Embracing Netflix
Managing Streaming Content on Your Wireless Network
About Me

• Steve Discher, from College Station, Texas, USA
• Class of ’87 Texas A&M University
• Using MikroTik since early 2004 when I started my first WISP
• Author of the book “RouterOS by Example”
• MikroTik Certified Trainer and teach RouterOS classes, MyWISPTraining.com
• Operate a wireless distribution company, ISPSupplies.com
Who Needs This?

- WISP’s
- Entertainment or resort venues with WiFi
- Any other fixed wireless operator
Streaming

Assumption 1
Your users are going to stream movies. Netflix for example currently has 33 million subscribers!
State of the Network

*Free actually means $9.99 per hour or an incredibly annoying Wi-Fi experience.

Sorry, it is what it is.
Assumption 2
You have been telling your customers “Streaming content is not supported on our network.”

Relax, you won’t have to say that too many more times.
1. Steve Discher is not an attorney nor does he play one on TV.

2. For all matters of law, please consult an attorney and do not rely on any advice I give you here today.

3. Question everything I tell you if it sounds like legal advice!
Open Internet Rules

The FCC has adopted three basic open Internet rules:

- **Transparency.** Broadband providers must disclose information regarding their network management practices, performance, and the commercial terms of their broadband services.

- **No blocking.** Fixed broadband providers (such as DSL, cable modem, or fixed wireless providers) may not block lawful content, applications, services, or non-harmful devices. Mobile broadband providers may not block lawful websites, or applications that compete with their voice or video telephony services.

- **No unreasonable discrimination.** Fixed broadband providers may not unreasonably discriminate in transmitting lawful network traffic over a consumer’s broadband Internet access service. Unreasonable discrimination of network traffic could take the form of particular services or websites appearing slower or degraded in quality.
Navigating Through the Gray Area

• Entertainment network operators, hotels, RV Parks, etc. can likely shape traffic however they wish.
• Fixed wireless operators, WISPS, etc. should use caution.
• My presentation will be based on the assumption that you are trying to help your customer.
• Purpose of traffic shaping is to enhance their streaming experience.
• Although these methods are applicable to the entire network, we will assume you will apply rate limits applicable for the level of service the customer is buying.
  • For Example:
    If a customer buys the 3 Mb/s download package, they should be able to stream Netflix at 3Mb/s, not be limited to 512k for Netflix and 3 Mb/s for everything else.
How Much Bandwidth?

- Netflix SuperHD requires a minimum of 5Mb/s download speed, not able to test in my area because my ISP not a member of the Netflix open connect network
- Non-HD, requires an average of 3-5Mb/s download speed
- Decent quality all the way down to 512k download, Netflix, Hulu and YouTube, likely others

Traffic through WAN interface, no shaping, watching an SD movie
Side by Side Comparison

5Mb/s

512k
512k Customer Rate Limit With One Other User Browsing Web
What is the Solution?

Ensure that streaming traffic always has access to sufficient bandwidth even if that means starving bandwidth from all other types of traffic.
How is that Done?

1. Identify the most popular sources of streaming traffic and mark those packets.

2. Create queues, sort traffic into those queues and ensure that the streaming queue is allowed to fill their queues first.
Background

We will use two main facilities of RouterOS, mangling using **Mangling** and queueing using **Queues** in the Queue tree and custom queue types.

Can I do the same thing with simple queues? Absolutely but I urge you to be a man and use the queue tree.

And, you will make Janis (technical not sales) smile!
Quick Start For The Impatient
Mangle Process
Step by Step

• We first need a Regex matcher

• The Regex is the heart of the config so it has to be right!

• This example is for Netflix

\(^.*((host|HOST))\.(netflix).*\)$
• Next we create a mangle rule in the forward chain, matching all packets and use the L7 matcher
Mangle Process
Step by Step

• Next we create a mangle rule in the forward chain, matching connection mark Netflix-Cons and mark the packets
Mangle Process Step by Step

• Next we create a mangle rule in the forward chain, matching all packets

This matches everything else that isn’t identified as streaming
Finally we create a mangle rule in the forward chain, matching connection mark AllOtherTrafficCons and mark the packets.
# Mangle Process Result

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>mangle</td>
<td>Forward</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Match Netflix, mark connections</td>
<td>Netflix-Cons</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>mangle</td>
<td>Forward</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Netflix-Cons</td>
<td>stream</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>mangle</td>
<td>Forward</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AllOtherTrafficCons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>mangle</td>
<td>Forward</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AllOtherTrafficCons</td>
<td>all_other_traffic</td>
<td></td>
</tr>
</tbody>
</table>
Queue Process

Step by Step

• Start by creating the top level queue, the parent.
• We should set the max limit, in this case the internet connection speed.
Queue Process Step by Step

- Next we create two child queues, one for streams and one for everything else.
### Firewall

<table>
<thead>
<tr>
<th>#</th>
<th>Action</th>
<th>Chain</th>
<th>Src. Address</th>
<th>Dst. Address</th>
<th>Connection Mark</th>
<th>New Packet Mark</th>
<th>New Connection Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>ma... forward</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>ma... forward</td>
<td></td>
<td></td>
<td></td>
<td>Netflix-Cons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>ma... forward</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AllOtherTrafficCons</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>ma... forward</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AllOtherTrafficCons</td>
<td>all_other_traffic</td>
</tr>
</tbody>
</table>

### Queue List

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Parent</th>
<th>Packet Marks</th>
<th>Limit At (bits/s)</th>
<th>Max Limit (bits/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All-Download</td>
<td>global</td>
<td></td>
<td></td>
<td></td>
<td>IM</td>
</tr>
<tr>
<td>AllOtherDownload...</td>
<td>All-Download</td>
<td>all_other_traffic</td>
<td></td>
<td></td>
<td>IM</td>
</tr>
<tr>
<td>StreamingTraffic</td>
<td>All-Download</td>
<td>stream</td>
<td></td>
<td></td>
<td>IM</td>
</tr>
</tbody>
</table>

### Queue List

<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>Target</th>
<th>Upload Max Limit</th>
<th>Download Max Limit</th>
<th>Pkg Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Customer Upload</td>
<td>192.168.0.0/24</td>
<td>512k</td>
<td>unlimited</td>
<td></td>
</tr>
</tbody>
</table>
Final Config - CLI

/ip firewall layer7-protocol
add name=Netflix regexp="^.*(host|HOST).+(netflix).*\$"

/queue simple
add disabled=no max-limit=512k/0 name="Customer Upload" target=
   192.168.0.0/24

/queue tree
add max-limit=1M name=All-Download parent=global queue=default
add limit-at=1M max-limit=1M name=StreamingTraffic packet-mark=stream parent=
   All-Download priority=1 queue=pcq-download-default
add max-limit=1M name=AllOtherDownloadTraffic packet-mark=all_other_traffic 
   parent=All-Download queue=pcq-download-default

/queue type
set pcq-download-default pcq-rate=512k

/ip firewall mangle
add action=mark-connection chain=forward comment="Match Netflix, mark connections" disabled=no layer7-protocol=Netflix 
   new-connection-mark=Netflix-Cons passthrough=yes
add action=mark-connection chain=forward comment="Match all other traffic, mark connections" disabled=no new-connection-mark=
   AllOtherTrafficCons passthrough=yes
add action=mark-packet chain=forward comment="Match Netflix connection mark, mark packets" connection-mark=Netflix-Cons 
   disabled=no new-packet-mark=stream passthrough=no
add action=mark-packet chain=forward comment="Match all other traffic connection mark, mark packets" connection-mark=
   Netflix-Cons disabled=no new-packet-mark=all_other_traffic passthrough=no

Config does not include standard setup items like DHCP, masquerade, etc.
Time To Dig In

MikroTik
BOOT CAMP

I like to teach the why’s rather than just the how.
Mangling

• The purpose of the mangle facility is to identify traffic and then do something meaningful to, like marking it so we can manage it later.

• Mangles can identify traffic based on source port, destination port, protocol, etc.,

OR

• By using Layer7 matcher expressions, better choice for streaming traffic since protocols like RTMP use port 80
Queues

Queues allow you to allocate bandwidth based on some criteria. In our case we will use packet marks as our criteria.

We can create hierarchal relationships between the queues such that some queues are allowed to fill before other queues. This is often called “traffic prioritization” which can be a misnomer.
L7 Matchers
Remember Layer 7?

- Remember the OSI Model?
- OSI - Open System Interconnection
- Seven tiered model for network communication
• In Layer 7 we can see the “flavor” of IP traffic.
• This layer provides application services for file transfers, e-mail, and other network software services. For example, Telnet and FTP are applications that exist entirely in the application level.
Layer 7 in ROS

• The L7 matcher collects the first 10 packets of a connection or the first 2KB of a connection and searches for a pattern. If pattern is not found in collected data, matcher does not inspect further.
• You should take into account that a lot of connections will significantly increase memory usage. To avoid it add regular firewall matchers to reduce amount of data passed to layer-7 filters.
Layer 7 in ROS

• An additional requirement is that the Layer7 matcher must see both directions of traffic (incoming and outgoing). To satisfy this requirement L7 rules should be set in the forward chain.
• If the rule is set in the input/prerouting chain then the same rule also must be set in the output/postrouting chain, otherwise the collected data may not be complete resulting in incorrectly matched patterns.
Layer 7 Uses Regex

• Regex, the abbreviation for Regular Expressions is a sequence of characters that forms a search pattern.
• For example, if I told you I was doing a search for “*” you would know that I meant “everything”.
• Likewise, if I searched for “*.exe” you would already know I was probably looking for an executable file with any file name.
• Regex is like search patterns on steroids!
Layer 7 Uses Regex

• This presentation is not on Regex.
• Examples:
  `^` matches the beginning of a string
  `. ` matches any character
  `*` matches 0 or more of the preceding character,
  so `. *` matches one or an unlimited number of
  any character
• Regex has different flavors but the one used by ROS is
  the same as the L-7 Filter Project found on
  Sourceforge.net ([http://l7-filter.sourceforge.net/protocols](http://l7-filter.sourceforge.net/protocols))
Sources of Regex Expressions

- MikroTik Wiki http://www.mikrotik.com/download/l7-protos.rsc
- My Web Site http://MyWISPTraining.com
Understanding Mangle Process

• **Optimal mangle** - match connections, passthrough and then mark packets
• Least resource intensive
• Wiki suggests we match connections/packets in the forward chain, that way we get to look at the upload and download streams
Why Mark connections Then Packets?

• Lease resource intensive.
• Makes troubleshooting easier.
• Remember, mangle order is important!
Queue Process
Step by Step

• Next we will create the queues.
• Queues are the basis of QOS or Quality of Service.
• In ROS, all queues are based on HTB
• The ability to prioritize queues, allowing some queues to fill before others is the key to ensuring service levels.
• Remember that prioritizing traffic does not “re-order” packets, they will still come and go in whatever order they are transmitted but we will help ensure network congestion is minimized for certain traffic types.
• In Version 6, the queue tree was revamped. We now have only 1 global queue called “global”, not global-in, out, total, etc.
• This greatly simplifies the queue tree but also pushes us toward simple queues.
• I like the hierarchal nature of the queue tree so we will use it for this configuration.
Queue trees are most effective when we break them down into upload and download queues. Since streaming traffic in this example is primarily download, we will only create download queues for simplicity.
Note We Are Using PCC Queue Type

- PCQ queues divide traffic into streams and queues it on a per IP basis.
- In this example, one queue handles multiple users each getting 512k until exhausted.
About the Queue Tree

• Remember that the top level queues (parents) will always try to satisfy the leaf queues’ (children) limit-at setting first, then the max-limit setting if they have enough bandwidth to distribute to the leaf queues
• Think of limit-at as a committed rate, use it sparingly
How Will This Configuration Behave?

We have multiple types of traffic entering the router, yet our stream gets entire 512k allocation, all other traffic share remaining bandwidth.
How Will This Configuration Behave?

When we have 2 streams in our example, streams get 512k each and remaining traffic gets “leftovers”, best effort.
How Do You Set The Queues?

<table>
<thead>
<tr>
<th>Download Speed</th>
<th># of Simultaneous Streams</th>
<th>Top Level max-limit</th>
<th>Leaf Queue Streams limit-at</th>
<th>Leaf Queue Streams max-limit</th>
<th>Leaf Queue Other max-limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>512k</td>
<td>1</td>
<td>512k</td>
<td>512k</td>
<td>512k</td>
<td>512k</td>
</tr>
<tr>
<td>1M</td>
<td>2</td>
<td>1M</td>
<td>1M</td>
<td>1M</td>
<td>1M</td>
</tr>
<tr>
<td>1.5M</td>
<td>3</td>
<td>1500k</td>
<td>1500k</td>
<td>1500k</td>
<td>1500k</td>
</tr>
<tr>
<td>2M</td>
<td>4</td>
<td>2M</td>
<td>2M</td>
<td>2M</td>
<td>2M</td>
</tr>
</tbody>
</table>

Leaf Queue Streams limit-at
Top Level max-limit
Leaf Queue Other max-limit
Leaf Queue Streams max-limit
What About Upload Rate Limiting?

- A major change in version 6 is the packet flow diagram.
- In previous versions simple queues were slow and would rob bandwidth from the queue tree.
- Simple queues are now AFTER the global HTB.
What About Upload Rate Limiting?

With the queue tree in place, create a simple queue for customer upload rate limit using:

- Manual Queue
- PPPoE/Radius Server
- Hotspot User Profile
- PPPoE Profile
Suggestions

• Reduce router load by making the packet matchers more selective

• Packet-mark = no-mark or connection-mark = no-mark are good ways to do this
New Product!

- Concept is similar to QuickSet but for more complex configurations
- Container app with plugin architecture
- Java - works on Windows/Mac
- QOS Plugin
- Load Balance Plugin
- Firewall plugin
- Other plugins available soon
- Join the email notification list at MikroTikConfig.com

MikroTik Configurator
Thank You!

- MyWISPTraining.com
- LearnMikroTik.com
- ISPSupplies.com
- “RouterOS by Example” available from distributors, Amazon.com, Kindle, iTunes