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High Availability Infrastructures for SMBs

Presented by
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2015 Canadian MUM
Montréal
October 19th 2015

About the trainer

- Electrical Engineering
- Over 20 years of experience with networking and server OS's
- Has experience with many types of clients
- Author of Mikrotik's current **MTCNA** course material

- CSPE (*Centre de Services Professionnels en Éducation*)
 - Educational services
 - My part: MikroTik and Telecommunications training
 - Introduction to the TCP/IP Protocol
 - Introduction to MikroTik Routers

Objectives

We will learn about:

- High availability
- How to configure MikroTik equipment to build robust and flexible networks

Presentation overview

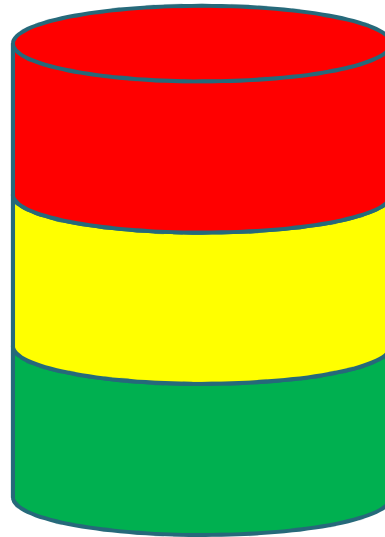
- Introduction
 - Concepts of “HA”
 - Causes of downtime
 - Topology: The anatomy of redundancy
- The technologies involved in “HA”
- Demo

Presentation complexity

Advanced

Intermediate

Introduction





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INTRODUCTION

Concepts



Wikipedia defines “**High Availability**” as

“... a characteristic of a system, which describes the duration (length of time) for which the system is operational.”

Concepts



I define “**High Availability**” as

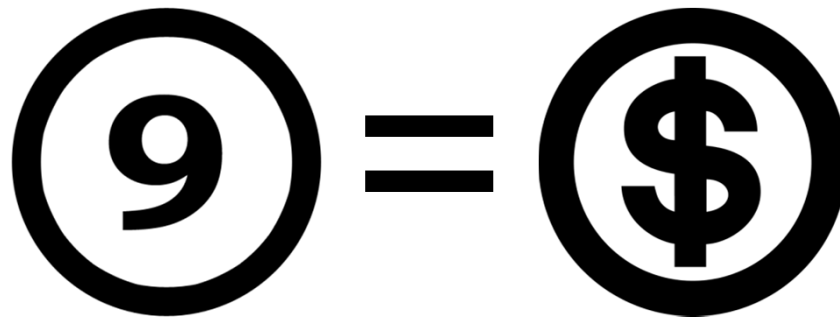
“Up time”

“I-keep-my-job time”

“Happy-boss time”

Concepts

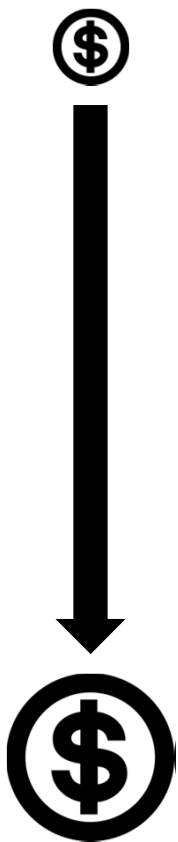
- “**High Availability**” is referred to as a percentage score
- We often hear “nines” of availability



Concepts

- What do the “nines” mean?

Concepts



Availability %	Nines	Downtime / year	Downtime / month	Downtime / week
90%	1	36.5 days	72 hours	16.8 hours
95%		18.25 days	36 hours	8.4 hours
97%		10.96 days	21.6 hours	5.04 hours
98%		7.30 days	14.4 hours	3.36 hours
99%	2	3.65 days	7.20 hours	1.68 hours
99.5%		1.83 days	3.60 hours	50.4 Min
99.8%		17.52 hours	86.23 Min	20.16 Min
99.9%	3	8.76 hours	43.8 Min	10.1 Min
99.95%		4.38 hours	21.56 Min	5.04 Min
99.99%	4	52.56 Min	4.38 Min	1.01 Min
99.995%		26.28 Min	2.16 Min	30.24 Sec
99.999%	5	5.26 Min	25.9 Sec	6.05 Sec
99.9999%	6	31.5 Sec	2.59 Sec	604.8 mSec
99.99999%	7	3.15 Sec	262.97 mSec	60.48 mSec
99.999999%	8	315.569 mSec	26.297 mSec	6.048 mSec
99.9999999%	9	31.5569 mSec	2.6297 mSec	0.6048 mSec

Concepts

- For a more realistic “up time” score:
 - Negotiate scheduled downtime
 - Not counted in the “High Availability” score

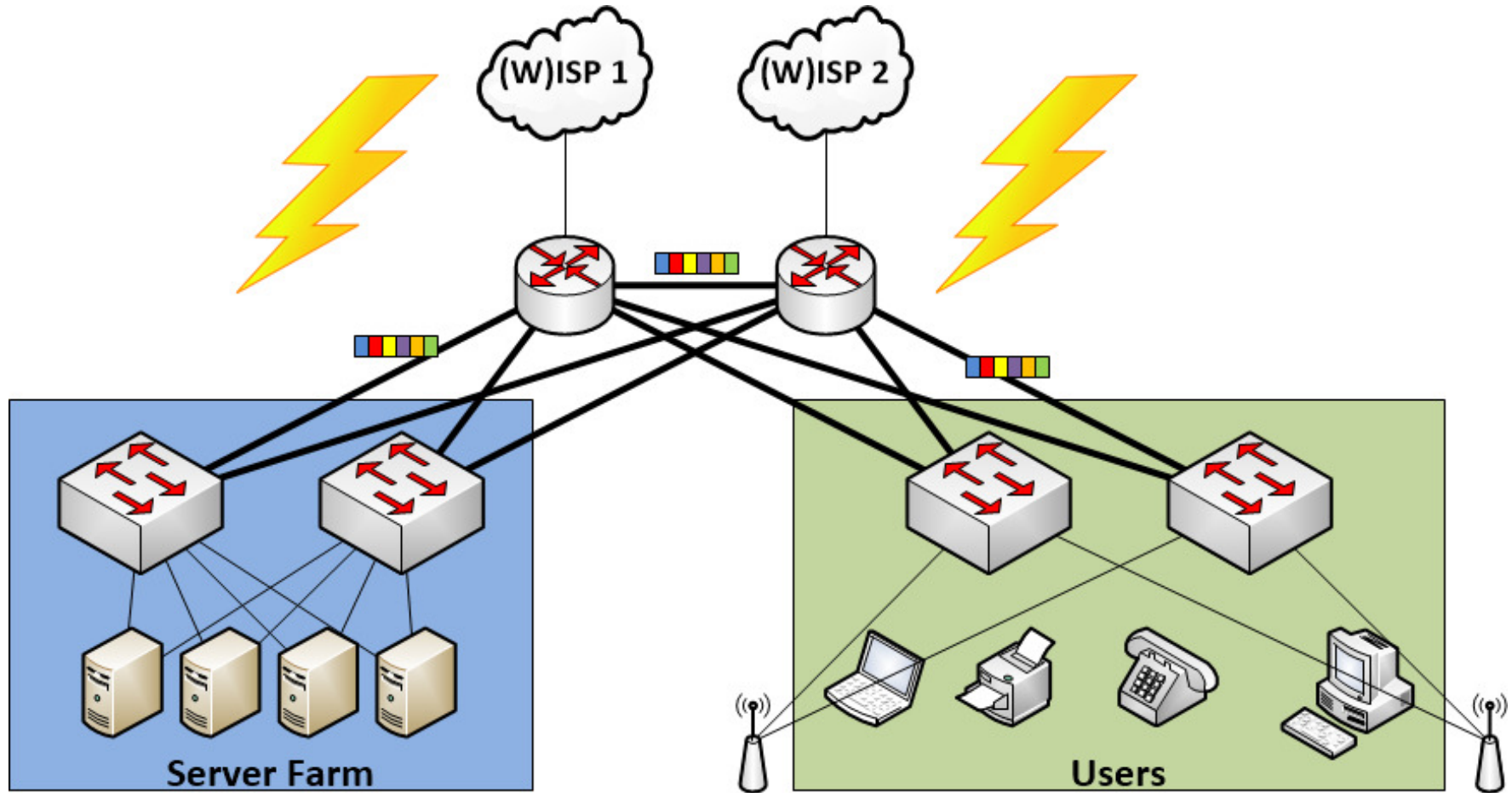
Causes of downtime

- Some causes are:
 - Hardware failure
 - Network failure
 - **Human error**
 - System overload
 - Electrical supply

Topology

- What would a great “High Availability” scenario look like?

Topology



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Topology

- How do we get there?
 - Duplicate hardware
 - Duplicate links
 - Duplicate electrical supplies
 - Circuits (120V/240V)
 - Power supplies (in routers)
 - Proper configuration
 - VLANs
 - VRRP
 - Various (optimization)



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TECHNOLOGIES

Legal Disclaimer

What I present in the coming slides is one approach. There are other ways to implement the discussed topics.





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FLEXIBILITY

Definition

Merriam Webster defines “**Flexibility**” as

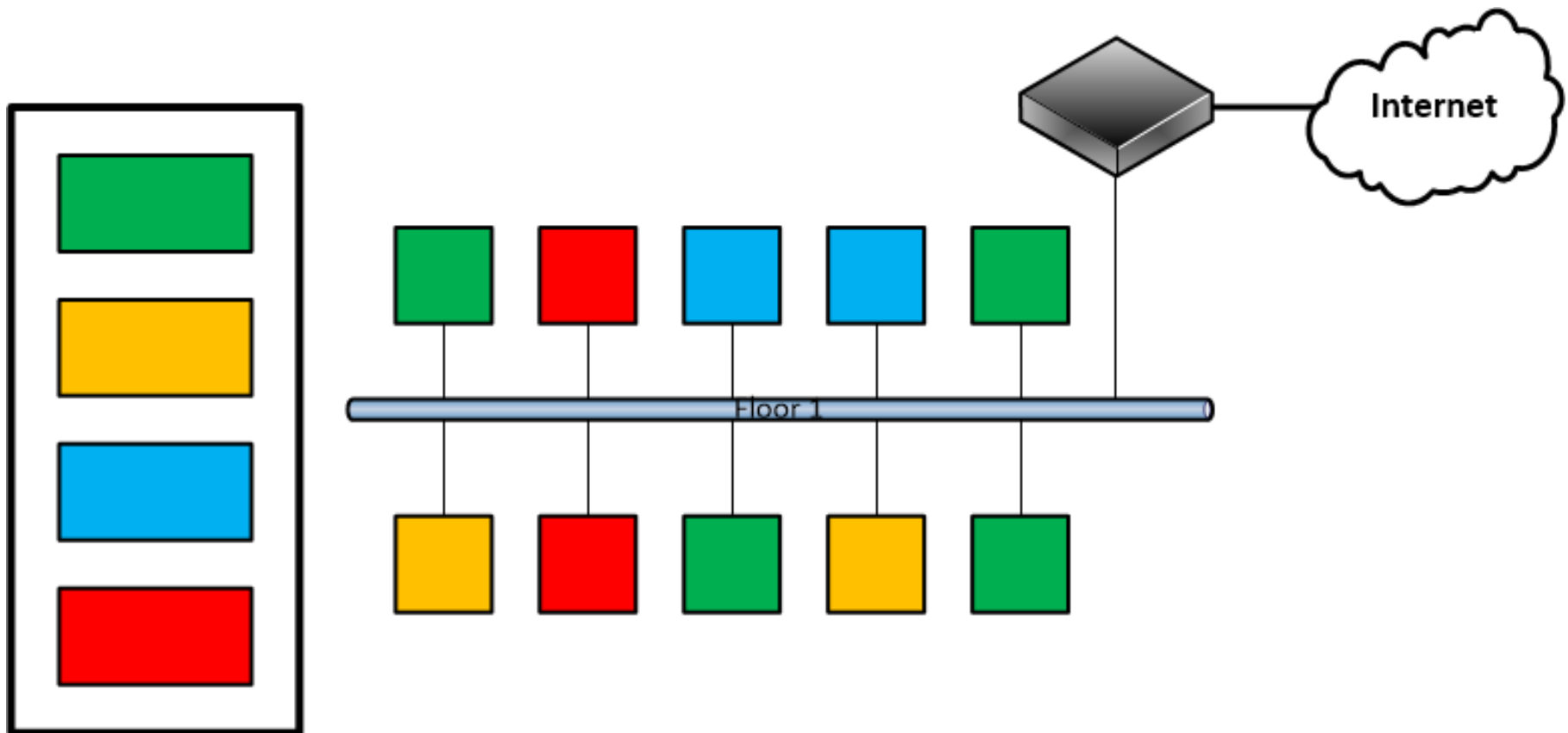
“Characterized by a ready capability to adapt to new, different, or changing requirements”

<http://www.merriam-webster.com/dictionary/flexibility>

Why design flexible networks?

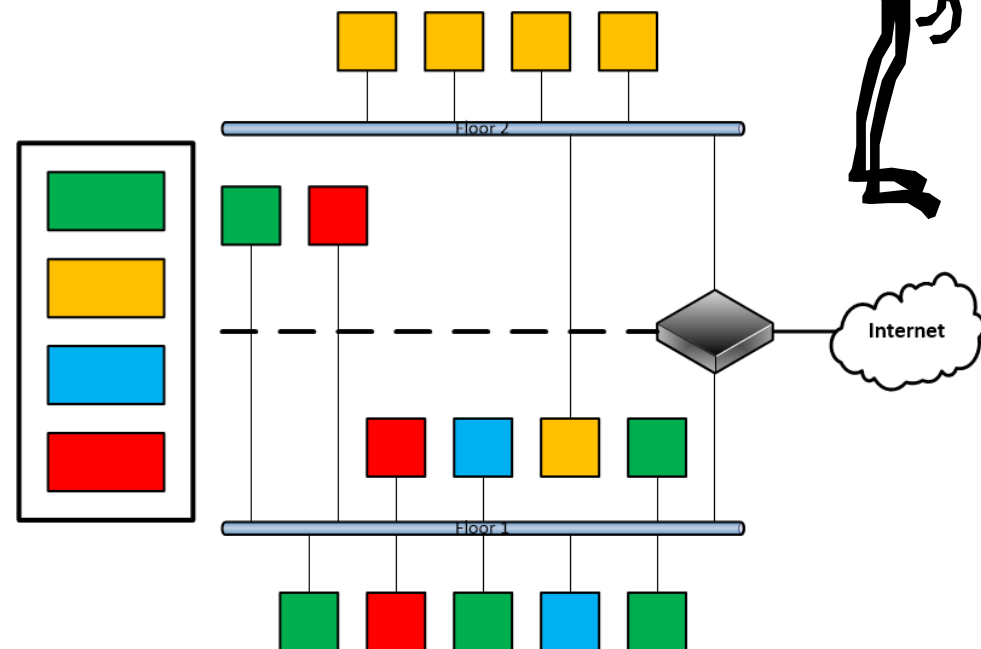
- Adapt quickly to organizational growth, demands and changes
- Minimize costs associated to those changes

1st design (*newbie*)



Design confronts reality

- Move Orange group to 2nd floor
- 1 Red and 1 Green on 2nd floor but connected to their LAN (1st floor)
- 1 Orange on 1st floor but connected to his LAN (2nd floor)
- Isolate Red group that plays Halo (and slows down the network)



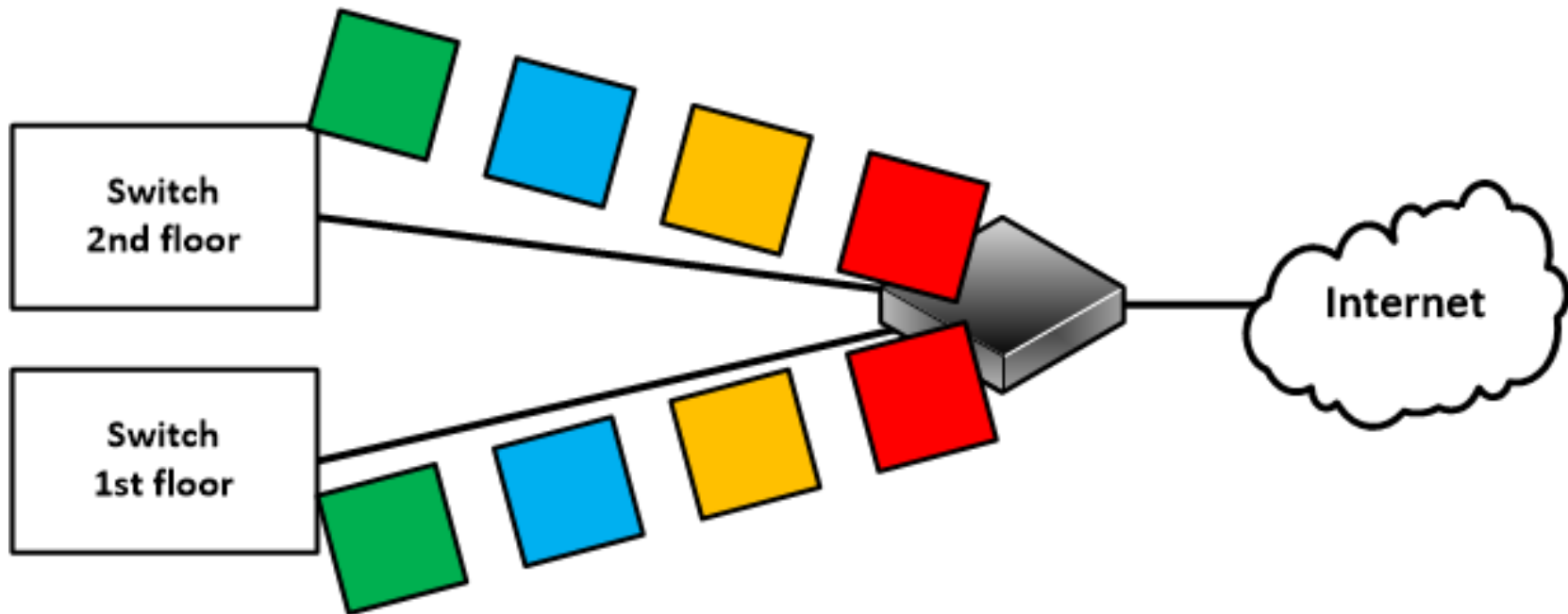
What to do?

- VLANs

What are VLANs?

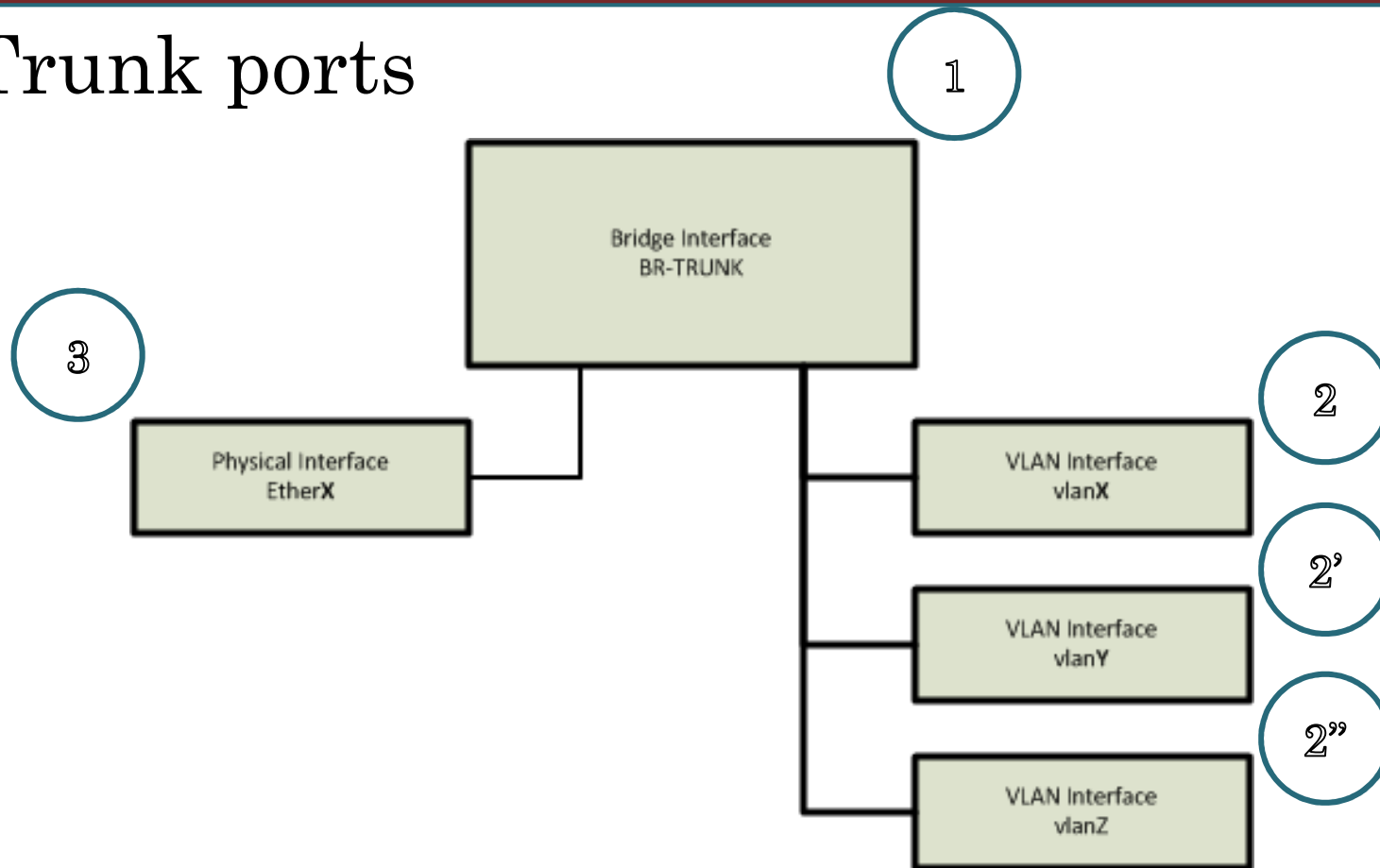
- Layer 2 technology used to partition networks into separate “virtual” broadcast domains

2nd design



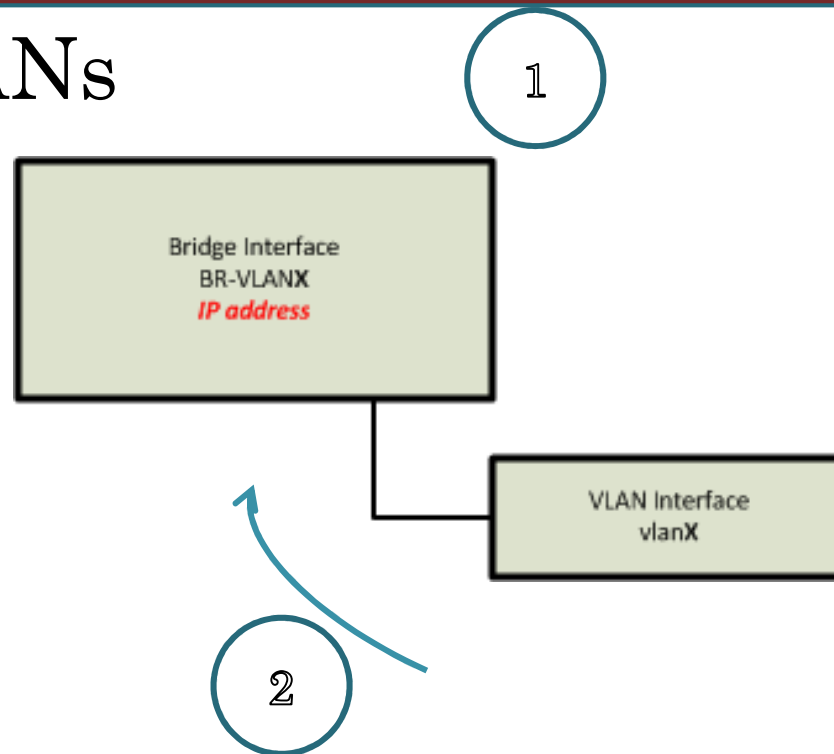
How to visualise VLAN configs

- Trunk ports



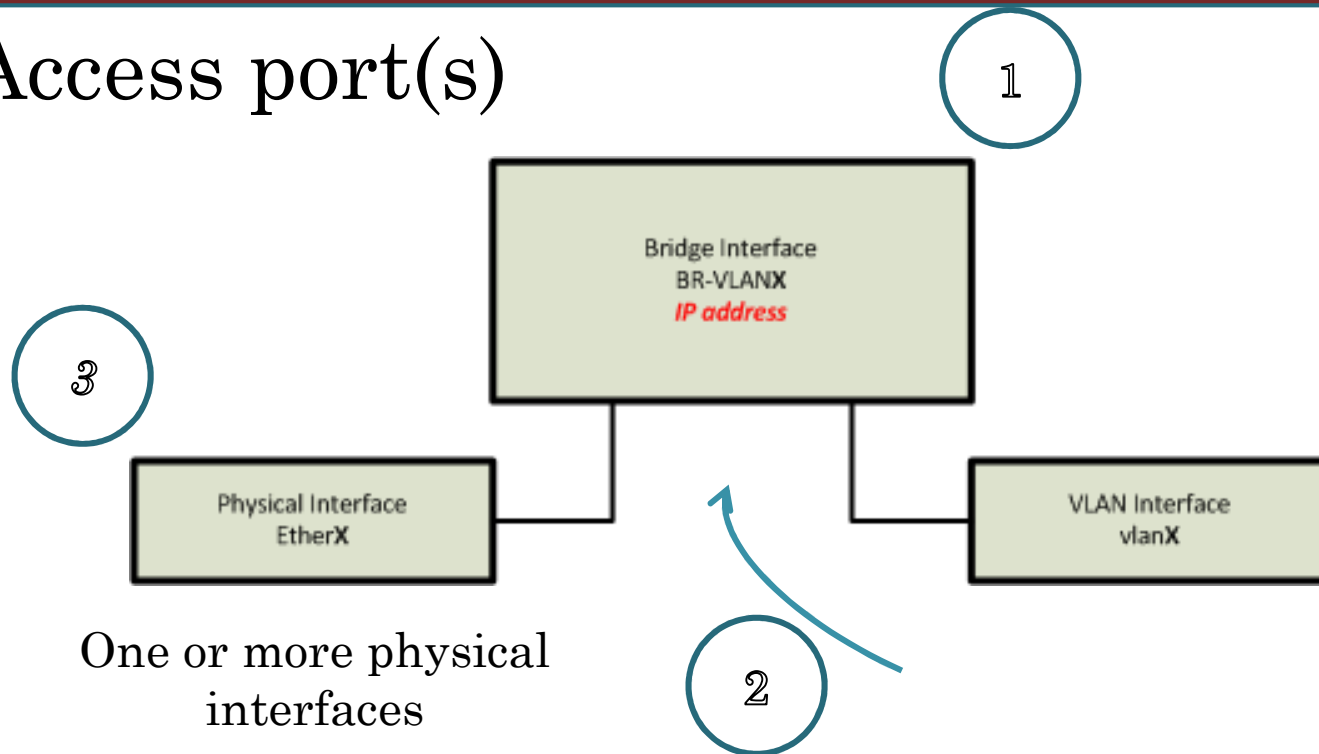
How to visualise VLAN configs

- Regular VLANs



How to visualise VLAN configs

- Access port(s)



VLANs



- How to do it

Creating VLANs (step by step)

- **Bridge interfaces**
 - 1 to host all VLANs
and
 - 1 per VLAN

```
/interface bridge  
add name=BR-TRUNK  
add name=BR-VLAN1  
add name=BR-VLAN2
```

Creating VLANs (step by step)

- **VLAN interfaces**
 - 1 per VLAN

```
/interface vlan  
add interface=BR-TRUNK name=vlan1 vlan-id=1  
add interface=BR-TRUNK name=vlan2 vlan-id=2
```


Creating VLANs (step by step)

Bind interfaces

- Trunk ports
 - 1 or more physical interfaces (*ex. → BR-TRUNK*)
- VLANs and access ports
 - 1 VLAN interface (*ex. → BR-VLANX*) (*must*)
 - 1 or more physical interfaces (*ex. → BR-VLANX*) (*for access ports if present*)

```
/interface bridge port
add bridge=BR-TRUNK interface=ether5
add bridge=BR-VLAN1 interface=vlan1
add bridge=BR-VLAN1 interface=ether1
```

Finishing touches

- Create:
 - IP addresses on VLANs
 - *BR-VLAN_x*
 - *Trunk bridge does not get IP address*
 - DHCP server on VLANs
 - *BR-VLAN_x*
 - *Trunk bridge does not get DHCP server*
 - Others parameters
 - DNS, (S)NTP, Identity, etc.

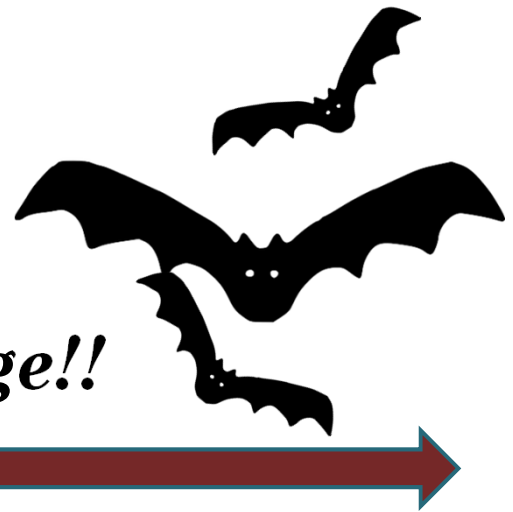
Optimization

- Bridge STP Priorities
 - Cores have higher priority
 - **Master** has higher (*ex. 1000 hex*)
 - **Backup** has lower (*ex. 1001 hex*)
 - Others routers keep default (*8000 hex*)

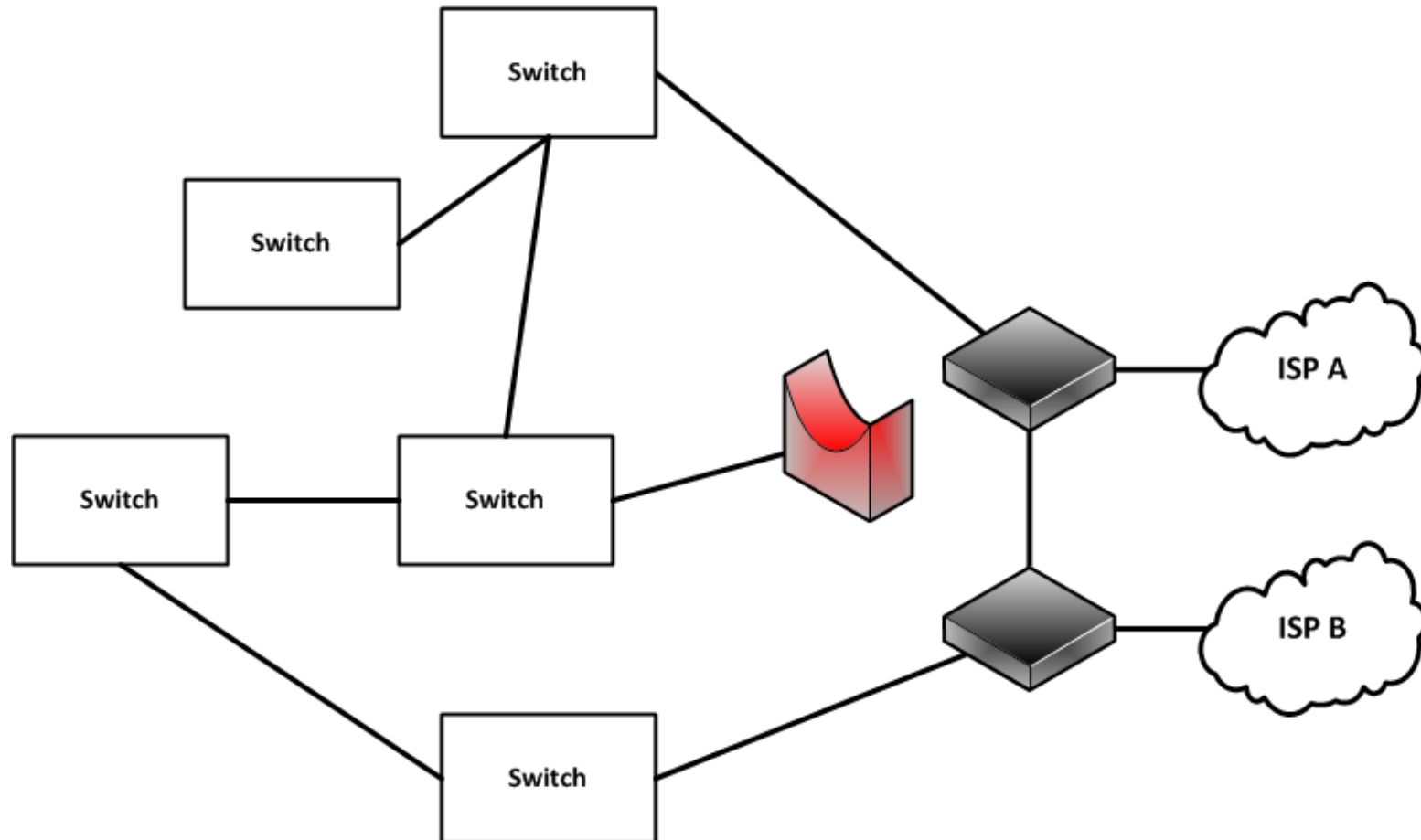
The screenshot shows a configuration window for 'Interface <BR-VLAN1>' with tabs for General, STP, Status, and Traffic. The STP tab is active. Under 'Protocol Mode', there are radio buttons for 'none', 'stp', and 'rstp'. The 'Priority' field is set to '1000' and is circled in red. Below it are fields for 'Max Message Age' (00:00:10), 'Forward Delay' (00:00:15), 'Transmit Hold Count' (6), and 'Ageing Time' (00:05:00). On the right side, there are buttons for OK, Cancel, Apply, Disable, Comment, Copy, Remove, and Torch. At the bottom, there are three status indicators: 'enabled', 'running', and 'slave'.

Optimization

- Why change STP priority?
 - Anecdote: *The forgotten bridge!!*

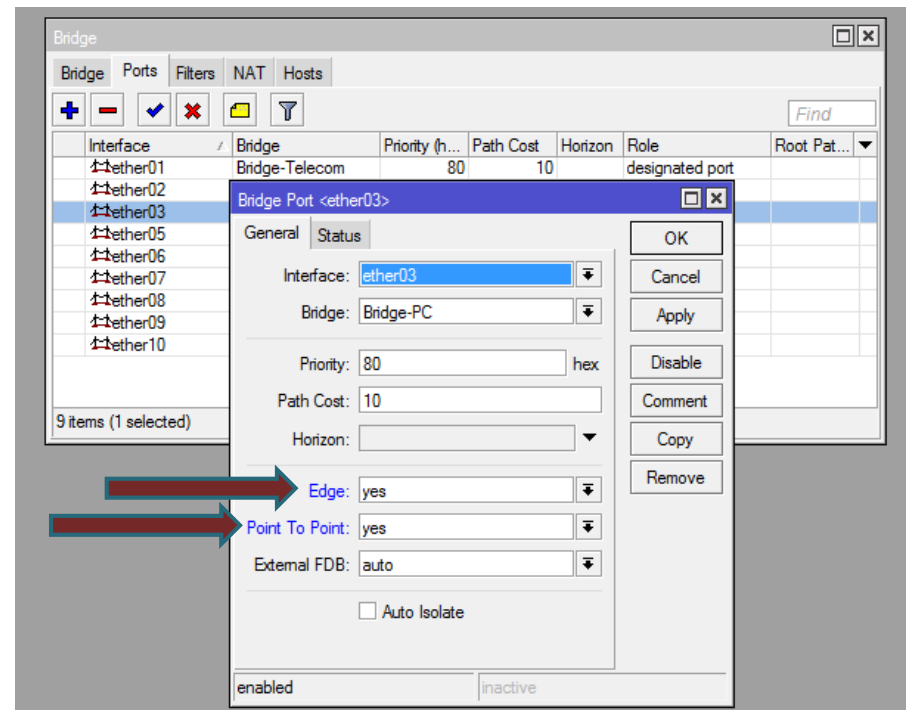


Optimization (anecdote)



Optimization

- Bridge ports
 - Edge (Trunk=no, Access=yes)
 - Point-to-point (Full duplex=yes, Half duplex=no)



Optimization

- Goals of all these steps:
 - Speed up convergence
 - Be able to predict network behavior and operations



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REDUNDANCY

Definition

Merriam Webster defines “**Redundancy**”
as

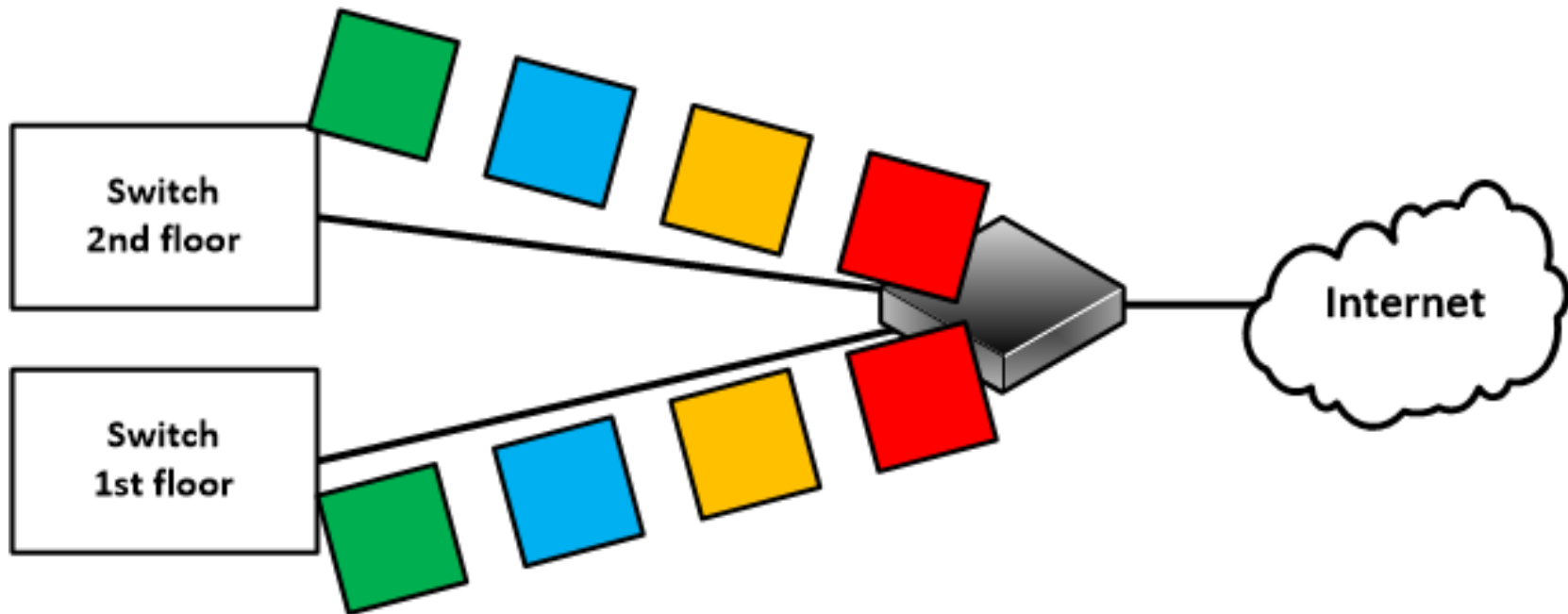
“A part in a machine, system, etc., that has the same function as another part and that exists so that the entire machine, system, etc., will not fail if the main part fails.”

<http://www.merriam-webster.com/dictionary/redundancy>

Why should we have a redundant network?

- Avoid downtime
 - Loss of productivity
 - Loss of revenue
- SLAs (*Service Level Agreements*) can carry cash penalties if ISPs fail to meet contractual goals

2nd design



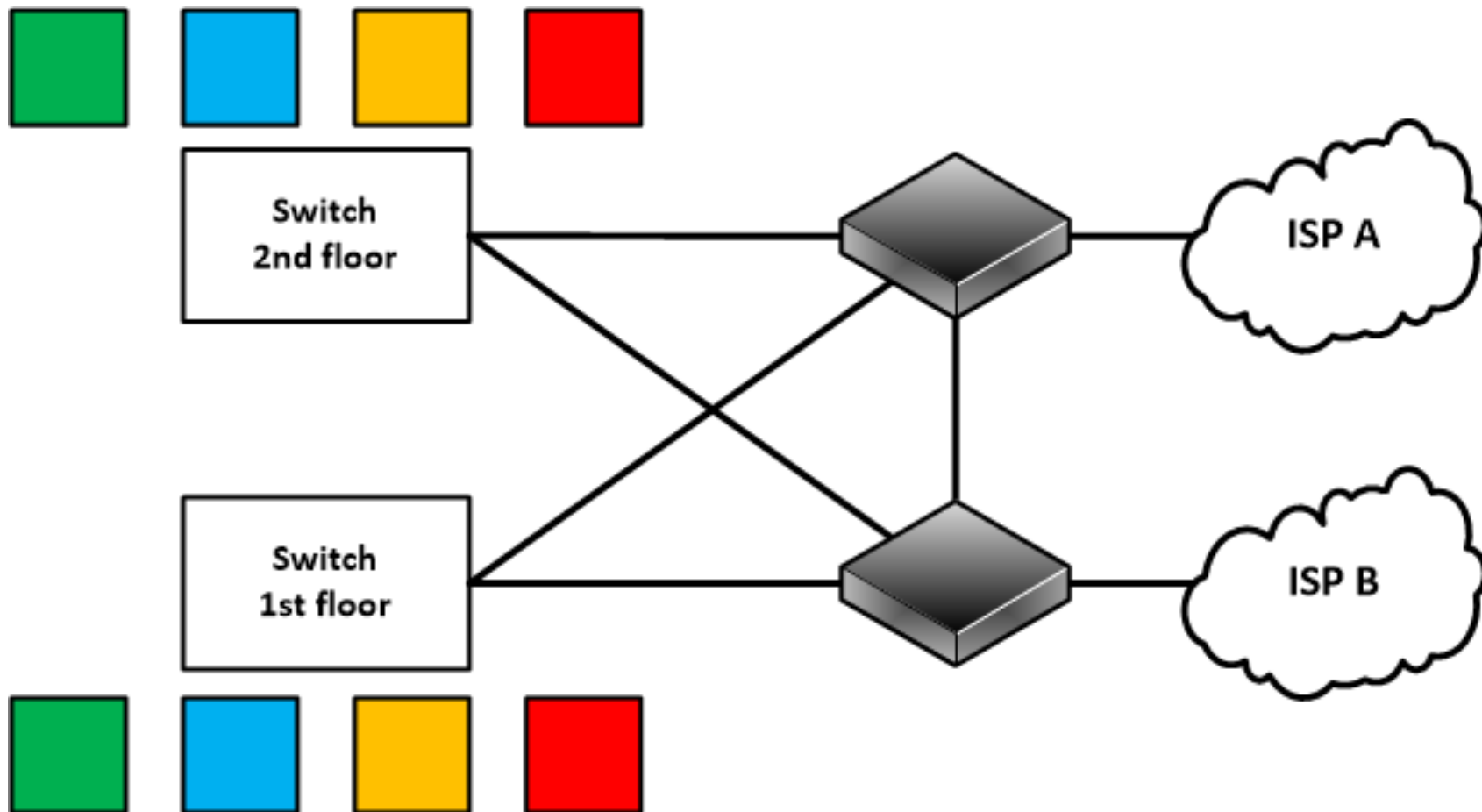
Design confronts reality



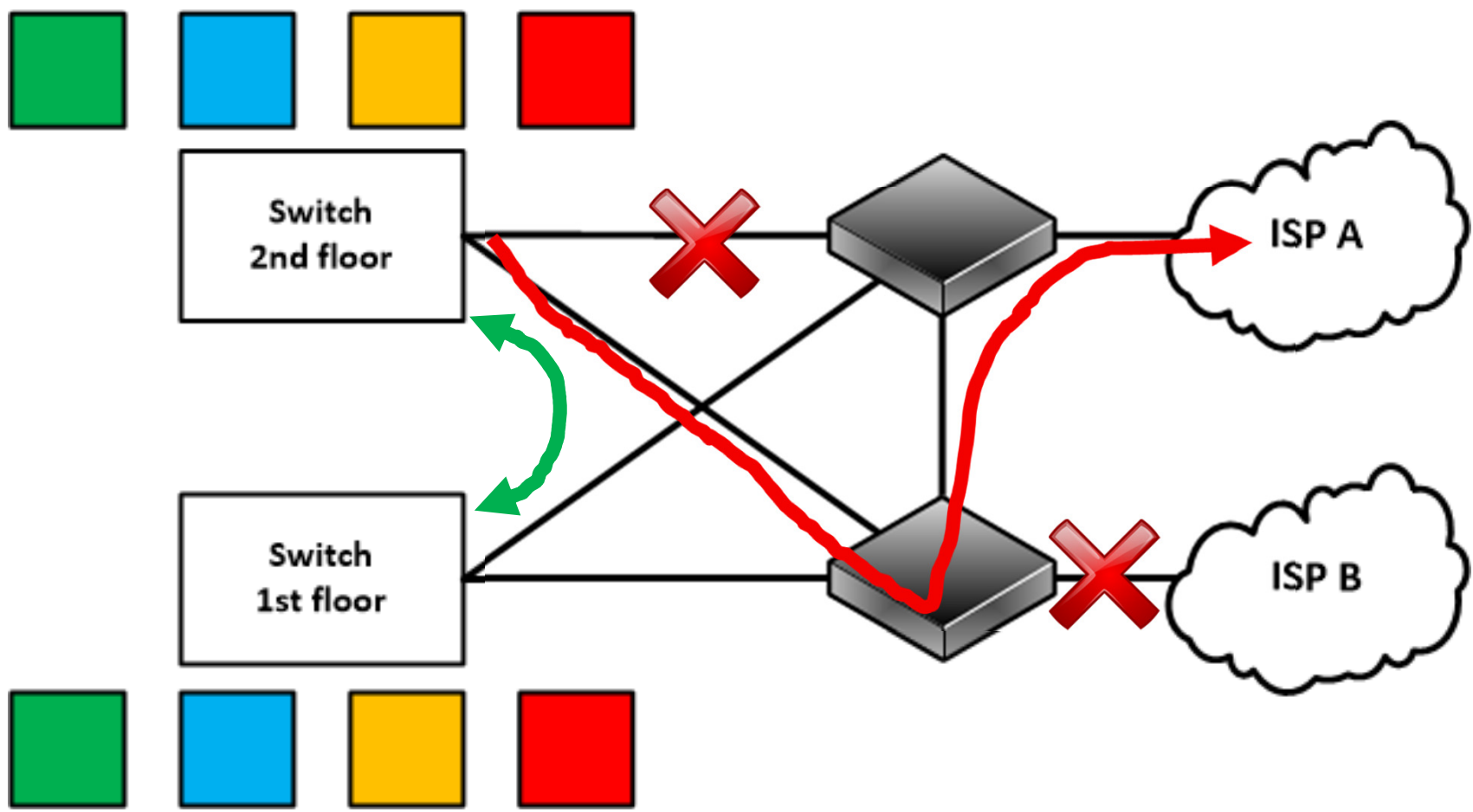
What to do?

- Hardware redundancy
- Link redundancy
- VRRP

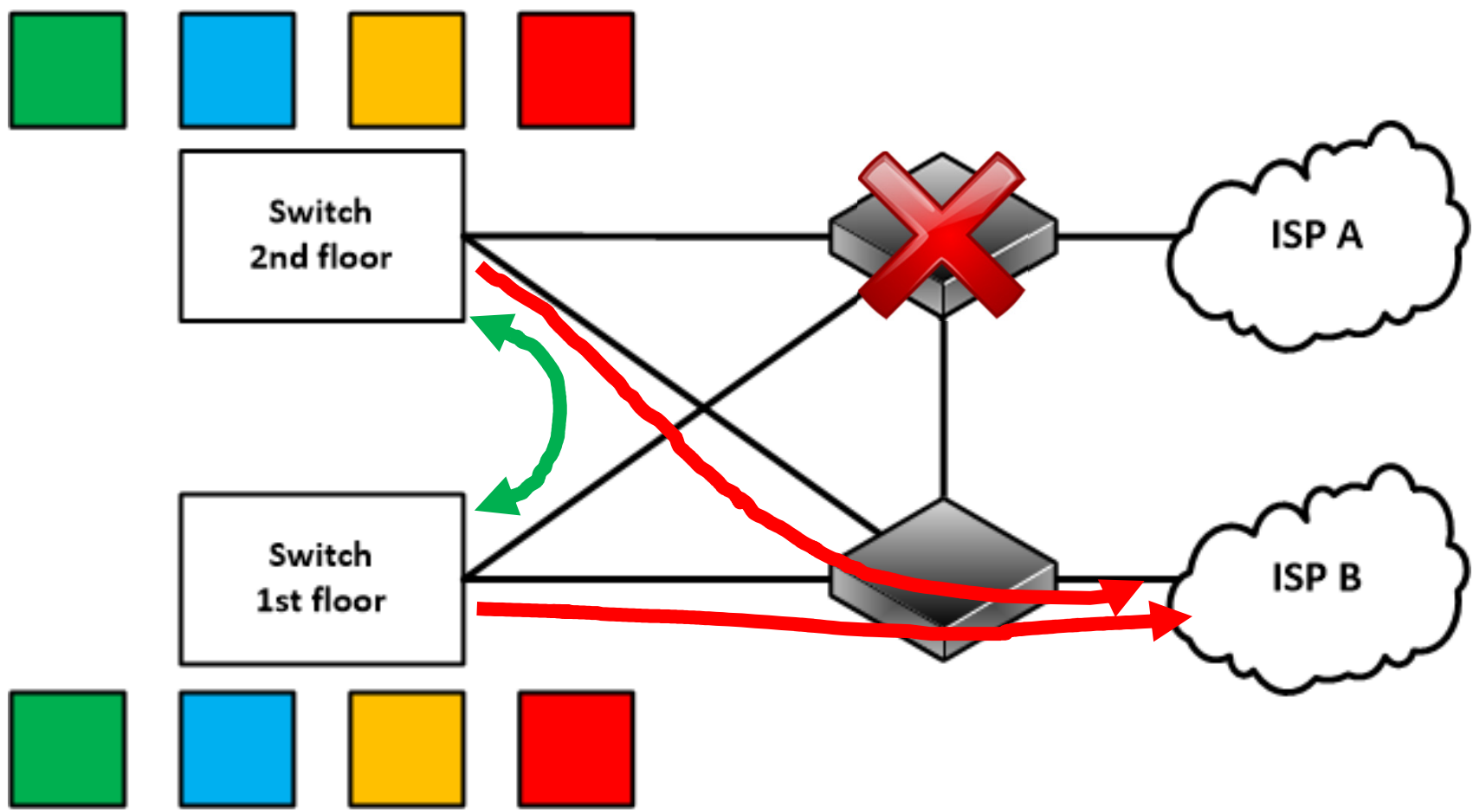
3rd design



3rd design



3rd design



Is hardware redundancy enough?

- NO!
 - Answer: VRRP

What is VRRP?

VRRP: *virtual router redundancy protocol*

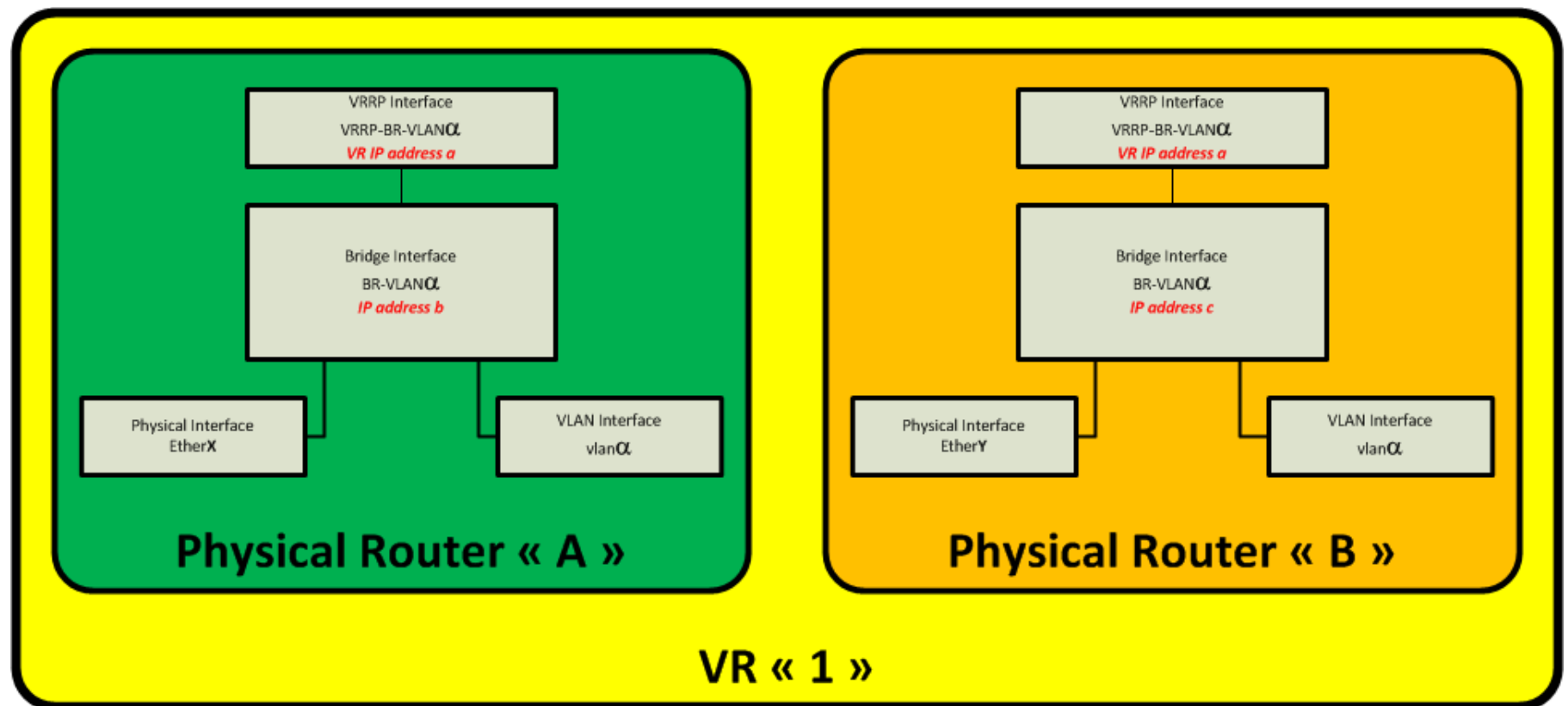
- A protocol that assigns responsibility for a virtual router (**VR**) to one physical router inside a group (*two or more routers*)
- Shares the control of a virtual IP address between those members

Why use VRRP?

- Insures the availability of the default gateway as long as one member remains active

How to visualise VRRP configs

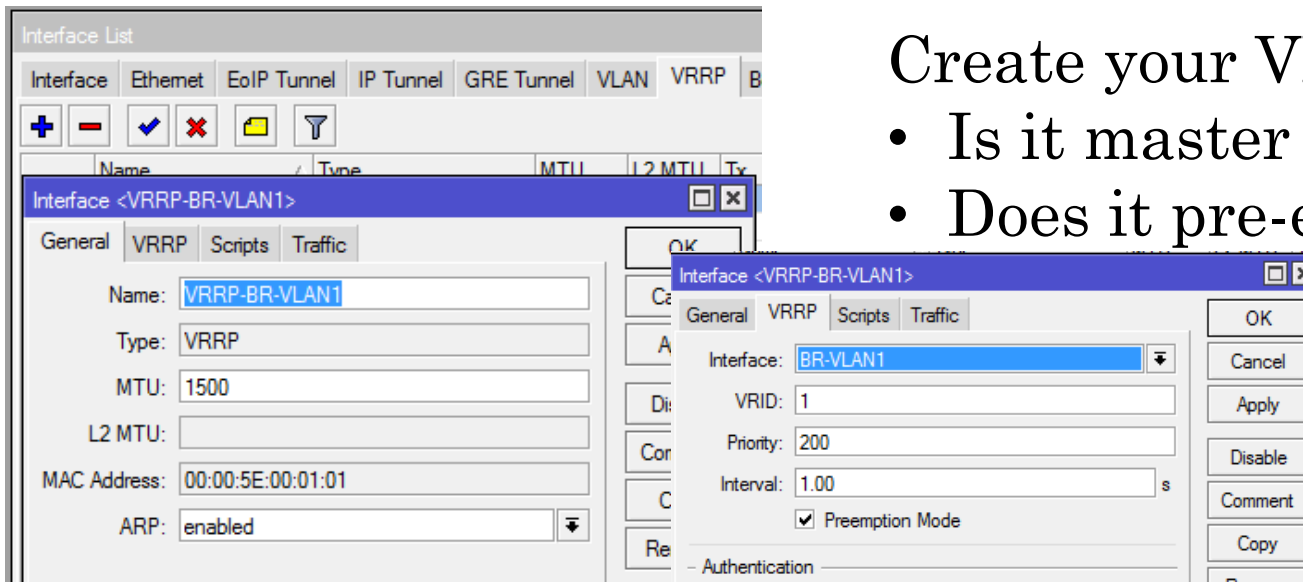
- VLAN α



VRRP

- How to do it

Activating VRRP (step by step)



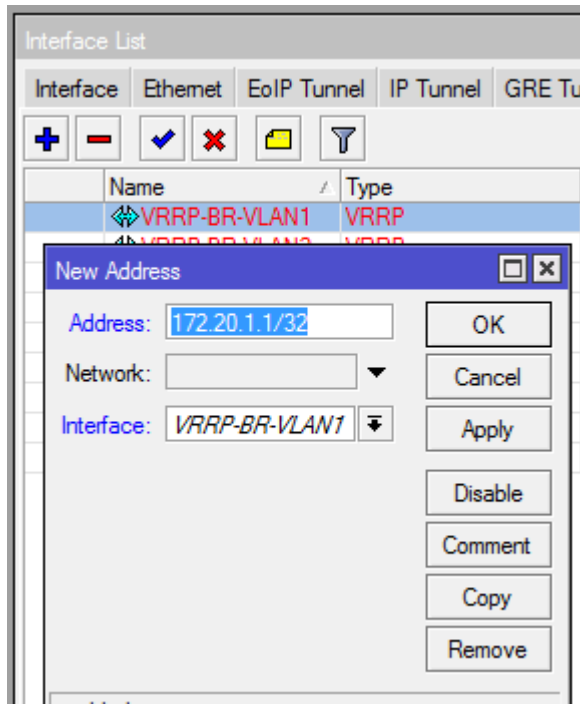
Create your VRRP interface.

- Is it master or backup?
- Does it pre-empt?

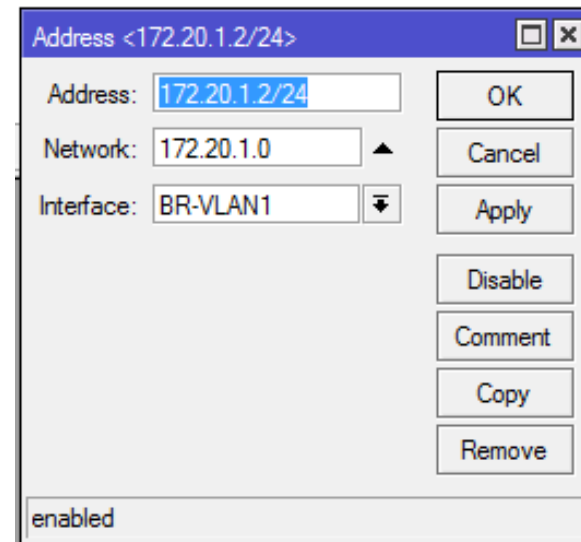
```
/interface vrrp
add interface=BR-VLAN1 name=VRRP-BR-VLAN1 priority=200
add interface=BR-VLAN2 name=VRRP-BR-VLAN2 priority=200 vrid=2
```

```
/interface vrrp
add interface=BR-VLAN1 name=VRRP-BR-VLAN1 preemption-mode=no
add interface=BR-VLAN2 name=VRRP-BR-VLAN2 preemption-mode=no vrid=2
```

Activating VRRP (step by step)



- Create an IP address for the VRRP interface.
 - Use free address
 - /32 mask
- If required, modify the IP address on the Bridge interface
- **Never have identical real & shared IP address**



Optimization

- VRRP priorities
 - One core router is master for all VLANs
 - Other core is backup for all VLANs
- Why?
 - If the master core router fails, the backup quickly takes over
 - If the backup core router fails... not much happens



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VARIOUS

Optimization

- OSPF Interface priority
 - DR=high value (*ex. 100*)
 - BDR=low value (*ex. 50*)
 - Member=0
- Everything must be predictable!
 - DR, BDR, members

OSPF <BR-VLAN1>

General Status

Interface: BR-VLAN1

Cost: 10

Priority: 100

Authentication: MD5

Authentication Key: MUM2015

Authentication Key ID: 1

Network Type: broadcast

Instance ID: 0

Passive

Use BFD

Retransmit Interval: 5 s

Transmit Delay: 1 s

Hello Interval: 10 s

Router Dead Interval: 30 s

dynamic passive State: designated router

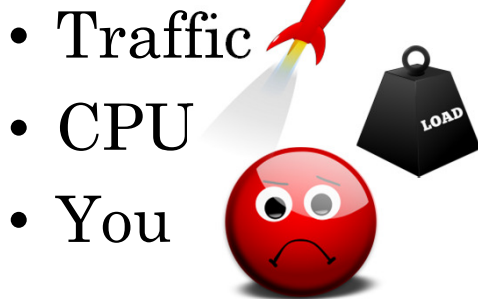
OK Copy Remove

Optimization

- OSPF
 - Lower “hello-interval”
 - Lower “dead-interval”
- Beware of more OSPF traffic!

Pitfalls

- Configure one step at a time
 - Configure routers first
 - Plug after, otherwise spanning tree loops!



Wish

- MSTP support
 - IEEE 802.1Q-2014, Chap. 13
- Why?
 - True Layer 2 and Layer 3 load-sharing
 - Load-shared VRRP config NOT recommended on two core routers without MSTP
 - In case of loss of a core router, only half affected (for a brief moment)
 - Easier migration from Cisco (PVSTP)



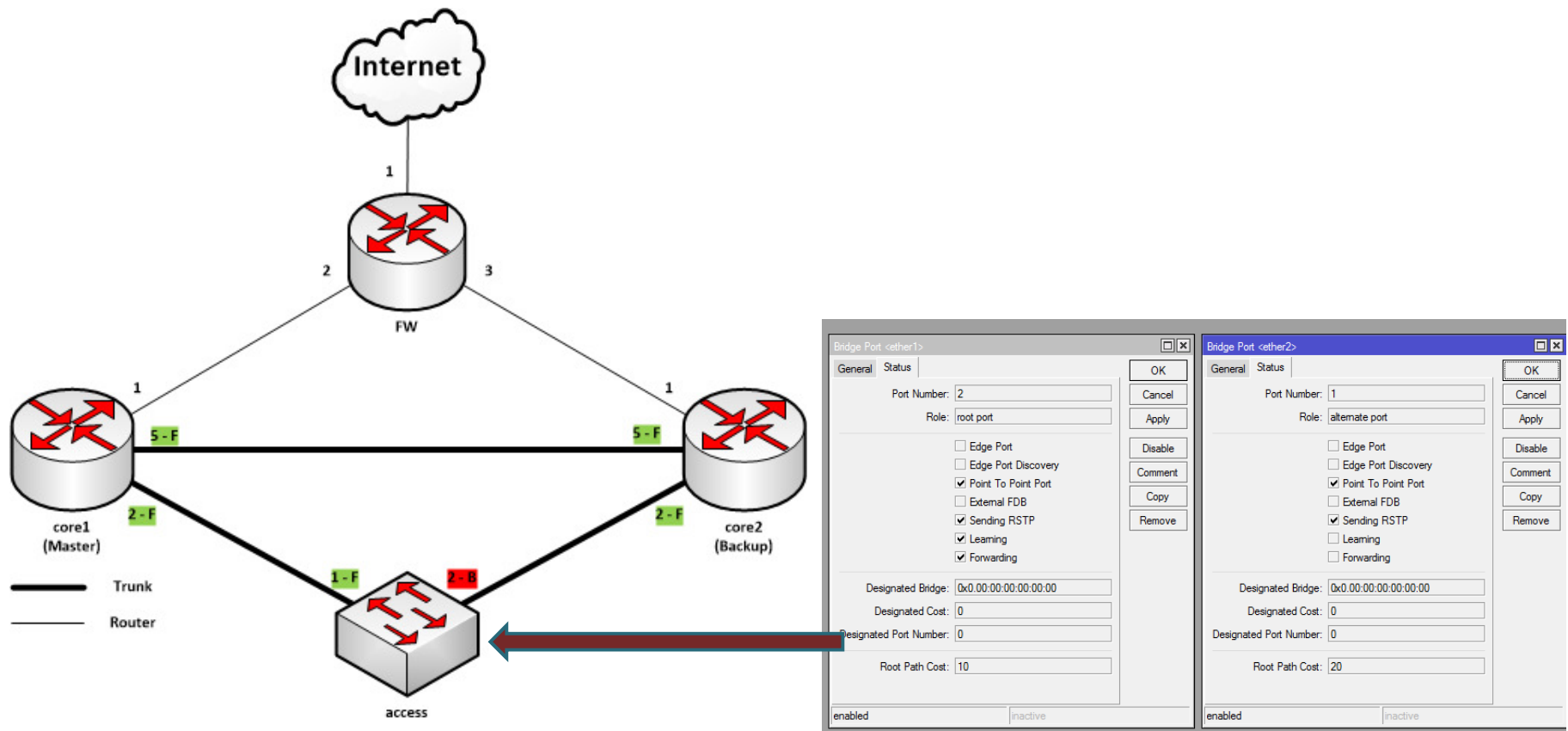


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DEMONSTRATIONS

Setup



Outage of main core



Démo1-core1.mp4

Outage of backup core



Démo1-core2.mp4



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FINAL WORDS

What have we seen?

- Flexibility using VLANs
- Redundancy by doubling links and hardware and by using VRRP
- Certain things to be aware of



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QUESTION PERIOD

1st MUM in Canada!

Thank you MikroTik!!

