
2025
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Core Networking Protocols: Design, Implementation, And Best Practices

Speakers

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Core Networking: Planning & Design

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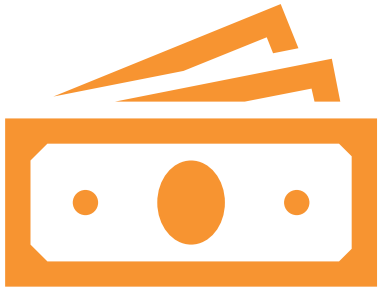
Who Am I?

Started in 2018 with a background in Enterprise IT.



Started with only $15,000

Who Am I?

- I've done over 800 installs by myself, with employees starting in 2021.

- Learned A LOT through trial-and-error and forums.

Planning & Design

“An ounce of prevention is worth a pound of cure”

Now Is The Best Time To Do It Right

I’m Speaking From Experience…..

4 Major Network Redesigns in 7 Years.

So What Are We Trying to Accomplish?

A Design That Works Well at 1 Tower and 1,000 Towers

Important Considerations

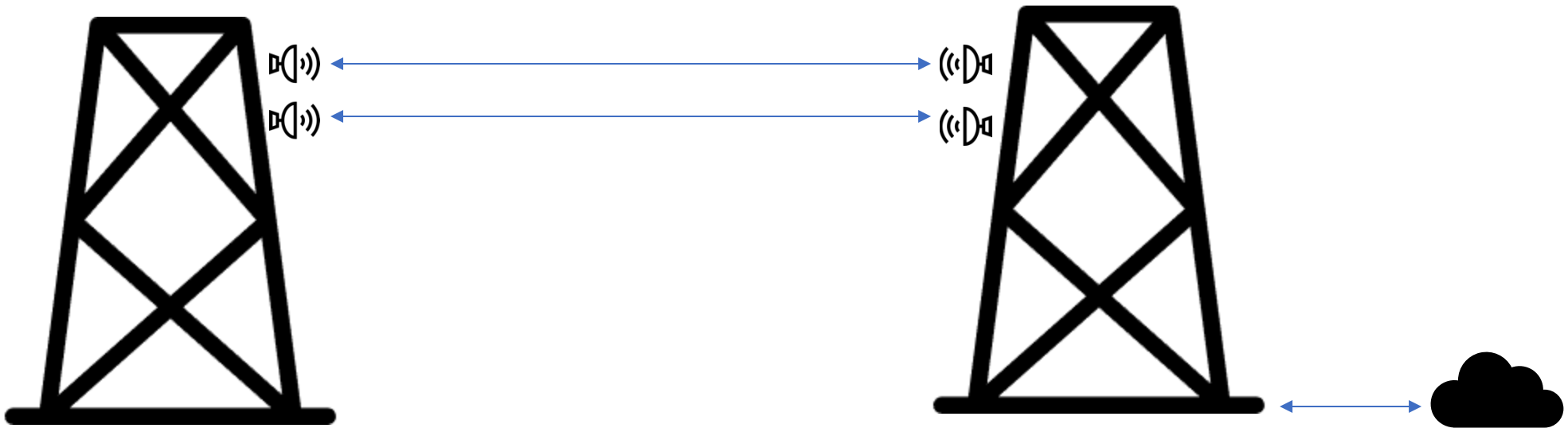
- Networking Protocols
- Equipment That Can Scale With You

Redundancy vs Resiliency

Redundancy: Duplicating hardware or software to avoid a network failure if something stops working.

Example:

Two backhauls pointing to the same tower in case one dies.

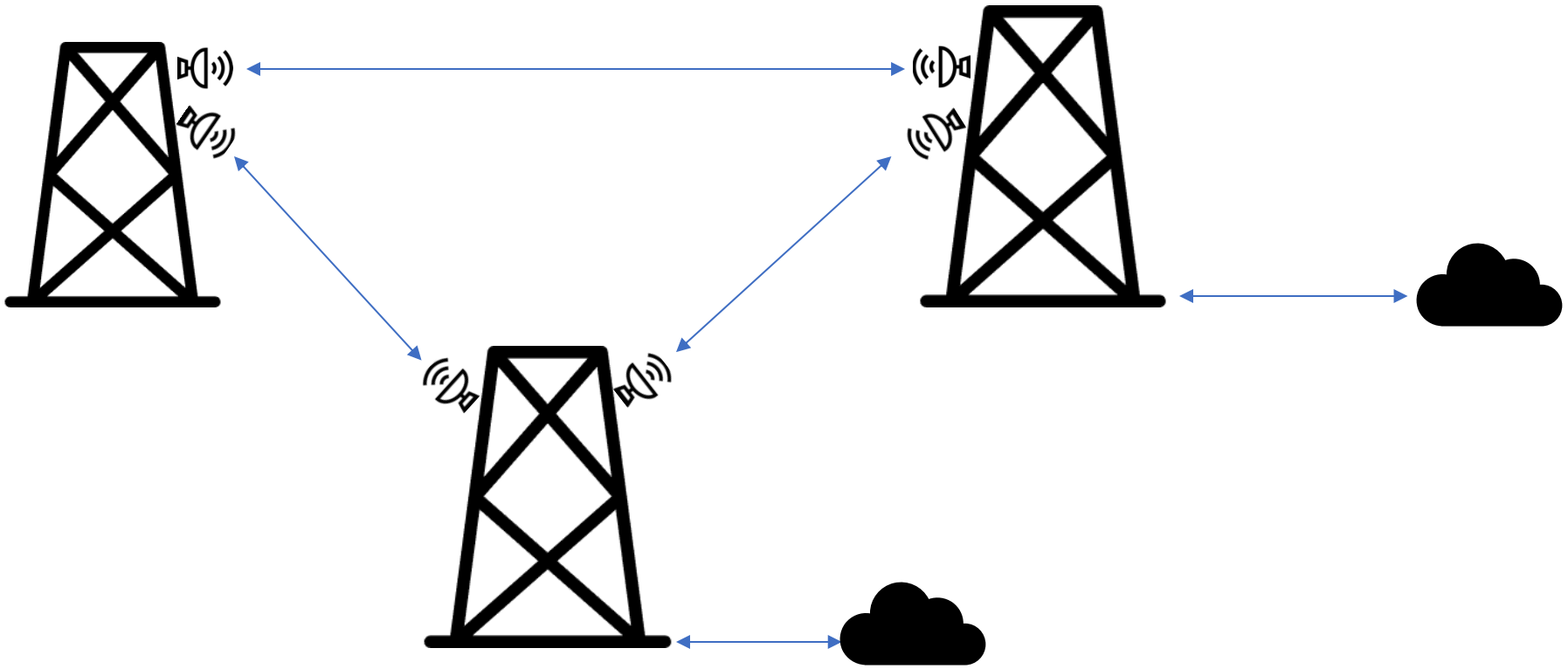


Redundancy vs Resiliency

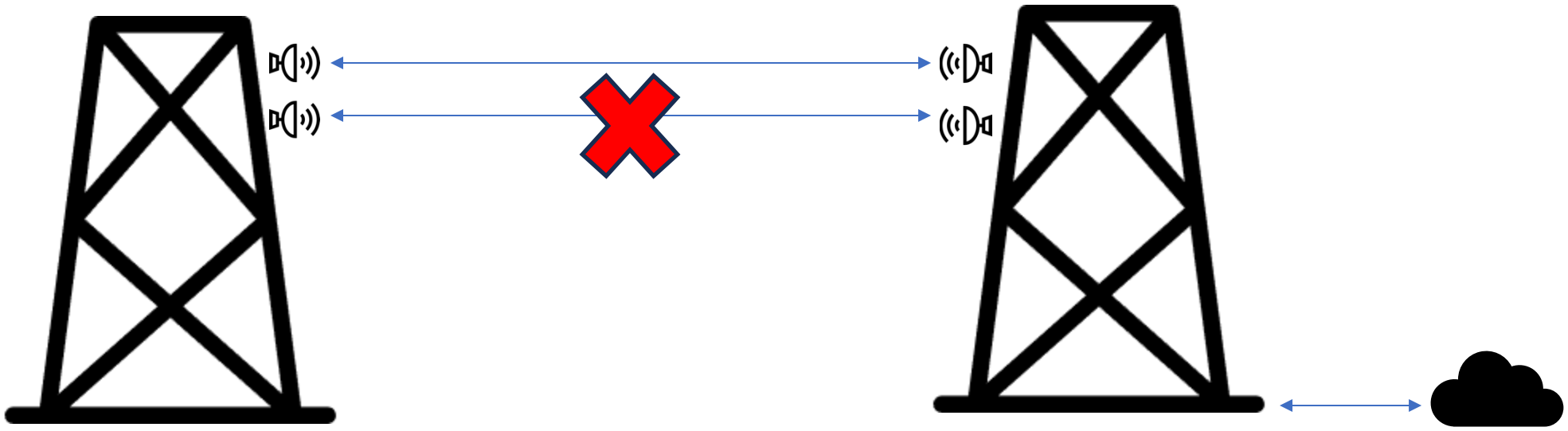
Resiliency: The self-recovery of a network in the event of failures.

Example:

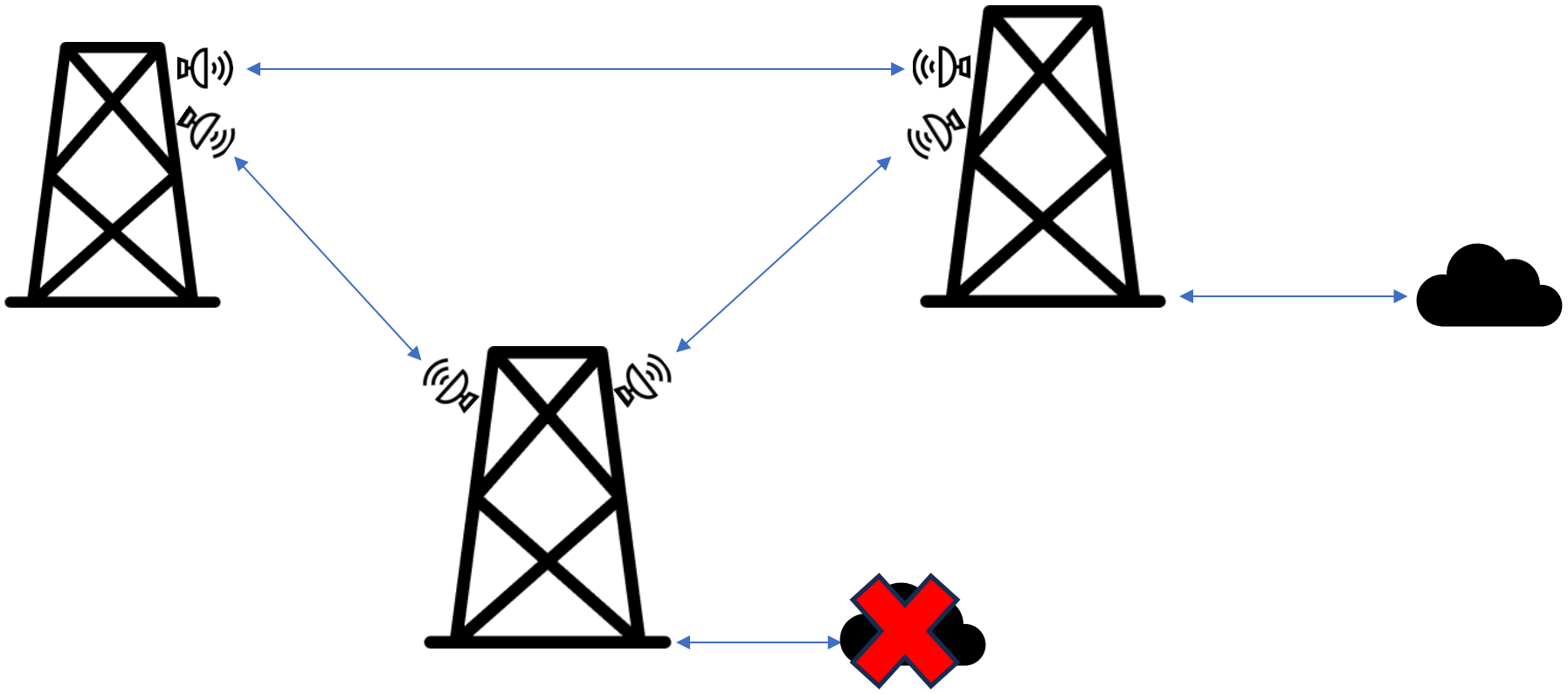
A network ring with multiple internet uplinks.



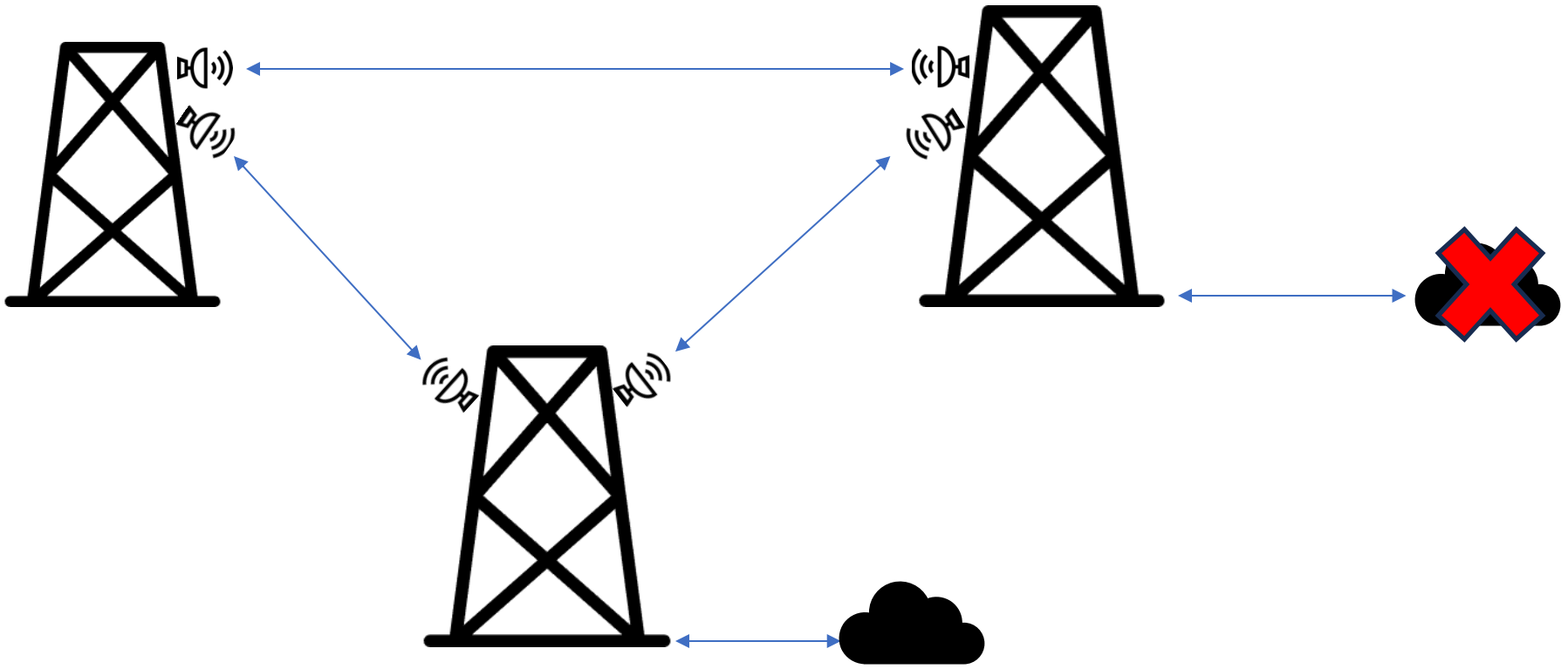
Redundancy



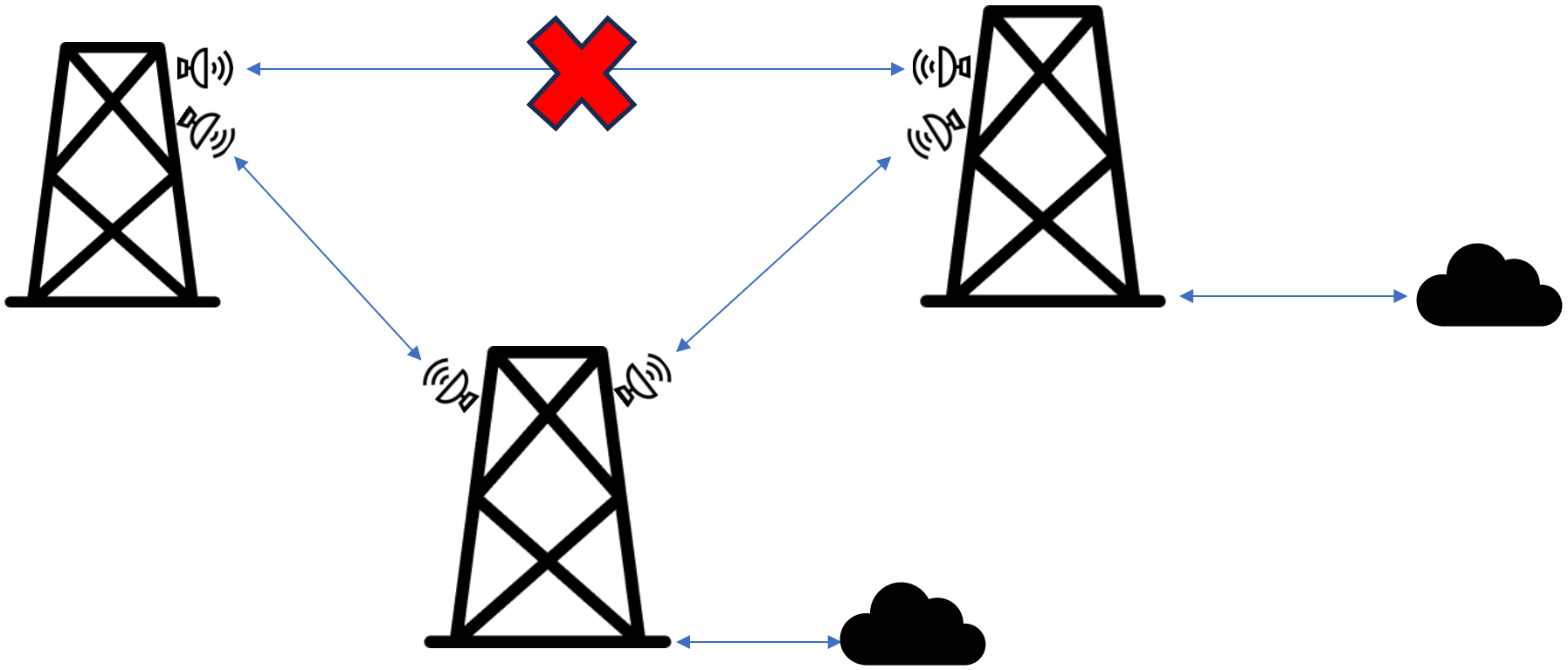
Resiliency



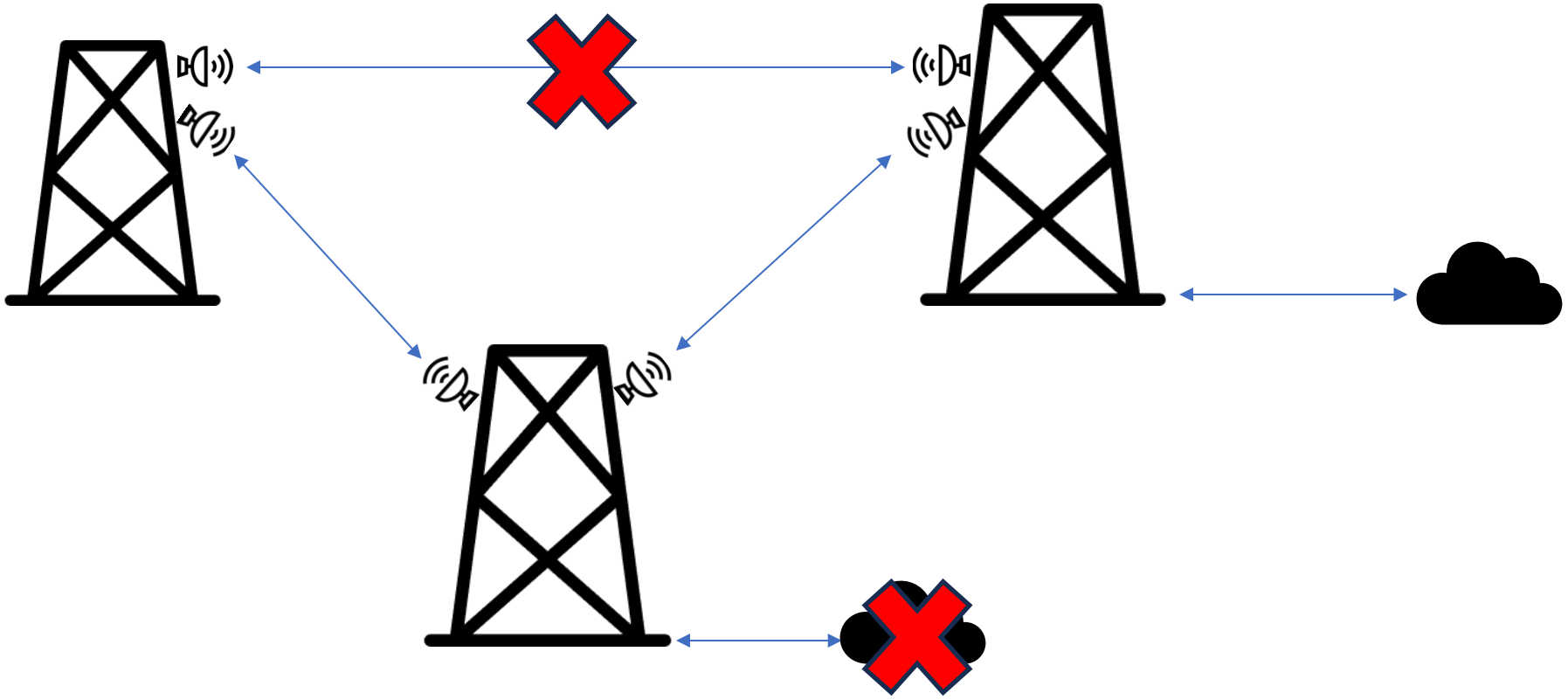
Resiliency



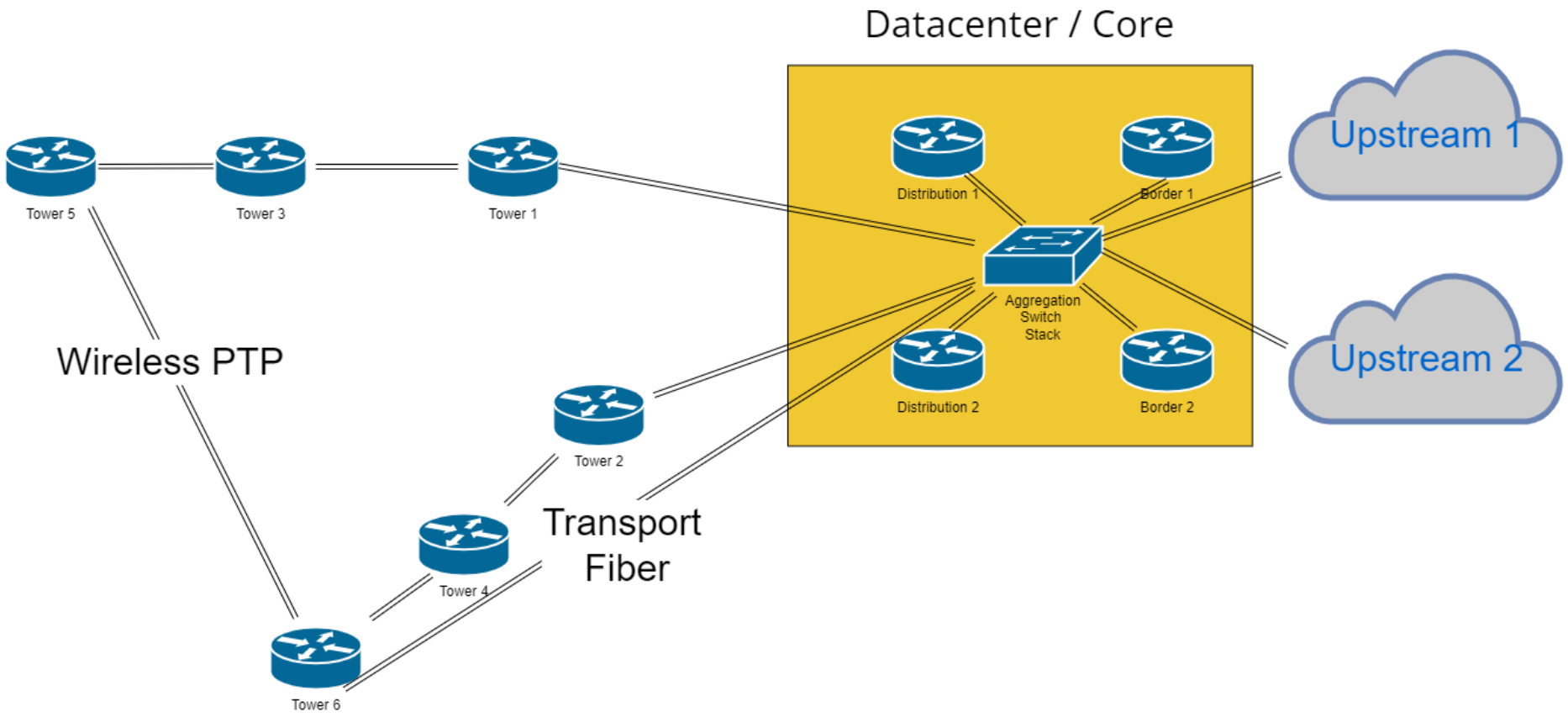
Resiliency



Resiliency



Not Only Tower Resilience, But Core Resillience



Nice to Have

Must Have

It All Comes Down To….

Reliability, Scalability, Capacity

How Are You Going to Build The Network Of Tomorrow?

Core Networking: Best Practices & Implementation

Adair Winter

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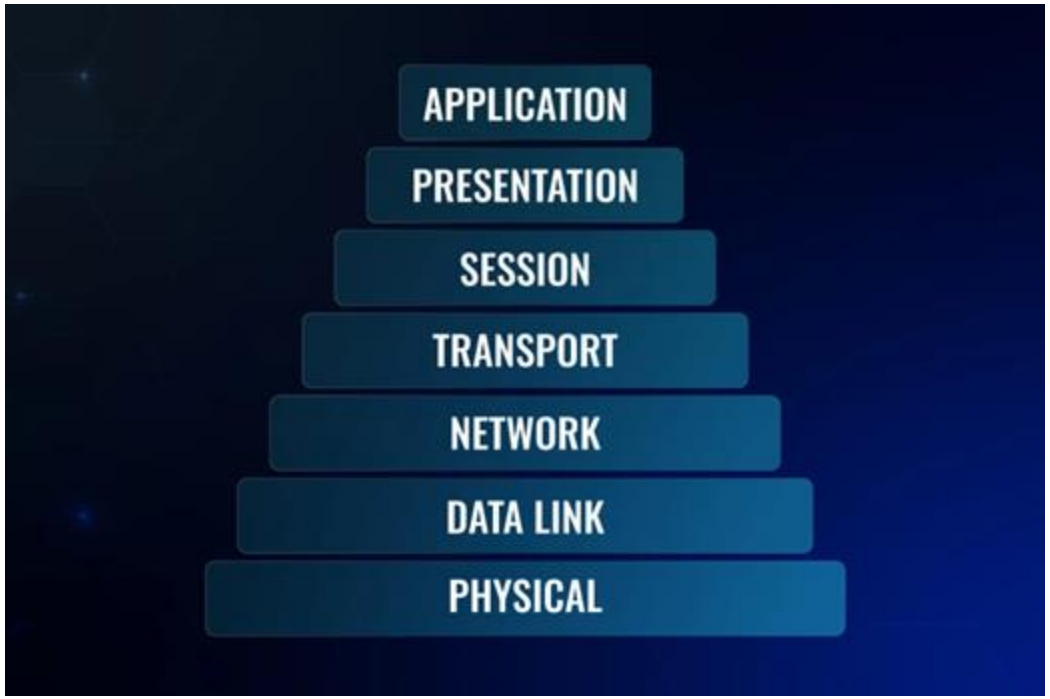
Why did the network engineer bring a ladder to the meeting?

Because he wanted to take the network to the next layer!



Topics

- ➔ IP address planning and management
- ➔ Core networking topologies
  - ◆ Layer 2 vs Layer 3
  - ◆ Layer 2 over Layer 3 (tunneling)
- ➔ Strategies for building a scalable network
  - ◆ Dynamic routing protocols as an underlay
    - OSPF
    - IS-IS
    - BGP
    - EIGRP
  - ◆ Tunneling protocol as an overlay
    - VPLS
    - EoIP
    - VXLAN

Disclaimer…

IP Address Management

We are all documenting our networks…..right?

Documentation Importance

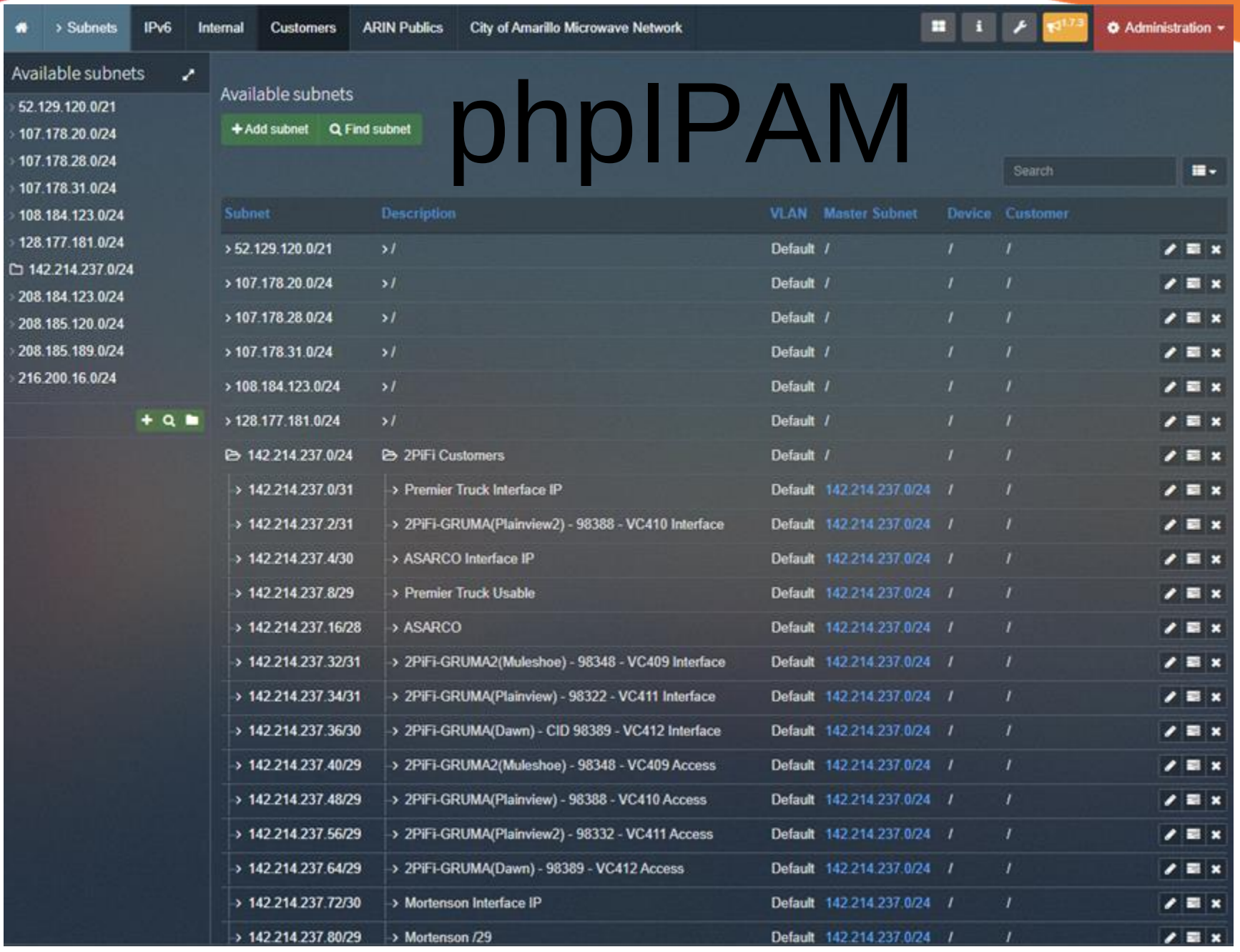
- IP Inventory Management
- Faster Troubleshooting
- Efficient Resource Management
- Preventing IP Address Conflicts
- Simplified Network Planning and Expansion
- Disaster recovery

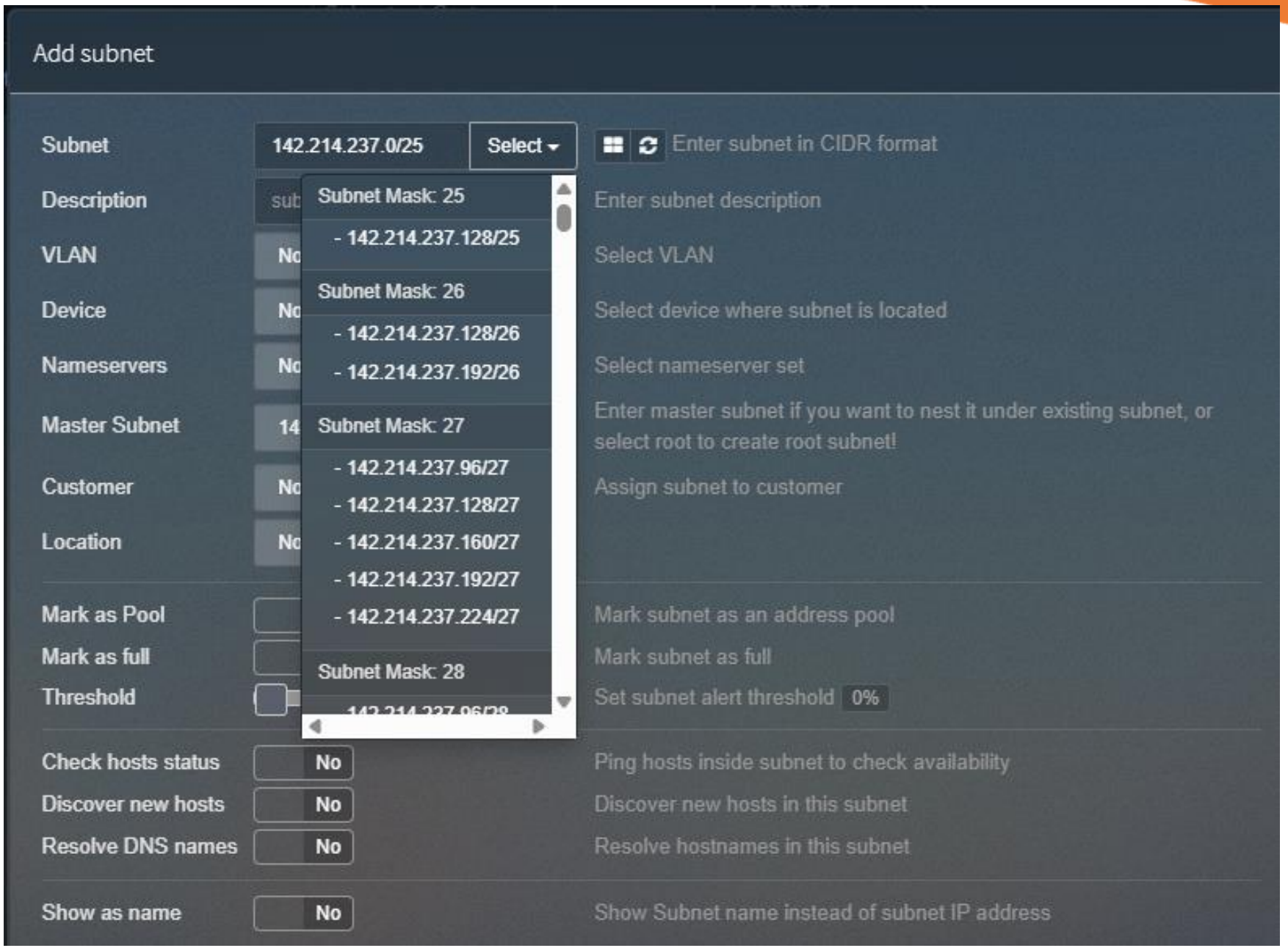
IPAM Options

- Spreadsheet
- phpIPAM
- Netbox
- Others?

Spreadsheet

Purpose	IP Address	Netmask	Gateway	Router
104.245.79.0/24				
104.245.79.0-31/27 - iBGP Network	VLAN 520		32	
AMA Route Reflector	104.245.79.1			
	104.245.79.2			
AMA Edge 1	104.245.79.3			
AMA Edge 2	104.245.79.4			
DAL Edge 1	104.245.79.5			
	104.245.79.6			
AMA Enterprise Router	104.245.79.7			
NetSkrt Amazon Cache	104.245.79.8			
	104.245.79.9			
	104.245.79.10			
	104.245.79.11			
	104.245.79.12			
	104.245.79.13			
	104.245.79.14			
	104.245.79.15			
	104.245.79.16			
	104.245.79.17			
	104.245.79.18			
	104.245.79.19			
	104.245.79.20			
	104.245.79.21			
	104.245.79.22			
	104.245.79.23			
	104.245.79.24			
	104.245.79.25			
	104.245.79.26			
	104.245.79.27			
	104.245.79.28			
	104.245.79.29			
	104.245.79.30			
104.245.79.32-63/27			32	
104.245.79.64-79/28			16	
104.245.79.80-87/29			8	
104.245.79.88-95/29	VLAN 601		8	Dallas EdgeNet
Dallas Edge 1	89			
Dallas Customer Subnets/Nat	90			
	91			





Subnetting Best Practice

Do you have a plan that you follow?

Ideas…

- Every PTP gets a /29
  - Makes additions down the road easier
  - /30 is fine for some situations.
- Every site gets a /22
  - Broken up into smaller subnets for various purposes

Network Site Example

172.16.96.0	/22	Masterson tower	AP's & CPE
172.16.97.0			Spare
172.16.98.0			Spare
172.16.99.0			/26 for site MGMT
172.16.100.0	/22	Panhandle West Tower	AP's & CPE
172.16.101.0			Spare
172.16.102.0			Spare
172.16.103.0			/26 for site MGMT
172.16.104.0	/22	Dawn Tower	AP's & CPE
172.16.105.0			Spare
172.16.106.0			Spare
172.16.107.0			/26 for site MGMT
172.16.108.0	/22	Hereford Elevator	
172.16.109.0			
172.16.110.0			
172.16.111.0			

Network Topologies

Layer 2 vs Layer 3 vs Hybrid

- Advantages of layer 2
  - Fast and easy
- Disadvantages
  - Doesn’t scale well.

- Advantages of Layer 3
  - Scalability
  - Allows dynamic routing
  - Enhanced security and flexibility
- Disadvantages
  - More complex
  - More hardware
  - Learning curve

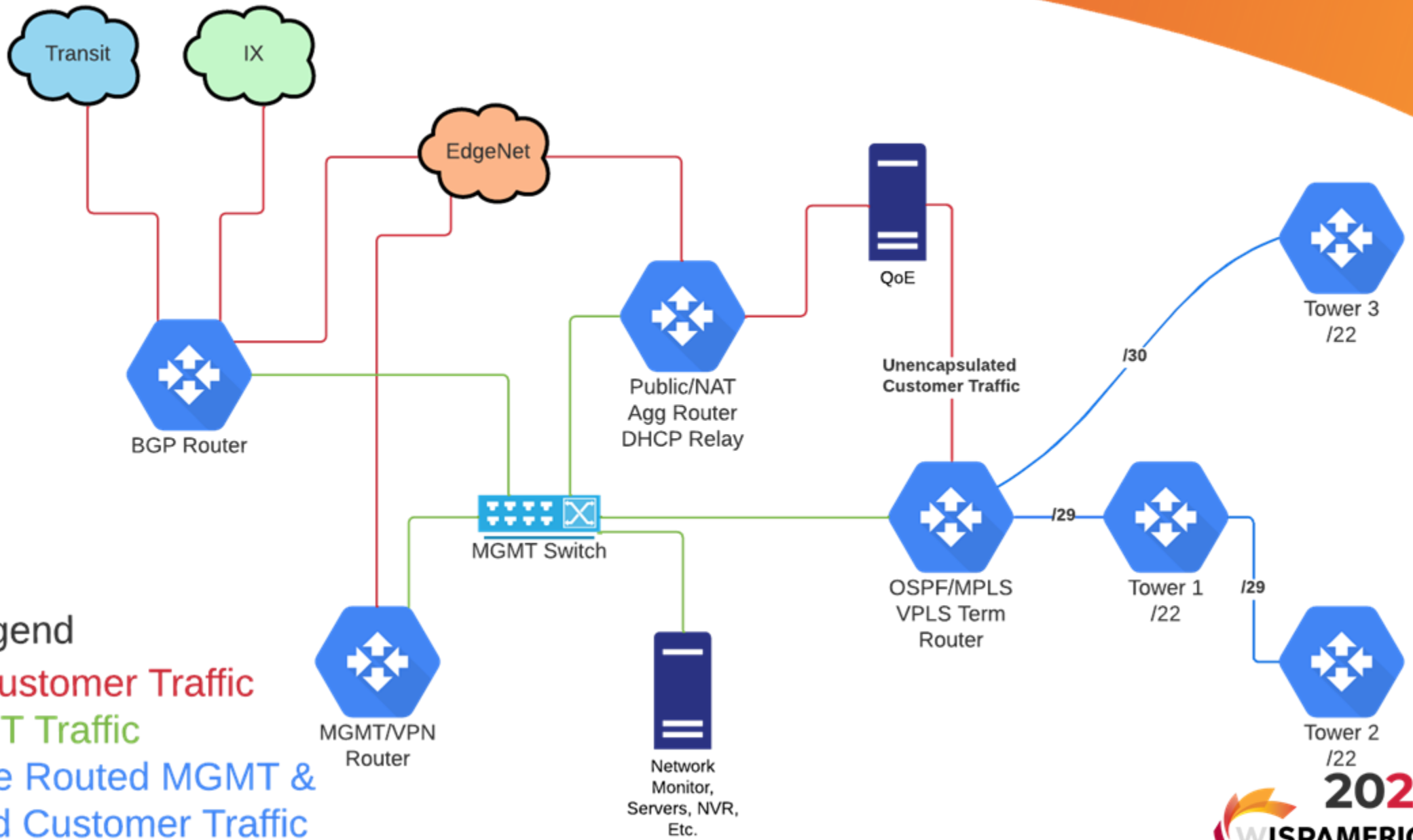
Hybrid

- You get all the advantages of L2 coupled with L3 Scalability & Flexibility.
- Better IP address utilization
- Offer additional services
  - Layer 2 transport between customers

Dynamic Routing

Which protocol is right for you?

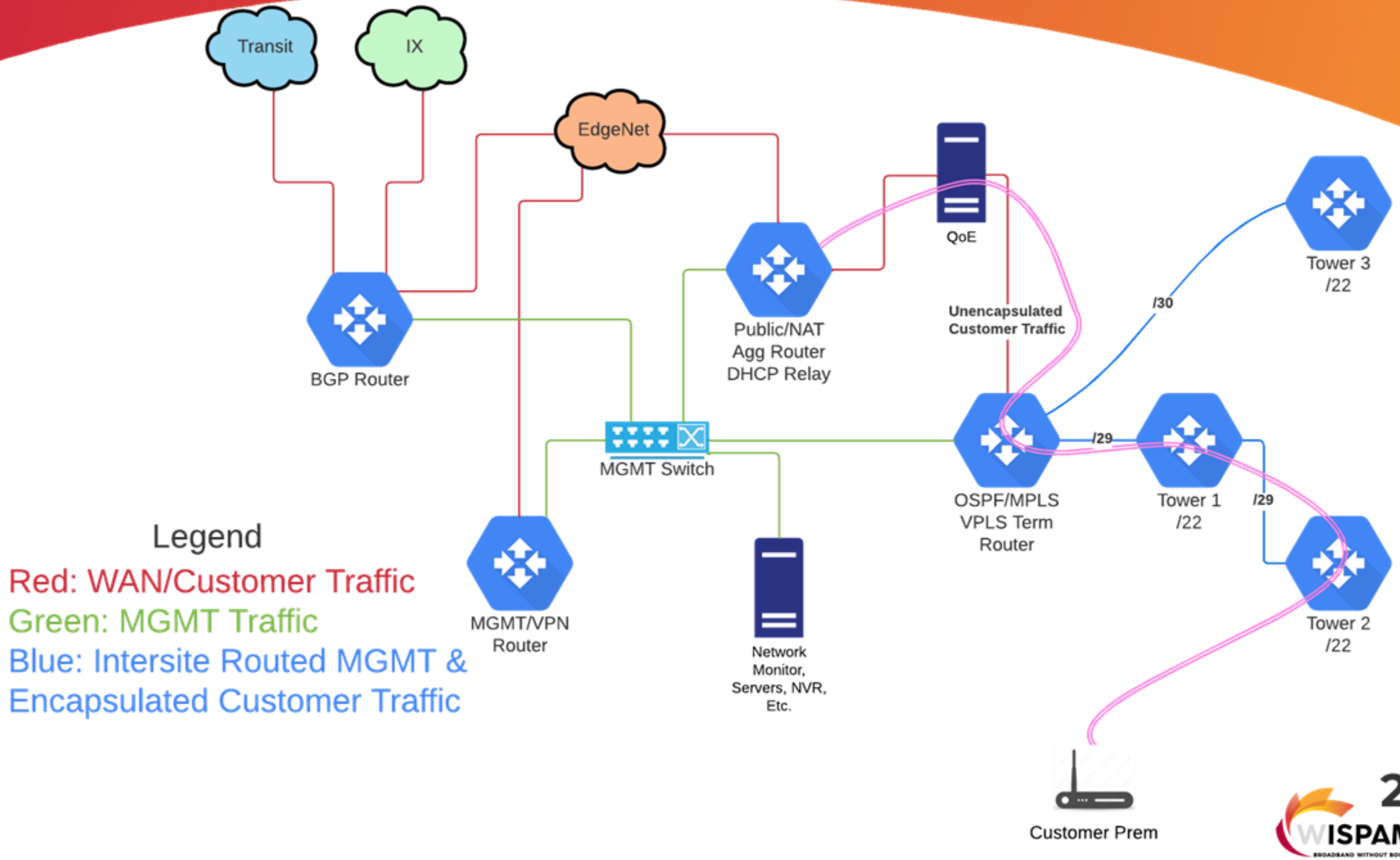
- The one you understand
  - But you also may need to learn something else to better suit your needs
- Two most common dynamic routing protocols
  - OSPF
  - BGP
- Deciding factors
  - Hardware deployed
  - Future scalability


Transit
IX
EdgeNet
BGP Router
Public/NAT
Agg Router
DHCP Relay
QoE
Unencapsulated
Customer Traffic
/30
Tower 3
/22
MGMT Switch
OSPF/MPLS
VPLS Term
Router
/29
Tower 1
/22
/29
Tower 2
/22
MGMT/VPN
Router
Network
Monitor,
Servers, NVR,
Etc.
Legend
Red: WAN/Customer Traffic
Green: MGMT Traffic
Blue: Intersite Routed MGMT &
Encapsulated Customer Traffic

Overlay Types

Overlays allow you to extend layer 2 over layer 3

- VPLS over MPLS
  - Advantage of traffic engineering
- EoIP
  - Allows for ECMP
- VXLAN
  - Good option if your hardware supports it
  - Can be used with many dynamic routing protocols



Closing thoughts

- Document your network, it’s important!
- Use a dynamic routing protocol.
  - Especially if you want to scale your network to thousands of routes/customers
- Leverage a layer 2 encapsulation method
  - IP addresses are not cheap or abundant…use them wisely!
  - Upsell your customers with other services

Core Networking Protocols Design, Implementation, And Best Practices

By Dennis Burgess

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Topics

- Why you should use ARIN IP Addresses
- Why you should use BGP
  - Benefits of IX
  - Or Caching solution
- Why we should be dual stacking.
- Self Hosting services
  - DNS
  - Internal Speed Test Server
- Monitoring
  - What you should be monitoring
  - How many systems do you need?

Why ARIN Internet Protocol Addresses

- Shows your company in speedtest.net
- Traffic going to/from your IPs count to Caching solutions
- You can control the Geo-Location
- If you are not using it,
  - Services like Netflix does not count traffic to Ips that are NOT yours towards caching deployment
  - Geolocation is not controlled
    - Your CDN services may not be accurate
    - I.e. going to the wrong CDN node

Why BGP

- First you need to be able to spell BGP
- Most ISPs set it up once, and never touch it
- Primary used for Multi-Homing
  - Allows your IPs to go in/out multiple internet connections
  - Not really “failover” but can be used that way
  - Allows you to be upstream independent.
- Also allows caching solutions
  - Go talk to NetSkrt

Dual Stacking

- Allows for V6 and V4 services at the same time
- We should be leading the V6 deployment
  - We are small and adjile
- Give all users public IPs
- Will help with NAT on Xbox

Self Hosting

- Virtualization solution
  - ESXI
  - Hyper-V
  - Proxmox
  - MikroTik RDS
- Virtualization Hardware
  - Lots of older generation Servers that ISPs can use
  - If you want new stuff go for it.

Servers

- Virtualize Servers
  - Speed Test Server
    - To be able to give the user what they are promised.
  - DNS
    - EVERY ISP over 300+ subs should have their own DNS servers
    - Fast DNS = Fast Internet
    - 8.8.8.8 Tracks everything users do
    - Closer DNS = Faster DNS
    - Saving 5ms is still 5ms saved, CNN does like 80 DNS queries, so that saves almost ½ of a second!!

Servers

- Virtualize Servers
  - Monitoring!
    - Every ISP should have four (4) monitoring solutions at the SAME TIME
    - WHY?
      - One for Single-Pane up/down view
        - Single window showing general network status.
      - One for Problem notifications/Charting
        - Interface speed changes
        - Tracks signals, light levels.
        - You should be able to set alerts when things change by % etc.

Hosted Monitoring

- Virtualize Servers
  - Monitoring!
    - Every ISP should have four (4) monitoring solutions at the SAME TIME
    - WHY?
      - One hosted to monitor reachability of your IPs
        - Website monitoring
        - This is the S*** has hit the fan if it detects something down
      - One to monitor your BGP advertisements, and upstream
        - If you loose one of your up streams, if its setup right, 99% won't know something is down, but you should!!
        - This can also be inside the second one to monitor your BGP peers
        - I prefer something that goes, XYZ is lost as an upstream.

Questions?

THANK YOU