

UrbanBox Fitness Studio
Secure and Scalable LAN Design Report
(Cisco Packet Tracer Prototype)

Module: Networking: Switching and VLAN Concepts

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Introduction

UrbanBox is a busy city-centre fitness studio preparing to open a new flagship location. The studio requires a secure and reliable LAN to support day-to-day operations such as class bookings, staff administration, instructor devices and connected fitness equipment. A well-designed network is essential to ensure good performance, protect business data and provide a consistent experience for members.

Project Overview

This project involves designing and building a prototype LAN in Cisco Packet Tracer for the new UrbanBox studio. The network must support multiple departments, secure communication between devices, and provide access to external services in this project it is the internet.

Project Goals

The main goals of the network design are:

- Department segmentation using VLANS
- Inter-VLAN communication and external connectivity using Layer 3 switching
- Dynamic IP allocation through DHCP
- Network redundancy for High availability
- Network device security and hardening

VLAN Design and Department Segmentation

The network is divided into multiple VLANs for traffic isolation, security and management efficiency. This helps protect sensitive data, reduce broadcast traffic and make the network easier to manage. Each VLAN is assigned its own /24 IPv4 network.

VLAN Requirements

UrbanBox requires separate VLANs for key departments and user groups:

- Reception: VLAN 10
- Finance: VLAN 20

- Executive: VLAN 30
- Instructors: VLAN 40
- Members: VLAN 50

10	reception	active	Fa0/1
20	finance	active	
30	executive	active	Fa0/2
40	instructors	active	
50	members	active	
99	native	active	
100	management	active	Fa0/3

Additional VLANS:

- Management VLAN: VLAN 100: for remote login to perform administrative tasks
- Native VLAN: VLAN 99: set to VLAN 99 rather than VLAN 1 to improve security

VLAN Configuration Details

Security best practices were applied: Example showing switch0

- Only required VLANs are allowed on each trunk:

Port	Vlans allowed on trunk
Pol	10,20,30,40,50,99,100
Fa0/3	10,20,30,40,50,99,100
Fa0/4	10,20,30,40,50,99,100
Fa0/6	10,20,30,40,50,99,100
Port	Vlans allowed and active in management domain
Pol	10,20,30,40,50,99,100
Fa0/3	10,20,30,40,50,99,100
Fa0/4	10,20,30,40,50,99,100
Fa0/6	10,20,30,40,50,99,100
Port	Vlans in spanning tree forwarding state and not pruned
Pol	10,20,30,40,50,99,100
Fa0/3	10,20,30,40,50,99,100
Fa0/4	10,20,30,40,50,99,100
Fa0/6	10,20,30,40,50,99,100

- VLAN 99 was set as native VLAN

Port	Mode	Encapsulation	Status	Native vlan
Pol	on	802.1q	trunking	1
Fa0/3	on	802.1q	trunking	99
Fa0/4	on	802.1q	trunking	99
Fa0/6	on	802.1q	trunking	99

- DTP is disabled to prevent unwanted trunk negotiation

```

-----
Name: Fa0/3
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: Off

```

Inter-VLAN Routing and External Connectivity

For communication between VLANs and to access external services, inter-VLAN routing has been implemented on a Layer 3 switch to ensure fast routing.

Inter-VLAN Routing Design

Each VLAN has a corresponding Switch Virtual Interface on the Layer 3 switch. Routing is enabled on the switch, allowing devices in different VLANs to communicate securely while maintaining isolation. Trunk ports carry VLAN traffic between switches and the Layer 3 device. Each VLAN is configured with their own unique IP address that serves as the default gateway.

1. Vlans created:

```

10    reception                active
20    finance                  active
30    executive                active
40    instructors              active
50    members                  active
99    native                   active
100   management               active

```

2. Default gateway for each VLAN and Ip route enabled:

```

Gateway of last resort is 172.16.1.1 to network 0.0.0.0

172.16.0.0/24 is subnetted, 1 subnets
C    172.16.1.0 is directly connected, FastEthernet0/5
C    192.168.10.0/24 is directly connected, Vlan10
C    192.168.20.0/24 is directly connected, Vlan20
C    192.168.30.0/24 is directly connected, Vlan30
C    192.168.40.0/24 is directly connected, Vlan40
C    192.168.50.0/24 is directly connected, Vlan50
C    192.168.99.0/24 is directly connected, Vlan99
C    192.168.100.0/24 is directly connected, Vlan100
S*   0.0.0.0/0 [1/0] via 172.16.1.1

```

3. Access ports for MLS

Port	Name	Status	Vlan	Duplex	Speed	Type
Fa0/1		notconnect	routed	auto	auto	10/100BaseTX
Fa0/2		connected	trunk	a-full	a-100	10/100BaseTX
Fa0/3		connected	trunk	a-full	a-100	10/100BaseTX
Fa0/4		connected	trunk	a-full	a-100	10/100BaseTX
Fa0/5		connected	routed	a-full	a-100	10/100BaseTX

Why Layer 3 Switch over Router-on-a-Stick

- **Faster:** Layer 3 switches are much faster than router-on-a-stick because everything is hardware switched and routed
- **Scalability:** Easily supports multiple VLANs as the network grows, more scalable than router on a stick.
- **VLAN Limitation:** Router-on-a-stick only supports up to 50 VLANs, if the gym merges with another and there is more than 50 VLANs entire network must be reworked.
- **Reliability:** No single trunk link limits connectivity, unlike router-on-a-stick
- **Easier to configure:** Create VLANs and assign IPS, no need for sub interfaces

External connectivity test:

IPv4 Addressing and DHCP

Ip addresses are allocated dynamically through a DHCP server for efficient network management and ease of use. DHCP ensures that Ip addresses are only used when the PC is turned on, preventing waste of IP addresses.

Addressing Scheme

Each VLAN is assigned a unique /24 subnet based on its VLAN number:

- VLAN 10 Reception: 192.168.10.0/24
- VLAN 20 Finance: 192.168.20.0/24
- VLAN 30 Executive: 192.168.30.0/24
- VLAN 40 Instructors: 192.168.40.0/24
- VLAN 50 Members: 192.168.50.0/24
- VLAN 100 Management: 192.168.100.0/24

```

ip dhcp pool VLAN10
 network 192.168.10.0 255.255.255.0
 default-router 192.168.10.1
ip dhcp pool VLAN20
 network 192.168.20.0 255.255.255.0
 default-router 192.168.20.1
ip dhcp pool VLAN30
 network 192.168.30.0 255.255.255.0
 default-router 192.168.30.1
ip dhcp pool VLAN40
 network 192.168.40.0 255.255.255.0
 default-router 192.168.40.1
ip dhcp pool VLAN50
 network 192.168.50.0 255.255.255.0
 default-router 192.168.50.1
ip dhcp pool VLAN100
 network 192.168.100.0 255.255.255.0
 default-router 192.168.100.1
,

```

DHCP Pools

DHCP pools are configured for each VLAN to provide dynamic addressing. Each pool matches the VLAN's subnet and includes the correct default gateway. This ensures devices automatically receive the correct IP address and can communicate across the network.

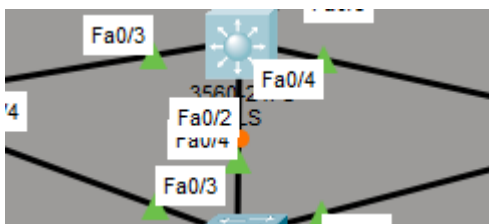
DHCP	Static	DHCP request successful.
Pv4 Address	192.168.40.12	
Subnet Mask	255.255.255.0	
Default Gateway	192.168.40.1	

5. Redundancy and High Availability

Redundancy ensures the network continues operating even if a device or link fails. Implementing redundancy minimises downtime. Redundancy has been implemented at layer 2 and layer 3 level.

5.1 Layer 2 Redundancy

Spanning Tree Protocol is used on switches to prevent loops and provide backup paths for traffic. Redundant links between switches ensure that if one link fails, another path keeps the network operational. An example of a redundant link can be seen below as fa0/2 has been blocked by STP indicated by the orange light.



5.2 Layer 3 Redundancy

Layer 3 redundancy is achieved by configuring a second SVIs and using protocol HSRP. This ensures inter-VLAN routing continues even if the primary routing path fails.

5.3 Benefits

- Prevents network downtime caused by switch or link failure
- Maintains communication between VLANs
- Supports continuous operation for services and devices

6. Device Security and Hardening

Password protection ensures that only authorized staff can modify the network configurations. By including passwords this stops random users from accessing the gyms network devices, prevents unwanted malicious attacks and protects configuration changes.

6.1 Security Requirements

- Prevent unauthorized access to network devices
- Secure management access to switches and routers
- Protect against common layer 2 attacks
- Ensure only authorized personnel can modify configurations

6.2 Configurations Implemented

- Enable password: password
- Line console 0 password: cisco
- Line VTY 0 15 password: cisco

User is prompted for the password upon entering the User EXEC mode and to entering privileged EXEC mode.



User Access Verification

Password:

Password:

s3>en

Password:

s3#

The passwords have been encrypted:

Line console and line VTY passwords can be seen encrypted below

```
!
line con 0
 password 7 0822455D0A16
 login
!
line vty 0 4
 password 7 0822455D0A16
 login
```

Enable secret password has been encrypted

```
!
enable secret 5 $1$mERr$GvDaTJK91hdXRUPWKA7400
!
!
```