Getting Started with IPv6 on the Mainframe

Part 1 of 2

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Collaborative Project

- India Internet Engineering Society (IIESoc) and Industry Network Technology Council (INTC)
- Past Funding: Grant from ISIF Asia (APNIC Foundation), ARIN Community Grants
- Thank you!

https://www.iiesoc.in/

https://industrynetcouncil.org/

Vision

Multi-year project: IPv6 deployment at enterprises.

- Provide training,
- Analysis of security and application conversion,
- Help enterprises plan their IPv6 deployment.

Classes

- Getting Started with IPv6 on the Mainframe : Part 1: November 4, 2021
- Getting Started with IPv6 on the Mainframe : Part 2: November 18, 2021
- IPv6 and Evolving 5G Deployments: December 16, 2021

2022

- IPv6 and IoT (multiple sessions)
- More IPv6 security
- IPv6 and DDI (DNS, DHCP, IPAM) (two sessions)
- Internet Standards Bodies
- IPv6 case studies

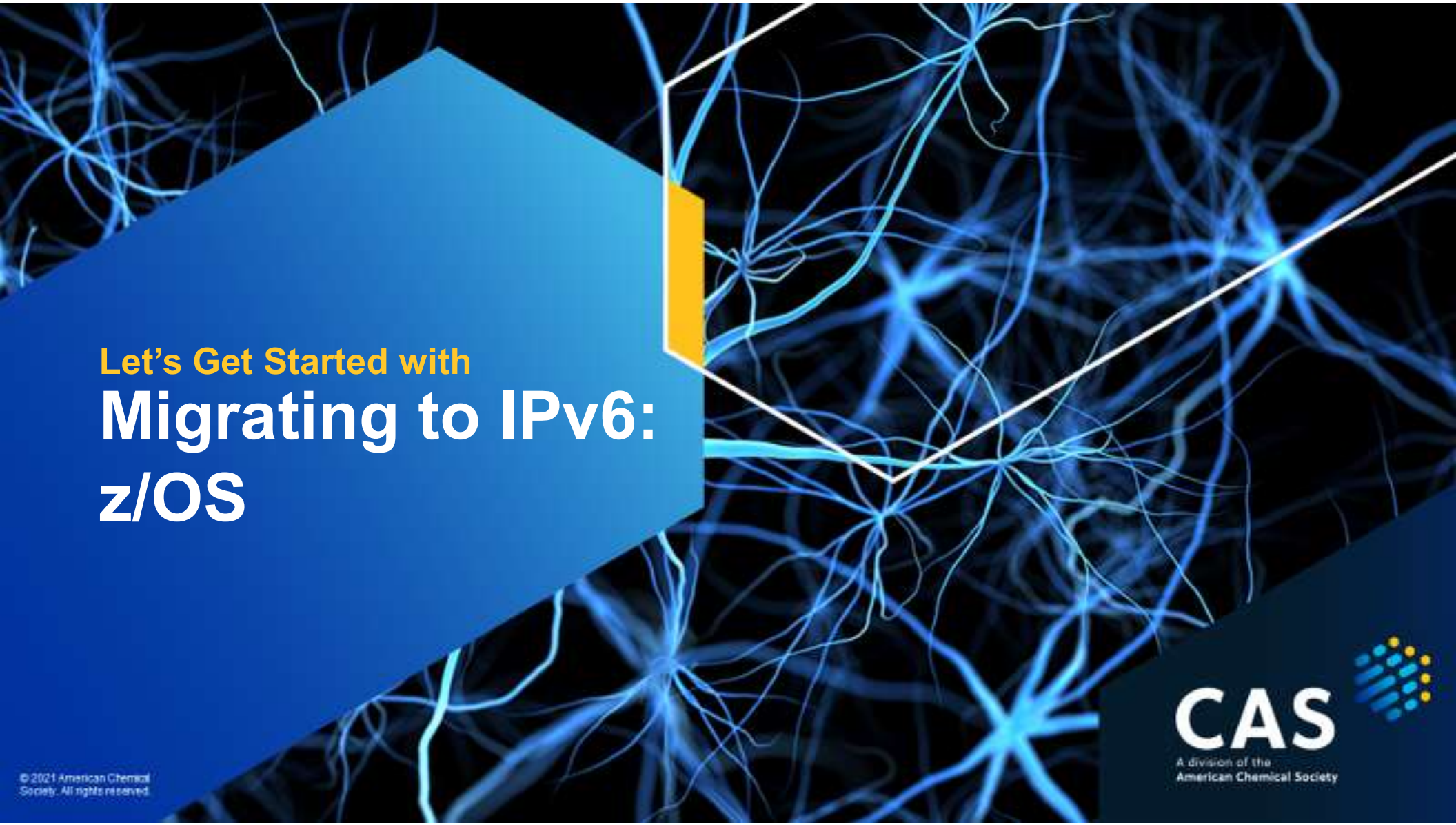
Send us requests!

A few words about me

- President: Industry Network Technology Council
- Founder & CEO: Inside Products, Inc.
- Advisory Board: India Internet Engineering Society
- RFCs: RFC8250 (Embedded performance and diagnostics for IPv6) and others
- Product developer (OEMed by IBM and others)
- Working with IPv6 for 15 years
- Working with network management, diagnostic, performance issues at large brick-and-mortar enterprises for over 30 years

A few words about Rob

- Rob started programming mainframe computers in 1971, and learned an exceptional array of languages, tools and techniques, all without internet assistance.
- He did some dazzling database work in the `80s and wrote over half of the first online registration system for the University of Toledo.
- In the ‘90s he did contracts with three oil companies, a software company and a credit bureau, involving VM, MVS, VSE, OS/2, several flavors of Unix, and an equal variety of networking protocols.
- He is now with Chemical Abstracts Service, a division of the American Chemical Society, supporting z/OS, z/VM and Linux, along with proprietary networking software.
- He has been involved with and a fan of IPv6 since early this century, performing the configuration and software upgrades required to support it on the mainframe.
- He happily notes that the mainframe was the first platform configured for it, with applications using IPv6 sockets exclusively.
- Rob is also co-author of RFC8250.



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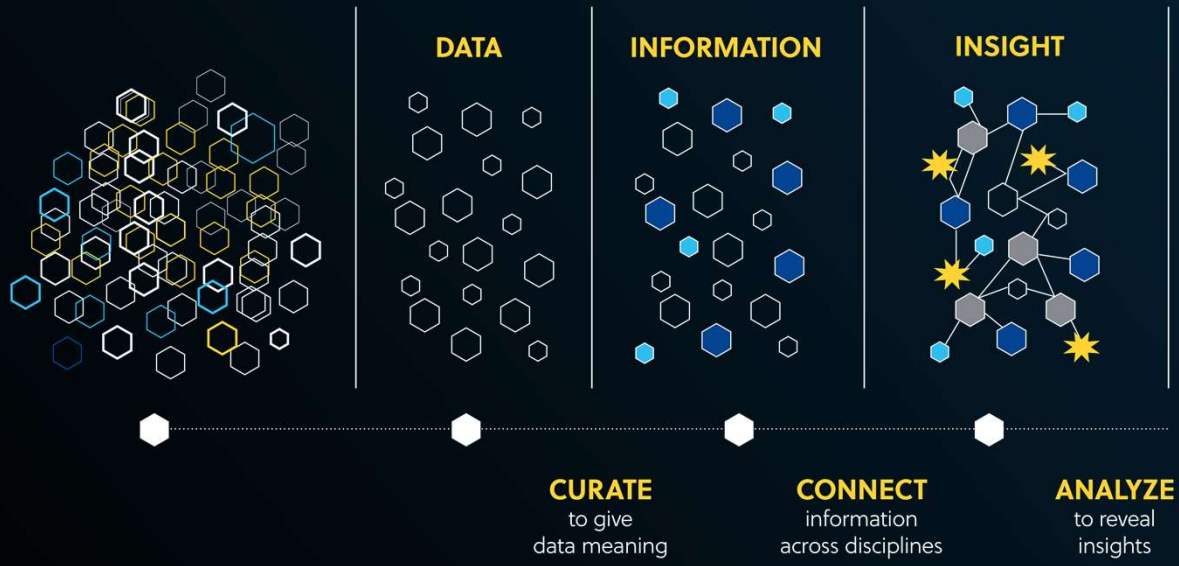

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			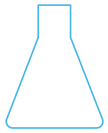	
48	**100**	**20**	**48**	**10**
of the top 50	of the top 100	of the top 25	of the top 50	of the top10 global patent offices

1. Pharm Exec's Top 50 Companies 2020. **2.** ShanghaiRanking's Global Ranking of Academic Subjects 2020. **3.** Genetic Engineering & Biotechnology News Top 25 Biotech Companies of 2019. **4.** C&EN's Global Top 50 for 2020. **5.** WIPO IP Facts and Figures 2019.

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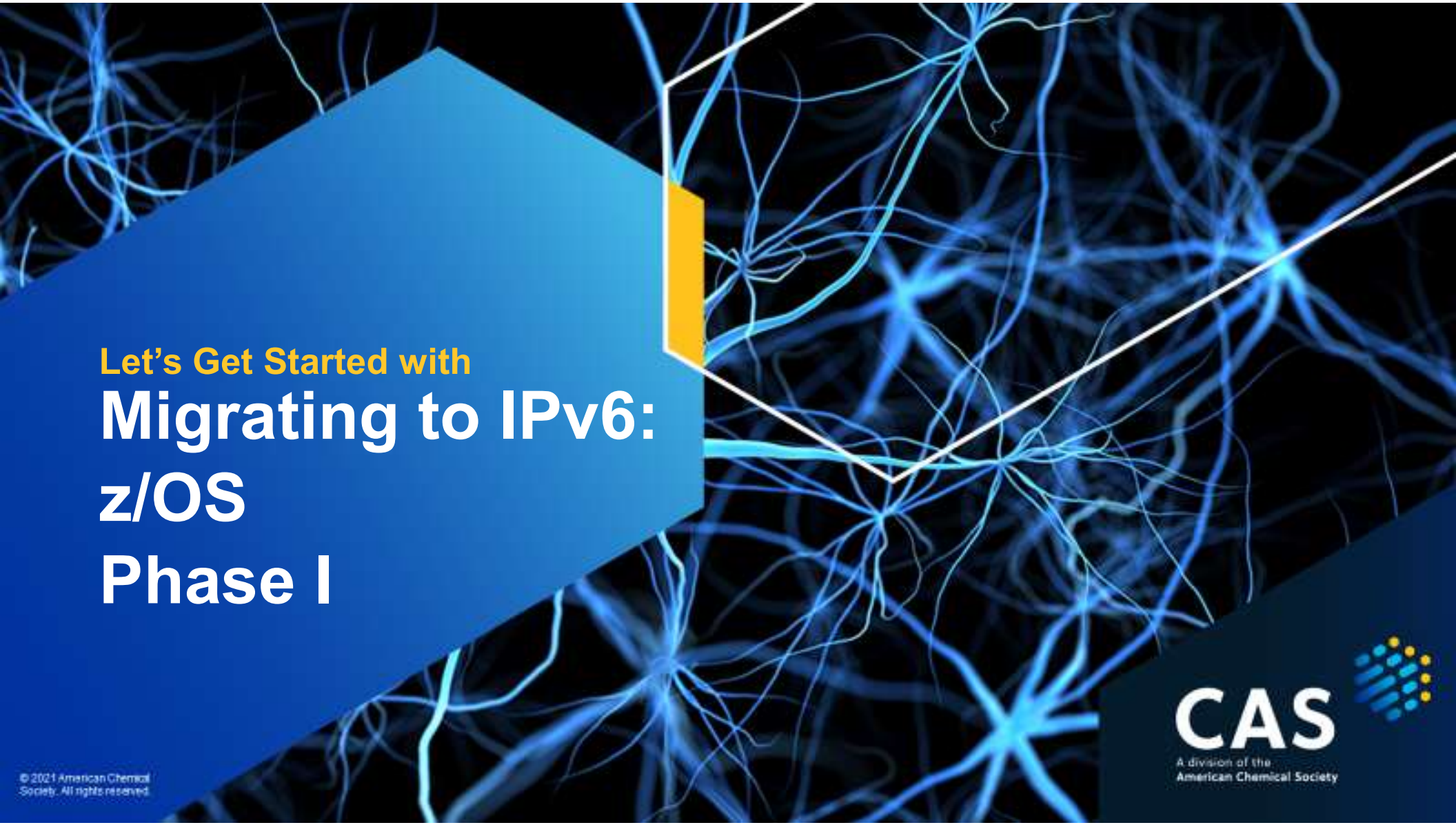

Migrating to IPv6: z/OS

DISCLAIMERS

- These are the steps I took in upgrading my z/OS IP stacks to use IPv6, generalized to make them look better. Your network may (most likely will) be different. The steps in these presentations will either get you there or get you well along on your migration journey. Your mileage may vary.
- As always, the IP addresses here that aren't publicly available have been changed, along with the names of other configurable items and hardware, to protect the guy who wrote this.

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Migrating to IPv6: z/OS

PREFACE: Why are we talking about IPv6 on a mainframe???

- Mainframes are used by:
  - 71% of the Fortune 500
  - 92% of the world's top 100 banks
  - All of the top 10 insurers
  - 23 of the top 25 retailers
  - 23 of the top 25 airlines
  - Airline and hotel reservations

Migrating to IPv6: z/OS

PREFACE: Why are we talking about IPv6 on a mainframe???

- Mainframes handle:
  - 90% of all credit card transactions (*Used your credit card today?*)
  - Over 95% of all ATM transactions (*Used your ATM card lately?*)
  - Over 2.5 Billion (with a B) transactions per day
  - A single z15 can handle 1.2 Million transactions PER SECOND (*How fast is* your *PC?*)

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PREFACE: Why are we talking about IPv6 on a mainframe???

- The mainframe has been doing virtualization since the 1960s.

  They're more than just pretty good at it.

- The mainframe was the original Cloud.

  Before there were PCs.

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Migrating to IPv6: z/OS

PREFACE: Why are we talking about IPv6 on a mainframe???

- Around 2000, a test was run to see how many Linux servers could run concurrently under VM (*not* VMWare) on a single mainframe, and the number was…

  97943.

Just think how the technology has improved since then…

That's why we're talking about IPv6 on a mainframe. If you haven't, it's time.

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PREFACE: Why are we talking about IPv6 on a mainframe???

This is what you don't want:

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PROLOGUE: Really BIG Hint

Use the *z/OS Communications Server: IPv6 Network and Application Design Guide* (NADG).

It was my best friend for several years.

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Migrating to IPv6: z/OS

What do we have to do: The Short List

- Plan
- Enable IPv6 sockets
- Define IPv6 addresses and addressing architecture
- Configure IPv6 communication components
  - We'll get to this in the next session

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Migrating to IPv6: z/OS

What will we be able to do when we are done today?

- We will be able to create IPv6 sockets
- We will be able to communicate over IPv6 sockets to other applications on the same z/OS system
- We will configure the RESOLVER to support IPv6 name-and-address lookups, as well as IPv4 name-and-address lookups

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What do we have to do: Plan

- Plan
  - Two kinds of IP stacks in z/OS:
    - IPv4-Only stack
    - Dual-Mode stack, supporting both IPv4 *and* IPv6
  - IP stacks:
    - Okay to play with IPv6 on your production stack?
    - Or, create or use a test IP stack, and migrate configuration to your production stack as permitted

Migrating to IPv6: z/OS

What do we have to do: Plan

- Plan
  - If you use a secondary stack, you should use a test stack, if possible, that is connectivity-restricted
  - What applications to enable, and how
  - Watch the other webinars in this series to learn about IPv6 addressing

Migrating to IPv6: z/OS

What do we have to do: Enable IPv6 Sockets

- **Update BPXParms:**
  - **OMVS handles all socketry in z/OS**
  - **OMVS is configured by the BPXPRM*nn* member of SYS1.PARMLIB**
  - **It already has some of the configuration items you need:**

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What do we have to do: Enable IPv6 Sockets

- **Update BPXParms:**

```
.
.
/* AF_INET file system for sockets
   CINET support - BPXTCINT and multiple stacks
 */

FILESYSTYPE TYPE(CINET)
            ENTRYPOINT(BPXTCINT)

.
.
  NETWORK DOMAINNAME(AF_INET)
          DOMAINNUMBER(2)
          MAXSOCKETS(64000)
          TYPE(CINET)
          INADDRANYPORT(63000)
          INADDRANYCOUNT(1000)

  NETWORK DOMAINNAME(AF_INET6)
          DOMAINNUMBER(19)
          MAXSOCKETS(64000)
          TYPE(CINET)

SUBFILESYSTYPE NAME(TCPIP1) TYPE(CINET) ENTRYPOINT(EZBPFINI) DEFAULT
SUBFILESYSTYPE NAME(TCPIP2) TYPE(CINET) ENTRYPOINT(EZBPFINI)
SUBFILESYSTYPE NAME(TCPIP3) TYPE(CINET) ENTRYPOINT(EZBPFINI)
```


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What do we have to do: Enable IPv6 Sockets

- **Update your TCP/IP Profile:**

```
.
.
.
IPCONFIG
    IGNOREREDIRECT
    MULTIPATH
    PATHMTUDISCOVERY
    SOURCEVIPA

IPCONFIG6
    IGNOREREDIRECT
    SOURCEVIPA
.
.
.
```


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What do we have to do: Define Addressing Architecture

- Define IPv6 addresses and addressing architecture
- The IPv6 Network and Application Design Guide says:
  - Avoid using IP addresses for identifying remote hosts
  - This is a good reason why:

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What do we have to do: Define Addressing Architecture

This is an IPv6 address:

01111100 11000011 11000001 11100010 00000000 00000000 00000000 00000101 00000000 00000000 00000000 00000000 00000010 00000000 01000000 00000000

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What do we have to do: Define Addressing Architecture

- Define IPv6 addresses and addressing architecture
- This is really about name and address resolution, a.k.a., the RESOLVER configuration:
  - HOSTS.LOCAL, HOSTS.SITEINFO, HOSTS.ADDRINFO are all IPv4-specific. They will still work, but…not for IPv6 names and addresses.
  - ETC.IPNODES is the new location for specifying IPv4 and IPv6 names and addresses
  - ETC.IPNODES is the ONLY location for specifying IPv6 names and addresses

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What do we have to do: Define Addressing Architecture

- You do not need HOSTS.LOCAL and its derivatives. You can mix IPv4 and IPv6 addresses in ETC.IPNODES
- This allows administration of local-host files to more closely resemble that on other platforms, and eliminates the need for post-processing the files (MAKESITE)

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What do we have to do: Define Addressing Architecture

- The SETUP DD statement in your RESOLVER PROC points to the basic configuration for RESOLVER. In that file you can specify, among others:
  - GLOBALIPNODES: a data set or ZFS file reference
  - DEFAULTIPNODES: a data set or ZFS file reference
  - COMMONSEARCH/NOCOMMONSEARCH

Migrating to IPv6: z/OS

What do we have to do: Define Addressing Architecture

- There is a standard search order for ETC.IPNODES files for IPv4 and IPv6 name and address resolution:
  1. GLOBALIPNODES specification
  2. RESOLVER_IPNODES environment variable (OMVS)
  3. *userid/jobname*.ETC.IPNODES
  4. *hlq*.ETC.IPNODES
  5. DEFAULTIPNODES specification
  6. /etc/ipnodes

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What do we have to do: Define Addressing Architecture

- **COMMONSEARCH, or NOCOMMONSEARCH?**
  - **COMMONSEARCH specifies to RESOLVER that you want the same search order and search files for IPv4 name and address resolution as for IPv6. *This is a good thing.* It means you only have to maintain a single source for domain name and IP address information.**
  - **NOCOMMONSEARCH specifies to RESOLVER that you want to use HOSTS.LOCAL et al. for IPv4 name and address resolution, and the ETC.IPNODES search order for both IPv4 and IPv6 name and address resolution.**

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Migration: Timeline

- **May, 2005:**
  US Office of Management and Budget (OMB) instructs federal agencies to "begin addressing key IPv6 planning considerations."

- **August, 2005:**
  A guidance was issued by the General Accounting Office (GAO) that included a deadline of June 2008 for all government agencies to convert their network backbones to IPv6.

Migrating to IPv6: z/OS

Migration: Timeline – Beginning

- **April, 2008:**
  - **Began experimenting with enabling IPv6 sockets in BPXParms**
- **September, 2008:**
  - **Began working on the program updates required to use IPv6 sockets.**

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Migrating to IPv6: z/OS

Migration: Timeline – Configuration Complete

- **February, 2012:**
  All stacks configured to use IPv6

- **Primary Production z/OS system:**
  - **IPv6 sockets enabled in BPXParm in February, 2010**
  - **IPCONFIG6 added to TCP/IP Profile at the end of 2009**
  - **IPv6 INTERFACEs configured and routing added to primary stack in November, 2011; to the secure stack in February, 2012**
  - **All IPv4 DEVICE/LINK/HOME specifications changed to INTERFACEs in August/September, 2017**

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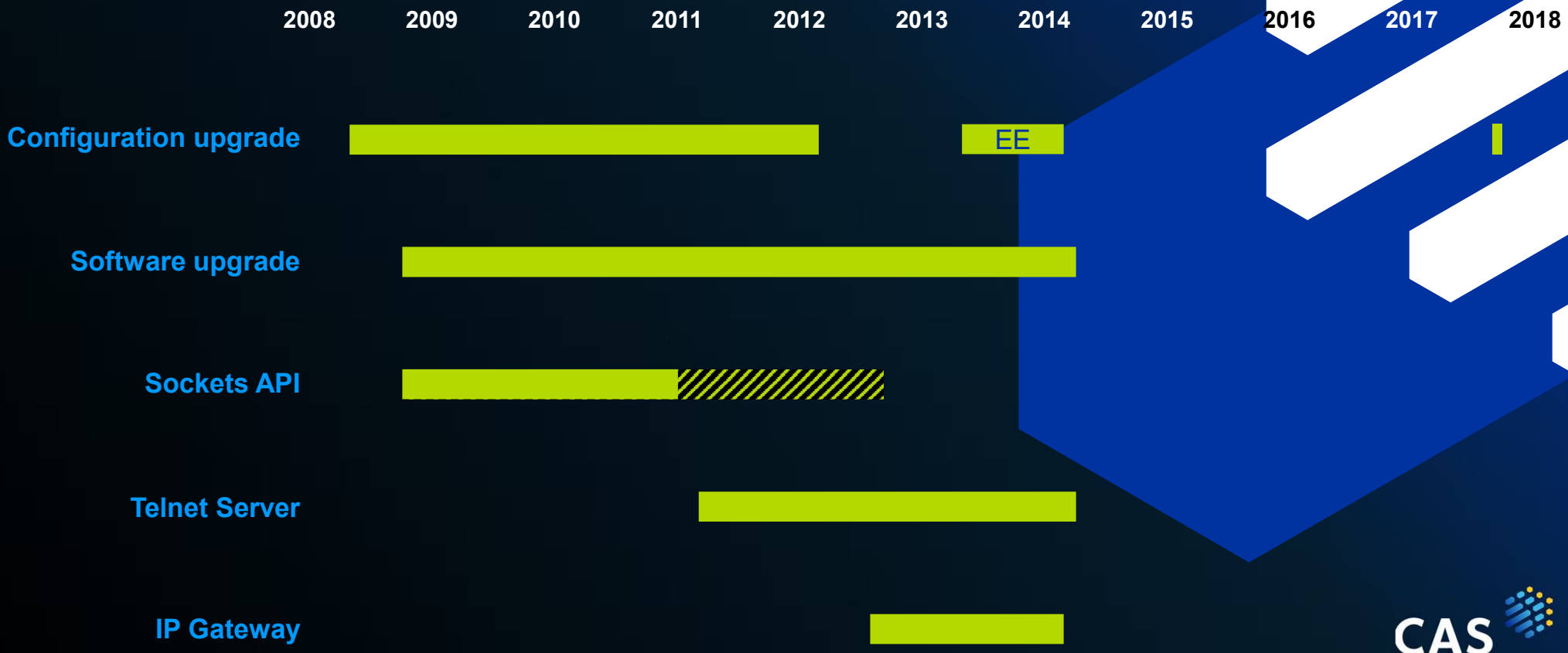
Migrating to IPv6: z/OS

Migration: Timeline



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Migrating to IPv6: z/OS

Here's What We've Covered:

- z/OS:
  - Planning
  - Enabling IPv6 Sockets
  - Configuring Name and Address Resolution

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This is what is left to do:

- z/OS:
  - Configuring IPv6 INTERFACEs
    - Configure OSA INTERFACEs
    - Configure HiperSockets INTERFACEs
    - Configure primary and application VIPAs
    - Configure the IP side of Enterprise Extender
  - Configuring IPv4/IPv6 Routing

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Questions?

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Thank you!!!

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