BGP/OSPF Implementation

Link Technologies, Inc.

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- **Mikrotik Certified Trainer / Engineer**
- **MikroTik Certified Dude Consultant**
- **Consulting Since 1997**
  - *Enterprise Class Networks*
  - *WAN Connectivity*
- **Certifications**
  - *Cisco, Microsoft, MikroTik*
- **BGP/OSPF Experience**
  - *Deployed many BGP and OSPF networks based on MikroTik, Cisco and Juniper*
- **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 are we going to Cover?

- **BGP**
  - **What is it?**
  - **Why do I need it?**
  - **What do I need to get started?**
  - **What does it cost? – with ARIN**
  - **BGP Implementation**
    - *Things to know!*
- **OSPF**
  - **Using OSPF with Multiple Default Gateways**
  - **Using OSPF with BGP**
  - **Several Methods and Implementations**

What is BGP?

- **Border Gateway Protocol**
  - **Exterior Gateway Protocol**
  - **Used as the core routing protocol on the Internet**
  - **Used to interconnect separate diverse networks**
  - **Uses AS numbers to identify networks**
  - **AS numbers advertise Prefixes – IP addresses**
  - **Only way to Properly Multi-Home your Network**

What is BGP?

- **Border Gateway Protocol**
  - **AS – Autonomous System**
    - *Collection of Prefixes under the control of one or more operators.*
    - *Typically a single 'network'*
    - *Many prefixes can be in one AS*
  - **Prefixes**
    - *38.114.84.0/22*
    - *12.0.0.0/8*

What is BGP?

- **Border Gateway Protocol**
  - **Multihoming**
    - *A process to increase the reliability of the internet connection for prefixes*
      - This allows you to connect your network at several points to either the same or multiple upstream providers.
      - Primary way to allow proper in/out operation of public IP space.
  - **Advertisements**
    - *Your AS will advertise your Prefixes*
    - *The advertisements are sent out to your BGP peers*
    - *These peers will then update their peers – so on and so forth*
    - *You can advertise your IP addresses out multiple internet connections (as long as they are running BGP)*

Why do you need BGP?

- **Multihoming**
  - **This is the primary method to prevent a single internet upstream connection from going down and still having full public IP connectivity**
    - *Advertising the same prefixes out multiple providers provides failover between those providers*
    - *Inbound traffic to those public IPs can go though any of your upstream providers (again as long as they have a BGP connection)*
- **Failover**
  - **This provides redundancy in your network operations**
  - **A single provider that goes down, does not affect your network operations**

What do you need to run BGP?

- AS Number
- IP Prefixes to Advertise
- Upstream – BGP Peer

What do you need to run BGP?

- **AS Number and IP Prefixes**
  - **RIR – Regional Internet Registry's**
    - *ARIN – US/Canada/Parts of the Caribbean*
    - *RIPE NCC – Europe, Middle East, Central Asia*
    - *AfriNIC - - Africa*
    - *APNIC – Asia, Australia, other neighboring countries*
    - *LACNIC – Latin America and parts of the Caribbean*
    - *You DO NOT have to have your own Prefixes in some cases*
- **Upstream – BGP Peer**
  - **Your upstream providers must have the capabilities to preform BGP peering**
    - *Most DSL / Cable / Broadband operators in USA do NOT allow BGP peers on these types of circuits*
    - *MetroE, Fiber Services, >= T1 Circuits will typically provide it*
    - *This is not in all cases, contact your provider to find out*

What are the costs to run BGP?

- **AS Number and IP Prefixes**
  - *AS Number – though ARIN*
    - $500 to register each AS number
    - $100 Maintenance fee for each AS per subsequent years

What are the costs to run BGP?

- **AS Number and IP Prefixes**
  - *IP Prefixes*
    - Blocks of IP addresses assigned to YOUR organization
    - Smallest block being assigned is a /22
      - Blocks Smaller than /20 are$1,250 per year
    - These IPs will require you to advertise these Prefix's via BGP
    - They can be used with ANY internet provider that offers BGP connectivity
      - You change upstream internet providers, no IP renumbering is required.

What are the costs to run BGP?

- **AS Number and IP Prefixes**
  - *IP Prefixes – IPv4 – with ARIN*
    - You will have to prove that you NEED these IP Addresses
      - Provide subnet list for POP locations
      - Provide IP / POP / Customer Information
      - Existing Subnets
        - Must be SWIPed to your business name
        - May need LOA from each provider showing you are assigned those subnets.
        - May need LOA between each provider allowing any existing subnets to be advertised by you.
      - Show Planned usage for the next 3 months only!
        - You must show that you have a plan to use the IP addresses assigned within 3 months .
    - You typically will also have to prove that you are or will be multi-homed

What are the costs to run BGP?

- **So…. With ARIN in the US**
  - **AS number**
    - *$500 First year*
    - *$100 each year afterword's*
  - **/22 – 4 /24 blocks – 1020 IP Addresses**
    - *$1,250 per year*

- **Rates and Fees may vary from your RIR.**

Ready to Run!

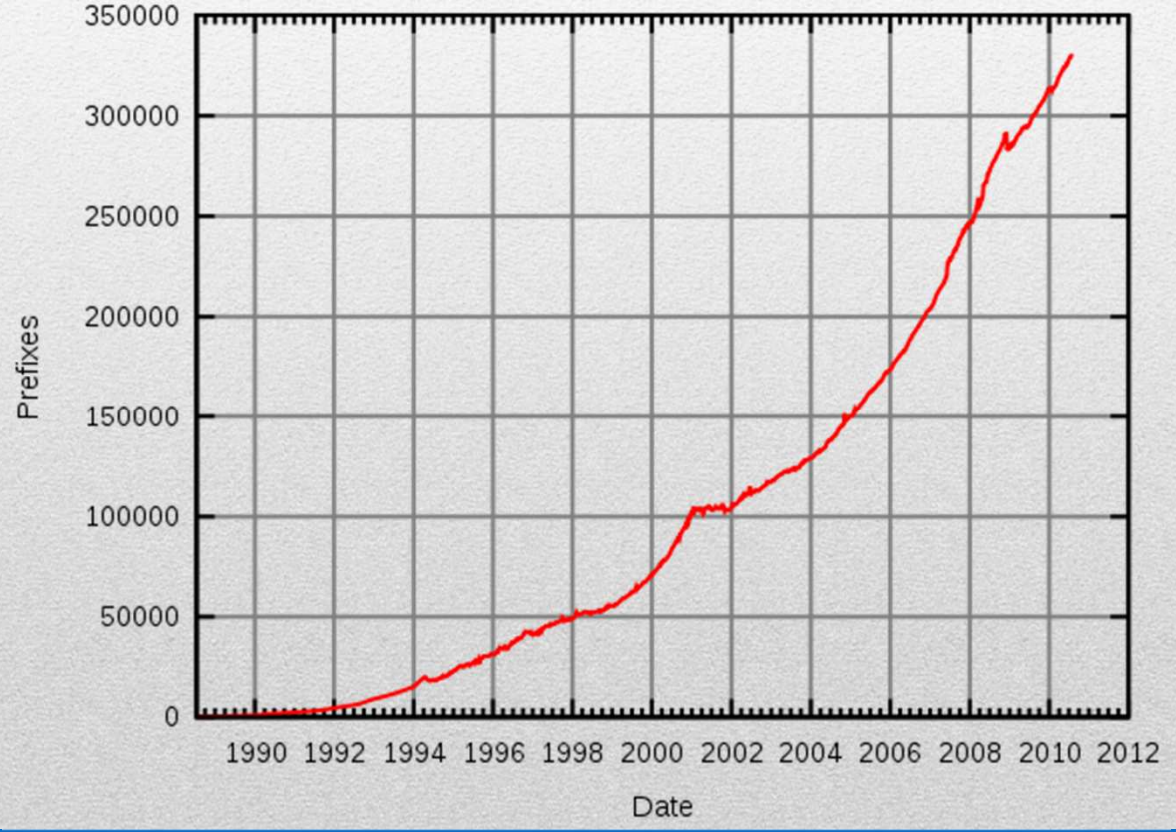
- **Your Providers**
  - **Typically will give you a BGP worksheet to fill out**
    - *What is your AS*
    - *What other AS's do you connect to*
    - *What Prefixes are you wishing to advertise*
      - Many Providers filter these!
  - **Return with BGP information**
    - *There AS*
    - *There BGP peer IP*
    - *MD5 Key*

BGP Prefix Feeds / Connections

- **Default Only**
  - **Provider sends only a default route via BGP**
- **Summary**
  - **Provides only a summarization of global routing table.**
  - **Typically a few hundred routes.**
  - **Depends on the provider, some summarize up to /8s some summarize down to /16s**

BGP Prefix Feeds / Connections

- **Full Table**
  - **Your provider will send you the entire Global Routing Table**



How BGP Selects Paths

- **AS Numbers ONLY!**
  - **An AS can be**
    - *5 Routers*
    - *200 Routers*
  - **An AS can be**
    - *100 routers in a single Town*
    - *20 routers across the mid-west*
- **BGP Only looks at AS Hop Count!**
  - **The number of routers you go though does NOT matter!**
  - **Typically you are within 5 AS hops from anywhere on the internet**
  - **A Global internet provider will be typically closer than a smaller internet provider**

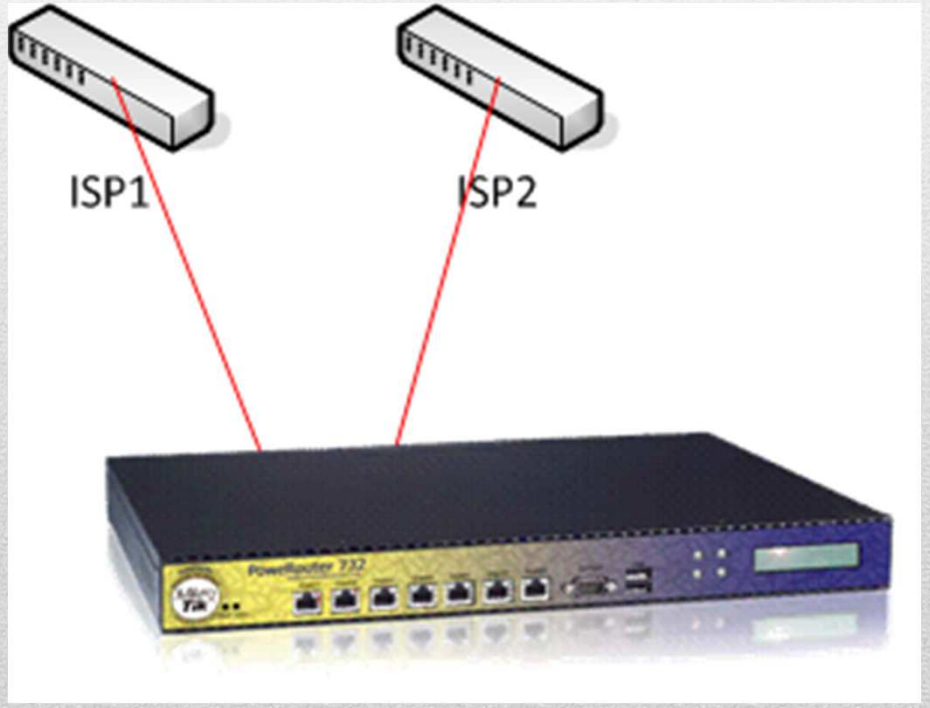
BGP Implementations

- **Things to Know**
  - **Some providers will allow you to announce there prefix's that are assigned to you**
    - *If you disconnect that provider, they typically want those prefixes back!*
  - **Most providers require you to tell them, what prefix's you are going to announce.**
    - *They filter based on the prefix's you tell them, so if you want to add a new prefix, you may have to tell your peers prior to announcing.*
    - *You may need to have a LOA if you are announcing another providers prefix.*

BGP Implementation Examples

BGP Implementations

- **Single Router – Two Upstream Providers**
  - **Very common in Datacenters**
  - **Two Providers Equal Bandwidth**
  - **Each offer BGP connections**



BGP Implementations

- **Single Router – Two Upstream Providers**
  - **Suggestions**
    - *Full Routing Tables from each provide*
      - Allows us to identify and use the most cost effective route from each provider
    - *Advertisements*
      - Since both peers are the same speed, we typically don't need to change our inbound routing.

BGP Implementations

- **Single Router – Two Upstream Providers**
  - **BGP Configuration**
    - *Do we require Default routes?*
      - All Prefixes on the Global Routing table are learned. No other routes should be needed!
    - *Dual Global Routing Tables*
      - BGP will use the AS hop count, some prefixes will go out though ISP1 and some will go though ISP2 based simply on AS Hop Count
      - Inbound Traffic will be the same

BGP Implementations

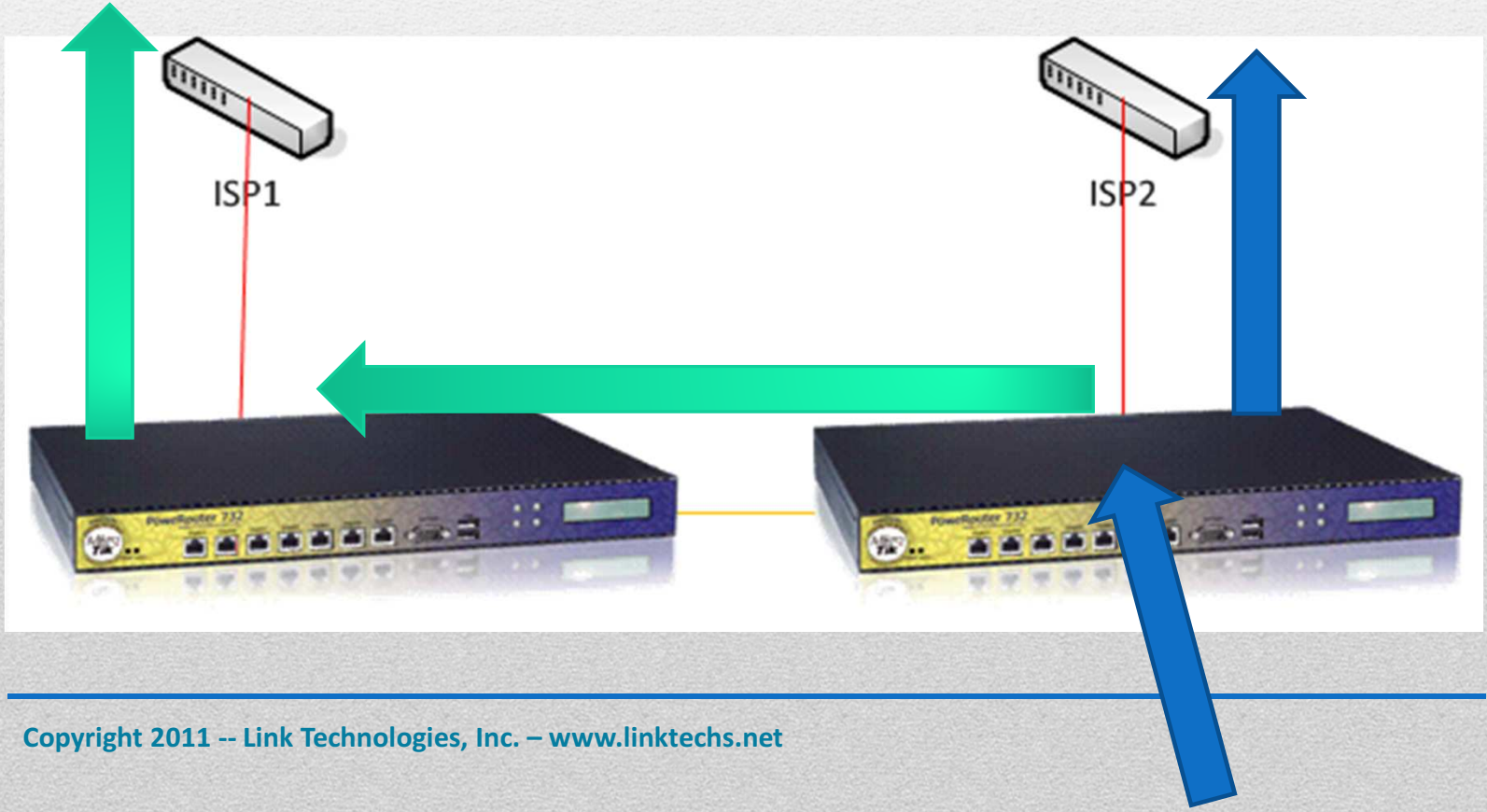
- **Two Routers -- Two Peers – Same Physical Location**

BGP Implementations

- **Two Routers -- Two Peers – Same Physical Location**
  - **Suggestions**
    - *Full Routes still needed*
    - *Create iBGP peer between two routers to share information*
      - This is done by creating a BGP peer with same AS numbers on both ends
    - *Extra router hop does NOT matter*
    - *If best AS path is though Router B, and packet comes in Router A, Router A will send packet to Router B*
      - Typically you will want a dedicated Ethernet or virtual connection between the two routers

BGP Implementations

- **Two Routers -- Two Peers – Same Physical Location**



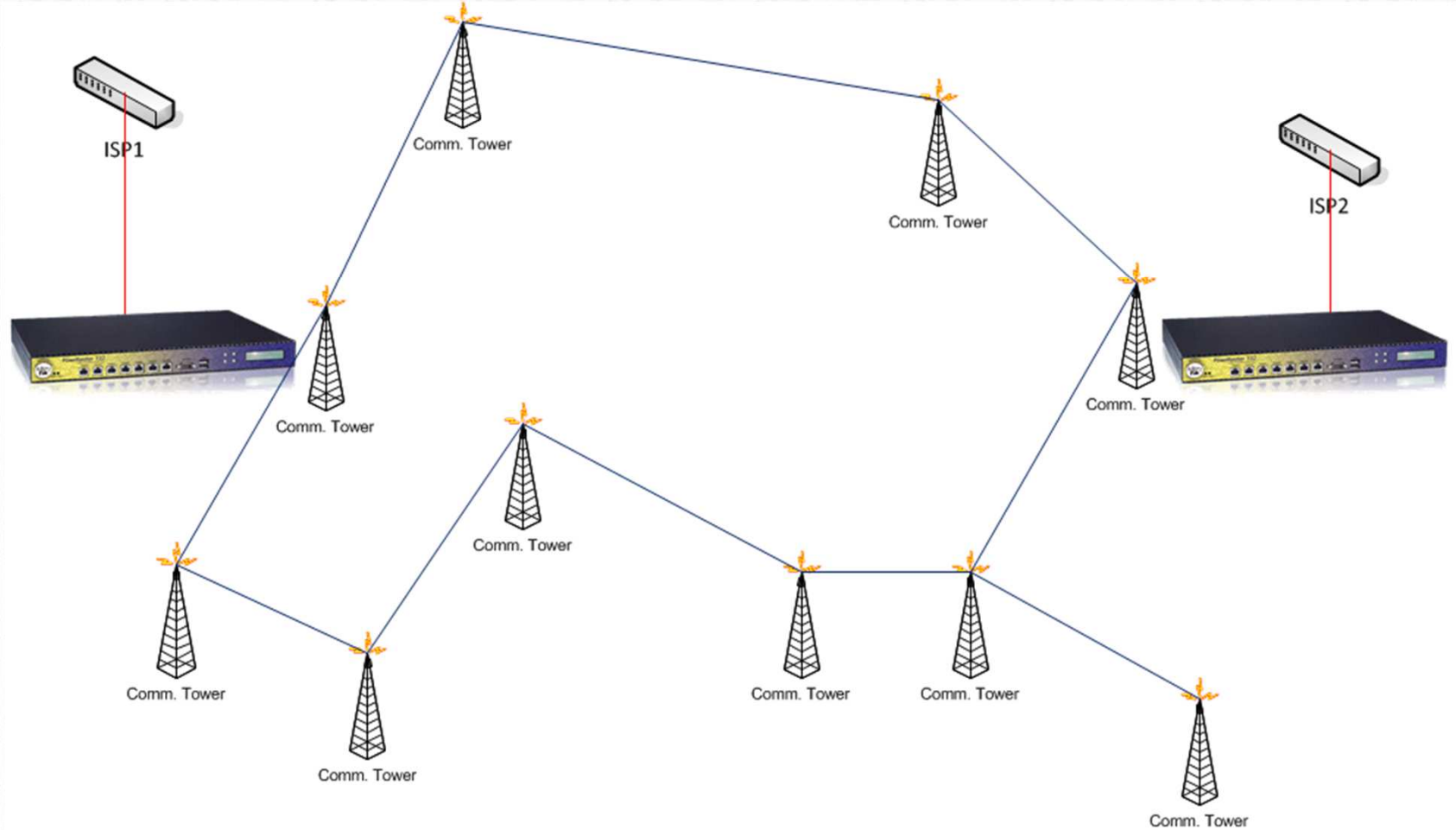
BGP

- **Use BGP to select best inbound/outbound route from your network to others**
  - **Remember BGP is a EGP (Exterior Gateway Protocol)**
    - *Designed to interconnect NETWORKS*
- **Use OSPF inside your network**
  - **To get traffic to and from your network edges**

OSPF Implementation Examples

OSPF Implementation

- **Multiple Diverse Internet Connections**

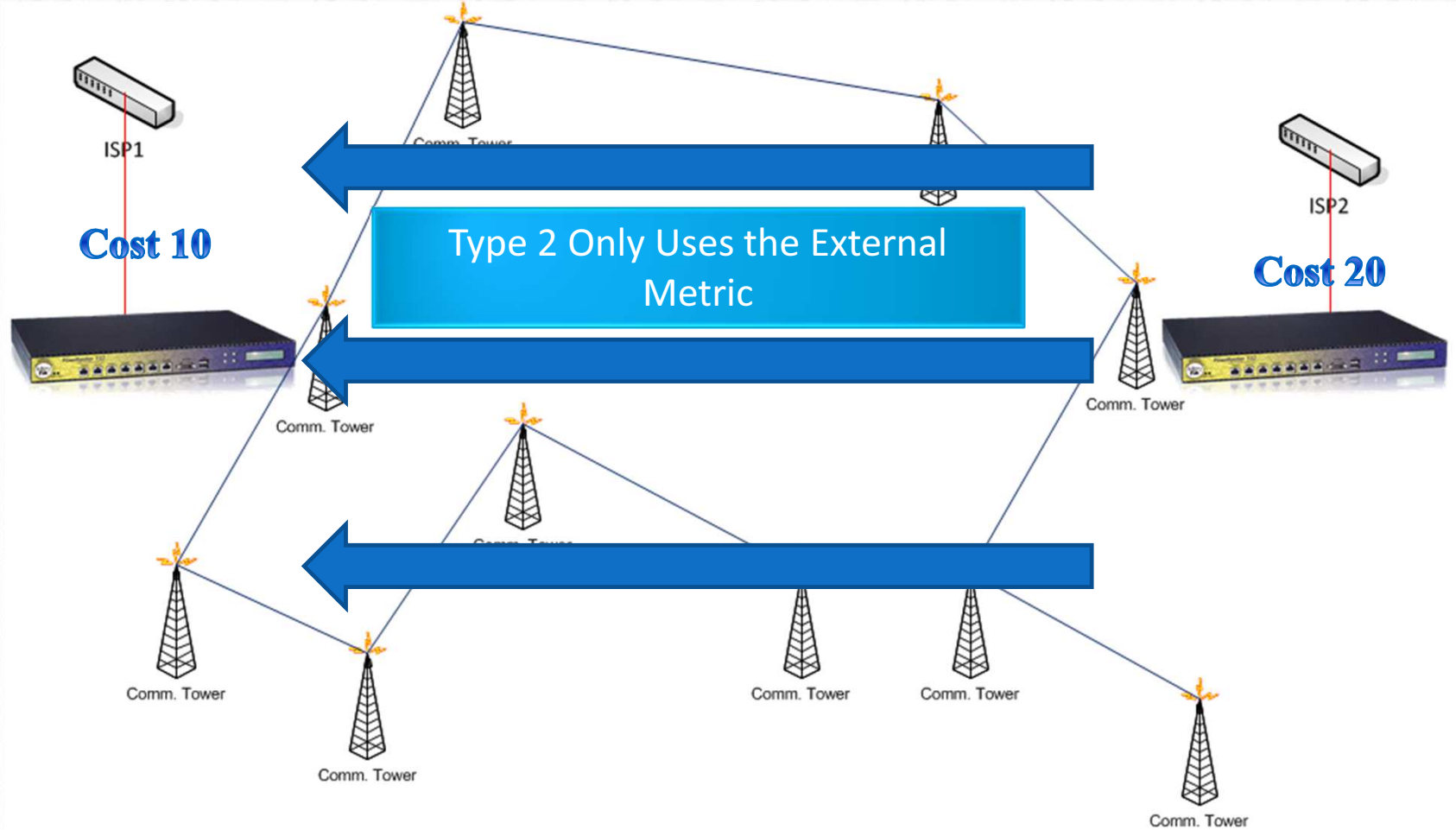


OSPF Implementation

- **Multiple Diverse Internet Connections**
  - **OSPF Type 1**
    - *Uses both Internal and External Metrics*
  - **OSPF Type 2**
    - *Uses ONLY External Metrics*
  - **Suggestions**
    - *Set Default route to OSPF Type 1*
      - This way you can SPLIT your network
        - Some traffic though ISP1 and some though ISP2
        - You can control this by increasing your link costs across interfaces
    - *Set Default route to OSPF Type 2*
      - Only one Default gateway will be used, unless unavailable or connectivity failure.

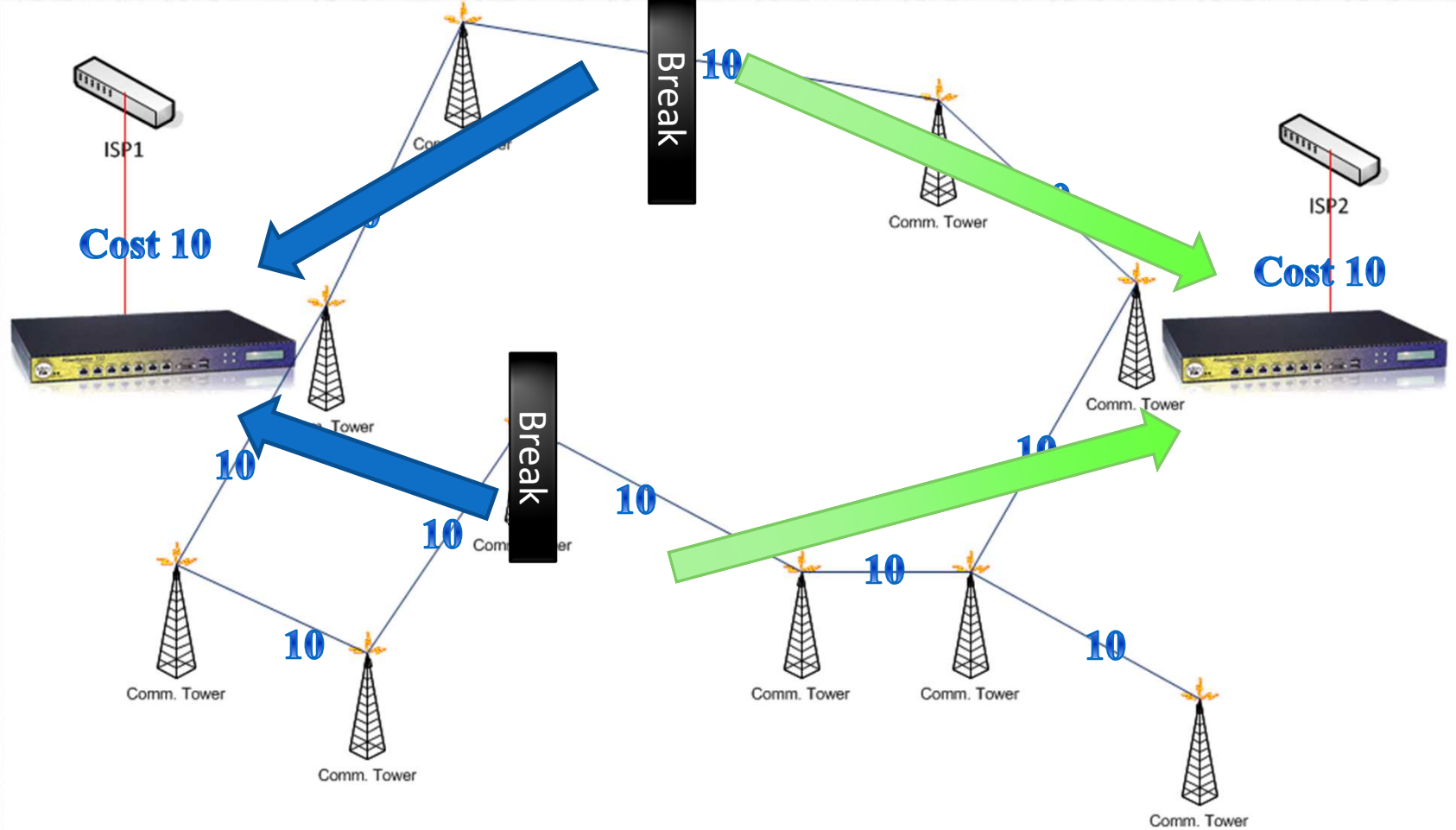
BGP Implementations

- **OSPF Type 2 Default Route**



OSPF Implementation

- **OSPF Type 1 Default Route**



OSPF Implementation

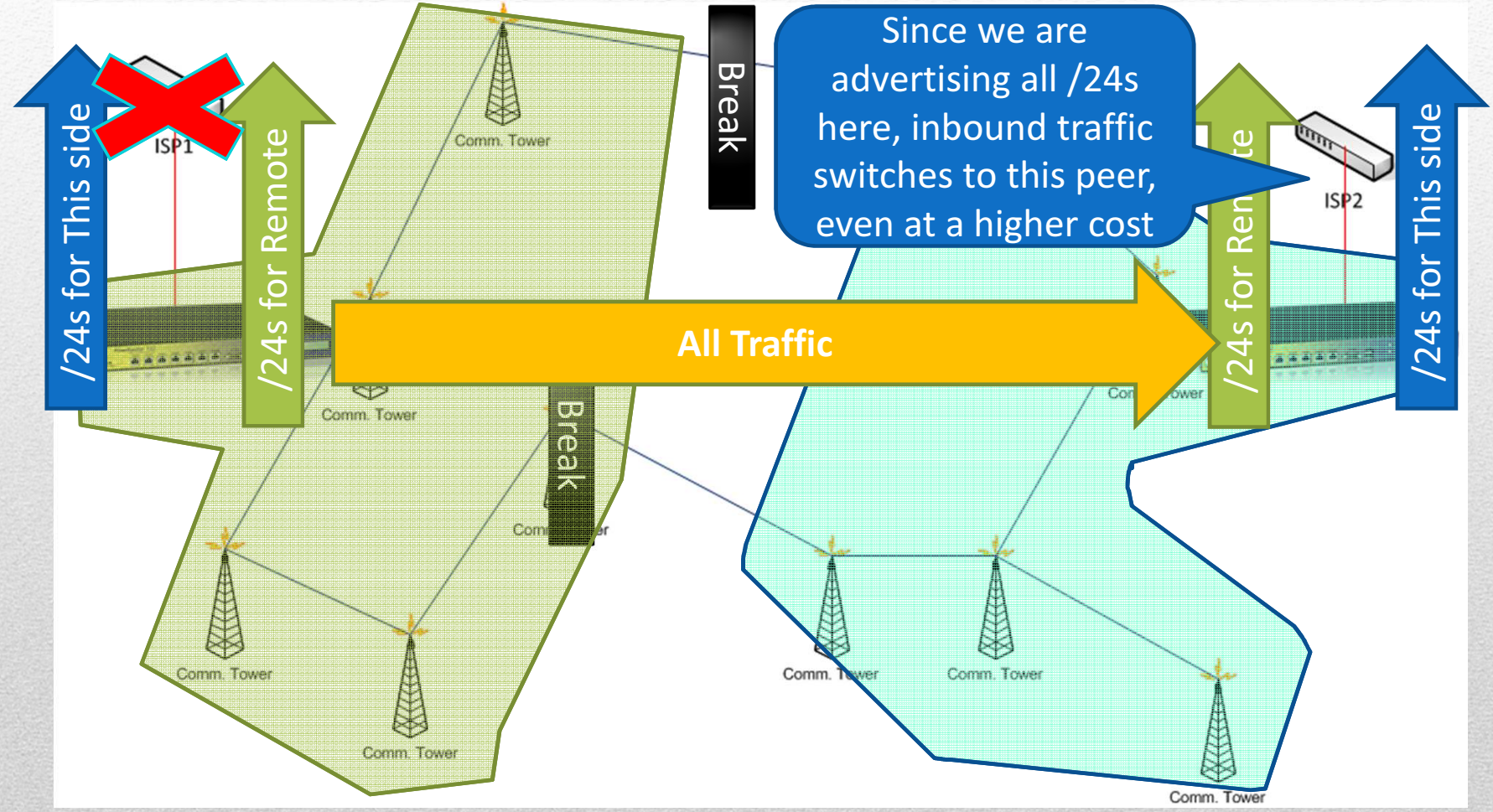
- **OSPF Type 1 Default Route**
  - **Breaks Network**
    - *In the event of failure on one gateway, all traffic goes to the other.*
    - *Also Useful for other BGP Routing*
  - **By using Two default routes you can balance out your outbound network traffic between both gateways**
    - *Does not balance inbound traffic*
    - *In many cases there would be NATs at each end*

BGP/OSPF Implementation

- **How do we use the OSPF Type 1 Default routes with BGP inbound routing?**
  - **Suggestions**
    - *Separate your prefixes to each "section" of your physical network topology*
    - *Only need Default routes from peers*
    - *The Smallest prefix typically allowed to advertise is /24*
      - Do not put subnets of /24s on different segments of your network
      - Always Keep /24s to either section
    - *Advertise /24 prefixes out their respective BGP peer*
    - *Advertise the other peers /24s with Prepends*
      - Adds AS cost to advertisement
      - Typically 3-5 prepends are sufficient

BGP/OSPF Implementation

- **Two Diverse BGP Peers – Two Providers**

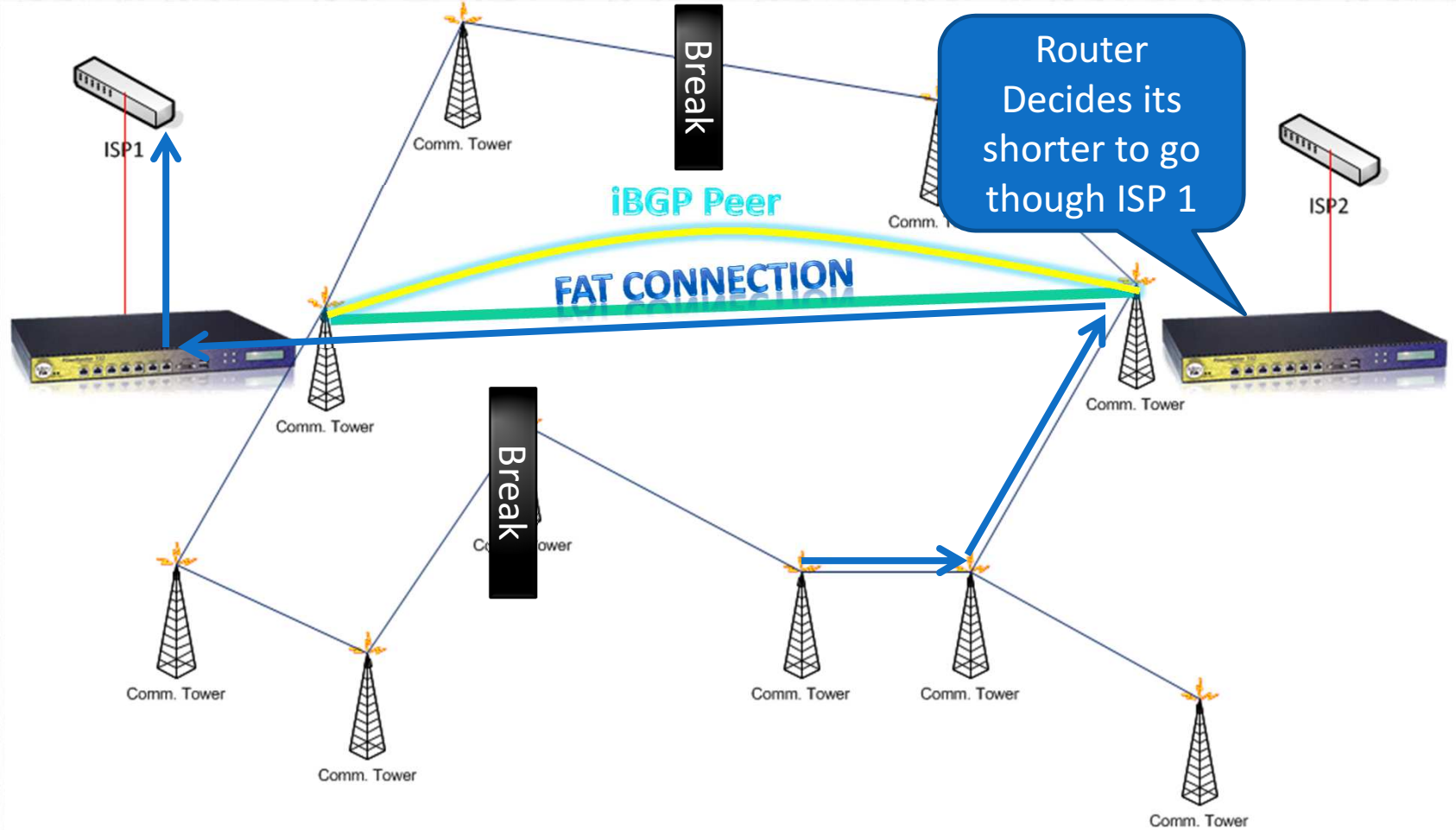


BGP/OSPF Implementation

- **Two Diverse BGP Peers – Two Providers**
  - **What if we add a "FAT PIPE" Between our diverse Connections?**
    - *We can now utilize full routing tables at each BGP peer*
    - *Routing occurs just like a single router with multiple peers*
      - Extra router hops within the same AS does not matter
    - *Best Path will be selected based on destination AS count*

BGP/OSPF Implementation

- **Two Diverse BGP Peer – Two Providers**



Other Information

- **BGP**
  - **Complete books entirely on traffic engineering, using things like communities, prepends, changing costs, etc.**
    - *Recommend that you setup lab environments to test prior to deployment*
    - *Consult with MikroTik Certified Consultant with BGP Experience*
- **OSPF**
  - **Books on OSPF deployments, areas, route summarization, path costing, full duplexing over half-duplex links.**
    - *Refer to these*

Your Presenter

- Dennis Burgess

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- "Learn RouterOS" Book
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