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!)

- Streakwave - California
  San Jose, CA, USA
  Tel: 1-888-604-5234
  Write e-mail

- Flytec Computers Inc.
  Miami, FL, USA
  Tel: +1 305 471-5142
  Write e-mail

- ROC-NOC
  Rockford, IL, USA
  Tel: +1 888 762 5662

- Baltic Networks USA
  Chicago, IL, USA
  Tel: 1-888-929-3610
  Write e-mail

- Eterna Tecnologia
  Los Angeles, CA
  Tel: Write e-mail

- ISP Supplies
  College Station, Texas, USA
  Tel: 855-947-7776 toll free
  Write e-mail

- Titan Wireless LLC
  Round Rock, TX, USA
  Tel: 512-291-7605, 888-277-9828
  Write e-mail

- Distriwave USA
  Miami, Florida, USA
  Tel: 305-418-2323
  Write e-mail
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.
4. Protocols to be used.
5. Rollout plan.
The Problem

Why are bridged wireless networks difficult to scale?
Network Organic Growth and Evolution
Network Organic Growth and Evolution
Network Organic Growth and Evolution
Network Organic Growth and Evolution
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

A single broadcast from single customer
Broadcast Traffic in a Bridged Network
Broadcast Traffic in a Bridged Network
Broadcast Traffic in a Bridged Network
Broadcast Traffic in a Bridged Network
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?

Resistance is futile!
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
Add Routers in Place of Switches

Many small collision domains
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
Add a /28 or smaller to each AP for public/static customers, /28 = 14 hosts.

One /30 per customer is another option, more wasteful.
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 network and 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

66.76.13.20/30
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**
  - $445
- **Good**
  - $395
- **Better**
  - $495

Thousands of Customers

<table>
<thead>
<tr>
<th>Name</th>
<th>RB1100-Hx2</th>
<th>RB1100AH</th>
<th>RB1100AHx2</th>
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<tr>
<td>CPU speed</td>
<td>1066MHz</td>
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<td>CPU cores</td>
<td>2</td>
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<td>2GB</td>
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<td>Architecture</td>
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<td>PPC</td>
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<tr>
<td>LAN ports</td>
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<td>13</td>
<td>13</td>
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<tr>
<td>Gigabit</td>
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<td>Yes</td>
<td>Yes</td>
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<td>1</td>
<td>1</td>
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<tr>
<td>Memory card type</td>
<td>microSD</td>
<td>microSD</td>
<td>microSD</td>
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<tr>
<td>Power Jack</td>
<td>110/220V</td>
<td>110/220V</td>
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# Head End Router

**Best**

**$955**

<table>
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<tr>
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<tr>
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</tr>
<tr>
<td>CPU cores</td>
<td>35</td>
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<td>RAM</td>
<td>4GB</td>
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<tr>
<td>Gigabit</td>
<td>Yes</td>
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<tr>
<td>Integrated Wireless</td>
<td>No</td>
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<tr>
<td>USB</td>
<td>Yes</td>
</tr>
<tr>
<td>Power Jack</td>
<td>IEC C14 standard connector 110/220V (PSU included)</td>
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Many Thousands of Customers
Tower Router

<table>
<thead>
<tr>
<th></th>
<th>Good</th>
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<tr>
<td>Price</td>
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Less than 120 Customers

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<th>BB403G</th>
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<tr>
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<td>680MHz</td>
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<tr>
<td>RAM</td>
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<tr>
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<td>MIPS-BE</td>
<td>MIPS-BE</td>
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<tr>
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<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Gigabit</td>
<td>n/a</td>
<td>n/a</td>
<td>yes, all 9</td>
</tr>
<tr>
<td>Mini/PCI</td>
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<td>3</td>
<td>3</td>
</tr>
<tr>
<td>USB</td>
<td>n/a</td>
<td>n/a</td>
<td>1, external power required</td>
</tr>
<tr>
<td>Power Jack</td>
<td>10-28V</td>
<td>10-28V</td>
<td>10-28V</td>
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Less than 120 Customers
# Small Tower Router

## Configuration Options

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<tr>
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<tr>
<td>RAM</td>
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<td>Architecture</td>
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<td>MIPS-EE</td>
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<tr>
<td>LAN ports</td>
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<td>5</td>
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<tr>
<td>Gigabit</td>
<td>n/a</td>
<td>Yes</td>
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<td>Memory Cards</td>
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<tr>
<td>Memory card type</td>
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<td>microSD</td>
</tr>
<tr>
<td>Power Jack</td>
<td>10-28V</td>
<td>10-28V</td>
</tr>
</tbody>
</table>

## Pricing

- **Good**: $99
- **Better**: $130

## Target Audience

- **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

855-WISP-PRO

Animal Farm 7
Questions?
Thank You