Emerald Retail WAN

Design Prototype



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# Full Design

**Description**: Emerald Retail Ltd., a growing Irish retail chain specialising in home goods, electronics and lifestyle products, has tasked you with designing and implementing a secure and efficient internetwork. The company operates from a headquarters in Dublin and has two branch offices located in Cork and Galway. Each location requires seamless communication, robust security and scalability to accommodate future growth.

I have designed a WAN for Emerald Retail that meets all its requirements. The WAN is made up of 3 LANs being the Dublin HQ LAN, Cork Branch LAN and the Galway Branch LAN. Each LAN is connected to the other two via routers with static routes to provide communication with each LAN.

All Switches and Routers should have a banner and login accounts or passwords on the VTY and console lines. Only the Dublin LAN has this configured in the prototype.

A computer network diagram with many computers connected to each other

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Each of the following sections will provide a detailed breakdown of each area of the WAN.

# Dublin HQ LAN

##### Overview

A computer network diagram with many computers connected to each other

AI-generated content may be incorrect.

The Dublin HQ LAN is made up employee PCs both wired and wireless, switches for local communication, an access point for wireless connection, a router for inter VLAN routing and communication with the Cork and Galway branches and the internet and a DHCP server to give the employee PCs IPv4 addresses. Security measures are implemented in this LAN to prevent attacks and ensure smooth operations of the LAN.

##### VLANS

The Dublin HQ LAN is split into the following VLANs. Operations and Governance are used for employee PCs and network management. Wireless is used for wireless employee Laptops. Native is used as the native VLAN for the trunk lines instead of the default native VLAN. Unused was created to put all unused ports on as a security measure. All VLANs are created on all the switches in the Dublin HQ LAN.

|  |  |
| --- | --- |
| VLANS | |
| **ID** | **NAME** |
| 10 | Operations |
| 20 | Governance |
| 50 | Wireless |
| 98 | Native |
| 99 | Unused |

A screenshot of a computer

AI-generated content may be incorrect.

The Dublin Router provides inter VLAN routing using sub interfaces on the g0/0/0 interface. Each sub interface acts as the default gateway for the VLAN matching its IP address.

A screenshot of a computer

AI-generated content may be incorrect.

##### IP Addressing

Employee PCs and Laptops receive their IP addresses from the DHCP server in the LAN. PCs in the operations VLAN are given an IP address in the 10.10.0.0/27 sub network. PCs in the Governance VLAN are given an IP address in the 10.20.0.0/30 sub network. Wireless clients in the wireless VLAN are given an IP address in the 192.168.50.0/24 sub network. The router is configured with an IP helper address to allow the PCs on the governance and wireless VLANs to contact the DHCP server on the operations VLAN.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| DHCP POOLS | | | | |
| **ID** | **NETWORK** | **RANGE** | **DEFAULT GATEWAY** | **MASK** |
| 10 | 10.10.0.0 | 15 to 126 | 10.10.0.1 | 255.255.255.128 |
| 20 | 10.20.0.0 | 2 to 29 | 10.20.0.1 | 255.255.255.224 |
| 50 | 192.168.50.0 | 2 to 255 | 192.168.50.1 | 255.255.255.0 |

A screenshot of a computer

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##### Wireless

An access point set up to be on the wireless VLAN is used to allow wireless clients to connect to the LAN. The access point has the configuration specified in the table below. Due to the limitations of Cisco Packet Tracer the access point uses WPA2 security but in the real-world implementation of the LAN WPA3 security would be used. SSID cloaking and MAC filtering could not be setup either.

I also tried an implementation of a LWAP and WLC however cisco packet tracer would not allow me to save the WLC configurations. Even with the WLC WPA3 security, SSID cloaking and MAC filtering could not be implemented.

|  |  |  |  |
| --- | --- | --- | --- |
| Wireless | | | |
| **SSID** | **Security** | **SSID Cloaking** | **MAC Filtering** |
| EmeraldHQ-Wifi | WPA2 | yes | yes |

A screenshot of a computer

AI-generated content may be incorrect.

##### WAN Communication

The Dublin router is set up with static routes and floating static routes to enable communication with the Cork and Galway branches and the internet.

The Dublin Router has a gateway of last resort created for all traffic that does not have a destination within the Emerald Retail WAN. All traffic that uses this route will go to the internet.

The Dublin Router has routes statically created for traffic with their destination in the Cork LAN. A single route is created as the Cork LAN is not split into multiple VLANs.

The Dublin Router has routes statically created for traffic with their destination in the Galway LAN. A single route is created as the Galway LAN is not split into multiple VLANs.

|  |  |  |  |
| --- | --- | --- | --- |
| ROUTES | | | |
| **TO** | **NETWORK** | **MASK** | **NEXT-HOP OR INT** |
| LAST RESORT | 0.0.0.0 | 0.0.0.0 | G0/1/0 |
| CORK | 192.168.1.0 | 255.255.255.224 | 192.168.4.6 |
| GALWAY | 192.168.2.0 | 255.255.255.224 | 192.168.4.2 |

Floating static routes are created to allow communications between LAN even if the primary route is down for any reason.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| FLOATING ROUTES | | | | | |
| **TO** | **VIA** | **NETWORK** | **MASK** | **INT** | **ADMIN DISTANCE** |
| LAST RESORT | x | 0.0.0.0 | 0.0.0.0 | G0/1/0 | 5 |
| CORK | GALWAY | 192.168.1.0 | 255.255.255.224 | S0/1/0 | 5 |
| GALWAY | CORK | 192.168.2.0 | 255.255.255.224 | S0/1/1 | 5 |

A screenshot of a computer

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##### Security

Security measures have been taken to prevent the following attacks.

• MAC Table Attacks: Prevent attackers from flooding the switch's MAC address table, causing traffic to broadcast to all ports. To prevent this type of attack firstly all unused ports are made to be access ports in the unused VLAN and shut down. Secondly the following port security has been added to all active access ports.

|  |  |  |
| --- | --- | --- |
| PORT SECURITY | | |
| MAX MACS | STICKY MACS | VIOLATION MODE |
| 5 | TRUE | RESTRICT |

• VLAN Attacks: Protect against VLAN hopping and double-tagging to ensure VLAN segmentation is not bypassed. To prevent this type of attack firstly all unused ports are made to be access ports in the unused VLAN and shut down this prevents DTP negotiations. Secondly the Trunk ports are configured manually with DTP negotiations disabled and the native VLAN changed from 1 to the created native VLAN.

|  |  |  |
| --- | --- | --- |
| TRUNK SECURITY | | |
| TRUNK | NO NEGOTIATE | NATIVE |
| TRUE | TRUE | 98 |

• DHCP Attacks: Mitigate DHCP starvation and rogue DHCP servers to prevent denial of service or unauthorised configurations. To prevent this type of attack DHCP snooping is enabled on all switches in the LAN. Trusted ports are configured on all the switches as needed and all other ports on the switches are left as untrusted.

• ARP Spoofing: Address ARP spoofing to prevent attackers from impersonating devices and intercepting traffic. To prevent this type of attack DHCP snooping and ARP inspection is enabled on all switches. Trusted ports are configured on all the switches as needed and all other ports on the switches are left as untrusted.

• STP (Spanning Tree Protocol) Attacks: Safeguard the spanning tree topology from malicious BPDUs that could cause loops or reroute traffic. To prevent this type of attack Port Fast and BPDU Guard is enabled globally on all switches. By enabling this security globally all access ports on the switches are given this security.

A screenshot of a computer

AI-generated content may be incorrect.

##### SSH

SSH with 2 local accounts has been set up on the Dublin router to prevent unauthorised access to the router and to allow remote access to the router.

This has been set up only on the Dublin router but would be set up on all routers and switches in a real-world situation.

|  |  |  |
| --- | --- | --- |
| SECURITY | | |
| **Name** | **Password** | **Priv** |
| Admin | cisco | 15 |
| Jradmin | cisco | 7 |

|  |  |
| --- | --- |
| SSH | |
| **Device** | **Domain name** |
| DublinR | DublinR |

A computer screen shot of a computer program

AI-generated content may be incorrect.

# Cork branch

A diagram of a computer network

AI-generated content may be incorrect.

The Cork Branch LAN is not fully developed as this prototype is only to show the interconnectivity between each LAN in the WAN. In a real-world situation, the Cork LAN would be fully developed with more devices and security for all users’ safety. It would be much the same as the Dublin HQ LAN.

No configuration has been added to the switch in the Cork LAN. The 2 employee PCs get their IP addresses dynamically, IPv4 from the DHCP server in the Dublin HQ and IPv6 from SLAAC via the Cork Router. The Cork router has an IP helper address added to point to the DHCP server.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| DHCP POOLS | | | | |
| **ID** | **NETWORK** | **RANGE** | **DEFAULT GATEWAY** | **MASK** |
| Cork | 192.168.1.0 | 2 to 29 | 192.168.1.1 | 255.255.255.224 |

|  |  |  |  |
| --- | --- | --- | --- |
| IPV6 SLAAC | | | |
| **ID** | **NETWORK** | **LINK-LOCAL** | **ROUTER ADDRESS** |
| Cork | 2001:db8:1::/64 | FE80:: | 2001:db8:1::1 |

The Cork Router has a gateway of last resort created for all traffic that does not have a destination within the Emerald Retail WAN. All traffic that uses this route will go to the internet via the Dublin HQ router.

The Cork Router has routes statically created for traffic with their destination in the Dublin HQ LAN. As the Dublin HQ LAN is split into different VLANs a route is created for each.

The Cork Router has a route statically created for traffic with their destination in the Galway Branch LAN in both IPv4 and IPv6. These routes go through the interface that is connected to the Galway Router, with this set up the Cork and Galway branches can communicate with each other even if the Dublin HQ router is down for any reason.

|  |  |  |  |
| --- | --- | --- | --- |
| ROUTES | | | |
| **TO** | **NETWORK** | **MASK** | **NEXT-HOP OR INT** |
| LAST RESORT | 0.0.0.0 | 0.0.0.0 | S0/1/0 |
| DUBLIN VLAN 10 | 10.10.0.0 | 255.255.255.128 | 192.168.4.5 |
| DUBLIN VLAN 20 | 10.20.0.0 | 255.255.255.224 | 192.168.4.5 |
| DUBLIN VLAN 50 | 192.168.50.0 | 255.255.255.224 | 192.168.4.5 |
| GALWAY | 192.168.2.0 | 255.255.255.224 | 192.168.4.9 |
| GALWAY IPV6 | 2001:DB8:2:: | /64 | S0/1/1 |

Floating static routes are created to allow communications between LAN even if the primary route is down for any reason.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| FLOATING ROUTES | | | | | |
| **TO** | **VIA** | **NETWORK** | **MASK** | **INT** | **ADMIN DISTANCE** |
| LAST RESORT | DUBLIN | 0.0.0.0 | 0.0.0.0 | S0/1/0 | 5 |
| DUBLIN VLAN 10 | GALWAY | 10.10.0.0 | 255.255.255.128 | S0/1/1 | 5 |
| DUBLIN VLAN 20 | GALWAY | 10.20.0.0 | 255.255.255.224 | S0/1/1 | 5 |
| DUBLIN VLAN 50 | GALWAY | 192.168.50.0 | 255.255.255.224 | S0/1/1 | 5 |
| GALWAY | DUBLIN | 192.168.2.0 | 255.255.255.224 | S0/1/0 | 5 |

A screenshot of a computer

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# Galway branch

A diagram of a computer network

AI-generated content may be incorrect.

The Galway Branch LAN is not fully developed as this prototype is only to show the interconnectivity between each LAN in the WAN. In a real-world situation, the Galway LAN would be fully developed with more devices and security for all users’ safety. It would be much the same as the Dublin HQ LAN.

No configuration has been added to the switch in the Galway LAN. The 2 employee PCs get their IP addresses dynamically, IPv4 from the DHCP server in the Dublin HQ and IPv6 from SLAAC via the Galway Router. The Galway router has an IP helper address added to point to the DHCP server.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| DHCP POOLS | | | | |
| **ID** | **NETWORK** | **RANGE** | **DEFAULT GATEWAY** | **MASK** |
| Galway | 192.168.2.0 | 2 to 29 | 192.168.2.1 | 255.255.255.224 |

|  |  |  |  |
| --- | --- | --- | --- |
| IPV6 SLAAC | | | |
| **ID** | **NETWORK** | **LINK-LOCAL** | **ROUTER ADDRESS** |
| Galway | 2001:db8::/64 | FE80:: | 2001:db8:2 |

The Galway Router has a gateway of last resort created for all traffic that does not have a destination within the Emerald Retail WAN. All traffic that uses this route will go to the internet via the Dublin HQ router.

The Galway Router has routes statically created for traffic with their destination in the Dublin HQ LAN. As the Dublin HQ LAN is split into different VLANs a route is created for each.

The Galway Router has a route statically created for traffic with their destination in the Cork Branch LAN in both IPv4 and IPv6. These routes go through the interface that is connected to the Cork Router, with this set up the Galway and Cork branches can communicate with each other even if the Dublin HQ router is down for any reason.

|  |  |  |  |
| --- | --- | --- | --- |
| ROUTES | | | |
| **TO** | **NETWORK** | **MASK** | **NEXT-HOP OR INT** |
| LAST RESORT | 0.0.0.0 | 0.0.0.0 | S0/1/0 |
| DUBLIN VLAN 10 | 10.10.0.0 | 255.255.255.128 | 192.168.4.1 |
| DUBLIN VLAN 20 | 10.20.0.0 | 255.255.255.224 | 192.168.4.1 |
| DUBLIN VLAN 50 | 192.168.50.0 | 255.255.255.224 | 192.168.4.1 |
| CORK | 192.168.1.0 | 255.255.255.224 | 192.168.4.10 |
| CORK IPV6 | 2001:DB8:1:: | /64 | S0/1/1 |

Floating static routes are created to allow communications between LAN even if the primary route is down for any reason.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| FLOATING ROUTES | | | | | |
| **TO** | **VIA** | **NETWORK** | **MASK** | **INT** | **ADMIN DISTANCE** |
| LAST RESORT | DUBLIN | 0.0.0.0 | 0.0.0.0 | S0/1/0 | 5 |
| DUBLIN VLAN 10 | CORK | 10.10.0.0 | 255.255.255.128 | S0/1/1 | 5 |
| DUBLIN VLAN 20 | CORK | 10.20.0.0 | 255.255.255.224 | S0/1/1 | 5 |
| DUBLIN VLAN 50 | CORK | 192.168.50.0 | 255.255.255.224 | S0/1/1 | 5 |
| CORK | DUBLIN | 192.168.1.0 | 255.255.255.224 | S0/1/0 | 5 |

A screenshot of a computer program

AI-generated content may be incorrect.