Burning Bridges - Routing Your Bridged WISP Network With MikroTik

Introduce Yourself

- Name
- Company & position there

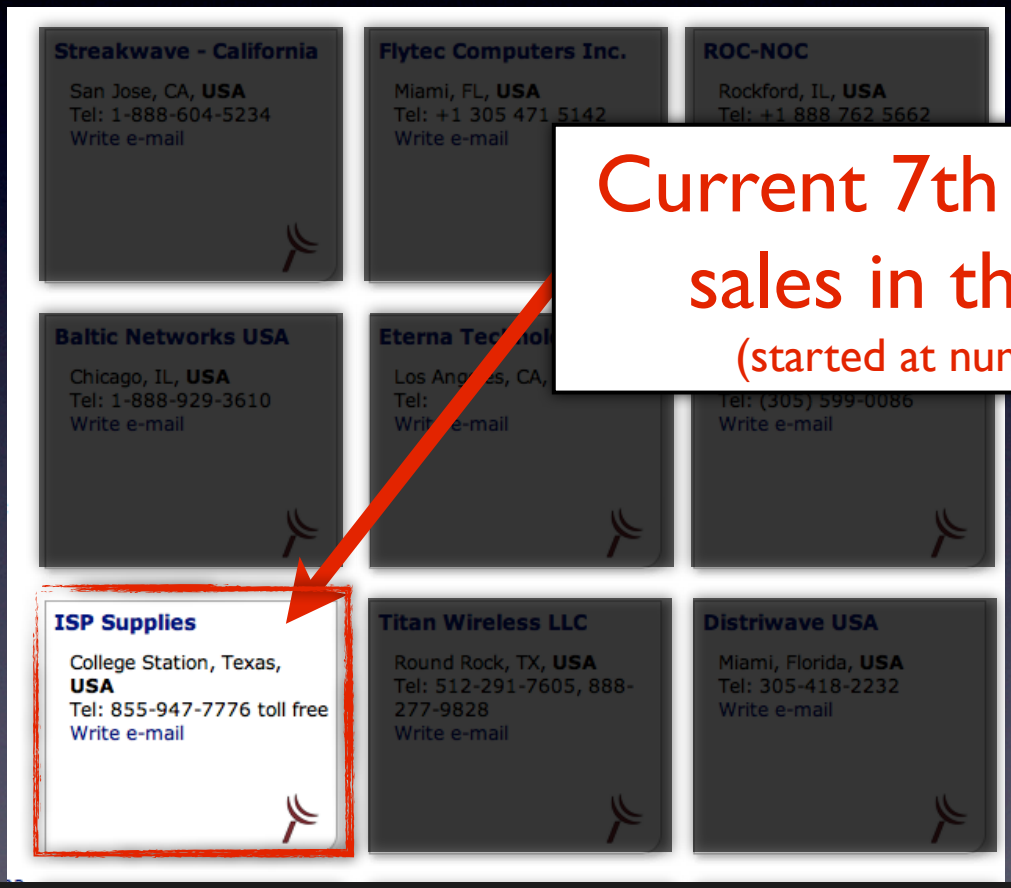
About Me

- Steve Discher
- 1987 graduate of Texas A&M University, in IT for more than 20 years
- Live in College Station, Texas
- Former WISP owner from 2004 to 2010
- Online distribution company, ISP Supplies
- Conduct MikroTik and Ubiquiti training www.mywisptraining.com

About ISP Supplies

- Entering our third year of business.
- We sell MikroTik, Ubiquiti, Cambium and all of the accessories.
- Also sell custom built products including silkscreened indoor and outdoor enclosures, RF shielding and antennas

Master MikroTik Stocking Distributor



Current 7th largest in sales in the USA

(started at number 20!)

Largest Problem Facing Growing WISP's

Number one consulting question I am asked is how do I convert my bridged wireless network to a routed one?

One Size Fits All Approach

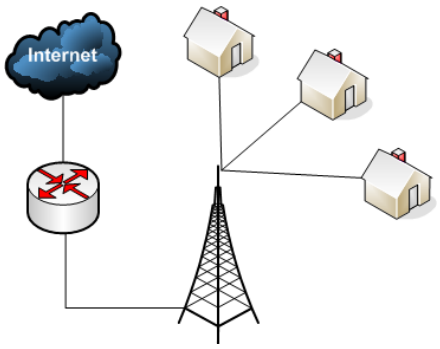
- There is none.
- Today, establish an attack plan using general processes.
- You will need to adapt to your particular scenario.

Today's Presentation

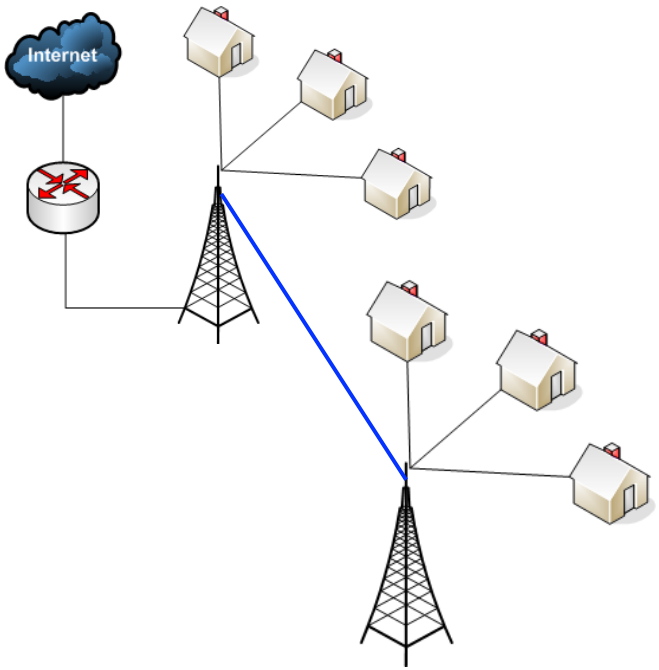
1. Why is excessive bridging a problem?
2. Routing - the solution to excessively bridged networks.
3. Network redesign, topology, IP planning and routing.
4. Protocols to be used.
5. Rollout plan.
6. Equipment selection.

The Problem

Why are bridged wireless networks difficult to scale?



Network Organic Growth and Evolution



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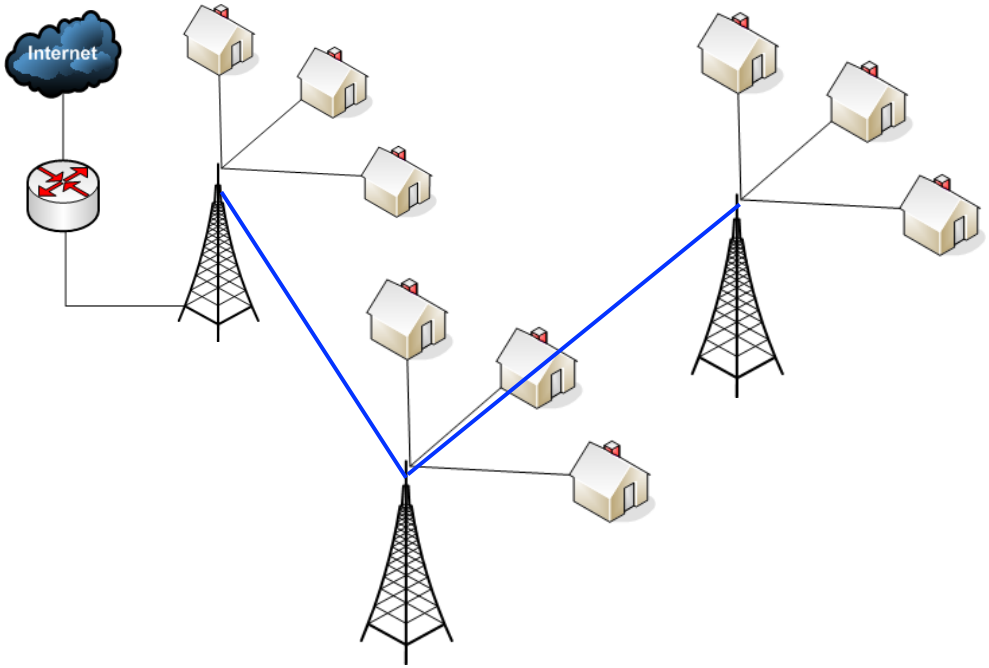

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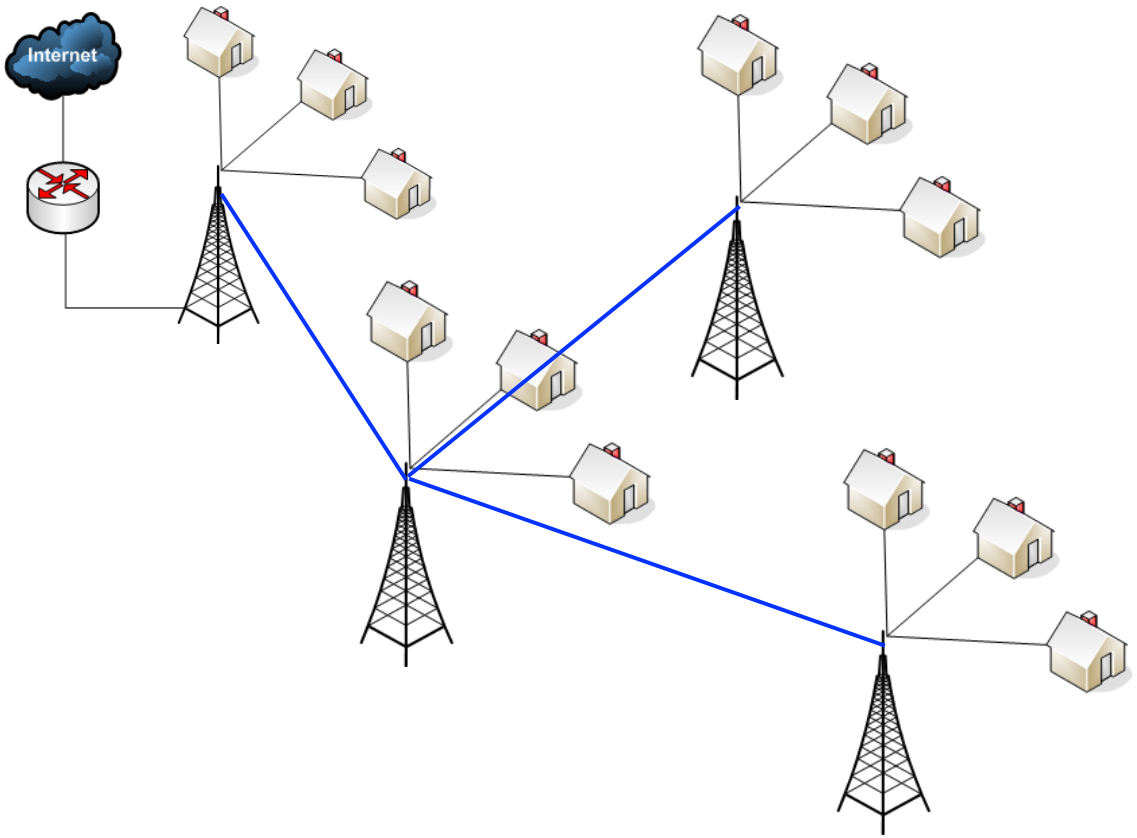

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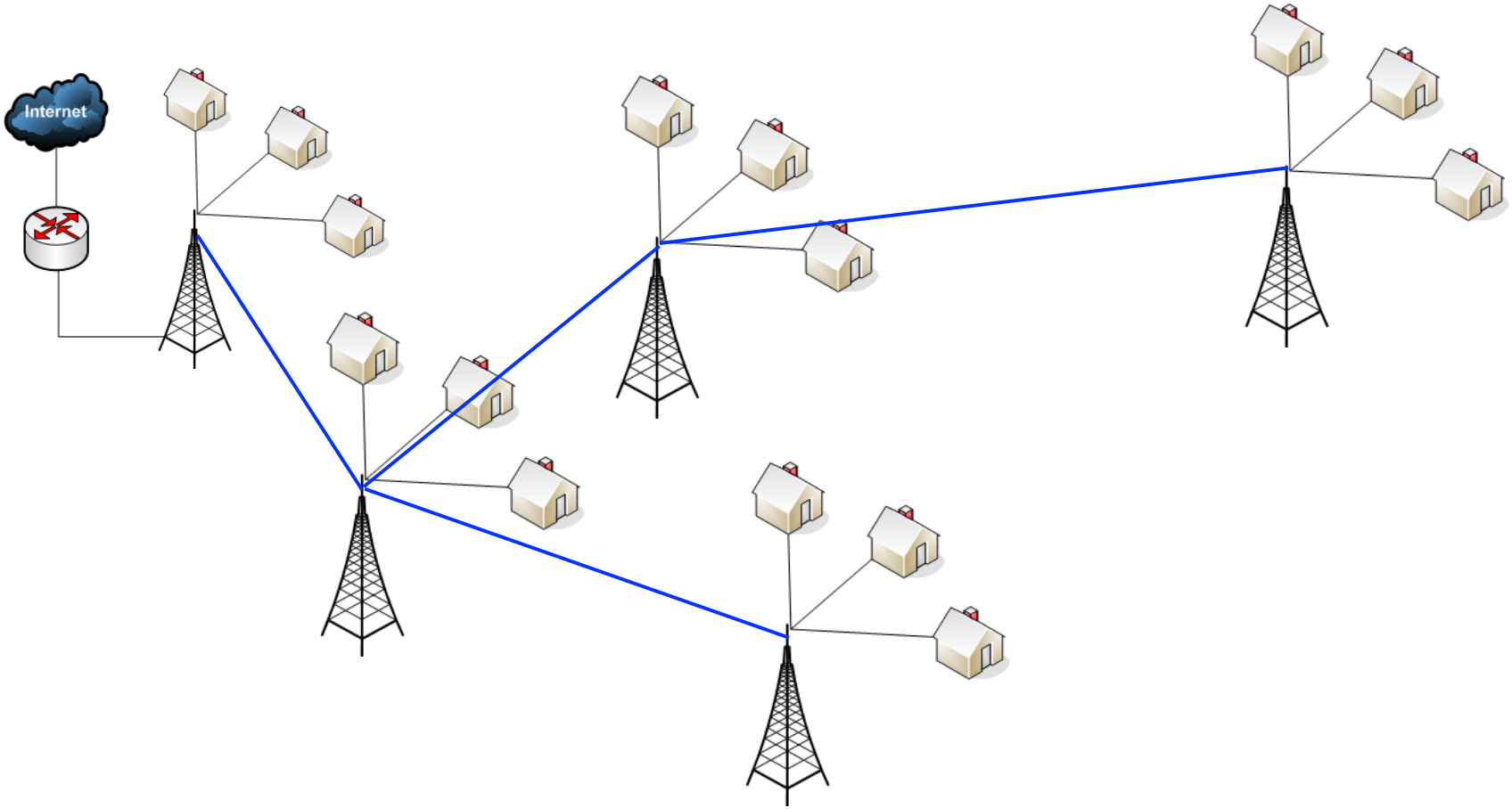
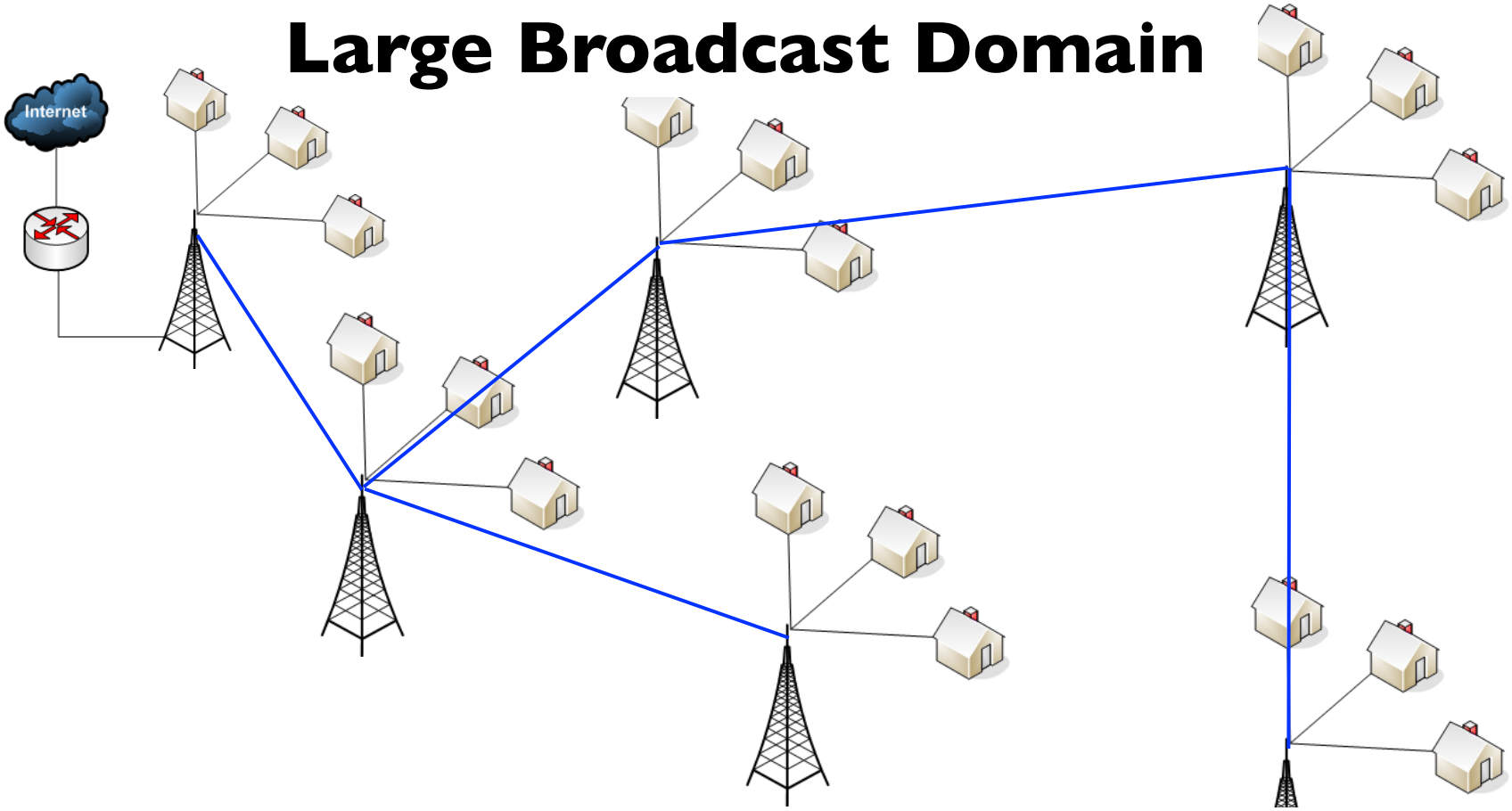


Network Organic Growth and Evolution

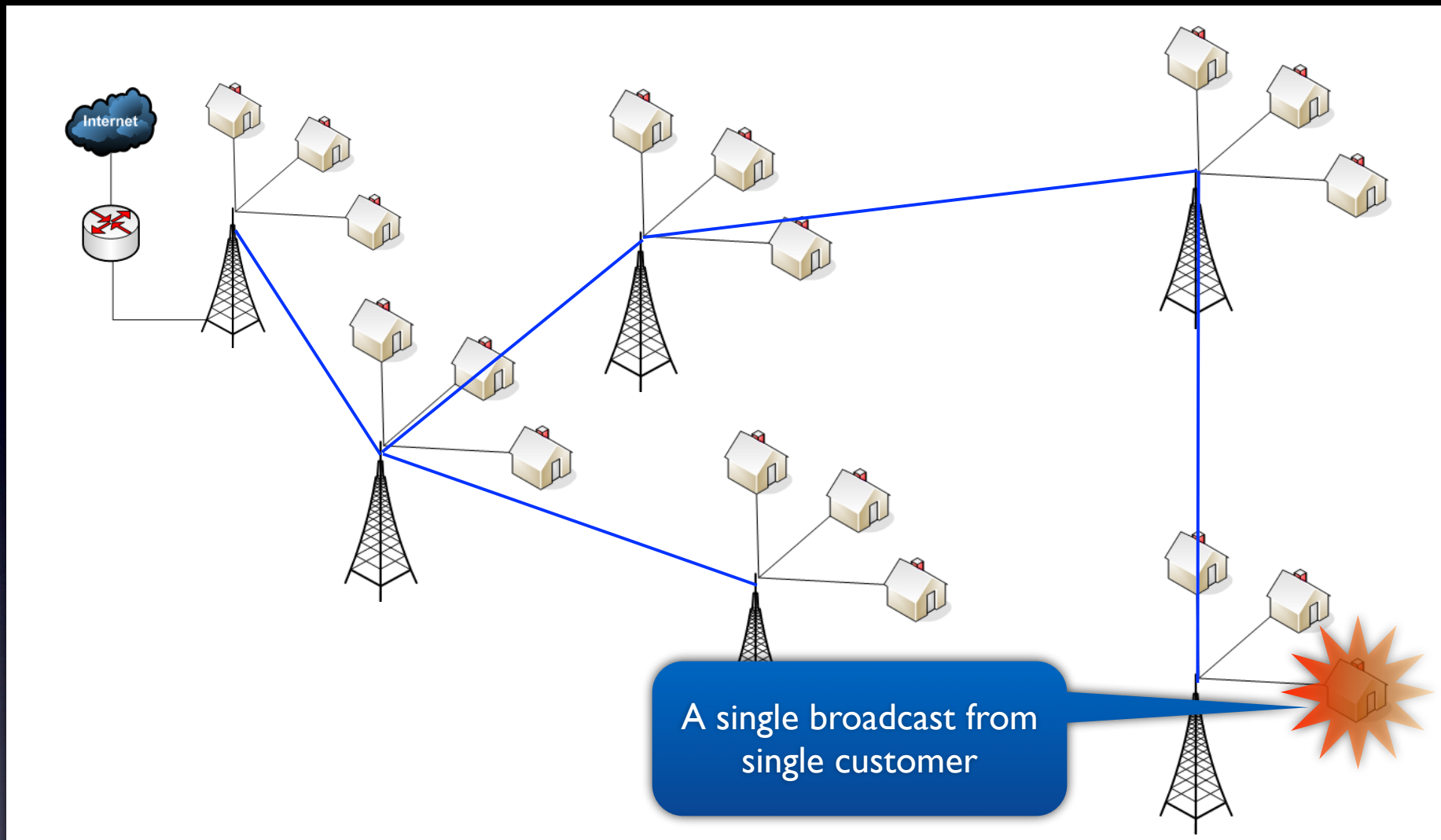
Large Broadcast Domain



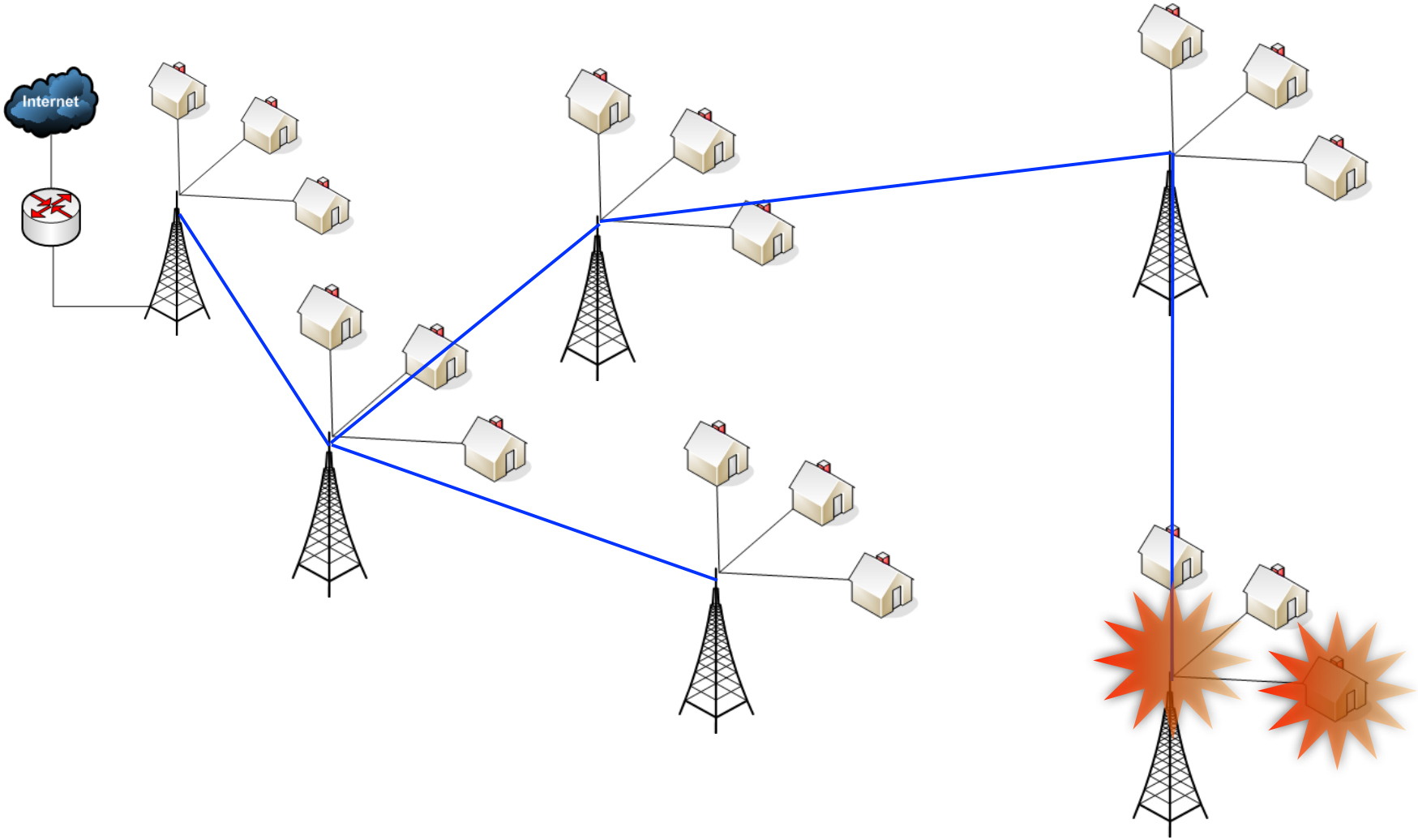
Somewhere around 300 customers on the average broadcast traffic reaches an unmanageable level

Broadcasts

- Broadcasts are a necessary part of an Ethernet network
- Switches use a process called “flood” and “learn” and then switch packets based on lookup tables, those entries in the lookup tables age out, then they flood again
- As network grows, lookup tables get too large, constantly flushed, once again broadcasts are flooded



Broadcast Traffic in a Bridged Network



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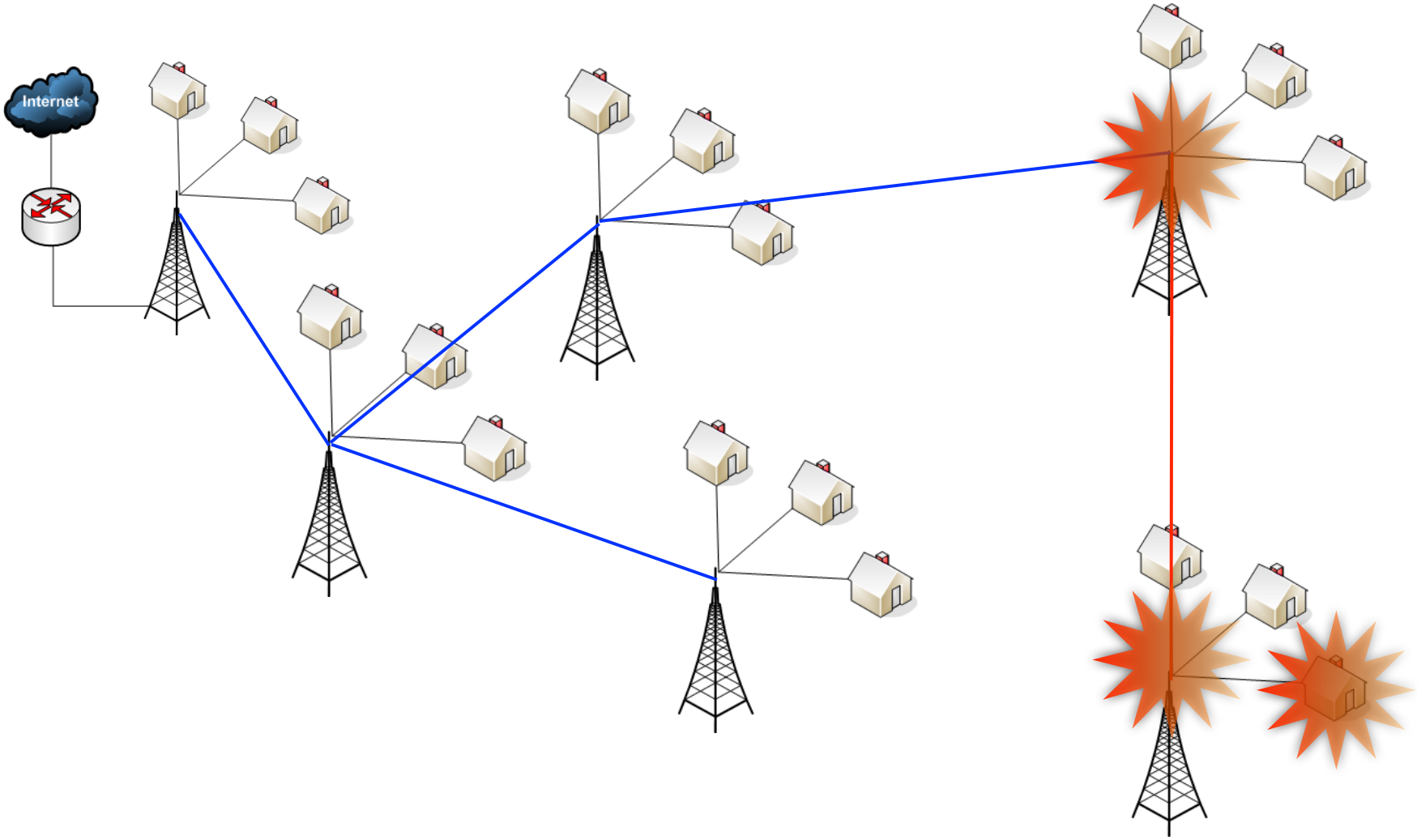

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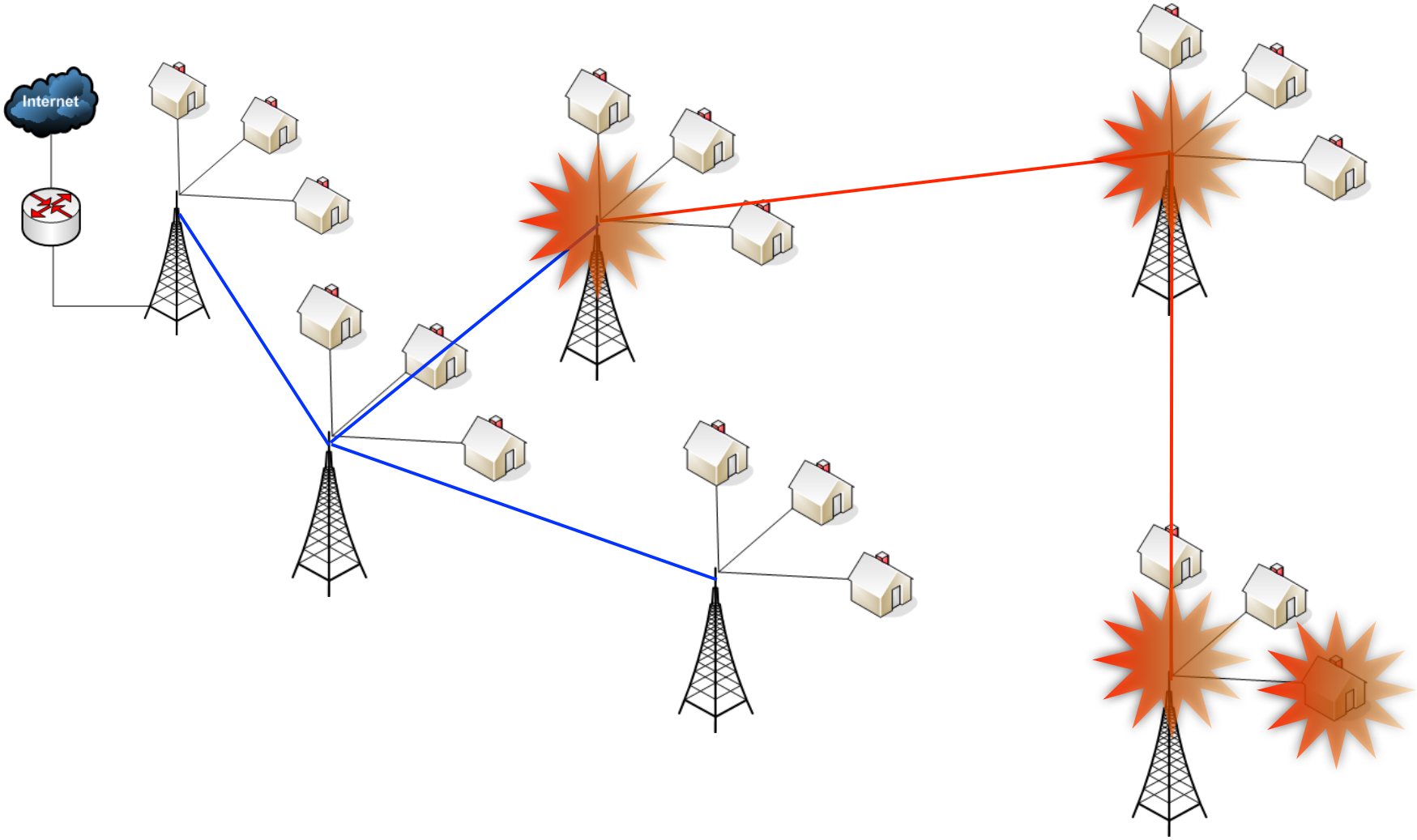

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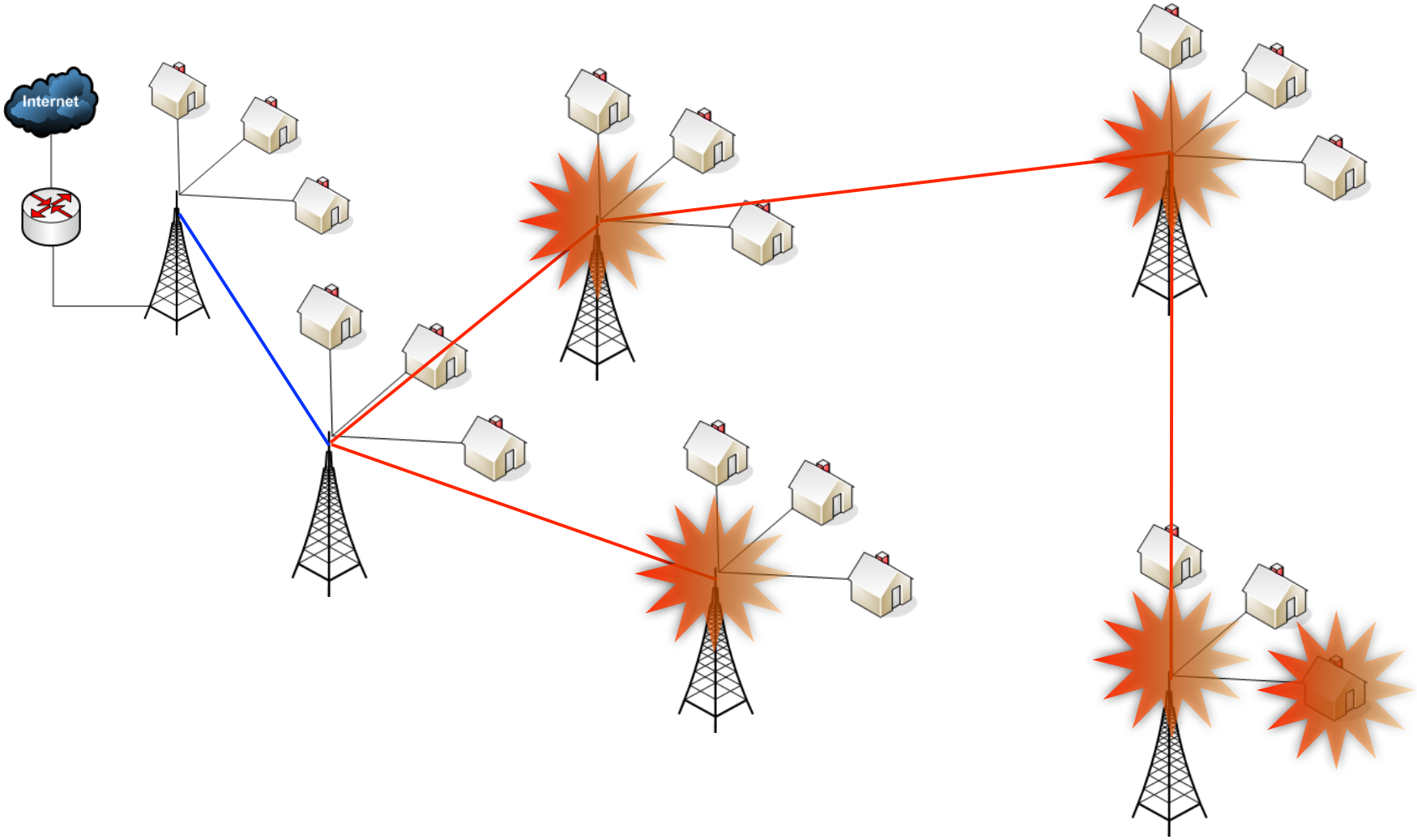

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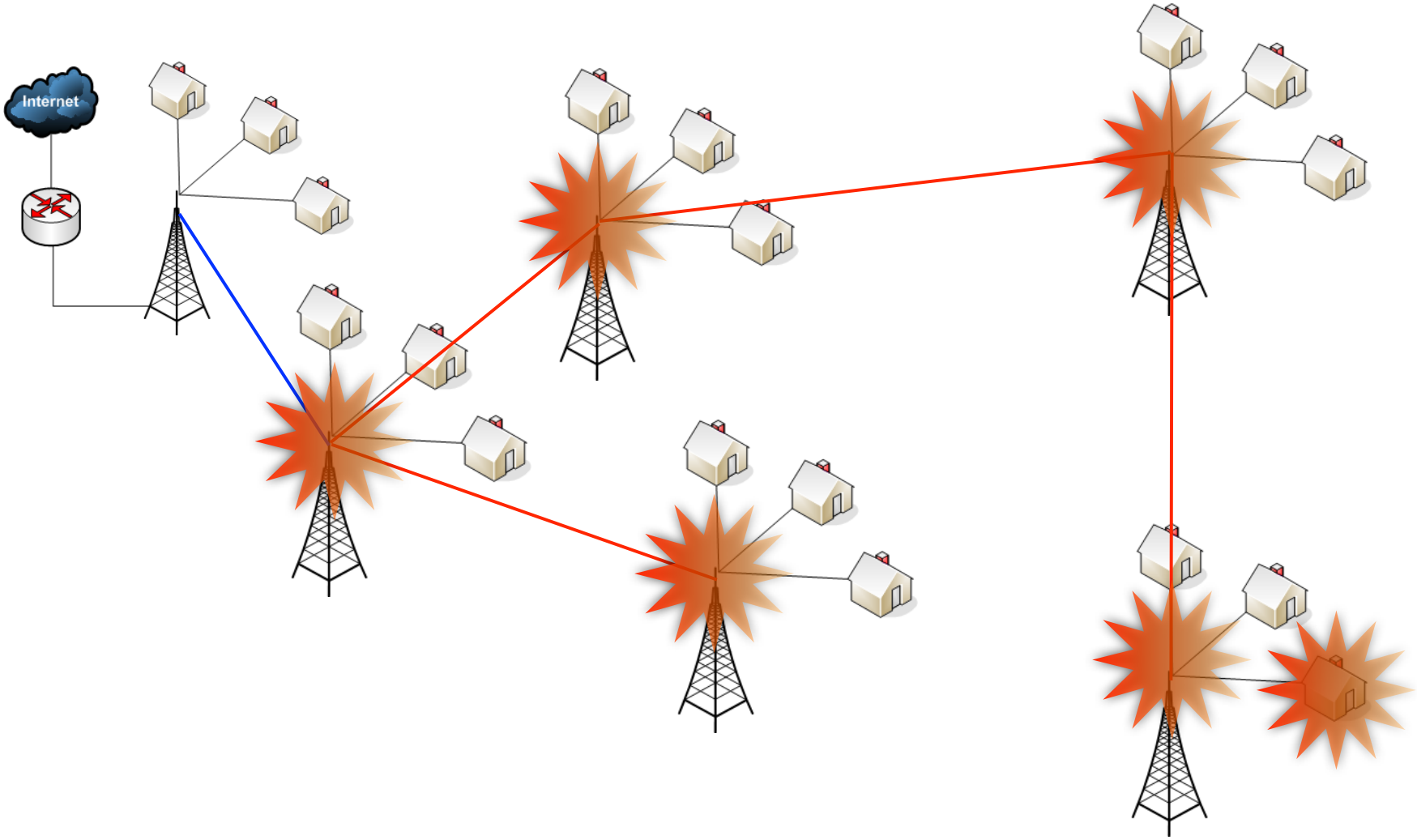
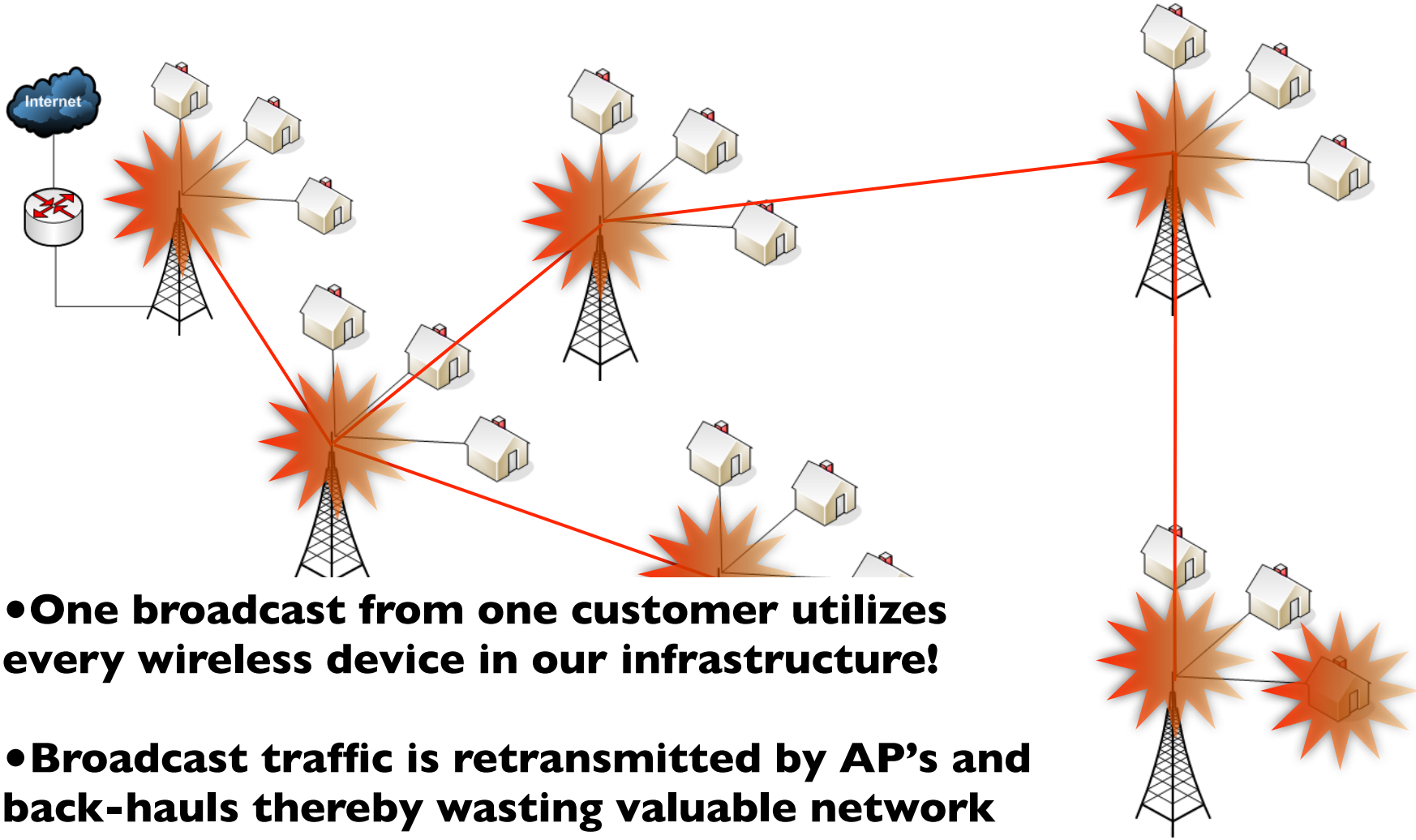


Broadcast Traffic in a Bridged Network



- **One broadcast from one customer utilizes every wireless device in our infrastructure!**

- **Broadcast traffic is retransmitted by AP's and back-hauls thereby wasting valuable network resources**

The Solution

- Routing, adding routers into the network
- Why? Routers block broadcast traffic, reduce the size of the collision domain
- More efficiently utilize resources by allowing you to transmit only necessary traffic across links it needs to cross
- Utilize traffic shaping and customer rate controls
- Offload workload like NAT to less utilized devices closer to the network edge

The Solution

- Adding routers can increase security by the addition of firewalls
- Prevent Layer 2 switch loops
- Prevent customer viruses from taking your network down
- Prevent rogue DHCP servers from infiltrating the entire network
- Increase the scalability of the network

The Solution

- Simplify troubleshooting
- Allow the creation of redundancy and failover

The Solution

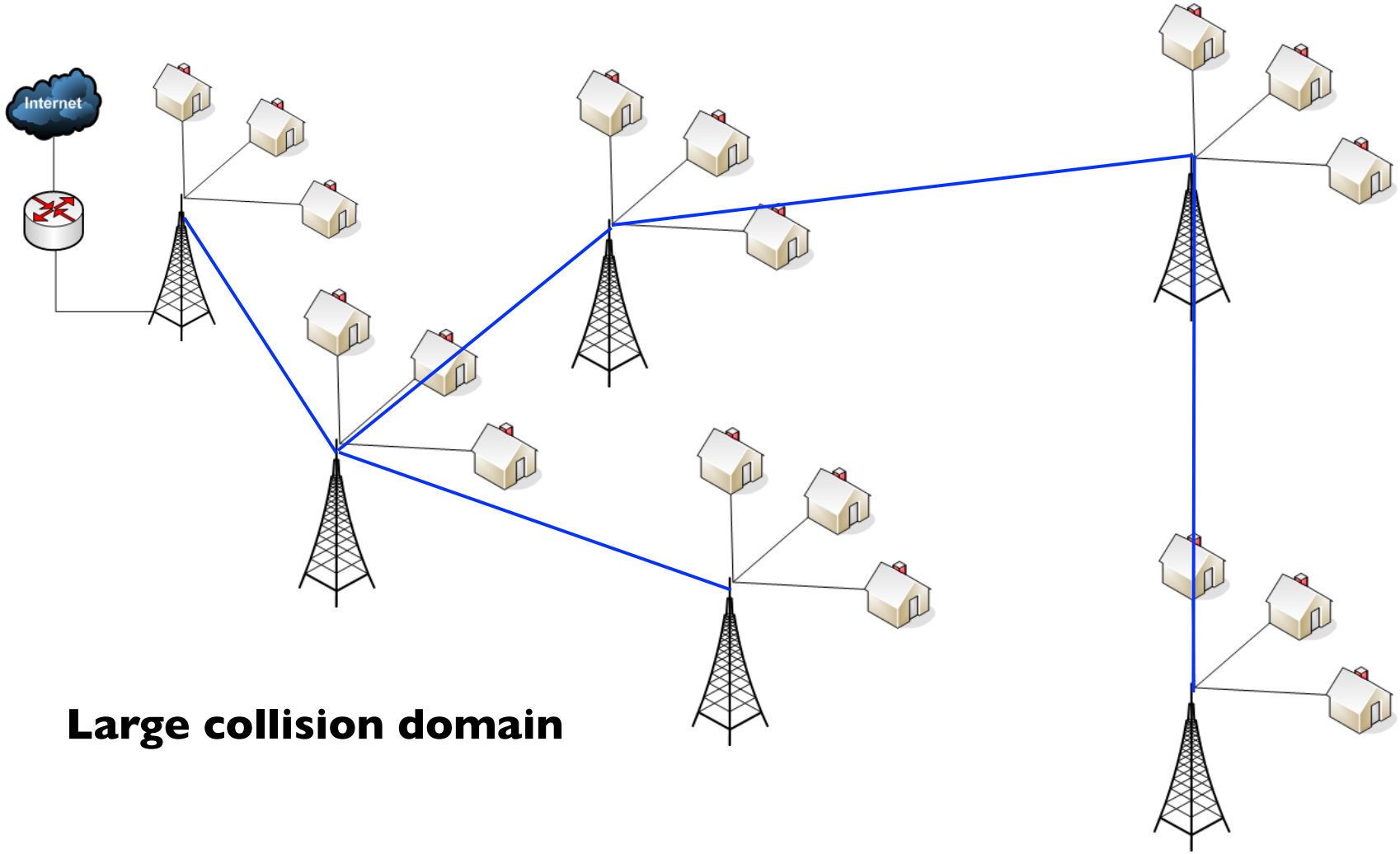
With so many benefits from routing over bridging why do we resist?

Routing vs Bridging

- Bridging is faster, easier to learn especially at first.
- Using routers requires me to learn routing.
- Using routers requires me to learn subnetting.
- Administration will be more difficult.

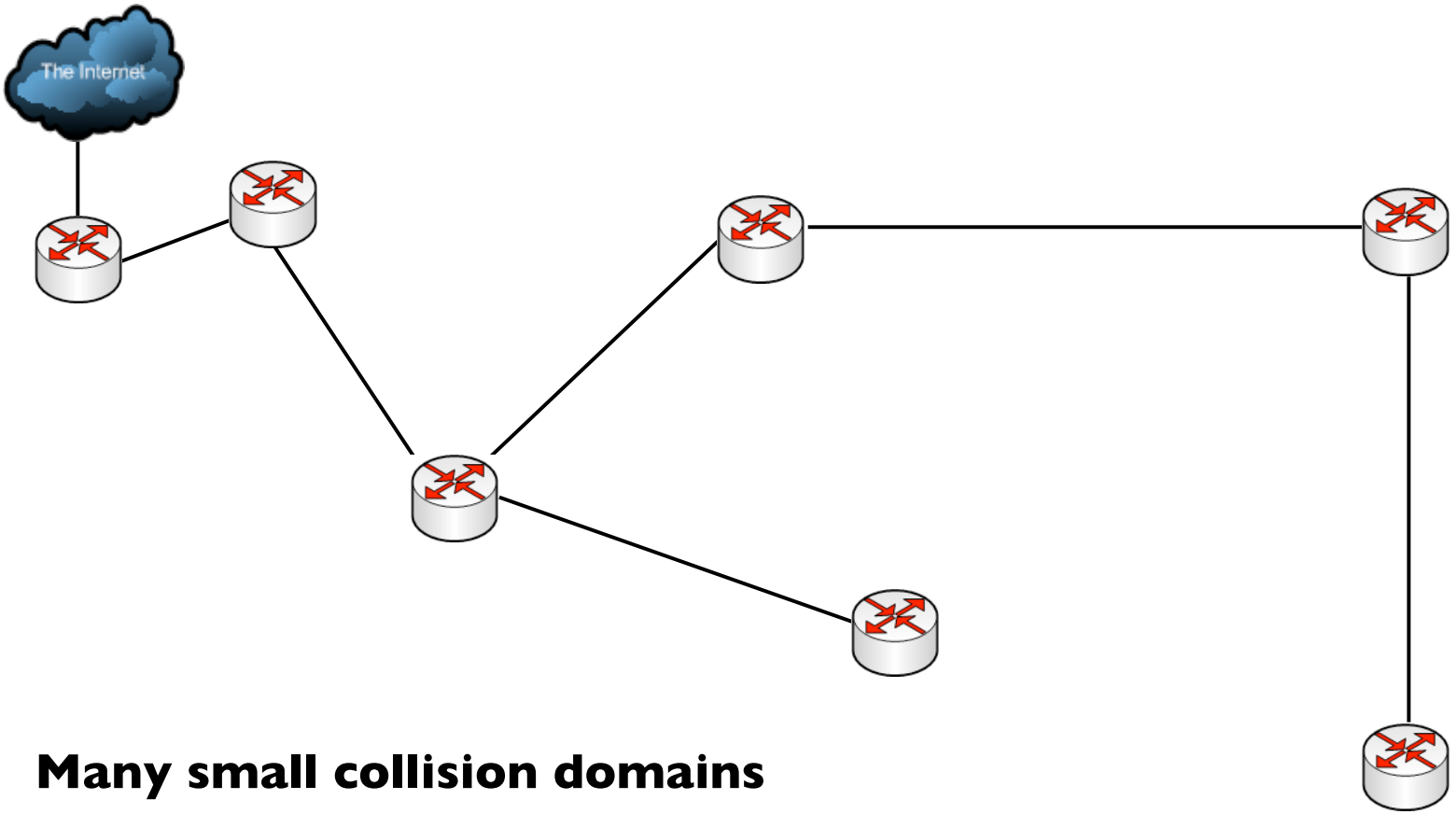
Network Redesign

- Redesigning a bridged network as a routed network requires:
  - A network diagram.
  - An IP plan.
  - Proper equipment.
  - Coordinated rollout.



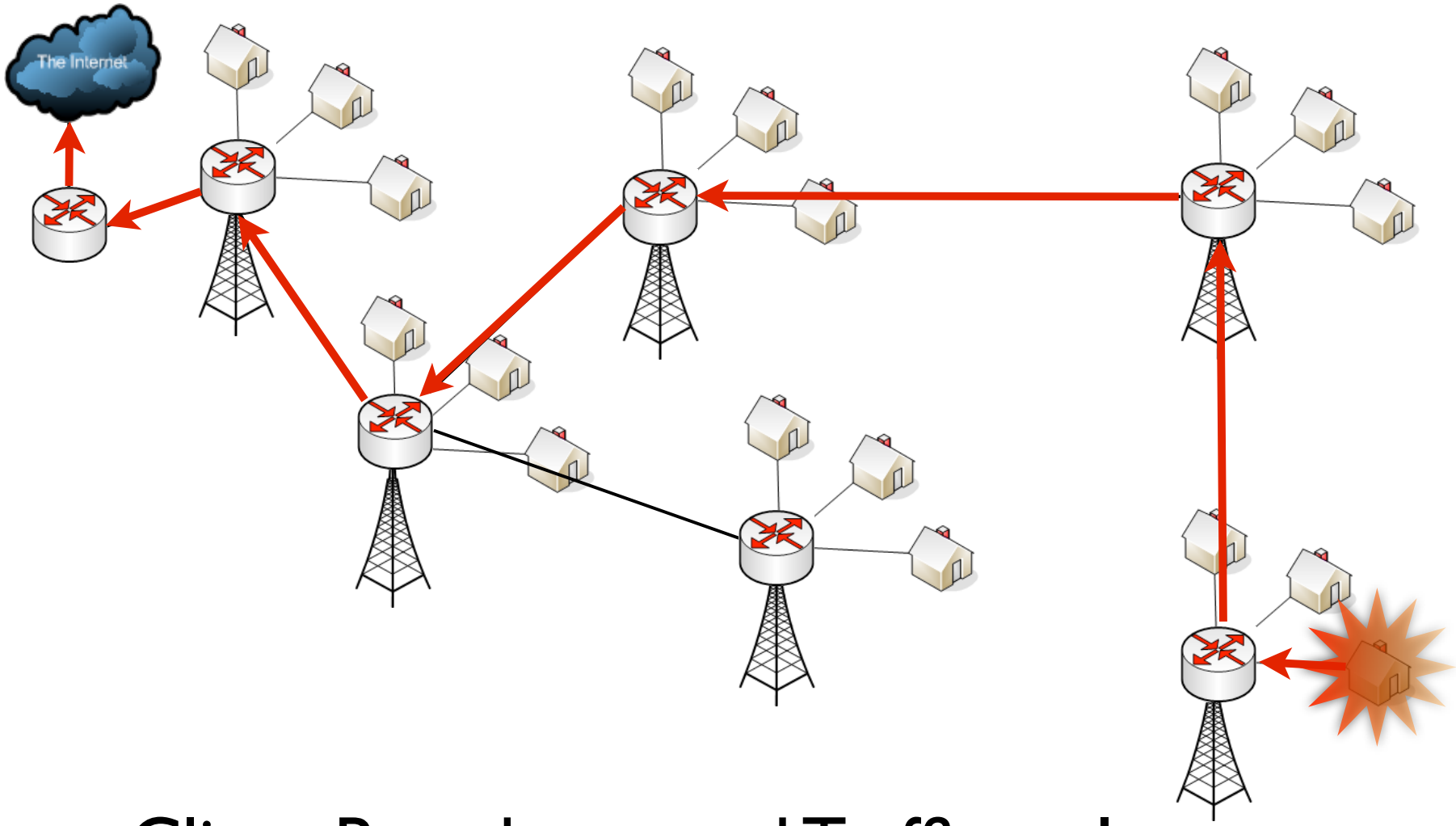
Large collision domain

Flat Bridged Network

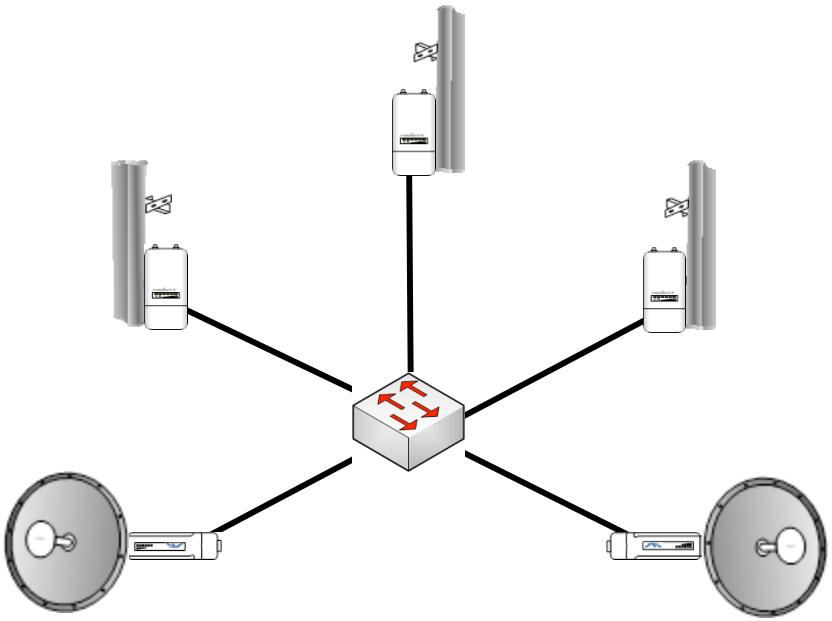


Many small collision domains

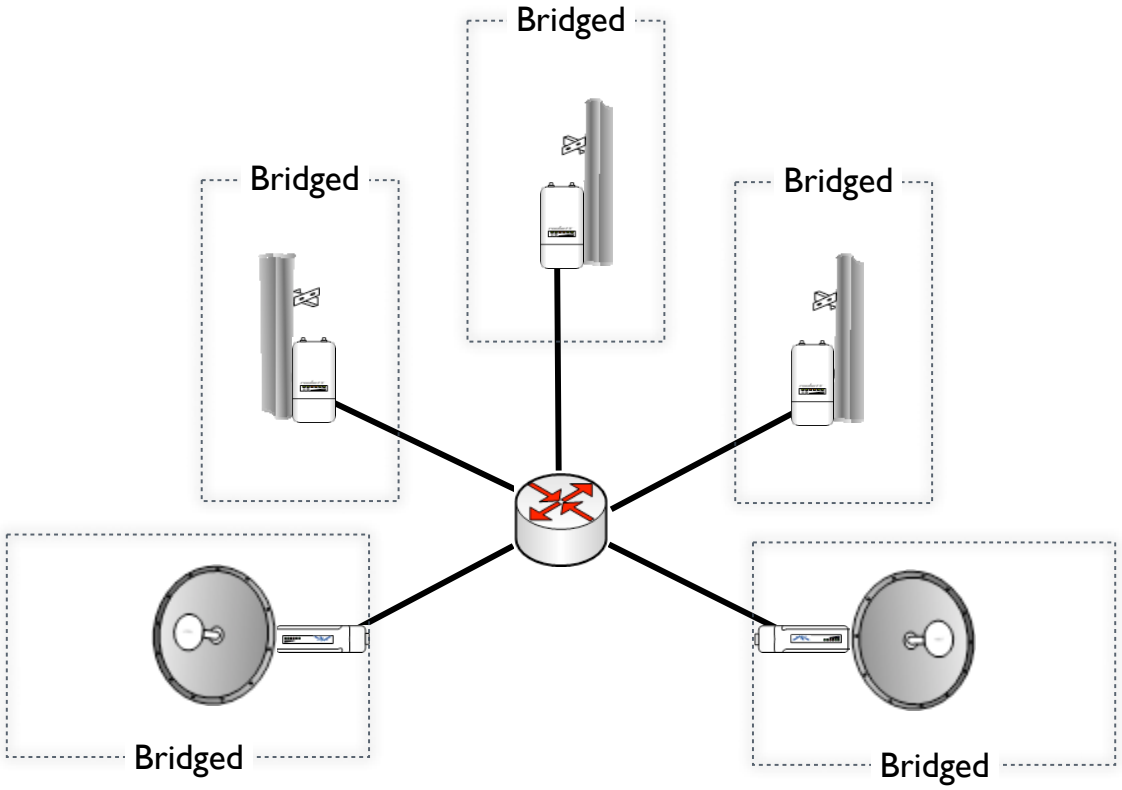
Add Routers in Place of Switches



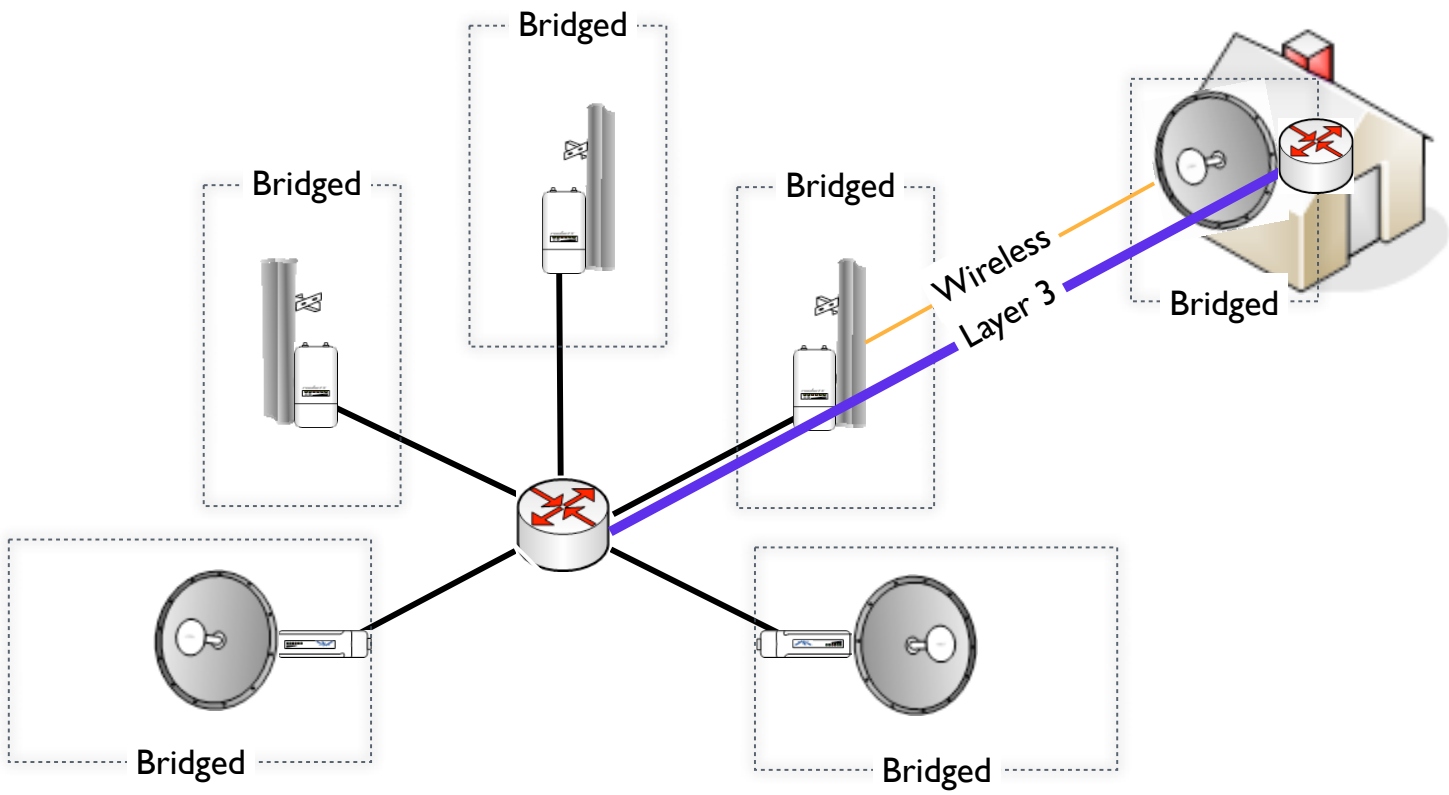
Client Broadcasts and Traffic to Internet



Typical Tower Detail - Bridged



Typical Tower Detail - Routed



Typical Tower Detail - Routed

IP Planning

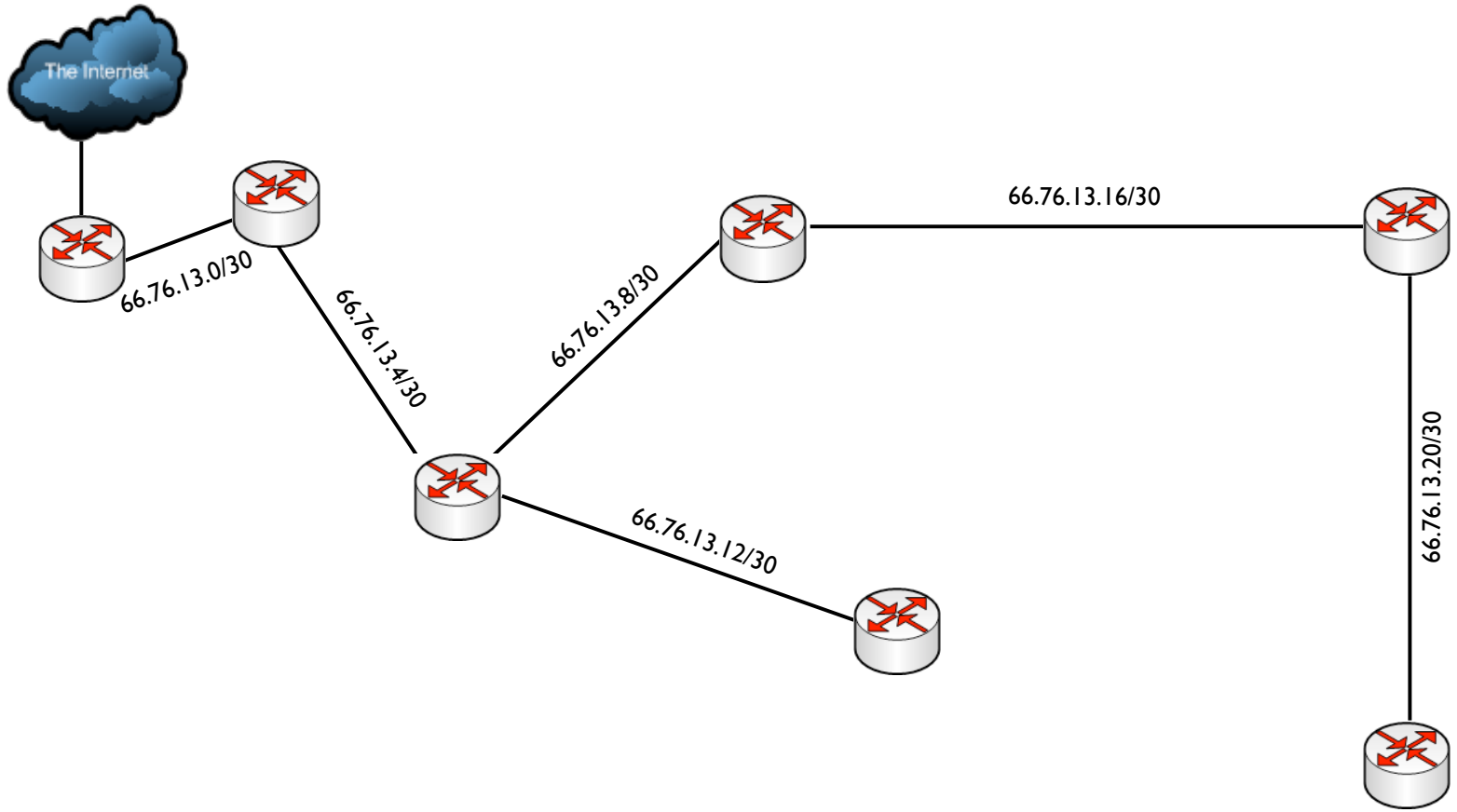
- Why? Public IP addresses are no longer a limitless resource
- Requires knowledge of subnetting
- Organized method of documentation - IP Plan, spreadsheet, etc.
- Organized methodology in deployment

IP Planning

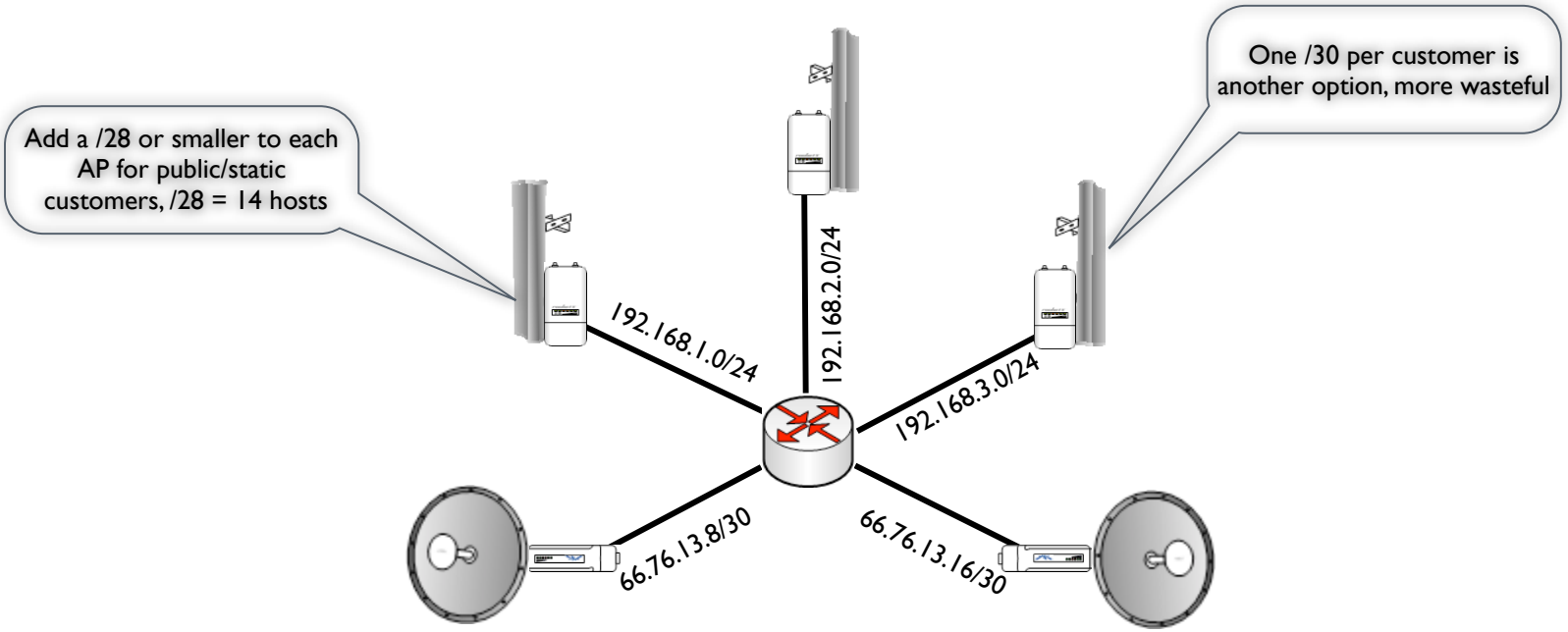
- Example:
- We have one /24 of public addresses
- Will use private addresses wherever possible and publics for customers as required

IP Planning

- Estimate the maximum planned number of towers with current public IP allocation, current + growth
- Subnet your /24 into enough /30 subnets to accommodate current + growth
- Our example network has 6 towers, so we need six /30's



Example 66.76.13.0/24 Block



Typical Tower Detail - Routed

Protocols

- Run dynamic Routing - OSPF on all tower routers and head end router
- BGP is an option but it is a bit of overkill for this job, OSPF is fast and easy
- Simplifies administration, adding a customer requires no route additions, only adding their address/subnet to the tower

Protocols

- Use PPPoE on each tower router, one PPPoE server per AP/Interface pair
- Allows the use of radius for PPPoE client authentication for integration in billing packages
- Auto assignment of rate limit at the tower router
- Auto assignment of static IP address
- Ability to disconnect non-paying customers or redirect them to the billing site

Protocols

- If PPPoE is not an option, DHCP with authentication based on MAC address is the second choice
- Allows more secure DHCP environment
- Allows the same automatic provisioning of rate limits as PPPoE
- May be more compatible with some billing packages
- Avoid unauthenticated DHCP and static addressing for clients

Traffic Shaping and Rate Limiting

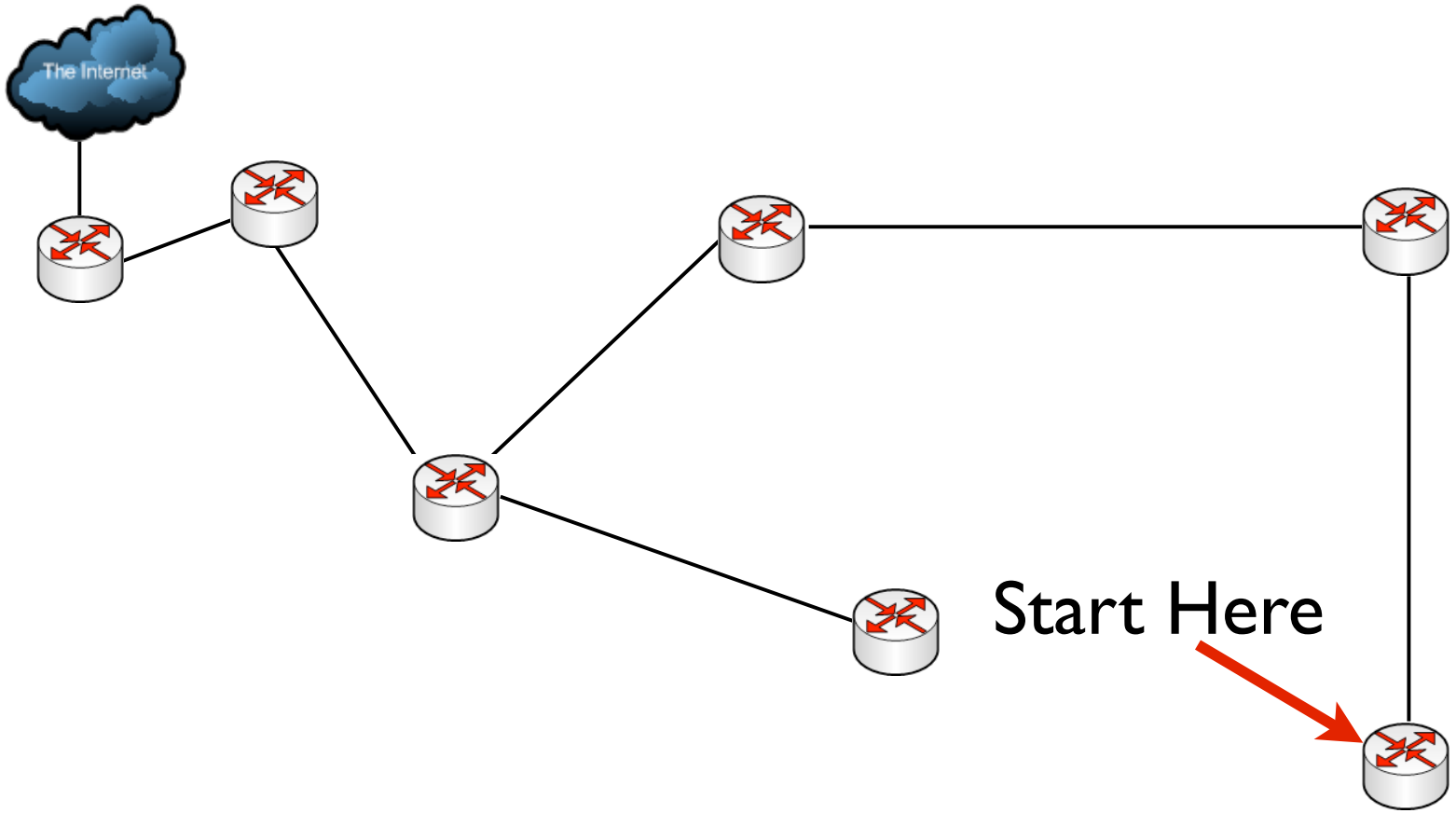
- With routed networks, we now control the traffic
- Rate limit customers at the tower, as close to the edge as possible, most efficient way
- Rate limits can be dynamically created using PPPoE or authenticated DHCP

Traffic Shaping and Rate Limiting

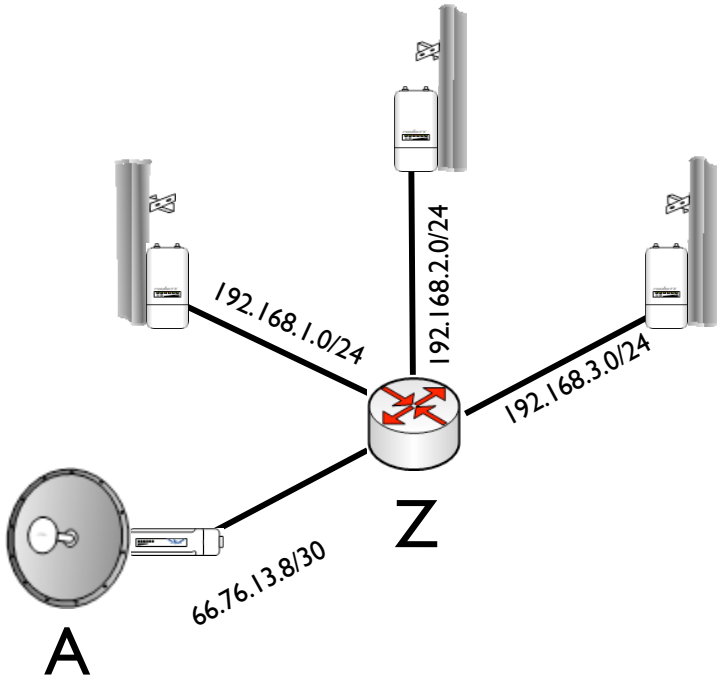
- Rate queues can be added to each router in the system to allocate bandwidth to high priority traffic which we will identify and mark using mangle rules
- VOIP and video can have TOS bit set, carried throughout the networkand prioritized

Plan Rollout

- Goal - deploy the new configuration while avoiding or reducing downtime
- Process - work from the edge of the network inward



Add Routers in Place of Switches



1. Add the new tower router to the existing switch.

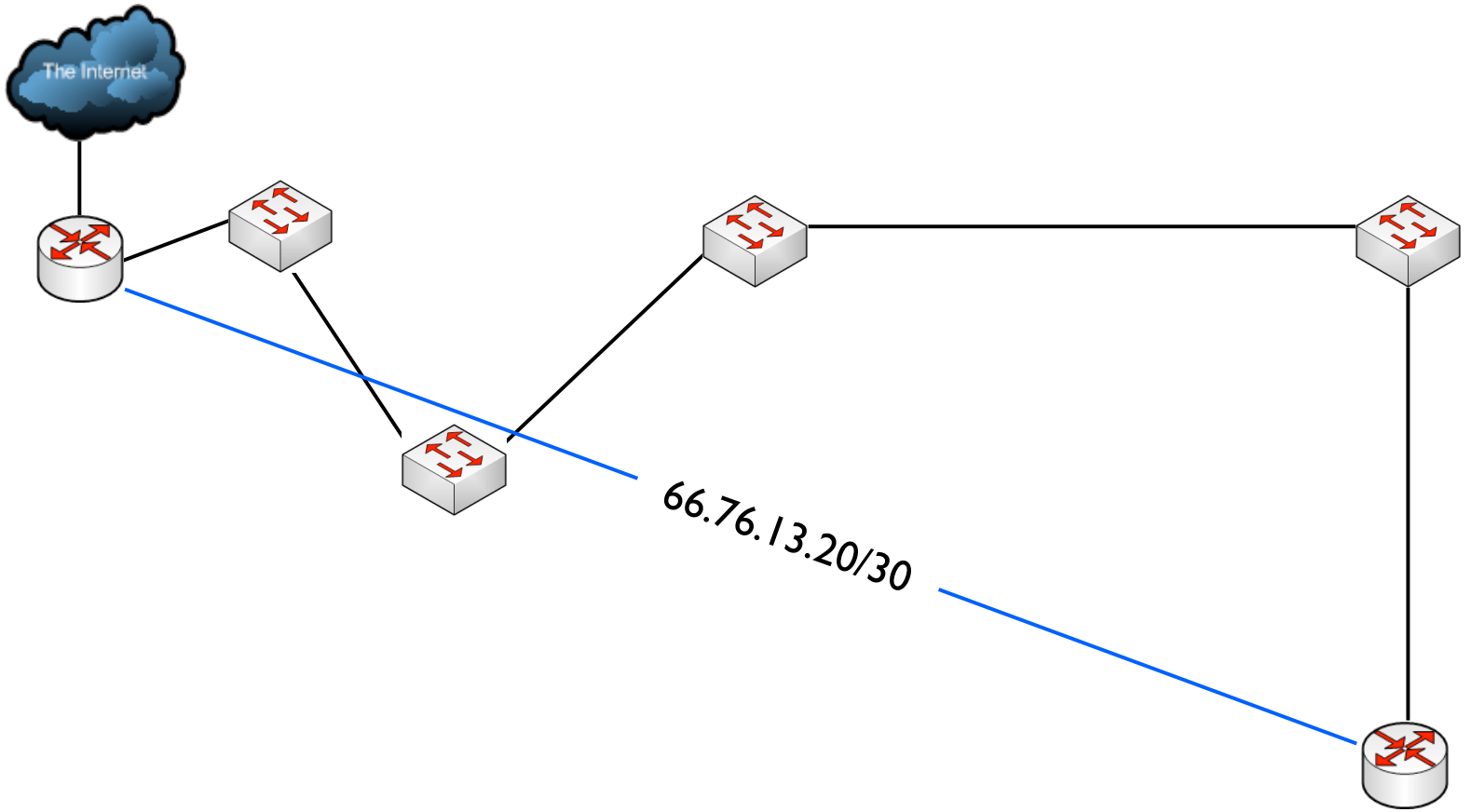
2. Temporarily use address A from 66.76.13.8/30 subnet on head end router and address Z on tower router. Address A will move to next hop upstream from this tower later.

3. Move AP's one at a time from switch to router, may require clients to power cycle to get a new IP.

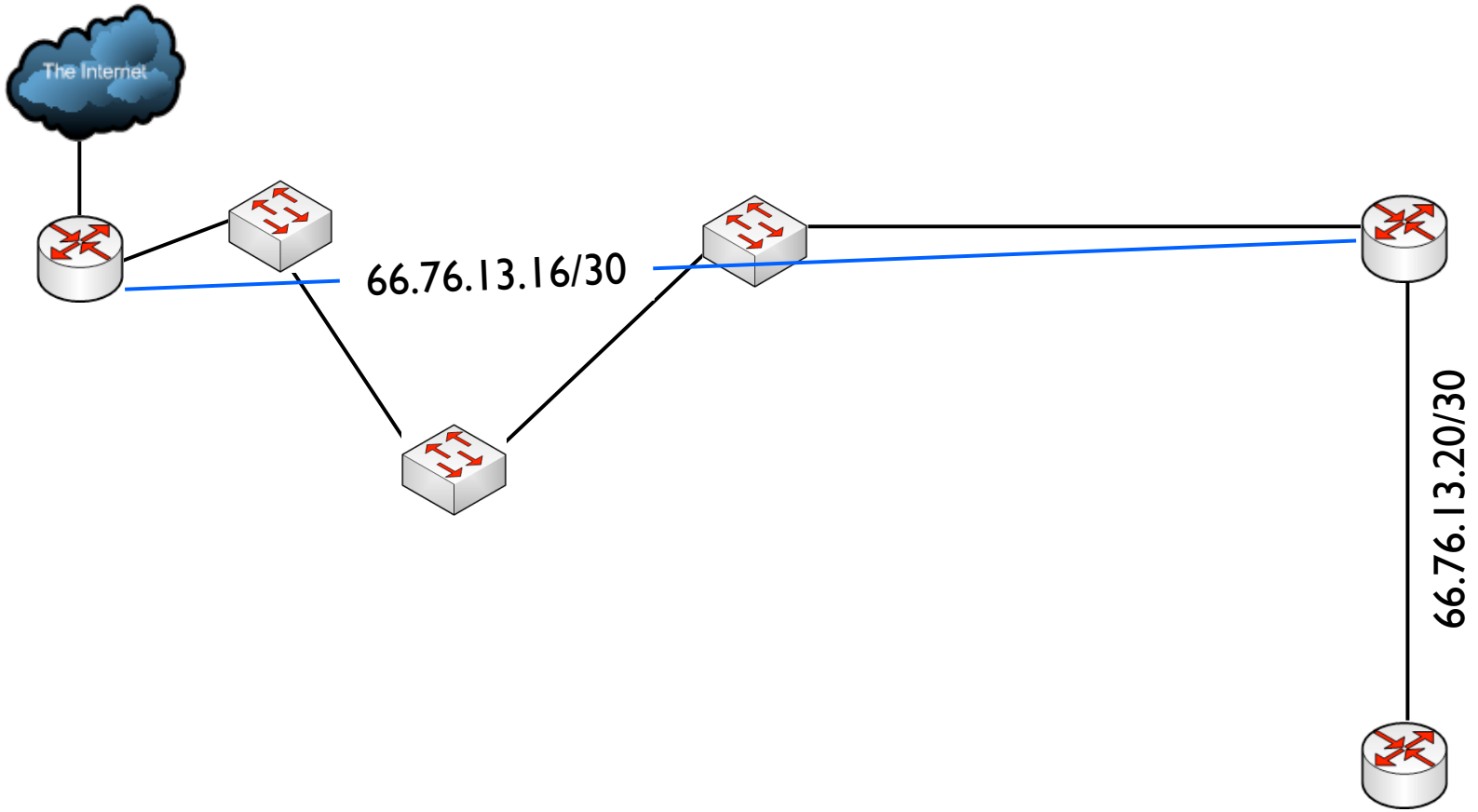
4.Once all clients have been rolled over, repeat for next tower upstream and move address A from head end to next upstream.

See next slide...

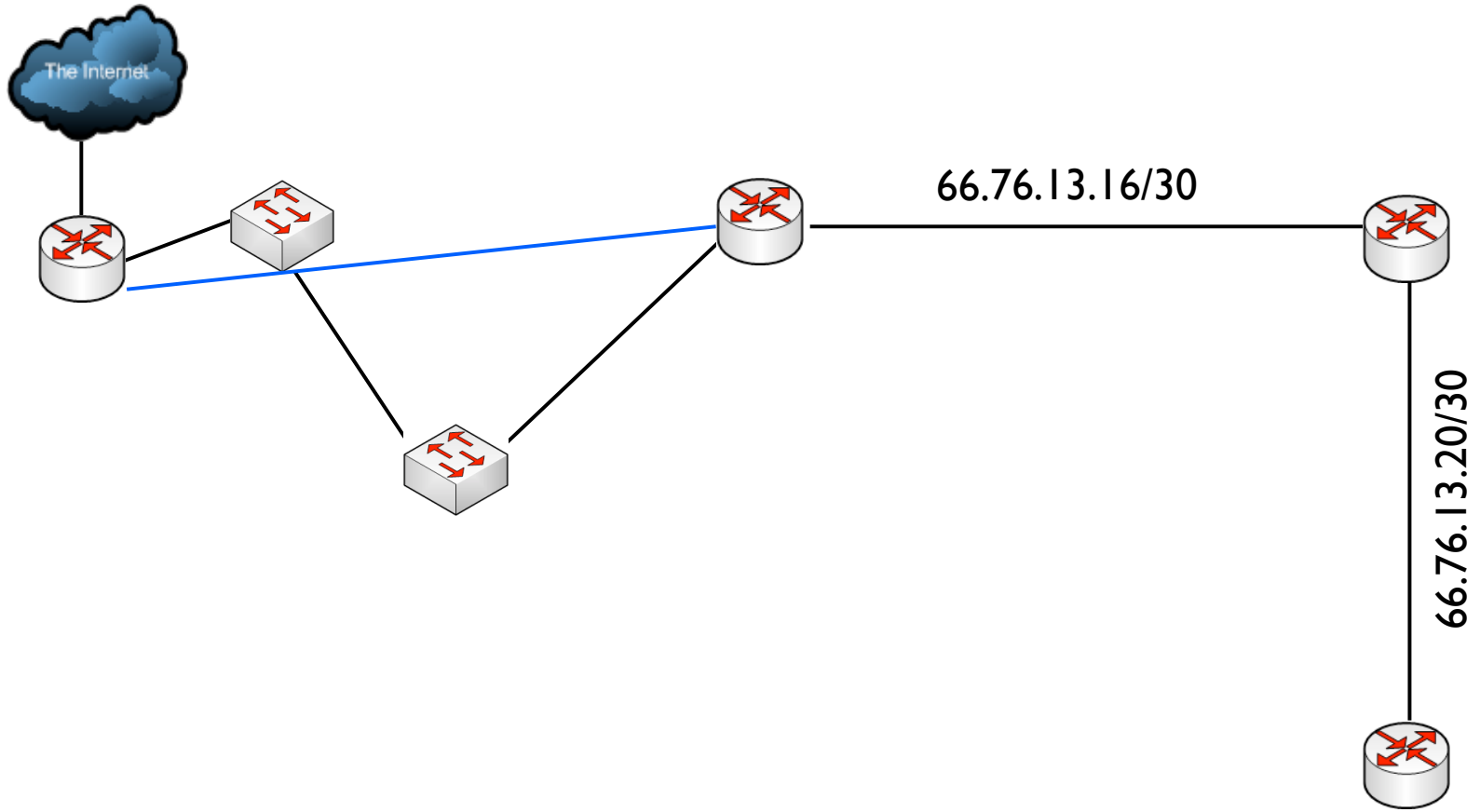
Rollout Plan



First Tower Deployment



Second Tower Deployment



Third Tower Deployment...

Plan Rollout

- Process can be tedious, require some coordination with crews at head end and tower
- OSPF will take care of routing as AP's are rolled over from switch to router
- DHCP or PPPoE will take care of customer addresses and rate limits
- Once entire network is rolled over, QOS can be added later

Equipment Selection

- Specific equipment selected depends on work load, number of physical port required and budget
- Examples

Head End Router

	Good	Good	Better
	$445	$395	$495
			
Name	RB1100Hx2	RB1100AH	RB1100AHx2
CPU speed	1066MHz	1066MHz	1066MHz
CPU cores	2	n/a	n/a
RAM	1GB	2GB	2GB
Architecture	PPC	PPC	PPC
LAN ports	13	13	13
Gigabit	Yes	Yes	Yes
Memory Cards	1	1	1
Memory card type	microSD	microSD	microSD
Power Jack	110/220V	110/220V	110/220V

Thousands of Customers

Head End Router

Best

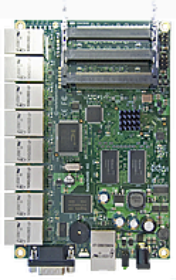
$955

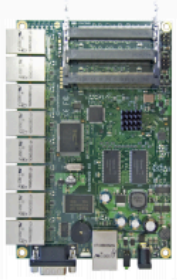
Name	CCR1036-12G-4S
CPU speed	1200MHz
CPU cores	36
RAM	4GB
Architecture	Tile GX
LAN ports	12
Gigabit	Yes
Integrated Wireless	No
USB	Yes
Power Jack	IEC C14 standard connector 110/220V (PSU included)

Many Thousands of Customers

Tower Router

	Good	Better	Best
	$159	$199	$240



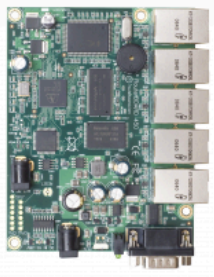


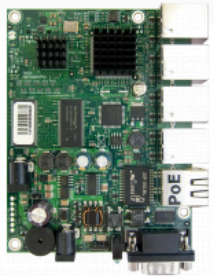
Name	RB493	RB493AH	RB493G
CPU speed	300MHz	680MHz	680Mhz
RAM	64MB	128MB	256MB
Architecture	MIPS-BE	MIPS-BE	MIPS-BE
LAN ports	9	9	9
Gigabit	n/a	n/a	yes, all 9
MiniPCI	3	3	3
USB	n/a	n/a	1, external power required
Power Jack	10-28V	10-28V	10..28v

Less than 120 Customers

Small Tower Router

	Good	Better
	$99	$130





Name	RB450	RB450G
CPU speed	300MHz	680MHz
RAM	32MB	256MB
Architecture	MIPS-BE	MIPS-BE
LAN ports	5	5
Gigabit	n/a	Yes
Memory Cards	n/a	1
Memory card type	n/a	microSD
Power Jack	10-28V	10-28V

20 or Less Customers

Summary

- Routed networks are infinitely scalable, bridged networks die at about 300 customers
- Routing your network requires a plan, IP plan, network layout and coordinated rollout
- Routed networks will require knowledge of OSPF, DHCP, Radius, PPPoE and possibly BGP later
- Once network is routed, roll out traffic shaping/ QOS
- Product recommendations

Products in Presentation

- MikroTik routers
- IP Plan (http://iptrack.sourceforge.net)
- Cobian Backup, free auto FTP client to backup your routers
- Integrated radius based billing solution, Platypus, DMA Softlab, Freeside, others?

Get Trained

- MikroTik / Ubiquiti training monthly:
  - MikroTik MTCINE Dallas, Feb 5-8
  - MikroTik MTCNA, College Station, Feb 11-13
  - Ubiquiti airMAX Training, Houston, March 5-7

Questions?

Thank You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