WISP TRACON

Conserving IPv4 Addresses in a Routed Network

MikroTik MUM – Slovenia 2016

Brian Horn – WISP TRACON LLC

Background

- WISP TRACON LLC
  - Solutions Training and Consulting Company
  - Operations in North America, Europe and Africa
  - MikroTik Certified Consultants and Trainers

- Winters Broadband LLC
  - California based WISP
  - Founded 2002
  - ARIN assigned ASN and /22 address block
    - CPE assigned static public IP address
      - Addresses DMCA issues
        - Digital Millennium Copyright Act

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Winters Broadband Network – 2012

- Existing
  - Edge Routed
    - Bridged/Switched backbone with routed subscriber connections
  - Script controlled redundant links
  - 40+ Access Point sites
  - Over 600 CPE's
  - Dual homed Internet connection
- Plan
  - Migrate to routed OSPF backbone
  - Subnetted by Site location
- Issues
  - Unable to get additional IPv4 address assignment
  - Subnetting issues – Poor address utilization

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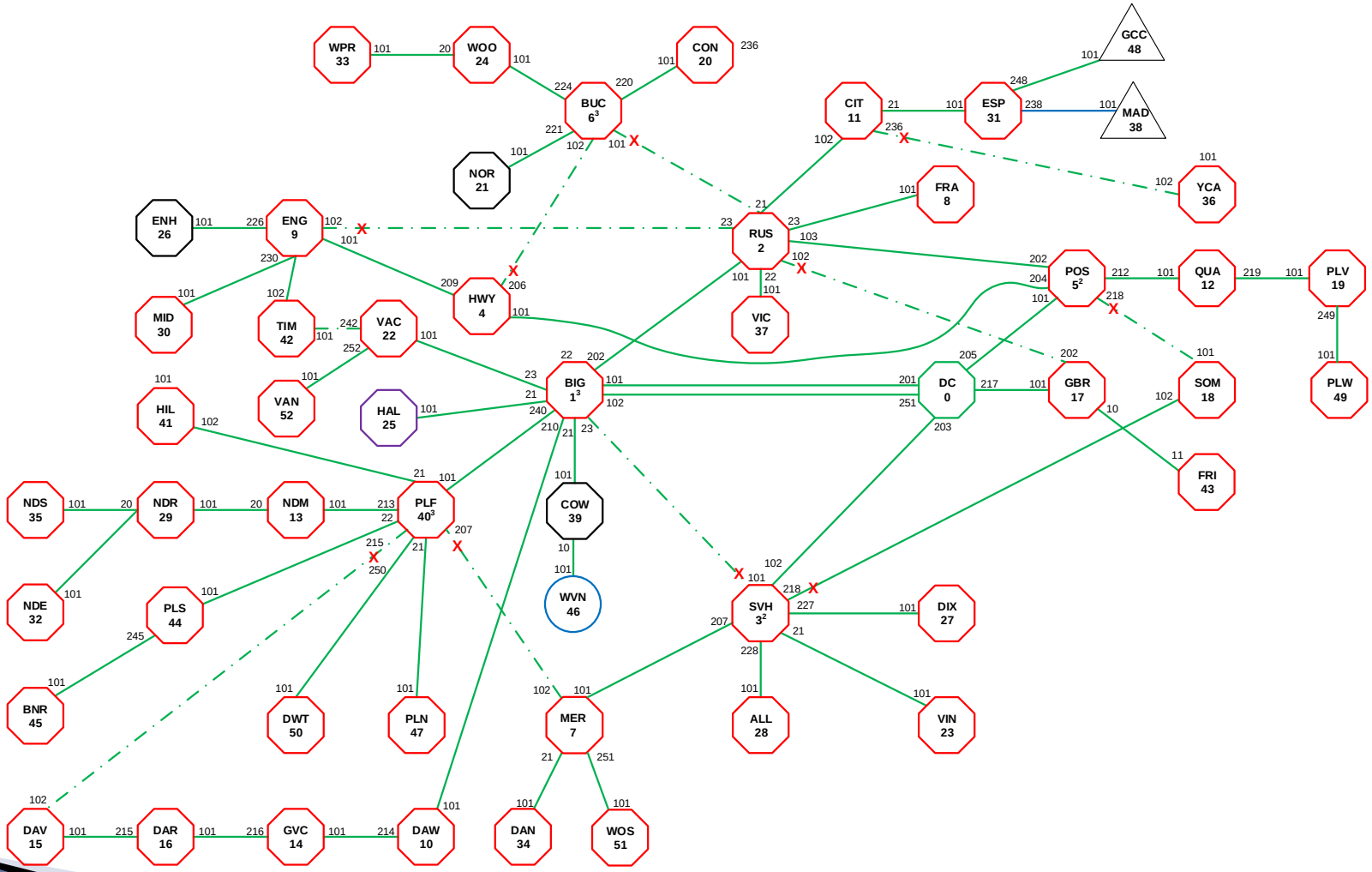
Network Architecture – 2012



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Subnetting /22

IP Address Block/Site			
4	5	6	7
DC	SVH	RUS	MER
GBR		BUC	NDM
BIG	SOM	CON	NDX
	VIN		
GBR	ALL	WOO	DAN
			FRA
HWY	DIX	POS	DAW
HAL			
VAC	NOR	PLF	GVC
	HIL		ESP
ENG	CIT	QUA	DAR
	ESP	PLV	DAV

/28 -- 16 Subnets -- 14 Hosts/Subnet		
Network #	IP Range	Broadcast
0	1 ~ 14	15
16	17 ~ 30	31
32	33 ~ 46	47
48	49 ~ 62	63
64	65 ~ 78	79
80	81 ~ 94	95
96	97 ~ 110	111
112	113 ~ 126	127
128	129 ~ 142	143
144	145 ~ 158	159
160	161 ~ 174	175
176	177 ~ 190	191
192	193 ~ 206	207
208	209 ~ 222	223
224	225 ~ 238	239
240	241 ~ 254	255

/26 -- 4 Subnets -- 62 Hosts/Subnet		
Network #	IP Range	Broadcast
0	1 ~ 62	63
64	65 ~ 126	127
128	129 ~ 190	191
192	193 ~ 254	255

/27 -- 8 Subnets -- 30 Hosts/Subnet		
Network #	IP Range	Broadcast
0	1 ~ 30	31
32	33 ~ 62	63
64	65 ~ 94	95
96	97 ~ 126	127
128	129 ~ 158	159
160	161 ~ 190	191
192	193 ~ 222	223
224	225 ~ 254	255

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Subnetting Disadvantages

- Loss of IP addresses
  - Network, Gateway and Broadcast addresses
- Limit on addresses in subnet
  - What happens when Site address allocation is exhausted?
- Switching CPE to different AP is complex
  - Requires new IP address assignment

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Winters Broadband Network – 2016

- Fully Routed with OSPF
  - Dual homed – 10 GHz and 1 GHz
- 56 Access Point sites
- All CPE's have /32 IP address
- No configuration issues
- Roaming supported for survey trucks

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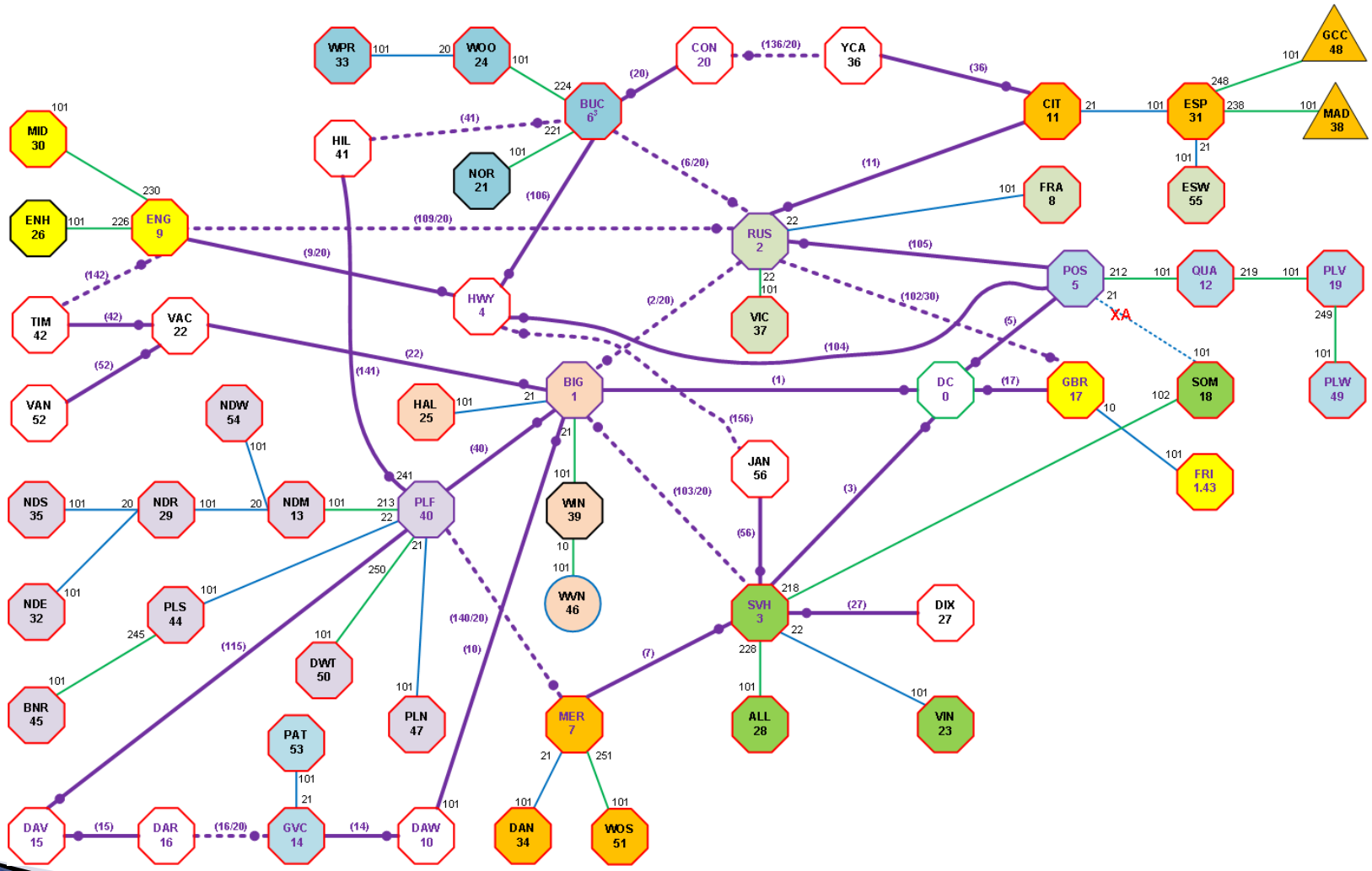
Network Architecture – 2016



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Documenting your Network

- Document
  - Do you have a documentation standard?
    - Now would be a good time to implement one
      - Schematics (Visio)
      - IP address assignment
      - Site designations
  - Network schematic
    - What you have now
    - What you want to achieve

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Documentation Standards

- Site/Link Naming Conventions
  - Keep it simple
  - Use 3 character abbreviations for sites
    - e.g. MER, PLF, SVH
  - Assign a unique number to each site
    - e.g. MER = site 7, SVH = site 3
  - Link names based on sites being connected
    - e.g. Link SVHMER or Link MERSVH

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Documentation Standards

- IP Addresses – Management Network
  - Choose a IP block for network management
    - e.g. 10.0.0.0/16
  - Assign IP addresses as 10.0.X.Y where:
    - X = Site number, 60 reserved for loopback addresses
    - Y = 1 for Site Router (increment if more than one router)

      10 for 2.4 GHz AP with omni-directional antenna

      11, 12, .. for 2.4 GHz AP's with sector antennas

      20 for 5 GHz AP with omni-directional antenna

      21, 22, .. For 5 GHz AP's with sector antennas

      3x … For 3.65 GHz AP's

      40 Power controller

      9x … For 900 MHz AP's

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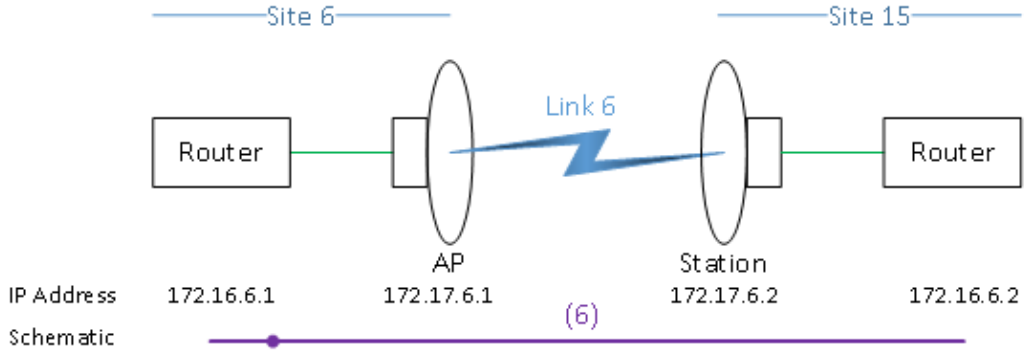
Documentation Standards

- IP Addresses – OSPF Links
  - Choose an IP subnet to be used e.g. 172.16.X.Y/30
    - Where X = Link # and Y = Device #
    - Use lowest site # for link #, if already used +100 to link #



    - (6) indicates link 6 with default OSPF cost of 10
    - (6/20) indicates link 6 with OSPF cost of 20
- IP Addresses – P2P Wireless Links
  - Choose an IP subnet to be used e.g. 172.17.X.Y/30
    - Where X = Link # and Y = Device #
    - Use lowest site # for link #, if already used +100 to link #

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Subscriber IP Addresses

- Subscriber are assigned a /32 public IP address
  - e.g. 216.206.4.5/32
- /32 Address allows 100% address utilization
  - Avoid sub-netting and out of address space issues

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OSPF Configuration Basics

- Ensure that all routers are:
  - Running the same version of RouterOS
  - Have been upgraded to the current firmware
  - Have their time zone and SNTP client configured
    - Check the Log for the correct time
    - A small router can be configured to be a NTP server
  - Set the router identity
  - Change the Ethernet port name to indicate its use
    - e.g. Change “ether2” to “ether2 – Link to Site 62”

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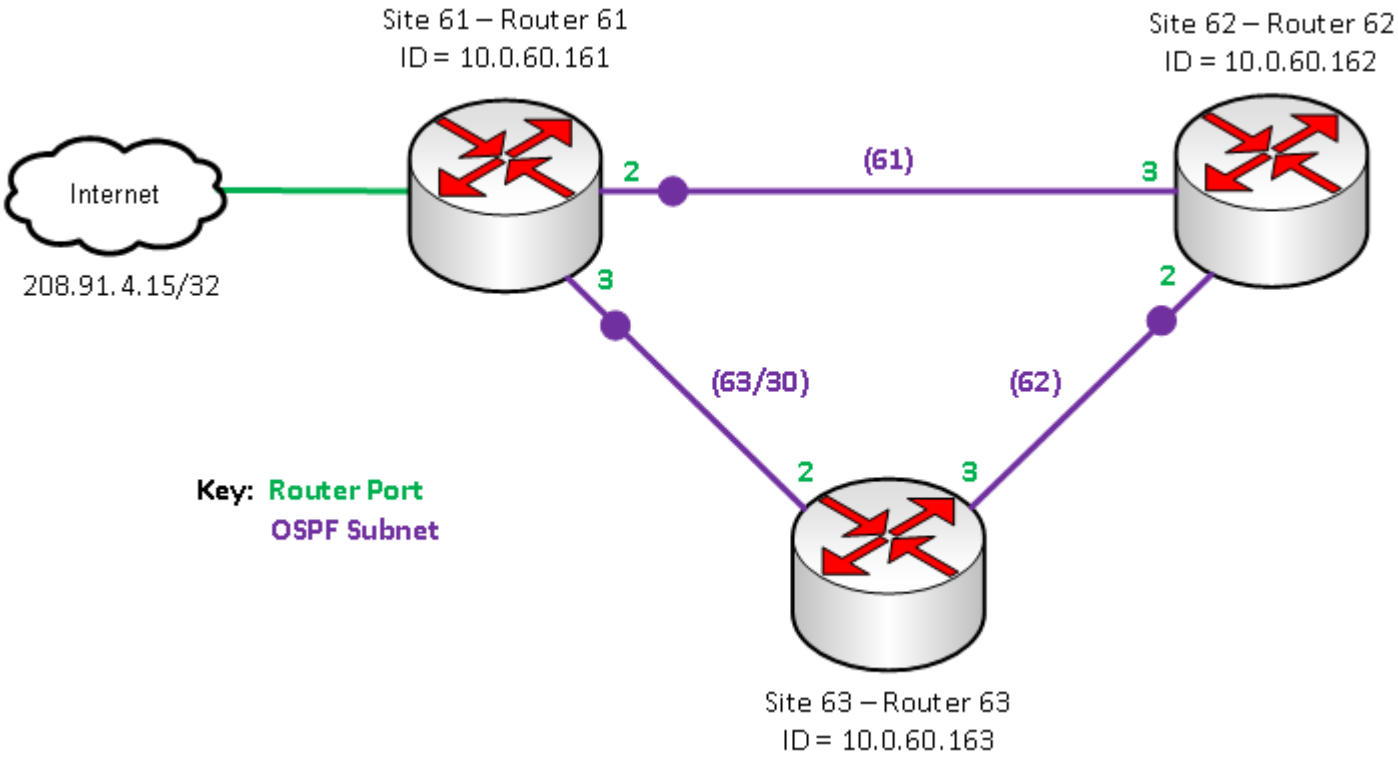
Configuring an OSPF Network

The following configuration steps illustrate the application in a three node network



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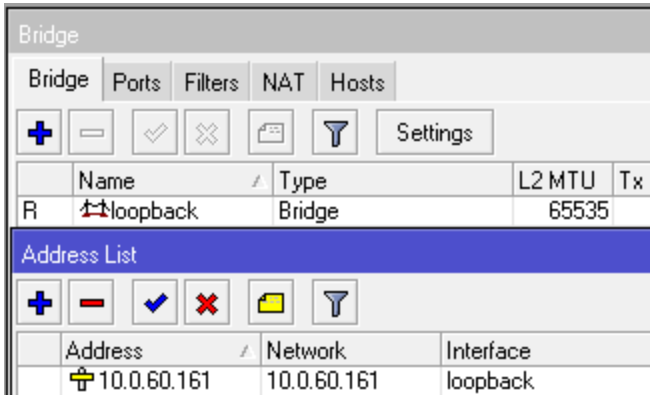
OSPF Configuration – loopback

- Router 61
  - Create “loopback” bridge
  - Add router ID as loopback address



- Repeat configuration for site 62 and 63 routers

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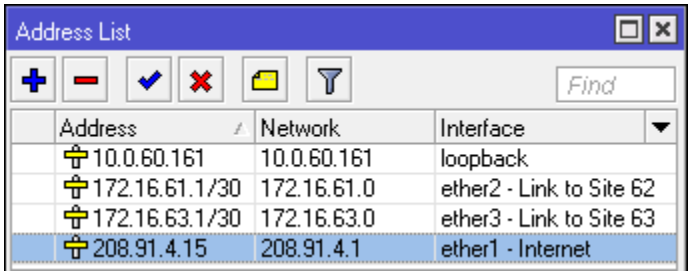
OSPF Configuration – IP Addresses

- Router 61 – Internet connection site



  - Loopback address
  - OSPF link addresses
  - Network Gateway address
    - /32 Gateway for subscriber assigned addresses
  - IP Address of your upstream provider
    - Public IP address gateway for ARIN assigned addresses

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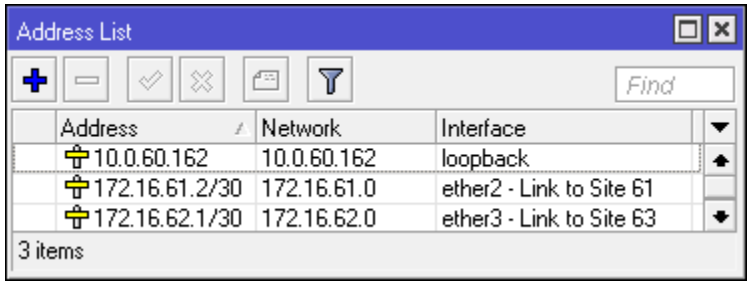
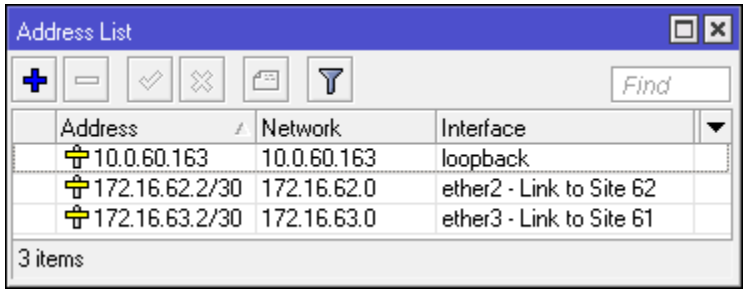
OSPF Configuration – IP Addresses

- Router 62



- Router 63



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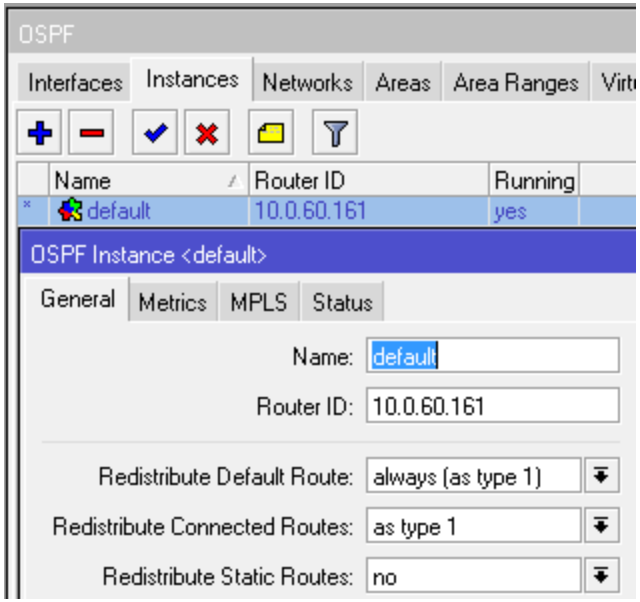
OSPF Configuration – Instances

- Router 61



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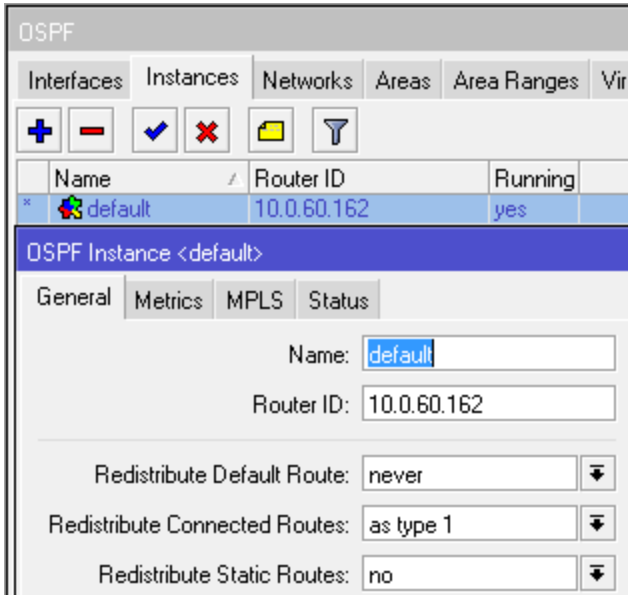
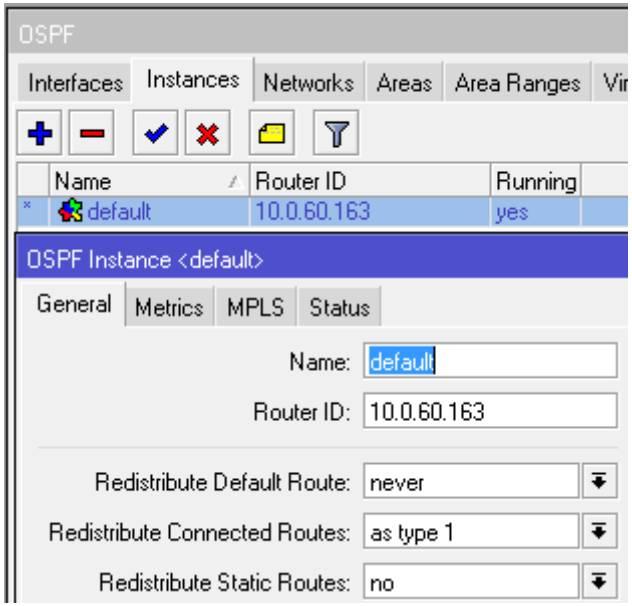
OSPF Configuration – Instances

- Router 62



- Router 63



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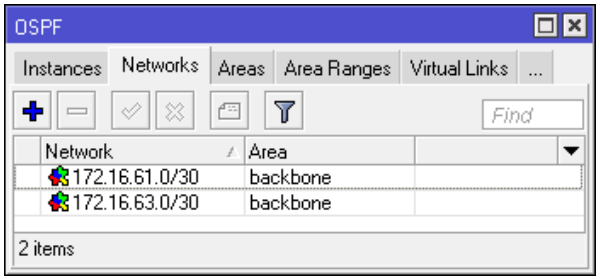
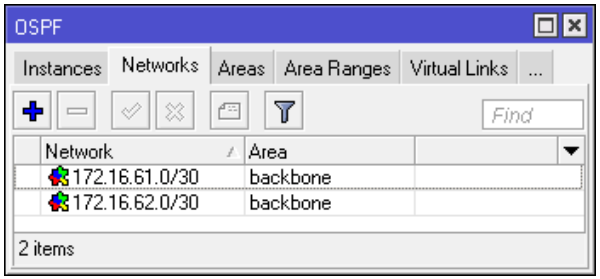
OSPF Configuration – Networks

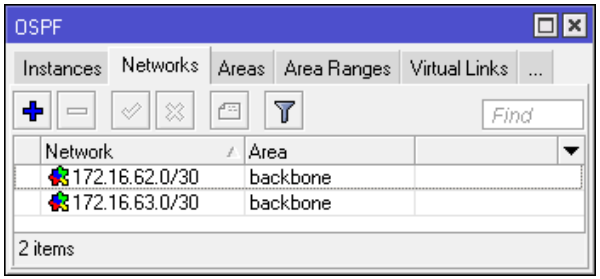
- Router 61



- Router 62



- Router 63



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Basic OSPF Configuration Complete

- At this stage you should have an operational three router OSPF network
- The status can be checked with:
  - OSPF Interfaces
  - OSPF Neighbors
  - OSPF Routes
  - OSPF LSA

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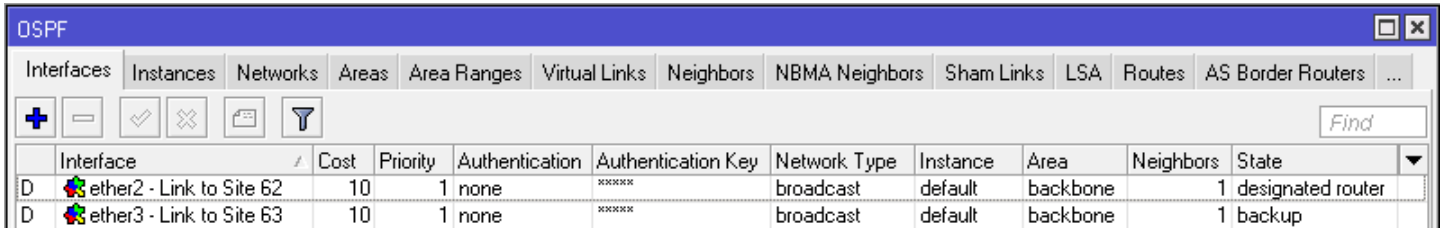
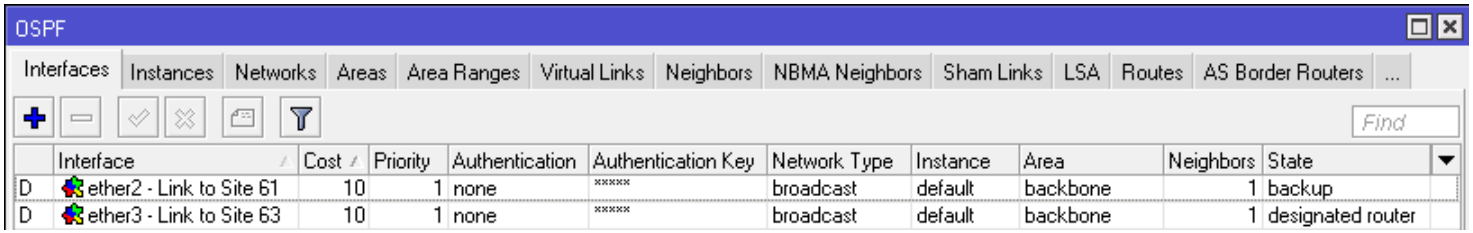
OSPF Interfaces

- Router 61

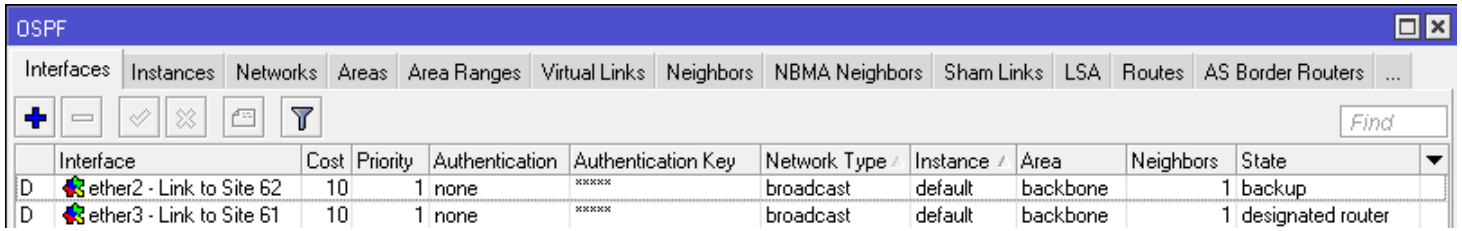


Cost != 30

- Router 62



- Router 63



Cost != 30

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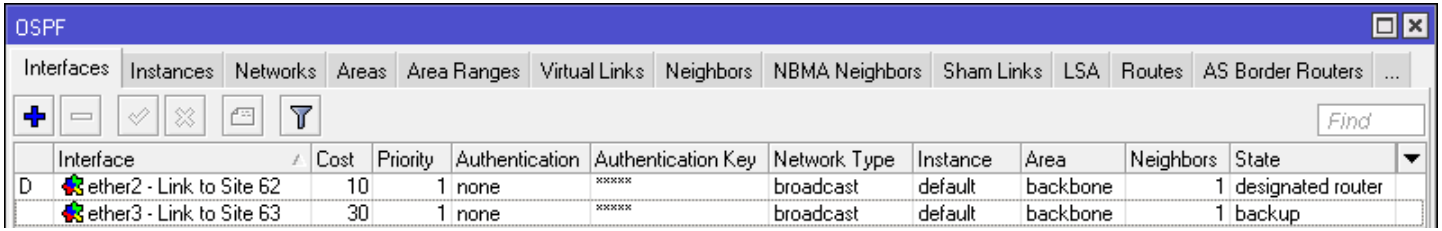
Changing Interface Cost

- Interfaces are dynamically created with a cost of 10
- To modify cost
  - Select Interface, Copy, change cost and Apply
  - Interface is replaced by statically configured one



  - Change cost must be changed at both ends of link

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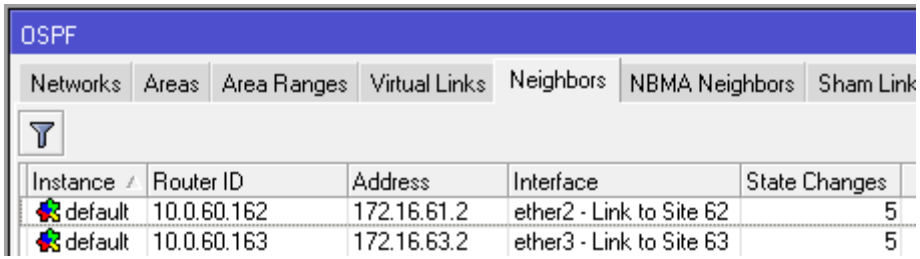
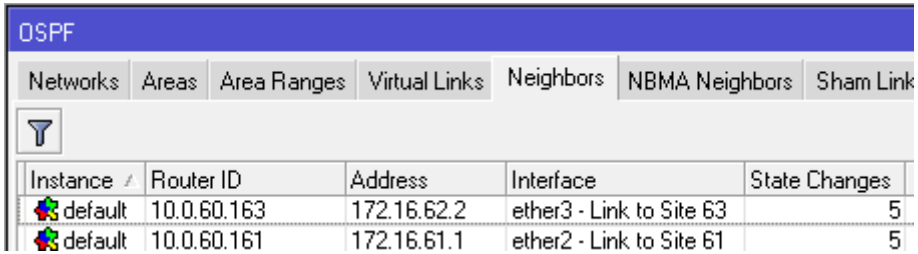
OSPF Neighbors

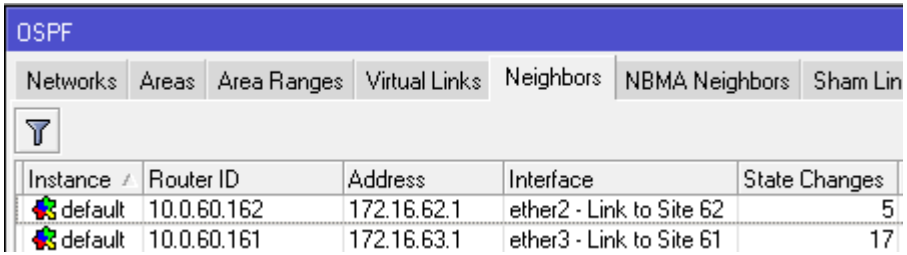
- Router 61



- Router 62



- Router 63



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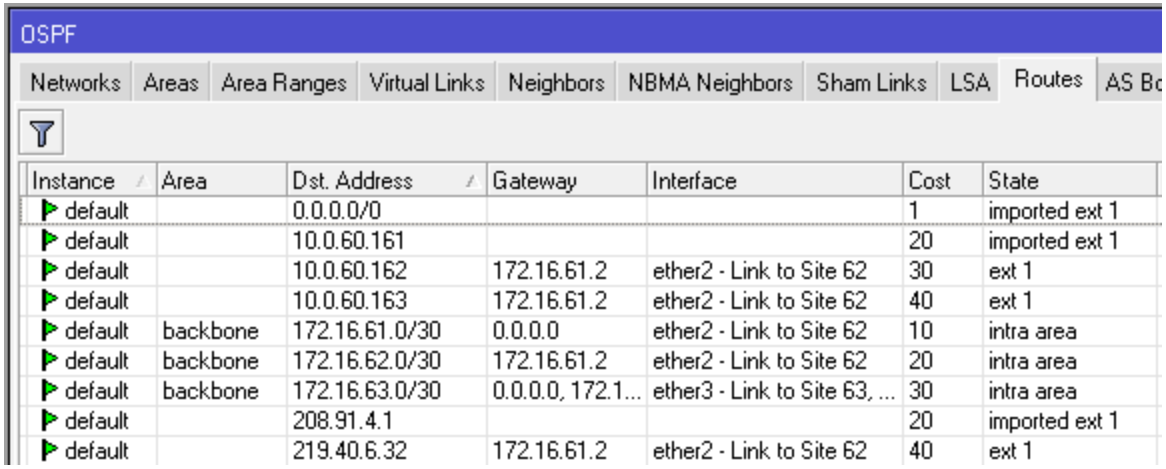
OSPF Routes – Router 61



Instance	Area	Dst. Address	Gateway	Interface	Cost	State
default		0.0.0.0/0			1	imported ext 1
default		10.0.60.161			20	imported ext 1
default		10.0.60.162	172.16.61.2	ether2 - Link to Site 62	30	ext 1
default		10.0.60.163	172.16.61.2	ether2 - Link to Site 62	40	ext 1
default	backbone	172.16.61.0/30	0.0.0.0	ether2 - Link to Site 62	10	intra area
default	backbone	172.16.62.0/30	172.16.61.2	ether2 - Link to Site 62	20	intra area
default	backbone	172.16.63.0/30	0.0.0.0, 172.1...	ether3 - Link to Site 63, ...	30	intra area
default		208.91.4.1			20	imported ext 1
default		219.40.6.32	172.16.61.2	ether2 - Link to Site 62	40	ext 1

- Route Lists shows:
  - Internet connection
  - Loopback addresses
  - OSPF networks
  - /32 connected device 219.40.6.32

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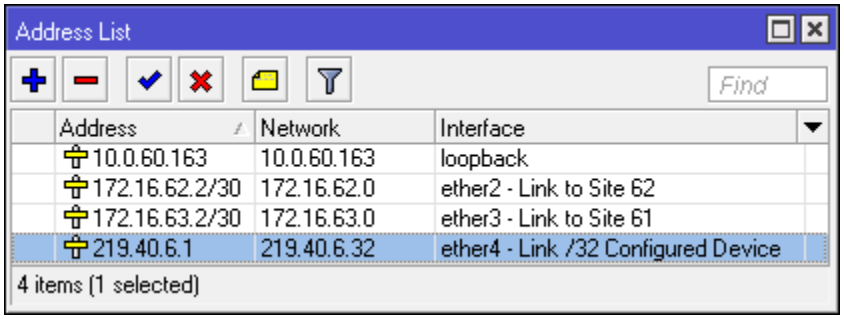
Implementing /32 Routing

- Router 63 to which subscriber is connected



  - Address = Gateway Address
  - Network = /32 Address assigned to subscriber

Note : Configure port to support proxy ARP

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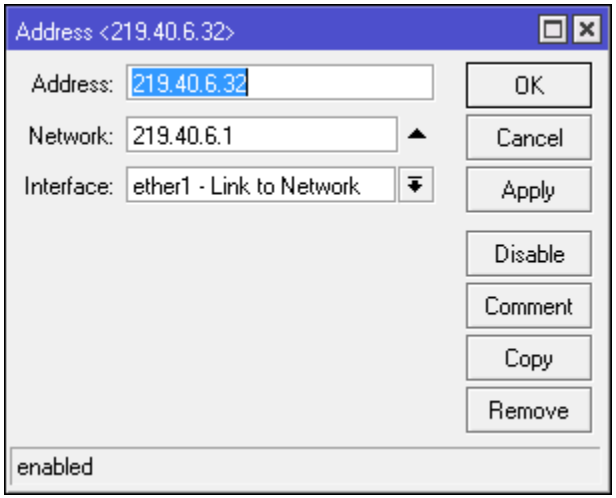
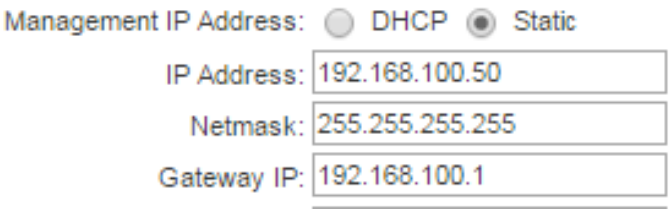
Subscriber /32 Address Configuration

- MikroTik



- Non MikroTik



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OSPF – Next Steps

- Firewall
  - OSPF uses protocol 89
- OSPF Network Type
  - broadcast, nbma, p2p or ptmp
- BFD (Bidirectional Forwarding Detection)
  - Faster link failure detection
  - Reduce recover from 10s to 8s
- Security
  - Add authentication (MD5)

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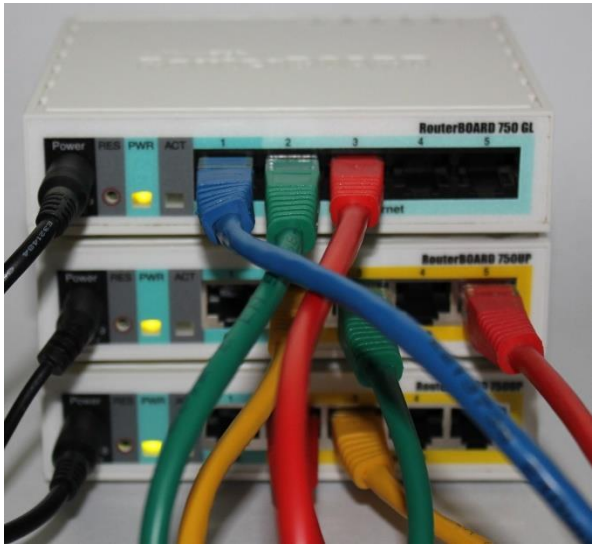
Implementation Guidelines

- Plan
  - Understand what you want to achieve
  - MikroTik MTCRE training
  - Consultant
- Document
  - Essential before configuration
- Prototype
  - Validate your plan
- Phased Approach
  - One bite at a time



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