Network Monitoring & Troubleshooting

Link Technologies, Inc.

9/19/2013

Dennis Burgess

- **Mikrotik Certified Trainer / Engineer**
- **MikroTik Certified Dude Consultant**
- **Consulting Since 1997**
  - *Enterprise Class Networks*
  - *WAN Connectivity*
- **Certifications**
  - *Cisco, Microsoft, MikroTik*
- **What I do Currently**
  - *Work with WISPs and CLECs all over the world, designing, and assisting in network configurations including wireless, OSPF, BGP, Traffic Management, Firewalling, and other Network Engineering*

What we will cover!

- What is the purpose of Network Monitoring
  - Customer Level
  - Network Operations Level
  - Why we should monitor
- What should we monitor
  - Why we should monitor devices
  - How we can monitor those devices
- Things to help troubleshoot your network issues
  - Network & Coverage Maps

Why Monitor

- **Network Issues Impact Day-to-Day Operations**
  - Failed Wireless Links
  - Overheating of equipment
  - Power Delivery
  - Generator and Standby Runtime Power Level
  - Signal Changes
  - Capacity Planning
  - Engineering of Network Design and Redundancy
  - Historical Information

Why Monitor

- **Network Issues Impact Day-to-Day Operations**
  - **Failed Wireless Links**
    - *Did your network reroute traffic? You need to know that the primary link is down!*
  - **Overheating of equipment**
  - **Power Delivery**
  - **Generator and Standby Runtime Power Level**
  - **Signal Changes**
  - **Capacity Planning**
  - **Engineering of Network Design and Redundancy**
  - **Historical Information**

Why Monitor

- **Network Issues Impact Day-to-Day Operations**
  - **Failed Wireless Links**
  - **Overheating of equipment**
    - *Do you have outages due to heat? What about a AC failure in the shack?*
  - **Power Delivery**
  - **Generator and Standby Runtime Power Level**
  - **Signal Changes**
  - **Capacity Planning**
  - **Engineering of Network Design and Redundancy**
  - **Historical Information**

Why Monitor

- **Network Issues Impact Day-to-Day Operations**
  - **Failed Wireless Links**
  - **Overheating of equipment**
  - **Power Delivery**
    - *Have you lost utility power? Really stinks to drive a hour to a tower that is down to find there is no power. You should know that prior to a drive!*
  - **Generator and Standby Runtime Power Level**
  - **Signal Changes**
  - **Capacity Planning**
  - **Engineering of Network Design and Redundancy**
  - **Historical Information**

Why Monitor

- **Network Issues Impact Day-to-Day Operations**
  - **Failed Wireless Links**
  - **Overheating of equipment**
  - **Power Delivery**
  - **Generator and Standby Runtime Power Level**
    - *If your system has battery / generators, you should know if you need to check on them, when did they start, when did you lose utility power? If the generator on-site runs for about 24 hours on a tank, when do you nee to ensure someone is there to refill?*
  - **Signal Changes**
  - **Capacity Planning**
  - **Engineering of Network Design and Redundancy**
  - **Historical Information**

Why Monitor

- **Network Issues Impact Day-to-Day Operations**
  - **Failed Wireless Links**
  - **Overheating of equipment**
  - **Power Delivery**
  - **Generator and Standby Runtime Power Level**
  - **Signal Changes**
    - *Did the signal change? Wind can turn antennas, or maybe a local decided they wanted to see what they can shoot at!*
  - **Capacity Planning**
  - **Engineering of Network Design and Redundancy**
  - **Historical Information**

Why Monitor

- **Network Issues Impact Day-to-Day Operations**
  - **Failed Wireless Links**
  - **Overheating of equipment**
  - **Power Delivery**
  - **Generator and Standby Runtime Power Level**
  - **Signal Changes**
  - **Capacity Planning**
    - *Have you planed enough capacity to handle a failed primary path? Does the backup path have enough capacity till around 3pm?*
  - **Engineering of Network Design and Redundancy**
  - **Historical Information**

Why Monitor

- **Network Issues Impact Day-to-Day Operations**
  - **Failed Wireless Links**
  - **Overheating of equipment**
  - **Power Delivery**
  - **Generator and Standby Runtime Power Level**
  - **Signal Changes**
  - **Capacity Planning**
  - **Engineering of Network Design and Redundancy**
    - *Does your secondary path have enough capacity to carry normal operations? If not, you need to know about it!*
  - **Historical Information**

Why Monitor

- **Network Issues Impact Day-to-Day Operations**
  - **Failed Wireless Links**
  - **Overheating of equipment**
  - **Power Delivery**
  - **Generator and Standby Runtime Power Level**
  - **Signal Changes**
  - **Capacity Planning**
  - **Engineering of Network Design and Redundancy**
  - **Historical Information**
    - *Was the latency to this tower always this bad or did it change recently?*

Know Thy Network!

Known thy Network!

- **Network Layout**
  - **Common Tower Names**
    - *Don't use 3 different names for the same location*
  - **Know how towers are connected**
    - *How to get redundancy if needed*
    - *Ability to send tech into field and they know what they are dealing with*
  - **Know how and where to get to towers**
    - *New tower climbers need to have directions*
    - *Take pictures of tower gear to understand what you have hooked up where!*

Known thy Network!

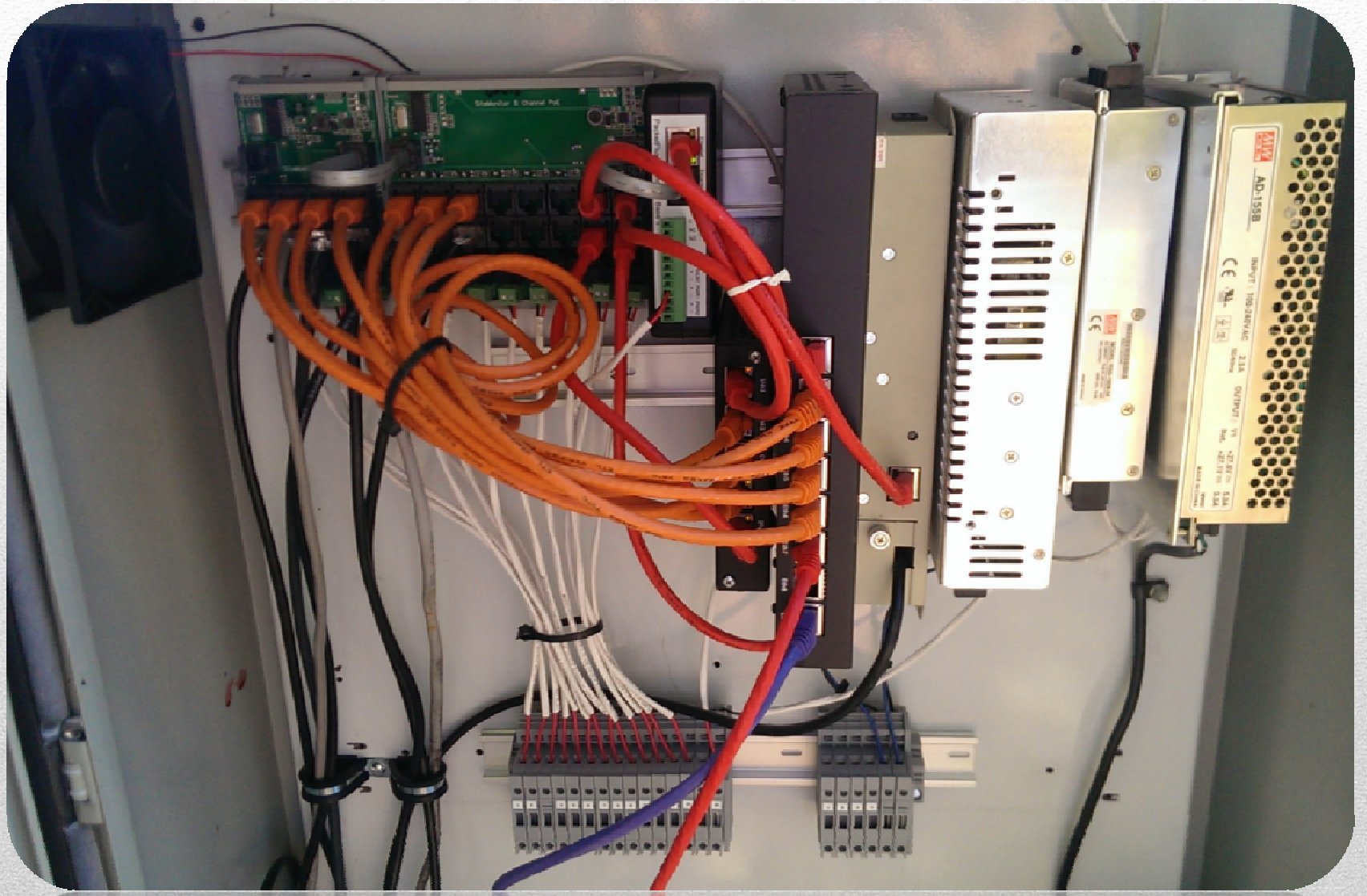
- **Coverage Areas**
  - **Difference between yes you can get signal and you might be able to is?**
    - *$50-$100 bucks!*
    - *Per trip !*
  - **New Staff**
    - *Do not know where you cover*
    - *Don't know if a trip out is worth it or not?*
    - *Do not know if a potential customer should or may not get service*
  - **Marketing**
    - *Know where your customers are requesting service*
    - *Does a new tower location extend coverage or simply increase capacity*

Known thy Network!

- **Network Layout**
  - **Keep organized!**

Photos courtesy of Ty Featherling

Known thy Network!



Photos courtesy of Ty Featherling

Known thy Network

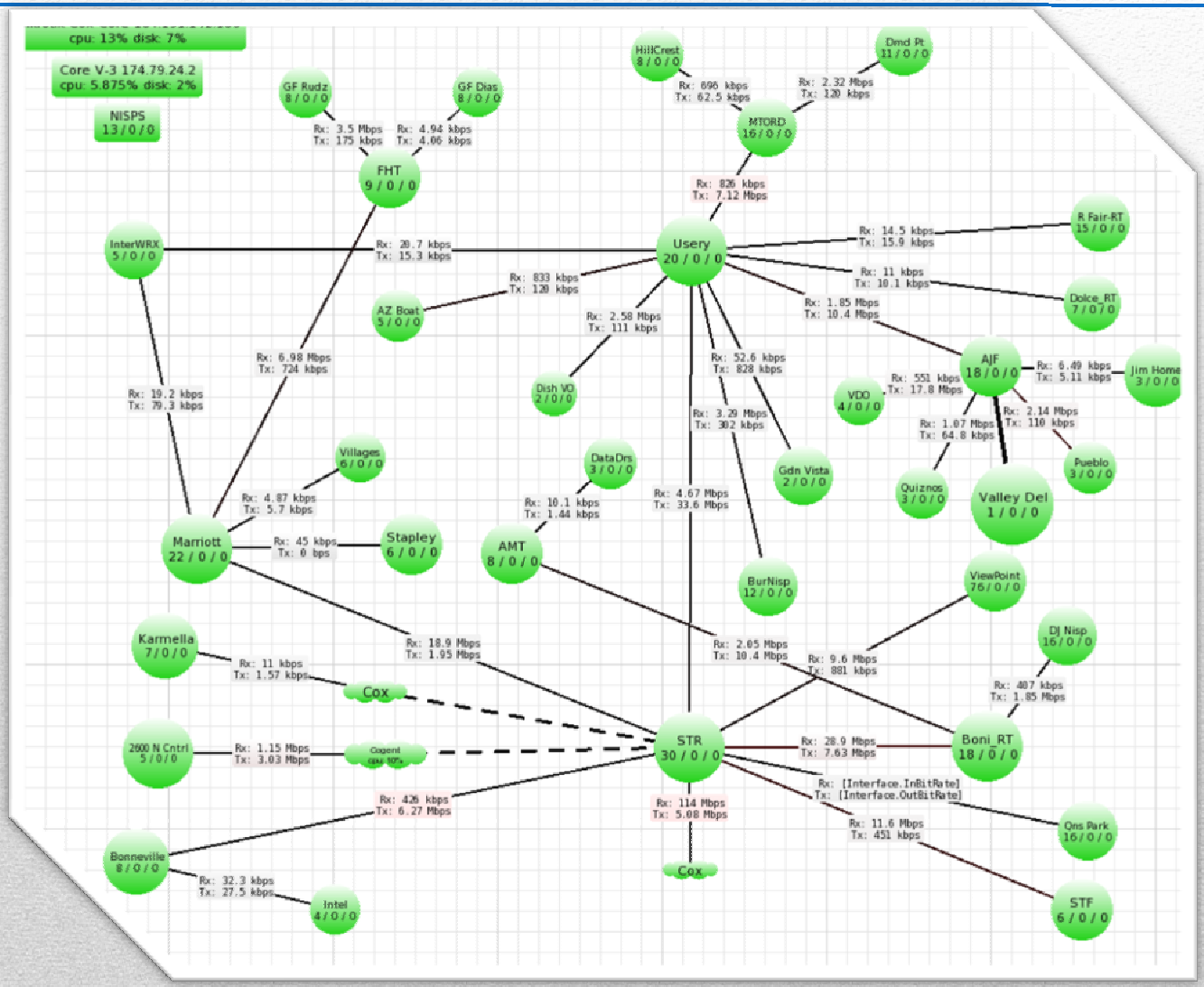
- Time = MONEY
  - Preventing truck rolls for known out of service areas!
  - Prevent these kinds of cabinets from being a service Issues!
- Network MAP!
  - Having network map helps facilitate troubleshooting
  - Faster troubleshooting = less downtime
  - Less downtime = less lost customers (or pissed off ones)
  - Less lost customers = MONEY!

Monitoring

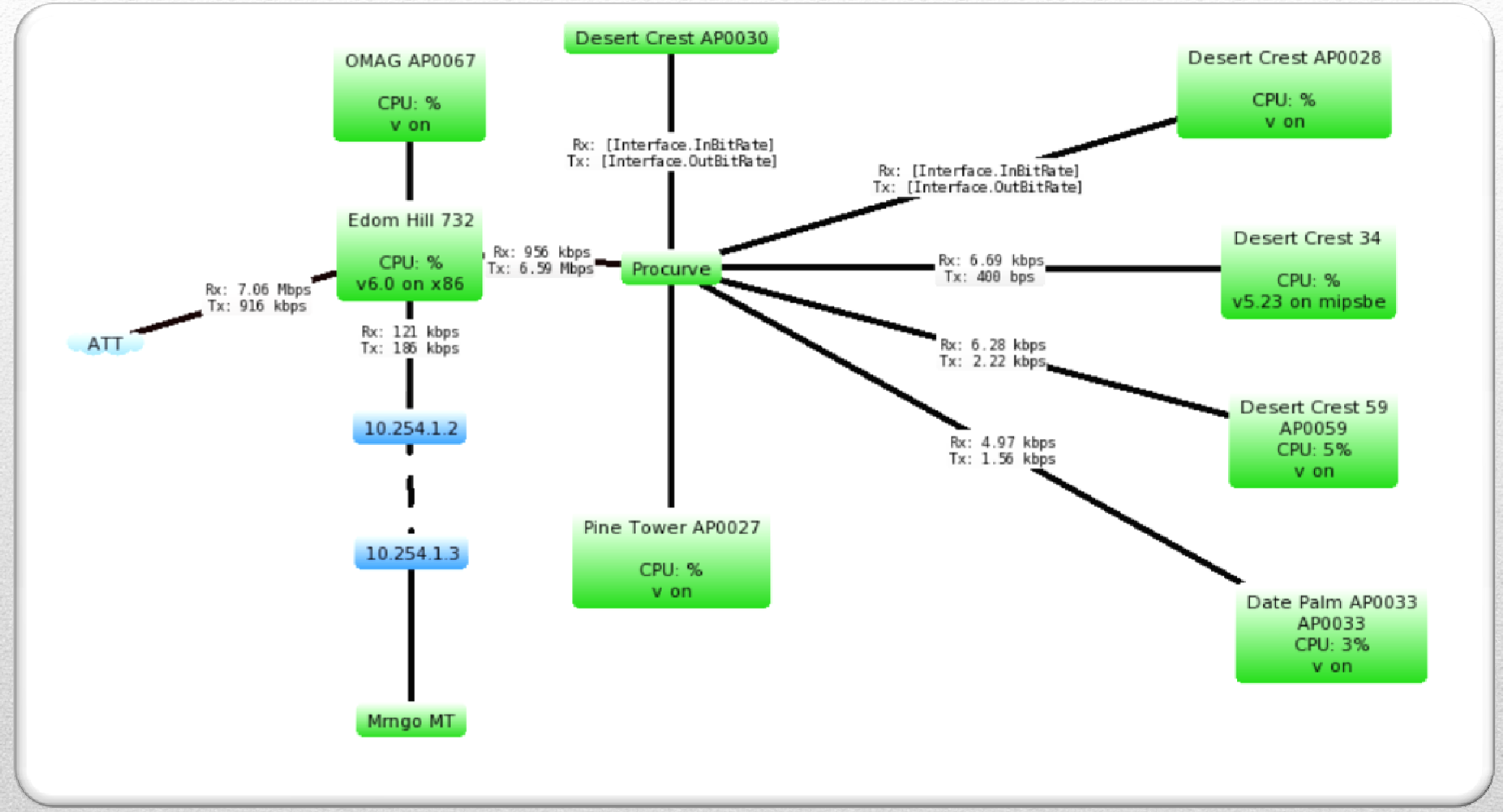
Instant Network Overview

- **Single Screen Overview**
  - **As you grow you need to understand what is operational.**
    - *You can inform your engineering team to work on the issue*
    - *Get trucks rolling quickly*
    - *Inform Customer Service so that they know the issue is already known and can give customers that information*
      - " Yes, we show you are current not connected, this is due to a local power outage that we already have dispatched a team to work on with the local utilities, they also have a temporary power source that they will put in place when they get there."
        - Vs
      - " I don't know why you are down, I am getting ready to head out there, but it will take me a hour just to get there."
  - **DO MORE WITH LESS WORK! Work Smarter Not Harder!**

Instant Network Overview



Instant Network Overview



Network Monitoring Levels

- Owner/CTO
  - Network Capacity Planning
  - Redundancy Planning
  - Network Status Overview
- Engineering / Tech / Dispatch
  - Network Overview
  - Major outage alerts / automated ticketing/dispatch
- Customer Service
  - Customer Service team has a method to find out about network level events quickly without manual communications
  - Automated Tickets showing customers down
  - Ability to contact customers before they even know they have an issue!
  - Have ticket updates from engineering to be able to give ETAs.

Network Monitoring Levels

- **Owner/CTO**
  - Network Capacity Planning
  - Redundancy Planning
  - Network Status Overview
- **Ability to plan network upgrades as needed**
- **Ability to know that in the event of a issue or upgrade, that your backup plan has enough capacity**
- **One screen network status overview!**
  - Always good to know the state of your network!

Network Monitoring Levels

- **Engineering / Tech / Dispatch**
  - **Network Overview**
  - **Major outage alerts / automated ticketing/dispatch**

- **Ability to find and see issues that affect a large number of subscribers quickly!**
  - **See that entire tower is out, just a AP or just one customer!**
    - *Can inform customer service, so that new tickets for customers off that tower/ap can be routed to master ticket for outage.*
  - **Power issues:**
    - *Find a geographic area that has a power outage, you see that customers in that area are out.*

Network Monitoring Levels

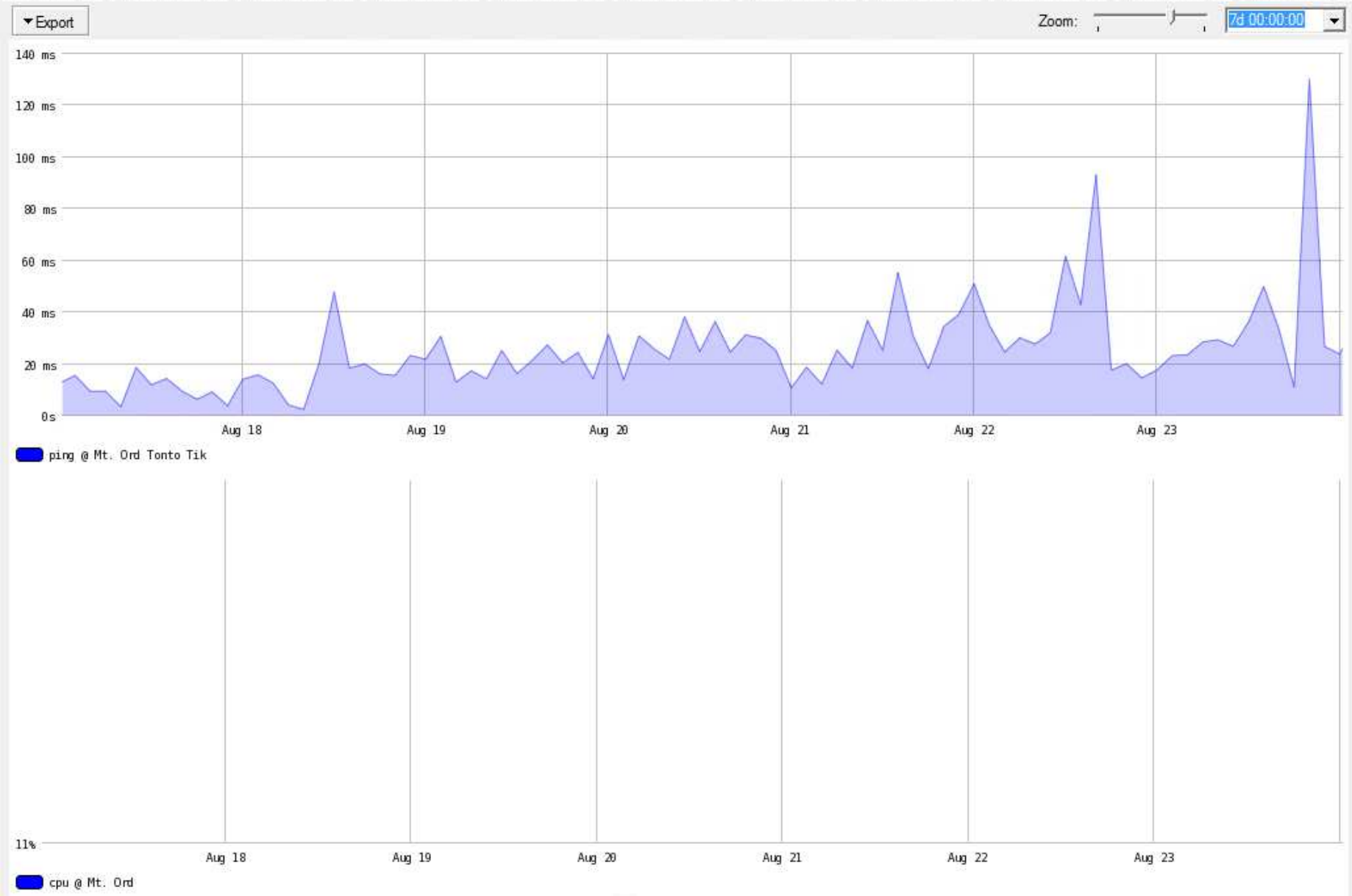
- **Customer Service**
  - Ability to call customers asking about their service outage (if any)
  - Proactive support shows the customers that you care about their service
  - Ability to self create tickets during a outage
  - Gives customer service knowledge quickly that a major outage is occurring and that customers may be calling in due to this

What to Monitor

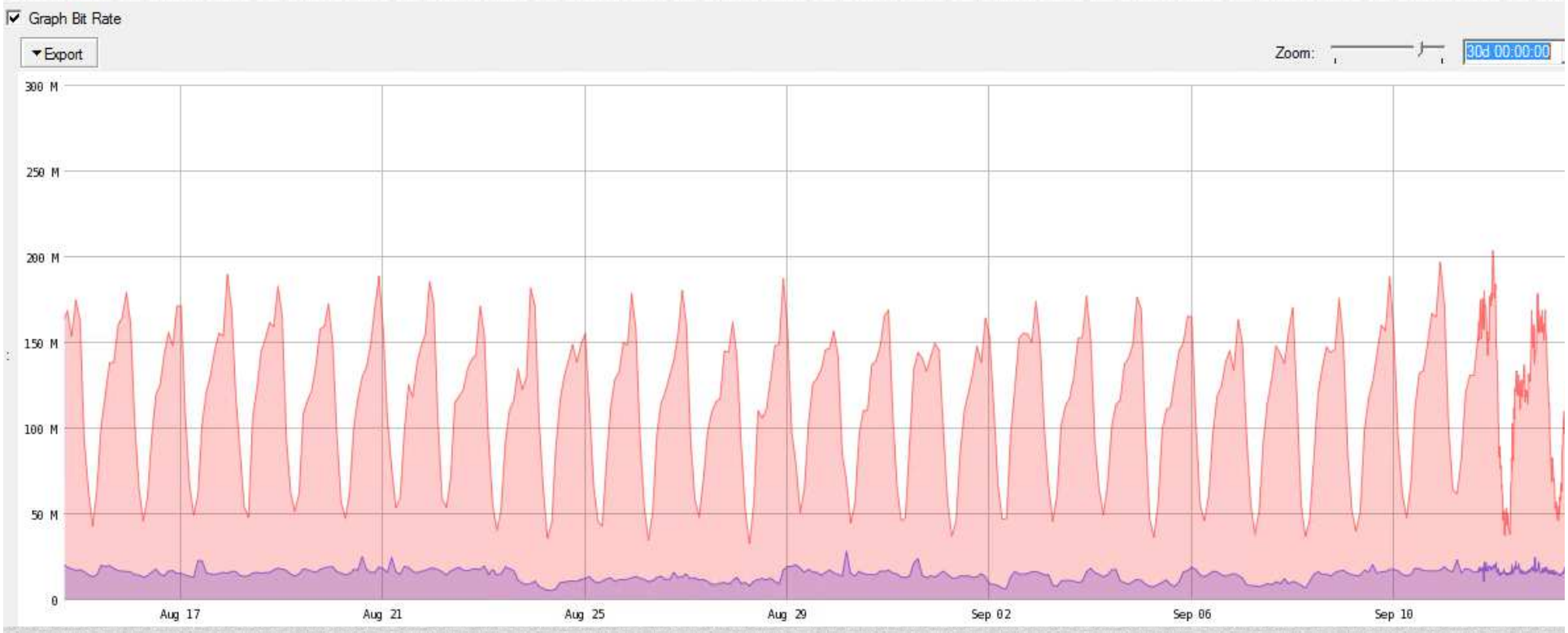
What to Monitor

- Ping Times
  - Historical information to spot issues!
- CPU Usage
  - Load on routers
  - Upgrades
- Bandwidth usage
  - Backup Backhauls should have little usage, if they don't, why!
  - Main backhauls may be starting to see capacity issues.
  - Growth trending, how soon do we need to upgrade!
- Critical Services
  - DNS
  - Mail
  - Web servers
  - Etc

Ping Times / Router CPU



Speed Monitor



What to Monitor

- **Customer Monitoring**
  - **Business vs. residential**
    - *Does residential customers get proactive tickets, alerts?*
    - *Do you create proactive tickets?*
      - Contact customers when you see an outage?
      - Allows techs to review to see if it may be a network issue or just the individual customer
      - --- Other considerations
        - Do you create tickets ASAP or wait a specific amount of time before you create one?
        - Monitoring system can delay the alert, i.e. wait for 5 min before generating the alert?

What to Monitor

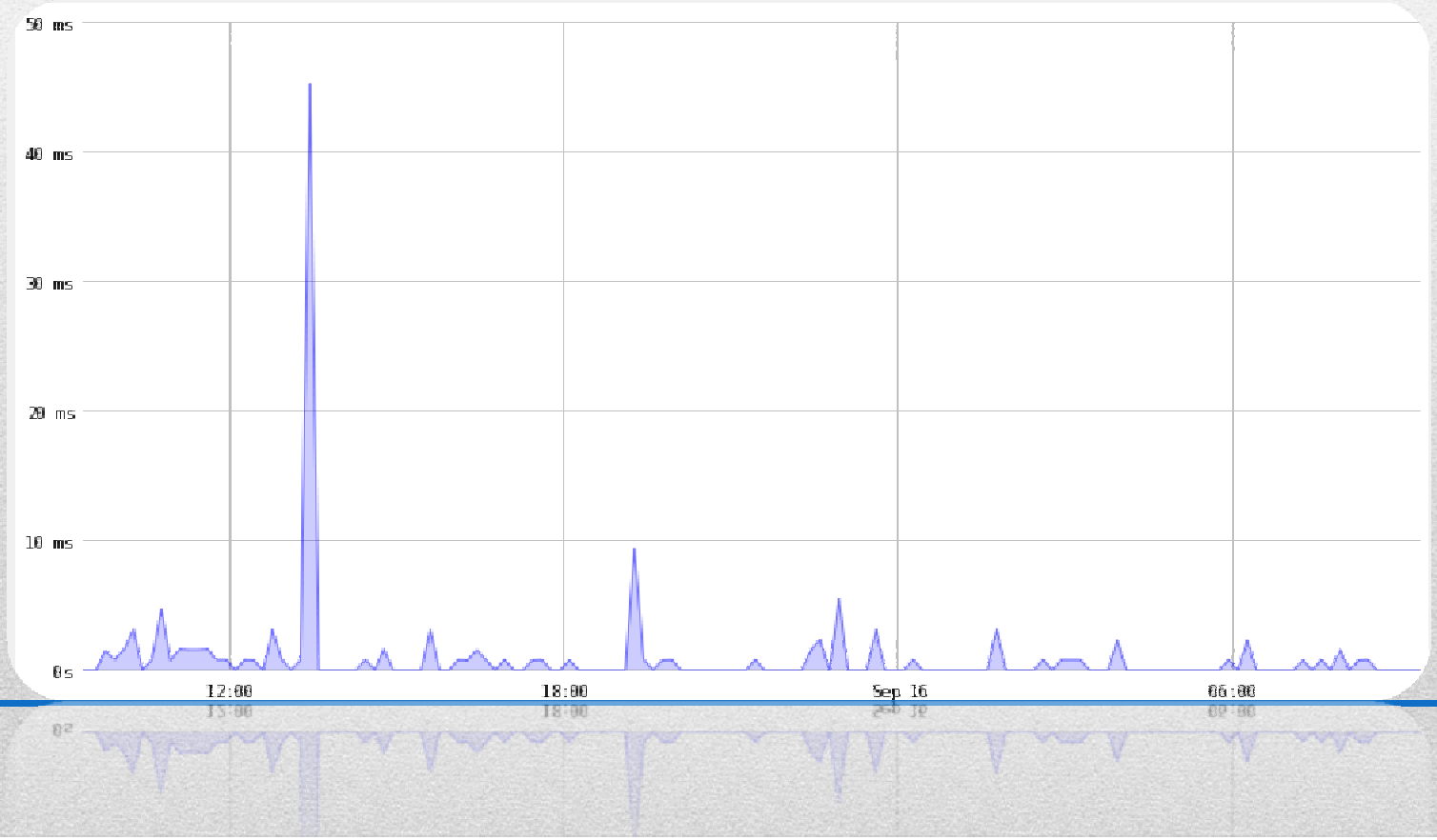
- **Signal Levels**
  - **Spot trouble links prior them becoming an issue**
  - **Set alarms in the event the signal becomes too low**
    - *Alerting you before a simple "the dish was not tightened enough" issue becomes a tower down issue!*

Ping times vs. Service Response Times

- **Pings**
  - **Round trip from monitoring system to server**
  - **Does not take into account "service time" needed to process said request**
- **Service Time**
  - **Service, such as DNS, etc, take time to process a request and respond to it**
    - *Slow DNS = Slow Internet for customers*
  - **Monitoring DNS servers is extremely important, even if you are using a upstream server**
    - *Know when you need your own resolving servers!*
    - *Know when upstream DNS issues are causing YOUR CUSTOMERS TO CALL YOU!*

Ping times vs. Service Response Times

- **Slow DNS times = Slow Internet Services**
  - **Critical to monitor these!**



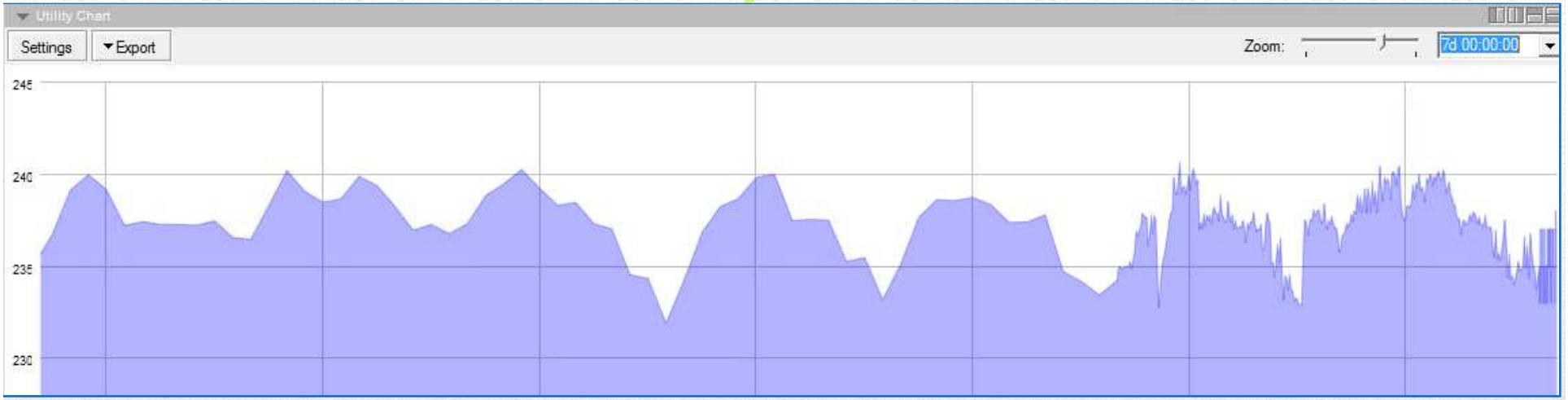
Ping Times

- **Troubleshooting can be hard if you don't know what normal is!**
  - **Normal ping times vs. high pings times**
  - **If pings from your NOC to tower3 is 30ms normally**
    - *Then ping times to tower2 at 100ms is not normal*
    - *Historical information for comparison brings issues that normally would be discarded into the light*

What to Monitor

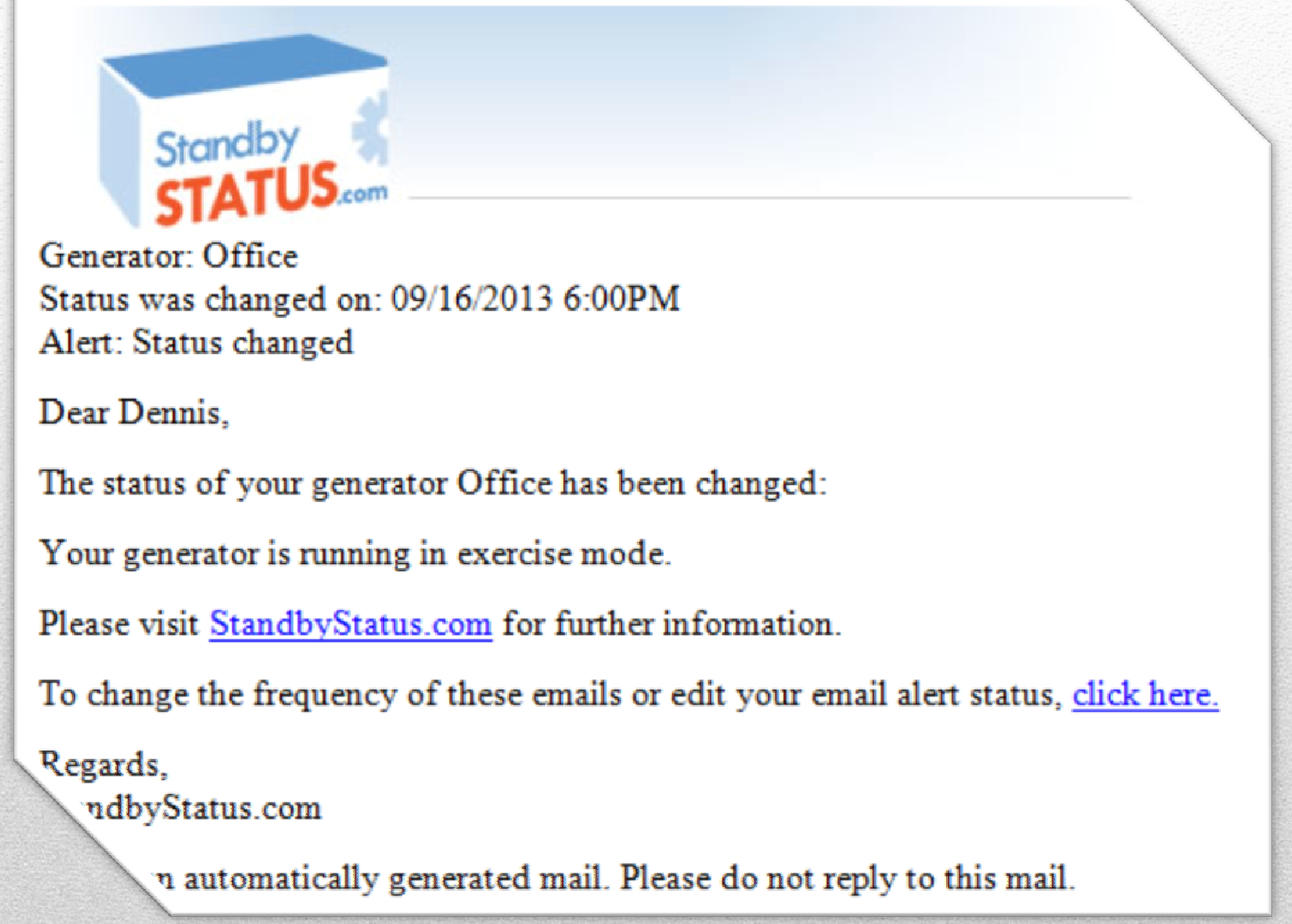
- **Power**
  - **Prevent truck rolls by knowing power status**
  - **Generator on/off**
  - **Generator's ready-to-run?**
    - *Weekly testing results?*
  - **What about strange voltages.**

Utility Power



- **AC voltage should be monitored**
  - **Don’t be caught in the dark about a power outage**
    - *Do you need to dispatch a generator ?*
    - *Estimated Run time?*
    - *Track how many power issues at each site you may have?*

Utility Power



Generator: Office
Status was changed on: 09/16/2013 6:00PM
Alert: Status changed

Dear Dennis,

The status of your generator Office has been changed:

Your generator is running in exercise mode.

Please visit StandbyStatus.com for further information.

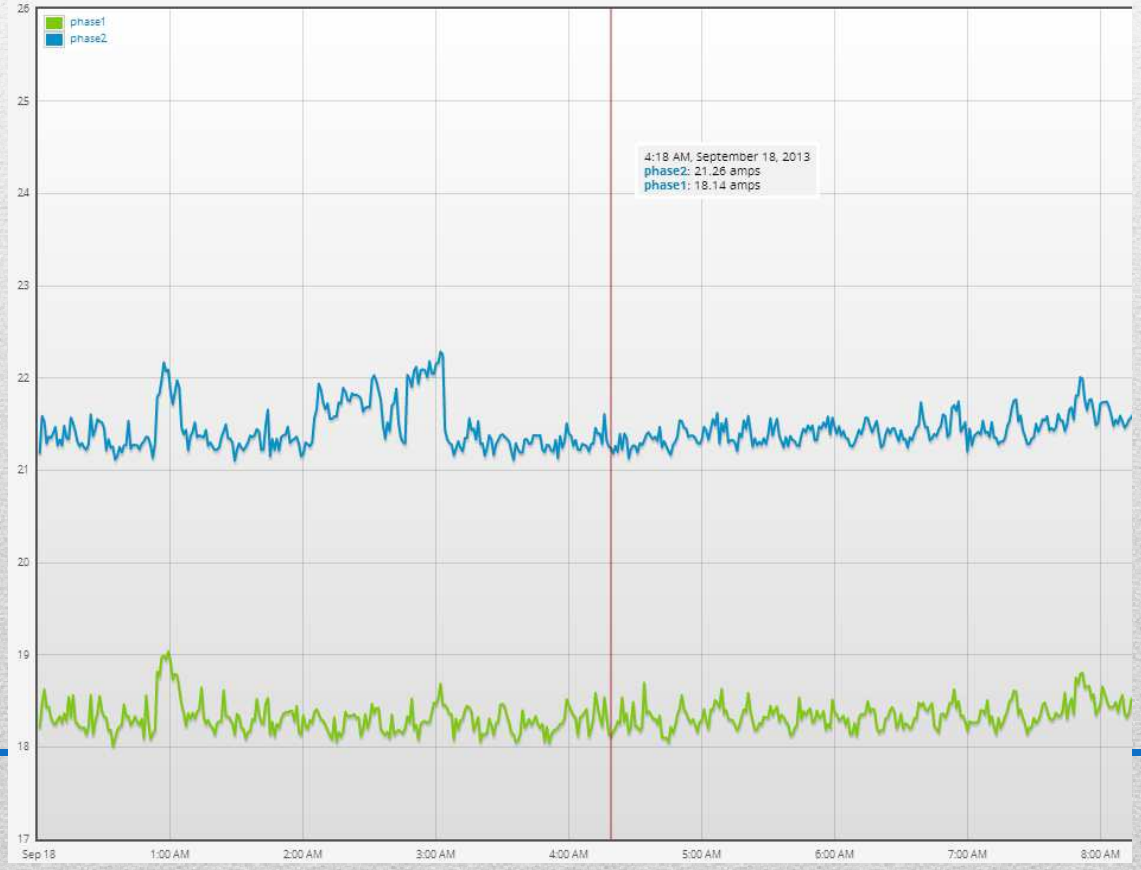
To change the frequency of these emails or edit your email alert status, click here.

Regards,
ndbyStatus.com

n automatically generated mail. Please do not reply to this mail.

Power Usage

- **NOC**
  - **Need to know how much power you use to know how much generator to have**
    - *N+1 is costly, but in larger installation that require to be up, a must*



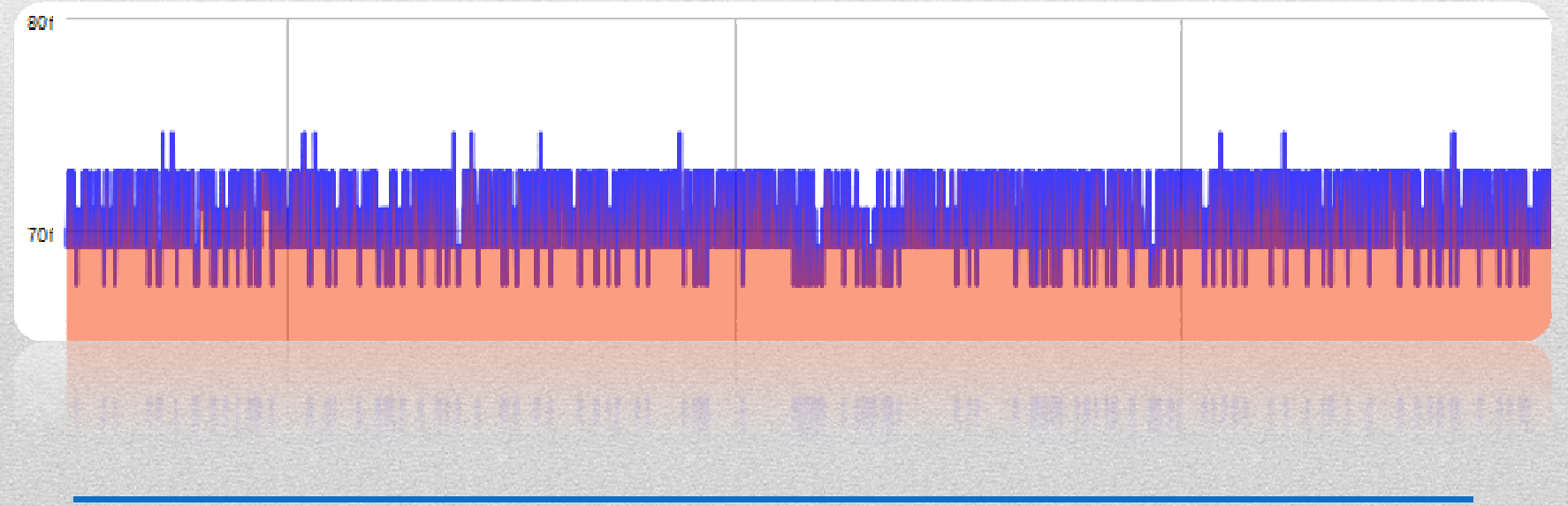
Power Usage

- **Products:**
  - **mPOwer**
  - **Mport + Current Sensor**
  - **Kill A Watt EZ**

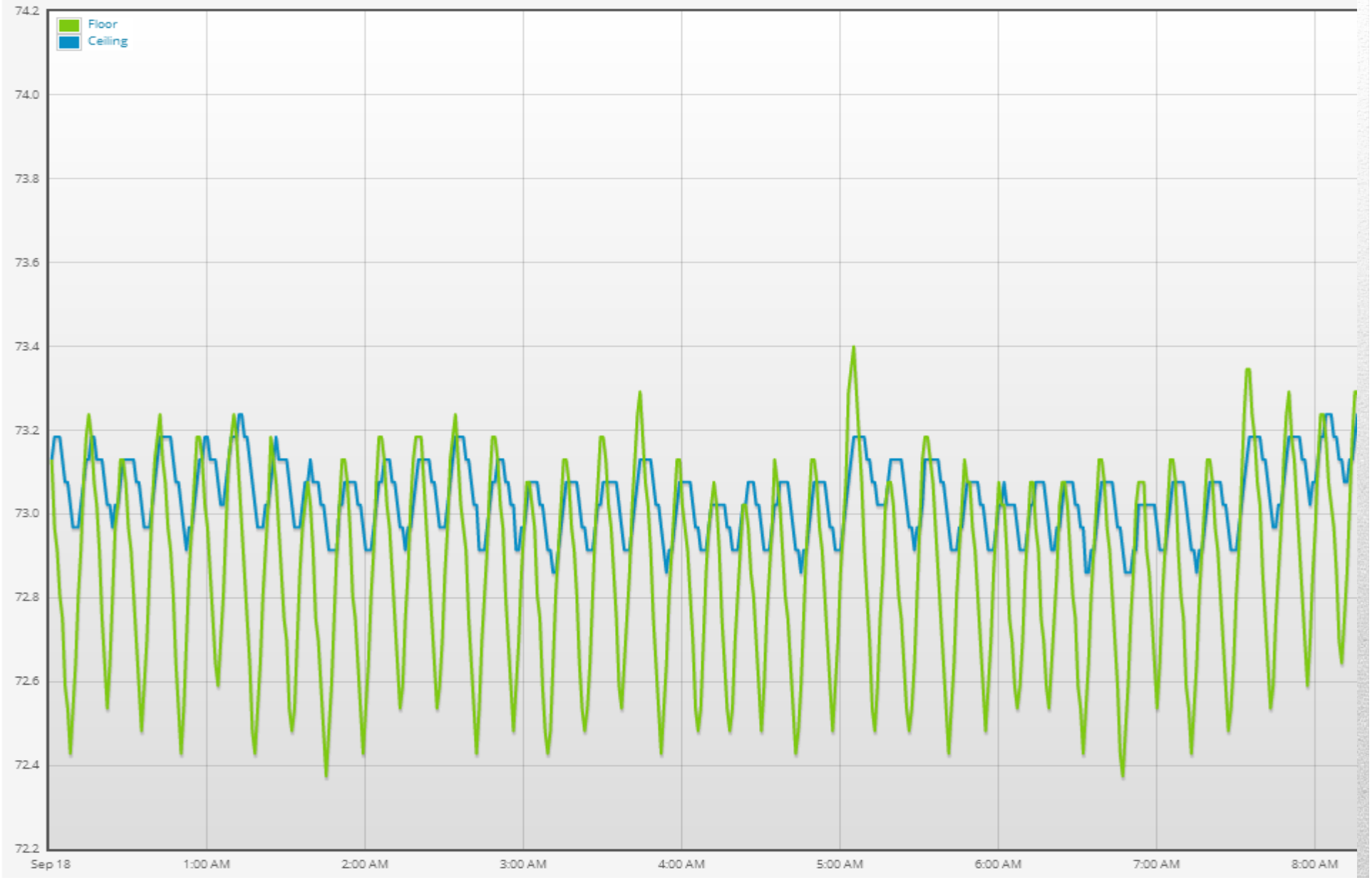
  - **Ability to measure power**
    - *Watts*
    - *What most Generators are scaled in for ease*

Temperature Monitor

- Monitoring temperatures in cabinet or server room
  - Floor and ceiling monitor – sensors on top/bottom
  - Front to back in server room
  - Alert during high temp Before things overheat!



Temperature Monitor



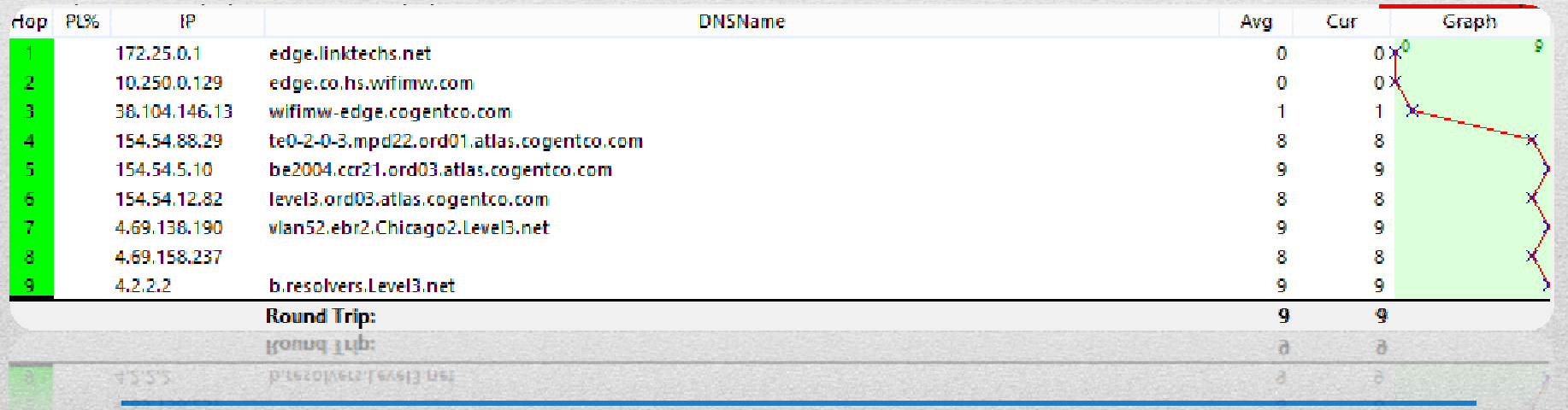
Outside Monitoring

- **If you have a single internet connection**
  - **You should have some kind of out of band monitoring system**
    - *Simply alert on SMS or alternate path for major events*
    - *Such as internet down*
      - If your monitoring server is inside your network, and you loose internet access, can you be notified via your cell phones?
      - NO e-mail works? Now what?
    - *SMS*
      - Simple text messages sometimes are preferred
      - Operate outside of your network
      - Can be sent even with your network down!

Tools

Tools

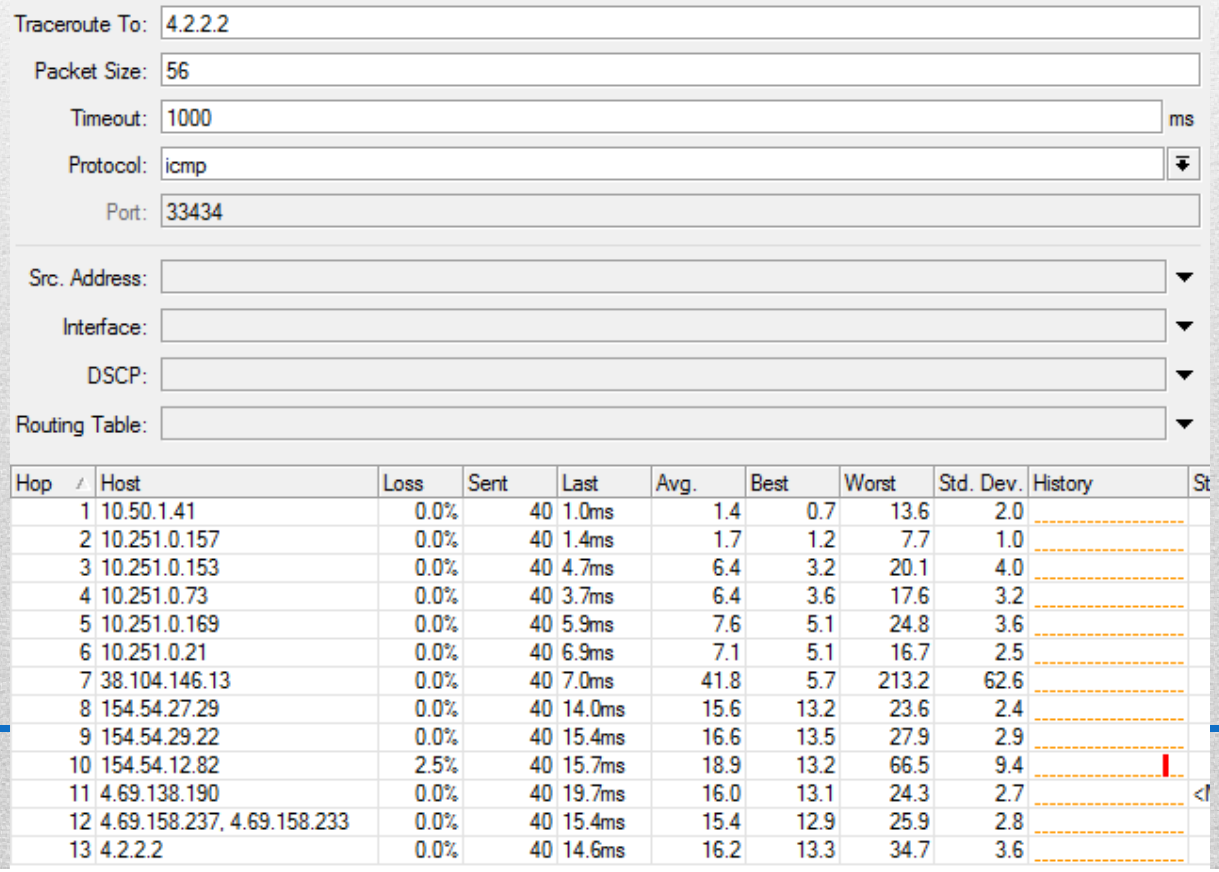
- **Ping Plotter**
  - **Shows full path traces (assuming a routed network)**
  - **Shows route changes**
  - **Path times from point A to B**
  - **Use when changing routing to verify operations**
    - *A single link with high ping times can show congestion*



Hop	PL%	IP	DNSName	Avg	Cur	Graph
1		172.25.0.1	edge.linktechs.net	0	0	
2		10.250.0.129	edge.co.hs.wifimw.com	0	0	
3		38.104.146.13	wifimw-edge.cogentco.com	1	1	
4		154.54.88.29	te0-2-0-3.mpd22.ord01.atlas.cogentco.com	8	8	
5		154.54.5.10	be2004.ccr21.ord03.atlas.cogentco.com	9	9	
6		154.54.12.82	level3.ord03.atlas.cogentco.com	8	8	
7		4.69.138.190	vlan52.ebr2.Chicago2.Level3.net	9	9	
8		4.69.158.237		8	8	
9		4.2.2.2	b.resolvers.Level3.net	9	9	
			Round Trip:	**9**	**9**	

Tools

- **MikroTik Ping**
  - **Provides information like ping plotter but form your router.**
  - **Gives history and averages!**



Traceroute To: 4.2.2.2
Packet Size: 56
Timeout: 1000 ms
Protocol: icmp
Port: 33434
Src. Address:
Interface:
DSCP:
Routing Table:

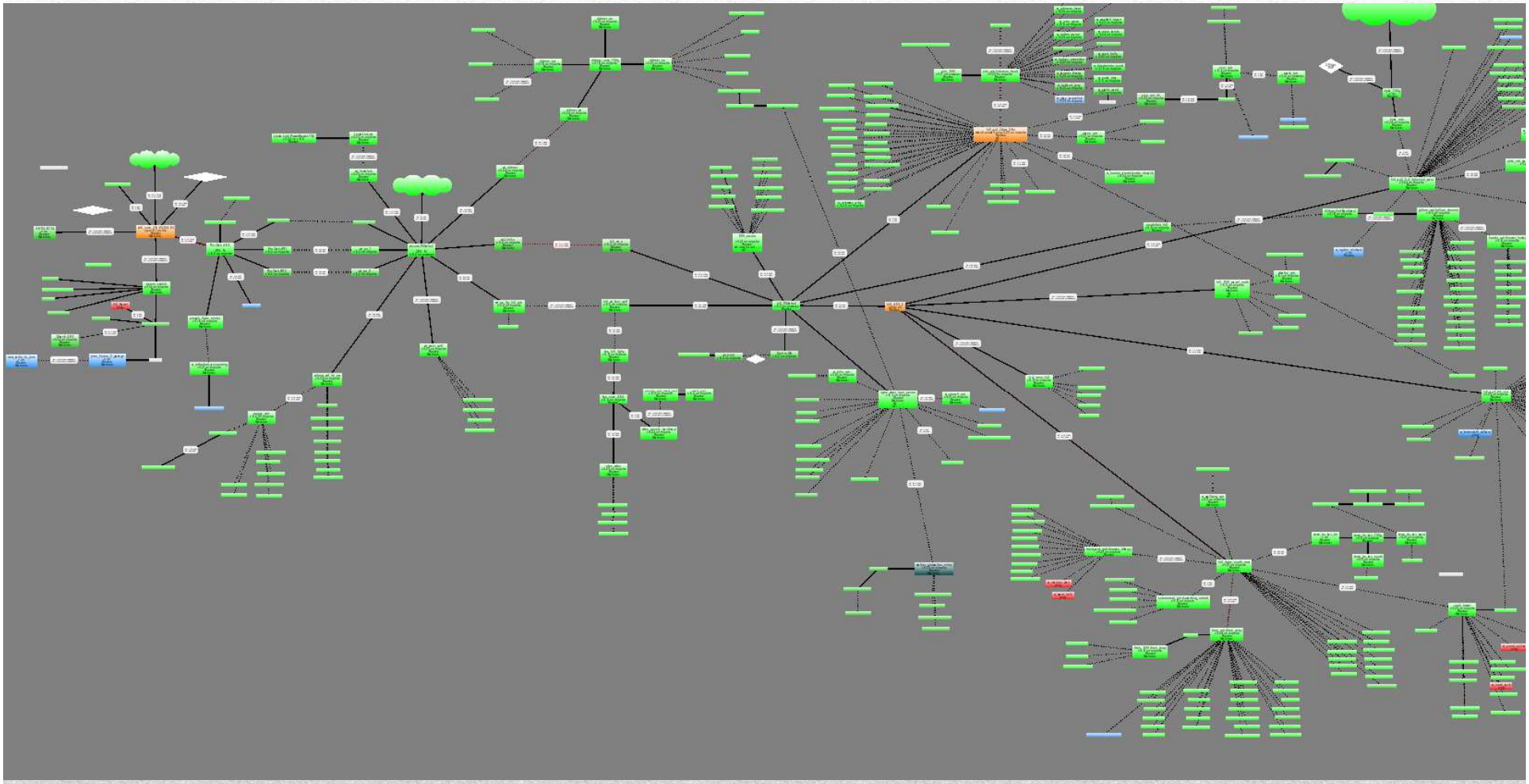
Hop	Host	Loss	Sent	Last	Avg.	Best	Worst	Std. Dev.	History	St
1	10.50.1.41	0.0%	40	1.0ms	1.4	0.7	13.6	2.0		
2	10.251.0.157	0.0%	40	1.4ms	1.7	1.2	7.7	1.0		
3	10.251.0.153	0.0%	40	4.7ms	6.4	3.2	20.1	4.0		
4	10.251.0.73	0.0%	40	3.7ms	6.4	3.6	17.6	3.2		
5	10.251.0.169	0.0%	40	5.9ms	7.6	5.1	24.8	3.6		
6	10.251.0.21	0.0%	40	6.9ms	7.1	5.1	16.7	2.5		
7	38.104.146.13	0.0%	40	7.0ms	41.8	5.7	213.2	62.6		
8	154.54.27.29	0.0%	40	14.0ms	15.6	13.2	23.6	2.4		
9	154.54.29.22	0.0%	40	15.4ms	16.6	13.5	27.9	2.9		
10	154.54.12.82	2.5%	40	15.7ms	18.9	13.2	66.5	9.4		
11	4.69.138.190	0.0%	40	19.7ms	16.0	13.1	24.3	2.7		
12	4.69.158.237, 4.69.158.233	0.0%	40	15.4ms	15.4	12.9	25.9	2.8		
13	4.2.2.2	0.0%	40	14.6ms	16.2	13.3	34.7	3.6		

Tools

- MikroTik Dude
  - Provides network Map
  - Centralized Upgrades
  - Centralized Router Management
  - UBNT devices you can WEB into as well quickly!
  - SNMP polling and charting!

Tools

- **Dude**



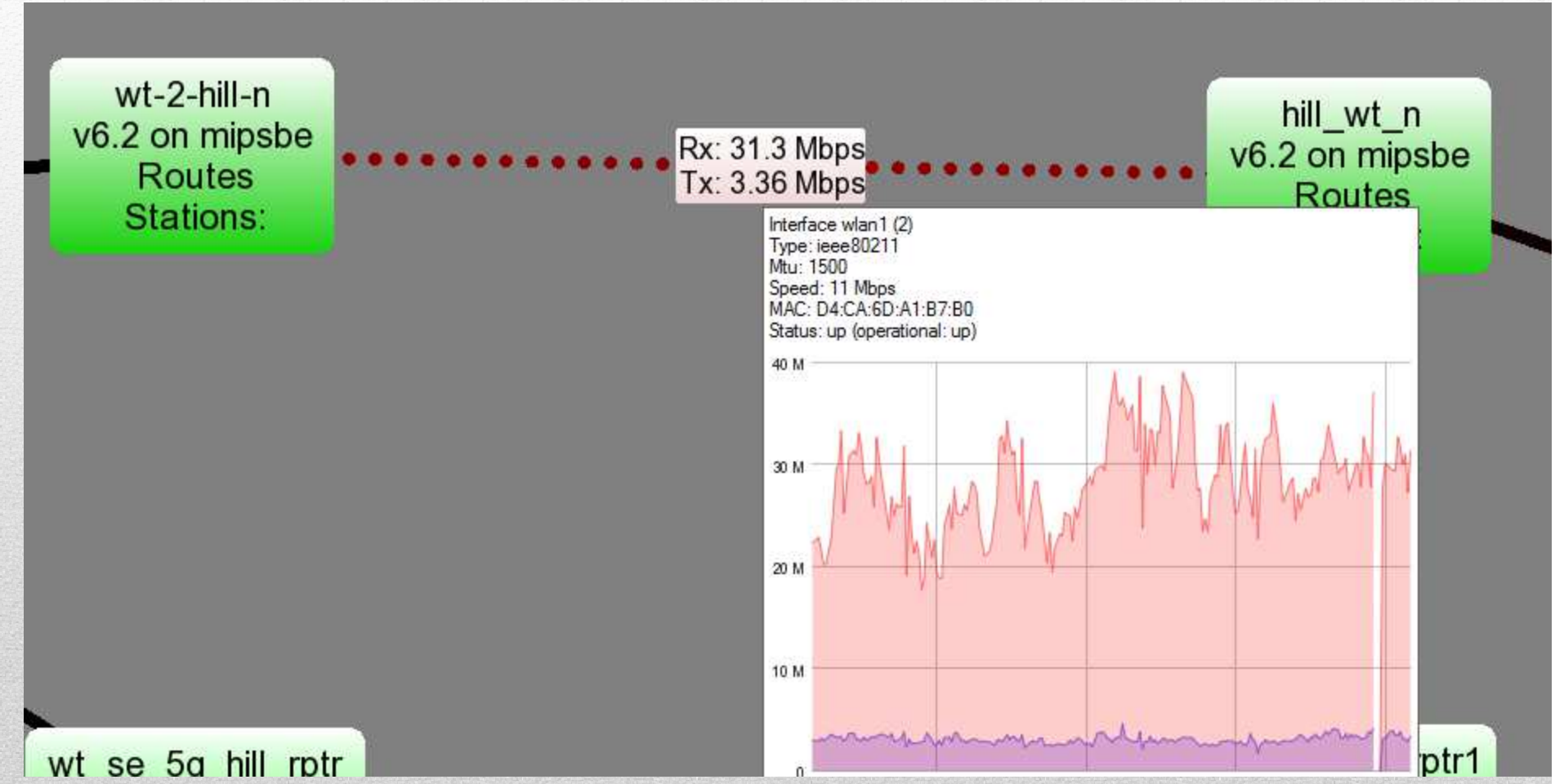
Tools

- **Dude**


wt-2-hill-n
v6.2 on mipsbe
Routes
Stations:
Rx: 27.3 Mbps
Tx: 2.89 Mbps
hill_wt_n
v6.2 on mipsbe
Routes
Stations:

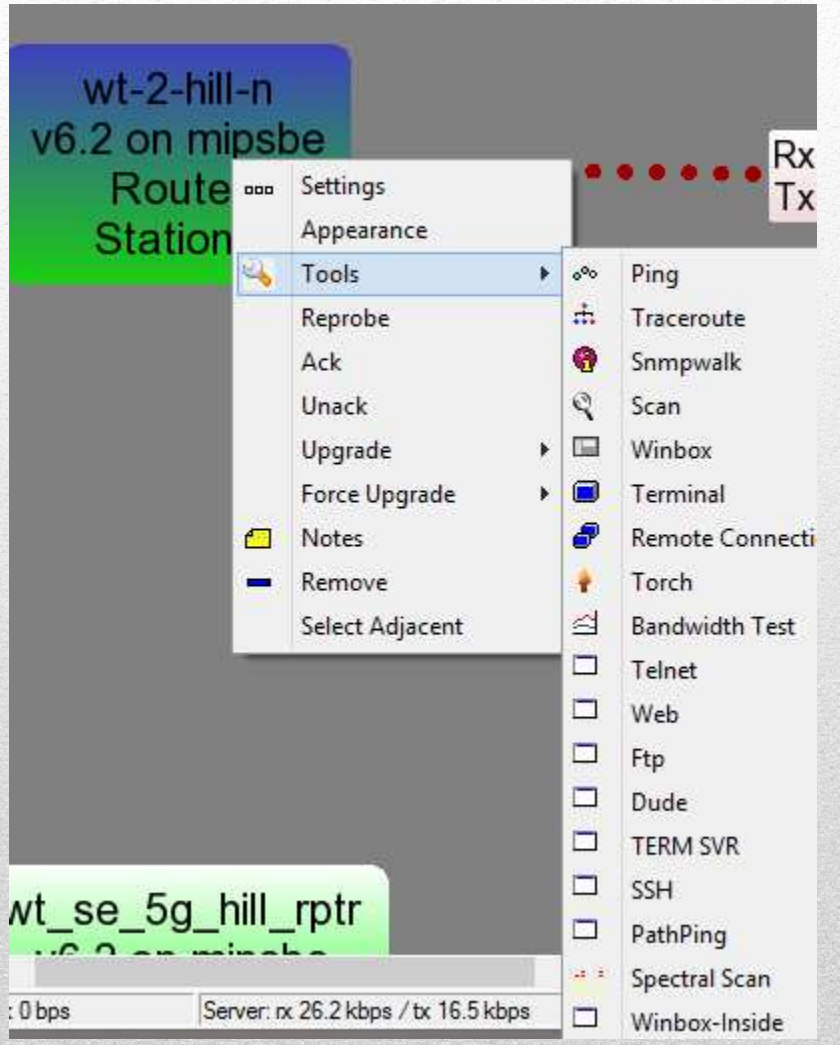
Tools

- **Dude**


wt-2-hill-n
v6.2 on mipsbe
Routes
Stations:
Rx: 31.3 Mbps
Tx: 3.36 Mbps
hill_wt_n
v6.2 on mipsbe
Routes
Interface wlan1 (2)
Type: ieee80211
Mtu: 1500
Speed: 11 Mbps
MAC: D4:CA:6D:A1:B7:B0
Status: up (operational: up)
40 M
30 M
20 M
10 M
0
wt_se_5g_hill_rptr
ptr1

Tools

- **Dude**
  - *Tools for Management*
    - Web
    - Winbox
    - Force Upgrade



Notifications

Notifications

- **Initial notification should be sent quick enough that you are ahead of the issue**
  - **But should be long enough to make sure that momentary issues (Such as a short drop in power) would not set off alarms**
  - **Too many notifications make engineers ignore them**
  - **Repeat notifications for major events**
- **Use Areas**
  - **If you cover a large area your system should allow you to page/sms/email specific people in those areas**
    - *Faster response time by local people*

Conclusion

- Ability to quickly see overviews greatly increase the effectiveness and speed of being responsive
- Get ahead the curve by being proactive
- Use Tools in your monitoring system to manage your system!
- Notify on major issues
- Use e-mail / ticketing system to track outages
- Monitoring and having a network map (if they are together even better) can be very beneficial == SAVE MONEY!

Your Presenter

- Dennis Burgess

Link Technologies, Inc.

- Contact Information
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- Tower Coverage Maps
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