# VA IPv6 Addressing Plan 

Options and Final Proposal
2/28/08

## Design Considerations

- VA IPv6 address space from ARIN
- 2610:00d8::/32
- /32 is considered as an ISP address space
- Since VA is an enterprise, it acts as a service provider to its entities
- Tier 1 Internet service providers will not advertise any block longer than a / 32 between themselves, thus breaking the multihoming capability of VA
- Stateful firewall checking is a requirement
- Multi-homing and its future - Currently being discussed at IETF and multiple RFCs are being developed.
- Keep bit boundaries as clean as possible - No overlapping at nibble boundary
- IPv6 based service - still pending


## Design Considerations

- VA current infrastructure
- Overall design is still in flux - current plan is to have One-VA Net that will connect all regions and subagencies
- Design based on consistencies in the network
- Internet routing gateways
- Regions and/or maybe VISN
- Data Center consolidation
- Zones (Production/Research) - Still in evaluation
- Many different ways to carve the space out as long as plan is easy to follow by the IP address administrators
- Plan based on current known design with as many consistencies as possible


## Overall Design view/goal conceptual



## Design Option 1

- 1st design option - Break down at the Internet gateway domain (IGD)
- ARIN assigned space - 2610:d8::/32
- 2610:d8:0:/36 to 2610:d8:f000://36 - Internet gateway domain (IGD)
- IGD 1 - 2610:d8:0::/36 to 2610:d8:3000::/36
- IGD 2 - 2610:d8:4000::/36 to 2610:d8:7000::/36
- IGD 3 - 2610:d8:8000::/36 to 2610:d8:B000::/36
- IGD 4 - 2610:d8:C000::/36 to 2610:d8:F000::/36
- Zones (production/research) - 1 more bit to /37
- This creates problems - boundaries are not clear as /37 only has 2 subnets and since there are 4 bits available in that particular nibble, which has potential of 14 more subnets to be clean in a /40 boundary. Reconsider zones or expand zones to /40 nibble, which might be wastage.
- 2610:d8:01::/37 - Production for IGD 1
- 2610:d8:02::/37 - Research for IGD 1
- /38-/54 reserved for subnets as listed in the overall design view
- /55 - /64 reserved for lower stacks


## Design Option 2

- Break down at the Internet gateway domain (IGD) - change zone concept
- Overall view of the $2^{\text {nd }}$ design
- ARIN assigned space - 2610:d8::/32
- IGD boundaries 2610:d8:UVWX:/36 (This seems to be same as region, so not sure if region is needed below this)
- U is from 0-F and each region has 2 production and 2 research zones
- VISN boundaries 2610:d8:UVWX:/40 (There are total 23 VISNs, approx. about 6 VISNs in each IGD/region)
- $V$ is from 0-F for each IGD, provides max of 16 VISN in each IGD/region
- Data centers can be accommodated under this level or can be moved one above (Need discussion???)
- Next subnet boundary to accommodate facilities that belong to each VISN (170 total facilities or approx. 8 facilities per VISN)
- Can be /48-2610:d8:UVWX::/48
- WX is total of 8 bits, which gives about 256 sites per VISN, still provides plenty of growth
- Each /48 can be further divided up to /64 and that is per facility and has a potential of 65,536 subnets.


## Design Option 2

2610:d8:0VWX::/36 2610:d8:1VWX::/36 2610:d8:2VWX::/36 2610:d8:3VWX::/36

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f_{r a}
$$

Facilities in VISN 1

1. $2610: \mathrm{d} 8: 0000: /: / 48$
2. $2610: \mathrm{d} 8: 0001: / / 48$ 3. 2610:d8:0002::/48 4. 2610:d8:0003.:/48 5. 2610:d8:0004::/48 7. 2610:d8:0006::/48 8. 2610:d8:0007::/48 ।

Facilities in VISN 6 1. 2610:d8:0500:/48 2. 2610:d8:0501:/48 3. 2610:d8:0502:/48 4. 2610:d8:0503:/48
5. $2610 \cdot \mathrm{~d}: 0504 / 48$ 5. 2610:d8:0504:/48
6. $2610: \mathrm{d} 8: 0505 \cdot / 48$ 7. 2610:d8:0506:/4 8. 2610:d8:0507:/48


Facilities in VISN 7

1. 2610:d8:4000:/48 2. $2610: \mathrm{d} 8: 4001: / 48$ 3. 2610:d8:4002:/48 4. $2610: d 8: 4003: / 48$ 5. 2610:d8:4004:/48 7. 2610:d8:4006:/48 8. 2610:d8:4007:/48।

Facilities in VISN 12 , $\frac{1}{1.2610: \mathrm{d} 8: 4500: / 48}$ 1 1 2610.d8.4501:/48 $1 \quad$ 4. $2610 \cdot \mathrm{~d} 8: 4503: / 48$ 5. $2610 \cdot \mathrm{~d} 8 \cdot 4504 \cdot / 48$ 5. $2610: d 8: 4504: / 48$
6. $2610: d 8: 4505: / 48$ 7. 2610:d8:4506:/48 8. 2610:d8:4507:/48

Facilities in VISN 13 1. 2610:d8:8000:/48 2. $2610: \mathrm{d} 8: 8001 / / 48$ 3. $2610: \mathrm{d} 8: 8002: / 48$ 4. $2610: \mathrm{d} 8: 8003: / 48$ 5. $2610: \mathrm{d} 8: 8004 / 48$ 6. 2610:d8:8005:/48 7. 2610:d8:8006:/48 8. 2610:d8:8007:/48

Facilities in VISN 18 1. 2610:d8:8500:/48 2. 2610:d8:8501:/48 2610:d8:8502:/48 5. 2610dd8:8504:/48 5. 2610:d8:8504:/48 7. 2610:d8:8506:/48 8. $2610: \mathrm{d} 8: 8507: / 48$

2610:d8:CVWX::/36 2610:d8:DVWX••/36 2610:d8:EVWX::/36 2610:d8:FVWX::/36
$\qquad$

IGD 3
Begion 3 $2610: \mathrm{d} 8: 8 \mathrm{VWX}:: / 36$ 2610:d8:9VWX::/36 2610:d8•AVWX․/36 2610:d8:AVWX::/36


2610:d8:CVWX::/36


Facilities in VISN 19 Facilities in VISN 23 1. 2610:d8:C000:/48 $\quad$ I 1.2610:d8:C400:/48 $\begin{array}{lll}\text { 2. } 2610: d 8: C 001: / 48 & \text { 2. } 2610: d 8: C 401: / 48 \\ \text { 3 } 2610 \mathrm{~d}\end{array}$ \begin{tabular}{l|l}
3. 2610:d8:C002:/48 \& 3. 2610:d8:C402:/48 <br>
4. 2610:d8:C003:/48 \& 4. 2610:d8:C403:/48

 

4. $2610: d 8: C 003: / 48$ \& 4. $2610: d 8: C 403: / 48$ <br>
5. $2610: d 8: C 004: / 48$ \& 5. $2610: d 8: C 404: / 48$

 

5. 2610:d8:C004:/48 \& 5. 2610:d8:C404:/48 <br>
6. $2610: \mathrm{d} 8: \mathrm{C005} / 48$ \& , $2610: \mathrm{d} 8: \mathrm{C} 405: / 48$

 

7. $2610: \mathrm{d} 8: \mathrm{C} 006: / 48$ \& 7. 2610:d8:C406:/48
\end{tabular} $\begin{array}{lll}\text { 8. } 2610: d 8: C 007: / 48 ~ I & \text { 8. 2610:d8:C407:/48 }\end{array}$

## Design Option 2 - For Example

- For Example
- ARIN assigned space - 2610:d8://32
- IGD boundaries 2610:d8:UVWX:/36 (same as regions as there are no 4 regions in each IGD) - $U$ is from O-F
- IGD 1 production - 2610:d8:0VWX::/36 to 2610:d8:1VWX::/36
- IGD 1 research - 2610:d8:2VWX::/36 to 2610:d8:3VWX::/36
- IGD 2 production - 2610:d8:4VWX::/36 to 2610:d8:5VWX::/36
- IGD 2 research - 2610:d8:6VWX::/36 to 2610:d8:7VWX::/36
- IGD 3 production - 2610:d8:8VWX::/36 to 2610:d8:9VWX::/36
- IGD 3 research - 2610:d8:AVWX::/36 to 2610:d8:BVWX::/36
- IGD 4 production - 2610:d8:CVWX::/36 to 2610:d8:DVWX::/36
- IGD 4 research - 2610:d8:EVWX::/36 to 2610:d8:FVWX::/36
- VISN boundaries 2610:d8:UVWX:/40 (6 VISNs in each IGD/region)
- V is from 0-F
- 2610:d8:UOWX:/40-2610:d8:UFWX:/40
" For IGD 1 and VISN 1 - 2610:d8:00WX:/40
" For IGD 1 and VISN 2 - 2610:d8:01WX:/40
" For IGD 2 and VISN 7 - 2610:d8:10WX::/40
- Doesn't answer Data center (Are they global at One-VA Net)


## Design Option 2 - For Example

- For Example - continued
- Facilities boundaries 2610:d8:UVWX::/48
- WX - 8 bits provide 256 subnets
- IGD 1/VISN 1/Facilty 1 -2610:d8:0000::/48
- IGD 1/VISN 1/Facilty 2 - 2610:d8:0001::/48
- IGD 1/VISN 2/Facilty 1-2610:d8:0100::/48
- IGD 1/VISN 2/Facilty 2-2610:d8:0101::/48
- IGD 2/VISN 7/Facilty 1-2610:d8:1600::/48
- IGD 2/VISN 8/Facilty 1-2610:d8:1700::/48, etc......
- Next subnet boundary to accommodate sites that belong to each Facility, such as CBOCs and outposts - Approx. 3 to 4 CBOCs for each facility
- 2610:d8:UVWX:YZST::/56 - This is another 256 subnets under each facility, where $Y Z$ is for the CBOCs under each facility
- Each /56 can be further divided into another /64 that is another 8 bits, which gives another 256 subnets as lower stacks
- 2610:d8:UVWX:YZST::/64 - This is another 256 subnets under each CBOC, where ST is for the location under each CBOC


## Design Option 2 - Overall view

| IGD 1/VISN 1/Facilty 1-2610:d8:0000::/48 <br> CBOC 1-2610:d8:0000:00ST::/56 <br> CBOC 2-2610:d8:0000:01ST::/56 <br> CBOC 3-2610:d8:0000:02ST::/56 | IGD 1/VISN 1/Facilty 2-2610:d8:0001::/48 <br> CBOC 1-2610:d8:0001:00ST::/56 <br> CBOC 2-2610:d8:0001:01ST::/56 <br> CBOC 3-2610:d8:0001:02ST::/56 | IGD 1/VISN 1/Facilty 3-2610:d8:0002::/48 <br> CBOC 1-2610:d8:0002:00ST::/56 <br> CBOC 2-2610:d8:0002:01ST::/56 <br> CBOC 3-2610:d8:0002:02ST::/56 |
| :---: | :---: | :---: |
| IGD 2/VISN 12/Facilty 3-2610:d8:4502::/48 <br> CBOC 1-2610:d8:4502:00ST::/56 <br> CBOC 2-2610:d8:4502:01ST::/56 <br> CBOC 3-2610:d8:4502:02ST::/56 | IGD 2/VISN 12/Facilty 4-2610:d8:4503::/48 <br> CBOC 1-2610:d8:4503:00ST::/56 <br> CBOC 2-2610:d8:4503:01ST::/56 <br> CBOC 3-2610:d8:4503:02ST::/56 | IGD 2/VISN 12/Facilty 5-2610:d8:4504::/48 <br> CBOC 1-2610:d8:4504:00ST::/56 <br> CBOC 2-2610:d8:4504:01ST::/56 <br> CBOC 3-2610:d8:4504:02ST::/56 |
| IGD 3/VISN 15/Facilty $1-2610: d 8: 8200:: / 48$ <br> CBOC 1-2610:d8:8200:00ST::/56 <br> CBOC 2-2610:d8:8200:01ST::/56 <br> CBOC 3-2610:d8:8200:02ST::/56 | IGD 3/VISN 15/Facilty 2-2610:d8:8201::/48 <br> CBOC 1-2610:d8:8201:00ST::/56 <br> CBOC 2-2610:d8:8201:01ST::/56 <br> CBOC 3-2610:d8:8201:02ST::/56 | IGD 3/VISN 15/Facilty 3-2610:d8:8202::/48 <br> CBOC 1-2610:d8:8202:00ST::/56 <br> CBOC 2-2610:d8:8202:01ST::/56 <br> CBOC 3-2610:d8:8202:02ST::/56 |

IGD 4/VISN 22/Facilty 2-2610:d8:C 301::/48 CBOC 1-2610:d8:C301:00ST::/56 CBOC 2-2610:d8:C $301: 01$ ST::/56 CBOC 3-2610:d8:C301:02ST::/56

IGD 4/VISN 22/Facilty 1-2610:d8:C $300:: / 48$
CBOC 1-2610:d8:C $300: 00$ ST::/56 CBOC 2-2610:d8:C $300: 01$ ST::/56 CBOC 3-2610:d8:C300:02ST::/56



IGD 4/VISN 22/Facilty 3-2610:d8:C302••/48 CBOC 1-2610:d8:C 302 :00ST::/56 CBOC 2-2610:d8:C $302: 01$ ST $:: / 56$ CBOC 3-2610:d8:C302:02ST::/56


## Design Option 3

Breakdown at the Internet Gateway Domain (IGD)
-ARIN assigned space - 2610:d8::/32

- /36 - IGDs
-/37 - Production/Development
-/38.../40 - Reserved Nibble
-/40.../47 - VISNs
- /48.../55 - Facility
-/56.../64 - Sub-Facility


## Design Option 4

- Breakdown at the Internet Gateway Domain (IGD)
- ARIN assigned space - 2610:d8::/32
- /37 - gateway
- /36 - Each pair of gateways (4 pairs)
- /54 - Location/Facility level (except clinics)
- /55.../64 - Sub-facility/subnet level Note: Backbone ULA (Unique Local Address)
Note: /38.../40 - Production/Development


## Final Allocation



## Address Allocation

- The VA was allocated IPv6 address block 2610:d8::/32 by the American Registry for Internet Numbers (ARIN) for allocation within the enterprise.
- Figure above depicts the proposed partitioning of the total VA addressing space. Of 2 possible /33 blocks, 1 /33 block will be active and used for Production and Development.
- The remaining / 33 block will be reserved for future use. This will support network growth, enabling applications that are not yet defined, and future renumbering requirements.
- The /36 block will be used to carve eight possible gateway or IDP, four will be utilized.
- Eight /40 blocks, each representing an autonomous system AS/Major Region.
- The /48 will be allocated to each facility.
- The $/ 56$ will allocated to sub-facility
- The /64 will be allocated to subnets. In cases of lower level to the subnet, contiguous allocation of / 64 will be assigned as to maintain bit boundary.

