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Technology · Connections · Results

Getting Started with IPv6 at the DTCC

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Inside Products, Inc.

Thursday, February 7, 2013
Session Number 12886

SHARE in San Francisco 2013

Our SHARE Sessions – San Francisco

- 12151: IPv6 Addressing
  Tuesday, February 5, 2013: 3:00 PM-4:00 PM

- 12947: IPv6 Security Implications for System Z
  Thursday, February 7, 2013: 12:15 PM-1:15 PM

- 12886: Getting Started with IPv6 at DTCC
  Thursday, February 7, 2013: 3:00 PM-4:00 PM

Agenda

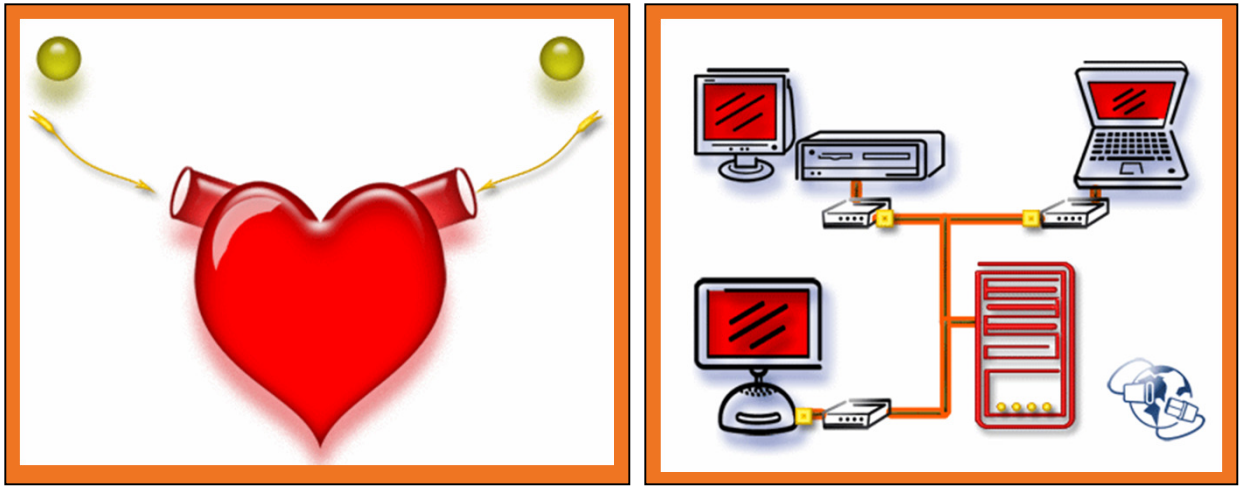
This session will discuss how DTCC is starting to integrate IPv6 into its network. We will discuss:

- Why now?
- Lab planning
- Address planning
- Problems encountered
- z/OS specifics

Introduction to DTCC

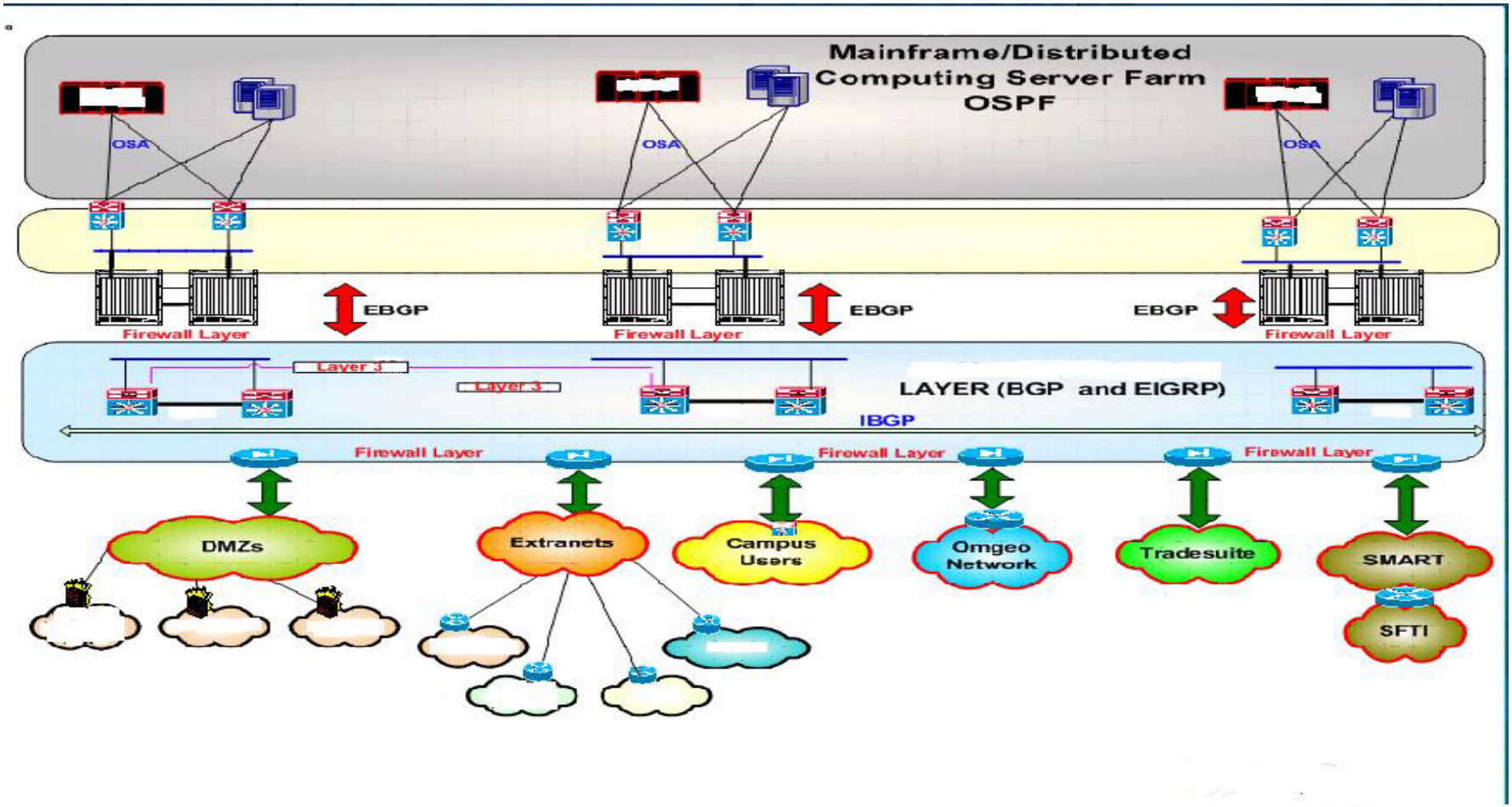
- The Depository Trust & Clearing Corporation (DTCC) is at the epicenter of the financial world.
- The business of DTCC involves the safe transfer of securities ownership and settlement of trillions of dollars in trade obligations, under tight deadlines every day.
- At the same time, DTCC's primary mission is to protect and mitigate risk for its members. DTCC ensures the capacity, certainty and reliability required to clear and settle today's enormous trading volumes.

DTCC Interconnects the Financial World



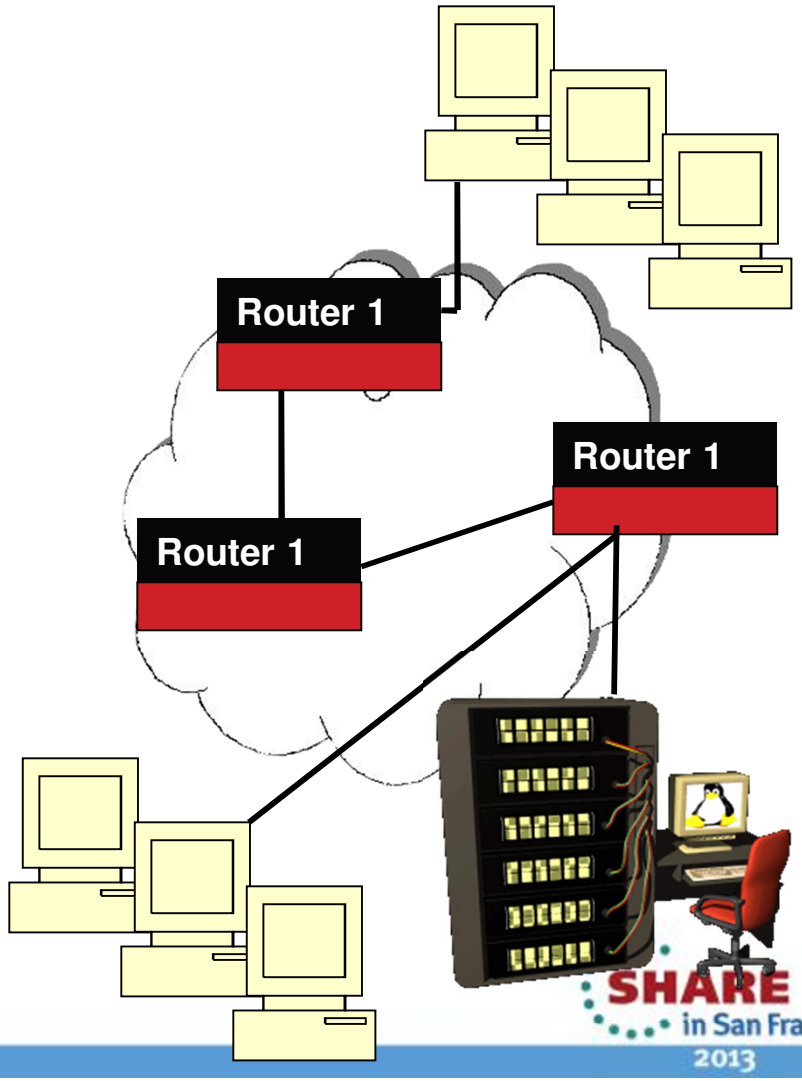
- The network is at the heart of DTCC's business.

High Level Network Diagram



Business Requirements

- We are a service provider
- Interconnect the financial world…
- We provide Settlement (DTC subsidiary) and Clearing (NSCC subsidiary) services for securities traded on NYSE, AMEX, and NASDAQ
- And… run it as a business
- So, we need to stay ahead of the game!
- That means… getting started with IPv6!



Why Now?

Why Now?

- Federal OMB mandates (2012 and 2014)
  - 2012 – external facing equipment
  - 2014 - applications
- What will the 2016 mandate be?
- IPv6 is inevitable and we want to be ready
  - Long lead times
  - Training
  - Web sites are crucial
  - Customers forced onto IPv6
  - Customers may be forced to go elsewhere.
  - We may need to expand network and use IPv6

IPv6 Readiness

- Take a look at who is getting ready for IPv6
  - Operating Systems: Microsoft, IBM, all Unix
  - Network Equipment Vendors: Cisco, Juniper, F5, A10, Brocade, Citrix
  - Content Providers: Google, Yahoo, FaceBook
  - Web site hosting companies: GoDaddy starting.
  - ISPs: AT&T, Verizon, Comcast, NTT
  - Cell phone providers: Verizon, Nokia, Google, Apple, etc
  - Government: Many…
  - Enterprises: Bechtel, insurance companies, financials, manufacturing, etc

- IETF creates the RFCs for TCP/IP architecture
  - No alternative to IPv6

Google is in the forefront

Google™ Official Blog

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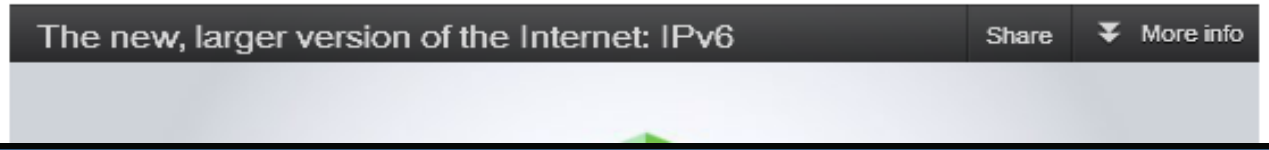
Search

World IPv6 Launch: Keeping the Internet growing

June 5, 2012 +1 649

When the Internet launched operationally in 1983, its creators never dreamed that there might be billions of devices and users trying to get online. Yet now, almost three decades later, that same Internet serves nearly 2.5 billion people and 11 billion devices across the globe. And we're running out of space.



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Go Daddy is Getting IPv6 Ready

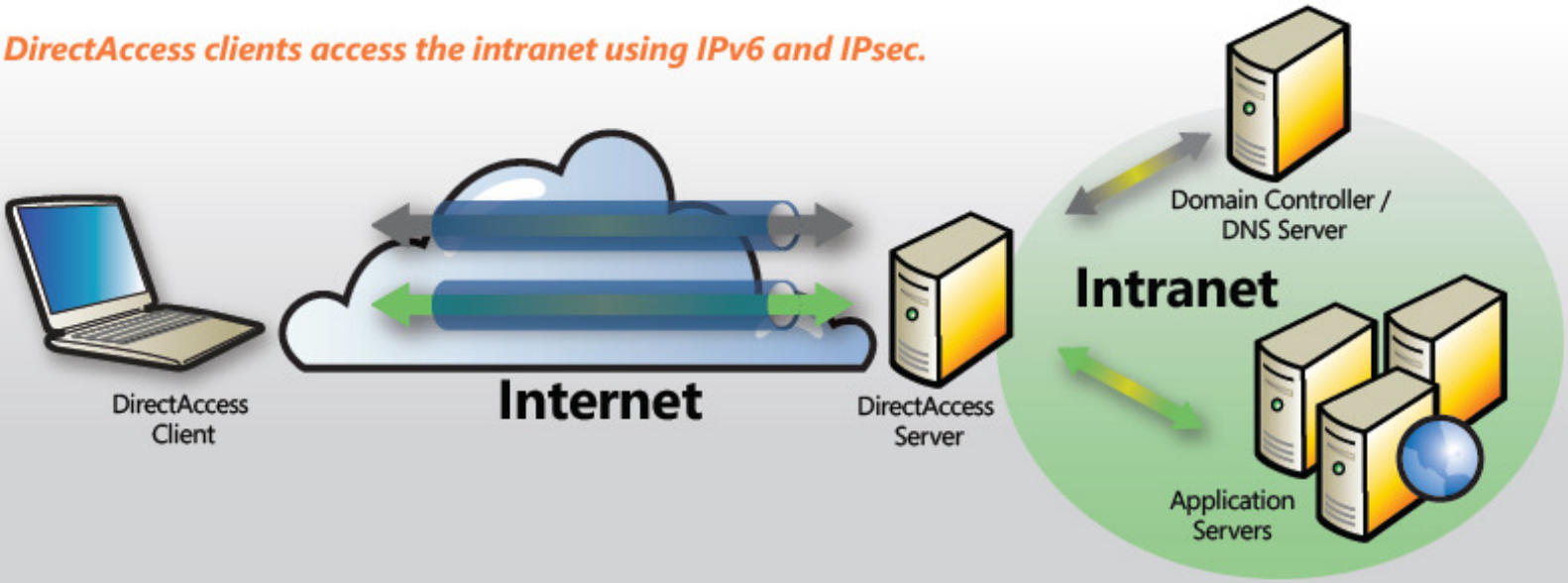
Microsoft has an IPv6 Only App

Microsoft

DirectAccess

Seamless, secure, anytime remote connectivity without VPN

DirectAccess clients access the intranet using IPv6 and IPsec.



Active IETF Working Groups

Active Working Groups:

6lowpan	IPv6 over Low power WPAN
6man	IPv6 Maintenance
ancp	Access Node Control Protocol
csi	Cga & Send maIntenance
dhc	Dynamic Host Configuration
dmm	Distributed Mobility Management
dnsext	DNS Extensions
hip	Host Identity Protocol
homenet	Home Networking
intarea	Internet Area Working Group
l2tpext	Layer Two Tunneling Protocol Extensions
lisp	Locator/ID Separation Protocol
lwig	Light-Weight Implementation Guidance
mif	Multiple Interfaces
mip4	Mobility for IPv4
multimob	Multicast Mobility
netext	Network-Based Mobility Extensions
ntp	Network Time Protocol
pcp	Port Control Protocol
pppext	Point-to-Point Protocol Extensions
savi	Source Address Validation Improvements
softwire	Softwires
sunset4	Sunsetting IPv4
tictoc	Timing over IP Connection and Transfer of Clock
trill	Transparent Interconnection of Lots of Links

- IETF creates RFCs
- NO talk of IPv8 nor alternatives
- Without RFCs, what vendor will implement?

Are they all going in the wrong direction?

DTCC has an IPv4 only Web Site

- In the next 5 years:
  - Some ISPs will run out of IPv4 addresses
  - Some customers of those ISPs will get IPv6 addresses.
  - How will they get to IPv4 only websites: for example: www.dtcc.com?
  - Yes, ISPs are offering tunneling but…
    - What is the performance?
    - Security risks?
    - What will it cost?

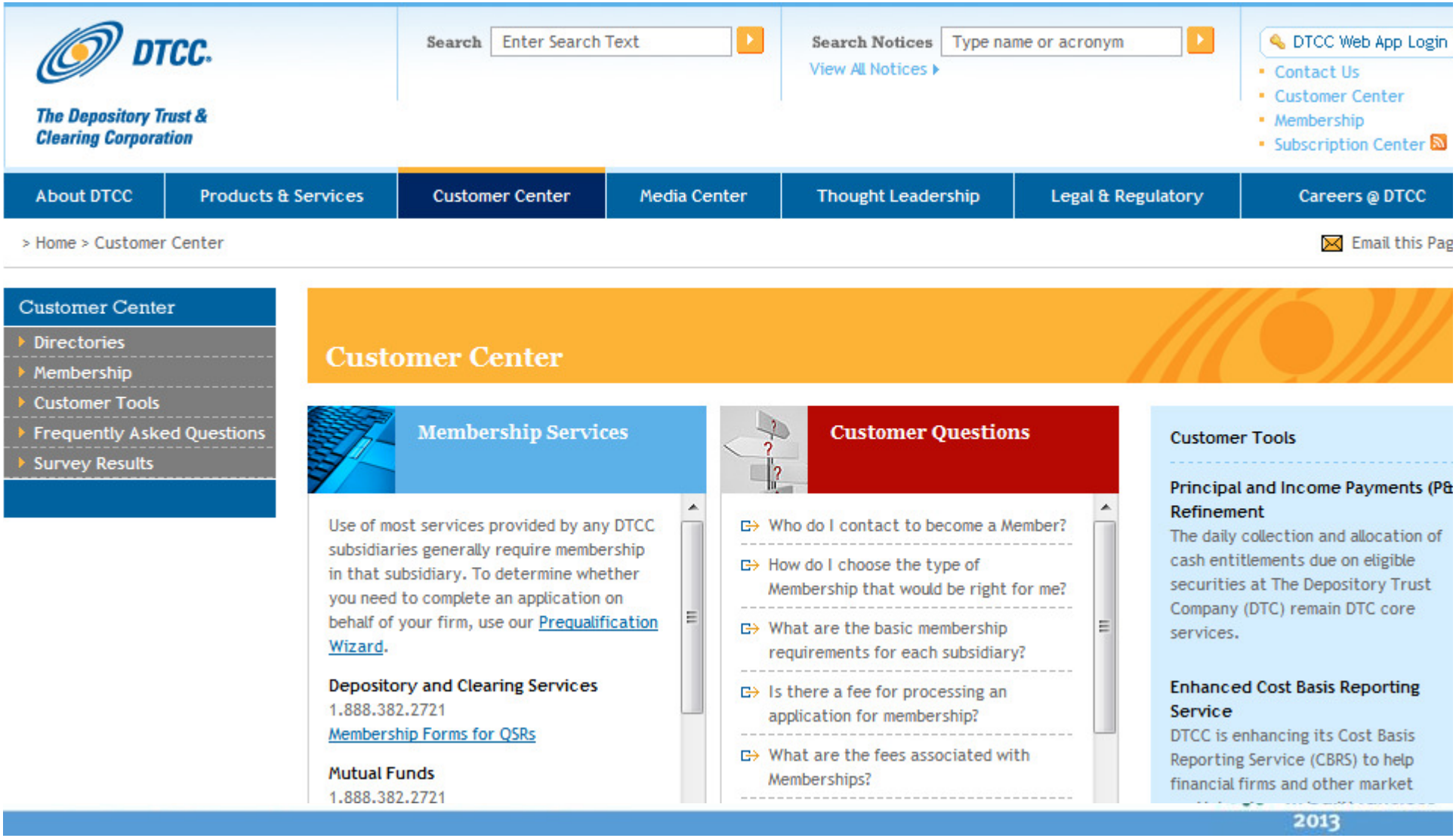
The Infamous App!

The Internet!

Can this really happen?

- Let's look at :
  - Functions offered by the DTCC web site
  - Who accesses the DTCC web site
  - Quality of the experience

DTCC Customer Center (Web Based)



DTCC Customer Tools

Customer Center
- Directories
- Membership
- Customer Tools
  - Principal and Income Payment (P&I) Refinement
  - Web Inquiry Notification System
  - Access Administration
  - Participant Browser Services
  - Password Management
  - CDTS Output Dashboard
- Frequently Asked Questions
- Survey Results

Customer Center
Customer Tools

This section provides information for customers on features of, and enhancements to, DTCC systems that save time for customers and reduce downtime in daily operations.

Principal and Income Payment (P&I) Refinement

The daily collection and allocation of cash entitlements due on eligible securities at The Depository Trust Company (DTC) remain DTC core services. Commonly referred to as principal and income payment (P&I), these entitlements include dividend, interest, periodic principal, redemption and maturity payments arising from the servicing of 3.5 million securities eligible at the depository.

Related Information
- P&I Cash Processing

Enhanced Cost Basis Reporting Service (CBRS)

DTCC is enhancing its Cost Basis Reporting Service (CBRS) to help financial firms and other market participants comply with a new January 2011 mandate requiring the reporting of cost basis information to investors and the federal government.

Related Information
- Cost Basis Reporting Service (CBRS)

Web Inquiry Notification System (WINS)

The Web Inquiry Notification System (WINS) replaces the Participant Inquiry Notification System (PINS) for entry and management of new customer inquiries.

Related Information
- Access WINS

Who to Call

Customer Service
1.888.382.2721

Customer Service (Int'l)
1.212.855.8099

Press Contacts
1.212.855.5471

Read More

DTCC and Chilean Depository Sign Agreement to Collaborate

Cooperative undertaking will leverage the technology and expertise of both organizations.

Read More

Related Links
- DTCC Relationship Management Highlights

A Question of Perception

Do you want to be thought of as a technology leader or someone who has to be dragged kicking and screaming into the future?

(That is, one who is rushing madly from the 19th to the 20th century)

Quality of Experience

- Web site / customer experience is mission critical.
- NOT just Internet companies. Brick and mortar, Fortune 100 type companies.
- Some have thousands of programmers working on web site.
- See what John Curran (CEO of ARIN) says next.

IPv6 Market Viability – Revisited

The emergence of the Internet Content industry –

- Internet Content wants quality access to the user including high-bandwidth, low-latency, low-jitter connections and with consistent network identification & location information
- Internet Content increasingly pays the bills via advertising revenue and content sales (music, video, applications, etc.)

Connectivity via layers of NAT simply does not meet Internet Content requirements for service quality –

- With NAT'ed IPv4, as the Internet grows, increasing address & port sharing causes impairment in reliable content delivery
- With IPv6, the end-to-end relationship is maintained and could easily be superior in the very near future
- Increasing plans from major Internet Content providers to be connected via both IPv4 and IPv6…

  e.g. "World IPv6 Launch" event

ARIN
American Registry for Internet Numbers

Will These Need IPv6?

"You don't want to be the only company that offers fax instead of email."

John Curran (CEO ARIN)

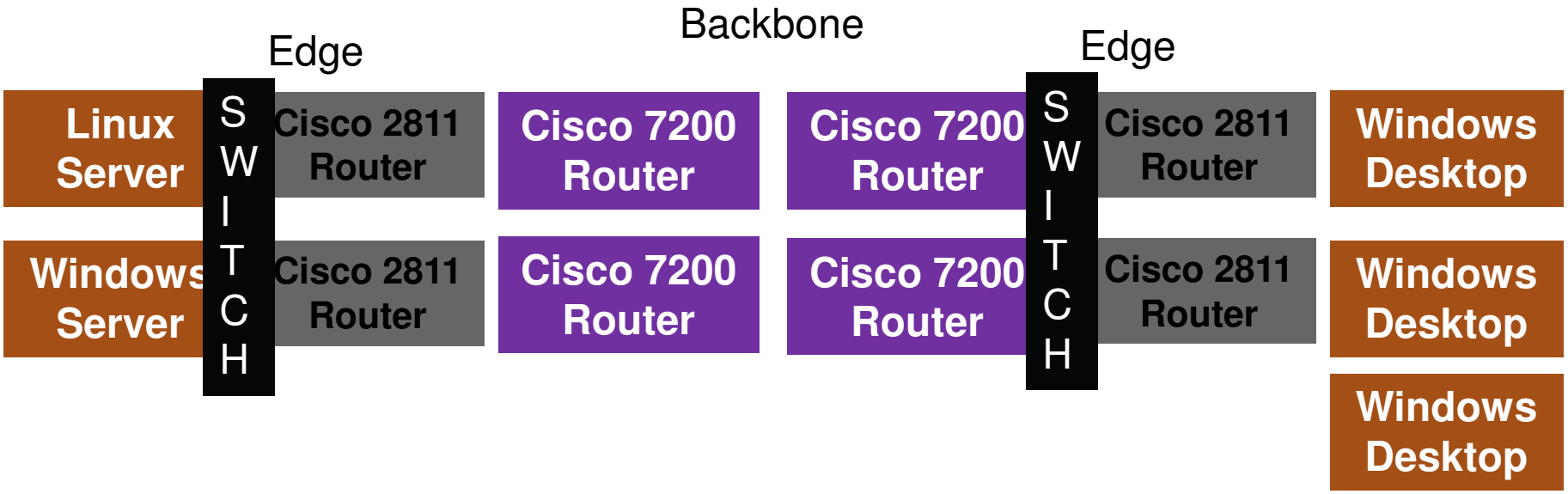
Why Now Summary

- The problem is that it takes a long time to change things in a large organization.
- The training, planning, migration of IPv6 integration must be controlled and well-executed. Many companies see this as a 10 – 15 year project.
- DTCC needs more expertise in IPv6. It takes years to get it.
- Other companies see IPv6 as a strategic competitive advantage.
- DTCC has started now to do our planning.

Lab Setup

- Classes not enough
- Need hands-on
- Training lab and simulation lab.

Training Lab Layout



Connection to mainframe coming!

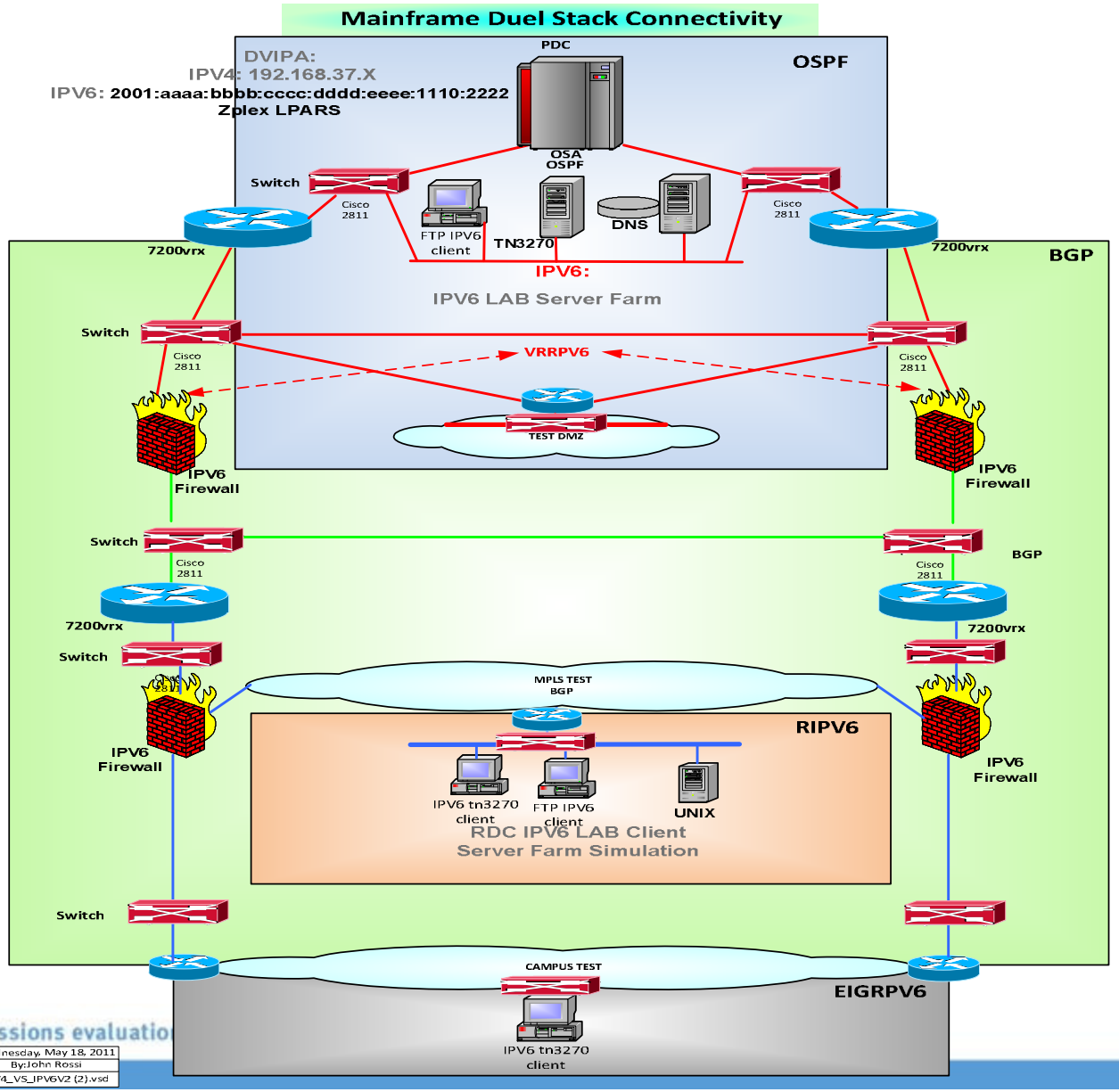
Addressing

Backbone:
2001:cccc:bbbb:1::1/64 (1-4)
192.168.n.1 (where n = 5-8)

Edge
2001:cccc:eeee:1::1/64 (1-4)
192.168.n.1 (where n = 1-4)

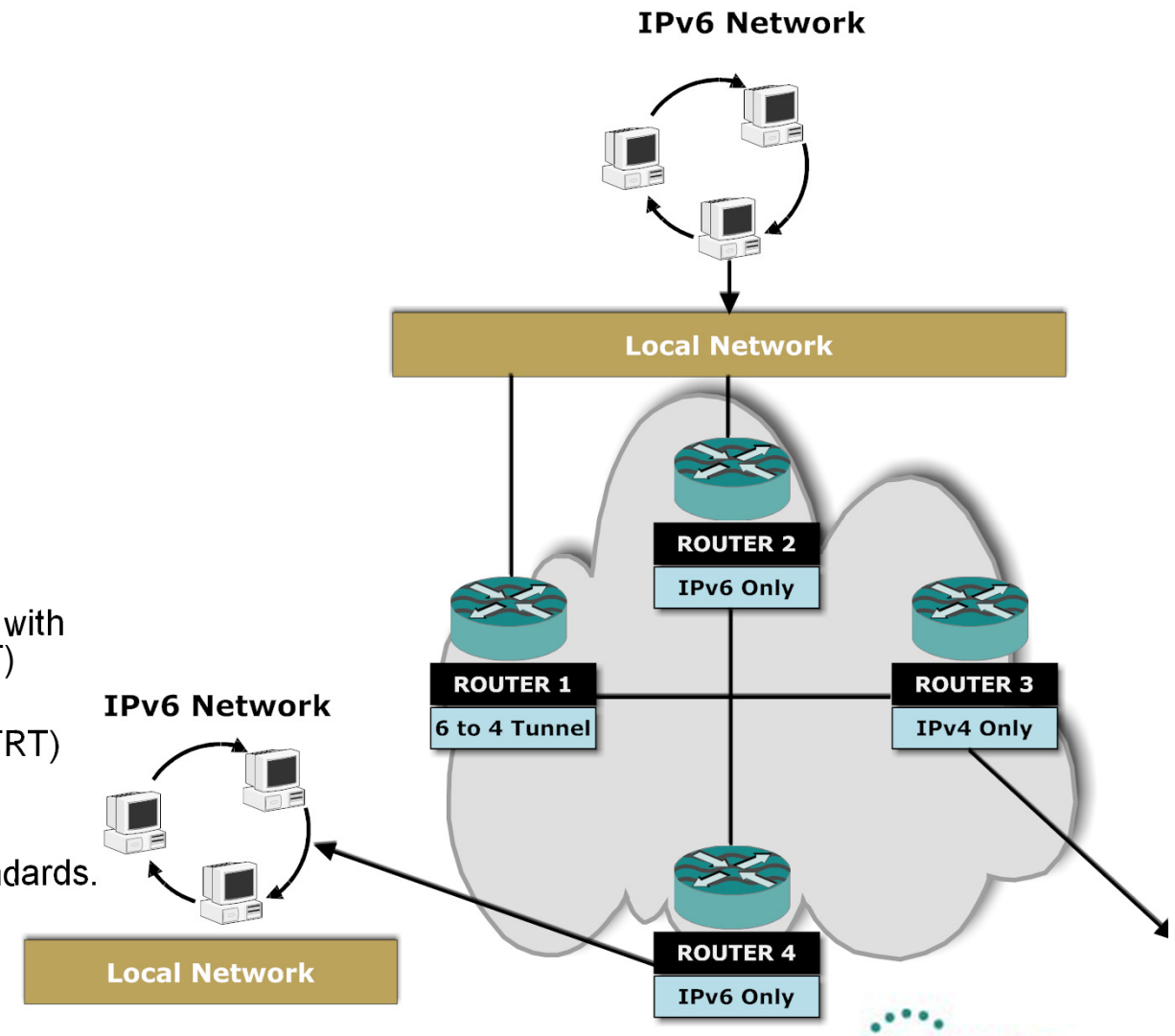
Note: All addresses are completely made up! NOT real addresses used!

Where we are going …



Develop Strategy

- How do we actually migrate?
  - Dual stack?
  - Tunneling?
  - Proxies?
  - Translation?
- Direct connection – 6 to 6
- Tunneling
  - 6 to 4 tunnels
  - Teredo
  - Automatic tunnels (ISATAP)
  - Manual
  - GRE (with IPSec)
- Translation
  - Network Address Translation with Protocol Translation (NAT-PT)
  - NAT64
  - Transport Relay Translator (TRT)
  - SLB-PT
- Test in simulation lab!
- Need to develop policies and standards.



Sample Strategy

- Can't convert the entire network to IPv6 in one day
- Need dual stack mode and tunneling

- Two potential scenarios for the architecture:
  - Option 1: Backbone becomes IPv6

  - Option 2: Regions, connections or tributaries convert to IPv6 or external government agency or business partner wants IPv6 access. Core backbone remains IPv4.

z/OS Specific

- IPv6 enable stack
- Define interfaces
- OMPRoute
- Trace!

Netstat Home (IPv6 Interfaces)

```
IntfName:   ETH6
  Address:  2001:face:b00c:1:1:2:3:4
    Type:   Global
    Flags:
  Address:  fe80::1:2:3:4
    Type:   Link_Local
    Flags:  Autoconfigured
IntfName:   LOOPBACK6
  Address:  ::1
    Type:   Loopback
    Flags:
```

Note: All addresses are completely made up! NOT real addresses used!

Netstat Route (before OMPRoute)

```
IPv6 Destinations
DestIP:   Default
  Gw:     fe80::200:ff:fe00:0
  Intf:   ETH6            Refcnt:  0000000000
  Flgs:   UGD              MTU:     1500
DestIP:   ::1/128
  Gw:     ::
  Intf:   LOOPBACK6       Refcnt:  0000000000
  Flgs:   UH              MTU:     65535
DestIP:   2001:face:b00c:1::/64
  Gw:     ::
  Intf:   ETH6            Refcnt:  0000000000
  Flgs:   UC              MTU:     1500
DestIP:   2001:face:b00c:1:1:2:3:4/128
  Gw:     ::
  Intf:   ETH6            Refcnt:  0000000000
Flgs:   UH              MTU:     1500
DestIP:   fe80::1:2:3:4/128
  Gw:     ::
  Intf:   ETH6            Refcnt:  0000000000
  Flgs:   UH              MTU:     1500
```

Netstat Devlinks

```
 IntfName: ETH6                IntfType:
IPAQENET6  IntfStatus: Ready
    PortName: PORTB     Datapath: 0406
DatapathStatus: Ready
    CHPIDType: OSD
    QueSize: 0    Speed: 0000001000
    MacAddress: 100BA9E38B08
    DupAddrDet: 1
    CfgRouter: Non
ActRouter: Non
    RtrHopLimit: 64
    CfgMtu: None                        ActMtu:
1500
    VLANid: None
VLANpriority: Disabled
    IntfID: 0001:0002:0003:0004
    ReadStorage: GLOBAL (4096K)
    InbPerf: Balanced
    ChecksumOffload: No
SegmentationOffload: No
    SecClass: 255
MonSysplex: No
    Isolate: No
OptLatencyMode: No
 TempPrefix: All
```

```
TempPrefix: All
Multicast Specific:
  Multicast Capability: Yes
  Group:     ff02::1:ff03:4
    RefCnt:  0000000002  SrcFltMd: Exclude
    SrcAddr: None
  Group:     ff01::1
    RefCnt:  0000000001  SrcFltMd: Exclude
    SrcAddr: None
  Group:     ff02::1
    RefCnt:  0000000001  SrcFltMd: Exclude
    SrcAddr: None
```

In OMPRoute Configuration File

```
;*************************************
; IPv6 OSPF Configuration Statements *
;*************************************
IPv6_OSPF
    RouterID = 64.64.64.64;
IPv6_Area
    Area_Number = 0.0.0.0;
IPv6_Area
    Area_Number = 6.6.6.6;
IPv6_OSPF_Interface
    Name = ETH6
    Prefix = 2001:face:b00c:1::/64
    Attaches_to_Area = 6.6.6.6;
```

Netstat Devlinks Changes

```
Multicast Specific:
  Multicast Capability: Yes
  Group:     ff02::6
    RefCnt:  0000000001  SrcFltMd: Exclude
    SrcAddr: None
  Group:     ff02::5
    RefCnt:  0000000001  SrcFltMd: Exclude
    SrcAddr: None
  Group:     ff02::1:ff03:4
    RefCnt:  0000000002  SrcFltMd: Exclude
    SrcAddr: None
  Group:     ff01::1
    RefCnt:  0000000001  SrcFltMd: Exclude
    SrcAddr: None
  Group:     ff02::1
    RefCnt:  0000000001  SrcFltMd: Exclude
    SrcAddr: None
```

FF02::5 = OSPFv3 All SPF routers

FF02::6 = OSPFv3 All DR routers

Netstat Stats (Had OMPRoute running)


```
ICMPv6 Statistics

                                Received    Sent
                                --------    ----
Messages                        11407       770
Errors                          0           0
Destination Unreachable         453         0
Time Exceeded                   0           0
Parameter Problems              0           0
Redirects                       453         0
Echos                           2           2
Echo Replies                    0           2
Administratively Prohibited     0           0
Packet Too Big                  0           0
Router Solicitations            0           1
Router Advertisements           10087       0
Neighbor Solicitations          151         612
Neighbor Advertisements         261         153
Group Membership Queries        0           0
Group Membership Responses      0           0
Group Membership Reductions     0           0
```

IPv6 Routing Table

```
F OMPROUTE,RT6TABLE
EZZ7979I IPV6 ROUTING TABLE 881
DESTINATION: ::/0
  NEXT HOP: FE80::200:FF:FE00:0
  TYPE: RADV*          COST:  1         AGE: 299
DESTINATION: 2001:FACE:B00C:1::/64
  NEXT HOP: ::
  TYPE:  DIR*          COST:  1         AGE: 1746
DESTINATION: 2001:FACE:B00C:1:1:2:3:4/128
  NEXT HOP: ::
  TYPE:  DIR*          COST:  1         AGE: 1746

DEFAULT GATEWAY IN USE.

TYPE COST     AGE       NEXT HOP
RADV 1        299       FE80::200:FF:FE00:0
                  0 NETS DELETED, 0 NETS INACTIVE
```

OSPFv6 Info

```
F OMPROUTE,IPV6OSPF,ALL
EZZ7970I IPV6 OSPF INFORMATION 885
TRACE6: 1, DEBUG6: 0
STACK AFFINITY              TCPIP
IPV6 OSPF PROTOCOL:         ENABLED
IPV6 OSPF ROUTER ID:        64.64.64.64 (*IPV6_OSPF)
DFLT IPV6 OSPF INST ID:     0
EXTERNAL COMPARISON:        TYPE 2
AS BOUNDARY CAPABILITY:     DISABLED
DEMAND CIRCUITS:            ENABLED
DR MAX ADJ. ATTEMPT:        0

EZZ7973I IPV6 OSPF AREAS
AREA ID          STUB DFLT-COST IMPORT-PREF DEMAND IFCS NETS RTRS ABRS
6.6.6.6           NO        N/A      N/A       ON      1    0    0    0
0.0.0.0           NO        N/A      N/A       ON      0    0    0    0

 EZZ7958I IPV6 OSPF INTERFACES
NAME             AREA             TYPE    STATE COST HELLO DEAD NBRS ADJS
ETH6             6.6.6.6          BRDCST  128      1    10    40    0    0
```

OSPFv6 Info

```
F OMPROUTE,IPV6OSPF,ALL
EZZ7970I IPV6 OSPF INFORMATION 963
TRACE6: 1, DEBUG6: 0
STACK AFFINITY              TCPIP
IPV6 OSPF PROTOCOL:         ENABLED
IPV6 OSPF ROUTER ID:        64.64.64.64 (*IPV6_OSPF)
DFLT IPV6 OSPF INST ID:     0
EXTERNAL COMPARISON:        TYPE 2
AS BOUNDARY CAPABILITY:     DISABLED
DEMAND CIRCUITS:            ENABLED
DR MAX ADJ. ATTEMPT:        0
EZZ7973I IPV6 OSPF AREAS
AREA ID          STUB DFLT-COST IMPORT-PREF DEMAND IFCS NETS RTRS ABRS
6.6.6.6           NO        N/A     N/A        ON      1    0    0    0
0.0.0.0           NO        N/A     N/A        ON      0    0    0    0

EZZ7958I IPV6 OSPF INTERFACES
NAME              AREA            TYPE    STATE COST HELLO DEAD NBRS ADJS
ETH6              6.6.6.6         BRDCST  128     5    5    20    0    0
```

Router Advertisement

```
1 ADCD113  PACKET   00000004 18:51:03.909205 Packet Trace
  From Interface    : ETH6             Device: QDIO Ethernet6   Full=72
   Tod Clock        : 2012/12/10 18:51:03.909189                Intfx: 12
   Segment #        : 0                Flags:  In
   Source           : fe80::200:ff:fe00:0
   Destination      : ff02::1
                                       Asid: 0042 TCB: 00000000
   QID              : 1
  IpHeader: Version : 6                Header Length: 40
   Class:           : 00               Flow: 000000
   Payload Length   : 32
   Hops             : 255              Protocol: ICMPv6
   Source           : fe80::200:ff:fe00:0
   Destination      : ff02::1

  ICMPv6
   Type/Code        : 86/0             Router Advertisement
   CheckSum         : A6FB FFFF
   Hop Limit        : 64               Flags:   O              Prf: 1(Hi)
   LifeTime         : 3600
   Reachable Time   : 0                Retransmit Timer: 0
   Option           : Mtu              Length: 8
    Mtu size        : 1500
   Option           : Source LinkAddr  Length: 8
    Link-Layer Addr : 00077D14FCD2
```

Neighbor Solicitation

```
62 ADCD113  PACKET   00000004 19:08:05.301971 Packet Trace
  To Interface      : ETH6             Device: QDIO Ethernet6   Full=72
   Tod Clock        : 2012/12/10 19:08:05.301954                Intfx: 12
   Segment #        : 0                Flags:  Out
   Source           : fe80::1:2:3:4
   Destination      : fe80::207:7dff:fe14:fcd4
                                       Asid: 0042 TCB: 00000000
   Next Hop         : fe80::207:7dff:fe14:fcd4
  IpHeader: Version : 6                Header Length: 40
   Class:           : 00               Flow: 000000
   Payload Length   : 32
   Hops             : 255              Protocol: ICMPv6
   Source           : fe80::1:2:3:4
   Destination      : fe80::207:7dff:fe14:fcd4

  ICMPv6
   Type/Code        : 87/0             Neighbor Solicitation
   CheckSum         : 413F FFFF
   Target           : fe80::207:7dff:fe14:fcd4
   Option           : Source LinkAddr  Length: 8
    Link-Layer Addr : 100BA9E38B08
```

Neighbor Advertisement

```
60 ADCD113  PACKET   00000004 19:08:03.973559 Packet Trace
 To Interface      : ETH6              Device: QDIO Ethernet6   Full=72
  Tod Clock        : 2012/12/10 19:08:03.973556                 Intfx: 12
  Segment #        : 0                 Flags:  Out
  Source           : fe80::1:2:3:4
  Destination      : fe80::200:ff:fe00:0
                                       Asid: 0042 TCB: 00000000
  Next Hop         : fe80::200:ff:fe00:0
 IpHeader: Version : 6                 Header Length: 40
  Class:           : 00                Flow: 000000
  Payload Length   : 32
  Hops             : 255               Protocol: ICMPv6
  Source           : fe80::1:2:3:4
  Destination      : fe80::200:ff:fe00:0

 ICMPv6
  Type/Code        : 88/0              Neighbor Advertisement
  CheckSum         : D415 FFFF
  Flags            :   S O
  Target           : fe80::1:2:3:4
  Option           : Target LinkAddr   Length: 8
   Link-Layer Addr : 100BA9E38B08
```

Redirect

```
61 ADCD113  PACKET   00000004 19:08:03.975409 Packet Trace
 From Interface    : ETH6              Device: QDIO Ethernet6   Full=160
  Tod Clock        : 2012/12/10 19:08:03.975405                 Intfx: 12
  Segment #        : 0                 Flags:  In
  Source           : fe80::200:ff:fe00:0
  Destination      : fe80::1:2:3:4
                                       Asid: 0042 TCB: 00000000
  QID              : 1
 IpHeader: Version : 6                 Header Length: 40
  Class:           : 00                Flow: 000000
  Payload Length   : 120
  Hops             : 255               Protocol: ICMPv6
  Source           : fe80::200:ff:fe00:0
  Destination      : fe80::1:2:3:4

 ICMPv6
  Type/Code        : 89/0              Redirect Message
  CheckSum         : E68E FFFF
  Target           : fe80::207:7dff:fe14:fcd4
  Destination      : fe80::207:7dff:fe14:fcd4
  Option           : Redirected        Length: 80
```

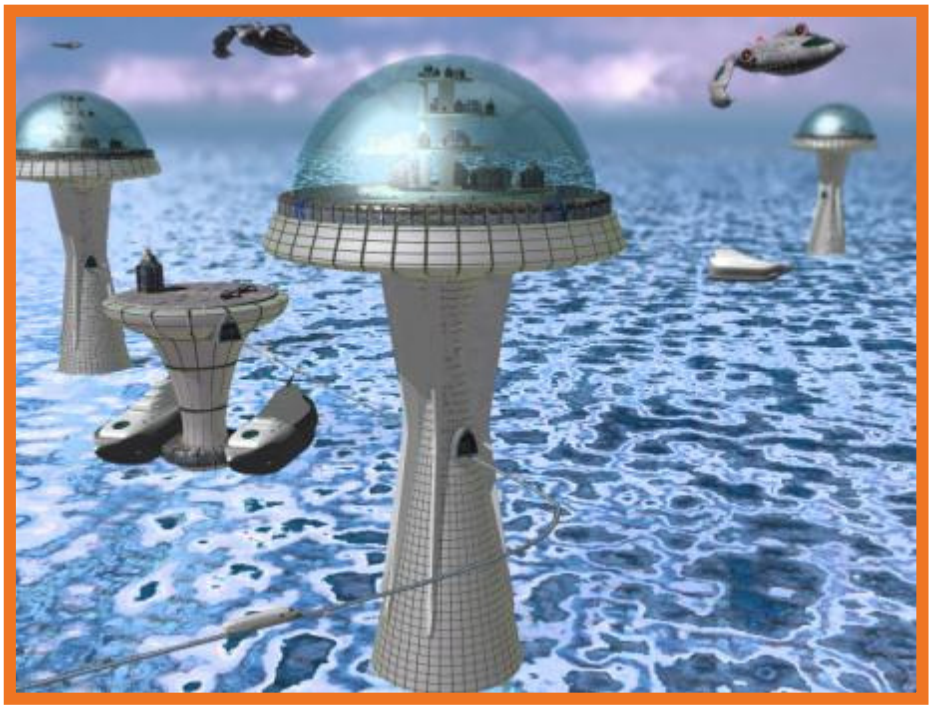
Problems Encountered

- Weird end-of-life layer 2 switch
- Addressing plan
- Not that many, really!
- Onward…

DTCC Runs IT as a Business

- How?
- Run lean
- Constant tuning
- High availability

Be prepared for the future!



Questions

?????

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Inside Products, Inc.

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