
G.E.E.K.6
GOVERNMENT EMPOWERING AND EMBRACING THE KICKOFF OF IPV6

Today's Objectives

- Provide a Path to Success
- Share Knowledge
- Dialog to Your Satisfaction
- Lessons Learned

Agenda

- Preliminary Planning
- Planning Team
- Executive Support
- Research
- Planning
- Addressing/Address Management
- Determine Core Network
- Planned Implementation
- IPv6 Workgroup Direction Check
- Institutional Processes
- Rehearsed Implementation
- Revise Plan
- Demonstrate Connectivity
- Results/Review
- Lessons Learned
- Specific Testing & Functions

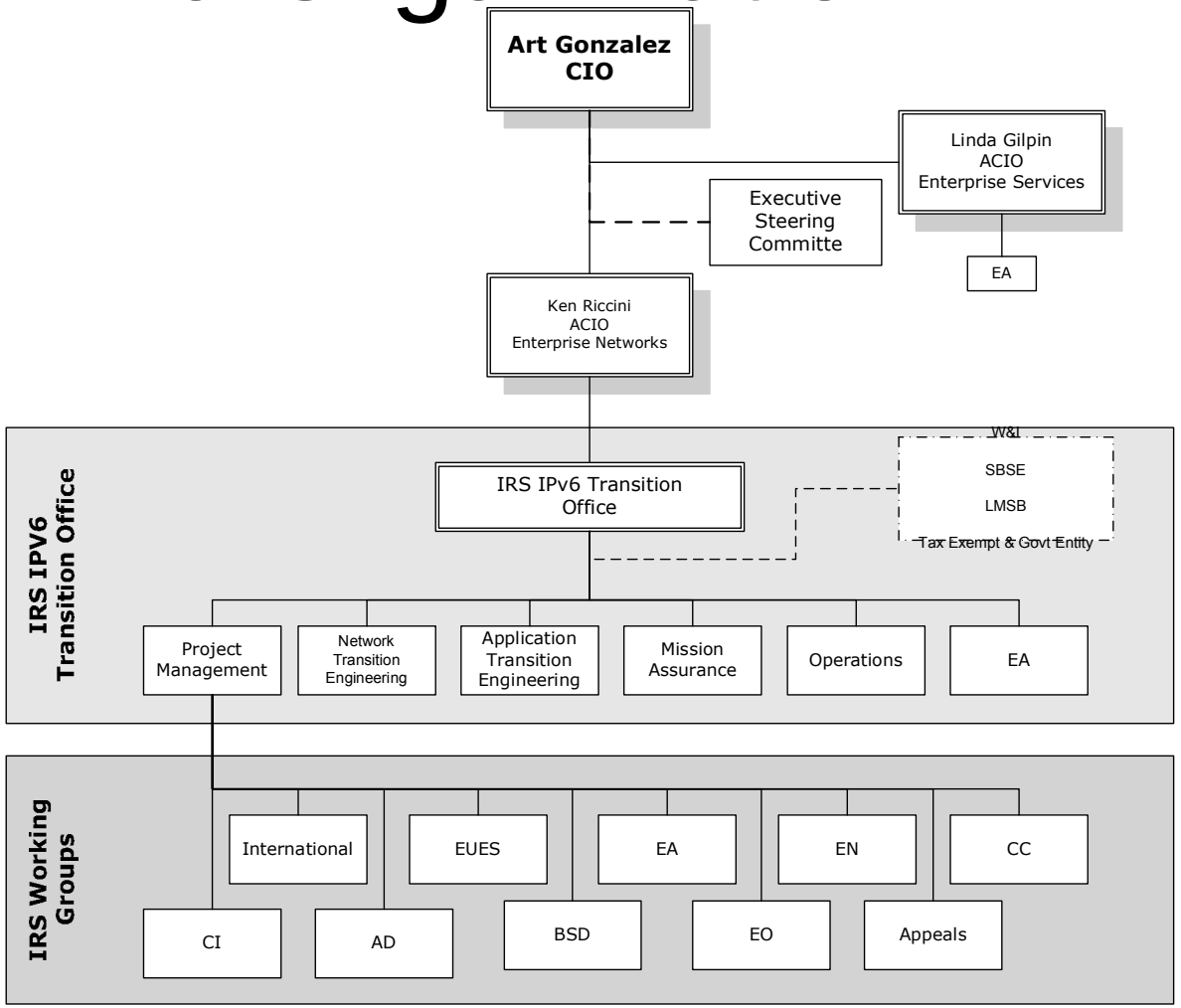
Preliminary Planning

- In the beginning –
  - “Very Focused” preliminary planning efforts
  - Understood “the big picture view”
  - Understood the need – World Competition & U.S. MUST win
  - Understood IPv6 is the future
  - Understood the objective of the requirement
  - Defined Core Network

Planning Team

- Focusing on specific skills
  - **Oversight & Collaboration**
  - **Processes & Strategic Planning**
  - **Routers & IP address management**
  - **Unix & Windows**

IRS IPv6 Organization



Executive Support

- Appointed Agency Lead
- Championed Funding Request for Lab & Additional Support
- Established Memorandum of Understanding with MITS Organizations
- Executive Steering Committee Approval

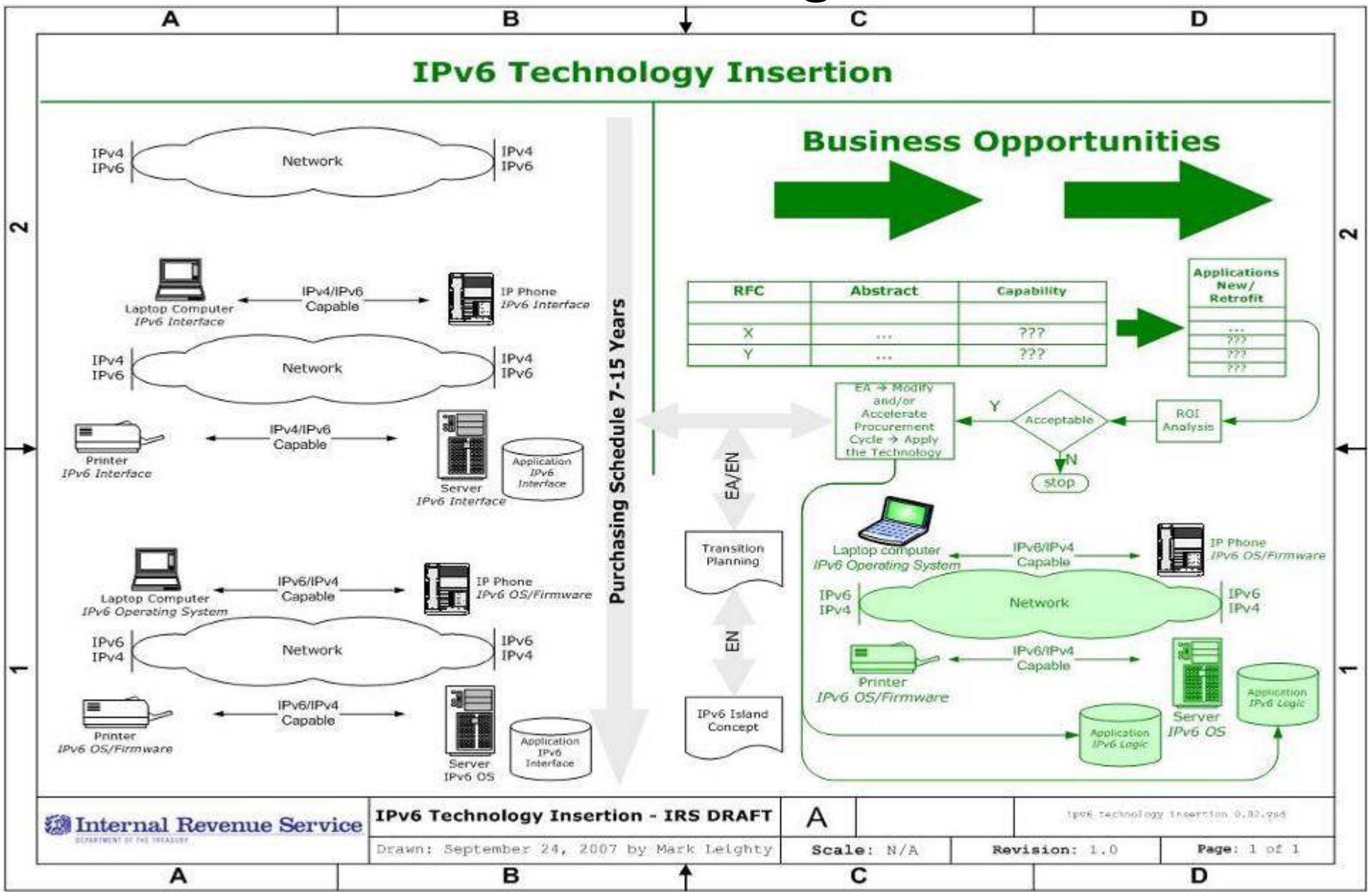
Research

- Research
  - Read RFC’s, magazines, books
  - Attended classes, seminars, webcast, etc
  - Other transition plans
  - Elevated our planning

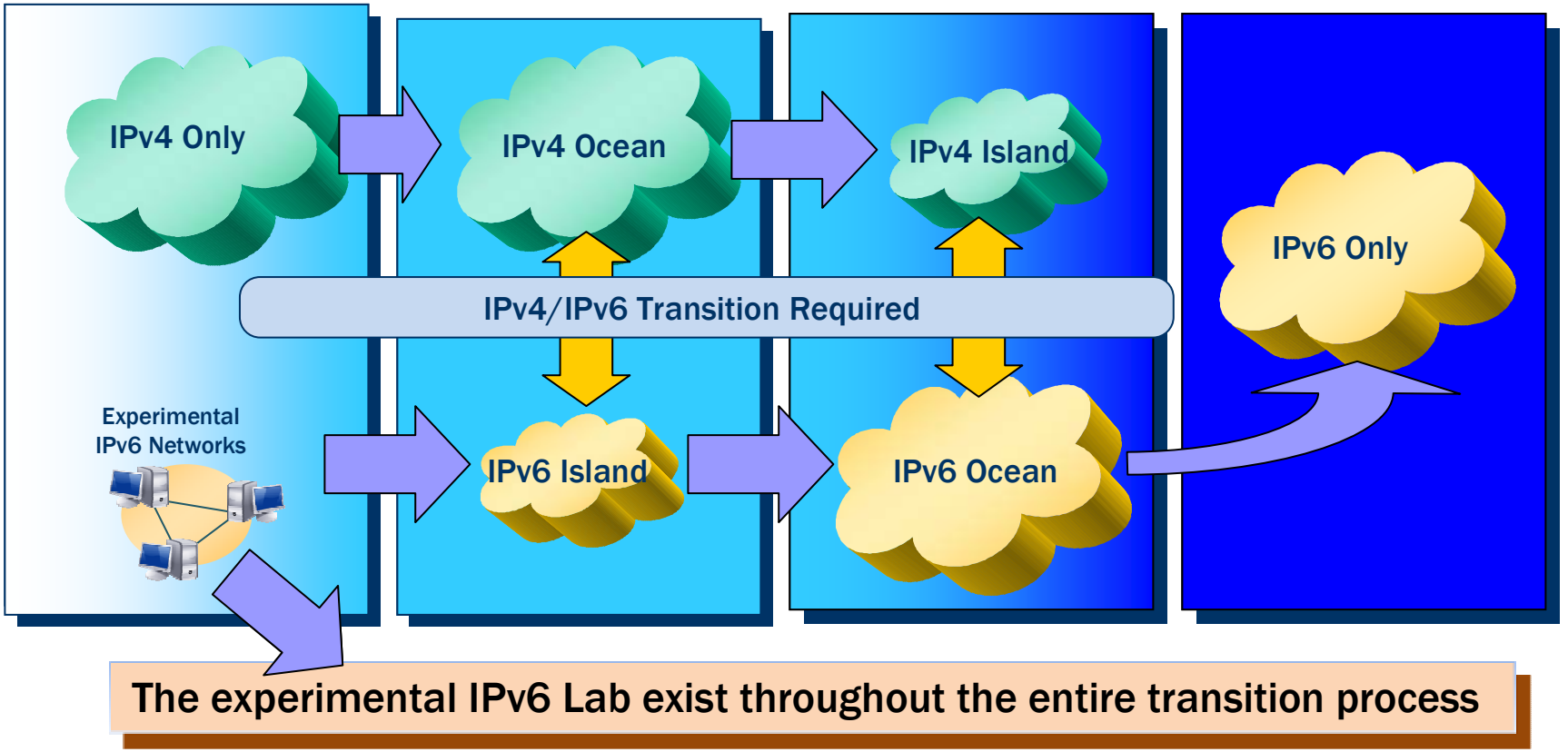
Planning

- Determining the IPv6 capability of the existing network devices
  - Performed Impact and Risk Analysis
  - Equipment Inventory
  - Designed/Built Lab
  - Developed Initial Transition Plan

Our Driving Plan …



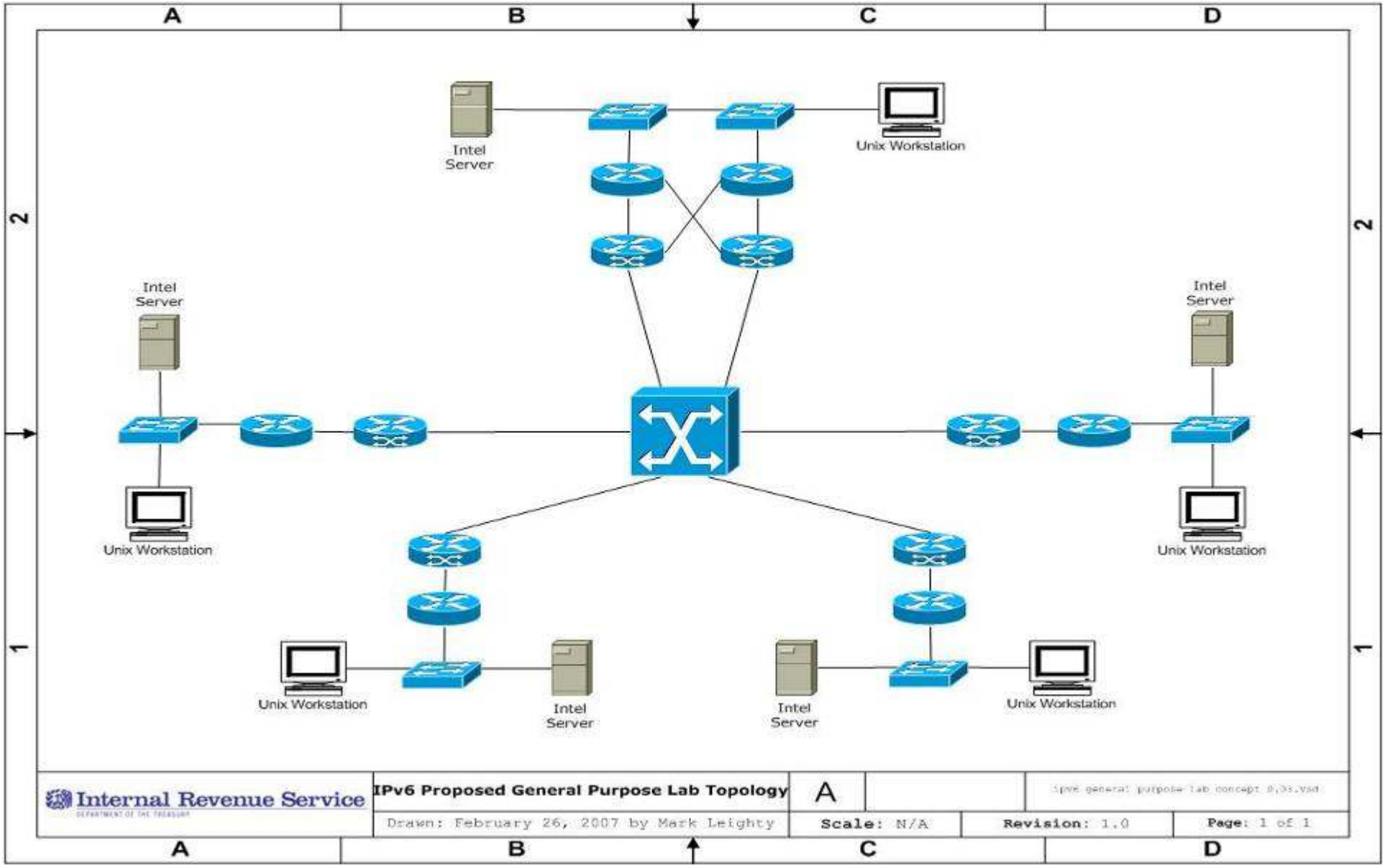
Vision-Ocean/Island Concept



LAB ……

- Setting up the test lab
  - How can IPv6 be tested without a lab?
    - No one providing approved information
    - No “how to” checklist
    - Cannot practice on live network
  - Executive support and Budget resources existed to build an IPv6 Lab
  - The IPv6 lab environment was designed and built as a scale model of the IRS Enterprise Network Core

Lab Environment…..



IP Address and Management

- IP Addresses

  2610:0030:0000:0000:0000:0000:0000:0000/32

  02/13/06

  http://www.ripe.net/rs/ipv6/stats/arin.html

  - Needed Database Management of IP Addresses
  - Developed Alternative Evaluation for IP Address Management Tool
  - Improve Productivity and Reliability

IP Address and Management

- Areas of Existing Concern
  - No big picture view
  - No central authority
  - Records kept on spreadsheets
  - Spreadsheets difficult to manage
- New Challenge
  - IPv6 addressing scheme
  - Managing IPv4 & IPv6 address space

Addressing Conventions: WAN

- Computing Center - /48
- Internet Gateway - /48
- WAN - /48
- Service Center - /54
- POD - /116

Addressing Conventions: VLAN

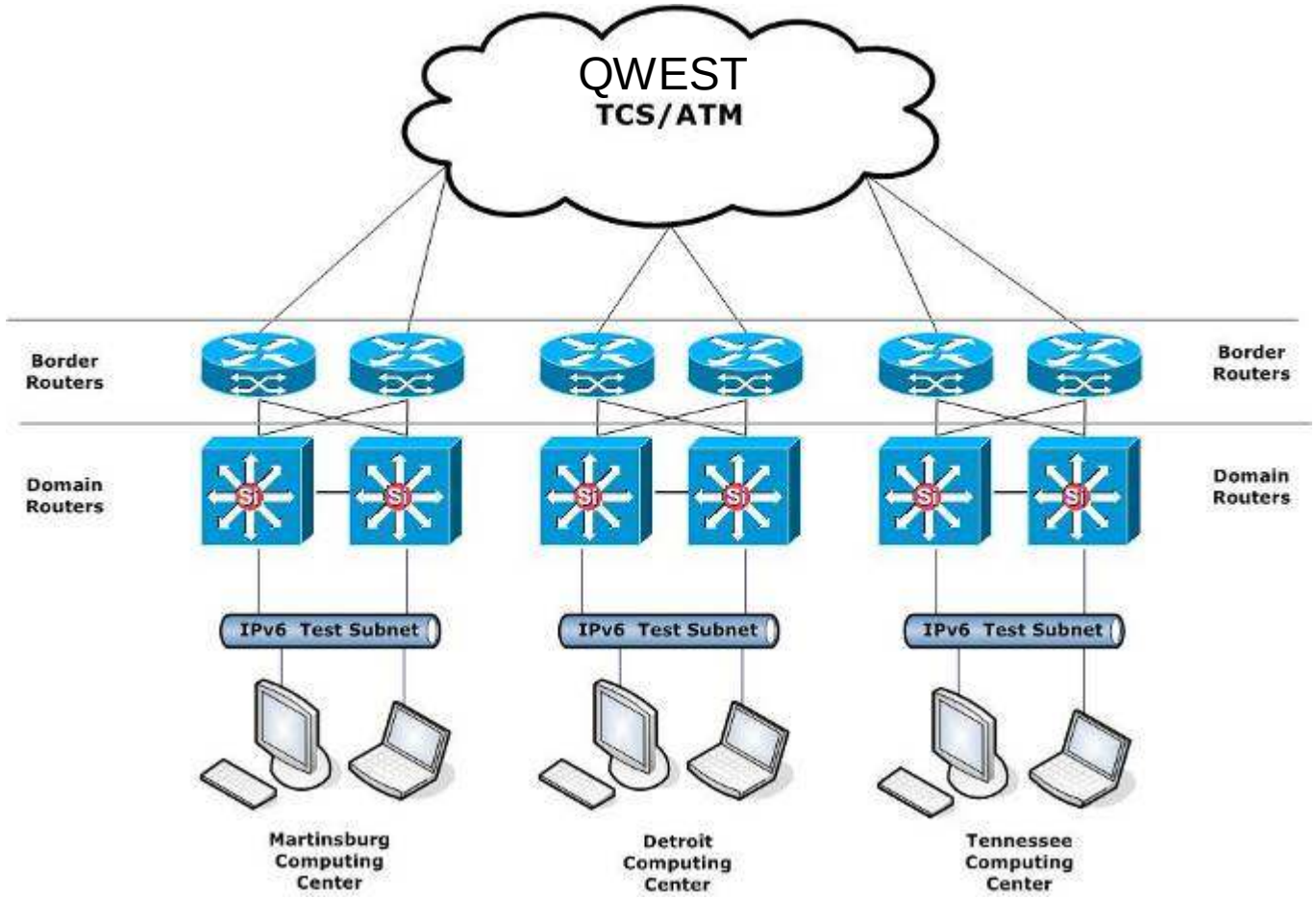
- Point-to-Point - /126
- Smallest VLAN - /120
- Test VLAN - /64
- Standard VLAN - /96

Defining Core

- Defining our core network
  - Assembled and vetted the necessary topology information from a variety of in-house sources
  - Identified core network as the topology and communications between the existing computing centers
    - ECC-Martinsburg
    - ECC-Detroit
    - ECC-Tennessee

"For the purposes of the IPv6 transition, the core network (a.k.a.backbone network) is the set of network transport devices (routers,switches) that provide the highest level of traffic aggregation in the network, and thus at the highest level of hierarchy in the network."

The Core Network…..



Planned Implementation Developed Training Plan

- **Track 1- Executives/Division Chief/Branch Chief**
  - *IPv6 Executive Overview*
  - *E-learning*
- **Track 2- Network Engineers**
  - *Building IPv6 Networks*
  - *Cisco IPv6 Fundamentals*
  - *Designing and Deploying IPv6 Networks in a Cisco Environment*
  - *IPv6 Security- Professional Development*

Training Plan

- **Track 3- Application Developers**
  - *Building IPv6 Networks*
  - *Programming for IPv6*
- **Track 4- Security Personnel**
  - *Building IPv6 Networks*
  - *Cisco IPv6 Fundamentals*
  - *IPv6 Security*
- **Track 5- Desktop Support**
  - *Building IPv6 Networks*

Planned Implementation

- Developed a Connectivity Test plan…
  - Executed in three phases
    - **Phase I** Installed IPal ™
    - **Phase II** Created IPv6 test Vlan's at each Enterprise Computing Center
    - **Phase III** Implemented Dual Stack at the Border and Domain levels

Planned Implementation

- Developed CORE Network Implementation Plan
  - – IPv6 Pre-Deployment Checklist
    - Centers
    - Devices
  - – IPv6 Pre-Deployment Critical Observations
    - ANY unique observations that are warranted, these observations should be documented
  - – IPv6 Go/No-Go Decision
    - Anomalies
  - – IPv6 Core Back-Out Checklist
    - Backout IPv6

Planned Implementation

- – IPv6 Core Support Configurations
  - Loopback Interfaces, etc
- – IPv6 Routing Protocol Configuration Checklist
  - ISIS Routing configuration
- – IPv6 Circuit Transition Checklists
  - Source Device & Interface & PVC
  - Destination Device & Interface & PVC
- – IPv6 VLAN6 Deployment Checklist
  - Limited to the Vlan differing by IP Address and Perhaps port assignment
- – IPv6 Center Border/Domain Connectivity Checklist
  - Configuration between the border & domain routing devices

Planned Implementation

CORE Requirements

Upgraded ……CORE Sites

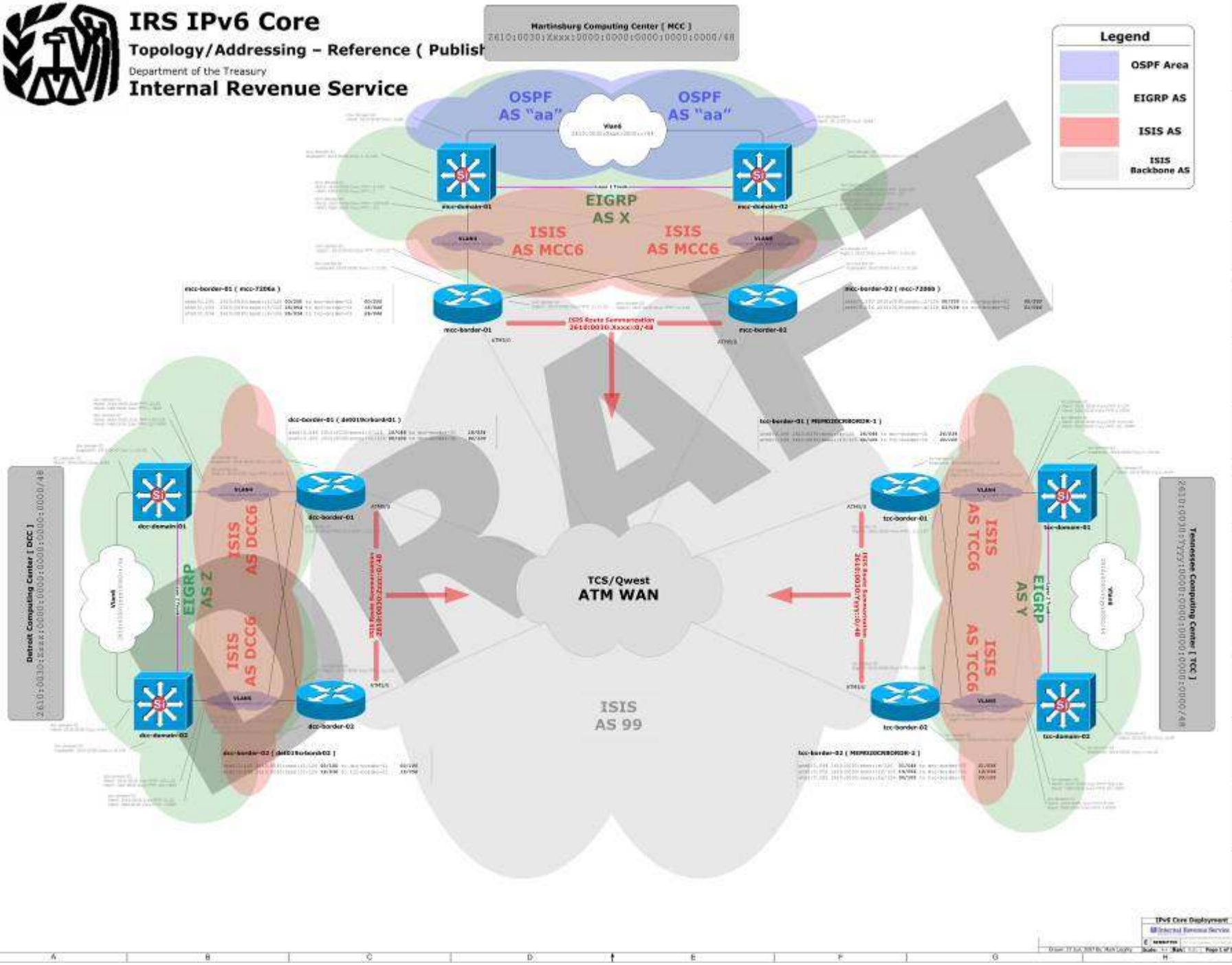
- Dual Stack Implementation
- Eliminated the use of Tunnels unless part of the infrastructure (our perspective)
- Tested IPv6 Functions and Operations

IRS IPv6 Core

Topology/Addressing – Reference (Publish

Department of the Treasury

Internal Revenue Service



IPv6 Workgroup Direction Check

- Reviewed DRAFT Test Plans
- Completed Testing Sequences in Lab

Institutional Processes

- **Approval Process …**
  - Understand the process for approval!
- Executive Steering Committees (ESC)
  - Multiple Enterprise Change Control Boards (CCB)
  - Release Readiness Review Board (RRRB)
  - Scheduling – Multiple Dates

Rehearsed Implementation

- Rehearsed in the lab
- Scripts were created for cut & paste
- Rehearsed Again … and Again … and Again …

Revise Plan

- Modified Cutover Plan
- Re-test
- Eliminated Errors

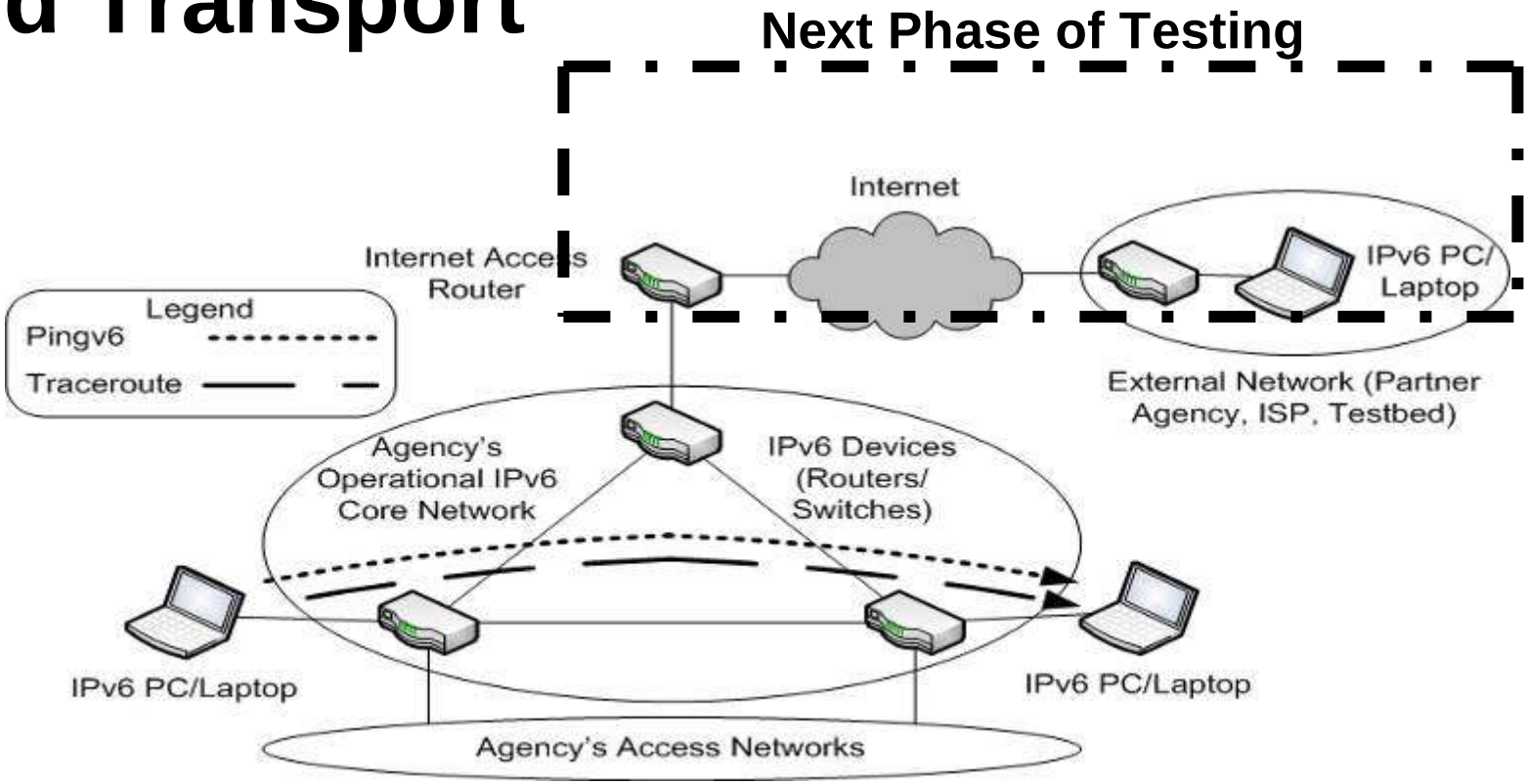
IPv6 Test Day ……

- Test Day ……. (September 8, 2007)
  - Readied our IPv6 Team
    - IPv6 Team Engineer at each site
    - IRS designated test team at each site
    - Lab Team
    - Cisco's Technical Assistance Center
    - Network Management team – standby

IPv6 Test Day ……

- Performed OMB Agency IPv6 Demonstration Plan
  - OMB appointed IPv6 Certifier – Peter Tseronis

Demonstrating Core Connectivity and Transport



Success !!!!!!

Met Real Objectives

- No interruption/corruption of services or processing
- IPv6
  - – Dual Stack – Works!!
  - – ssh works
  - – ATM Encryption
  - – DNS works
- On 9-8-2007……We made IPv6 work!!

Results/Review

Testing Pings ……

Test Day …

```
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2610:30:6000:1::1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/32/36 ms


Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2610:30:6000:FFFF::10, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/33/36 ms
```

Testing DNS ……

Test Day …

```
[MCC-IPv6-svr1]/var/named>
08-Sep-2007 11:52:11.744 client 2610:30:8000::22#32821: transfer of
     '0.0.0.6.0.3.0.0.0.1.6.2.ip6.arpa/IN': AXFR started
08-Sep-2007 11:52:11.745 client 2610:30:8000::22#32821: transfer of
     '0.0.0.6.0.3.0.0.0.1.6.2.ip6.arpa/IN': AXFR ended
08-Sep-2007 11:52:11.746 client 2610:30:8000::22#32822: transfer of 'mcc6.irs6.gov/IN': AXFR started
08-Sep-2007 11:52:11.747 client 2610:30:8000::22#32822: transfer of 'mcc6.irs6.gov/IN': AXFR ended
08-Sep-2007 12:02:20.180 zone dcc6.irs6.gov/IN: refresh: retry limit for master 2610:30:8000::22#53
     exceeded (source ::#0)
08-Sep-2007 12:02:20.180 zone dcc6.irs6.gov/IN: Transfer started.
08-Sep-2007 12:02:43.863 transfer of 'dcc6.irs6.gov/IN' from 2610:30:8000::22#53: connected using
     2610:30:6000::22#32909
08-Sep-2007 12:02:43.966 zone dcc6.irs6.gov/IN: transferred serial 1
08-Sep-2007 12:02:43.966 transfer of 'dcc6.irs6.gov/IN' from 2610:30:8000::22#53: end of transfer
08-Sep-2007 12:02:49.705 zone 0.0.0.8.0.3.0.0.0.1.6.2.ip6.arpa/IN: Transfer started.
08-Sep-2007 12:02:49.739 transfer of '0.0.0.8.0.3.0.0.0.1.6.2.ip6.arpa/IN' from 2610:30:8000::22#53:
     connected using 2610:30:6000::22#32910
08-Sep-2007 12:02:49.820 zone 0.0.0.8.0.3.0.0.0.1.6.2.ip6.arpa/IN: transferred serial 1
08-Sep-2007 12:02:49.820 transfer of '0.0.0.8.0.3.0.0.0.1.6.2.ip6.arpa/IN' from 2610:30:8000::22#53: end
     of transfer
```

Testing DNS ……

Test Day …

```
[MCC-IPv6-svr1]/var/named>
[MCC-IPv6-svr1]/var/named>dig @2610:0030:7000::22 -6 tcc-border-01.tcc6.irs6.>

; <<>> DiG 9.4.1-P1 <<>> @2610:0030:7000::22 -6 tcc-border-01.tcc6.irs6.gov AAAA
; (1 server found)
;; global options:  printcmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 1533
;; flags: qr aa rd; QUERY: 1, ANSWER: 1, AUTHORITY: 1, ADDITIONAL: 1
;; WARNING: recursion requested but not available

;; QUESTION SECTION:
;tcc-border-01.tcc6.irs6.gov.   IN      AAAA

;; ANSWER SECTION:
tcc-border-01.tcc6.irs6.gov. 10800 IN   AAAA    2610:30:7000:ffff::1

;; AUTHORITY SECTION:
tcc6.irs6.gov.          10800   IN      NS      dns6-tcc-01.tcc6.irs6.gov.

;; ADDITIONAL SECTION:
dns6-tcc-01.tcc6.irs6.gov. 10800 IN     AAAA    2610:30:7000::22

;; Query time: 31 msec
;; SERVER: 2610:30:7000::22#53(2610:30:7000::22)
;; WHEN: Sat Sep  8 11:36:53 2007
;; MSG SIZE  rcvd: 127
```

Testing Trace Route ……

```
mtb012crbordr01(tcl)#tclsh

mtb012crbordr01(tcl)#foreach address {
+>2610:30:6000:1::1
+>2610:30:6000:FFFF::10
+>2610:30:6000:FFFF::111
+>2610:30:FF00::9
+>2610:30:FF00::5
+>2610:30:FF00::1
+>2610:30:6000:1::2
+>2610:30:6000:FFFF::2
+>2610:30:6000:FFFF::103
+>2610:30:FF00::D
+>2610:30:FF00::2
+>2610:30:6000:1::3
+>2610:30:6000:FFFF::110
+>2610:30:6000:FFFF::11
+>2610:30:6000::2
+>2610:30:6000:1::4
+>2610:30:6000:FFFF::102
+>2610:30:6000:FFFF::3
+>2610:30:6000::3
+>2610:30:7000:1::1
+>2610:30:7000:FFFF::10
+>2610:30:7000:FFFF::111
+>2610:30:FF00::A
+>2610:30:7000:1::3
+>2610:30:7000:FFFF::110
+>2610:30:7000:FFFF::11
+>2610:30:FF00::E
+>2610:30:FF00::16
+>2610:30:7000:1::2
+>2610:30:7000:FFFF::1
+>2610:30:7000:FFFF::101
+>2610:30:7000::1
```

Testing Trace Route ……

```
+>2610:30:8000:1::1
+>2610:30:8000:FFFF::10
+>2610:30:8000:FFFF::111
+>2610:30:FF00::6
+>2610:30:8000:1::3
+>2610:30:8000:FFFF::110
+>2610:30:8000:FFFF::11
+>2610:30:FF00::15
+>2610:30:8000:1::2
+>2610:30:8000:FFFF::2
+>2610:30:8000:FFFF::103
+>2610:30:8000:1::4
+>2610:30:8000:FFFF::102
+>2610:30:8000:FFFF::3
+>2610:30:8000::5
+>} {
+>puts "\n\n\n"
+>Traceroute $address
+>}



Type escape sequence to abort.
Tracing the route to 2610:30:6000:1::1

  1 2610:30:6000:1::1 0 msec 0 msec 4 msec



Type escape sequence to abort.
Tracing the route to 2610:30:6000:FFFF::10
```

Testing Trace Route …….

```
1 2610:30:6000:FFFF::10 0 msec 0 msec 0 msec



Type escape sequence to abort.
Tracing the route to 2610:30:6000:FFFF::111

  1 2610:30:6000:FFFF::111 0 msec 4 msec 0 msec



Type escape sequence to abort.
Tracing the route to 2610:30:FF00::9

  1 2610:30:FF00::9 0 msec 4 msec 0 msec



Type escape sequence to abort.
Tracing the route to 2610:30:FF00::5

  1 2610:30:FF00::5 0 msec 4 msec 0 msec
```

Lessons Learned

- **Approval Process …**
  - Understand the process for approval!
  - Just in case you missed it “Understand the process for approval”
  - Executive Steering Committees (ESC)
  - Multiple Enterprise Change Control Boards (CCB)
  - Release Readiness Review Board (RRRB)
  - Scheduling – Multiple Dates
  - Executive support/trust existed when necessary based on past initiatives

Lessons Learned

- Eliminate Surprises
  - Identify all processes for approval
  - Communicate changes to management, security, and approval boards prior to implementation/deployment
  - Minimize scheduling conflicts
  - Start from a common baseline (trust but verify)
  - Notify all peripheral team members

Lessons Learned

- Identify testing participants and their roles
- Develop a well defined testing script that is understood by all participants
- Perform a dress rehearsal prior to the test
- Designate a strong knowledgeable testing host/facilitator to control the testing process (their word is law)
- Designate a scribe

Lessons Learned

- Document Test results
- Conduct Post-Mortem

Routing Protocols

Routing Protocols

- EIGRP
- ISIS
- BGP

System Configuration

- Cisco 7206/NPEG2
- Cisco IOS 12.4(11T)

EIGRP IPv4

- **router eigrp 1**
  network 192.168.10.0 0.0.0.255
  no auto-summary
  no shutdown

- **interface Gigabitethernet 0/1**
  ip address 192.168.10.1 255.255.255.0
  no shutdown

EIGRP v6

- **ipv6 router eigrp 1**
  summary-address 2001:1099:1040::/48
  redistribute static route-map METRICS

EIGRP v6

- **Ipv6 unicast-routing**
  ipv6 cef

- **interface Gigabitethernet 0/1**
  ip address 2001:100::1/120
  ipv6 address fe80:100::1 link-local
  ipv6 router eigrp 1
  no shutdown

ISIS v4

- **router isis IRS**
  net 01.1040.1099.0576.00
  is-type level-1-2

- **interface Gigabitethernet 0/1**
  ip address 192.168.1.1 255.255.255.0
  ip router isis IRS

ISIS v6

- **router isis IRS**
  net 01.1040.1099.0576.00
  is-type level-1-2
  address-family ipv6

- **interface Gigabitethernet 0/1**
  ipv6 address 2001:100::1/120
  ipv6 router isis IRS

Real World Experiences

- EIGRP vs. ISIS
- Readiness
  - EIGRP v6 functions on routers
  - EIGRP v6 not functional on Cisco 6509 Switches
- Scalability
- Platform Independence

BGP v4

- **router bgp 1099**

  neighbor 175.1.1.1 remote as 1040

  neighbor 175.1.1.1 update-source Loopback0

  network 192.168.1.0 mask 255.255.255.0

  redistribute connected

  redistribute static

BGP v6

```
router bgp 1099
no bgp default ipv4-unicast
neighbor 2001:2007:5::1 remote as 1040
neighbor 2001:2007:5::1 update-source Loopback0

address-family ipv6
network 2001:1099:1040::/48
neighbor 2001:2007:5::1 activate
redistribute connected
redistribute static
no syncronization
```

IPv6 Route Filtering & Control

- The Song Remains the Same
  - Route Maps
  - AS Path Filtering
  - IP Prefix-List
  - Redistribution
- THEY OPERATE THE SAME IN v6 as they do currently in v4

More Real World Experiences

- Number Systems
  - Decimal (0-9)
    - 192.168.1.1/2
    - 192.168.1.5/6
    - 192.168.9/10
    - 192.168.13/14
  - Hexadecimal (0-F)
    - 2001::192.168.1.1/2
    - 2001::192.168.1.5/6
    - 2001::192.168.9/10
    - 2001::192.168.13/14

More Real World Experiences

- Addressing
  - 2001:1099:1040;;1
  - 2001:10991040::1
  - 2001:1099:1040:1
  - 2001:1099:1040.1

Solaris 10

IPv

Background …

- Sun Microsystems' Solaris has contained support for IPv6 since SunOS/Solaris 8.
- The IRS has an organization known as 'Tier 2' to support a large installed base of Sun Microsystems' Equipment
- 'The IPv6 changes do not affect the operation (or combined operation) of IPv4 with respect to Solaris Applications and/or Services

Changes …

- As the IPv6 protocol expands in the Enterprise and beyond, Operating Systems/Environments must be capable of communicating in an IPv6 environment.
- Solaris 10 is relatively mature in the IPv6 realm.

Lab Testing …

- We tested Solaris 10 in the IRS IPv6 Lab
- The testing involved the following:
  - Addressing
  - Client Server Applications
  - Routing
  - Security
  - All testing is available on the Treasury Sharepoint site in pdf format

Lab Testing …

- Hardware/Software Details …

- Hardware
  - Sun Microsystems V210
    - 1 CPU
    - 2 GB RAM
    - 2 72GB Hard Disk Drive

- Software
  - Solaris 10
  - Patch Level 118833-36
  - Various Software Packages pertinent to the IRS and Lab environments

The Details …

- There are two different ways to turn on IPv6 within Solaris
  - Installation
  - Post Installation

Installation ...

- No big deal
- Solaris 10 will ask if IPv6 support is required
- Simply follow the prompts

Post Installation …

- Update /etc/hosts appropriately

  2001:db8:100::e100 test.irsv6.gov

- Create /etc/hostname6.*dmfe0*

  addif 2001:db8:100::e100 up

- Create /etc/inet/ndpd.conf

Post Installation …

- Assign the address …

ifconfig dmfe0 inet6 addif 2001:db8:100::e100/64 plumb up

- Test the connectivity …
  - Ping

    ping –s –A inet6 2001:db8:100::1

  - traceroute

    traceroute 2001:db8:100::1

Network Security …

- A classic Solaris Security Application has been ported to IPv6.
- tcp_wrappers

```
#inetadm –M tcp_wrappers=true
#svccfg –s inetd setprop defaults/tcp_wrappers=true

/etc/hosts.allow and hosts.deny
# Ipv6 numeric address
someservice: [x:x:x::x]
# Ipv6 network
otherservice: [x:x:x::x/prefix]
```

Network Security

- The SSH implementation shipped with Solaris 10 is IPv6 capable …

[DCC-IPv6-srv1]# ssh -2 -6 -l < some account > 2001:db8:100::e100

Acceptable variations:

[DCC-IPv6-srv1]# ssh -2 -l < some account > 2001:db8:100::e100

[DCC-IPv6-srv1]# ssh -l < some account > 2001:db8:100::e100

Applications …

- Applications are being tested in the IPv6 Lab
- Notably the following applications have been successfully tested
- DNS [BIND 9.4.2]
- Apache 2.0

demo …

- Demonstration of ssh connection with IPv6

DNS (Domain Name System)

IPv

Background …

- The adoption of IPv6 has necessitated changes in the operation and configuration of Domain Name System (DNS) services.
- As with most systems, the changes are related to the 128bit address.
- ‘The IPv6 changes do not affect the operation (or combined operation) of IPv4 with respect to DNS services

Changes …

- For forward lookups …
  - IPv4 used an “A” record
  - IPv6 uses a “AAAA” record

- For reverse lookups …
  - IPv4 → PTR record/domain of in-addr.arpa
  - IPv6 → PTR record/domain of ip6.arpa

Forward Lookup …

```
; Zone file for dcc6.irs6.gov
$TTL 3h
dcc6.irs6.gov. IN SOA      dns6-dcc-01.dcc6.irs6.gov. hostmaster.dcc6.irs6.gov. (
                           01                         ; Serial Number -- Suggest format of YYMMddHHMM
                           3h                         ; Refresh after 3 hours
                           1h                         ; Retry after 1 hour
                           1w                         ; Expire after 1 week
                           1h )                       ; negative caching ttl of 1 hour
;
; Name Server Records ( NS )
;
dcc6.irs6.gov.                          IN           NS           dns6-dcc-01.dcc6.irs6.gov.
;
; Special Case for the loopback as always
;
localhost.dcc6.irs6.gov.   IN           AAAA         0000:0000:0000:0000:0000:0000:0000:0001
;
; IPv6 Address Records ( AAAA )
;
dns6-dcc-01.dcc6.irs6.gov.          IN  AAAA         2610:0030:8000:0000:0000:0000:0000:0022
dcc-border-01.dcc6.irs6.gov.        IN  AAAA         2610:0030:8000:ffff:0000:0000:0000:0001
dcc-border-02.dcc6.irs6.gov.        IN  AAAA         2610:0030:8000:ffff:0000:0000:0000:0002
dcc-domain-01.dcc6.irs6.gov.        IN  AAAA         2610:0030:8000:ffff:0000:0000:0000:0003
dcc-domain-02.dcc6.irs6.gov.        IN  AAAA         2610:0030:8000:ffff:0000:0000:0000:0004
;
; You may wish to add alias entries ( CNAME ) here
;
;somehost.dcc6.irs6.gov.   IN           CNAME        someotherhost.dcc6.irs6.gov.
```

Reverse Lookup …

```
; Zone file for 0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.8.0.3.0.0.0.1.6.2.ip6.arpa.
$TTL 3h
0.0.0.8.0.3.0.0.0.1.6.2.ip6.arpa.        IN SOA dns6-dcc-01.dcc6.irs6.gov. hostmaster.dcc6.irs6.gov. (
                                         01                        ; Serial Number -- YYMMddHHMM
                                         3h                        ; Refresh after 3 hours
                                         1h                        ; Retry after 1 hour
                                         1w                        ; Expire after 1 week
                                         1h )                      ; negative caching ttl of 1 hour

;
; Name Server Records ( NS )
;

0.0.0.8.0.3.0.0.0.1.6.2.ip6.arpa.       IN           NS           dns6-dcc-01.dcc6.irs6.gov.

;
; IPv6 Pointer Records ( PTR ) NOTE - ip6.arpa configuration
;

2.2.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.8.0.3.0.0.0.1.6.2.ip6.arpa. IN PTR dns6-dcc-01.dcc6.irs6.gov.
1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.f.f.f.f.0.0.0.8.0.3.0.0.0.1.6.2.ip6.arpa. IN PTR dcc-border-01.dcc6.irs6.gov.
2.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.f.f.f.f.0.0.0.8.0.3.0.0.0.1.6.2.ip6.arpa. IN PTR dcc-border-02.dcc6.irs6.gov.
3.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.f.f.f.f.0.0.0.8.0.3.0.0.0.1.6.2.ip6.arpa. IN PTR dcc-domain-01.dcc6.irs6.gov.
4.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.f.f.f.f.0.0.0.8.0.3.0.0.0.1.6.2.ip6.arpa. IN PTR dcc-domain-0.dcc6.irs6.gov.
```

Loopback … (special case)

```
; Zone file for 1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.ip6.arpa ( Loopback Interface )
$TTL 3h
1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.ip6.arpa. IN SOA dns6-dcc-01.dcc6.irs6.gov.
     hostmaster.dcc6.irs6.gov. (
                                        01                      ; Serial Number -- Suggest format of YYMMddHHMM
                                        3h                      ; Refresh after 3 hours
                                        1h                      ; Retry after 1 hour
                                        1w                      ; Expire after 1 week
                                        1h )                    ; negative caching ttl of 1 hour

;
; Name Server Records ( NS )
;
1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.ip6.arpa. IN NS dns6-dcc-01.dcc6.irs6.gov.

1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.ip6.arpa. IN PTR localhost.
```

named.conf … (single zone)

```
// named.conf --- IPv6 ONLY for Testing!!!
//
// revision 0.001 04Sep2007
//
// DCC - Primary
options {
      directory "/var/named";
      // query-source address * port 53;
     listen-on-v6 { any; };
};
// acl to limit DNS traffic to IPv6 at DCC, MCC, TCC ONLY!
acl "ipv6-hosts" { ::1; 2610:0030:6000::/48; 2610:0030:7000::/48; 2610:0030:8000::/48; };
// acl to restrict any zone transfers to our IPv6 Hosts
acl "ipv6-dns" { 2610:0030:6000::100; 2610:0030:7000::100; 2610:0030:8000::100; };
zone "1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.ip6.arpa" IN {
        type master;
        file "db.v6localhost";
        allow-update { none; };
};
zone "dcc6.irs6.gov" IN {
      type master;
      file "db.dcc6.irs6.gov";
      allow-update { none; };
      allow-query { ipv6-hosts; };
      allow-transfer { ipv6-dns; };
};
zone "0.0.0.8.0.3.0.0.0.1.6.2.ip6.arpa" IN {
       type master;
       file "db.2610-0030-8000";
      allow-update { none; };
      allow-query { ipv6-hosts; };
      allow-transfer { ipv6-dns; };
```

named.conf … (multi-zone 1)

```
// named.conf --- IPv6 ONLY for Testing!!!
//
// revision 0.001 04Sep2007
//
// DCC - Primary
// MCC - Secondary
// TCC - Secondary
//
options {
      //directory "/var/named";
      // query-source address * port 53;
     listen-on-v6 { any; };
};
// acl to limit DNS traffic to IPv6 at DCC, MCC, TCC ONLY!
acl "ipv6-hosts" { ::1; 2610:0030:6000::/48; 2610:0030:7000::/48; 2610:0030:8000::/48; };
// acl to restrict any zone transfers to our IPv6 Hosts
acl "ipv6-dns" { 2610:0030:6000::100; 2610:0030:7000::100; 2610:0030:8000::100; };
zone "1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.ip6.arpa" IN {
        type master;
        file "db.v6localhost";
        allow-update { none; };
};
zone "dcc6.irs6.gov" IN {
      type master;
      file "db.dcc6.irs6.gov";
      allow-update { none; };
      allow-query { ipv6-hosts; };
      allow-transfer { ipv6-dns; };
};

zone "0.0.0.8.0.3.0.0.0.1.6.2.ip6.arpa" IN {
        type master;
        file "db.2610-0030-8000";
       allow-update { none; };
       allow-query { ipv6-hosts; };
       allow-transfer { ipv6-dns; };
```

named.conf … (multi-zone 2)

```
zone "mcc6.irsv6.gov" IN {
     type slave;
     file "2nd-db.mcc6.irs6.gov";
     allow-query { ipv6-hosts; };
     allow-transfer { ipv6-dns; };
     masters { 2610:0030:6000::100; };
};

zone "0.0.0.6.0.3.0.0.0.1.6.2.ip6.arpa" IN {
        type slave;
        file "2nd-db.2610-0030-6000";
     allow-query { ipv6-hosts; };
     allow-transfer { ipv6-dns; };
     masters { 2610:0030:6000::100; };
};

zone "tcc6.irsv6.gov" IN {
     type slave;
     file "2nd-db.tcc6.irs6.gov";
     allow-query { ipv6-hosts; };
     allow-transfer { ipv6-dns; };
     masters { 2610:0030:7000::100; };
};

zone "0.0.0.7.0.3.0.0.0.1.6.2.ip6.arpa" IN {
        type slave;
        file "2nd-db.2610-0030-7000";
     allow-query { ipv6-hosts; };
     allow-transfer { ipv6-dns; };
     masters { 2610:0030:7000::100; };
};
```

nslookup … syntax

- The syntax for nslookup in IPv6 is …

```
[DCC-IPv6-srv1]/var/named>nslookup
> server
Default server: 10.1.1.21
Address: 10.1.1.21#53
> server ::1
Default server: ::1
Address: ::1#53
> set q=AAAA
> dns6-dcc-01.dcc6.irs6.gov
Server:         ::1
Address:        ::1#53

dns6-dcc-01.dcc6.irs6.gov       has AAAA address 2610:30:8000::100
```

dig … syntax

```
[MCC-IPv6-svr1]/var/named>
[MCC-IPv6-svr1]/var/named>dig @2610:0030:7000::22 -6 tcc-border-01.tcc6.irs6.gov AAAA

; <<>> DiG 9.4.1-P1 <<>> @2610:0030:7000::22 -6 tcc-border-01.tcc6.irs6.gov AAAA
; (1 server found)
;; global options:  printcmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 1533
;; flags: qr aa rd; QUERY: 1, ANSWER: 1, AUTHORITY: 1, ADDITIONAL: 1
;; WARNING: recursion requested but not available

;; QUESTION SECTION:
;tcc-border-01.tcc6.irs6.gov.   IN      AAAA

;; ANSWER SECTION:
tcc-border-01.tcc6.irs6.gov. 10800 IN   AAAA    2610:30:7000:ffff::1

;; AUTHORITY SECTION:
tcc6.irs6.gov.          10800   IN      NS      dns6-tcc-01.tcc6.irs6.gov.

;; ADDITIONAL SECTION:
dns6-tcc-01.tcc6.irs6.gov. 10800 IN     AAAA    2610:30:7000::22

;; Query time: 31 msec
;; SERVER: 2610:30:7000::22#53(2610:30:7000::22)
;; WHEN: Sat Sep  8 11:36:53 2007
;; MSG SIZE  rcvd: 127
```

demo …

- Demonstration of DNS lookup with IPv6

IPv6 Address Management

IPv6 Address Management

- Where to start?
- Large Address Space
- /32 = 79.2 Octillion Addresses (27 0's)
- Do it right, keep it organized, keep it centralized

IPv4 Address Management

- No big picture view
- No central authority
- Records kept on spreadsheets
- Spreadsheets not up to date

IP Address Management System

- Investigate and evaluate vendors
- Vendors:
  - INS: http://www.ins.com/
  - BlueCat: http://www.bluecatnetworks.com/
  - IA: http://www.internetassociatesllc.com/
- Develop a business case
- Decided on IPal™ by Internet Associates

Microsoft Testing

IPv

Microsoft Testing

Current

- Windows Server 2003
- Windows XP Professional

Future

- Windows Server 2008 (Longhorn)
- Windows Vista

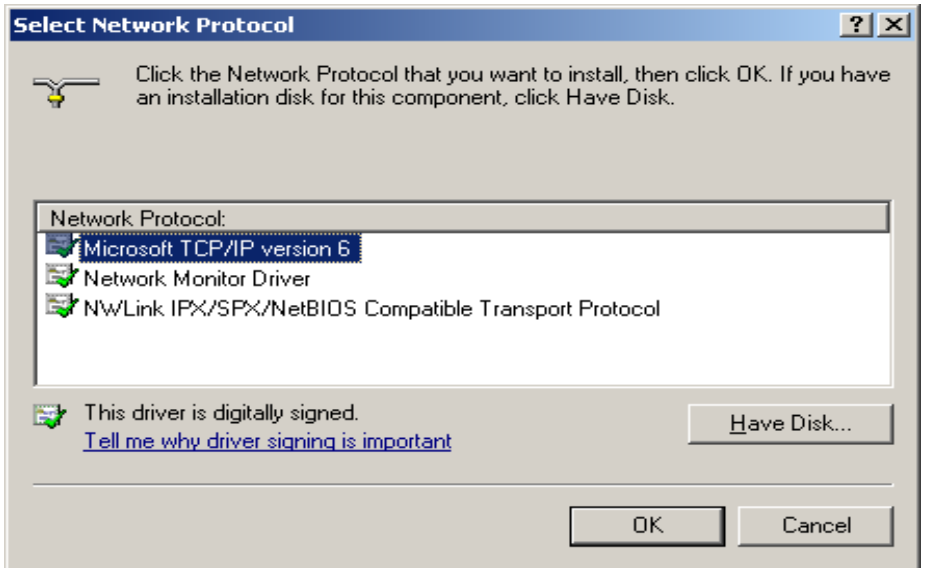
Microsoft Testing

- IPv6 – Enable/Disable
- DNS
- DHCPv6

Microsoft Testing

- IPv6 – Enable/Disable
  - Command line using NETSH command
    - netsh interface ipv6 install/uninstall
  - GUI – via “Local Area Connection Properties”
  - Installed and enabled by “default” in Windows Vista and Server 2008

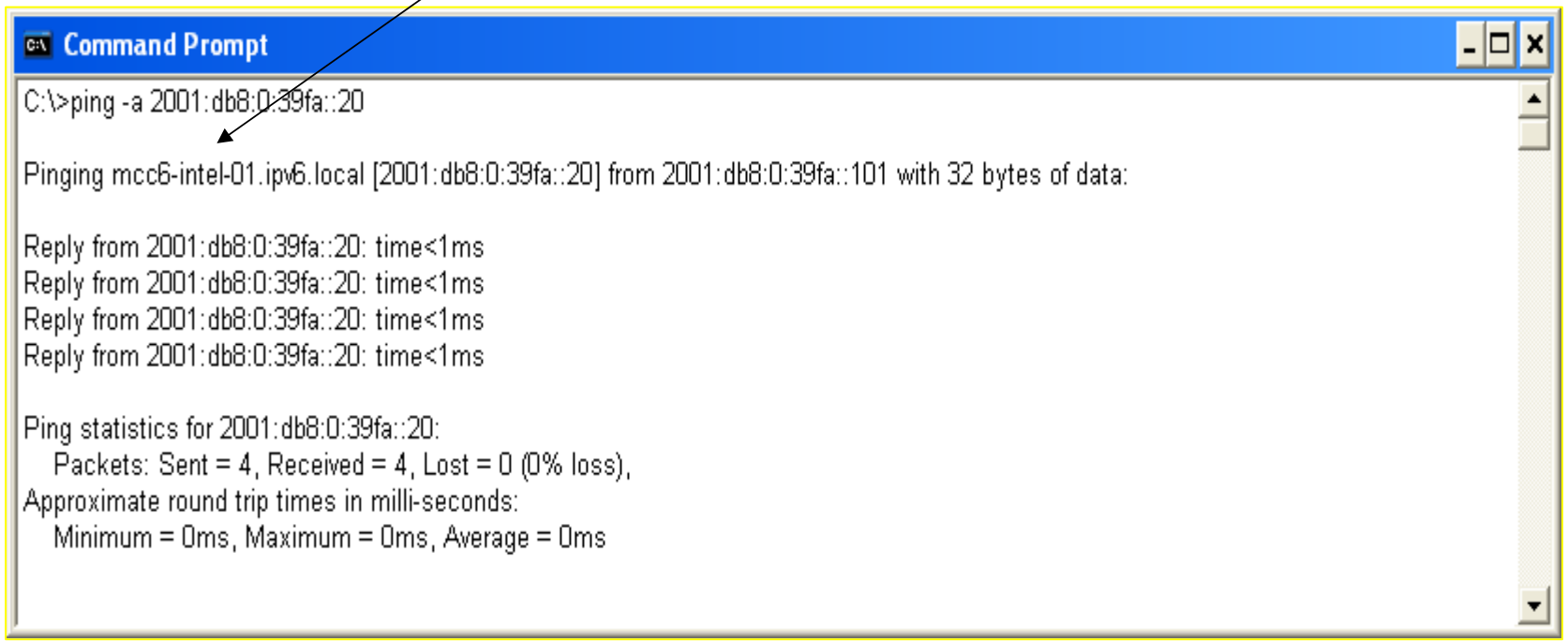
Microsoft Testing



Microsoft Testing

- DNS
  - Dynamic registration of host names
  - Reverse lookup done manually using reverse nibble notation
    - For example, for the 2001:db8:0:39fa::/64 prefix, the IPv6 reverse lookup zone name is a.f.9.3.0.0.0.0.8.b.d.0.1.0.0.2.ip6.arpa .

Microsoft Testing



Microsoft Testing

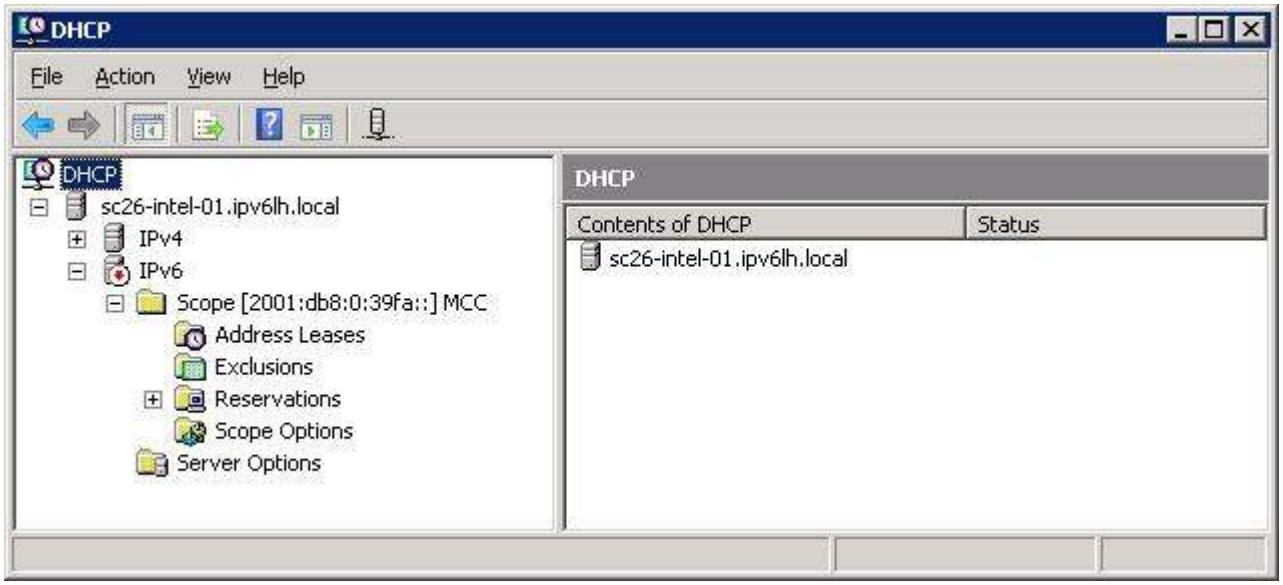
- DHCPv6
  - Not supported in Windows XP and Server 2003
    - Link local
    - Autoconfig if router advertisements are enabled
    - Manual
      - netsh interface ipv6 add address “IPv6 Lab” 2001:db8:0:39fa::20

Microsoft Testing

- DHCPv6 (continued)
  - Supported in Windows Vista and Server 2008
    - Router advertisements must be enabled
    - Managed (M) and Other (O) flags must be set on router

Microsoft Testing

- DHCPv6 (continued)



Appendix

IPv

Appendix

- Team Bio/Contact info
- Training
- IPAL
- IPv6 Federal Working Group
- IPv6 links

Team Bio/Contact info

IRS IPv6 Lab Team- 202-283-1839

Solaris/DNS-Dennis Baldwin (dennis.j.baldwin@irs.gov)
IP Address Management and Routing- Mike Calhoon (micheal.s.calhoon@irs.gov)
Routing- Keith Peterson (keith.a.peterson@irs.gov)
Microsoft-Mark Satterfield (mark.satterfield@irs.gov)

Technical Lead

Mark Leighty- 202-283-7061 (mark.leighty@irs.gov)

Business Analyst

Irv Lawson 202-283-7778 (irvin.b.lawson@irs.gov)

Project Management

David White 202-283-4654 (david.w.white@irs.gov)
Tony Zanfordino 202-283-4563 (anthony.j.zanfordino@irs.gov)

Training- Curriculum

- **Track 1- Executives/Division Chief/Branch Chief**
  - *IPv6 Executive Overview*
  - *E-learning*
- **Track 2- Network Engineers**
  - *Building IPv6 Networks*
  - *Cisco IPv6 Fundamentals*
  - *Designing and Deploying IPv6 Networks in a Cisco Environment*
  - *IPv6 Security- Professional Development*

Training- Curriculum

- **Track 3- Application Developers**
  - *Building IPv6 Networks*
  - *Programming for IPv6*
- **Track 4- Security Personnel**
  - *Building IPv6 Networks*
  - *Cisco IPv6 Fundamentals*
  - *IPv6 Security*
- **Track 5- Desktop Support**
  - *Building IPv6 Networks*

Training- Vendors

- Command Information

  www.commandinformation.com

- Sunset Learning

  www.sunsetlearning.com

- Global Knowledge

  www.globalknowledge.com

Training- E Learning and Books

- www.6diss.org/e-learning/

Book Name	Author	Cost
IPv6 Essentials	Silvia Hagen	$45.00
Understanding IPv6	Joseph Davies	$25.00
Deploying IPv6 Networks	Ciprian P. Popoviciu, et el	$50.00
IPv6, 2nd Edition: Theory, Protocol, and Practice	Peter Loshin	$40.00
Cisco Self-Study: Implementing Cisco IPv6 Networks	Regis Desmeules	$47.00
Mobile IPv6: Mobility in a Wireless Internet	Hesham Soliman	$36.00
IPv6 in Practice: A Unixer's Guide to the Next Generation Internet	Benedikt Stockebrand	$50.00
Voice Over IPv6: Architectures for Next Generation VoIP Networks	Daniel Minoli	$60.00
Migrating to IPv6: A Practical Guide	Marc Blanchet	$68.00
Running IPv6	Iljitsch van Beijnum	$28.66

IPal.net Enterprise

The network engineer in a box

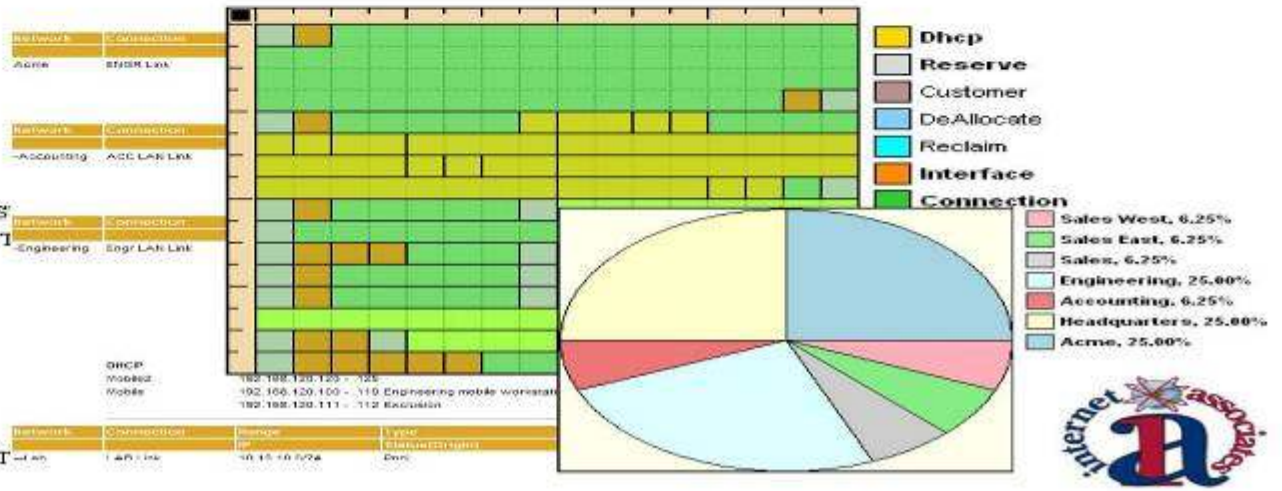
Proper addressing is vital to your network performance. Ensure the accuracy and efficiency of your IP addresses with full IP address life cycle management from **IPal.net Enterprise** by Internet Associates.

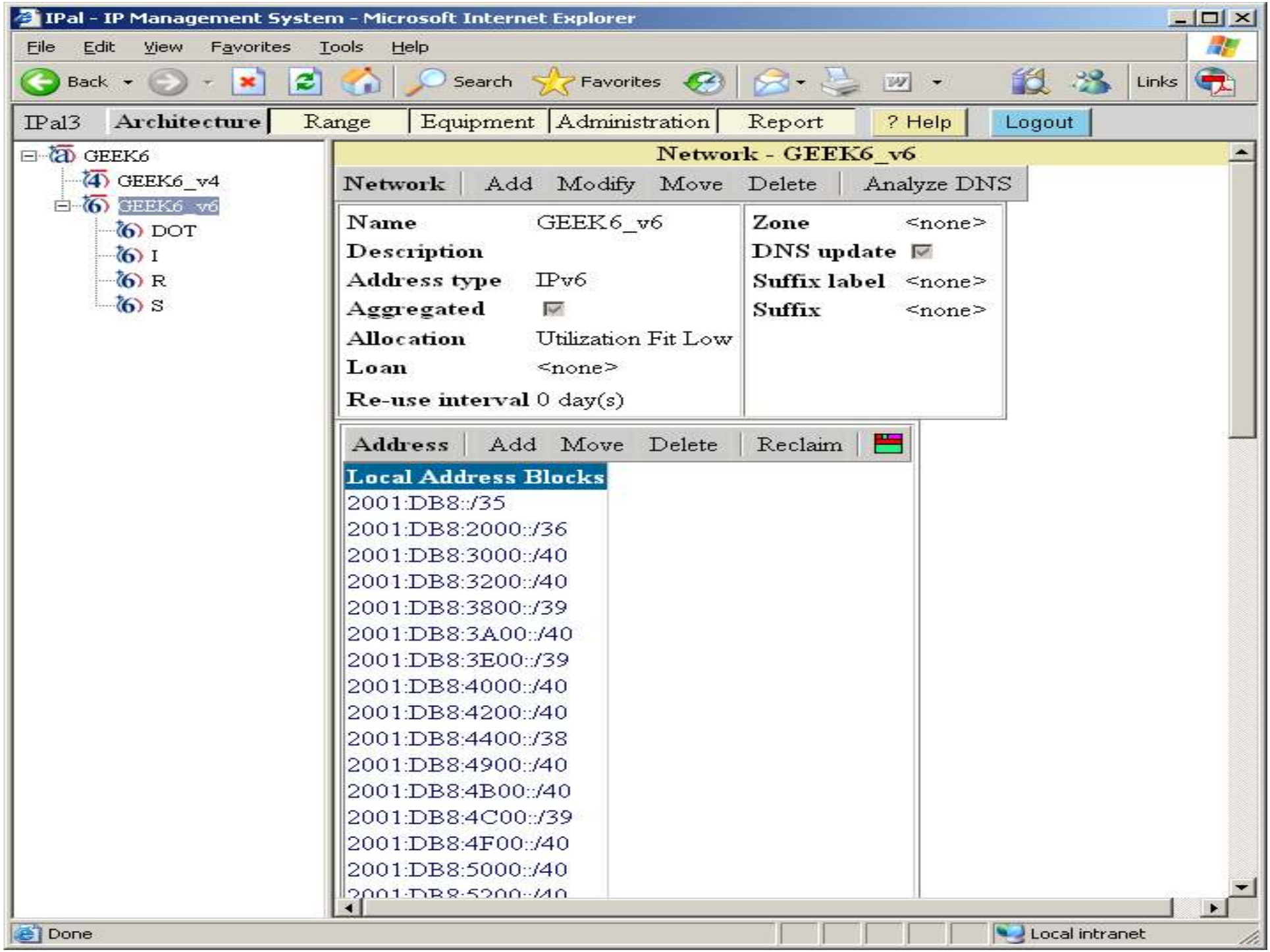
IPal.net is...

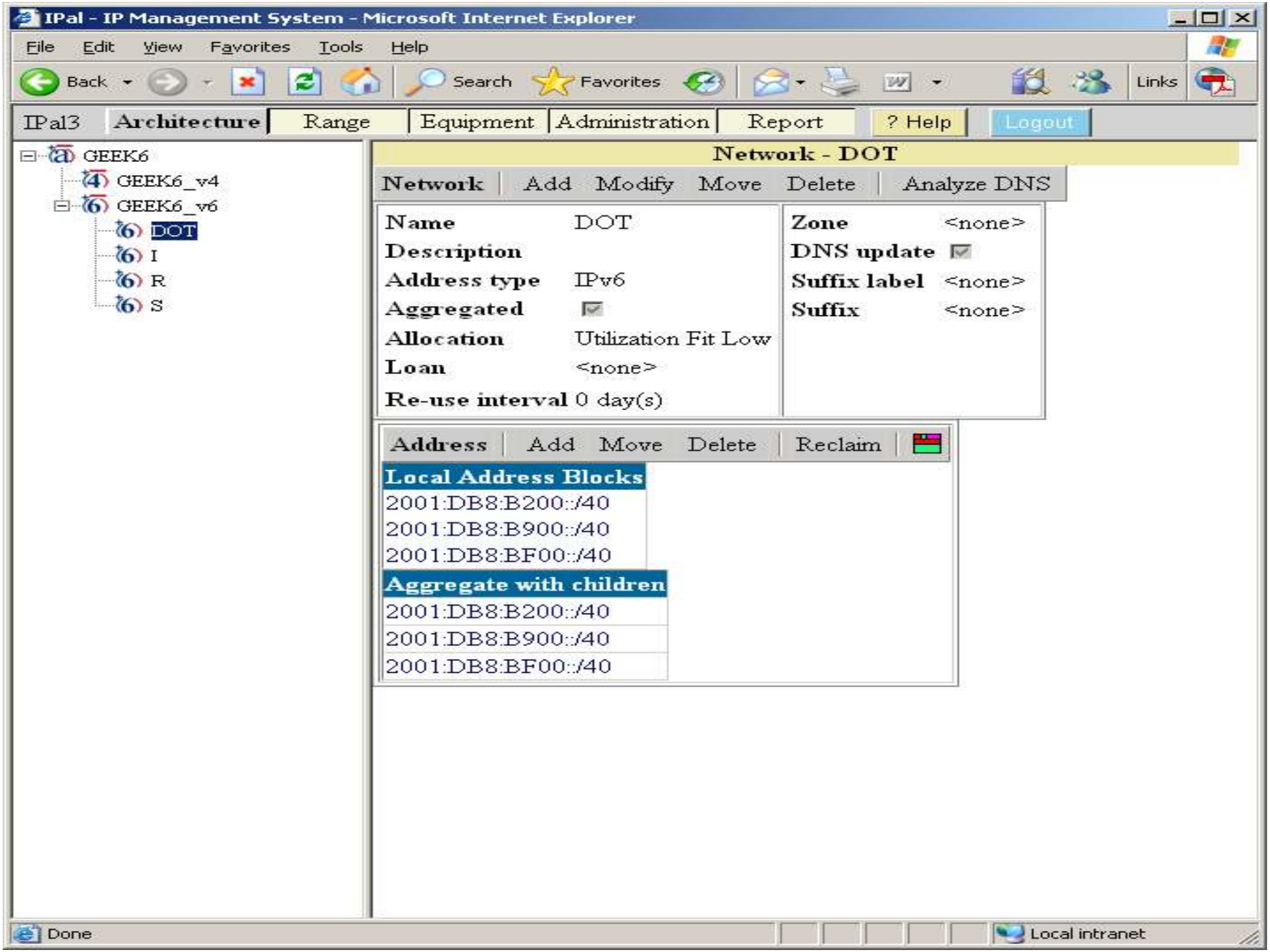
- On call, all the time
- Multi-user / multi access
- Accessible web-based interface
- Secured by customizable user accounts
- Fast - no waiting for a network engineer
- Accurate - no incorrect or duplicate addresses
- User friendly GUI to non-engineers

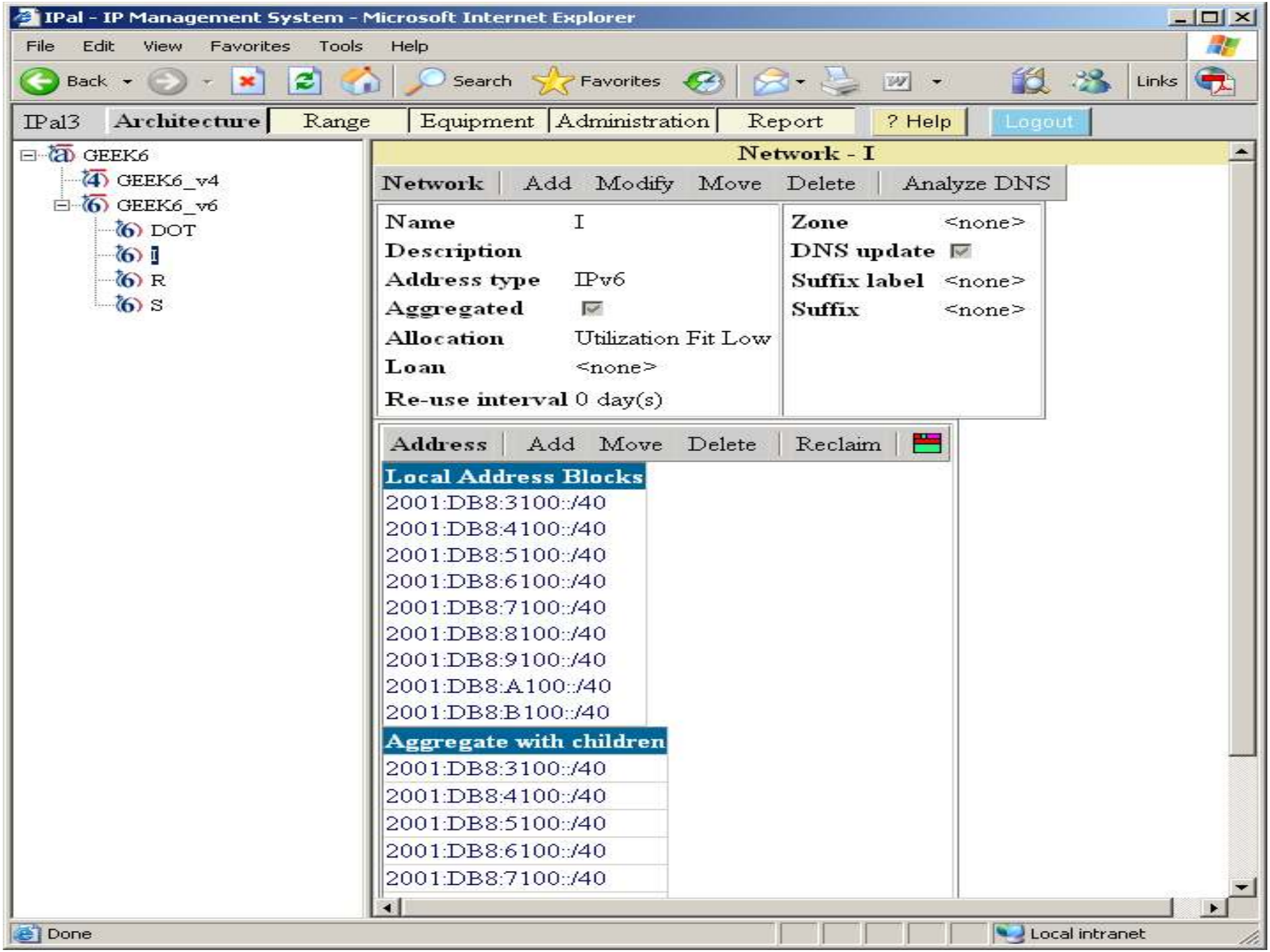
Helping your business...

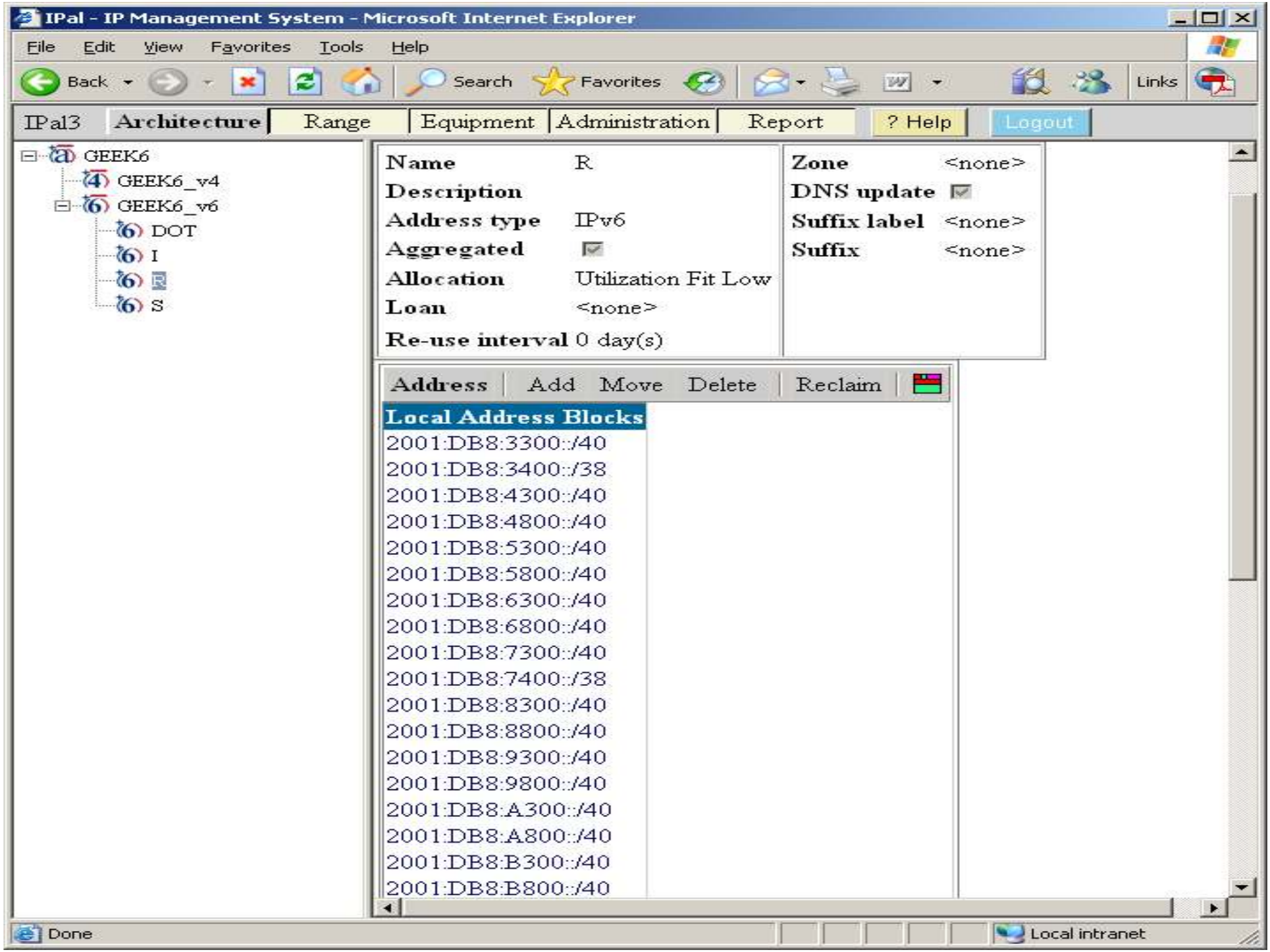
- Speed up deployment
- Reduce downtime due to address errors
- Automate time-consuming address calculations
- Reduce network operating costs
- Report address usage by network, segment, equipment, and more in real time
- Adopt or convert to IPv6
- Interface with other network administration tools
- Scale with your growing network

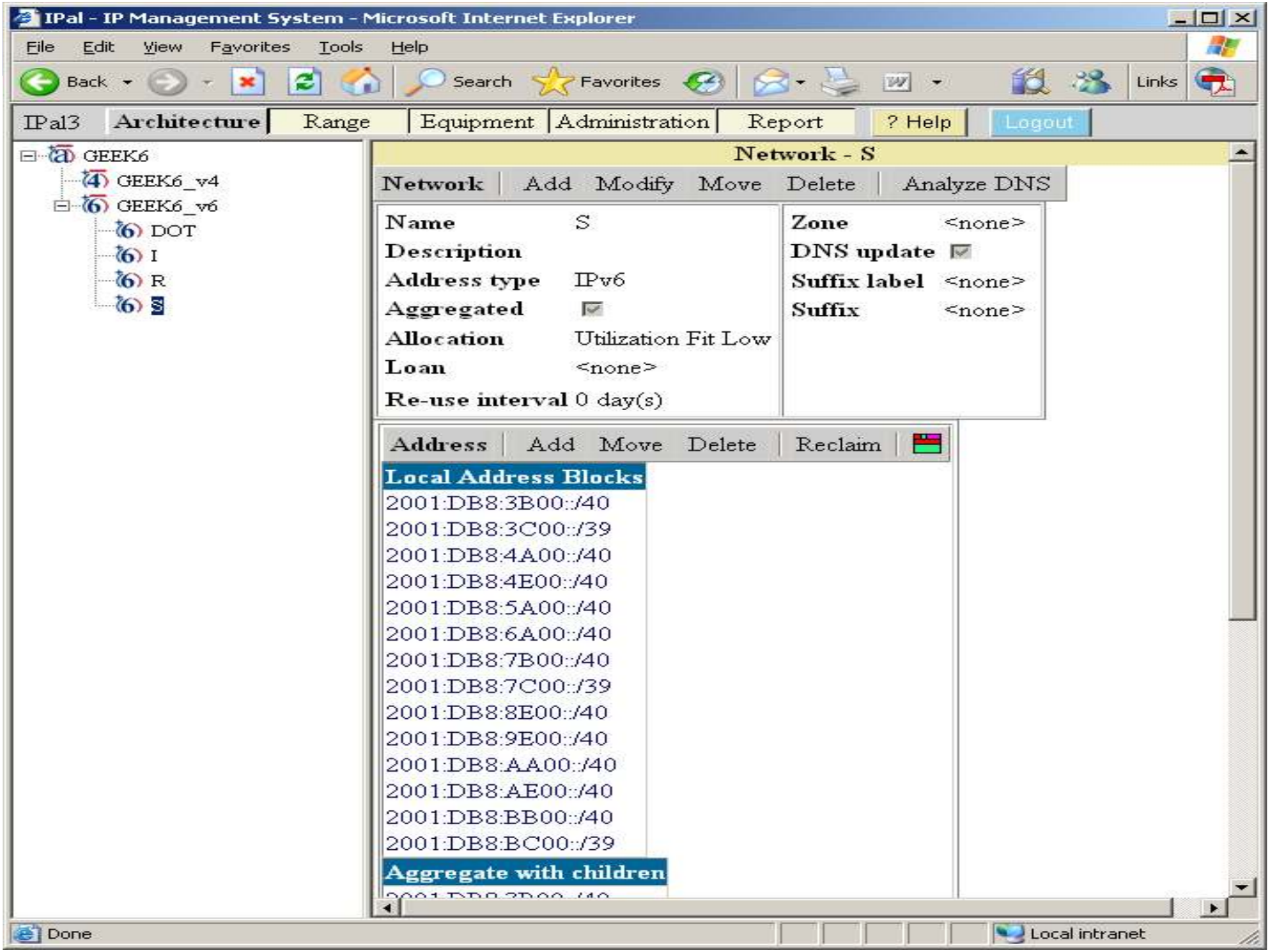


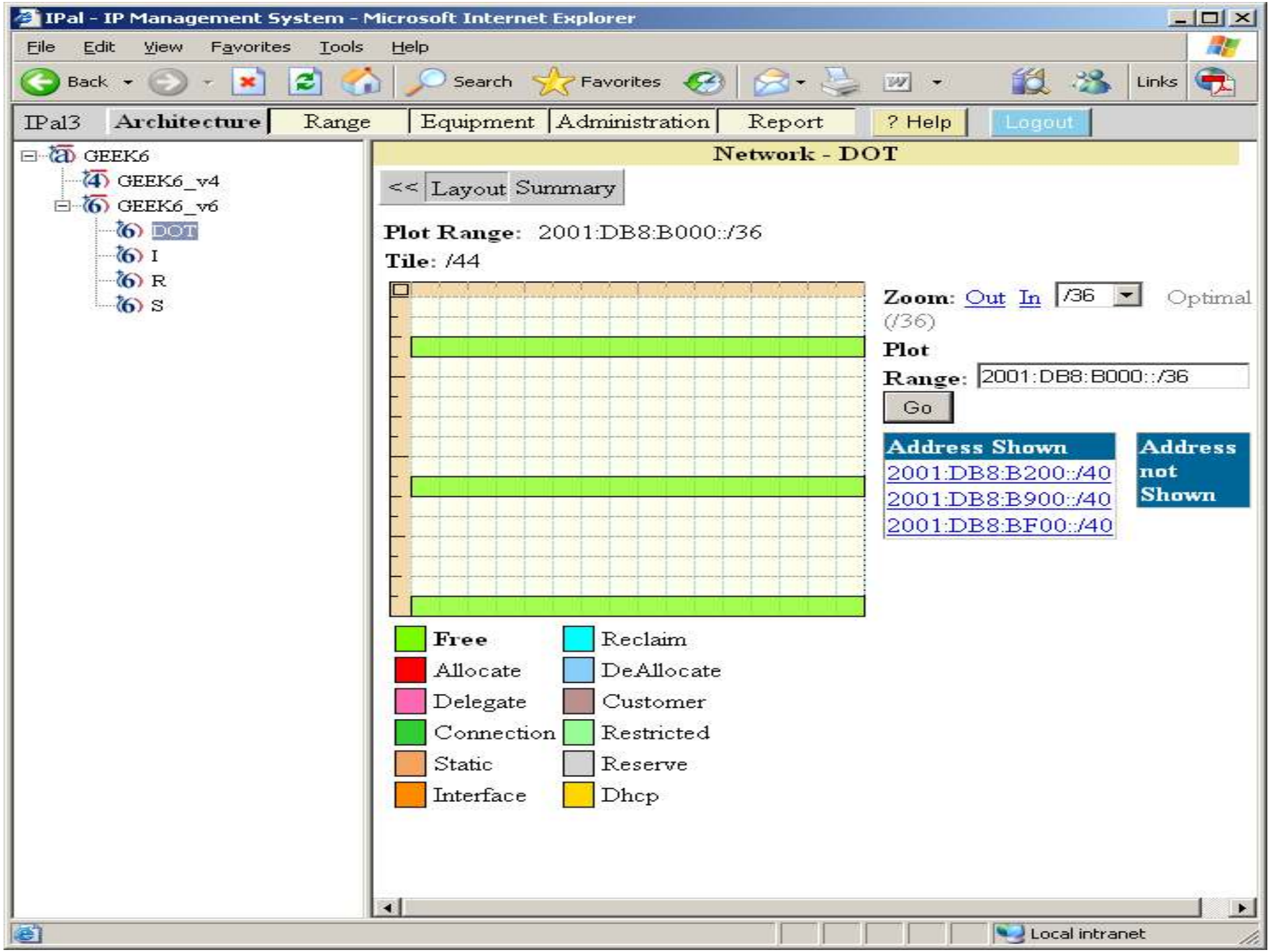

IPal - IP Management System - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Links
IPal3 Architecture Range Equipment Administration Report ? Help Logout
GEEK6
GEEK6_v4
GEEK6_v6
DOT
I
R
S
Network - GEEK6_v6
Network Add Modify Move Delete Analyze DNS
Name GEEK6_v6
Description
Address type IPv6
Aggregated
Allocation Utilization Fit Low
Loan <none>
Re-use interval 0 day(s)
Zone <none>
DNS update
Suffix label <none>
Suffix <none>
Address Add Move Delete Reclaim
Local Address Blocks
2001:DB8::/35
2001:DB8:2000::/36
2001:DB8:3000::/40
2001:DB8:3200::/40
2001:DB8:3800::/39
2001:DB8:3A00::/40
2001:DB8:3E00::/39
2001:DB8:4000::/40
2001:DB8:4200::/40
2001:DB8:4400::/38
2001:DB8:4900::/40
2001:DB8:4B00::/40
2001:DB8:4C00::/39
2001:DB8:4F00::/40
2001:DB8:5000::/40
Done
Local intranet

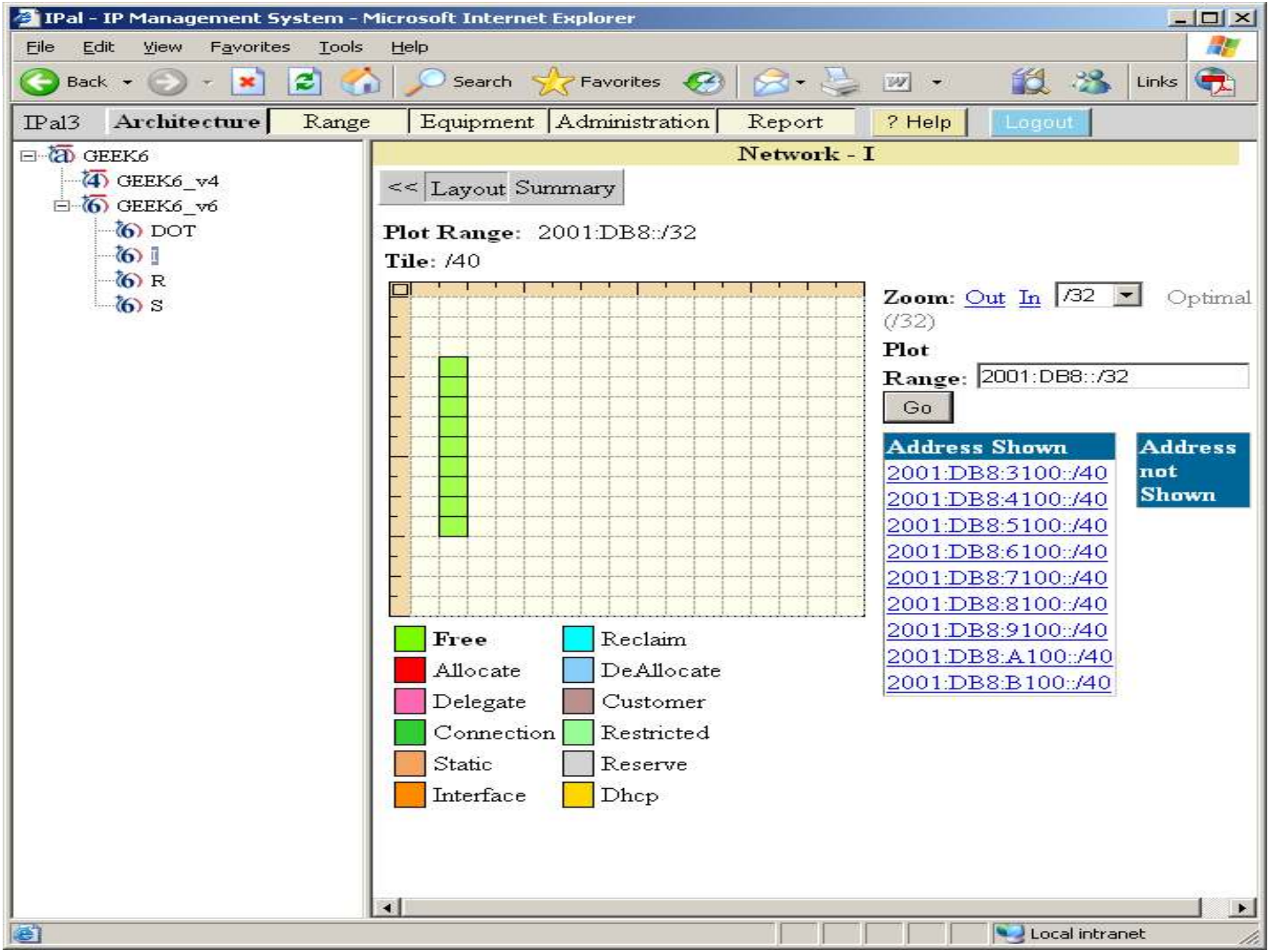

IPal - IP Management System - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Links
IPal3 Architecture Range Equipment Administration Report ? Help Logout
GEEK6
GEEK6_v4
GEEK6_v6
DOT
I
R
S
Network - DOT
Network Add Modify Move Delete Analyze DNS
Name DOT
Description
Address type IPv6
Aggregated
Allocation Utilization Fit Low
Loan <none>
Re-use interval 0 day(s)
Zone <none>
DNS update
Suffix label <none>
Suffix <none>
Address Add Move Delete Reclaim
Local Address Blocks
2001:DB8:B200::/40
2001:DB8:B900::/40
2001:DB8:BF00::/40
Aggregate with children
2001:DB8:B200::/40
2001:DB8:B900::/40
2001:DB8:BF00::/40
Done
Local intranet

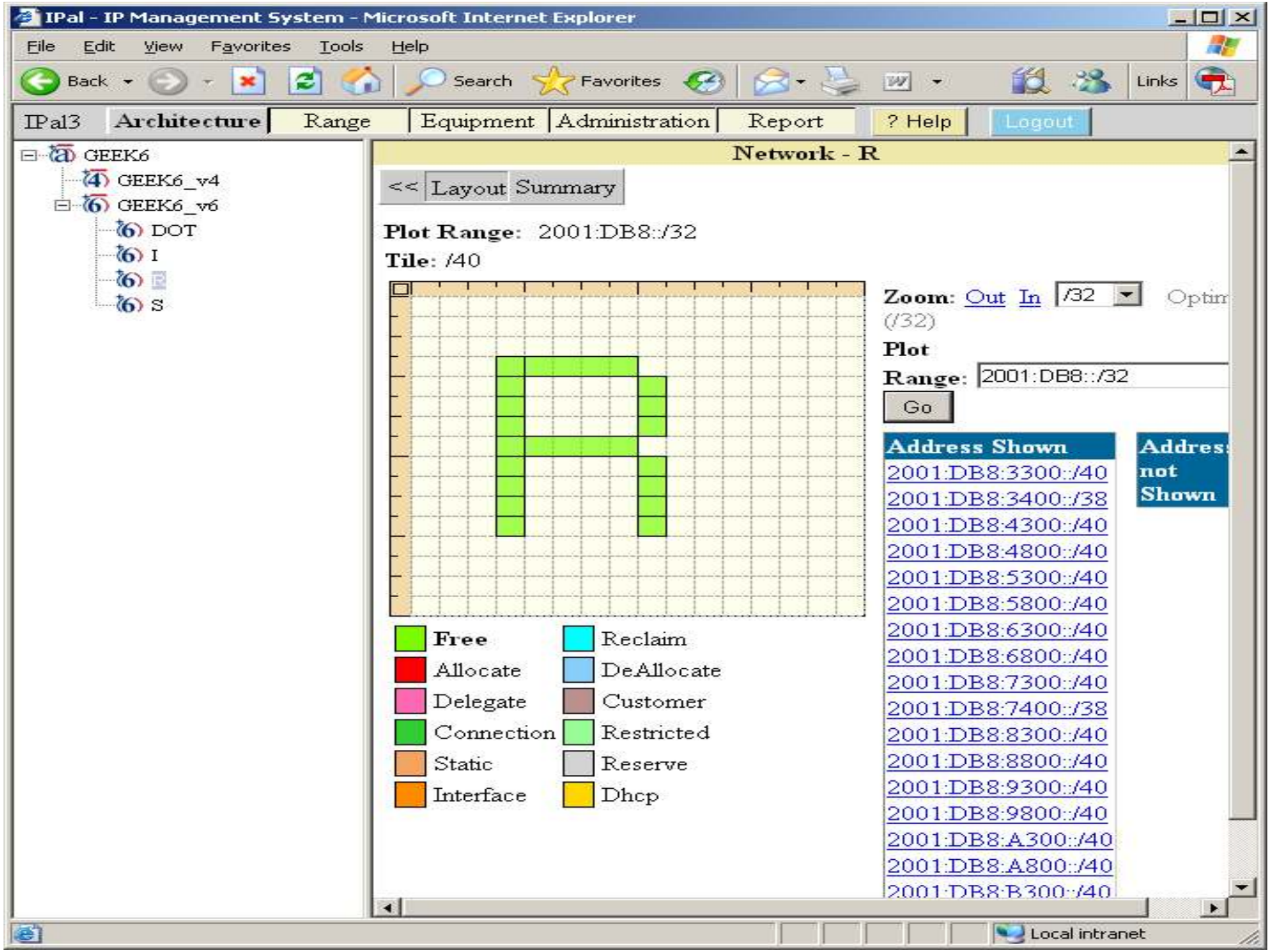

IPal - IP Management System - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Links
IPal3 Architecture Range Equipment Administration Report ? Help Logout
GEEK6
GEEK6_v4
GEEK6_v6
DOT
I
R
S
Network - I
Network Add Modify Move Delete Analyze DNS
Name I
Description
Address type IPv6
Aggregated
Allocation Utilization Fit Low
Loan <none>
Re-use interval 0 day(s)
Zone <none>
DNS update
Suffix label <none>
Suffix <none>
Address Add Move Delete Reclaim
Local Address Blocks
2001:DB8:3100::/40
2001:DB8:4100::/40
2001:DB8:5100::/40
2001:DB8:6100::/40
2001:DB8:7100::/40
2001:DB8:8100::/40
2001:DB8:9100::/40
2001:DB8:A100::/40
2001:DB8:B100::/40
Aggregate with children
2001:DB8:3100::/40
2001:DB8:4100::/40
2001:DB8:5100::/40
2001:DB8:6100::/40
2001:DB8:7100::/40
Done
Local intranet


IPal - IP Management System - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Links
IPal3 Architecture Range Equipment Administration Report ? Help Logout
GEEK6
GEEK6_v4
GEEK6_v6
DOT
I
S
Name R
Description
Address type IPv6
Aggregated
Allocation Utilization Fit Low
Loan <none>
Re-use interval 0 day(s)
Zone <none>
DNS update
Suffix label <none>
Suffix <none>
Address Add Move Delete Reclaim
Local Address Blocks
2001:DB8:3300::/40
2001:DB8:3400::/38
2001:DB8:4300::/40
2001:DB8:4800::/40
2001:DB8:5300::/40
2001:DB8:5800::/40
2001:DB8:6300::/40
2001:DB8:6800::/40
2001:DB8:7300::/40
2001:DB8:7400::/38
2001:DB8:8300::/40
2001:DB8:8800::/40
2001:DB8:9300::/40
2001:DB8:9800::/40
2001:DB8:A300::/40
2001:DB8:A800::/40
2001:DB8:B300::/40
2001:DB8:B800::/40
Done
Local intranet


IPal - IP Management System - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Links
IPal3 Architecture Range Equipment Administration Report ? Help Logout
GEEK6
GEEK6_v4
GEEK6_v6
DOT
I
R
S
Network - S
Network Add Modify Move Delete Analyze DNS
Name S
Description
Address type IPv6
Aggregated
Allocation Utilization Fit Low
Loan <none>
Re-use interval 0 day(s)
Zone <none>
DNS update
Suffix label <none>
Suffix <none>
Address Add Move Delete Reclaim
Local Address Blocks
2001:DB8:3B00::/40
2001:DB8:3C00::/39
2001:DB8:4A00::/40
2001:DB8:4E00::/40
2001:DB8:5A00::/40
2001:DB8:6A00::/40
2001:DB8:7B00::/40
2001:DB8:7C00::/39
2001:DB8:8E00::/40
2001:DB8:9E00::/40
2001:DB8:AA00::/40
2001:DB8:AE00::/40
2001:DB8:BB00::/40
2001:DB8:BC00::/39
Aggregate with children
Done
Local intranet


IPal - IP Management System - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Links
IPal3 Architecture Range Equipment Administration Report ? Help Logout
GEEK6
GEEK6_v4
GEEK6_v6
DOT
I
R
S
Network - DOT
<< Layout Summary
Plot Range: 2001:DB8:B000::/36
Tile: /44
Zoom: Out In /36 Optimal (/36)
Plot Range: 2001:DB8:B000::/36
Go
Address Shown
2001:DB8:B200::/40
2001:DB8:B900::/40
2001:DB8:BF00::/40
Address not Shown
Free
Allocate
Delegate
Connection
Static
Interface
Reclaim
DeAllocate
Customer
Restricted
Reserve
Dhcp
Local intranet


IPal - IP Management System - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Links
IPal3 Architecture Range Equipment Administration Report ? Help Logout
GEEK6
GEEK6_v4
GEEK6_v6
DOT
I
R
S
Network - I
<< Layout Summary
Plot Range: 2001:DB8::/32
Tile: /40
Zoom: Out In /32 Optimal (/32)
Plot Range: 2001:DB8::/32
Go
Address Shown
2001:DB8:3100::/40
2001:DB8:4100::/40
2001:DB8:5100::/40
2001:DB8:6100::/40
2001:DB8:7100::/40
2001:DB8:8100::/40
2001:DB8:9100::/40
2001:DB8:A100::/40
2001:DB8:B100::/40
Address not Shown
Free
Allocate
Delegate
Connection
Static
Interface
Reclaim
DeAllocate
Customer
Restricted
Reserve
Dhcp
Local intranet


IPal - IP Management System - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Links
IPal3 Architecture Range Equipment Administration Report ? Help Logout
GEEK6
GEEK6_v4
GEEK6_v6
DOT
I
S
Network - R
<< Layout Summary
Plot Range: 2001:DB8::/32
Tile: /40
Zoom: Out In /32 Optim
(/32)
Plot
Range: 2001:DB8::/32
Go
Address Shown
2001:DB8:3300::/40
2001:DB8:3400::/38
2001:DB8:4300::/40
2001:DB8:4800::/40
2001:DB8:5300::/40
2001:DB8:5800::/40
2001:DB8:6300::/40
2001:DB8:6800::/40
2001:DB8:7300::/40
2001:DB8:7400::/38
2001:DB8:8300::/40
2001:DB8:8800::/40
2001:DB8:9300::/40
2001:DB8:9800::/40
2001:DB8:A300::/40
2001:DB8:A800::/40
Addres
not
Shown
Free
Allocate
Delegate
Connection
Static
Interface
Reclaim
DeAllocate
Customer
Restricted
Reserve
Dhcp
Local intranet

IPal - IP Management System - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites Links

IPal3 | Architecture | Range | Equipment | Administration | Report | ? Help | Logout

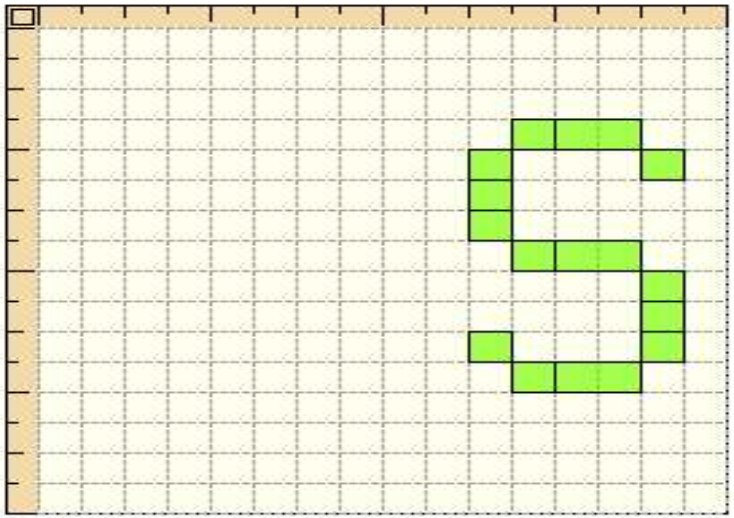
- GEEK6
  - GEEK6_v4
  - GEEK6_v6
    - DOT
    - I
    - R
    - S

Network - S

<< Layout Summary

Plot Range: 2001:DB8::/32

Tile: /40



Zoom: Out In /32 Optimal (/32)

Plot Range: 2001:DB8::/32

Go

Free	Reclaim
Allocate	DeAllocate
Delegate	Customer
Connection	Restricted
Static	Reserve
Interface	Dhcp

Address Shown	Address not Shown
2001:DB8:3B00::/40	
2001:DB8:3C00::/39	
2001:DB8:4A00::/40	
2001:DB8:4E00::/40	
2001:DB8:5A00::/40	
2001:DB8:6A00::/40	
2001:DB8:7B00::/40	
2001:DB8:7C00::/39	
2001:DB8:8E00::/40	
2001:DB8:9E00::/40	
2001:DB8:AA00::/40	
2001:DB8:AE00::/40	
2001:DB8:BB00::/40	
2001:DB8:BC00::/39	

Done Local intranet

IPal - IP Management System - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites Links

IPal3 | Architecture | Range | Equipment | Administration | Report | ? Help | Logout

- GEEK6
  - GEEK6_v4
  - GEEK6_v6
    - DOT
    - I
    - R
    - S

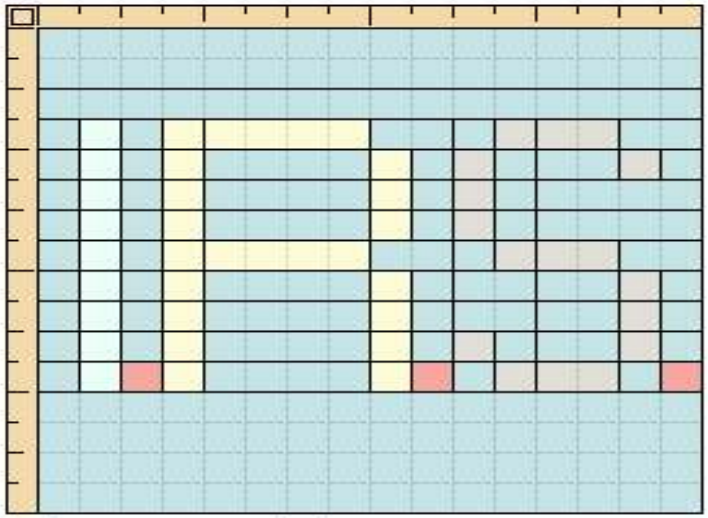
Network - GEEK6_v6

<< Layout Summary

○ Local ○ Include Descendant ● Show Network

Plot Range: 2001:DB8::/32

Tile: /40



GEEK6_v6 DOT
I R
S

Zoom: Out In /32 Optimal (/32)

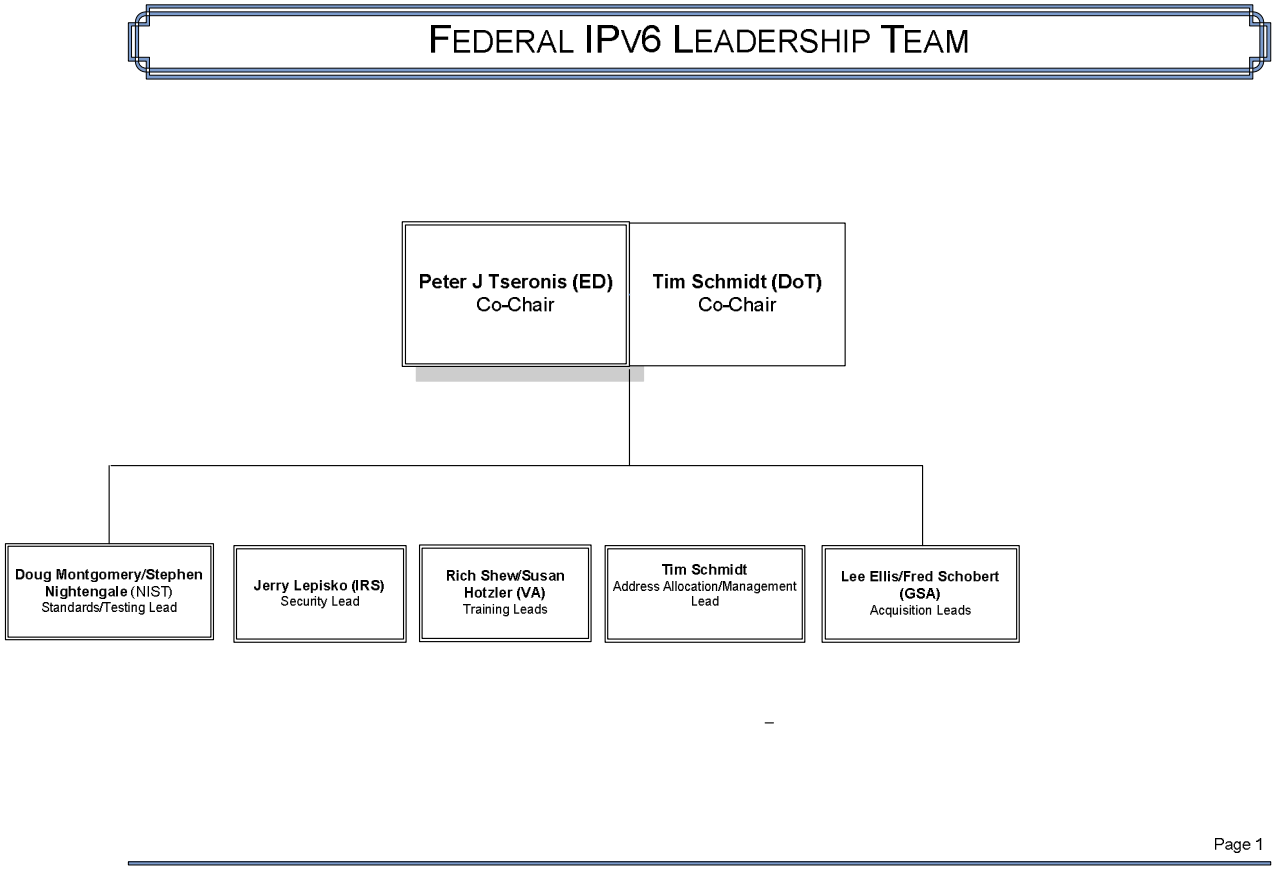
Plot Range: 2001:DB8::/32

Go

Address Shown	Address not Shown
2001:DB8::/35	
2001:DB8:2000::/36	
2001:DB8:3000::/40	
2001:DB8:3100::/40	
2001:DB8:3200::/40	
2001:DB8:3300::/40	
2001:DB8:3400::/38	
2001:DB8:3800::/39	
2001:DB8:3A00::/40	
2001:DB8:3B00::/40	
2001:DB8:3C00::/39	
2001:DB8:3E00::/39	
2001:DB8:4000::/40	
2001:DB8:4100::/40	
2001:DB8:4200::/40	

Local intranet

IPv6 Federal Working Group



IPv6 Links

- http://www.gao.gov/new.items/d05845t.pdf
- http://www.ntia.doc.gov/ntiahome/ntiageneral/ipv6/final/ipv6final.pdf
- http://www.whitehouse.gov/omb/egov/documents/Federal_Architect_Mar_06.pdf
- http://www.ietf.org/html.charters/ipv6-charter.html
- http://www.cisco.com/en/US/products/ps6553/products_ios_technology_home.html
- http://www.ipv6forum.org/
- http://www.ipv6.org/
- http://ipv6.internet2.edu/
- http://www.lumeta.com/IPv6/research.asp
- http://www.microsoft.com/technet/network/ipv6/default.mspx
- http://www.nav6tf.org/
- http://www.ipv6tf.org/