsoft Defender for Endpoint (MDE)

| Component | Technology | Version | Deployment |
|-------------------------------------|---|----------------------------------|---|
| Antivirus Engine | Microsoft Defender Antivirus | Built-in to Windows 10/11/Server | Enabled by default |
| EDR Platform | Microsoft Defender for Endpoint Plan 1 or Plan 2 | Cloud-based | Optional (recommended) |
| Threat Intelligence Scanning | Microsoft Defender Threat Intelligence Real-time protection + on-demand scans | Cloud-updated N/A | Automatic updates Configured via GPO |

Alternative Solutions (if MDE not available): - Symantec Endpoint Protection - CrowdStrike Falcon - Trend Micro Apex One - Any FIPS 140-2 validated AV/EDR

Configuration:

```
# Enable real-time protection
```

```
Set-MpPreference -DisableRealtimeMonitoring $false
```

```
# Scan file before transfer
```

```
Start-MpScan -ScanPath "C:\Staging\firmware.exe" -ScanType CustomScan
```

```
# Check for threats
```

```
Get-MpThreat
```

Update Frequency: Daily definition updates (automatic via Windows Update)

5.3 Firewall

Technology: Windows Defender Firewall with Advanced Security

Management: - Local: wf.msc (Windows Defender Firewall with Advanced Security snap-in) - Group Policy: Computer Configuration → Policies → Windows Settings → Security Settings → Windows Defender Firewall - PowerShell: New-NetFirewallRule, Set-NetFirewallRule

Profile Configuration:

Domain Profile: Enabled (default deny inbound, allow outbound)
Private Profile: Enabled (default deny inbound, allow outbound)
Public Profile: Enabled (block all inbound, allow outbound)

Required Rules:

RDP (scoped to jumper IP)

```
New-NetFirewallRule -Name "RDP-Jumper-Only" -DisplayName "RDP from Jumper Server" `
                    -Enabled True -Direction Inbound -Protocol TCP -LocalPort 3389 `
                    -RemoteAddress 10.50.100.10 -Action Allow -Profile Domain
```

WinRM HTTPS (scoped to jumper IP)

```
New-NetFirewallRule -Name "WinRM-HTTPS-Jumper-Only" -DisplayName "WinRM HTTPS from Jumper Server" `
                    -Enabled True -Direction Inbound -Protocol TCP -LocalPort 5986 `
                    -RemoteAddress 10.50.100.10 -Action Allow -Profile Domain
```

Logging: - Path: %SystemRoot%\System32\LogFiles\Firewall\pfirewall.log
- Log dropped packets: Yes - Log successful connections: Yes (for RDP/WinRM rules)

6. Authentication & Identity

6.1 Active Directory (AD)

Role: Centralized user and computer account management

Domain Controller OS: Windows Server 2016/2019/2022 (LVHN responsibility)

Functional Level: - Domain Functional Level: Windows Server 2016 (minimum) - Forest Functional Level: Windows Server 2016 (minimum)

Account Types:

User Accounts: firstname.lastname@lvhn.local (UPN)
Admin Accounts: firstname.lastname.admin (JIT accounts)
Computer Accounts: JUMPER-SERVER-01\$ (jumper server), EKVM-DEVICE-01\$ (eKVM)

Group Policy Objects (GPOs): - GPO-Jumper-Server-Hardening -
GPO-eKVM-RDP-Hardening - GPO-eKVM-WinRM-Config - GPO-eKVM-Maintenance-Window
(time-based drive mapping)

6.2 Multi-Factor Authentication (MFA)

SSL VPN MFA: - **Technology:** LVHN SSL VPN solution (e.g., Palo Alto GlobalProtect, Cisco AnyConnect, Fortinet FortiClient) - **MFA Methods:** -

Hardware token (YubiKey, RSA SecurID) - Software token (Microsoft Authenticator, Duo Mobile) - SMS OTP (least preferred) - **Enforcement:** Mandatory for all VPN connections

Jumper Server MFA (Optional Enhancement): - **Technology:** Microsoft Entra ID (Azure AD) Multi-Factor Authentication - **Integration:** Windows Hello for Business or third-party MFA (Duo Security) - **Use Case:** Second MFA challenge when accessing jumper server via RDP

6.3 Privileged Access Management (PAM)

Recommended Solution: Microsoft LAPS (Local Administrator Password Solution)

Configuration:

Install LAPS on jumper server

Install-WindowsFeature -Name RSAT-AD-PowerShell

Import-Module AdmPwd.PS

Configure LAPS GPO

Set-AdmPwdComputerSelfPermission -Identity "OU=JumperServers,DC=lvhn,DC=local"

Alternative Solutions: - CyberArk Privileged Access Manager - BeyondTrust Privileged Remote Access - Thycotic Secret Server

JIT Account Workflow: 1. Operator requests JIT account (change ticket) 2. LVHN IT provisions `firstname.lastname.admin` with 4-hour expiration 3. Account disabled automatically at H+4 (post-window) 4. LAPS rotates local admin passwords daily

6.4 Certificate Services

Technology: Active Directory Certificate Services (AD CS)

Certificate Types:

1. RDP Server Certificate (jumper server, eKVM devices)
 - Subject: CN=jumper-server-01.lvhn.local
 - Key Usage: Server Authentication
 - Validity: 2 years
2. WinRM HTTPS Certificate (jumper server, eKVM devices)
 - Subject: CN=jumper-server-01.lvhn.local
 - SAN: DNS:jumper-server-01, DNS:jumper-server-01.lvhn.local
 - Key Usage: Server Authentication
 - Validity: 2 years

3. Code Signing Certificate (optional, for Ionic binaries)

- Subject: CN=Ionic Inc, O=Ionic, C=US
- Key Usage: Code Signing
- Validity: 3 years

Certificate Enrollment: - Automatic via Group Policy (computer certificates)

- Manual via `certreq` or MMC Certificates snap-in

Certificate Revocation: - CRL (Certificate Revocation List) published via HTTP - OCSP (Online Certificate Status Protocol) preferred

7. Monitoring & Logging

7.1 Windows Event Logging

Event Logs to Collect:

| Log Name | Key Event IDs | Retention (Local) | Forward to SIEM |
|---|------------------------------------|-------------------|-----------------|
| Security | 4624, 4625, 4634, 4672, 4688, 4776 | 90 days | Yes |
| System | 6005, 6006, 7036, 7040 | 90 days | Yes |
| Application | 1000, 1001, 1033, 1034 | 90 days | Yes |
| Microsoft-Windows-TerminalServices-LocalSessionManager/Operational | 21, 22, 24, 25 | 90 days | Yes |
| Microsoft-Windows-TerminalServices-RemoteConnectionManager/Operational | 21, 24, 25, 39, 40 | 90 days | Yes |
| Microsoft-Windows-PowerShell/Operational | 4103, 4104 (ScriptBlock Logging) | 90 days | Yes |
| Microsoft-Windows-WinRM/Operational | 6, 8, 142, 161 | 90 days | Yes |
| Microsoft-Windows-SMBServer/Operational | 1006, 1009 | 30 days | Yes |

Configuration:

```
# Enable PowerShell ScriptBlock Logging
Set-ItemProperty -Path "HKLM:\SOFTWARE\Policies\Microsoft\Windows\PowerShell\ScriptBlockLogging"
                 -Name "EnableScriptBlockLogging" -Value 1

# Enable PowerShell Module Logging
Set-ItemProperty -Path "HKLM:\SOFTWARE\Policies\Microsoft\Windows\PowerShell\ModuleLogging"
                 -Name "EnableModuleLogging" -Value 1
```

Log Size Limits: - Security: 1 GB (auto-archive) - System: 512 MB - Application: 512 MB - TerminalServices logs: 100 MB each - PowerShell: 512 MB

7.2 SIEM (Security Information and Event Management)

Recommended Solutions (LVHN Choice):

| SIEM Platform | Deployment | Log Ingestion Method | Cost Model |
|---------------------------|----------------------|--|----------------------|
| Microsoft Sentinel | Cloud (Azure) | Azure Monitor Agent (AMA) or Log Analytics Agent | Per GB ingested |
| Splunk Enterprise | On-premises or cloud | Splunk Universal Forwarder | Per GB/day license |
| IBM QRadar | On-premises or cloud | WinCollect agent | Per EPS (events/sec) |
| LogRhythm | On-premises or cloud | System Monitor agent | Per log source |

Log Forwarding Technology: - **Windows Event Forwarding (WEF):** Built-in; push or pull model - **Agent-based:** Splunk UF, Azure Monitor Agent, QRadar WinCollect

Configuration Example (WEF):

```
# On jumper server / eKVM (source)
wecutil qc

# On SIEM collector (destination)
winrm quickconfig
wecutil cs subscription.xml # Import subscription config
```

Sample Subscription XML:

```
<Subscription xmlns="http://schemas.microsoft.com/2006/03/windows/events/subscription">
  <SubscriptionId>LVHN-eKVM-Security-Events</SubscriptionId>
  <Query>
```

```

<QueryList>
  <Query Id="0">
    <Select Path="Security">*[System[(EventID=4624 or EventID=4625)]]</Select>
  </Query>
</QueryList>
</Query>
</Subscription>

```

7.3 Performance Monitoring

Technology: Windows Performance Monitor (PerfMon)

Key Counters:

| | |
|--------------------|--|
| Processor: | % Processor Time |
| Memory: | Available MBytes, % Committed Bytes In Use |
| LogicalDisk: | % Free Space, Avg. Disk Queue Length |
| Network Interface: | Bytes Total/sec, Packets/sec |
| Terminal Services: | Active Sessions, Inactive Sessions |

Data Collector Sets: - Create custom DCS for jumper server baseline - Run 24-hour baseline before pilot - Alert on: CPU >80%, Memory <10% free, Disk <15% free

Optional: System Center Operations Manager (SCOM) for enterprise monitoring

8. Automation & Scripting

8.1 PowerShell

Version: PowerShell 7.4.x (latest LTS) or PowerShell 5.1 (Windows built-in)

Installation:

```

# Install PowerShell 7.x (on jumper server)
winget install Microsoft.PowerShell

```

Modules Required:

| Module Name | Purpose | Installation |
|-------------|-------------------------------|-------------------|
| PSReadLine | Enhanced command-line editing | Built-in (PS 7.x) |

| Module Name | Purpose | Installation |
|-------------------------|------------------------------------|---|
| PowerShellGet | Module installation from PSGallery | Built-in |
| Pester | Unit testing for scripts | Install-Module -Name Pester |
| PSScriptAnalyzer | Script linting and best practices | Install-Module -Name PSScriptAnalyzer |
| ActiveDirectory | AD cmdlets | Install-WindowsFeature RSAT-AD-PowerShell |

Execution Policy:

```
# Set execution policy (allow signed scripts)
Set-ExecutionPolicy RemoteSigned -Scope LocalMachine

# Verify
Get-ExecutionPolicy -List
```

Script Examples: - Validate-Prerequisites.ps1 (pre-window validation)
 - Copy-FirmwareToEKVM.ps1 (WinRM file transfer) - Verify-SHA256.ps1 (integrity verification) - Collect-Evidence.ps1 (post-window evidence gathering)

PowerShell Transcription:

```
Start-Transcript -Path "C:\Evidence\CHG0012345\transcript-$(Get-Date -Format 'yyyyMMdd-HH:mm:ss').log"
# ... operations ...
Stop-Transcript
```

8.2 Task Scheduler

Technology: Windows Task Scheduler

Use Cases: 1. **Pre-Window Automation:** - Task: Enable RDP drive mapping (GPO modification) - Trigger: 1 hour before maintenance window - Action: Set-GPRegistryValue (PowerShell)

2. Post-Window Cleanup:

- Task: Disable JIT accounts, revert GPOs
- Trigger: 1 hour after maintenance window end
- Action: Disable-ADAccount (PowerShell)

Configuration:

```
# Create scheduled task (example)
$action = New-ScheduledTaskAction -Execute "PowerShell.exe" `
    -Argument "-File C:\Scripts\Enable-DriveMapping.ps1"
```

```
$trigger = New-ScheduledTaskTrigger -Once -At "18:00" -RepetitionInterval (New-TimeSpan -Day
Register-ScheduledTask -TaskName "Enable-DriveMapping-PreWindow" -Action $action -Trigger $trigger
```

8.3 Group Policy Management

Technology: Group Policy Management Console (GPMC)

Installation:

```
Install-WindowsFeature -Name GPMC
```

Key GPOs for Project:

| GPO Name | Scope | Purpose |
|-----------------------------|------------------|---|
| GPO-Jumper-Hardening | Jumper Server OU | RDP hardening, firewall rules, security baselines |
| GPO-eKVM-RDP-Config | eKVM OU | RDP settings (NLA, TLS, encryption) |
| GPO-eKVM-WinRM-Config | eKVM OU | WinRM listeners, TrustedHosts (if needed) |
| GPO-eKVM-Maintenance-Window | eKVM OU | Time-based drive mapping enable/disable |
| GPO-Audit-Logging | All systems | Enable advanced audit policies, log sizes |

GPO Deployment:

```
# Link GPO to OU
New-GPLink -Name "GPO-Jumper-Hardening" -Target "OU=JumperServers,DC=lvhn,DC=local"

# Force GPO update
gpupdate /force
```

8.4 Desired State Configuration (DSC)

Technology: PowerShell Desired State Configuration (DSC)

Use Case: Automated jumper server baseline configuration

Example DSC Configuration:

```
Configuration JumperServerBaseline {
    Node "jumper-server-01" {
        WindowsFeature RDS {
            Ensure = "Present"
        }
    }
}
```

```

        Name = "RDS-RD-Server"
    }

    Registry RDPEncryption {
        Ensure = "Present"
        Key = "HKLM:\SYSTEM\CurrentControlSet\Control\Terminal Server\WinStations\RDP-Terminal\rdpdr\MinEncryptionLevel"
        ValueName = "MinEncryptionLevel"
        ValueData = 3
        ValueType = "Dword"
    }

    Service WinRM {
        Name = "WinRM"
        State = "Running"
        StartupType = "Automatic"
    }
}

```

Deployment:

```

JumperServerBaseline -OutputPath "C:\DSC"
Start-DscConfiguration -Path "C:\DSC" -Wait -Verbose

```

9. Network Infrastructure

9.1 Virtual Private Network (VPN)

Technology Options (LVHN Existing):

| VPN Solution | Vendor | Protocol | MFA Support |
|----------------------|----------------------------|----------------|--------------------------|
| GlobalProtect | Palo Alto Networks | SSL/TLS | Yes (SAML, RADIUS) |
| AnyConnect | Cisco | SSL/TLS, IPsec | Yes (Duo, RSA, RADIUS) |
| FortiClient | Fortinet | SSL/TLS, IPsec | Yes (FortiToken, RADIUS) |
| Always On VPN | Microsoft (Windows Server) | IKEv2, SSTP | Yes (via NPS/RADIUS) |

Configuration Requirements: - Split tunneling: Allow (only Ionic CDN and eKVM subnet routed via VPN) - MFA: Mandatory - Allowed client OS: LVHN-managed Windows 10/11 devices only - Session timeout: 8 hours (re-authenticate)

9.2 Firewall

Recommended Solutions (LVHN Existing):

| Firewall Platform | Management | Features Used |
|---|----------------------------|---|
| Palo Alto PA-Series | Panorama (centralized) | App-ID, User-ID, URL Filtering, Threat Prevention |
| Cisco ASA / Firepower Fortinet FortiGate | ASDM / FMC FortiManager | Access rules, VPN, IPS Firewall policies, SD-WAN, SSL Inspection |
| Check Point | SmartConsole | Firewall rules, IPS, Application Control |

Required ACL Rules:

Rule 1: Allow VPN → Jumper Server (RDP)

Source: SSL-VPN-Pool (10.200.0.0/24)

Destination: Jumper-Server-01 (10.50.100.10)

Service: TCP/3389

Action: Allow

Logging: Yes

Rule 2: Allow Jumper → eKVM Subnet (RDP, WinRM, SMB)

Source: Jumper-Server-01 (10.50.100.10)

Destination: eKVM-Subnet (10.60.200.0/24)

Service: TCP/3389, 5985, 5986, 445

Schedule: Maintenance-Window-Only

Action: Allow

Logging: Yes

Rule 3: Allow Jumper → Internet (HTTPS for downloads)

Source: Jumper-Server-01 (10.50.100.10)

Destination: ionic.com, *.ionic.com

Service: TCP/443

Action: Allow

Logging: Yes

Rule 4: Default Deny

Source: Any

Destination: eKVM-Subnet (10.60.200.0/24)

Service: Any

Action: Deny
Logging: Yes (denied connections)

9.3 DNS

Technology: Windows DNS Server (Active Directory-integrated)

DNS Records Required:

A Record: jumper-server-01.lvhn.local → 10.50.100.10
A Record: ekvm-device-01.lvhn.local → 10.60.200.101
A Record: ekvm-device-02.lvhn.local → 10.60.200.102
PTR Record: 10.10.50.100.in-addr.arpa → jumper-server-01.lvhn.local

DNS Security: - DNSSEC: Recommended (if supported by LVHN) - DNS over HTTPS (DoH): Optional enhancement

9.4 Network Time Protocol (NTP)

Technology: Windows Time Service (W32Time)

Configuration:

Configure NTP server (on jumper server)

```
w32tm /config /manualpeerlist:"time.nist.gov,0x8" /syncfromflags:manual /reliable:YES /update  
w32tm /resync
```

Verify

```
w32tm /query /status
```

Importance: Accurate time synchronization critical for: - Kerberos authentication (± 5 min tolerance) - Log correlation across systems - Certificate validation

10. Development & DevOps Tools

10.1 Version Control

Technology: Git (command-line) + GitHub (repository hosting)

Installation:

```
winget install Git.Git
```

Repository Structure:

```
jumpserver/  
  .github/
```

```
docs/
runbooks/
specs/
scripts/          # PowerShell automation scripts
    pre-window/
    execution/
    post-window/
tests/            # Pester tests
```

Commit Workflow:

```
git checkout -b feature/update-mop-section-5
# Make changes
git add docs/procedures/MOP-eKVM-Update.md
git commit -m "docs: Update MOP section 5 with new validation steps"
git push origin feature/update-mop-section-5
```

10.2 Documentation Tools

Primary: Markdown (.md files)

Editors: - Visual Studio Code with extensions: - Markdown All in One - markdownlint - Markdown Preview Enhanced - Typora (WYSIWYG Markdown editor)

Diagram Tools: - draw.io (diagrams.net) – for architecture diagrams - PlantUML – for sequence diagrams (as code) - Microsoft Visio (if available)

10.3 Testing Tools

PowerShell Testing: Pester

Installation:

```
Install-Module -Name Pester -Force
```

Example Test:

```
# tests/Validate-Prerequisites.Tests.ps1
Describe "Pre-Window Prerequisites" {
    It "Jumper server RDP port is reachable" {
        $result = Test-NetConnection -ComputerName jumper-server-01 -Port 3389
        $result.TcpTestSucceeded | Should -Be $true
    }

    It "SHA-256 hash matches expected value" {
        $actualHash = (Get-FileHash -Path "C:\Staging\firmware.exe" -Algorithm SHA256).Hash
    }
}
```

```

        $expectedHash = "a1b2c3d4e5f6..."
        $actualHash | Should -Be $expectedHash
    }
}

```

Run Tests:

```
Invoke-Pester -Path ".\tests\" -Output Detailed
```

11. Licensing & Cost Model

11.1 Windows Server Licensing

Jumper Server: - **License:** Windows Server 2022 Standard (1 license) - **CAL Requirements:** None (RDP connections use eKVM device CALs or VDA) - **Estimated Cost:** \$972 (Standard) or \$6,155 (Datacenter) retail (LVHN may have volume licensing)

Note: LVHN likely has existing Enterprise Agreement (EA) or volume licensing; incremental cost may be \$0.

11.2 Remote Desktop Services (RDS) Licensing

RDS CAL Requirements: - Not required if jumper server only used for administrative access (not user sessions) - If RDS required: ~\$120/device CAL or ~\$168/user CAL

Project Assessment: RDS CALs not required (administrative use only)

11.3 Microsoft Defender for Endpoint

License: Microsoft Defender for Endpoint Plan 1 or Plan 2

| Edition | Cost (per device/month) | Features |
|---------|-------------------------|--|
| Plan 1 | ~\$3-5 | Next-gen AV, attack surface reduction, EDR |
| Plan 2 | ~\$5-7 | Plan 1 + automated investigation, threat hunting, advanced hunting |

Project Scope: 1 jumper server + ~50-100 eKVM devices = \$150-700/month (Plan 1)

Alternative: Use built-in Windows Defender Antivirus (free) without EDR capabilities

11.4 SIEM Licensing

| SIEM | Cost Model | Estimated Cost (100 devices) |
|---------------------------|-----------------|--|
| Microsoft Sentinel | Per GB ingested | ~\$200-500/month (estimate: 50-100 GB/month) |
| Splunk | Per GB/day | ~\$150/GB/day (~\$2,250/month for 15 GB/day) |
| QRadar | Per EPS | ~\$10,000-20,000/year (500 EPS) |

Project Assumption: LVHN has existing SIEM; incremental cost = log ingestion only

11.5 Total Cost of Ownership (TCO) – 3 Years

| Component | Year 1 | Year 2 | Year 3 | 3-Year Total |
|--|----------|----------|----------|-----------------|
| Jumper Server Hardware (if new) | \$5,000 | \$0 | \$0 | \$5,000 |
| Windows Server License | \$1,000 | \$0 | \$0 | \$1,000 |
| MDE Plan 1 (100 devices) | \$6,000 | \$6,000 | \$6,000 | \$18,000 |
| SIEM (incremental) | \$2,400 | \$2,400 | \$2,400 | \$7,200 |
| VPN Licenses (if new) | \$0 | \$0 | \$0 | \$0 (existing) |
| Labor (LVHN IT) | \$10,000 | \$2,000 | \$2,000 | \$14,000 |
| Labor (Ionic) | \$15,000 | \$3,000 | \$3,000 | \$21,000 |
| TOTAL | \$39,400 | \$13,400 | \$13,400 | \$66,200 |

Cost Savings vs. Atera: - Atera RMM: ~\$100/month/technician × 5 technicians = \$6,000/year - 3-year Atera cost: \$18,000 - Net savings: \$18,000 - \$7,200 (incremental SIEM) = **\$10,800 over 3 years**

12. System Requirements

12.1 Jumper Server Hardware

Minimum Specifications:

| Component | Minimum | Recommended | Notes |
|--------------------|-----------------------------------|-------------------------------------|-----------------------------------|
| CPU | 4 vCPUs (2.0 GHz) | 8 vCPUs (2.5 GHz+) | Intel Xeon or AMD EPYC |
| RAM | 8 GB | 16 GB | For concurrent RDP/WinRM sessions |
| Storage | 100 GB | 250 GB SSD | C: (OS) + D: (staging) |
| Network | 1 Gbps NIC | 10 Gbps NIC or dual 1 Gbps (teamed) | Low latency preferred |
| Form Factor | Virtual Machine (VMware, Hyper-V) | Physical server (if required) | VM preferred for flexibility |

Storage Layout:

| | | |
|----------------|--------|-----------------------------|
| C:\ (OS) | 80 GB | (NTFS) |
| D:\ (Staging) | 150 GB | (NTFS, BitLocker encrypted) |
| E:\ (Evidence) | 20 GB | (NTFS, BitLocker encrypted) |

12.2 eKVM Device Hardware and Software

CRITICAL: eKVM specifications are FIXED and NOT MODIFIABLE by LVHN

Provided and Managed by Ionic (Fixed Specifications):

| Component | Fixed Specification | Modifiable by LVHN? |
|------------------------|---|----------------------------|
| CPU | Intel Core i5 or i7 (8th gen+) | No (hardware) |
| RAM | 8-16 GB DDR4 | No (hardware) |
| Storage | 256-512 GB SSD | No (hardware) |
| Network | Dual 1 Gbps NICs (redundancy) | No (hardware) |
| GPU | Integrated or discrete (for video processing) | No (hardware) |
| OS Edition | Windows 11 Pro | No (cannot change edition) |
| OS Architecture | 64-bit (x64) | No |
| OS Version | 24H2 (2024 Update) | No (cannot downgrade) |

| Component | Fixed Specification | Modifiable by LVHN? |
|----------------------|--------------------------------------|---------------------------------|
| OS Build | 26100.4202 (as of 2025-11-11) | Updates via Windows Update only |
| nCommand Lite | Ionic proprietary application | No (managed by Ionic) |

What LVHN CAN Configure: - Enable/disable RDP (via registry or GPO) - Enable/disable WinRM (via PowerShell or GPO) - Windows Firewall rules (ports 3389, 5985, 5986, 445) - Apply Windows Updates (monthly cumulative updates) - Configure security settings (NLA, TLS, encryption levels) - Create local user accounts (for maintenance access) - Install Windows Defender definitions (automatic)

What LVHN CANNOT Do: - Reinstall or reimage the operating system - Change from Windows 11 Pro to Enterprise/IoT/LTSC - Downgrade to Windows 10 - Modify hardware components (CPU, RAM, storage) - Uninstall or modify nCommand Lite application - Change OS architecture (64-bit to 32-bit)

Important Notes: - eKVM hardware and software managed entirely by Ionic - LVHN responsible only for network connectivity and remote access configuration - All maintenance procedures must work with existing Windows 11 Pro 24H2 Build 26100.4202 - Jumper server must support standard Windows protocols compatible with Windows 11

12.3 Network Requirements

Bandwidth: - Jumper → eKVM: 100 Mbps minimum (for 500 MB firmware transfer in <1 min) - Jumper → Internet: 50 Mbps minimum (for CDN downloads) - VPN → Jumper: 10 Mbps minimum (for operator RDP sessions)

Latency: - Jumper → eKVM: <10 ms (same data center preferred) - Jumper → Internet: <100 ms (CDN) - VPN → Jumper: <50 ms (acceptable for RDP responsiveness)

Availability: - Jumper Server: 99.5% uptime (planned maintenance windows allowed) - eKVM Network: 99.9% uptime (clinical requirement)

13. Technology Roadmap

13.1 Current State (Phase 1 – Q4 2025)

Technologies Deployed: - Windows Server 2022 (jumper server) - RDP with NLA and TLS 1.2 - WinRM over HTTPS - PowerShell 7.x automation - Win-

dows Defender Antivirus - Windows Event Forwarding to existing SIEM

Status: Foundation established; ready for pilot

13.2 Near-Term Enhancements (Phase 2 – Q1 2026)

Planned Upgrades: 1. **Microsoft Defender for Endpoint:** Deploy Plan 1 on jumper + eKVM devices 2. **PowerShell DSC:** Automate jumper server baseline configuration 3. **Azure Automation:** Integrate with Azure Automation for runbook execution (optional) 4. **Enhanced MFA:** Add conditional access policies via Microsoft Entra ID

Dependencies: - MDE requires Microsoft 365 E5 or standalone license - Azure Automation requires Azure subscription

13.3 Long-Term Vision (Phase 3 – 2027+)

Future Technologies:

| Technology | Benefit | Timeline |
|---|---|----------|
| Windows Server 2025 | Latest security features, ARM support | Q3 2027 |
| Zero Trust Network Access (ZTNA) | Replace VPN with per-app access (Azure AD App Proxy, Zscaler) | Q2 2027 |
| Microsoft Sentinel SOAR | Automated incident response playbooks | Q4 2026 |
| Windows 365 Cloud PC | Cloud-based jumper server (eliminate on-prem hardware) | Q1 2028 |
| AI-Powered Threat Detection | Microsoft Security Copilot for advanced threat hunting | Q3 2027 |

14. Technology Decision Matrix

14.1 Key Technology Choices

| Decision Point | Option A | Option B | Chosen | Rationale |
|----------------------|---------------------------------|-------------------------------------|--------------------|---|
| Jumper OS | Windows Server 2022 | Windows Server 2019 | 2022 | Latest LTS; support until 2031; TLS 1.3 native |
| Remote Access | RDP | SSH | RDP | Native Windows; NLA support; LVHN expertise |
| File Transfer | WinRM | SMB | WinRM | Scriptable; encrypted by default; no share management |
| Scripting | PowerShell 7.x | PowerShell 5.1 | 7.x | Cross-platform; better performance; LTS support |
| AV/EDR | Microsoft Defender for Endpoint | Third-party (Symantec, CrowdStrike) | MDE | Native integration; lower cost; existing M365 license |
| SIEM | Microsoft Sentinel | Splunk | LVHN Choice | Depends on existing LVHN investment |
| Certificate | Self-signed | AD CS | AD CS | Trusted CA; automatic renewal; Kerberos integration |

15. Compliance & Standards Alignment

15.1 Microsoft Security Baselines

Applied Baselines: - Microsoft Security Compliance Toolkit - Windows Server 2022 Security Baseline - Microsoft Edge Security Baseline - Microsoft Defender Antivirus Baseline

Implementation:

```
# Import baseline GPO
Import-GPO -BackupGpoName "MSFT Windows Server 2022 - Computer" -Path "C:\Baselines" -Target
```

15.2 CIS Benchmarks

Relevant Benchmarks: - CIS Microsoft Windows Server 2022 Benchmark v1.0.0 (Level 1) – For jumper server - CIS Microsoft Windows 11 Enterprise Benchmark v3.0.0 (Level 1) – Adapted for eKVM (Windows 11 Pro)

Note on eKVM CIS Benchmark: - CIS provides benchmarks for Windows 11 Enterprise, not specifically for Pro edition - Most Level 1 controls applicable to Windows 11 Pro - Some Enterprise-only features (e.g., AppLocker, Credential Guard) may not be available in Pro - Apply CIS Windows 11 Enterprise Benchmark with Pro edition limitations documented

Automated Assessment: - CIS-CAT Pro (automated scanning tool) - Microsoft Secure Score (for cloud-connected devices) - Manual validation for Pro-specific limitations

15.3 FIPS 140-2 Compliance

FIPS-Validated Components: - Windows 10/11/Server 2022: FIPS 140-2 validated cryptographic modules - BitLocker: FIPS 140-2 compliant (when enabled) - TLS 1.2/1.3: Uses FIPS-approved algorithms (AES, SHA-256)

Enable FIPS Mode:

```
# Registry (not recommended unless required by policy)
Set-ItemProperty -Path "HKLM:\SYSTEM\CurrentControlSet\Control\Lsa\FIPSAAlgorithmPolicy" -Name "Enabled" -Value 1
```

Note: FIPS mode can break some third-party applications; test thoroughly.

16. Migration from Atera

16.1 Atera vs. Native Windows Comparison

| Feature | Atera | Native Windows | Notes |
|-----------------------|-------------------|-------------------------|-------------------------------------|
| Agent Required | Yes (Atera Agent) | No (built-in RDP/WinRM) | No new agent = lower attack surface |

| Feature | Atera | Native Windows | Notes |
|-----------------------|--------------------|--------------------|---------------------------|
| Remote Desktop | Via Atera console | Via RDP (mstsc) | Native Windows experience |
| File Transfer | Drag-and-drop | WinRM Copy-Item | WinRM requires scripting |
| Automation | Atera scripts | PowerShell | PowerShell more powerful |
| Monitoring | Atera dashboard | SIEM + PerfMon | Requires SIEM integration |
| Alerting | Email/SMS | SIEM alerts | SIEM more flexible |
| Cost | \$100/month/tenant | SIEM logs only | Lower cost |
| Audit Logging | Atera logs | Windows Event Logs | Native, tamper-resistant |

16.2 Migration Steps

Phase 1: Parallel Operation (Month 1) 1. Deploy jumper server with native Windows stack 2. Test RDP/WinRM access to 3 pilot eKVM devices 3. Keep Atera active as backup

Phase 2: Pilot Migration (Month 2) 4. Perform 3 updates via native Windows (pilot) 5. Compare evidence quality: Atera logs vs. Windows Event Logs 6. Validate SIEM ingestion

Phase 3: Full Migration (Month 3-4) 7. Migrate all eKVM devices to native Windows management 8. Decommission Atera agents from eKVM devices 9. Cancel Atera subscription

Phase 4: Optimization (Month 5-6) 10. Tune PowerShell automation scripts 11. Optimize SIEM alert rules 12. Document lessons learned

17. Support & Maintenance

17.1 Vendor Support Contacts

| Technology | Vendor | Support Level | Contact |
|---------------------------|-------------------------|------------------------------------|----------------------------------|
| Windows Server | Microsoft | Premier Support or Unified Support | support.microsoft.com |
| Microsoft Defender | Microsoft | Included with license | security.microsoft.com |
| Active Directory | Microsoft | Premier Support | support.microsoft.com |
| PowerShell | Microsoft (open source) | Community + Premier | github.com/PowerShell/PowerShell |
| SIEM (if Sentinel) | Microsoft | Azure Support | portal.azure.com |

17.2 Patch Management

Windows Update Strategy:

| Component | Update Frequency | Method | Testing |
|-----------------------|--------------------------|----------------|--------------------------------------|
| Jumper Server | Monthly (Patch Tuesday) | WSUS or SCCM | Test in lab 1 week before production |
| eKVM Devices | Monthly (Patch Tuesday) | WSUS or SCCM | Coordinate with firmware updates |
| PowerShell 7.x | Quarterly (LTS releases) | Manual update | Test scripts in lab |
| AV Definitions | Daily (automatic) | Windows Update | No testing required |

Windows Update Commands:

```
# Check for updates
```

```
Get-WindowsUpdate
```

```
# Install updates (PSWindowsUpdate module)
```

```
Install-WindowsUpdate -AcceptAll -AutoReboot
```

```
# Exclude specific updates
```

```
Get-WindowsUpdate -Hide -KBArticleID KB5001234
```

17.3 Backup & Recovery

Jumper Server Backup: - **Technology:** Windows Server Backup or Veeam Backup & Replication - **Frequency:** Daily incremental, weekly full - **Retention:** 30 days - **Recovery Point Objective (RPO):** 24 hours - **Recovery Time Objective (RTO):** 4 hours

Backup Scope: - C: (OS and configuration) - D: (staging area) – optional - E: (evidence archive) – mandatory - System State (AD-related if domain-joined)

Disaster Recovery Plan: - Document jumper server rebuild procedure (6-8 hours) - Maintain offline copy of hardening scripts - Test DR annually

18. Acceptance Criteria

18.1 Technology Validation

Each technology component must satisfy:

Jumper Server Validation

| Component | Validation Method | Pass Criteria |
|---------------------------------|---|---|
| Windows Server 2022 | winver, check build number | Build 20348.x |
| RDP (NLA + TLS) | Get-ItemProperty HKLM:\SYSTEM\...\RDP-Tcp | UserAuthentication=1, SecurityLayer=2 |
| WinRM (HTTPS) | Test-WSMan -UseSSL | No errors; valid certificate |
| PowerShell 7.x | \$PSVersionTable | PSVersion 7.4.0 |
| SHA-256 | Get-FileHash -Algorithm SHA256 | Hash output 64 chars |
| Support Windows Defender | Get-MpComputerStatus | AntivirusEnabled=True, RealTimeProtectionEnabled=True |
| Event Logging | Get-WinEvent -LogName Security -MaxEvents 1 | Events present |
| SIEM Forwarding | Query SIEM for jumper server logs | Logs visible within 5 min |

eKVM Device Validation

| Component | Validation Method | Pass Criteria |
|-----------------------|-------------------|---|
| Windows 11 Pro | winver | Version 24H2, Build 26100.4202 or later |

| Component | Validation Method | Pass Criteria |
|----------------------------------|--|--|
| OS Edition | <code>Get-ComputerInfo \. \</code> <code>Select OsName</code> | Windows 11 Pro (confirm not Home/Enterprise) |
| RDP Capability | <code>Test-NetConnection -Port</code> 3389 (from jumper) | <code>TcpTestSucceeded=True</code> (when enabled) |
| WinRM Capability | <code>Test-WSMan -ComputerName</code> ekvm-01 | <code>ProductVersion 3.0+</code> |
| PowerShell 5.1 | <code>\$PSVersionTable</code> (on eKVM) | <code>PSVersion = 5.1.x</code> (built-in) |
| Windows Defender | <code>Get-MpComputerStatus</code> (on eKVM) | <code>AntivirusEnabled=True</code> |
| nCommand Lite Running | Check processes | nCommand Lite process active |

19. Glossary

| Term | Definition |
|----------------|---|
| AD CS | Active Directory Certificate Services |
| AES | Advanced Encryption Standard |
| CAL | Client Access License |
| CredSSP | Credential Security Support Provider |
| DSC | Desired State Configuration (PowerShell) |
| EDR | Endpoint Detection and Response |
| FIPS | Federal Information Processing Standards |
| GPO | Group Policy Object |
| JIT | Just-In-Time (access provisioning) |
| LAPS | Local Administrator Password Solution |
| LTSC | Long-Term Servicing Channel (Windows edition) |
| MDE | Microsoft Defender for Endpoint |
| MFA | Multi-Factor Authentication |
| NLA | Network Level Authentication |
| OCSP | Online Certificate Status Protocol |
| PAM | Privileged Access Management |
| RDP | Remote Desktop Protocol |
| SIEM | Security Information and Event Management |
| SMB | Server Message Block |
| TLS | Transport Layer Security |
| UPN | User Principal Name (user@domain.com) |
| WinRM | Windows Remote Management |
| WSUS | Windows Server Update Services |

20. Appendix: Quick Reference Commands

20.1 RDP Commands

```
# Connect to jumper server
mstsc /v:jumper-server-01.lvh.n.local /f

# Check RDP configuration
Get-ItemProperty -Path "HKLM:\SYSTEM\CurrentControlSet\Control\Terminal Server\WinStations\RemoteDesktop"

# Enable RDP
Set-ItemProperty -Path "HKLM:\SYSTEM\CurrentControlSet\Control\Terminal Server" -Name "fDenyConnections" -Value 0
```

20.2 WinRM Commands

```
# Test WinRM
Test-WSMan -ComputerName ekvm-device-01

# Create session
$s = New-PSSession -ComputerName ekvm-device-01 -Credential (Get-Credential)

# Copy file
Copy-Item -Path "C:\file.exe" -Destination "C:\Temp\" -ToSession $s

# Close session
Remove-PSSession $s
```

20.3 File Hash Verification

```
# Compute SHA-256
$hash = (Get-FileHash -Path "firmware.exe" -Algorithm SHA256).Hash

# Compare
if ($hash -eq "a1b2c3d4...") { Write-Host "PASS" } else { Write-Host "FAIL" }
```

20.4 Firewall Commands

```
# Create rule
New-NetFirewallRule -Name "RDP-Jumper" -DisplayName "RDP from Jumper" `
    -Direction Inbound -Protocol TCP -LocalPort 3389 `
    -RemoteAddress 10.50.100.10 -Action Allow

# List rules
Get-NetFirewallRule | Where-Object {$_.DisplayName -like "*RDP*"}

```

```
# Remove rule  
Remove-NetFirewallRule -Name "RDP-Jumper"
```

20.5 Event Log Queries

```
# Successful RDP logons (last 24 hours)  
Get-WinEvent -FilterHashtable @{LogName='Security'; ID=4624; StartTime=(Get-Date).AddDays(-1)  
    Where-Object {$_.Properties[8].Value -eq 10}  
  
# Failed logons  
Get-WinEvent -FilterHashtable @{LogName='Security'; ID=4625; StartTime=(Get-Date).AddHours(-1)}
```

Document Owner: Ionic Engineering Team **Last Updated:** 2025-11-11 **Review Cycle:** Quarterly or after technology changes

End of Technology Stack Specification