IP Address Management

INET 2000

Network Training Workshops

Overview

- Definitions
- Principles of Addressing
- Management
- Addressing Plan Example
- References

Definitions

- Allocation and Assignment
  - Allocation
    - A block of address space held by an IR for subsequent allocation or assignment
  - Assignment
    - A block of address space used to address an operational network
    - May be provided to LIR customers, or used for an LIR's infrastructure ("self-assignment")

Definitions

- Addressing
  - *Non portable - 'Provider Aggregatable' (PA)*
    - Customer uses members' address space
    - Customer has to renumber if changing ISP
    - Only way to effectively scale the Internet
  - *Portable - 'Provider Independent' (PI)*
    - Customer gets addresses independent from ISP
    - Customer keeps addresses when changing ISP
    - Bad for size of routing tables
    - Customer may be filtered, flap dampened...

Principles of Addressing

- Separate customer & infrastructure address pools
  - Manageability
    - Different personnel manage infrastructure and assignments to customers
  - Scalability
    - Easier renumbering - customers are difficult, infrastructure is easy

Principles of Addressing

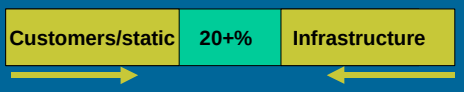
- Routing protocols
  - Use an IGP (OSPF, ISIS, EIGRP) for:
    - Carrying network infrastructure addresses used by dynamic routing protocols
  - Examples
    - Point to point addresses of backbone connections
    - Router Loopback addresses
  - Minimise what is carried in IGP for efficiency

Principles of Addressing

- IBGP
  - Carry all other network prefixes in iBGP
- Examples
  - Customer networks
  - RAS server address pools
  - Virtual web and content hosting
  - Mail, DNS servers
- IBGP can carry 100,000k prefixes

Management - Simple Network

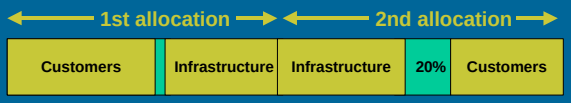
- First allocation from APNIC
  - Infrastructure is known, customers are not
  - 20% free is trigger for next request



- Grow usage of blocks from edges
- Assign customers sequentially

Management - Simple Network

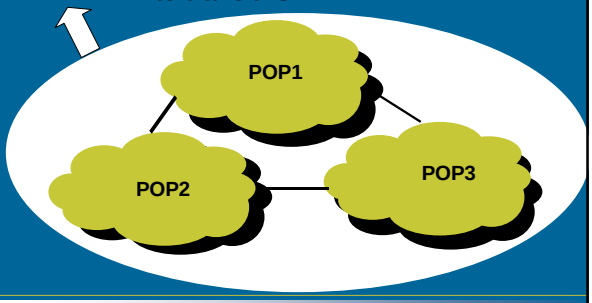
- If second allocation is contiguous



- Reverse order of division of first block
- Maximise contiguous space for infrastructure
  - Easier for debugging
- Customer networks can be discontiguous

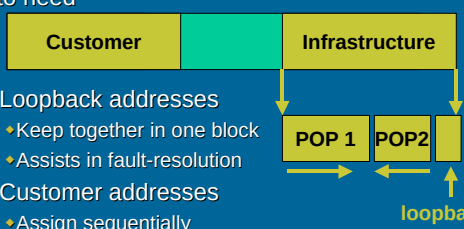
Management - Many POPs

- WAN link to transit ISP



Management - Many POPs

- POP sizes
  - Choose address pool for each POP according to need



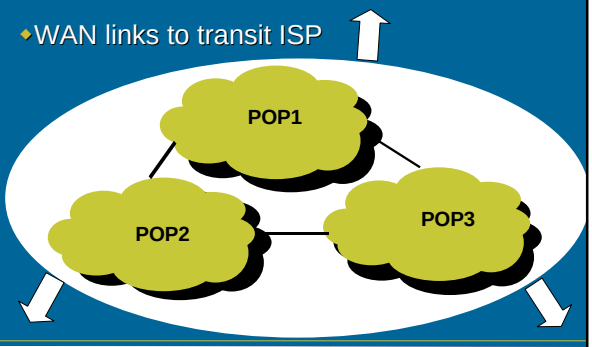
- Loopback addresses
  - Keep together in one block
  - Assists in fault-resolution
- Customer addresses
  - Assign sequentially

Management - Many POPs

- /19 minimum allocation is not enough for all your POPs?
  - Deploy addresses on infrastructure first
- Common mistake
  - Reserving customer addresses on a per POP basis
- Do not constrain network plans due to lack of address space
  - Re-apply once address space has been used

Management - Multiple Exits

- WAN links to transit ISP



Management - Multiple Exits

- Create a 'national' infrastructure pool

National Infrastructure	20% free	POP1	POP2	POP3

  - Carry in IGP
    - Eg. loopbacks, p2p links, infrastructure connecting routers and hosts which are multiply connected
  - On a per POP basis
    - Consider separate memberships if requirement for each POP is very large from day one.

Addressing Plan

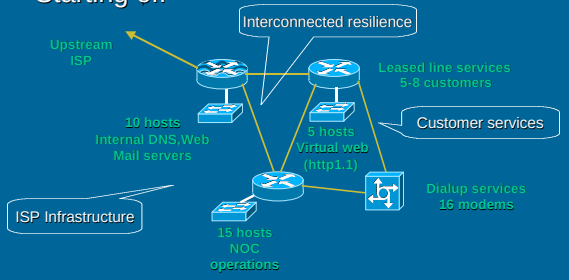
- To complete documentation
  - First need a technical PLAN
    - Documenting the architecture of the present and eventual goal
  - IP addressing is fundamental part of network design
  - IP addressing 'planning' example to follow..

Addressing Plan

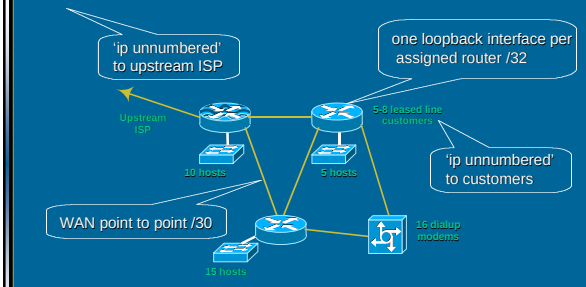
- Identify components of network
  - Customer services
  - ISP internal infrastructure
- Identify phases of deployment
  - Starting off, 6 months, 12 months
- Identify equipment and topology changes
  - Need for redundancy
  - Need for increased scale

Network Plan

- Starting off



Network Plan



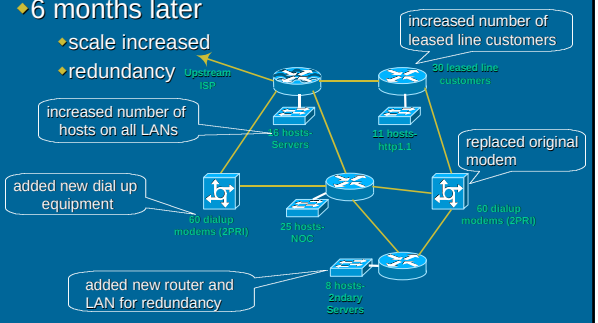
Addressing Plan

- Initial addressing plan
  - -numbers of host addresses (interfaces)

network-plan:	**16**	analogue dialup modems, vendor 'x'
network-plan:	**5**	LAN -web hosting (http1.1)
network-plan:	**128**	**5-8 leased line customers (/28)**
network-plan:	**15**	LAN -NOC and Ops management
network-plan:	**10**	LAN -mail,DNS, web servers internal
network-plan:	**4**	loopback router interfaces
network-plan:	**2**	router WAN ports
network-plan:	**2**	router WAN ports (x 5 lines)

Network Plan

- 6 months later
  - scale increased
  - redundancy



Addressing Plan

- Network plan at 6 months
  - -increases in hosts (interfaces)

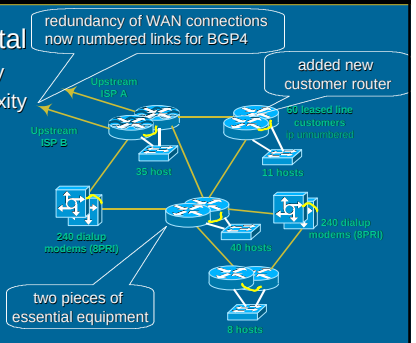
Changed description

network-plan:	16/	**60**	**2 PRI dialup modems, vendor 'y'**
network-plan:	5/	**11**	LAN -web hosting (http1.1)
network-plan:	128/	**512**	30 leased line customers (pool)
network-plan:	15/	**25**	LAN -NOC and Ops management
network-plan:	10/	**16**	LAN -mail,DNS, web servers internal
network-plan:	4/	**6**	loopback router interfaces
network-plan:	2/	**2**	router WAN ports
network-plan:	2/	**2**	router WAN ports (x 8 lines)
network-plan:	**0/**	**60**	**2 PRI dialup modems**
network-plan:	**0/**	**8**	**LAN-secondary servers**

New hardware

Network Plan

- 12 months total
  - site redundancy
  - greater complexity
  - *efficiency*



Addressing Plan

- Network plan at 12 months
  - -increases in hosts (interfaces)
  - -one year total

network-plan:	16/60/	**240**	8 PRI dialup modems, vendor x
network-plan:	0/60/	**240**	8 PRI dialup modems, vendor y
network-plan:	5/11/	**11**	LAN -web hosting (http1.1)
network-plan:	128/512/	**1024**	60 leased line customers (pool)
network-plan:	15/25/	**40**	LAN -NOC and Ops management
network-plan:	10/16/	**35**	LAN -mail,DNS, web servers internal
network-plan:	0/8/	**8**	LAN-secondary servers
network-plan:	2/2/	**2**	router WAN ports
network-plan:	2/2/	**2**	router WAN ports (x 8 lines)
network-plan:	4/6	**12**	loopback router interfaces

Addressing Plan

- Can now determine subnet sizes

network-plan:	**256**	16/60/**240**	8 PRI dialup modems, vendor x
network-plan:	**256**	0/60/**240**	8 PRI dialup modems, vendor y
network-plan:	**16**	5/11/**11**	LAN -web hosting (http1.1)
network-plan:	**1024**	128/512/**1024**	60 leased line customers (pool)
network-plan:	**64**	15/25/**40**	LAN -NOC and Ops management
network-plan:	**64**	10/16/**35**	LAN -mail,DNS, web servers internal
network-plan:	**8**	0/8/**8**	LAN-secondary servers
network-plan:	**4**	2/2/**2**	router WAN ports
network-plan:	**4**	2/2/**2**	router WAN ports (x 8 lines)
network-plan:	**16**	4/6/**12**	loopback router interfaces

Addressing Plan

- Addressing plan for network-plan
  - determination of relative subnet addresses
  - re-ordered **large to small** according to relative subnet size

network-plan:	**0.0.0.0**	1024	128/512/1024	60 leased line customers (pool)
network-plan:	**0.0.4.0**	256	16/60/240	8 PRI dial up modems, vendor x
network-plan:	**0.0.5.0**	256	0/60/240	8 PRI dial up modems, vendor y
network-plan:	**0.0.6.0**	64	10/16/35	LAN -mail,DNS, web internal
network-plan:	**0.0.6.64**	64	15/25/40	LAN -NOC and Ops management
network-plan:	**0.0.6.128**	16	5/11/11	LAN -web hosting (http1.1)
network-plan:	**0.0.6.144**	16	0/8/8	LAN -secondary servers
network-plan:	**0.0.6.160**	16	4/6/12	loopback router interfaces
network-plan:	**0.0.6.176**	4	2/2/2	router WAN ports (x8)

- cumulative total 0.0.6.208

Addressing Plan

- Addressing plan for network-plan
  - determination of subnet masks

network-plan:	0.0.0.0	**255.255.252.0**	1024	128/512/1024	60 leased line customers
network-plan:	0.0.4.0	**255.255.255.0**	256	16/60/240	8 PRI dial up modems, vendor x
network-plan:	0.0.5.0	**255.255.255.0**	256	0/60/240	8 PRI dial up modems, vendor y
network-plan:	0.0.6.0	**255.255.255.192**	64	10/16/35	LAN -mail,DNS, web internal
network-plan:	0.0.6.64	**255.255.255.192**	64	15/25/40	LAN -NOC & Ops management
network-plan:	0.0.6.128	**255.255.255.240**	16	5/11/11	LAN -web hosting (http1.1)
network-plan:	0.0.6.144	**255.255.255.240**	16	0/8/8	LAN -secondary servers
network-plan:	0.0.6.160	**255.255.255.240**	16	4/6/12	loopback router interfaces
network-plan:	0.0.6.176	**255.255.255.252**	4	2/2/2	router WAN ports (x 8)

Addressing Plan

- Addressing plan for network-plan
  - connect to the Internet (full-time, part-time)?

network-plan:	0.0.0.0	255.255.252.0	**YES**	1024	128/512/1024	60 leased customers
network-plan:	0.0.4.0	255.255.255.0	**PART**	256	16/60/240	8 PRI dial up modems..
network-plan:	0.0.5.0	255.255.255.0	**PART**	256	0/60/240	8 PRI dial up modems..
network-plan:	0.0.6.0	255.255.255.192	**YES**	64	10/16/35	LAN -mail,DNS, web internal
network-plan:	0.0.6.64	255.255.255.192	**YES**	64	15/25/40	LAN -NOC & Ops managemer
network-plan:	0.0.6.128	255.255.255.240	**YES**	16	5/11/11	LAN -web hosting (http1.1)
network-plan:	0.0.6.144	255.255.255.240	**YES**	16	0/8/8	LAN -secondary servers
network-plan:	0.0.6.160	255.255.255.240	**YES**	16	4/6/12	loopback router interfaces
network-plan:	0.0.6.176	255.255.255.252	**YES**	4	2/2/2	router WAN ports (x 8)

Addressing Plan

- Addressing plan complete
  - total planned for customer assignments /22
  - total planned for ISP infrastructure /24 + /23

network-plan:	0.0.0.0	255.255.252.0	YES	1024	128/512/1024	60 leased line customers
network-plan:	0.0.4.0	255.255.255.0	PART	256	16/60/240	8 PRI dial up modems..
network-plan:	0.0.5.0	255.255.255.0	PART	256	0/60/240	8 PRI dial up modems..
network-plan:	0.0.6.0	255.255.255.192	YES	64	10/16/35	LAN -mail,DNS, web internal
network-plan:	0.0.6.64	255.255.255.192	YES	64	15/25/40	LAN -NOC & Ops managemer
network-plan:	0.0.6.128	255.255.255.240	YES	16	5/11/11	LAN -web hosting (http1.1)
network-plan:	0.0.6.144	255.255.255.240	YES	16	0/8/8	LAN -secondary servers
network-plan:	0.0.6.160	255.255.255.240	YES	16	4/6/12	loopback router interfaces
network-plan:	0.0.6.176	255.255.255.252	YES	4	2/2/2	router WAN ports (x 8 lines)

- detailed, efficient and accurate

Where To Get IP Addresses

- APNIC
  - http://www.apnic.net
- ARIN
  - http://www.arin.net
- RIPE NCC
  - http://www.ripe.net
  - Membership required
- Fees are charged for services by all RIRs

Policy References

- APNIC
  - http://www.apnic.net/docs/add-manage-policy.html
- ARIN
  - http://www.arin.net/regserv/IPv4services.htm
- RIPE NCC
  - http://www.ripe.net/ripe/docs/ripe-185.html
- RFC2050: *RIR Allocation Guidelines*
  - http://ftp.apnic.net/ietf/rfc/rfc2000/rfc2050.txt

Recommended Reading

- Classless techniques
  - CIDR
    - http://ftp.apnic.net/ietf/rfc/rfc1000/rfc1517-19.txt
    - Network Addressing when using CIDR ftp://ftp.uninett.no/pub/misc/eidnes-cidr.ps.Z
    - Variable Length Subnet Table http://ftp.apnic.net/ietf/rfc/rfc1000/rfc1878.txt
- Private Address Space
  - *Address Allocation for Private Internets*
    - http://ftp.apnic.net/ietf/rfc/rfc1000/rfc1918.txt
  - Counter argument: *Unique addresses are good*
    - http://ftp.apnic.net/ietf/rfc/rfc1000/rfc1817.txt

Questions?