

# CCNA

## Introduction to Networking Technologies

RADMANN NETWORK  
All your world is connected!!!

مدرس: سید صمد رضوی

radmannetwork@gmail.com



www.RadmanNetwork.ir



@Radman\_Network



+98 937 474 8013



# CCNA

## What Is A Computer Network?

RADMANN NETWORK  
All your world is connected!!!

# CCNA

---

## Course Objectives

- + For those thinking of pursuing a career in computer networking, but are still investigating, this course will identify what a computer network is, and common components of a computer network.

# CCNA

*Some of reasons:*

---

**Good Earnings**

**Getting Some Certification**

**Getting a Job**

**Recognition Computer Components**

# CCNA

- + A Desire To Learn
- + Basic Familiarity With A Computer

## Course Prerequisites

# CCNA

- + A Desire To Learn
- + Basic Familiarity With A Computer

**A professional network engineer have  
50% Knowledge & 50% Art**

**Course Prerequisites**

CCNA

# What Is A Computer Network?

RADMANNETWORK  
All your world is connected!!!



## What Is A Computer Network?

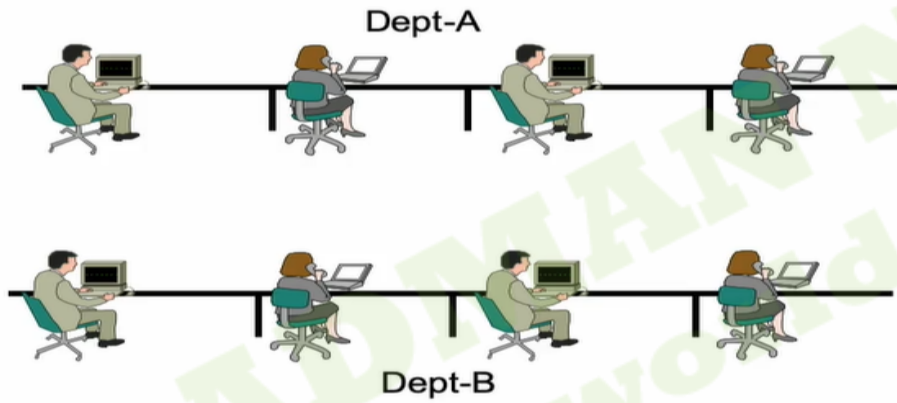
Dept-A

Dept-B

**RADMAN NETWORK**  
All your world is connected!!!

# CCNA

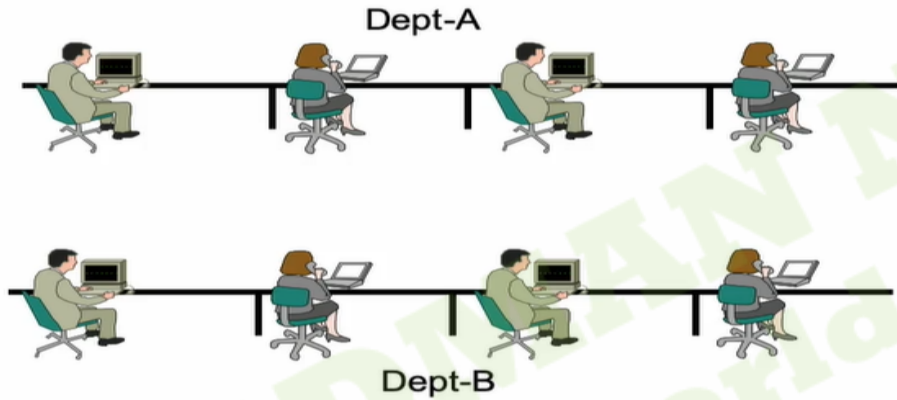
## What Is A Computer Network?



RADMANNETWORK  
All your world is connected!!!

# CCNA

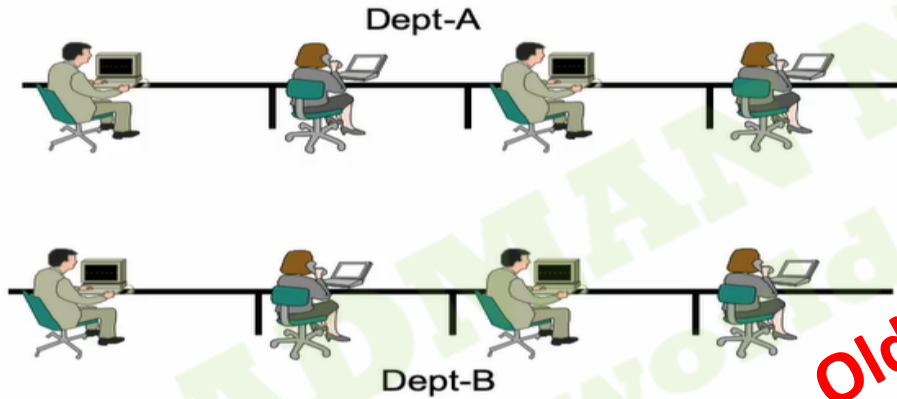
## What Is A Computer Network?



**A network is two or more devices need to share information and resources.**

# CCNA

## What Is A Computer Network?

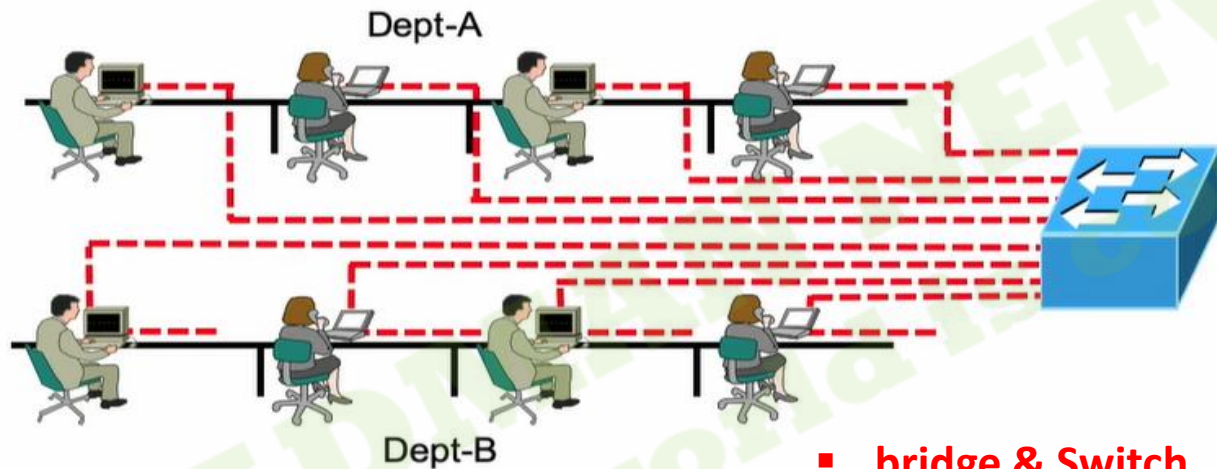


**Oldest Version of Network Was SneakerNet...!!??**

After:

- Cabling Was First idea
- Just one person can talk at same time
- Collision was common and so disturbance

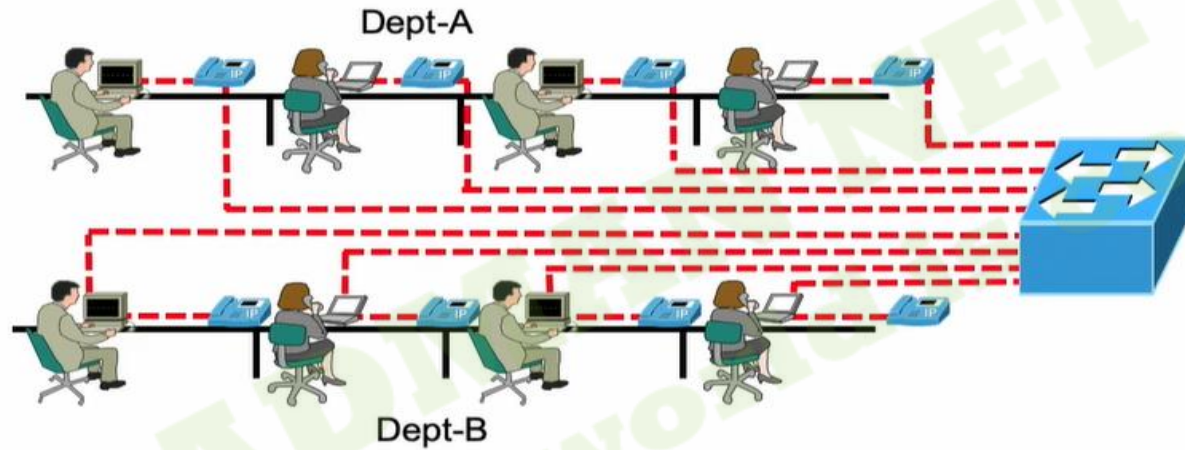
## What Is A Computer Network?



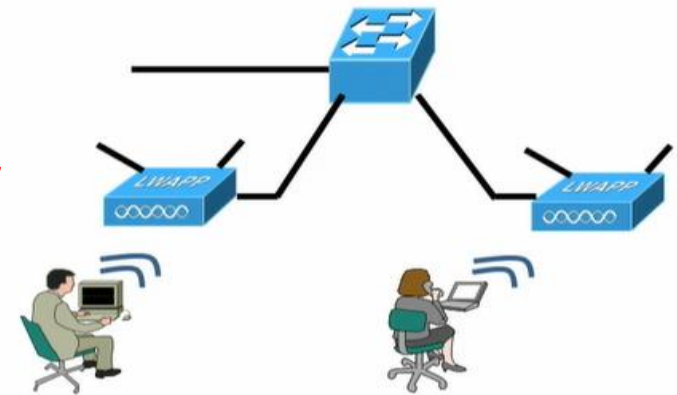
- **bridge & Switch**
- **Individual cable for a device**
- **Each one of users can talk whenever they want**
- **Switches can determine all devices by collecting their information**

# CCNA

## What Is A Computer Network?

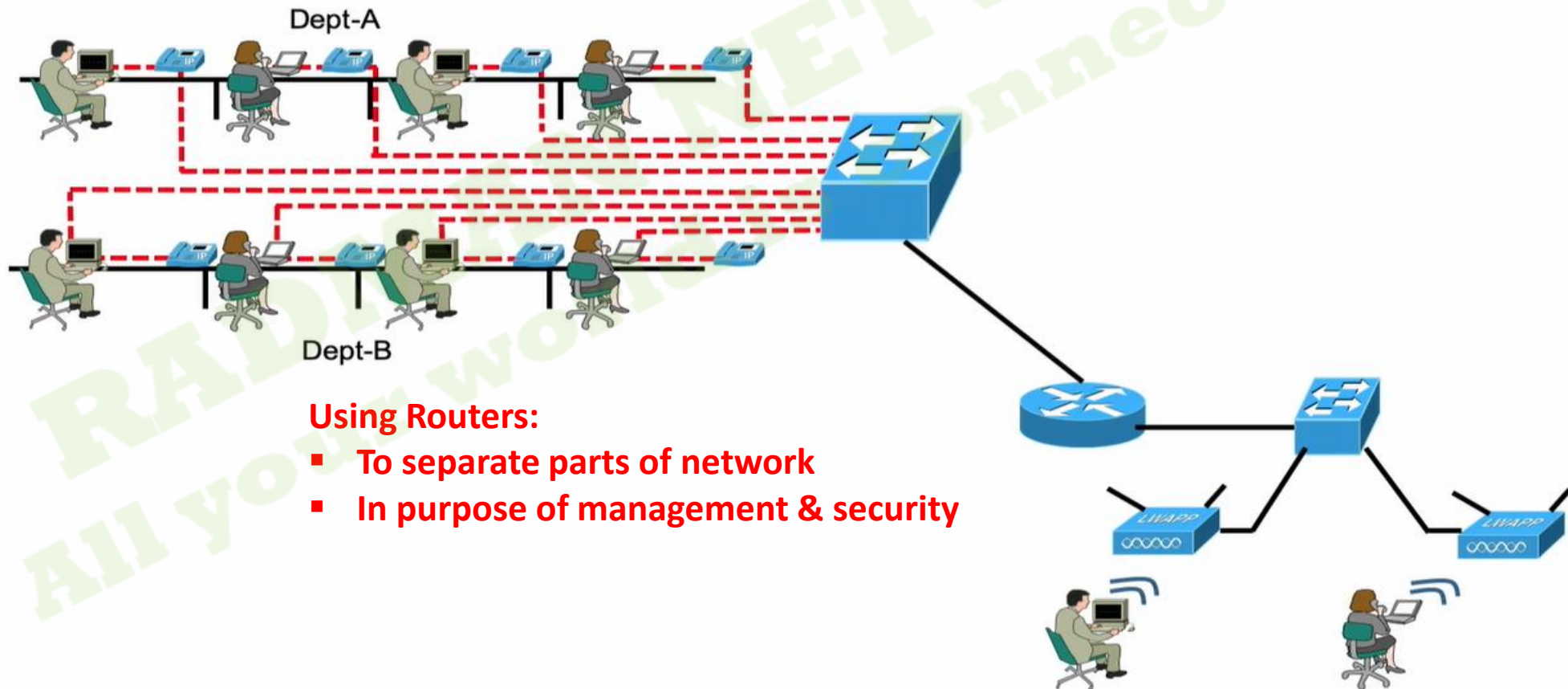


- **Wireless networks introduced by using radio frequency**
- **Access points is same as switches in wireless networks**



# CCNA

## What Is A Computer Network?

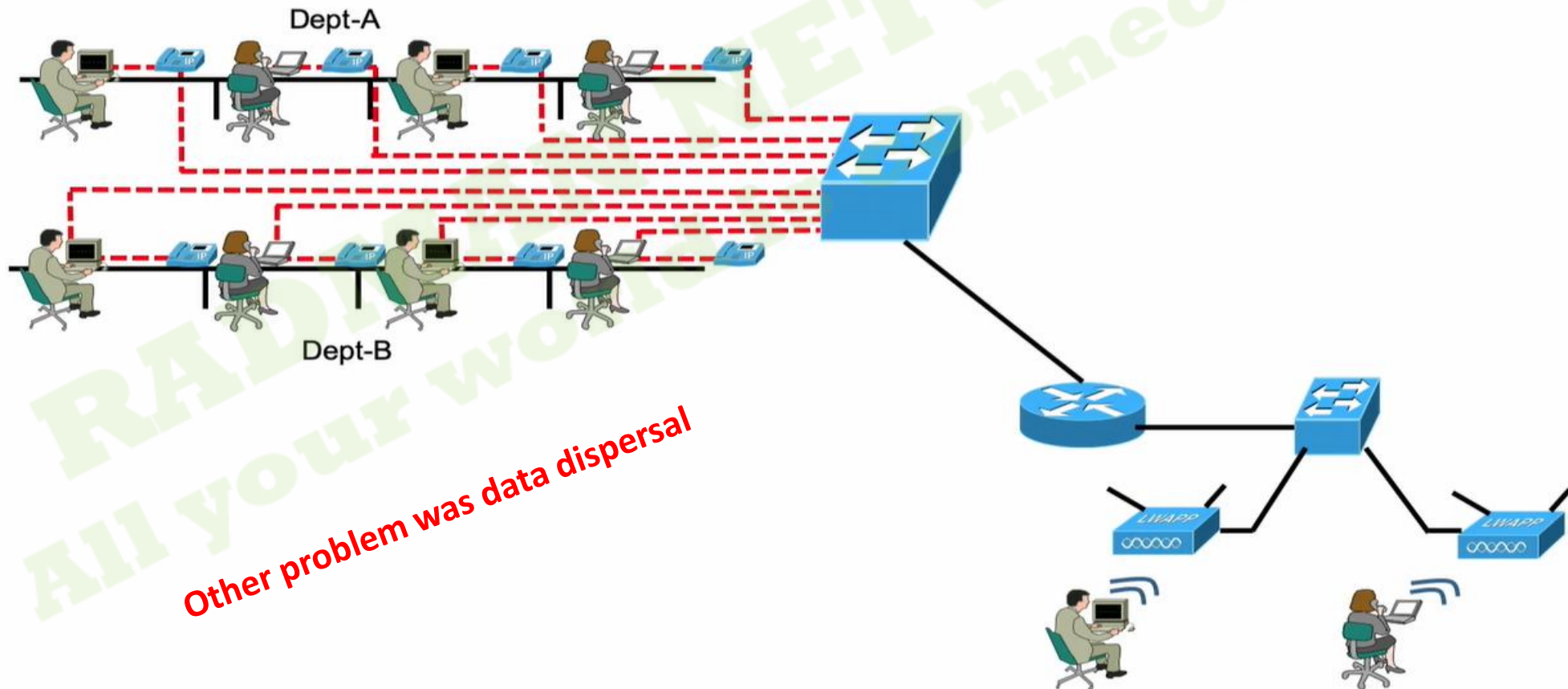


### Using Routers:

- To separate parts of network
- In purpose of management & security

# CCNA

## What Is A Computer Network?



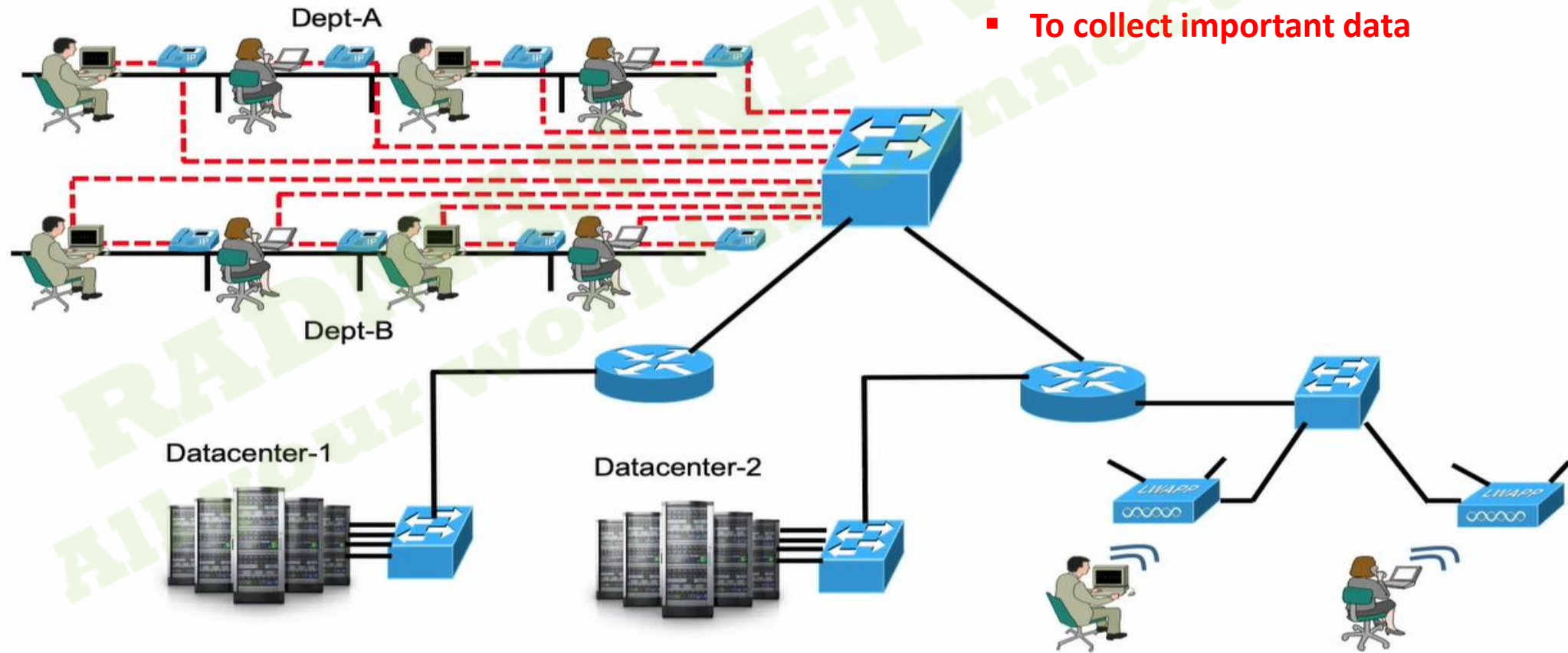
*Other problem was data dispersal*



## What Is A Computer Network?

Using Datacenters :

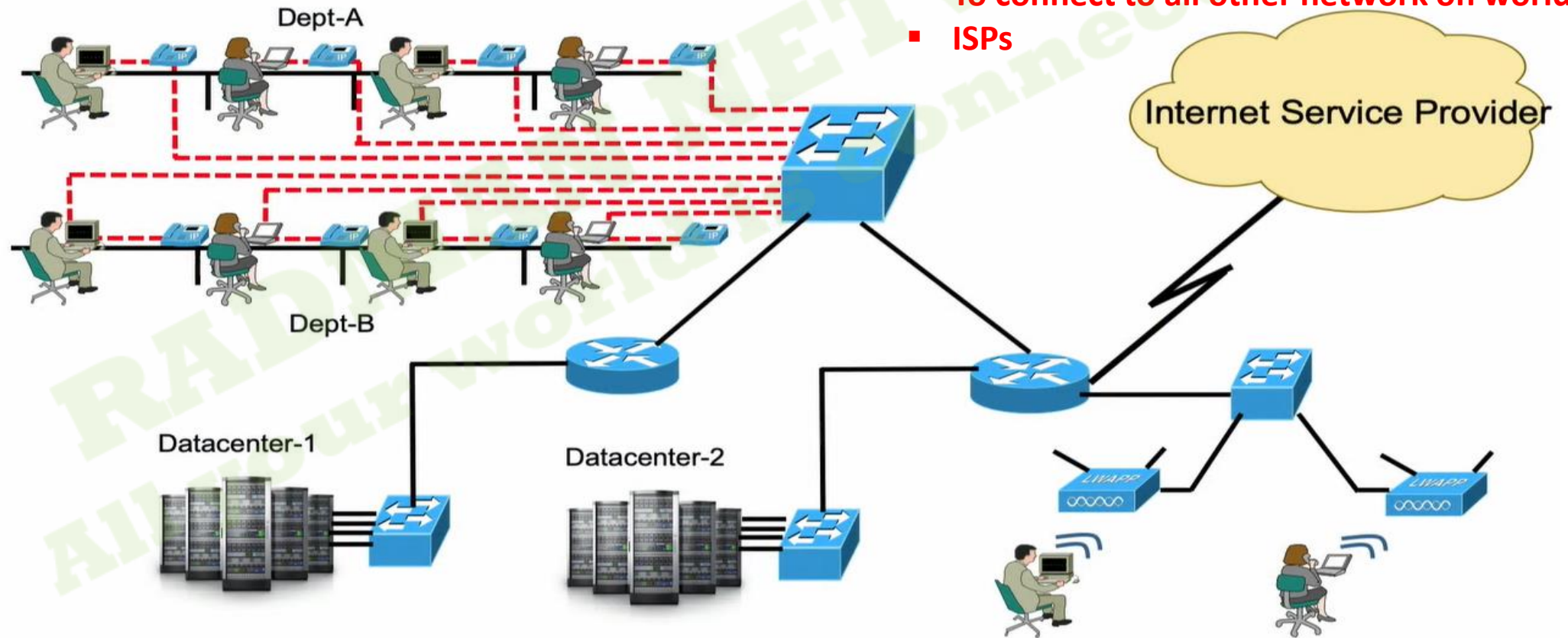
- To collect important data



## What Is A Computer Network?

Using Internet or interconnection of networks:

- To connect to all other network on world
- ISPs



## Common Vocabulary

### + LANs versus WANs

#### Local area networks:

- A local area network (LAN) is a collection of devices connected together in one physical location, such as a building, office, or home.

#### Wide area networks:

- A wide area network (WAN) is a large network of information that is not tied to a single location.

# CCNA

## Common Vocabulary

- + LANs versus WANs
- + Node or Host
  - A node is also a broader term that includes anything connected to a network, while a host requires an IP address.

# CCNA

## Common Vocabulary

- + LANs versus WANs
- + Node or Host
- + Local versus Remote Resources
  - Local means related to or restricted to this place here.
  - Remote means in some other place or distant.

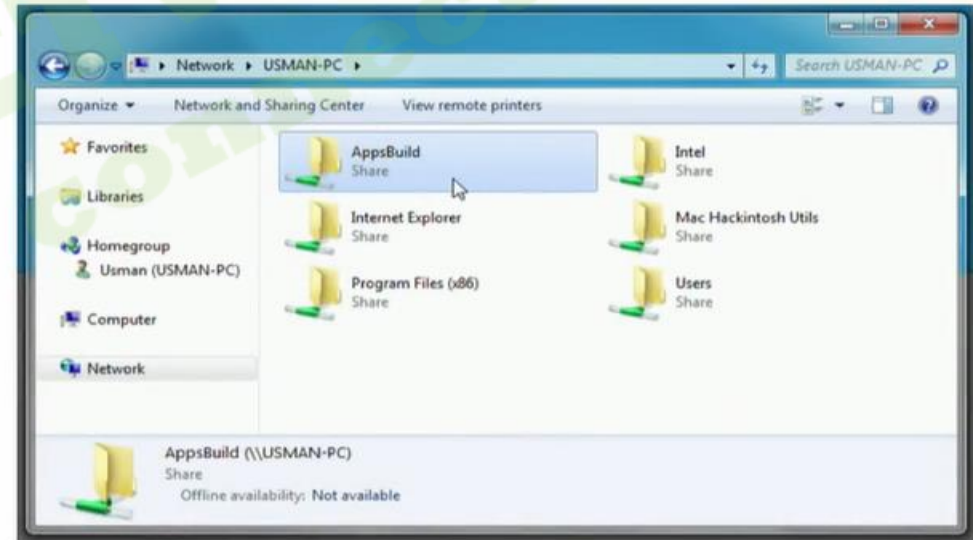
# CCNA

## Common Vocabulary

- + LANs versus WANs
- + Node or Host
- + Local versus Remote Resources
- + The Internet
  - interconnection of networks

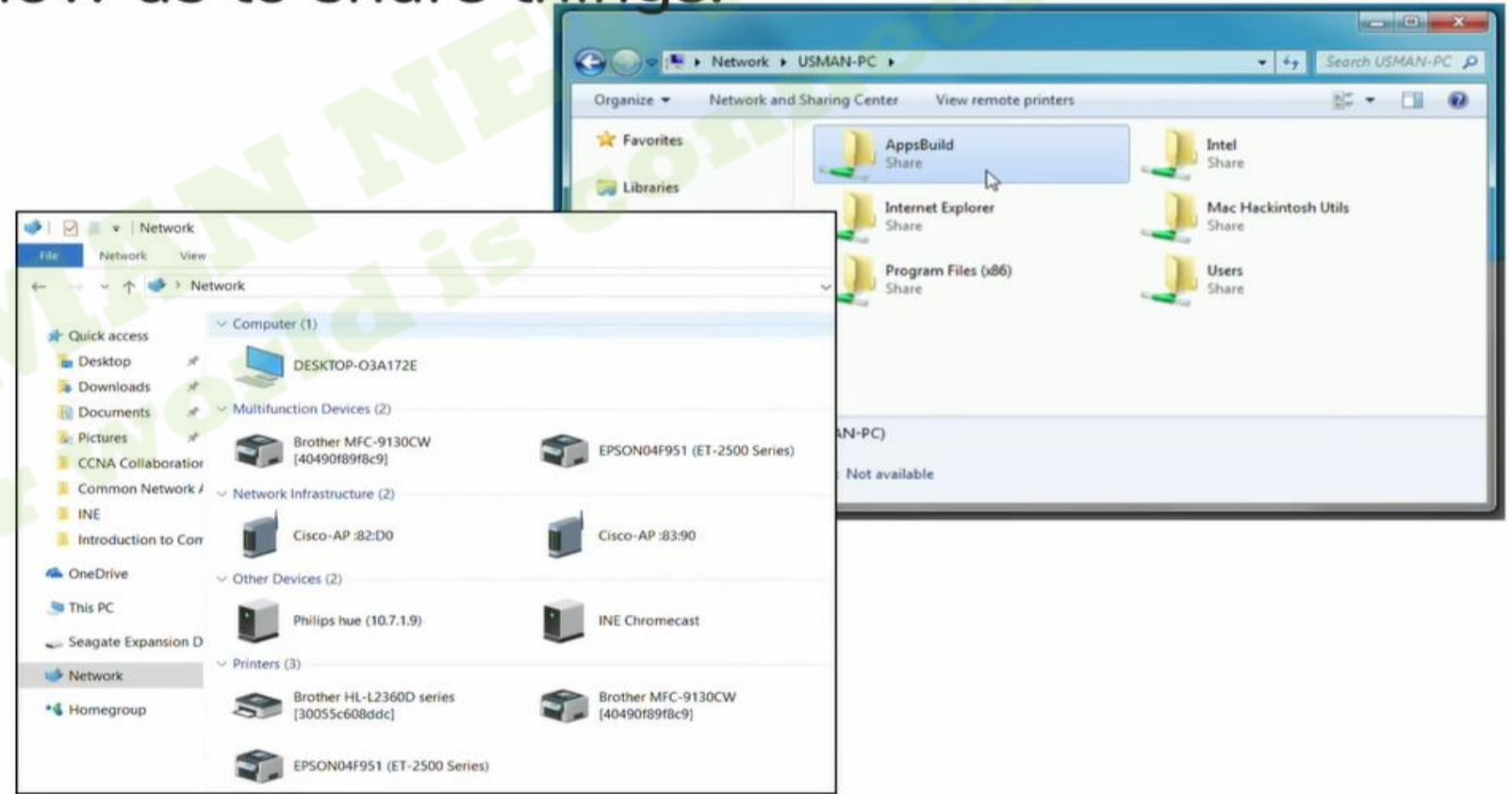
# CCNA

## Why Do We Need Computer Networks?



## Why Do We Need Computer Networks?

- + Networks allow us to share things:
- + Files
- + Programs
- + Resources





## Components Of Computer Networks Servers, NICs, Switches, Routers & Firewalls

# CCNA

## Topic Overview

+ Servers & Clients

RADMAN NETWORK  
All your world is connected!!!

# CCNA

## Topic Overview

- + Servers & Clients
- + Local & Remote Resources

RADMANN NETWORK  
All your world is connected!!!

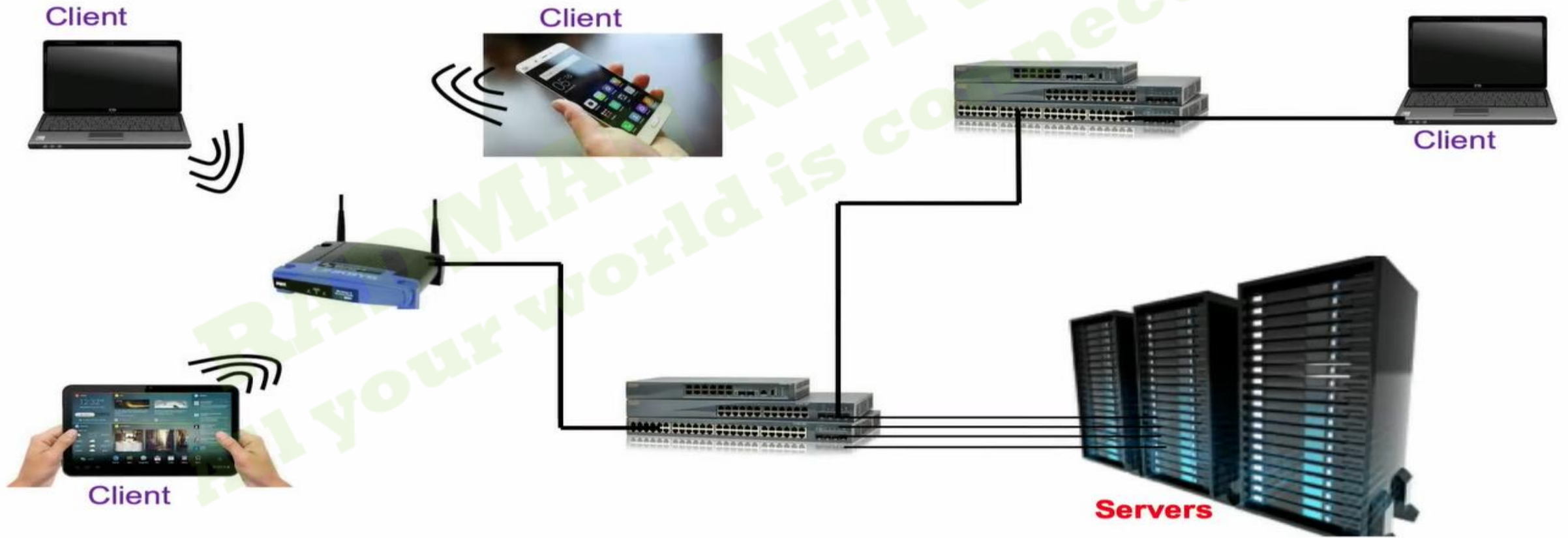
# CCNA

## Topic Overview

- + Servers & Clients
- + Local & Remote Resources
- + Common Network Components

# CCNA

## Servers & Clients



# CCNA

## Local & Remote Resources

- + Local Resources:

**RADMAN NETWORK**  
All your world is connected.!!!

# CCNA

## Local & Remote Resources

- + Local Resources:
  - + Your own HDD

**RADMAN NETWORK**  
All your world is connected.!!!

# CCNA

## Local & Remote Resources

- + Local Resources:
  - + Your own HDD
  - + Memory
  - + Keyboard
  - + DVD-ROM Drive
- + Network Resources:
  - + Networked HDDs
  - + Networked Printers
  - + Networked Optical Drives connected to Network Servers



# CCNA

## Common Network Components - NICs

- + Network Interface Cards, Connectors and Cables



# CCNA

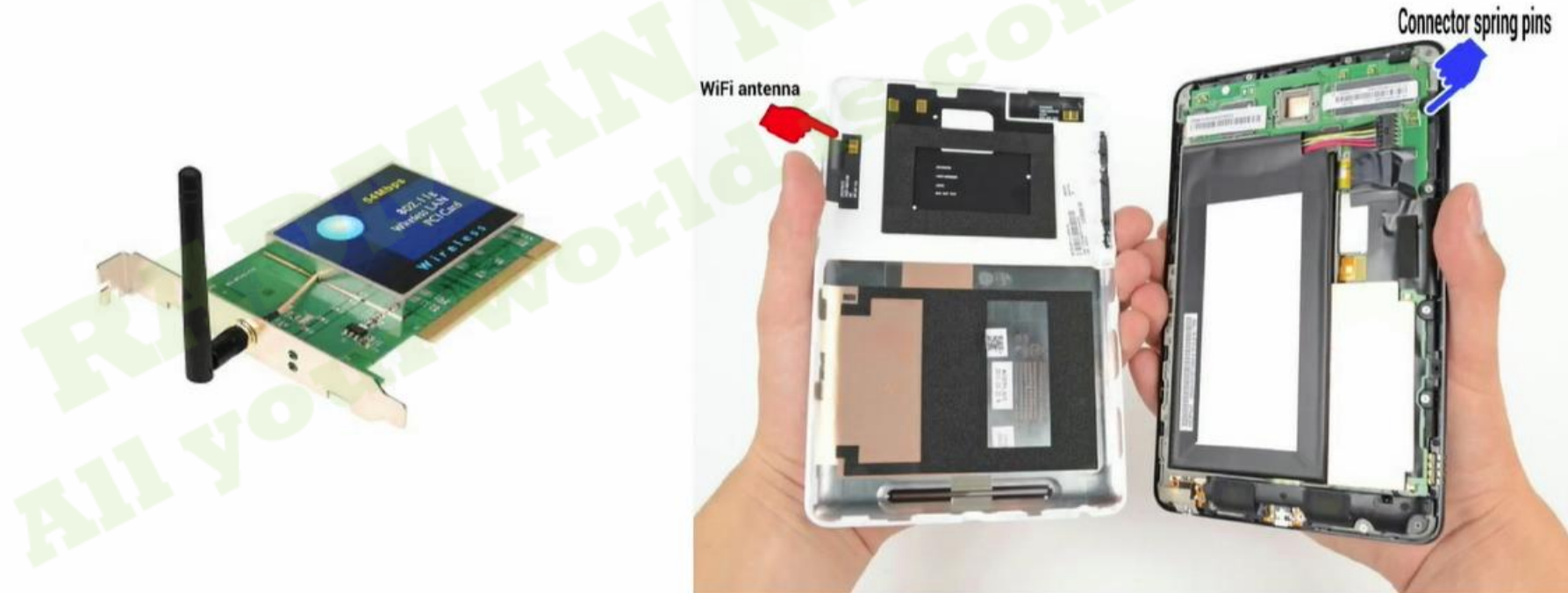
## Common Network Components - NICs

- + Coaxial Cable NICs



# CCNA

## Common Network Components - NICs



# CCNA

## Common Components - Switches



# CCNA

## Common Components - Routers

+ Routers



# CCNA

## Common Components – Firewalls & IPS

- + Traditional Firewalls
  - + Inspected only network address (IPv4/v6) and TCP/UDP port numbers
  - + Based all forward-or-block decisions based off of those values

# CCNA

## Common Components – Firewalls & IPS

- + Traditional Firewalls
  - + Inspected only network address (IPv4/v6) and TCP/UDP port numbers
  - + Based all forward-or-block decisions based off of those values
- + Next-Generation Firewalls

## Common Components – Firewalls & IPS

- + Traditional Firewalls
  - + Inspected only network address (IPv4/v6) and TCP/UDP port numbers
  - + Based all forward-or-block decisions based off of those values
- + Next-Generation Firewalls
  - + Allow for deep-packet inspection
  - + Ability to forward or block packet based on application awareness
  - + Can utilize outside services to detect malicious attacks
- + IPS = Intrusion Prevention System



# CCNA

## Common Components – Firewalls & IPS



Cisco ASA 5500-X



Firepower 9000 Series

# CCNA

## Components Of Computer Networks

### Wi-Fi & DNA Center

RADMANN NETWORKS  
All your world is connected!!!

## Topic Overview

- + Common Wi-Fi Components
- + Introduction To Cisco DNA Center

# CCNA

## Common Components – Wi-Fi

- + Wi-Fi Access Points



## Common Components – Wi-Fi Controllers

- + Controllers
  - + Central point of management for groups of Access Points
  - + Control Wi-Fi access for Clients
- + Controller differentiators
  - + Quantity of Wi-Fi Clients supported
  - + Features available
  - + Appliance or Cloud-based
  - + Type & quantity of uplink interfaces



# CCNA

## Components - Cisco DNA Center

- + DNA = Digital Network Architecture
- + Cisco DNA Center is a centralized management dashboard for complete control of a network
- + Provides a central automation and analytics platform to facilitate “Intent-Based Networking”

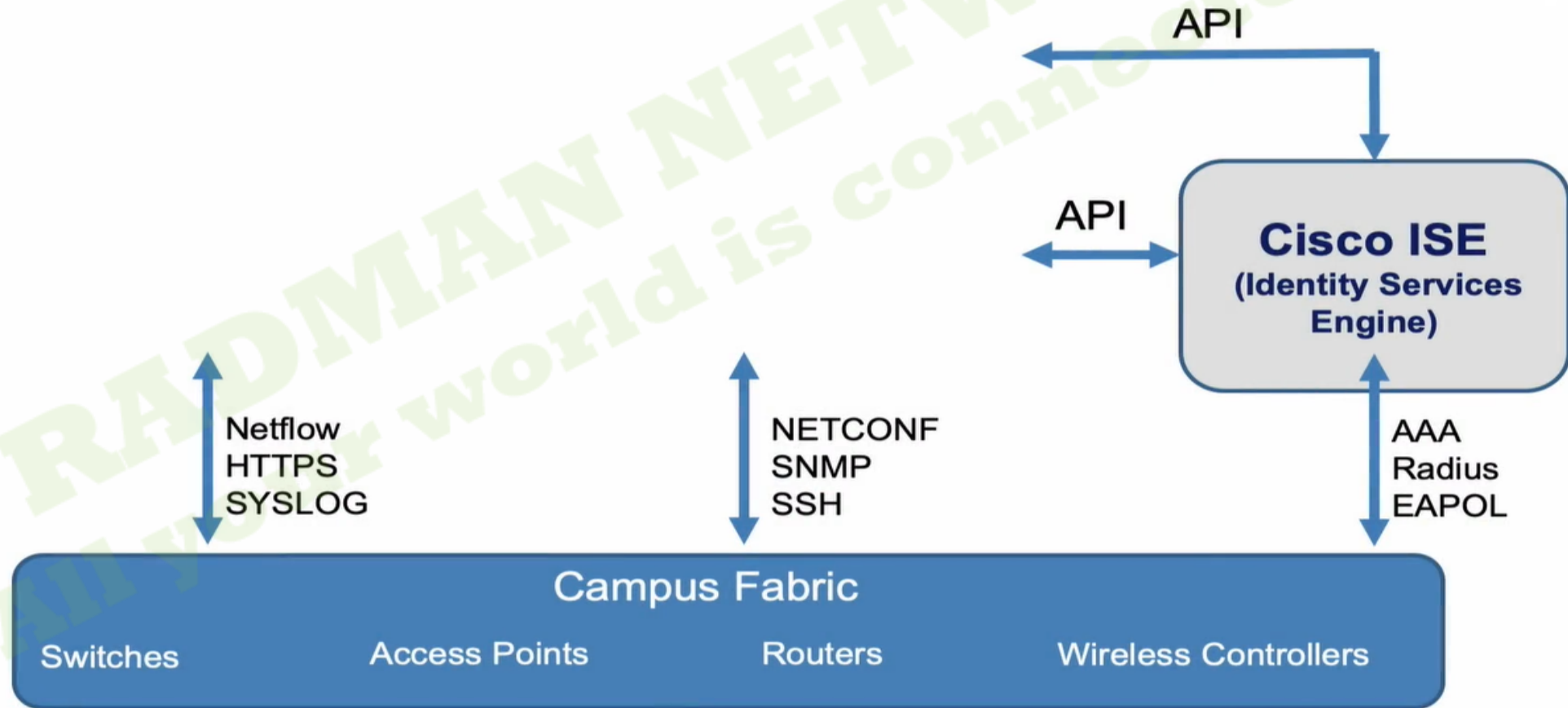
# CCNA

## Cisco DNA Center

- + Appliance pre-built with Cisco DNA Center software
- + A controller and analytics platform
- + Central point of GUI-based network control allowing:
  - + Design your network
  - + Create topology maps and diagrams
  - + Identify/list “Golden Images” for software deployments
  - + Create wireless profiles and SSIDs
  - + GUI-based configuration of network devices

# CCNA

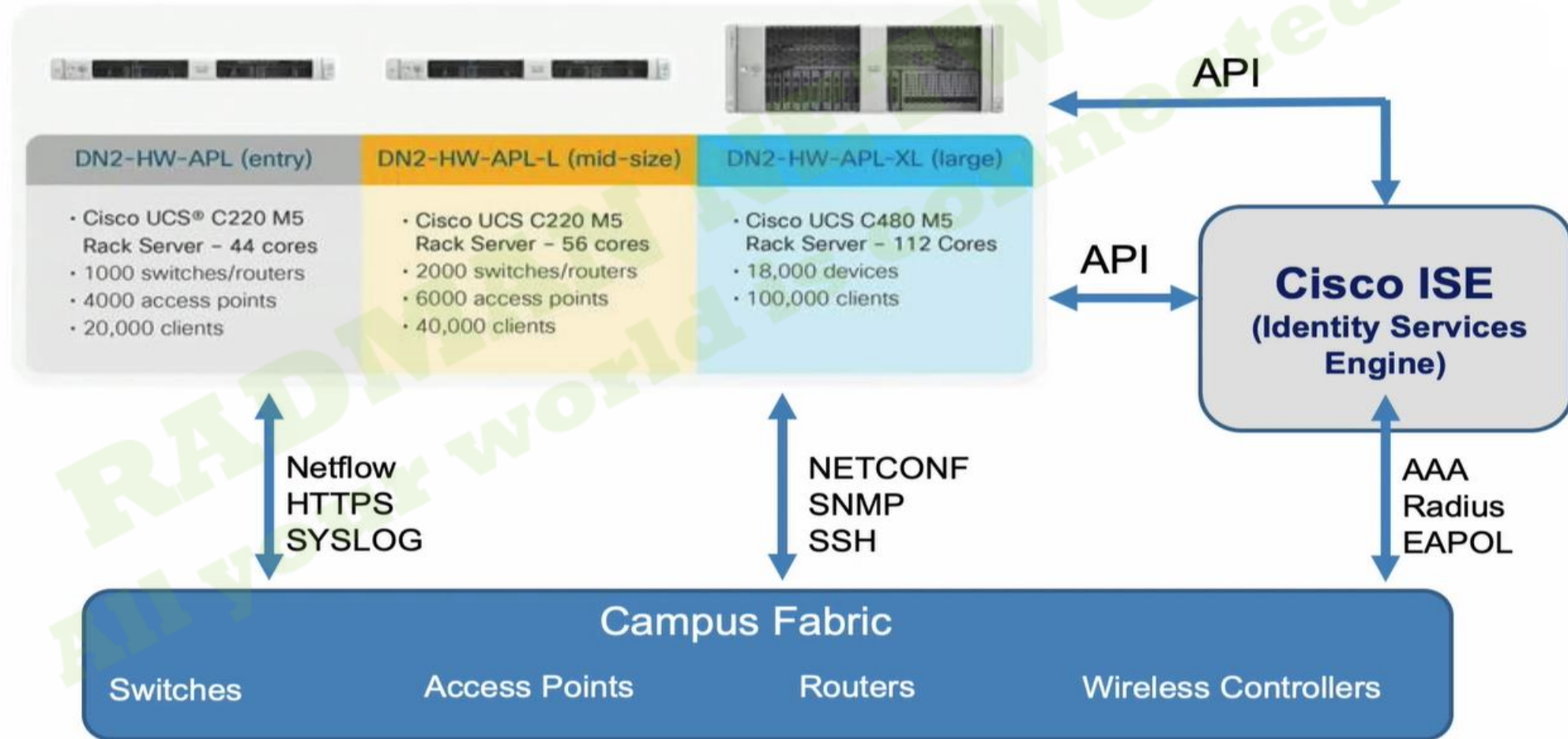
## Cisco DNA Center Components





# CCNA

## Cisco DNA Center Components



# CCNA

## Network Math: Binary

RADMANN NETWORK  
All your worlds connected!!!

# CCNA

## Topic Overview

- + Introduction To Binary

**RADMAN NETWORK**  
All your world is connected!!!

# CCNA

## Binary Math

**RADMAN NETWORK**  
All your world is connected.!!!

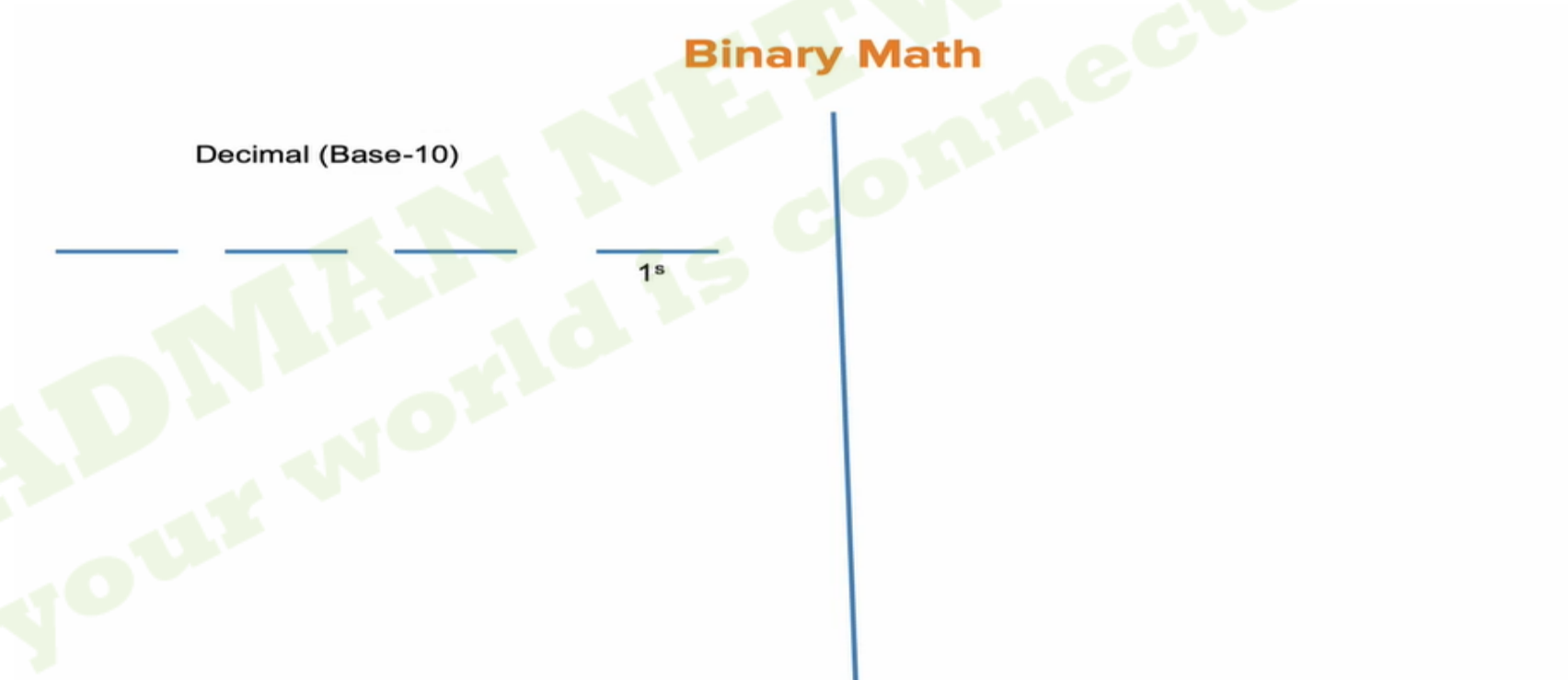
# CCNA

## Binary Math

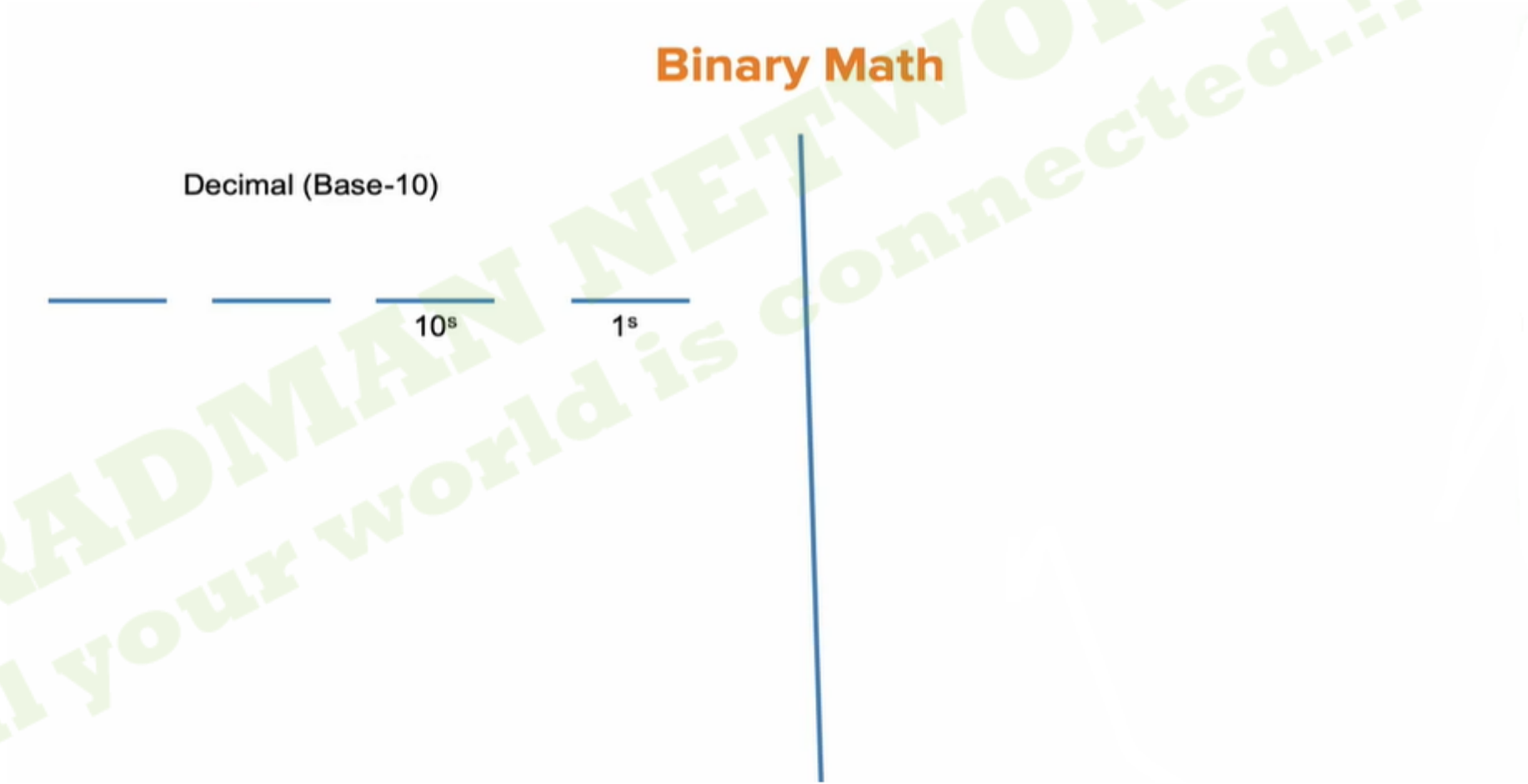
Decimal (Base-10)

RADMAN NETWORK  
All your world is connected.!!!

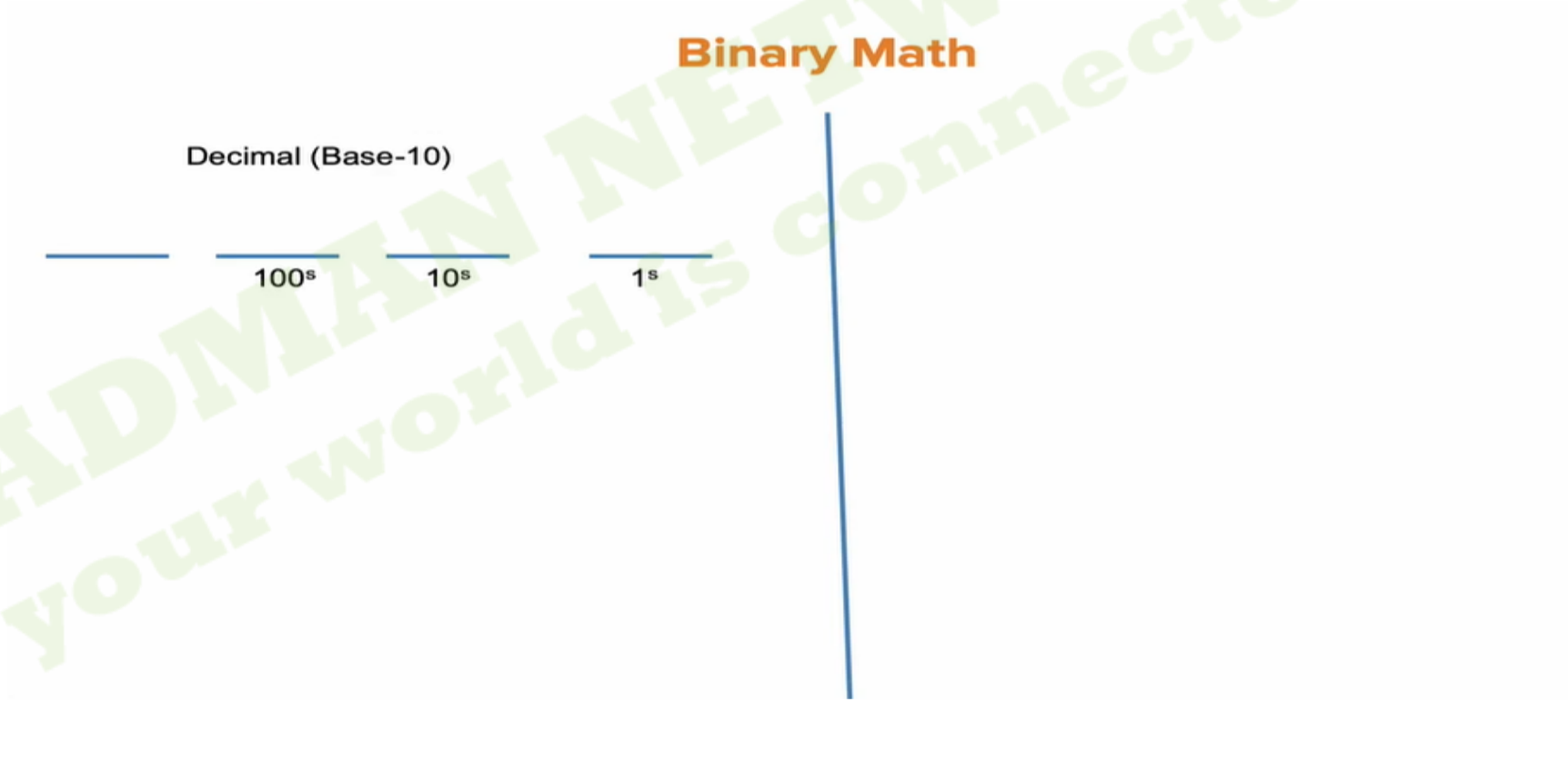
# CCNA



# CCNA

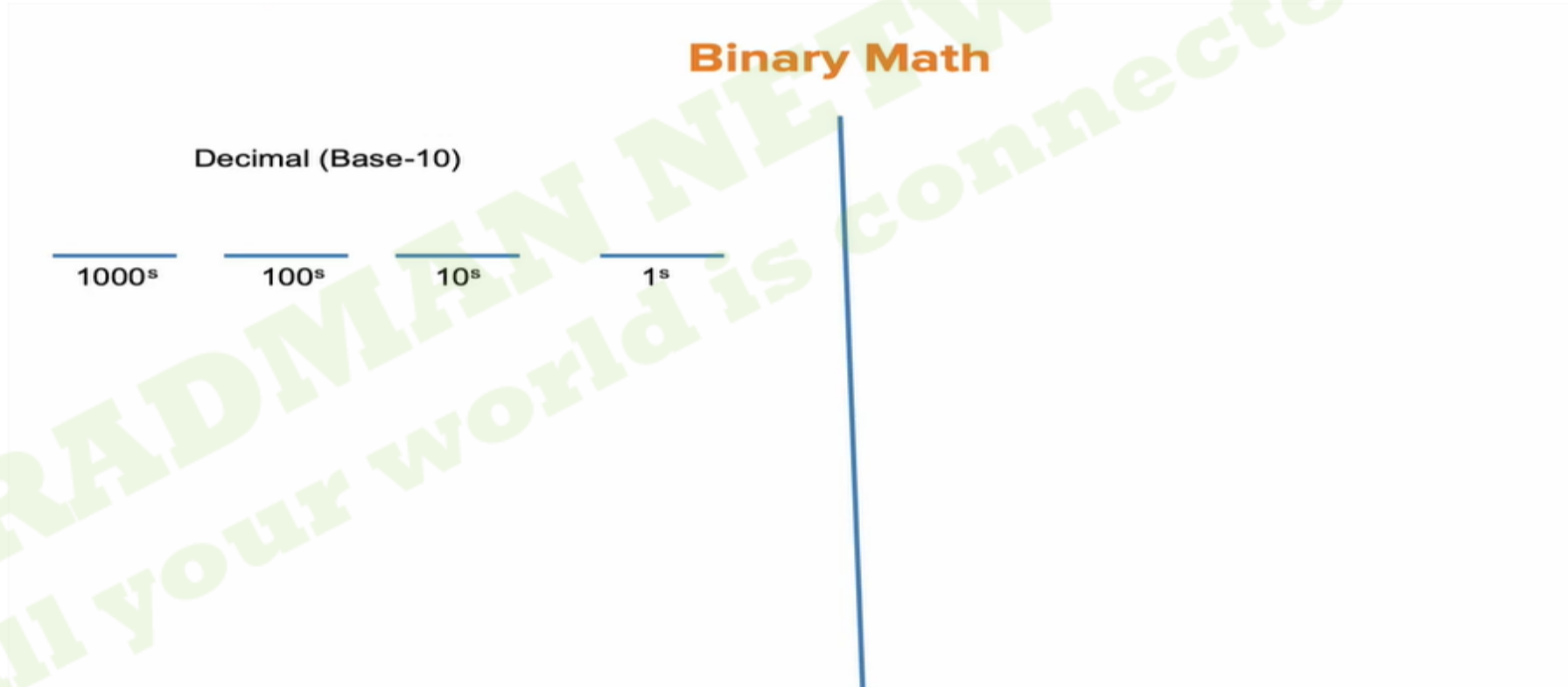


# CCNA

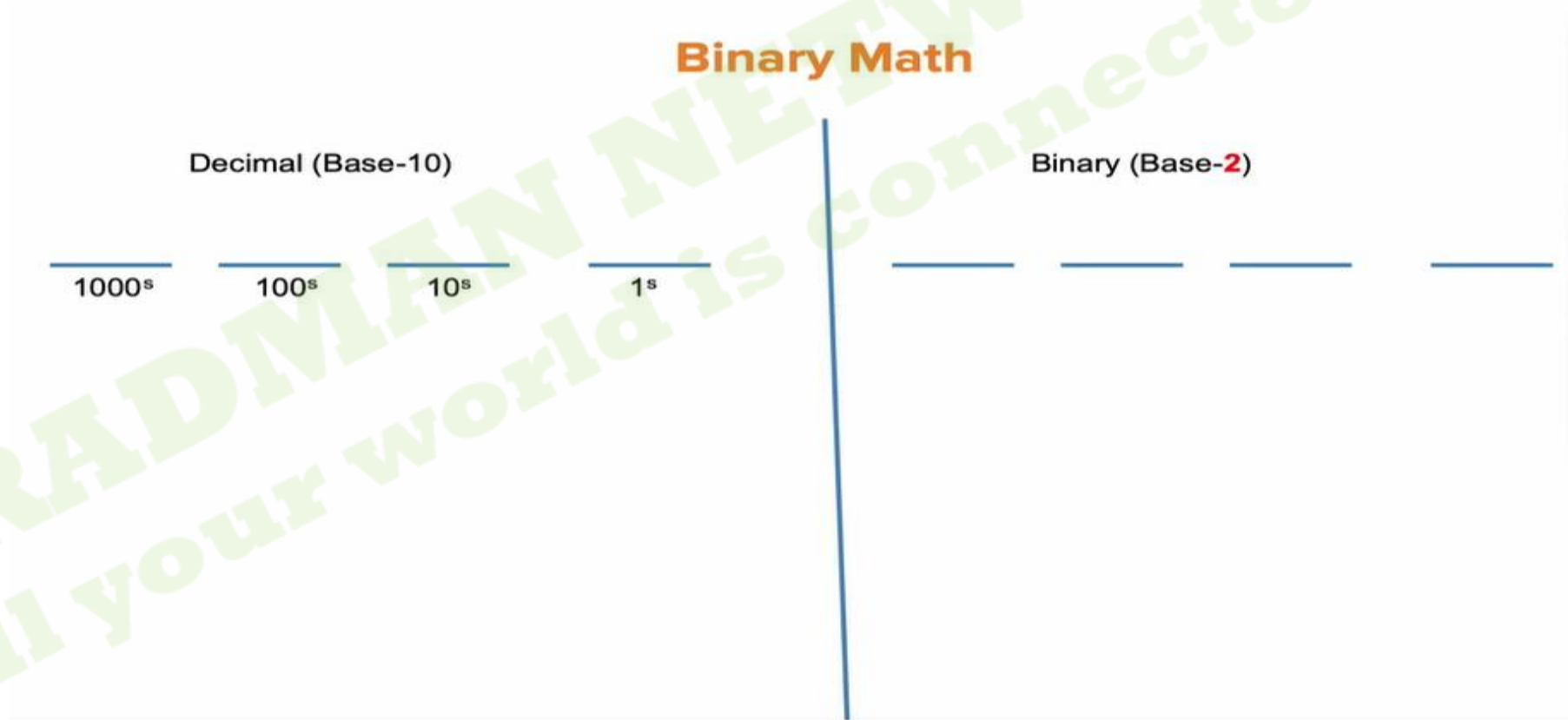




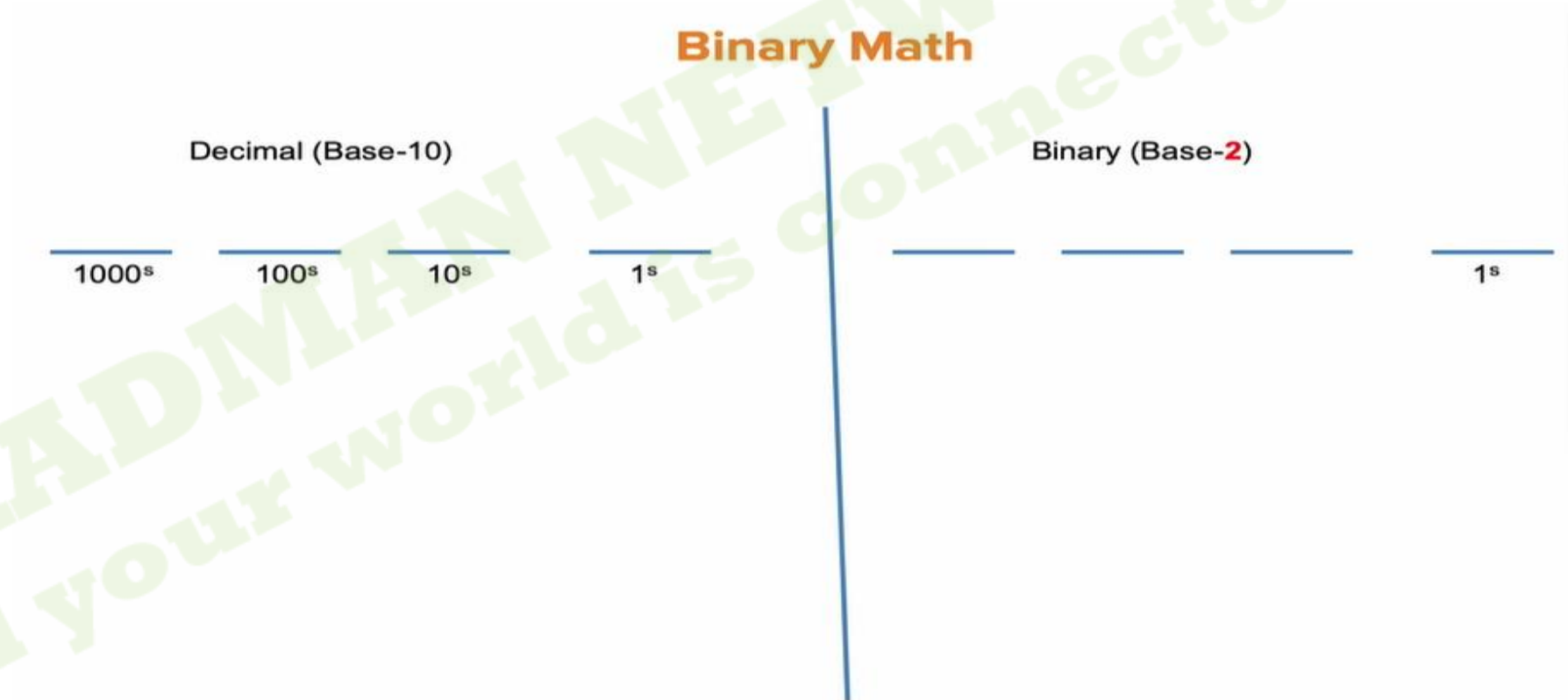
# CCNA



# CCNA



# CCNA



# CCNA

## Binary Math

Decimal (Base-10)

1000<sup>s</sup>

100<sup>s</sup>

10<sup>s</sup>

1<sup>s</sup>

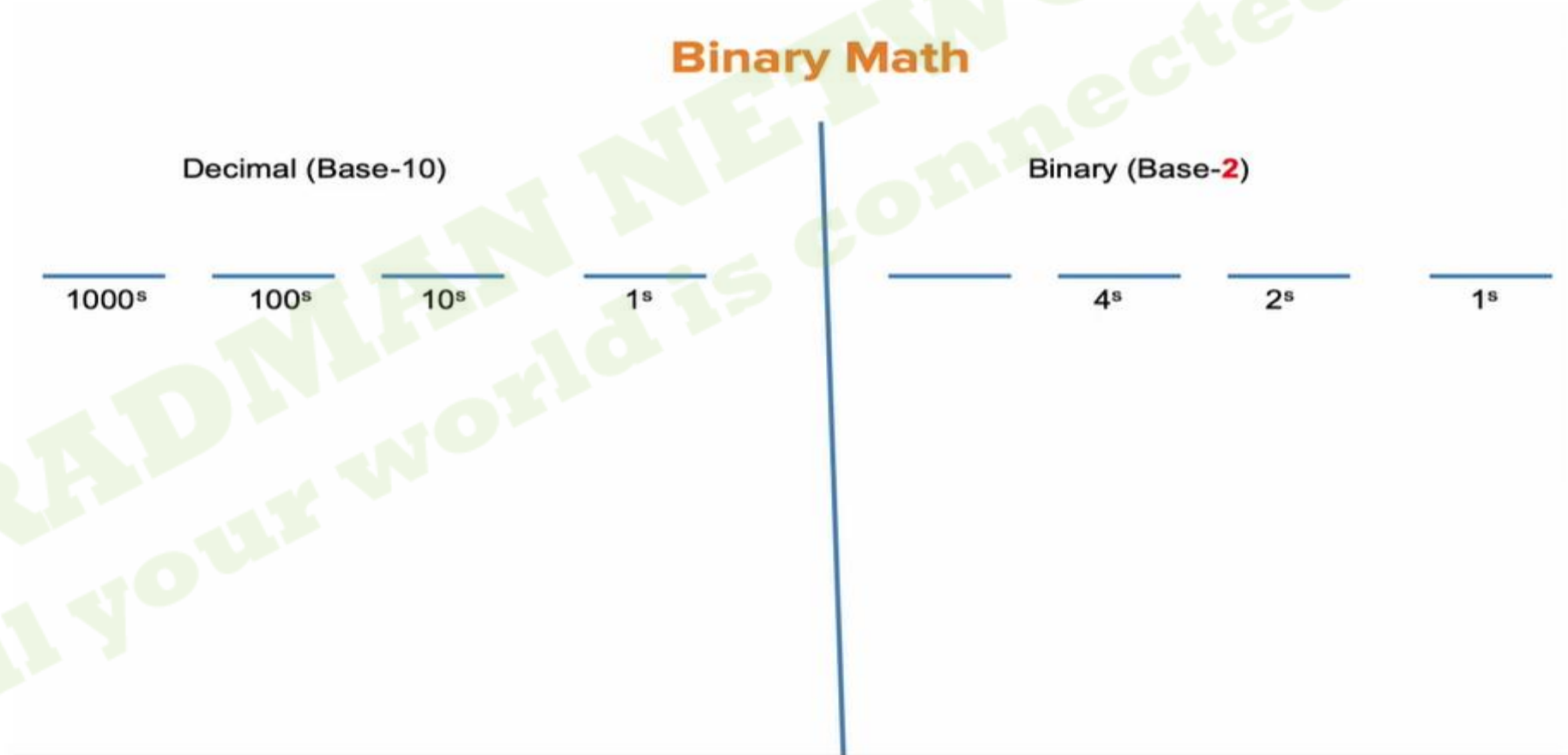
Binary (Base-2)

2<sup>s</sup>

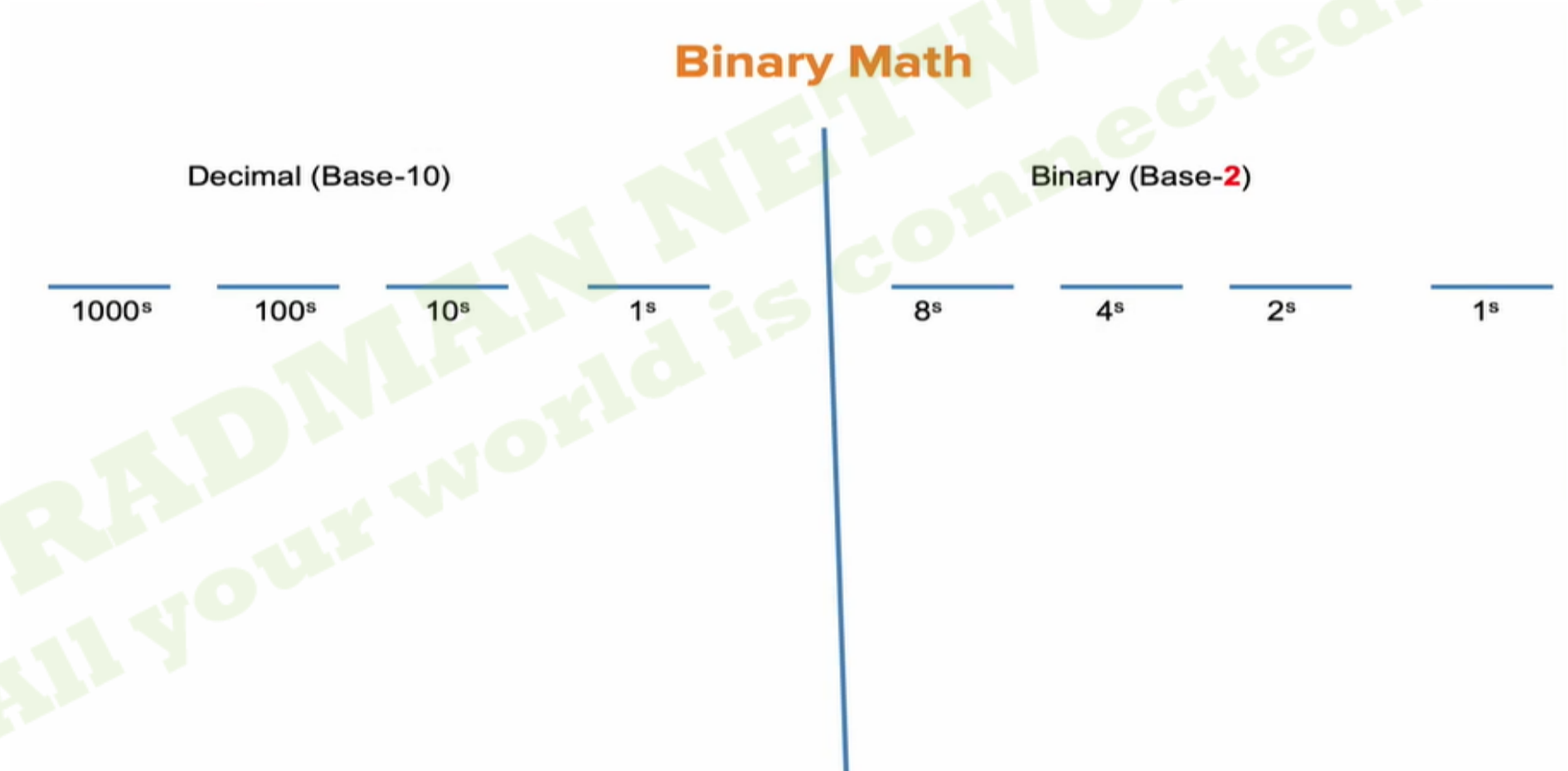
1<sup>s</sup>

RADMANN NETWORK  
All your world is connected.!!!

# CCNA



# CCNA



## Binary Math

Decimal (Base-10)

$1000^s$     $100^s$     $10^s$     $1^s$

Binary (Base-2)

$8^s$     $4^s$     $2^s$     $1^s$

Common Binary Patterns To Memorize:

$00000000 = 0$   
 $10000000 = 128$   
 $11000000 = 192$   
 $11100000 = 224$   
 $11110000 = 240$   
 $11111000 = 248$   
 $11111100 = 252$   
 $11111110 = 254$   
 $11111111 = 255$

## Binary Numbers In Networking

```
interface Serial1/2  
description Connection-to-Backbone-Rtr  
ip address 1.2.1.1 255.255.255.0
```

```
ip route 33.33.33.3 255.255.255.255 2.4.2.33
```

```
Sw-3(config)#router bgp 444  
Sw-3(config-router)#network 23.150.1.32 mask 255.255.255.224
```



CCNA

# Network Math: Hexadecimal

RADMANN NETWORK  
All your world is connected!!!

# CCNA

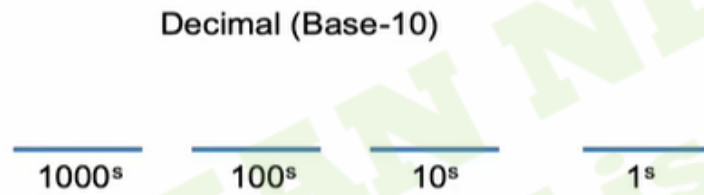
## Topic Overview

- + Introduction To Hexadecimal

RADMANN NETWORK  
All your world is connected!!!

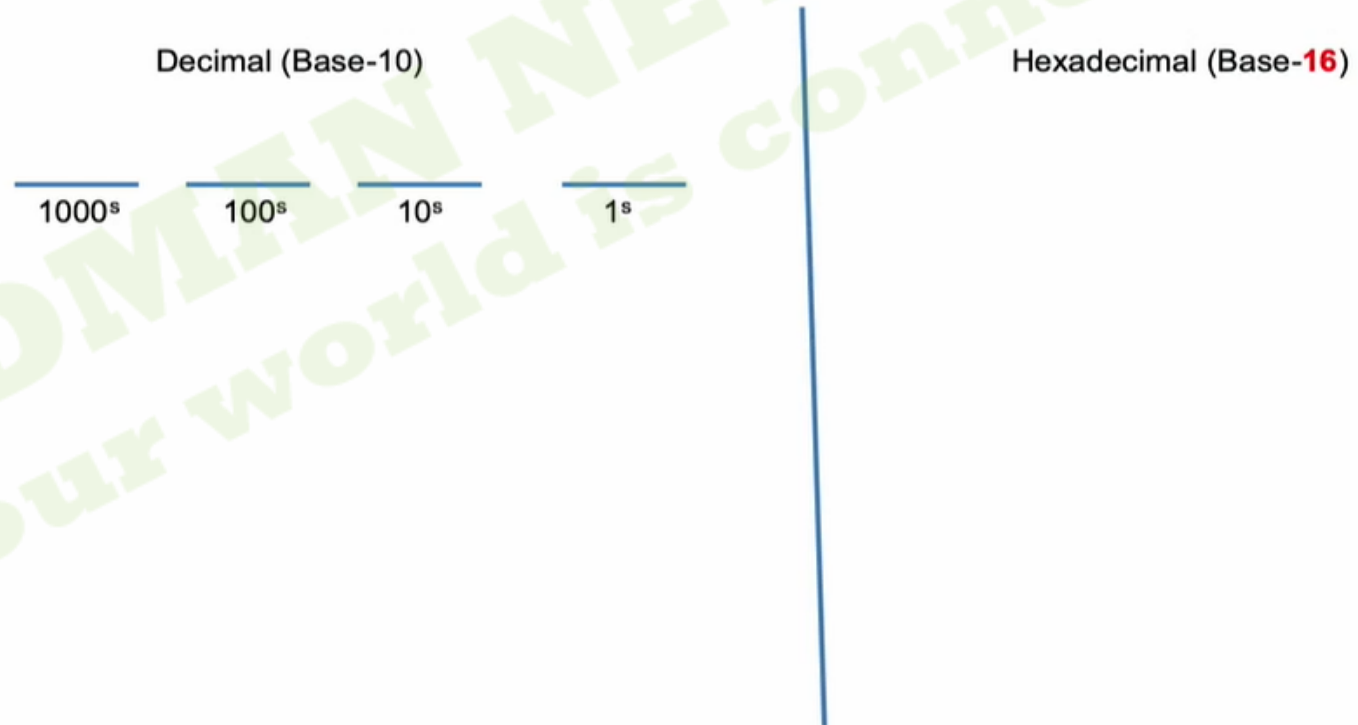
# CCNA

## Hexadecimal Math



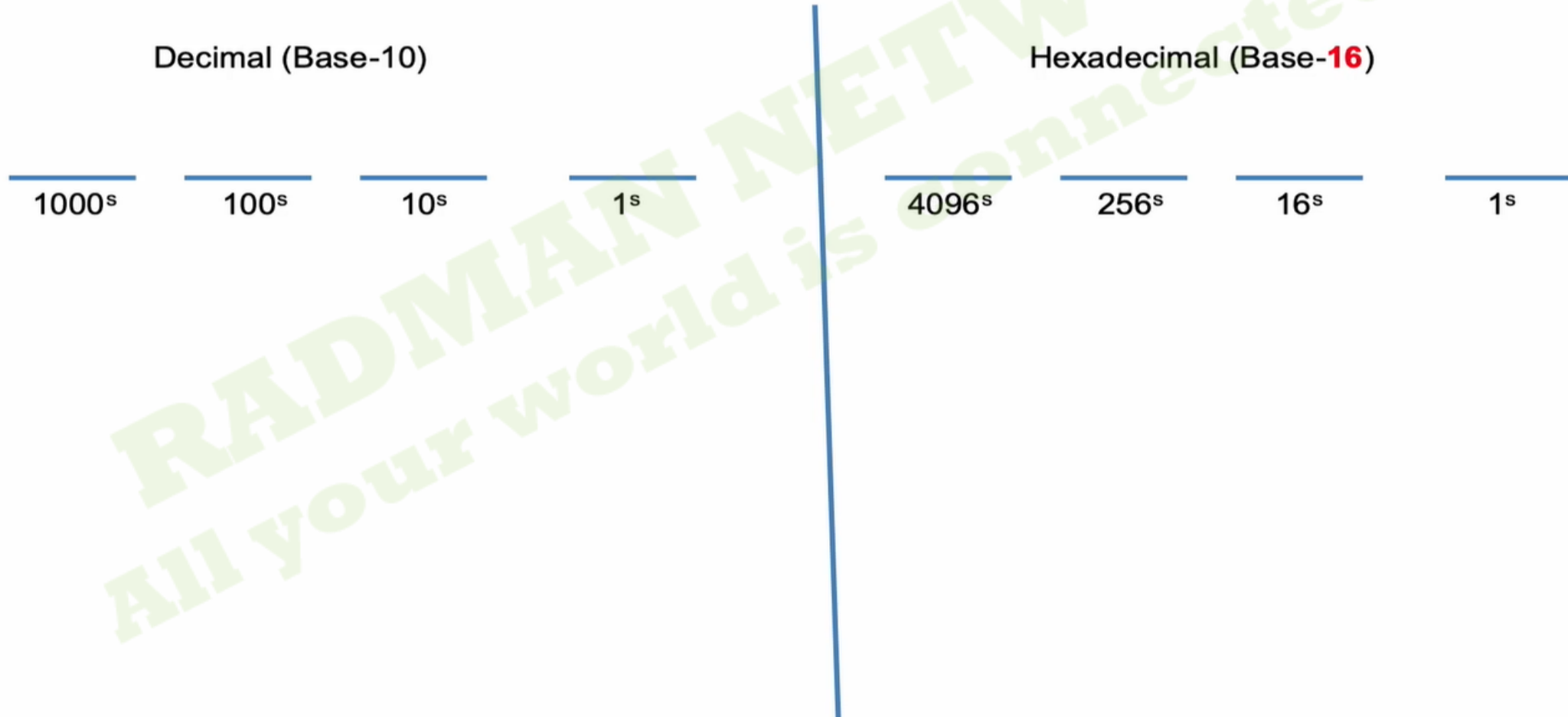
# CCNA

## Hexadecimal Math



# CCNA

## Hexadecimal Math



## Hexadecimal Numbers In Networking

```
Rtr-1(config)#int ser 1/1  
Rtr-1(config-if)#ipv6 address 2003:1acd:55ef:1bcde::1/64
```

```
Configuration register is 0x2142 (will be 0x2102 at next reload)
```

```
Sw-1#sho mac address-table  
Mac Address Table  
-----  
Vlan      Mac Address      Type      Ports  
----      -
```

Vlan	Mac Address	Type	Ports
All	0100.0ccc.cccc	STATIC	CPU

# CCNA

## Network Topology Architectures

RADMANN NETWORK  
All your world is connected!!!

## Topic Overview

- + 2-Tier & 3-Tier Architectures
- + Spine-Leaf Architectures
- + WAN Architectures
- + SOHO Architectures
- + On-Premise Vs. Cloud-Based Architectures



## Network Topology Architectures

- + Networks can be designed in a variety of ways
- + Each of these ways (i.e. an Architecture) will dictate things such as:
  - + Physical devices and cabling needed
  - + Path of data traffic
  - + Redundancy
  - + Use of 3<sup>rd</sup> party services

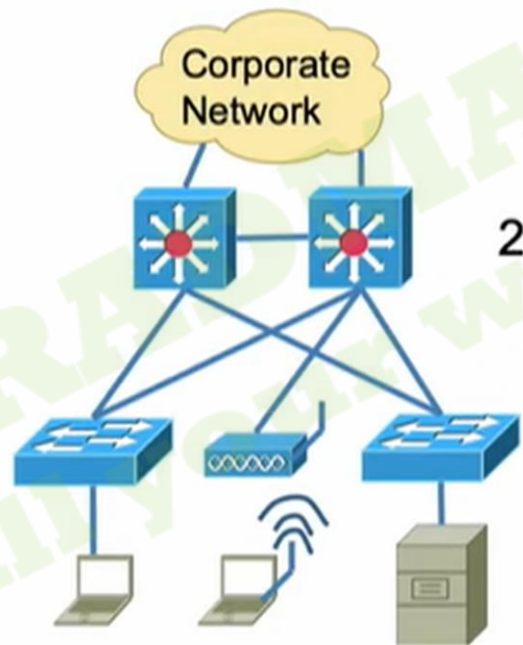
## 2-Tier & 3-Tier Architectures

- + The enterprise/campus LAN networks are typically designed as either 2-tier or 3-tier networks



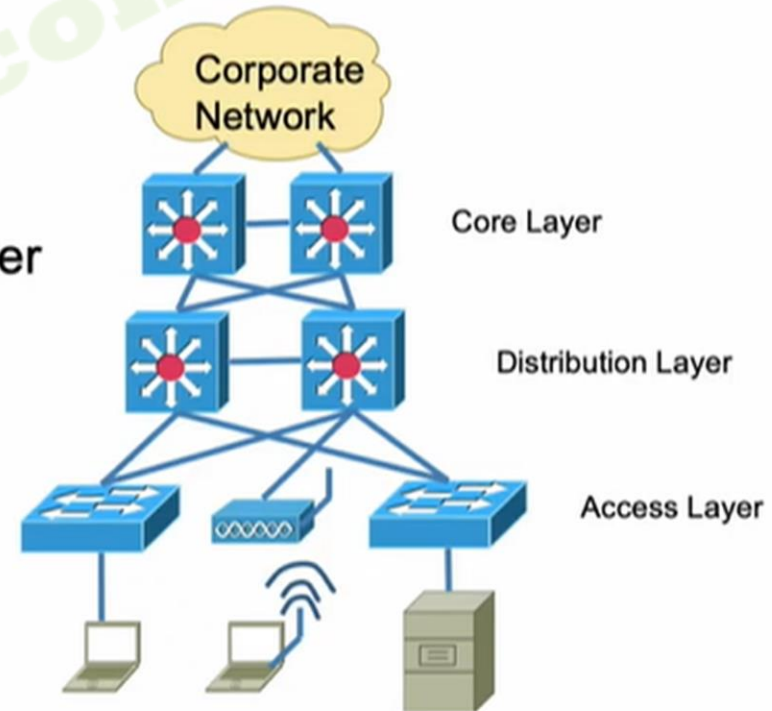
## 2-Tier & 3-Tier Architectures

- + The enterprise/campus LAN networks are typically designed as either 2-tier or 3-tier networks



2-Tier

3-Tier



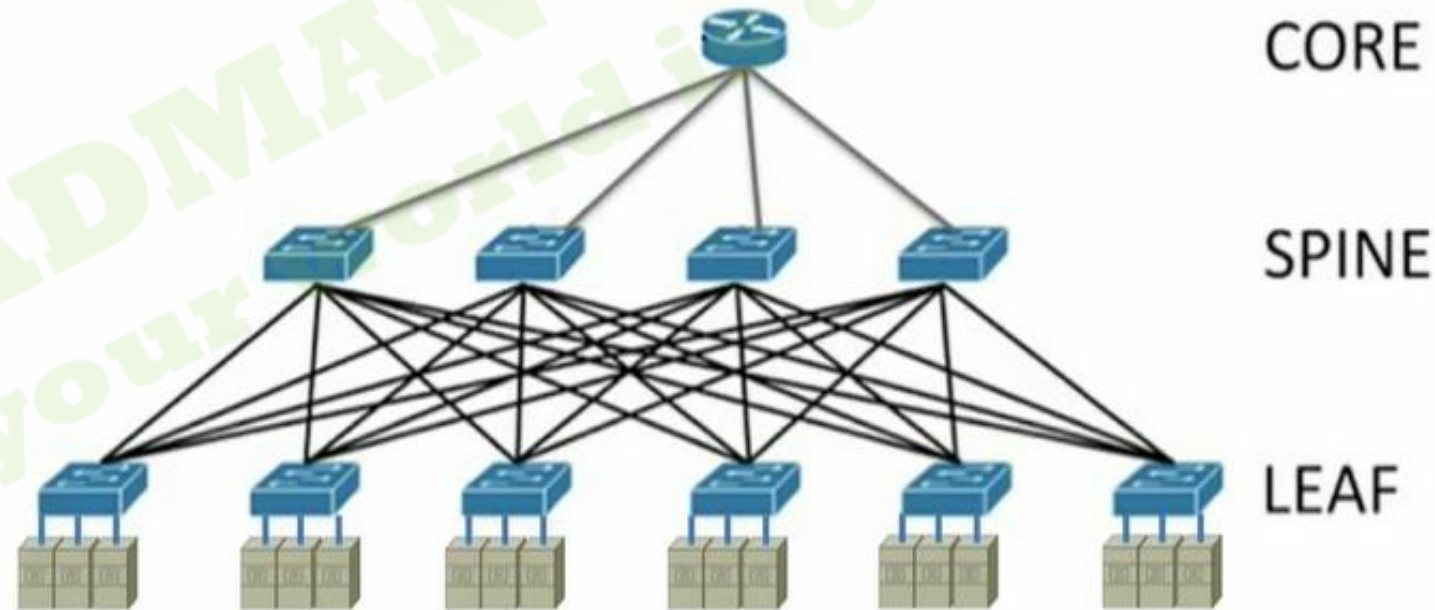
Core Layer

Distribution Layer

Access Layer

## Spine-Leaf Architectures

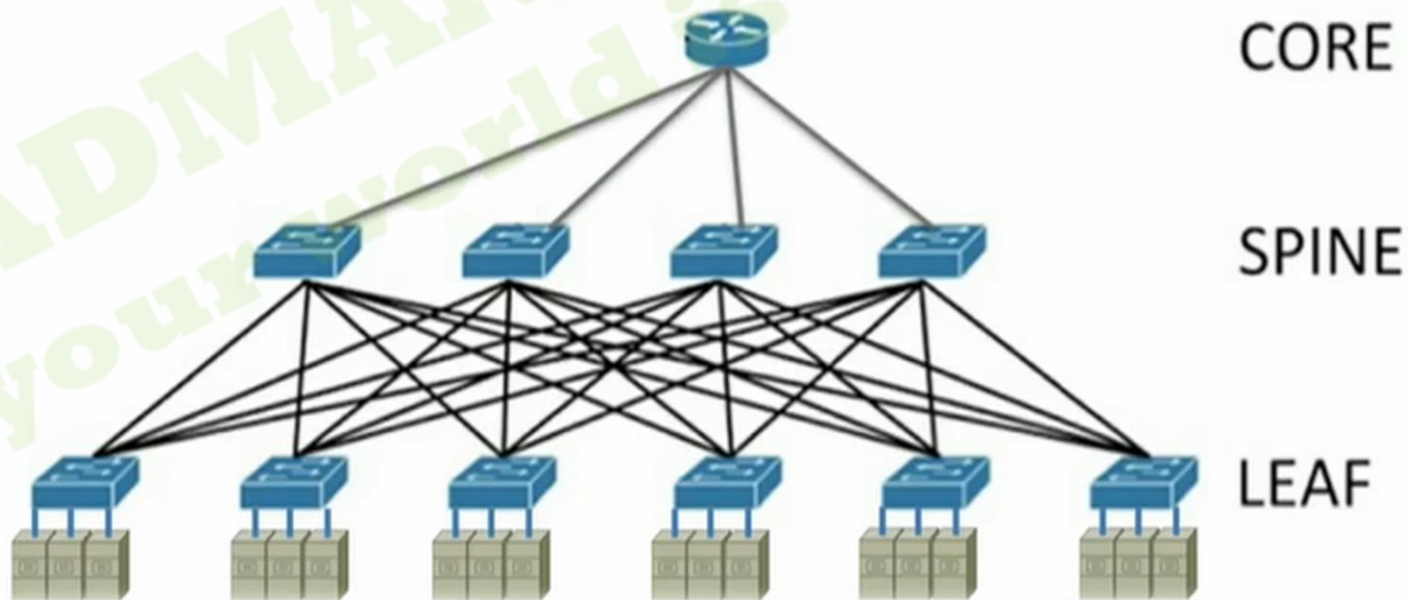
- + Data center networks are typically designed as Spine-Leaf architectures



# CCNA

## Spine-Leaf Architectures

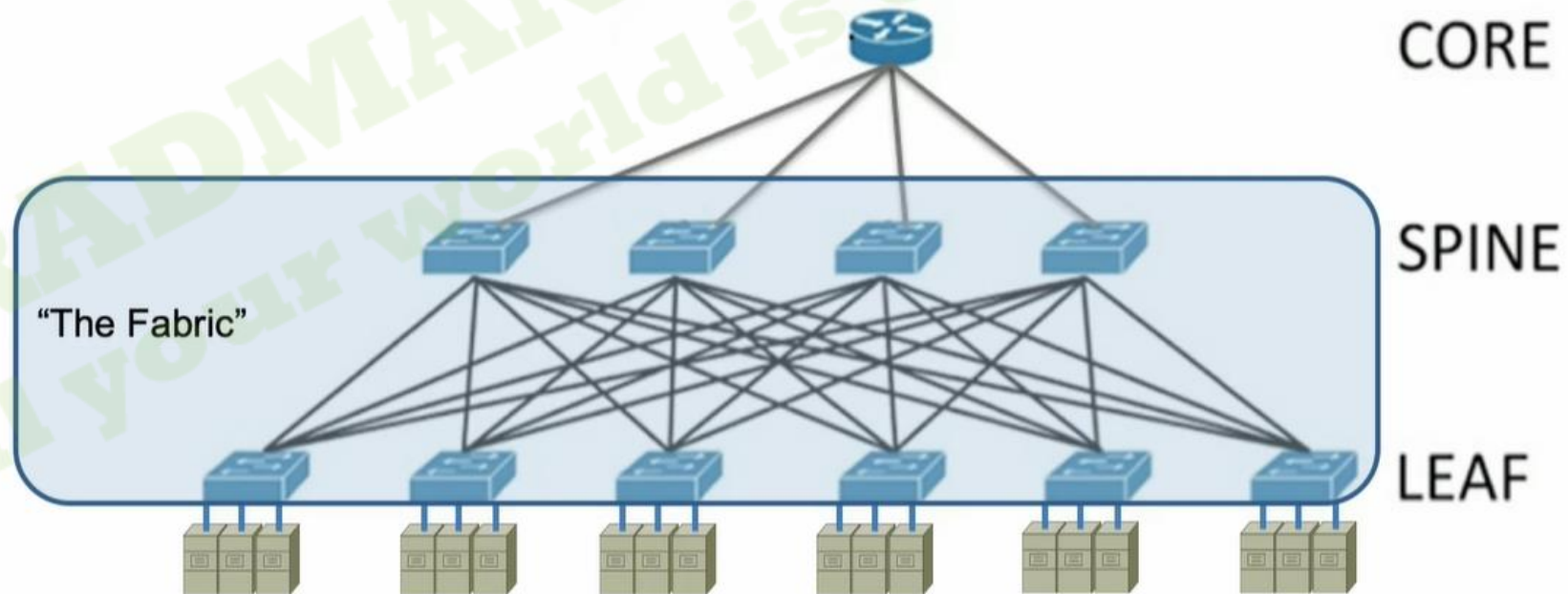
- + Data center networks are typically designed as Spine-Leaf architectures
- + Interconnections between switches can be L2 or L3



# CCNA

## Spine-Leaf Architectures

- + Data center networks are typically designed as Spine-Leaf architectures
- + Interconnections between switches can be L2 or L3



# CCNA

## WAN Architectures

- + WANs provide a variety of connection methods
- + Several transport methods:

**RADMAN NETWORK**  
All your world is connected!!!

## WAN Architectures

- + WANs provide a variety of connection methods
- + Several transport methods:
  - + Point-to-Point





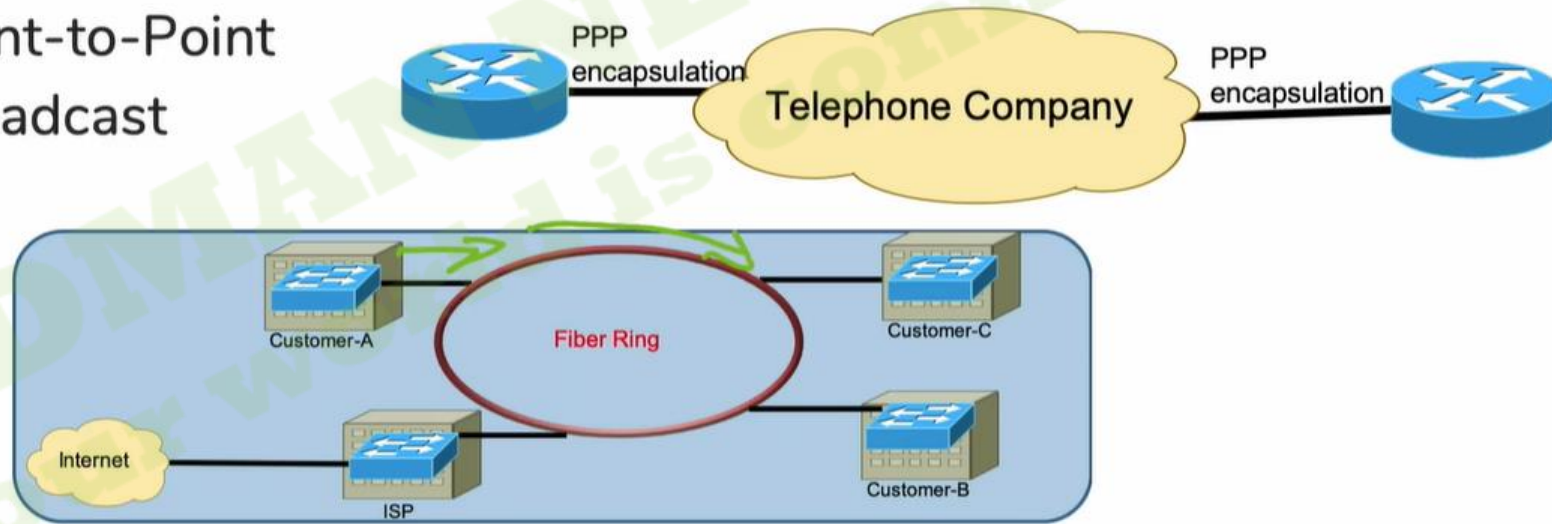
## WAN Architectures

- + WANs provide a variety of connection methods
- + Several transport methods:
  - + Point-to-Point
  - + Broadcast



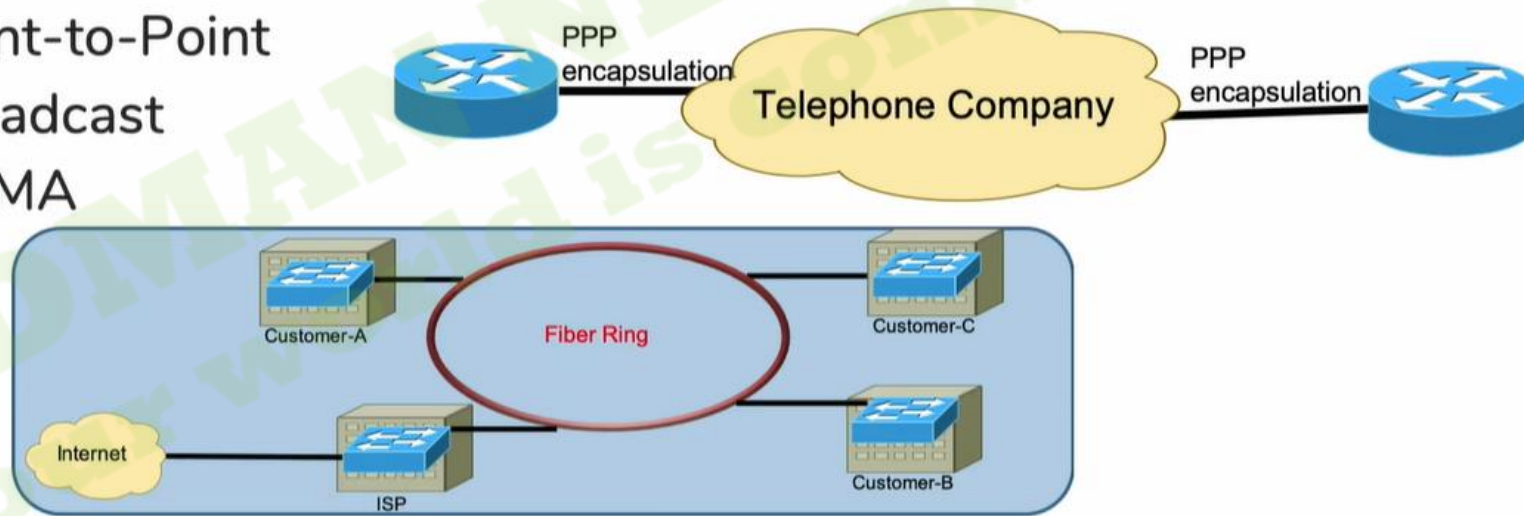
## WAN Architectures

- + WANs provide a variety of connection methods
- + Several transport methods:
  - + Point-to-Point
  - + Broadcast



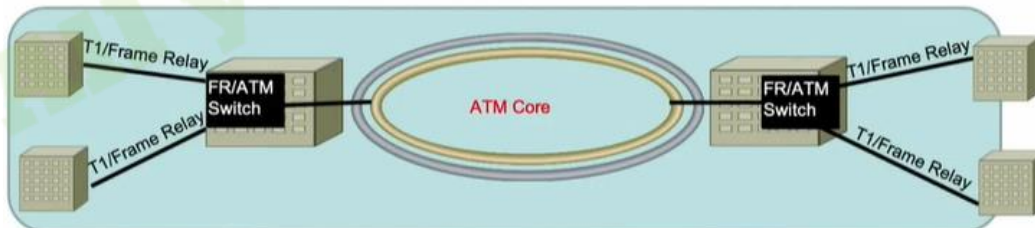
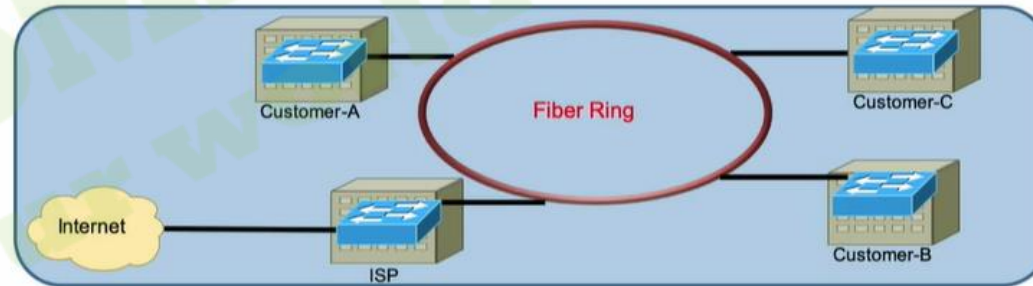
## WAN Architectures

- + WANs provide a variety of connection methods
- + Several transport methods:
  - + Point-to-Point
  - + Broadcast
  - + NBMA



## WAN Architectures

- + WANs provide a variety of connection methods
- + Several transport methods:
  - + Point-to-Point
  - + Broadcast
  - + NBMA



# CCNA

## SOHO Architectures

Small Office Network



Home Office Network



## SOHO Architectures

- + SOHO = Small Office / Home Office
  - + Less equipment demands
  - + Less need for authentication and security
  - + Difficult to manage and enforce policy from HQ

Small Office Network



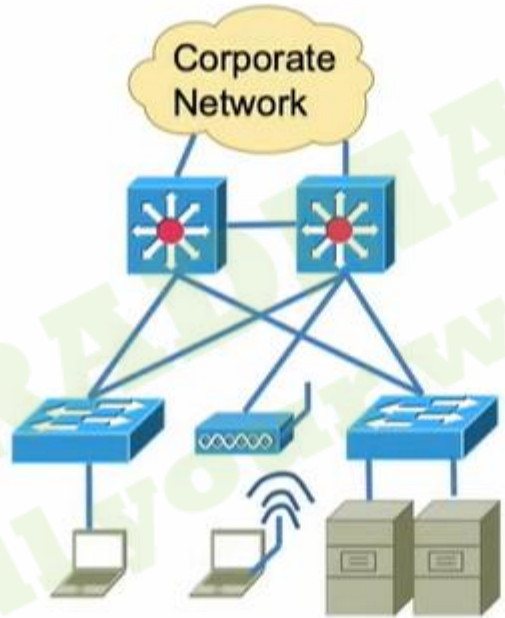
Home Office Network



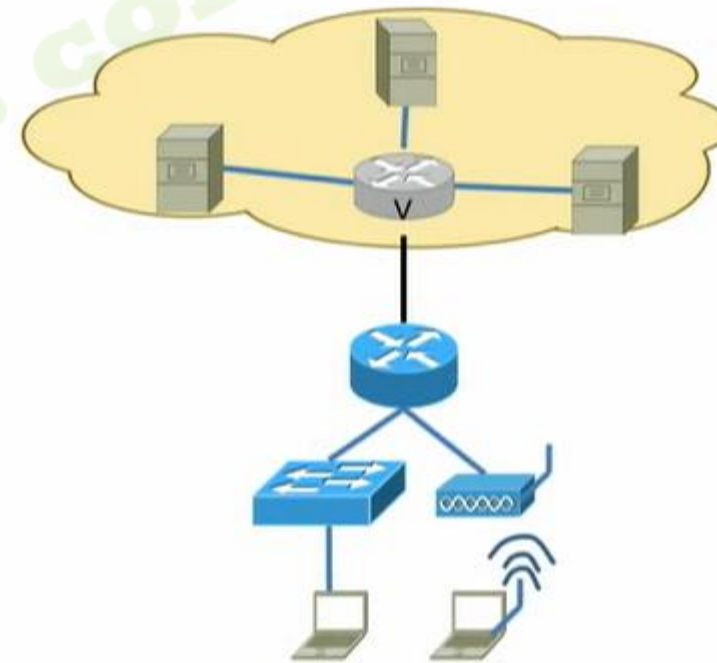
# CCNA

## On-Premise Vs. Cloud-Based Architectures

On-Premises Network



Cloud-Based Network



# CCNA

## Power Over Ethernet (PoE)



## Topic Overview

- + Why Do We Need PoE?
- + What Can Be Powered?
- + Benefits Of PoE
- + PSE & PD Defined
- + How Much Power Can Be Sent?
- + How Is Power Delivered?
- + PoE Detection & Negotiation
- + PoE Monitoring

# CCNA

Why Do We Need PoE?

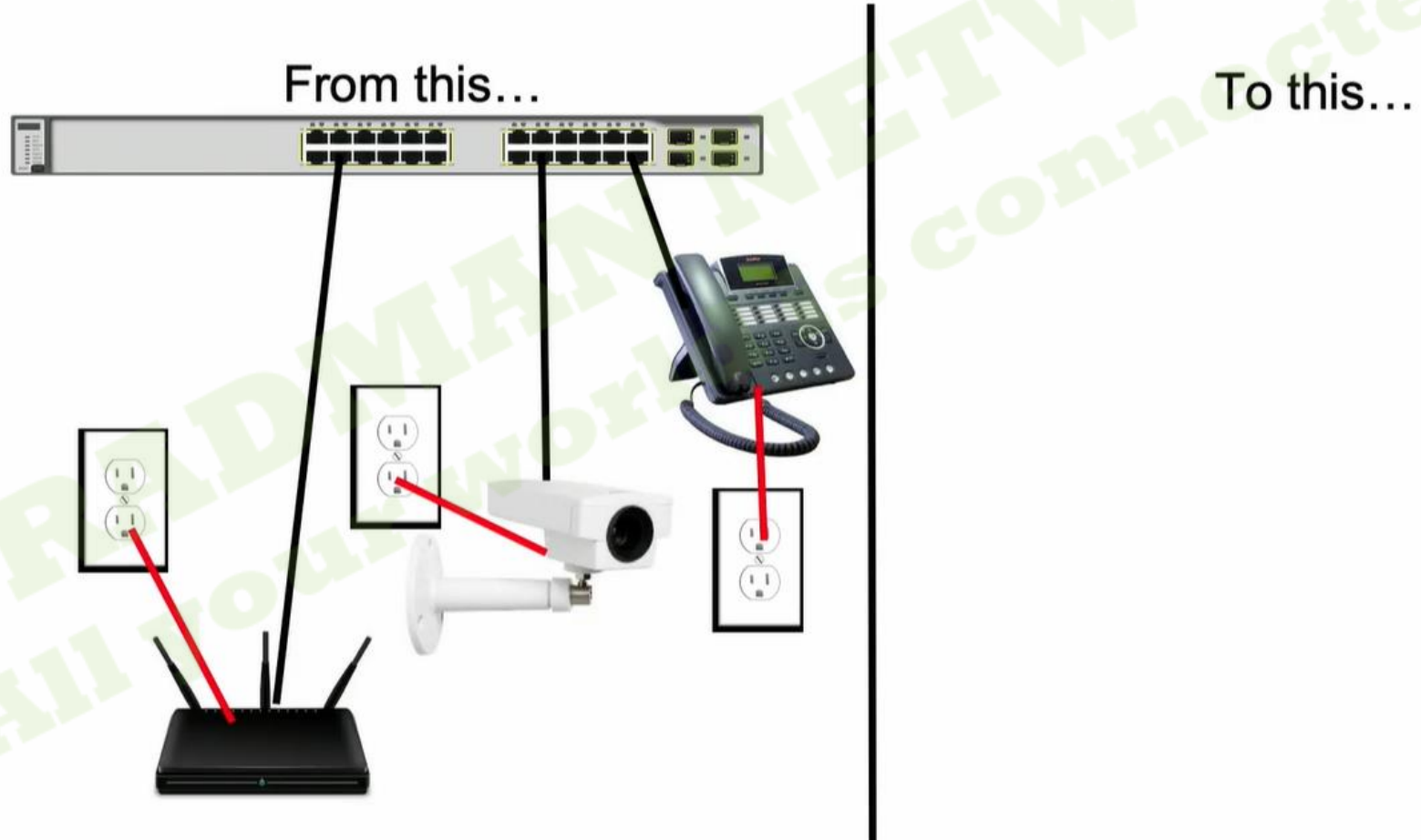
**RADMAN NETWORK**  
All your world is connected.!!!

## Why Do We Need PoE?

- + All host devices that connect to a network require power
  - + Laptops
  - + PCs
  - + Printers
  - + IP Phones
  - + IoT devices
- + Finding available AC connections for all of these devices can be difficult
- + PoE allows us to provide power to these devices directly from the network switch

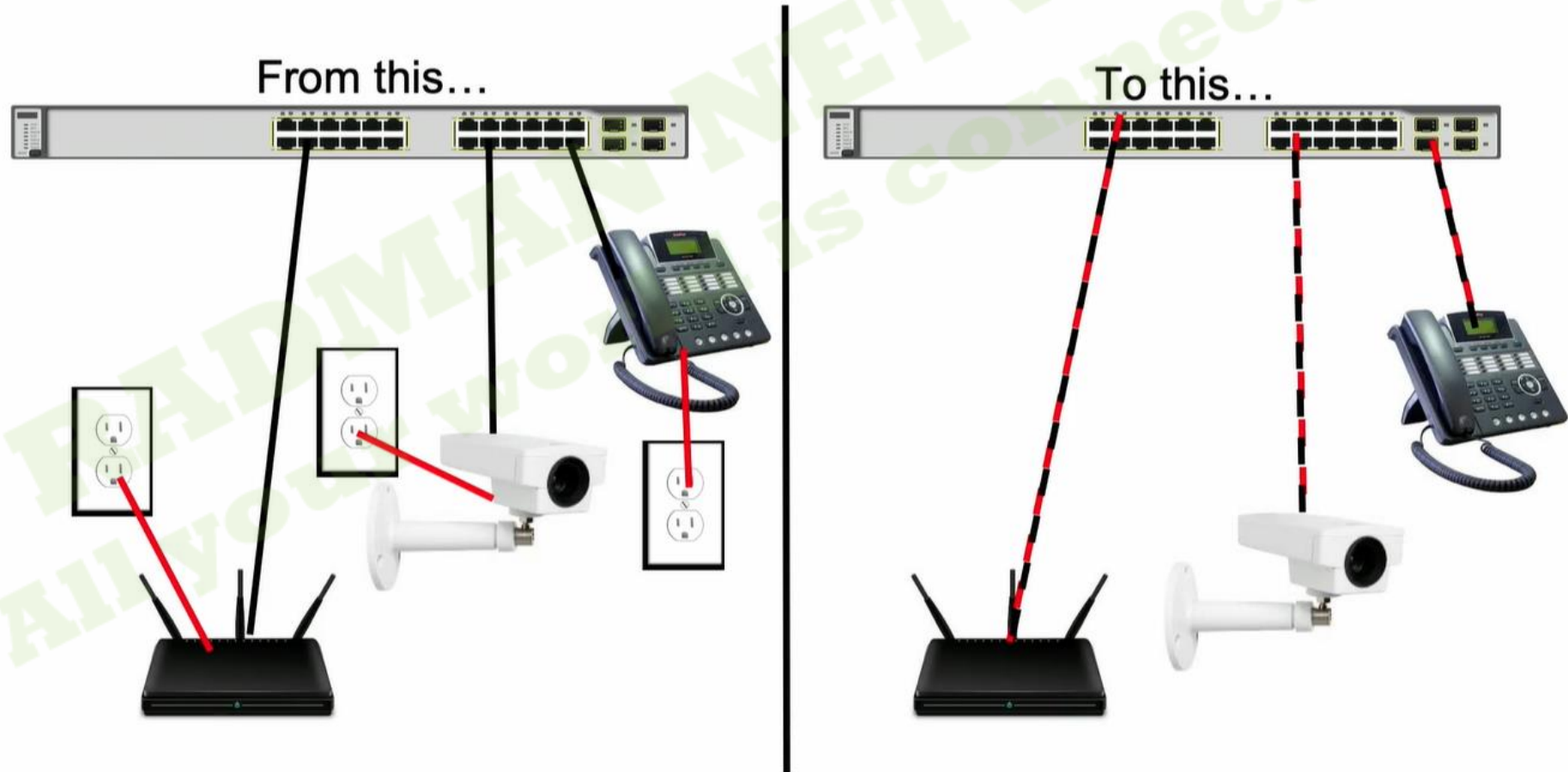
# CCNA

## What Can Be Powered?



# CCNA

## What Can Be Powered?



# CCNA

## Benefits Of PoE

- + Time and cost savings
- + Flexibility
- + Safety
- + Reliability
- + Scalability

# CCNA

## PSE & PD

**RADMAN NETWORK**  
All your world is connected.!!!

# CCNA

## PSE & PD

- + Standards-based PoE relies on the IEEE 802.3af, 802.3at and 802.3bt standards
- + PoE devices categorized as:
  - + PSE – Power Sourcing Equipment
  - + PDs – Powered Devices
- + PSEs are typically network switches or power injectors



## PSE & PD

- + Standards-based PoE relies on the IEEE 802.3af, 802.3at and 802.3bt standards
- + PoE devices categorized as:
  - + PSE – Power Sourcing Equipment
  - + PDs – Powered Devices
- + PSEs are typically network switches or power injectors

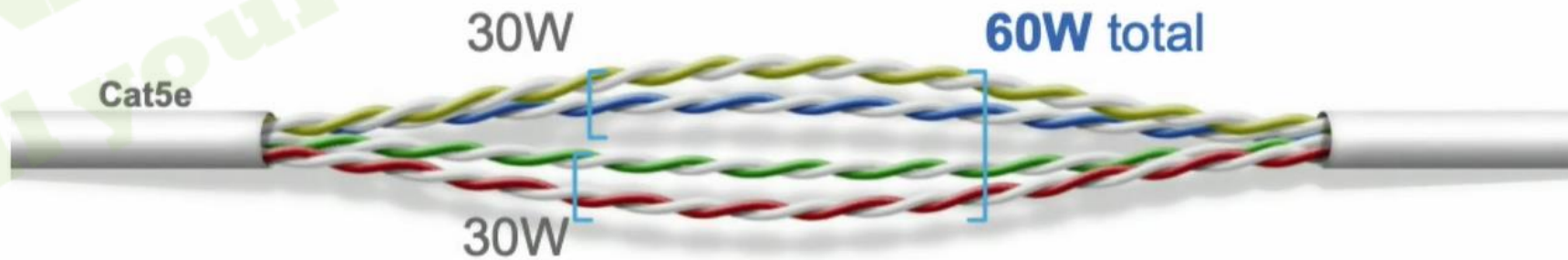


## How Much Power Can I Get?

IEEE Standard	Type	Power Budget per Device
IEEE 802.3af	Type 1	15.4W
IEEE 803.2at / PoE+	Type 2	30.8W
802.3bt / Cisco UPoE	Type 3	60W
IEEE 802.3bt / UPoE+	Type 4	90-95W

# CCNA

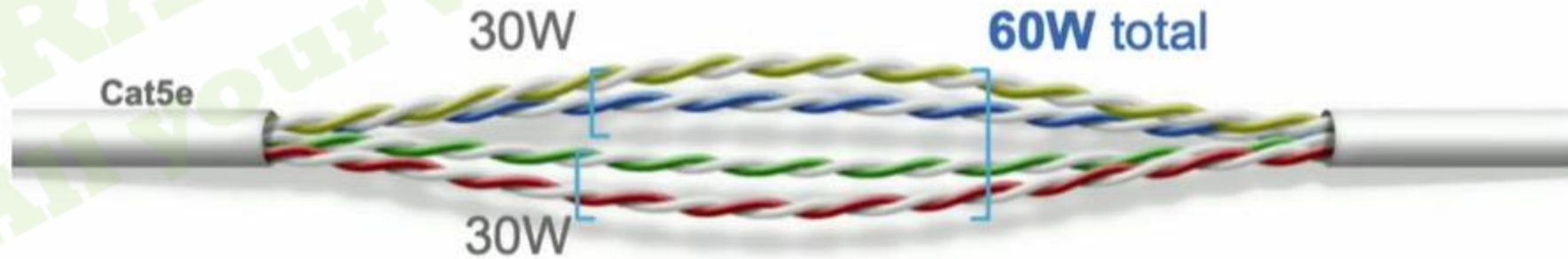
## How Is Power Delivered?



# CCNA

## How Is Power Delivered?

- + Ethernet cables contain four pairs of twisted cables (8-wires total)
- + IEEE 802.3af and 802.3at standards utilize two of these pairs (4-wires) to deliver power
- + Cisco UPoE and UPoE+ utilize all 8-pairs to deliver power



# CCNA

## PoE Detection & Negotiation

**RADMAN NETWORK**  
All your world is connected.!!!

## PoE Detection & Negotiation

- + PoE uses a detection technique to determine if:
  - + PSE is connected to a PD or not
  - + How much power the PD requires
- + General summary of initial steps
  - + PSE outputs a small amount of power to detect if there is any resistance
  - + PDs have a special resistor in the NIC that will respond, and limit this incoming voltage and reflect back a certain amount to PSE
  - + PSE now knows it is connected to a PD and, depending on the current/voltage it receives back, performs this step a few more times to detect the type-and-classification of PD

## Monitoring PoE On Cisco Devices

```
Stack-1# show cdp neighbor detail
-----
Device ID: SEP001121116D78
Entry address(es): IP address: 192.168.1.249
Platform: Cisco IP Phone 7970, Capabilities: Host Phone
Interface: GigabitEthernet1/0/2, Port ID (outgoing port): Port 1
Holdtime : 150 sec
Version : SCCP70.8-0-0-74S
advertisement version: 2
Duplex: full
Power drawn: 10.250 Watts
Power request id: 28024, Power management id: 3
Power request levels are:10250 6300 0 0 0
```

## Monitoring PoE On Cisco Devices

```
Stack-1# show cdp neighbor detail
```

```
-----  
Device ID: SEP001121116D78
```

```
Entry address(es): IP address: 192.168.1.249
```

```
Platform: Cisco IP Phone 7970, Capabilities: Host Phone
```

```
Interface: GigabitEthernet1/0/2, Port ID (outgoing port): Port 1
```

```
Holdtime : 150 sec
```

```
Version : SCCP70.8-0-0-74S
```

```
advertisement version: 2
```

```
Duplex: full
```

```
Power drawn: 10.250 Watts
```

```
Power request id: 28024, Power management id: 3
```

```
Power request levels are:10250 6300 0 0 0
```



## Monitoring PoE On Cisco Devices

```
Stack-1# show cdp neighbor detail
-----
Device ID: SEP001121116D78
Entry address(es): IP address: 192.168.1.249
Platform: Cisco IP Phone 7970, Capabilities: Host Phone
Interface: GigabitEthernet1/0/2, Port ID (outgoing port): Port 1
Holdtime : 150 sec
Version : SCCP70.8-0-0-74S
advertisement version: 2
Duplex: full
Power drawn: 10.250 Watts
Power request id: 28024, Power management id: 3
Power request levels are:10250 6300 0 0 0
```

## Monitoring PoE On Cisco Devices

```
Stack-1# show power inline
```

```
Module      Available      Used      Remaining  
(Watts)     (Watts)       (Watts)
```

```
-----  
1           420.0         22.2      397.8  
2           370.0         18.2      351.8
```

```
Interface  Admin  Oper   Power   Device      Class Max  
(Watts)
```

```
-----  
Gi1/0/1    auto   on     6.3     IP Phone 7960    0     15.4  
Gi1/0/2    auto   on     10.3    IP Phone 7970    3     15.4  
Gi2/0/1    auto   on     15.4    IP Phone CP-7970G  3     15.4  
Gi2/0/2    auto   on     8.5     AIR-AP1220-IOS  n/a   15.4
```

## Monitoring PoE On Cisco Devices

```
Stack-1# show power inline
```

```
Module      Available      Used      Remaining  
(Watts)     (Watts)       (Watts)
```

```
-----  
1           420.0         22.2     397.8  
2           370.0         18.2     351.8
```

```
Interface  Admin  Oper  Power  Device  Class  Max  
(Watts)
```

Interface	Admin	Oper	Power (Watts)	Device	Class	Max
Gi1/0/1	auto	on	6.3	IP Phone 7960	0	15.4
Gi1/0/2	auto	on	10.3	IP Phone 7970	3	15.4
Gi2/0/1	auto	on	15.4	IP Phone CP-7970G	3	15.4
Gi2/0/2	auto	on	8.5	AIR-AP1220-IOS	n/a	15.4

## Monitoring PoE On Cisco Devices

```
Stack-1# show power inline
```

```
Module      Available      Used      Remaining  
(Watts)     (Watts)       (Watts)
```

```
-----  
1           420.0         22.2     397.8  
2           370.0         18.2     351.8
```

```
Interface  Admin  Oper    Power  Device          Class Max  
(Watts)
```

```
-----  
Gi1/0/1    auto   on      6.3    IP Phone 7960   0    15.4  
Gi1/0/2    auto   on     10.3   IP Phone 7970   3    15.4  
Gi2/0/1    auto   on     15.4   IP Phone CP-7970G 3    15.4  
Gi2/0/2    auto   on      8.5    AIR-AP1220-IOS n/a   15.4
```