Day – 19 Network Troubleshooting & Concepts
Operating System and Data Integrity

Potential for data loss when changing an operating system using a key.

Changing an operating system, even with a valid product key, inherently carries the risk of data loss. The key itself is merely for authentication and does not protect your data. The primary reason for data loss is the need to format the hard drive during the installation process, which erases all existing files and programs. To prevent this, it is crucial to create a complete backup of all your important data to an external drive or cloud storage before beginning the OS installation.

Windows Command Prompt (CMD)

How to check the Windows operating system type using Command Prompt (CMD).

You can quickly determine your Windows operating system version using the Command Prompt. The `systeminfo` command provides detailed system information, including the OS name and version. For a more direct approach, the command `wmic os get Caption` will display the specific edition of Windows you are running. A simpler command, `ver`, will show the Windows version number.

Network Link Speed and Duplex Settings

The definition and impact of setting a network port's link speed.

A network port's link speed refers to the rate at which data can be transferred between the port and a connected device. This is typically measured in megabits per second (Mbps) or gigabits per second (Gbps). While most modern network devices can automatically negotiate the best link speed, manually setting it can be a useful troubleshooting step for certain connectivity issues. However, an incorrect manual setting can lead to a slow or unstable connection.

The difference between Half-Duplex (HDX) and Full-Duplex (FDX) network settings.

Half-duplex and full-duplex are two modes of data transmission over a network.

- **Half-Duplex (HDX):** In this mode, data can only be sent or received at any given moment, not simultaneously. This is similar to a walkie-talkie, where only one person can speak at a time.
- **Full-Duplex (FDX):** Full-duplex allows for simultaneous two-way communication, enabling data to be sent and received at the same time. This is comparable to a telephone conversation where both parties can speak and be heard concurrently. Full-duplex significantly improves network efficiency.

Troubleshooting a slow network connection by manually changing the link speed.

If you're experiencing a slow network connection, a mismatch in the link speed and duplex settings between your device and the network switch could be the culprit. As a troubleshooting measure, you can try manually setting the link speed and duplex mode on both your device's network adapter and the switch port to identical values (e.g., 1 Gbps and Full-Duplex). This can sometimes resolve auto-negotiation issues. However, if this doesn't solve the problem, it's recommended to revert to auto-negotiation.

How to correctly set link speed on a UDM Pro for a high-speed internet plan.

For optimal performance with a high-speed internet plan on a UDM Pro, the recommended setting for the WAN port link speed is "Automatically Negotiate." This allows the UDM Pro and your Internet Service Provider's (ISP) modem to establish the fastest possible connection they both support. If you encounter issues with auto-negotiation, you can try manually setting the speed to match your internet plan, for instance, 1 Gbps FDX for a gigabit connection.

Why "Automatically Negotiate" is the recommended setting for link speed.

"Automatically Negotiate" is the preferred setting because it enables two connected network devices to communicate their capabilities and select the highest-performing transmission mode they both support. This process helps to prevent duplex mismatches, which can severely degrade network performance. By automatically determining the optimal speed and duplex settings, you ensure the most reliable and efficient connection without manual intervention.

UDM Pro WAN Configuration

How to set up a second router for load balancing on a UDM Pro.

The UDM Pro features a secondary WAN port that can be used for either failover or load balancing. To set up load balancing with a second internet connection, connect the modem of the second ISP to the WAN2 port on your UDM Pro. Then, within the UniFi Network Controller, navigate to the WAN settings and configure WAN2. You will need to select the "Load Balancing" option, which allows you to distribute traffic across both internet connections. You can also set a load balancing ratio to determine how the traffic is distributed between the two WAN ports.

The difference between Failover and Load Balancing WAN modes.

Failover and load balancing are two distinct methods for managing dual WAN connections:

- **Failover:** In this configuration, the second WAN connection acts as a backup. It remains inactive until the primary internet connection fails, at which point it automatically takes over to maintain internet connectivity.

- **Load Balancing:** This mode utilizes both internet connections simultaneously to distribute network traffic. This can increase your total available bandwidth and improve network performance, especially in environments with high internet usage.

Explanation of different WAN connection types (DHCPv4, Static IP, PPPoE).

When configuring your WAN connection on the UDM Pro, you will encounter several connection types:

- **DHCPv4:** This is the most common type for residential internet connections. With DHCP, your ISP automatically assigns an IP address to your router.
- **Static IP:** A static IP is a fixed, unchanging IP address assigned by your ISP. This is often used by businesses that need a consistent IP address for hosting servers or other services.
- **PPPoE (Point-to-Point Protocol over Ethernet):** This connection type is commonly used with DSL internet services and requires a username and password to establish a connection with the ISP.

Determining the "best" WAN connection type for load balancing.

The "best" WAN connection type for load balancing ultimately depends on the offerings of your ISPs. In most residential scenarios, you will likely use DHCP for both connections. The key to successful load balancing is having two active and reliable internet connections, regardless of their specific connection type.

How to identify and troubleshoot an offline or disconnected WAN port on a UDM Pro.

If a WAN port on your UDM Pro is showing as offline or disconnected, you can take the following troubleshooting steps:

1. **Check Physical Connections:** Ensure the Ethernet cable is securely plugged into both the UDM Pro's WAN port and the modem. It's also a good idea to try a different Ethernet cable to rule out a faulty cable.
2. **Verify Modem Status:** Check the status lights on your ISP's modem to ensure it has a stable internet connection. Power cycling the modem by unplugging it for 30 seconds and then plugging it back in can often resolve connectivity issues.
3. **Inspect UDM Pro Interface:** In the UniFi Network Controller, check the status of the WAN port. If it's disconnected, review the configuration for that port to make sure it matches the settings provided by your ISP.
4. **Contact Your ISP:** If you have gone through the above steps and the WAN port is still offline, it's possible there is an issue with your internet service, and you should contact your ISP for further assistance.

Advanced Windows Management

- **Using PowerShell for System Information:** A comparison of Command Prompt's `systeminfo` versus PowerShell's `Get-ComputerInfo` cmdlet for gathering detailed hardware and software data.
- **Disk Management with `diskpart`:** How to use the `diskpart` command-line utility to manage partitions and volumes, including creating, deleting, and formatting them without a graphical interface.
- **Windows Subsystem for Linux (WSL):** An explanation of what WSL is, how it allows you to run a Linux environment directly on Windows, and its benefits for developers and power users.
- **Understanding Windows Registry:** A high-level overview of the Windows Registry, its critical role in the operating system's function, and a strong caution about the risks of manual editing.
- **System File Checker (SFC) and DISM:** How to use the `sfc /scannow` and Deployment Image Servicing and Management (`DISM`) command-line tools to find and repair corrupted or missing system files in Windows.

Advanced UDM Pro & Network Management

- **Virtual Local Area Networks (VLANs):** The definition of a VLAN and its purpose in segmenting a network. This includes how to create separate, isolated networks for different types of devices (e.g., guest, IoT, and trusted devices) on a UDM Pro to enhance security and reduce network congestion.
- **Setting up a Virtual Private Network (VPN):** A guide on how to configure the UDM Pro to act as a VPN server (e.g., using L2TP or WireGuard). This would allow you to securely access your home or office network from a remote location.
- **Firewall Rules and Traffic Management:** How to create custom firewall rules on the UDM Pro to block or allow specific types of traffic between VLANs or from the internet. This includes creating rules for port forwarding to make an internal service (like a web server) accessible from the outside.
- **Intrusion Detection and Prevention Systems (IDS/IPS):** An explanation of what IDS and IPS are and how the UDM Pro's Threat Management feature can be configured to monitor network traffic for malicious activity and automatically block potential threats.
- **Quality of Service (QoS) and Smart Queues:** How to use Smart Queues on the UDM Pro to prioritize internet traffic for specific applications or devices. This is useful for ensuring that activities like video conferencing or online gaming have a smooth connection, even when other devices are using a lot of bandwidth.
- **Policy-Based Routing:** A more advanced form of traffic management where you can route specific types of traffic (e.g., all video streaming) out of a particular WAN port, giving you granular control over your load-balanced connections.

Network Troubleshooting & Concepts

- **Understanding Subnet Masks:** A clear explanation of what a subnet mask (like 255.255.255.0 or /24) does and how it defines the size of a local network and determines which IP addresses are on the same network.
- **The Role of a DNS Server:** What a Domain Name System (DNS) server does (translating domain names like www.google.com into IP addresses) and the pros and cons of using your ISP's default DNS versus a third-party service like Cloudflare (1.1.1.1) or Google (8.8.8.8).
- **Troubleshooting with `ping` and `traceroute`:** How to use these fundamental command-line tools to test connectivity to another device on your network or on the internet and to trace the path your data takes to reach a destination.
- **Wi-Fi Channel Management and Interference:** An explanation of why selecting the right Wi-Fi channel and channel width is crucial for good wireless performance and how to use the UniFi Network Controller's tools to scan for RF interference and choose the best channels.