

Enterprise Extender Planning, Migration, and Implementation

Cover

This session discusses Enterprise Extender (EE), an advanced HPR technology that can be used to connect different HPR nodes to each other using an IP network. Although it has some similarity to the AnyNet SNA over TCP/IP technology because it allows SNA nodes to communicate using an underlying IP network, it is a more recent and advanced technology.

Agenda, Page 2

The presentation contains five topics:

- What is Enterprise Extender ?
- Planning for Enterprise Extender
- Using EE with other Technologies
- EE Implementation
- EE Operations

What is Enterprise Extender?, Page 3

Enterprise Extender is a technology available with several different HPR platforms which allows these nodes to establish connections and sessions using an IP, rather than SNA network. With Enterprise Extender, the IP network looks like a transmission group (TG) to the APPN nodes.

The diagram is showing an example of how an IP network could be used for connectivity between various HPR nodes . In the diagram, the dashed/dotted line is depicting normal IP traffic, such as that between clients and servers, including a TN3270 client attached to a TN3270 server in the S/390 using the underlying IP network. This same IP network is also being used to carry SNA sessions. The SNA client (i.e. 3270, banking terminal, etc.) in the center bottom is connected to a platform, such as a Cisco router with SNA Switch, acting as a DLUR node. The Cisco Router is using Enterprise Extender to a S/390 with Enterprise Extender (EE). Note that the sessions are using a combination of SNA connections (shown by the solid line) and IP EE connections. In the same manner, the Cisco router has another EE connection to a channel attached node, such as a 2216 or 3746-MAE and the sessions are using routes consisting of both SNA connections (the solid lines) and IP EE connections (the dashed line). The S/390 to S/390 connections/sessions could also be using both SNA connections, such as MPC+, OSA ATM or XCF (the solid line) or EE IP connections, such as OSA Gigabit Ethernet (the dashed line).

Although not shown on the diagram, sessions could also exist with resources in Subarea Networks through use of attachments to a VTAM performing Interchange Node functions.

Advantages of Enterprise Extender, Page 4

The advantages of Enterprise Extender include:

1. SNA transport over native IP network - EE allows SNA resources to access each other using an underlying IP network, eliminating the need to provide two different networks, one for SNA and one for IP, as many customers do today.
2. No changes to SNA applications - the use or implementation of EE nodes in the network is transparent to the SNA applications. They can participate in sessions (all kinds -- APPC, LU2, LU1, LU0, etc.) without change because the underlying IP network just looks like an APPN TG to the SNA network.
3. Fully enables parallel sysplex - the SNA Parallel Sysplex functions are dependent upon using APPN and HPR within the Parallel Sysplex. As compared with HPR just within the Parallel Sysplex, implementing EE in the network can provide higher availability since HPR can be exploited to route around additional node/link failures.
4. End-to-End failure protection - because EE uses the underlying HPR technology, there is much more end-to-end failure protection as compared with older SNA technologies, such as subarea networking, DLSw, etc..

Enterprise Extender Planning, Migration, and Implementation

5. End-to-End data prioritization -- EE by default implements setting of different PORTs and different Type of Service (TOS) bits based on the APPN Class of Service being used (network, high, medium, or low priority).
6. Can reduce APPN network complexity while exploiting IP alternate routing/redundancy technologies - because EE exploits use of underlying IP network alternate routing technologies, there is reduced need to implement a lot of network nodes and links between them in the SNA portion of the network. EE can also be combined with Branch Extender technology, allowing routers to appear as ENs, rather than NNs. EE can therefore simplify the APPN network design and complexity.
7. SNA traffic can exploit OSA Gigabit Ethernet -- the OSA Gigabit Ethernet, which has produced impressive throughput benchmark results, does not support SNA (only TCP/IP) connections. With use of EE, the SNA traffic can exploit the very high speed connectivity provided by the OSA Gigabit Ethernet adapter.
8. EE can use any S/390 IP network connection -- channel attached router, OSA, etc.. Since many customers are currently building fast, redundant IP networks for the Web and client/server applications running in the S/390, EE provides the advantage of being able to use any of these high-speed IP connections for SNA traffic, as well.

Enterprise Extender, Page 5

This diagram conceptually shows an EE connection between a S/390 and a DLUR node. Native SNA nodes are attached to the DLUR router using the normal LAN or link connections that they've used previously. Note that both CS/390 in the S/390 and the HPR DLUR functions in the router are providing the HPR Rapid Transport Protocol (RTP) endpoint functions in addition to the ability to transform the SNA data into UDP IP packets to send across the underlying IP network. The applications in each EE node work as usual and communicate with the RTP endpoint which then uses UDP packets to send the data through the IP layer out through the DLC (Data Link Control). UDP, rather than TCP, has been used for EE, since the RTP endpoints already contain all the functions needed to acknowledge and recover frames, to provide flow control, etc..

The nodes use native IP routing (no encapsulation such as that used with DLSw) which maximizes the throughput of the routers in the IP network. As shown in the diagram, pure IP routing directly into the S/390 is possible, although not required if the customer prefers to use a channel attached APPN node that provides the EE functions. Because native IP routing is used, the SNA network and applications can take advantage of the advances that are being made in IP routing and networking.. There may also be an advantage to those customers who wish to use a single network transport, rather than different network transports for their IP network versus their SNA network.

The HPR function in each EE node provides error detection and selective retransmission of HPR data frames which are in error. HPR also allows non-disruptive rerouting around node or link failures. In addition to the alternate routing provided in the IP network shown in the diagram, if for some reason, the connection between the two EE endpoints goes down and there were another route (either pure SNA or another EE connection) between the nodes, the sessions using the failed EE connection could be non-disruptively rerouted around the failure. HPR also provides congestion control, allowing the sending node to dynamically adjust its sending rate based on the rate at which the receiving node is receiving the data. HPR also provides prioritization of the frames based on the SNA transmission priority of the data within the frame. In the IP network, the IP routers provide packet forwarding and can also prioritize the EE frames based on the PORT or Type of Service (TOS) bit settings associated with each packet. The EE nodes automatically associate different PORTs and TOS settings with the SNA data based on the APPNCOS transmission priority associated with each session.

Enterprise Extender, Page 6

The Enterprise Extended function in Communications Server for OS/390 is implemented through use of a separate UDP layer, sometimes called Fast UDP which is optimized for EE communications. The communication between VTAM (HPR over IP, EE) and IP (Fast UDP) in CS/390 is accomplished through use of the IUTSAMEH device. This is the same sort of mechanism that is used for communication between two TCP/IP stacks running on the same OS/390. Multiple TCP/IP stacks and EE can use this mechanism concurrently. VTAM, through use of a Start Option designation must indicate which TCP/IP stack is to be used for EE when running in this sort of environment.

Enterprise Extender Planning, Migration, and Implementation

Planning for Enterprise Extender, Page 7

The list of products which have Enterprise Extender includes:

1. OS/390 V2R6 and higher. For both OS/390 V2R6 and V2R7 maintenance is needed in order to use EE. The APAR numbers are OW36113 for OS/390 V2R6 and OW36458 for OS/390 V2R7
2. IBM 2216, Network Utility, 2210, 3746-MAE
3. Communications Server V6+ for AIX and Windows
4. PCOMM V4R3
5. Cisco SNA Switch

Some of these products have both EE and Branch Extender which can be used together. Use of EE with Branch Extender can simplify the APPN network design in two different ways. First, by using the IP network for the routing and alternate routing functions, the need for NNs is reduced. Second, by placing routers appearing as ENs (with the Branch Extender function) at the appropriate sites to handle the SNA devices, allowing them to communicate with other SNA resources accessed through use of the IP network, registration of resources can be increased and broadcast searching and TDU exchanges can be decreased.

Enterprise Extender Planning, Page 8

When planning for Enterprise Extender, the following items should be considered:

1. IP Routing and Addressing - This may be the largest planning task associated with Enterprise Extender. Each of the EE nodes needs to have at least one IP address (which may not already exist if the network has been pure SNA in the past). The IP network addressing and routing needs to be planned for. In the S/390, both the VIPA and IUTSAMEH device/link need IP addresses, different from those associated with actual physical interfaces. These may not already exist and need to be planned for. Although Dynamic Routing is NOT required in order to use VIPA, it should be implemented in order to provide a redundant, more highly available network. Most SNA networks have been designed for years with alternate routing and backup facilities. Using EE without Dynamic IP routing essentially means that the SNA traffic is dependent on the primary network interface being continuously available, since use of alternate/backup network interfaces won't work automatically unless Dynamic IP routing is implemented.
2. APPN Link Weights - Since the IP network looks like an HPR TG to SNA when using EE, this TG has a link weight, like other APPN TGs. If there is alternate/preferred routing available, the normal planning tasks associated with links weights and "least weight routes" needs to be performed. The Enterprise Extender function in VTAM provides two new Transmission Group Profiles (TGPs) for use with EE links. These are located in SAMPLIB and can be copied into VTAMLST.
3. Backup configurations - Use of EE probably means that the current network design will change significantly, in which case this is also a very large planning task. Planning for backup includes items such as backup DLURs and/or Network Node Servers for the peripheral SNA resources, backup DLUSs for the DLURs, alternate routing should primary routes be unavailable and the capacity planning for the backup nodes /routes that accompanies this task.
4. Router setup if priority used - EE automatically uses different PORTs and TOS bits for the different priorities used with SNA traffic. If the router network is going to prioritize traffic based on these PORT or TOS bit settings, the routers need to be configured appropriately.
5. Startup of VTAM EE links needs to follow activation of TCP/IP - Until OS/390 R10 (or V2R8 with OW43814 and PQ38173), the VTAM XCA Major node can't be activated until TCP/IP is available. Since TCP/IP is dependent upon VTAM being up first (until V2R10), customers today activate VTAM before TCP/IP and normally use VTAM's CONFIG list for all the Major Nodes that should be activated at startup. Without R10 (or the R8 maintenance), if the EE XCA Major Node is activated when TCP/IP is not available, it will need to be recycled when TCP/IP becomes available
6. EE is "HPR only" DLC - the EE Data Link Control can only handle HPR traffic (not APPN ISR, Intermediate Session Routing, traffic). Because of this, in environments with BOTH Subarea and APPN networks, planning is required. The next few foils covers this item in more detail.

ICNs With Subarea and HPR, Page 9

Enterprise Extender Planning, Migration, and Implementation

As demonstrated on the top picture, prior to an enhancement in OS/390 V10 (and in R6+ via maintenance), a VTAM Interchange Node (ICN), must use APPN Intermediate Session Routing (ISR) for sessions involving both a subarea resource and an adjacent NN. As demonstrated by the bottom picture, the ICN can use HPR on the hop to an adjacent EN for sessions which also involve a subarea resource, but is unable to use HPR when the adjacent node is a NN.

The “HPR-Only” DLC Issue, Page 10

As described on the previous page, for subarea to ICN to NN routes, ISR, not HPR, is used on the hop between the ICN and the NN. While the ICN can use HPR to adjacent ENs for sessions using subarea to ICN to EN routes, the ICN can NOT do this when the next hop on the subarea to ICN to APPN network route is a NN. Therefore, it is very important to consider this issue when using Data Link Controls that can only carry HPR (not ISR) traffic.

For VTAM to VTAM connections using MPC+ on APPN Host to Host Channels or using XCF, the DLCs allow both HPR and ISR traffic. However, when using VTAM to IBM N Ways nodes MPC+ channel connections or VTAM to VTAM OSA Native ATM connections, these DLCs are “HPR-only”. Therefore, if these N ways MPC+ connected nodes are NNs or the VTAM OSA Native ATM connected nodes are NNs, sessions involving these nodes and resources in the subarea network will fail. All Enterprise Extender connections are HPR only, so attention should be paid to the network design if ICNs will handle sessions involving subarea network resources and EE connected NNs.

The picture shows an example of where some sessions may fail. Assuming one session partner is in the subarea network, sessions between it and resources on the MPC+ connected VTAM NN will work (since this DLC supports ISR as well as HPR traffic). Sessions between the subarea network resources and the MPC+ connected VTAM EN or 2216 EN will also work since the ICN converts the subarea messages directly to HPR when destined for an EN. However, sessions involving the subarea network resource and resources on the MPC+ connected 2216 will fail because this DLC is “HPR-only” and the ICN needs to use ISR on the hop to the NN.

OS/390 V2R10 provides a solution for this type of environment, discussed on the next page. Prior to having this enhanced code, customers can use network designs involving no HPR-only DLCs, HPR-only DLCs only to ENs (or routers using Branch Extender function), or use a design with the ICN attached using APPN to another VTAM which has the HPR-only attachment to other nodes. This last design type allows the ICN to use ISR between it and the APPN attached VTAM which can then use HPR for the next hop(s) of the session routes.

The “HPR-Only” DLC Solution, Page 11

With R10 (or OS/390 V2R6 or higher with APAR OW44611), for subarea-ICN-NN routes, the ICN will use a "one hop" HPR route between the ICN and the NN. This allows sessions to use both subarea and "HPR-only" DLCs in session routes. As shown in the picture, with this enhancement, sessions involving subarea resources will use HPR on the hop between the ICN and the APPN nodes shown. Although the diagram shows EE as the DLC, the ICN will perform this with any HPR capable DLC (including the “HPR-only” DLCs OSA native ATM and MPC+ to IBM N Ways routers). In order for this to work with environments where the NN is not the endpoint of the session (such as sessions going through the VTAM R10 NN in the picture further into the HPR network), the enhanced code is not only needed on the ICN, but on the NN that is acting as an intermediate node for subarea to HPR sessions. The reason the enhanced code is needed here is that the ICN brings up a one-hop HPR connection to this node and this node will have to bring up another HPR connection to the RTP endpoint of the session partner to handle the session traffic.

Enhancement for “HPR-Only” DLCs, Page 12

This visual shows more detail on how the enhanced code works. Note that sessions involve resources in the subarea network (the connection to the subarea network looks like TG 254 as far as the APPN network is concerned). The ICN with the enhanced code brings up a one hop HPR connection to the adjacent NN. If sessions continue through an adjacent VTAM NN, this NN also needs the enhanced code so that it can bring up an additional HPR connection to the actual endpoint to handle the session traffic.

Enterprise Extender Planning, Migration, and Implementation

The enhanced code is contained in OS/390 V2R10 and is available for prior OS/390 R6 and higher levels of code with APAR OW44611.

Using EE and other Technologies, Page 13

The visual shows an example of how Enterprise Extender might be used with other technologies. This example contains two data centers with multiple VTAMs, peripheral resources, etc., as well as a large IP network environment. Using EE, the same network that is used to support IP client/server communication, TN3270 client/server communication, WebServing, etc. can be used to connect the VTAMs to each other. In some customer locations, significant investment has been made in fast, redundant IP networks to the extent that they are faster and more redundant than the SNA network. Using EE, the SNA sessions may take advantage of these fast, redundant IP networks.

Using EBN and EE Together, Page 14

Using Extended Border Node and Enterprise Extender together is of interest to customers who are trying to converge onto a single protocol transport network and who also use SNI extensively for SNA connections to other networks. This visual shows a simplified version of one customer's ideas of how to exploit these two technologies in their environment (the customer actually has multiple data centers and NETIDs, not just the two shown on the visual).

This customer has a very large, high speed IP network as well as a large, complex SNA network. There are multiple data centers, as well as connections to other companies. The customer has employed VTAM ICNs (since they also have a large NCP network) and ENs in each data center. For their mainframe to IP network connectivity they have employed IBM routers for native IP traffic and as DLUR TN3270 gateways (using the Branch Extender technology to allow these routers to appear to VTAM as ENs). For data center to data center traffic, the customer's idea is to use the Enterprise Extender and Extended Border Node functions in the IBM routers (shown as NNs in the picture) since these data centers have different NETIDs (SNI has been used for interconnection in the past, followed by VTAM-VTAM channel extenders using Extended Border Node as a migration step).

This design should allow the customer to migrate to a converged network carrying both their IP and SNA traffic.

CS/390 Enterprise Extender Definitions, Page 15

The definitions involved with Enterprise Extender are listed below. There are a few definitions for VTAM and a few for TCP/IP. Part 2 of this presentation provides more detail on these definitions. The VTAM definitions for EE are:

1. Start Options - The Start Options IPADDR, to specify the VIPA address to be used, and TCPNAME, to specify the procedure name of TCP/IP, are new for EE. The VIPA address and procedure name both point to definitions of the TCP/IP running on the same host where VTAM is running.
2. XCA Major Node for EE DLC - The connection between VTAM's EE function and Fast UDP is specified through an XCA definition with MEDIUM=HPRIP.
3. Switched Major Nodes for Link stations - Partner EE nodes provide an XID3 similar to other attached APPN nodes. As with other APPN nodes, Switched Major Node definitions with matching CPNAMEs are used to define the link stations to the partner EE nodes.
4. Choice of ARB-2 - The EE function also provides a choice of a new HPR Adaptive Rate Based Flow and Congestion Control (ARB) algorithm. This newer one is sometimes called ARB-2 to contrast it with the original algorithm. The original algorithm is now also called BASE whereas the newer algorithm is called Responsive Mode. One or the other can be designated via the Start Option HPRARB (which defaults to Responsive Mode). The original algorithm is optimized for use in a reliable, low error rate network, similar to many of today's SNA networks. However, when sharing facilities with IP, there may be more possibility of lost data, discarded frames, etc.. Therefore, the newer algorithm is designed to be much less sensitive to lost data than the original algorithm and to also try to guarantee that SNA gets its fair share of the bandwidth.

The TCP/IP definitions needed for EE are:

Enterprise Extender Planning, Migration, and Implementation

1. By default, EE uses PORTS 12000-12004 and the Type of Service (TOS) bit settings of C0,80,40,20 (for network, high, medium, and low priority traffic, respectively). These PORTs should be reserved for VTAM's use in the TCP/IP profile.
2. IUTSAMEH device and link for communication between VTAM and TCP/IP.
3. A Virtual IP address (VIPA). This address can be the same VIPA address that is used for other resources on this TCP/IP or can be a different one. It cannot be a Dynamic VIPA.

Enterprise Extender Definitions, Page 16

When defining the use of Enterprise Extender on a CS/390 node, there are several definitions involved. These include VTAM Start Options, an XCA Major Node, one or more Switched Major Nodes, and definitions in the TCP/IP profile including a VIPA, the IUTSAMEH device and link, and PORTs. Specific examples are shown over the next few pages, but these definitions are briefly described here.

VTAM Start Options used with Enterprise Extender are:

1. IPADDR - points to the Virtual IP address (VIPA) that is to be used for Enterprise Extender communications. If IPADDR is not specified, the default is to use the first VIPA in the local TCP/IP stack's HOME list. IPADDR can be dynamically modified.
2. HPRARB - defaults to RESPMODE, the newer HPR algorithm that is generally recommended for use with Enterprise Extender. If the original algorithm is desired, HPRARB can be set to BASE. It is dynamically modifiable and, unfortunately, is not documented in the R6, R7, or R8 manuals.
3. TCPNAME - points to the procedure name of the TCP stack that VTAM uses for Enterprise Extender communications. TCPNAME can be dynamically modified, but in order to dynamically use a different stack, the XCA Major node should be recycled.

Other VTAM definitions used with Enterprise Extender are:

- A single XCA Major Node specifying MEDIUM=HPRIP on the PORT statement. This XCA Major Node specifies a LINE/PU (through use of the AUTOGEN parameter) for each concurrent Enterprise Extender partner that this VTAM connects to using the IP network.
- One or more Switched Major nodes with matching control point name (CPNAME) of the Enterprise Extender partner nodes. The switched major node also can specify the HOSTNAME or IP Address of the Enterprise Extender partner(s) on the PATH statement(s) which is used for "dial-out" operations to contact the partner(s).

The CS/390 TCP/IP Profile needs the following definitions for Enterprise Extender:

- VIPA - this consists of defining a VIRTUAL DEVICE and LINK statement and assigning an IP address to the LINK on the HOME statement in the TCP/IP profile
- IUTSAMEH device and link - this consists of defining an MPCPTP DEVICE with the name IUTSAMEH and an MPCPTP LINK and assigning an IP address to the LINK on the HOME statement in the TCP/IP profile
- PORT definitions - the PORTs used by Enterprise Extender are UDP PORTs and should be reserved using the PROFILE statement. Normally, Enterprise Extender uses PORTs 12000, 12001, 12002, 12003, and 12004 for LDLC signal traffic, network-priority data, High-priority data, Medium-priority data and Low-priority data, respectively. They can be reserved for Enterprise Extender by specifying the VTAM procedure name (normally NET) in the "user" field.

Lab Diagram, Page 17

This is a picture of the lab configuration in Gaithersburg, MD that was used to develop this presentation material. This picture is the same one used in the Extended Border Node presentation. This lab contains a wide range of SNA connectivity including the implementation of Enterprise Extender on the ICN CSSNET.CSS2 and the NN USIBMWZ.S183CDRM as well as on two workstations (not shown). The Enterprise Extender portion of this lab is shown in more detail on the next page. The general description of the connectivity on this picture is reviewed in the next two paragraphs.

Enterprise Extender Planning, Migration, and Implementation

The main networking lab is the one in the middle, with the NETID CSSNET. It has both IP and SNA connectivity to many other nodes. A subset of the SNA connectivity is shown on this visual. There are two ICNs, CSS1 (at OS/390 V2R4) and CSS2 (at OS/390 V2R8) and they are connected to each other with a variety of APPN and subarea connections. CSS1 normally owns the two NCPs, HANSL and GRETL (note the box around these three nodes showing that they are a CNN). There are several workstations which are normally token-ring attached to GRETL. The workstations are frequently reconfigured to token-ring attach to the 2210/2216s, the 3646-900, each other, etc.. There is a 3746-900 running as a NN which is channel attached to CSS1 and CSS2 as well as frame relay attached to the 2210 and 2216. The 2210 and 2216 are also frame relay attached to HANSL.

In terms of connectivity to other networks, GRETL and the NCP WZ6NCP in the network USIBMWZV have both SNI SDLC link connectivity between them and a token-ring border node connection (both CSS1 and USIBMWZV.WZVCDRM are started with BN=YES. GRETL also has token ring connectivity to a PC running CM/2 which is a NN with a NETID of NETX (NETX.CPWS15). Since this is a connection between the CNN, CSSNET.CSS1 and the NN NETX.CPWS15, a peripheral border node connection is brought up by CSS1. The CNN CSS1/GRETL also has token-ring border node connectivity to an LPAR (via OSA), USIBMWZ.S183CDRM, which has also been started with BN=YES.

CSS2 and S183CDRM also have IP connectivity through use of token-ring (the same OSA as used for SNA on S183CDRM and a 3172 and 2216 for CSS2). This will be shown in more detail later in this presentation, but these two border nodes connect to each other using Enterprise Extender along with Extended Border Node functions.

Enterprise Extender Lab Diagram, Page 18

This visual shows the four nodes in the Gaithersburg, MD that use Enterprise Extender for communication with partner Enterprise Extender nodes. The four nodes are:

1. CSSNET.CSS2 - this is an OS/390 V2R8 system with VTAM configured as an Interchange Node and Border Node which runs two TCP/IP stacks, NM2ATCP (the one used for Enterprise Extender communications) and NM2BTCP. The VIPA used for Enterprise Extender on this system is 9.82.67.170. The NM2ATCP stack has two token-ring interfaces, a 3172 and a 2216, to the IP network.
2. CSSNET.CPWS1 - this is a Windows NT Server system running Communications Server for Windows NT V6.1 configured as a NN and DLUR using CSSNET.CSS2 as its DLUS. This system uses a token-ring adapter for connectivity to the IP network. Its IP address is 9.82.131.142.
3. CSSNET.CPWS3 - this is a Windows NT Workstation system running Personal Communications for Windows NT V4.3 configured as a EN and DLUR using CSSNET.CSS2 as its DLUS. This system uses a token-ring adapter for connectivity to the IP network. Its IP address is 9.82.131.143.
4. USIBMWZ.S183CDRM - this is a OS/390 V2R8 system with VTAM configured as a Network Node and Border Node which runs a single TCP/IP stack, TCPIP1. The VIPA used for Enterprise Extender on this system is 9.82.25.9. TCPIP1's connectivity to the IP network is an OSA token-ring adapter.

The workstations have connections defined to CSSNET.CSS2, although it would be possible to define connections to USIBMWZ.S183CDRM. Recalling the earlier discussion of importance of NETID, if CSSNET.CPWS3 (an EN) were connected to USIBMWZ.S183CDRM and used it as its network node server (for example, if CSSNET.CSS2 weren't available), CSSNET.CPWS3 would become part of USIBMWZ.S183CDRM's network. If CSSNET.CPWS1 (a NN) were connected to USIBMWZ.S183CDRM, a peripheral border node connection would be brought up by USIBMWZ.S183CDRM..

TCP/IP Profile at S183CDRM, Page 19

This visual shows various statements from TCPIP1's profile associated with Enterprise Extender. The PORTs 12000 through 12004 have been reserved for Enterprise Extender through specification of the port number, UDP, and the procedure name of the VTAM running on this system. Please note that the procedure name of VTAM on S183CDRM is actually NET and an error was made in this specification because of copying of some documentation which was coded in this manner. Although these PORT statements are coded incorrectly (they should say 12000 UDP NET, for example), this coding worked with Enterprise Extender.

Enterprise Extender Planning, Migration, and Implementation

```
12000 UDP VTAM          ; EE
12001 UDP VTAM          ; EE
12002 UDP VTAM          ; EE
12003 UDP VTAM          ; EE
12004 UDP VTAM          ; EE
```

The VIPA device and link for Enterprise Extender are coded as:

```
DEVICE  VDEV1    VIRTUAL  0
LINK    VLINK1  VIRTUAL  0    VDEV1
```

The IUTSAMEH device and link for Enterprise Extender are coded as :

```
DEVICE  IUTSAMEH MPCPTP
LINK    TOVTAM   MPCPTP  IUTSAMEH
```

The VIPA Link and OSA Token-ring Link are assigned IP addresses through coding:

```
HOME
  9.82.25.9    VLINK1      ; VIPA link
  ...
  9.82.131.234 OSATRA00
```

The OSA and IUTSAMEH devices are started automatically through coding:

```
START OSAA00
START IUTSAMEH
```

TCP/IP Profile at S183CDRM, Page 20

The TCP/IP Profile at S183CDRM specifies SOURCEVIPA in the IPCONFIG statement. This is not required for Enterprise Extender, although one of the reference materials states that it is. We used Enterprise Extender with both SOURCEVIPA and NOSOURCEVIPA and both worked fine.

Although dynamic routing is highly recommended when using virtual IP addresses, it is not a requirement. TCPIP1 is configured for static, not dynamic, IP routing. One of the reference materials states that dynamic IP routing is a requirement for Enterprise Extender. This is not true but it would be a good idea to implement dynamic IP routing to enable a more highly available system from an IP networking standpoint.

Enterprise Extender requires use of a VIPA, but this should not be a Dynamic VIPA. Dynamic VIPAs are used for applications that may be recovered on other OS/390 systems. In the case of VTAM (which the Enterprise Extender VIPA is used for), a single VTAM is always associated with each OS/390 system and is not moved from place to place.

The VTAM procedure name on S183CDRM is NET and NET is what should have been coded on the 12000-12004 PORT statements in TCPIP1's profile. However, even though VTAM is coded here (a mistake), Enterprise Extender works fine. The same coding was used on the other OS/390 system where VTAM's procedure name is neither VTAM nor NET, and Enterprise Extender failed in this case.

Here is the complete TCP/IP profile that was used during Enterprise Extender testing on S183CDRM:

```
ARPAGE 20
;
TELNETPARMS
  PORT 23
  INACTIVE 7200
  TIMEMARK 600
  SCANINTERVAL 120
  SMFINIT STD
```


Enterprise Extender Planning, Migration, and Implementation

```
SMFTERM STD
ENDTELNETPARMS
IPCONFIG
  MULTIPATH PERP
  DATAGRAMFWD FWMULT PERP
  SOURCEVIPA
TCPCONFIG          RESTRICTLOWPORTS
TCPSENBFRSIZE 32K
TCPCVBUFRSIZE 32K
UDPCONFIG          RESTRICTLOWPORTS
SACONFIG
COMMUNITY MVSSUB
ENABLED
AGENT 161
SETSEENABLED
AUTOLOG 5
  FTPSERVE          ; FTP Server
  OSNMPD            ; SNMP Agent Server
ENDAUTOLOG
;
PORT
  7 UDP MISC SERV          ; Miscellaneous Server
  7 TCP MISC SERV
  9 UDP MISC SERV
  9 TCP MISC SERV
  19 UDP MISC SERV
  19 TCP MISC SERV
  20 TCP OMVS            NOAUTOLOG ; FTP Server
  21 TCP FTPSERVE        ; FTP Server
  23 TCP INTCLIEN        ; Telnet Server
  25 TCP SMTP            ; SMTP Server
  53 TCP NAMESRV         ; Domain Name Server
  53 UDP NAMESRV         ; Domain Name Server
  80 TCP OMVS            ; Base WEB Server access OMVS
  443 TCP OMVS           ; secure WEB Server access OMVS
  111 TCP PORTMAP        ; Portmap Server
  111 UDP PORTMAP        ; Portmap Server
  135 UDP LLBD           ; NCS Location Broker
  161 UDP OSNMPD         ; SNMP Agent
  162 UDP OMVS           ; OSNMP Command (SNMP Manager)
  512 TCP RXSERVE        ; Remote Execution Server
  514 TCP RXSERVE        ; Remote Execution Server
  515 TCP LPSERVE        ; LPD Server
  520 UDP OROUTED        ; Routed Server
  580 UDP NCPROUT        ; NCPROUTE Server
  750 TCP MVSKERB        ; Kerberos
  750 UDP MVSKERB        ; Kerberos
  751 TCP ADM@SRV        ; Kerberos Admin Server
  751 UDP ADM@SRV        ; Kerberos Admin Server
  2000 TCP IOASRV        ; OSA/SF Server
  3000 TCP CICSTCP       ; CICS Socket
  12000 UDP VTAM         ; EE
  12001 UDP VTAM         ; EE
  12002 UDP VTAM         ; EE
  12003 UDP VTAM         ; EE
  12004 UDP VTAM         ; EE
;
DEVICE  VDEV1          VIRTUAL  0
LINK    VLINK1         VIRTUAL  0    VDEV1
;
```

Enterprise Extender Planning, Migration, and Implementation

```
DEVICE IUTSAMEH MPCPTP
LINK TOVTAM MPCPTP IUTSAMEH
;
DEVICE OSAA00 LCS A00
LINK OSATRA00 IBMTR 0 OSAA00
;
DEVICE BGIGF8 MPCIPA NONROUTER
LINK GIG1 IPAQGNET BGIGF8
;
DEVICE BGIGFC MPCIPA NONROUTER
LINK GIG2 IPAQGNET BGIGFC
;
HOME
    9.82.25.9      VLINK1      ; VIPA link
    9.82.24.43    GIG1
    9.82.24.58    GIG2
    9.82.131.234 OSATRA00
;
PRIMARYINTERFACE GIG1
;
GATEWAY
; Network  First Hop  Link Name  Packet Size  Subnet Mask  Subnet Value
    9          =      OSATRA00    2000        0.255.224.0  0.82.128.0
    9          =      GIG2        1492        0.255.255.0  0.82.24.0
    9          =      GIG1        1492        0.255.255.0  0.82.24.0
    9          =      TOVTAM     1492        0.255.255.248 0.82.25.8
;
DEFAULTNET 9.82.128.1 OSATRA00 DEFAULTSIZE 0 0
;
TRANSLATE
;
ITRACE OFF
;
BEGINVTAM
TELNETDEVICE 3278-2-E NSX32702 ; 24 line screen - default of NSX32702
TELNETDEVICE 3279-2-E NSX32702 ; 24 line screen - default of NSX32702
TELNETDEVICE 3278-3-E NSX32703 ; 32 line screen - default of NSX32702
TELNETDEVICE 3279-3-E NSX32703 ; 32 line screen - default of NSX32702
TELNETDEVICE 3278-4-E NSX32704 ; 48 line screen - default of NSX32702
TELNETDEVICE 3279-4-E NSX32704 ; 48 line screen - default of NSX32702
TELNETDEVICE 3278-5-E NSX32705 ; 132 column screen - default of NSX327
TELNETDEVICE 3279-5-E NSX32705 ; 132 column screen - default of NSX327
; Define the LUs to be used for general users.
DEFAULTTLUS
    TCP00001..TCP94000
ENDDEFAULTTLUS
MSG07
LUSESSIONPEND ; On termination of a Telnet server connection,
                ; the user will revert to the DEFAULTAPPL
LINEMODEAPPL TSO ; Send all line-mode terminals directly to TSO.
ALLOWAPPL SAMON QSESSION ; SAMON appl does CLSDST Pass to next appl
ALLOWAPPL TSO* DISCONNECTABLE ; Allow all users access to TSO
                                ; applications.
                                ; TSO is multiple applications all beginning with TSO,
                                ; so use the * to get them all. If a session is closed,
                                ; disconnect the user rather than log off the user.
RESTRICTAPPL IMS ; Only 3 users can use IMS.
    USER USER1 ; Allow user1 access.
        LU TCPIMS01 ; Assign USER1 LU TCPIMS01.
    USER USER2 ; Allow user2 access from the default LU pool.
```

Enterprise Extender Planning, Migration, and Implementation

```
USER USER3      ; Allow user3 access from 3 Telnet sessions,
                ; each with a different reserved LU.
    LU TCPIMS31 LU TCPIMS32 LU TCPIMS33
ALLOWAPPL *    ; Allow all applications that have not been
                ; previously specified to be accessed.

;
USSTCP TNUSSTAB GIG1
USSTCP TNUSSTAB GIG2
USSTCP TCPTST  OSATRA00
ENDVTAM
;
START BGIGF8
START OSAA00
START IUTSAMEH
```

TCP/IP Profile at CSS2, Page 21

The TCP/IP Profile for NM2ATCP at CSS2 has several differences from the one at S183CDRM. Differences include the fact the SOURCEVIP is not specified, that there are multiple VIPAs defined and used, and that dynamic IP routing is used, sometimes OROUTED and sometimes OMPROUTE.

The IP Configuration Guide discusses considerations for OROUTED if running Enterprise Extender and using the IUTSAMEH device to communicate with other TCP/IP stacks as well. If using IUTSAMEH just for EE (there are no other TCP/IP stacks on the same image), the Guide instructs disabling RIP on the link through use of the “options interface linkname address ripoff” statement. If there are other TCP/IP stacks the Guide contains instructions for the setting of the BSDROUTINGPARMS statement along with the instructions on the RIP settings.

DYNAMIC VIPA is not used for Enterprise Extender. This is not clearly described in the IP Configuration Guide until the R10 manual.

On CSS2, the VTAM procedure name is CSSNET and this is coded on the PORT statements for Enterprise Extender. When the PORT statements were defined to say VTAM, as is used on S183CDRM, Enterprise Extender did not work.

On CSS2, there are multiple TCP/IP stacks as well as Enterprise Extender so the single IUTSAMEH device/link defined on NM2ATCP is "shared" between communicating with VTAM and with the second TCP stack, NM2BTCP. On CSS2, the VIPA and IUTSAMEH IP addresses are in different subnets. The VIPA is 9.82.67.169 and the IUTSAMEH is 192.168.251.1.

The complete profile for NM2ATCP is included here:

```
DATASETPREFIX SYS1.TCPIP
;
TCPCONFIG
    UNRESTRICTLowports
    TCPSENBfrsize 16384      ; Range is 256-256K - Default is 16K
    TCPRCVBufsize 16384     ; Range is 256-256K - Default is 16K
    TCPMAXRCVBUFSIZE 262144 ; Range is 256-256K - Default is 16K
    SENDGARBAGE FALSE      ; Packet contains no data
;
UDPCONFIG
    UNRESTRICTLowports
    UDPCHKsum      ; Do checksum
    UDPSENDBfrsize 16384 ; Range is 1 - 65535- Default is 16K
    UDPRCVBufsize 16384  ; Range is 1 - 65535- Default is 16K
;
IPCONFig
```

Enterprise Extender Planning, Migration, and Implementation

```
ARPTO 300 ; In seconds
DATAGRamfwd
NOSOURCEVIPA
VARSUBNETTING ; For RIPV2
IGNORERedirect
REASSEMBLYtimeout 15 ; In seconds
STOPONclawerror
TTL 60 ; In seconds, but actually Hop count
;
SACONFig
COMMUNity FRED
AGENT 161
ENABLed
;
GLOBALCONFIG
TCPIPStatistics
AUTOLOG 5
NM2AOMPR JOBNAME NM2AOMPR ; OMPROUTE Server
NM2AFTP JOBNAME NM2AFTP1 ; FTP Server
; NM2AROU JOBNAME NM2AROU ; Routed Server
; IMWEBSRV ; WEB SERVER (HOD function)
NM2AWEBS ; Domino Go Web Server
; NM2AHOD JOBNAME NM2AHOD5 ; HOD Sever
NM2ASNMP ; SNMP Agent Server
; NM2APAGE ; Policy Agent
NM2ADRST ; INETD restarted (APAR OW38139)
ENDAUTOLOG
PORT
7 TCP MISCSERV ; Miscellaneous Server
7 UDP MISCSERV
9 TCP MISCSERV
9 UDP MISCSERV
19 TCP MISCSERV
19 UDP MISCSERV
20 TCP OMVS NOAUTOLOG ; FTP Server
21 TCP NM2AFTP1 ; FTP Server
23 TCP INTCLIEN ; Telnet (TN3270E) Server
723 TCP INTCLIEN ; Telnet Server for dual block capability
25 TCP NM2ASMTTP ; SMTP Server
37 TCP NM2ATIME ; TIMED Server (generic server)
53 TCP NM2ADNSA ; Domain Name Server - Parent Process
53 UDP NM2ADNSA ; Domain Name Server - Parent Process
67 UDP NM2ADHCP NOAUTOLOG ; DHCP started as procedure
68 UDP NM2ADHCP NOAUTOLOG ; DHCP started as procedure
80 TCP OMVS ; Domino base webserver (NM2AWEBS)
111 TCP OMVS ; Portmap Server
111 UDP OMVS ; Portmap Server
135 UDP LLBD ; NCS Location Broker
161 UDP NM2ASNMP NOAUTOLOG ; SNMP Agent (for our proc)
162 UDP NM2ASNQE ; SNMP Query Engine
443 TCP OMVS ; Domino Secure Web Server
514 UDP OMVS ; SYSLOGD or NM2ASYSL
1512 TCP NM2AREXE ; MVS Remote Execution Server
1514 TCP NM2AREXE ; MVS Remote shell Server
515 TCP NM2ALPD ; LPD Server
520 UDP NM2AOMPR NOAUTOLOG ; OMPROUTE Server
580 UDP NM2ANCP ; NCPROUTE Server
750 TCP MVSKERB ; Kerberos
750 UDP MVSKERB ; Kerberos
751 TCP ADM@SRV ; Kerberos Admin Server
```

Enterprise Extender Planning, Migration, and Implementation

```

    751 UDP ADM@SRV          ; Kerberos Admin Server
    2162 UDP OMVS            ; for OSNMP trap commands
    3005 TCP NM2AHWS        ; IMS Sockets (OTMA)
    3012 TCP NM2AIMSL       ; IMS Sockets (Listener)
    8989 TCP OMVS NOAUTOLOG ; HOD Server (NM2AHOD5) (Serv.Mgr.)
    8999 TCP OMVS NOAUTOLOG ; HOD Server (NM2AHOD5) (Serv-Client)
    12000 UDP CSSVTAM       ; EE ..
    12001 UDP CSSVTAM       ; EE
    12002 UDP CSSVTAM       ; EE
    12003 UDP CSSVTAM       ; EE
    12004 UDP CSSVTAM       ; EE
    20000 TCP CICS410       ; CICS Sockets
    20001 TCP CICS410       ; CICS Sockets Server
PORTRANGE 50000 2000 TCP OMVS ; UNIX Ephemeral TCP ports 50000-51999
PORTRANGE 50000 2000 UDP OMVS ; UNIX Ephemeral UDP ports 50000-51999
;
VIPADYNAMIC
  VIPADEFINE 255.255.255.0 10.0.0.1 10.0.0.2
ENDVIPADYNAMIC
VIPADYNAMIC
  VIPABACKUP 100          10.0.1.1
  VIPABACKUP 100          9.82.25.17
ENDVIPADYNAMIC
VIPADYNAMIC
  VIPARANGE 255.255.255.0 10.0.2.1
ENDVIPADYNAMIC
;
DEVICE VDEV1 VIRTUAL 0
LINK VLINK1 VIRTUAL 0 VDEV1
DEVICE VDEV2 VIRTUAL 1
LINK VLINK2 VIRTUAL 0 VDEV2
;
DEVICE IUTSAMEH MPCPTP
LINK LNK2SAME MPCPTP IUTSAMEH
DEVICE LCS1 LCS 3F0 AUTORESTART
LINK TR1 IBMTR 0 LCS1
DEVICE LCS216DD LCS 680 AUTORESTART
LINK LCS216DL IBMTR 0 LCS216DD
DEVICE TRL2216A MPCPTP AUTORESTART
LINK TRL2216A MPCPTP TRL2216A
DEVICE TRL216DL MPCPTP AUTORESTART
LINK TRL216DL MPCPTP TRL216DL
HOME
;
; Leave VLINK2 first so that
; SOURCEVIPA will work if turned on
;
    9.82.67.170 VLINK1 ; was LNK2SAME - changed to VLINK1
    192.168.253.1 VLINK2 ; 2nd VIPA Link
    9.82.1.170 TR1
    192.168.251.1 LNK2SAME ; Changed from VIPA1 to LNK2SAME
    9.82.84.70 TRL216DL ; MPC TRL to 2216D (TCP/SNA tm.)
    9.82.131.141 LCS216DL ; LCS 3172emul. 2216D (TCP/SNA tm.)
    9.82.36.1 TRL2216A ; MPC TRL to 2216A
PRIMARYINTERFACE TR1
GATEWAY
; Following required for OMPROUTE program!!! Do not delete next three.
    9.82.1.107 = TR1 2000 HOST
    9 = TRL216DL 2000 0.255.255.128 0.82.84.0
    9.82.1.62 9.82.84.72 TRL216DL 2000 HOST
; The TelNet definitions are in other files INCLUDED below
INCLUDE SYS1.TCPPARMS (NM2ATN23)
```

Enterprise Extender Planning, Migration, and Implementation

```
INCLUDE SYS1.TCPPARMS (NM2ATN73)
START LCS1 ; 3172m3 Token Ring connection to WSC backbone
; The IUTSAMEH is started with a VARY START to avoid error messages in
; the log when the other side is not up
; START IUTSAMEH ; SAMEHOST LINK (IUTSAMEH) to BAGEND (LNK2SAME)
```

EE VTAM Start Options, Page 22

The VTAM Start Options specific to Enterprise Extender are IPADDR, which specifies the VIPA VTAM uses for EE, TCPNAME, which specifies the procedure name of the TCP/IP stack that VTAM is to use for Enterprise Extender, and HPRARB, which specifies which HPR Adaptive Rate Based Flow/Congestion Control (ARB) algorithm is to be used. If IPADDR is not specified, the default is the first VIPA in TCP/IP's home list. TCPNAME should be specified if there are multiple TCP/IP stacks running on the same system as VTAM is. HPRARB defaults to RESPMODE, but BASE can be specified, if it is desired to use the original HPR ARB algorithm, rather than the Responsive Mode ARB algorithm.

These three Start Options are set on CSS2 to be: HPRARB = RESPMODE, IPADDR = 9.82.67.170, and TCPNAME = NM2ATCP. The three Start Options are set on S183CDRM to be: HPRARB = RESPMODE, IPADDR = 9.82.25.9, and TCPNAME = TCPIP1.

HPR is required for Enterprise Extender, so VTAM must also be configured for APPN and as an HPR RTP endpoint (the HPR= Start Option).

EE Start Options, Page 23

Other considerations for the VTAM Enterprise Extender related Start Options are listed on this visual.

The VIPA that VTAM uses for Enterprise Extender doesn't have to be a VIPA exclusively for VTAM's use. For example, the VIPA could also be used as for access to other TCP/IP applications, such as the TN3270 Server. However, in some cases, for other TCP/IP applications, a Dynamic VIPA may be a better choice and dynamic VIPAs should not be used for Enterprise Extender, only static VIPAs.

VTAM does NOT issue an error message when activating the XCA Major node and IPADDR has been set to a real (not VIPA) address. The XCA Major Node activates normally, but any attempts to make connections using Enterprise Extender will fail unless the IP address being used for Enterprise Extender is a VIPA.

Although the Responsive Mode ARB algorithm is included with any node that is Enterprise Extender capable, it is NOT mandatory that it be used for EE. The Responsive Mode ARB algorithm provides more fairness when sharing bandwidth with TCP/IP than does the original ARB algorithm, but Enterprise Extender will operate using either algorithm.

Until OS/390 V2R10 (or V2R8 or higher with APARs OW43814 and PQ38173), the XCA Major Node should not be included in VTAM's Configuration List. Until the enhanced function, the XCA Major Node needs to be activated AFTER TCP/IP is activated. If TCP/IP is not available when the XCA Major Node is activated, it will need to be recycled after TCP/IP is available. With the enhanced function, the XCA Major Node's LINES will stay in a pending state until TCP/IP is available at which time they will automatically become ACTIVE.

XCA and Switched Major Nodes, Page 24

On both CSS2 and S183CDRM, similar XCA Major Nodes are coded as follows:

```
XCAEE      VBUILD TYPE=XCA
PORTEE     PORT   MEDIUM=HPRIIP, SAPADDR=4,
           LIVTIME=15, SRQTIME=15, SRQRETRY=9           C
GRPEE     GROUP  DIAL=YES, AUTOGEN=(10, E, X), DYNPU=YES, DYNPUPFX=EE,
           CALL=INOUT, ISTATUS=ACTIVE                 C
```

Note that there are several parameters for which defaults could be. These are:

Enterprise Extender Planning, Migration, and Implementation

- IPTOS which defaults to 20, 40, 80, C0, C0. These are the TOS bit settings that EE uses for low, medium, high, network, and signal priorities, respectively.
- IPPORT which defaults to 12000 and causes the PORTs 12000, 12001, 12002, 12003, and 12004, to be used by EE for signal, network, high, medium and low priority, respectively.
- LIVTIME which defaults to 10 seconds
- SRQRETRY which defaults to 3
- SRQTIME which defaults to 15 seconds

One reference manual states that they had to elongate the LIVTIME, SRQRETRY, and SRQTIME values to keep the EE TG from dropping. Therefore, we coded longer times on these parameters than the defaults.

The Switched Major Node at both S183CDRM and CSS2 specifies two PUs so that two different TGs are established between S183CDRM and CSS2 using the IP network. The Switched Major Node at S183CDRM is coded as follows:

```
CSS2SWN  VBUILD  TYPE=SWNET
CSS2PU   PU      ADDR=22, DISCNT=YES, CPNAME=CSS2, NETID=CSSNET,          *
          CONNTYPE=APPN, PUTYPE=2, DWACT=YES, TGP=EEXTCAMP
CSS2PATH PATH    IPADDR=9.82.67.170, GRPNM=GRPEE
*
CSS2PUB  PU      ADDR=22, DISCNT=YES, CPNAME=CSS2, NETID=CSSNET,          *
          CONNTYPE=APPN, PUTYPE=2, DWACT=YES, TGP=EEXTCAMP
CSS2PATB PATH    IPADDR=9.82.67.170, GRPNM=GRPEE, SAPADDR=8
```

The Switched Major Node at CSS2 is coded as follows:

```
S183EESW VBUILD  TYPE=SWNET
S183PUEE PU      PUTYPE=2, CPNAME=S183CDRM, ADDR=01, NETID=USIBMWZ,      X
          DISCNT=(YES,F), CONNTYPE=APPN, TGP=EEXTCAMP,                  X
          MODETAB=AMODETAB, DLOGMOD=M2SDLCQ, ANS=CONTINUE
S183PATH PATH    IPADDR=9.82.25.9, GRPNM=GRPEE
S183PUEB PU      PUTYPE=2, CPNAME=S183CDRM, ADDR=01, NETID=USIBMWZ,      X
          DISCNT=(YES,F), CONNTYPE=APPN, TGP=EEXTCAMP,                  X
          MODETAB=AMODETAB, DLOGMOD=M2SDLCQ, ANS=CONTINUE
S183PATB PATH    IPADDR=9.82.25.9, GRPNM=GRPEE
*
```

Note that the VIPA address of the partner node is coded on the PATH statement. The partner's HOSTNAME could be used here instead. If using HOSTNAME, it must resolve to the correct VIPA address (not a real IP address).

EE Operations, TCP/IP, Page 25

This visual shows the DISPLAY TCPIP,NETSTAT,HOME command as issued at S183CDRM. This shows that the VIPA address is 9.82.25.9 (VLINK1). The network interface that is used for connection to the LAN is the OSA Token-Ring adapter shown below as OSATRA00 at IP address 9.82.131.234. This display also shows the IUTSAMEH link (TOVTAM) at address 9.82.25.10.

```
D TCPIP, ,NETSTAT,HOME
EZZ2500I NETSTAT CS V2R8 TCPIP1 274
HOME ADDRESS LIST:
ADDRESS          LINK              FLG
9.82.25.9        VLINK1           P
9.82.24.43       GIG1
9.82.24.58       GIG2
9.82.131.234    OSATRA00
127.0.0.1        LOOPBACK
```

Enterprise Extender Planning, Migration, and Implementation

5 OF 5 RECORDS DISPLAYED

EE Operations, TCP/IP, Page 26

This visual shows the DISPLAY TCPIP,NETSTAT,DEVLINKS command as issued at S183CDRM. An edited version of the full display is shown, but it shows that the VIPA, IUTSAMEH, and OSA devices are READY:

```
D TCPIP, ,NETSTAT,DEVLINKS
EZZ2500I NETSTAT CS V2R8 TCPIP1 276
...
DEVNAME: VDEV1             DEVTYPE: VIPA             DEVNUM: 0000
DEVSTATUS: READY
LNKNAME: VLINK1           LNKTYPE: VIPA             LNKSTATUS: READY
NETNUM: 0    QUESIZE: 0    BYTEIN: 0000000000
...
DEVNAME: IUTSAMEH         DEVTYPE: MPC              DEVNUM: 0000
DEVSTATUS: READY
LNKNAME: TOVTAM           LNKTYPE: MPC              LNKSTATUS: READY
...
DEVNAME: OSAA00           DEVTYPE: LCS              DEVNUM: 0A00
DEVSTATUS: READY
LNKNAME: OSATRA00         LNKTYPE: TR               LNKSTATUS: READY
NETNUM: 0    QUESIZE: 0    BYTEIN: 0927131147
```

EE Operations, XCA Activation, Page 27

When the XCA Major Node with MEDIUM=HPRIP is activated, message EZZ4324I is issued indicating that VTAM successfully connected to the TCP/IP stack using the IP address shown in the message. Here is an example of the XCA Major Node activation messages from S183CDRM:

```
V NET,ACT,ID=XCAEE
IST097I VARY ACCEPTED
IST093I XCAEE ACTIVE
EZZ4324I CONNECTION TO 9.82.25.9 ACTIVE FOR DEVICE IUTSAMEH
```

If a real IP address, rather than a VIPA, is mistakenly specified in the Start Option, IPADDR, message EZZ4324I is still issued but EE connections do not complete successfully. If the IUTSAMEH device hasn't been started, message IST093I is issued, but message EZZ4324I is not issued. If the IUTSAMEH device is subsequently started, message EZZ4324I is issued at that point.

A display of the XCA Major Node shows that the LINES are ACTIV. Message IST1679I shows that this is a MEDIUM=HPRIP XCA Major Node. Message IST1685I indicates the procedure name of the TCP/IP stack that is being used for EE and message IST1680I displays the VIPA:

```
D NET,ID=XCAEE,E
IST097I DISPLAY ACCEPTED
IST075I NAME = XCAEE, TYPE = XCA MAJOR NODE 279
IST486I STATUS= ACTIV, DESIRED STATE= ACTIV
IST1679I MEDIUM = HPRIP
IST1685I TCP/IP JOB NAME = TCPIP1
IST1680I LOCAL IP ADDRESS 9.82.25.9
IST654I I/O TRACE = OFF, BUFFER TRACE = OFF
IST1656I VTAMTOPO = REPORT, NODE REPORTED - YES
IST170I LINES:
IST232I LNEE000  ACTIV
IST232I LNEE001  ACTIV
```


Enterprise Extender Planning, Migration, and Implementation

```
IST232I LNEE002  ACTIV
```

XCA Operational Considerations, Page 28

This visual shows the activation of an XCA Major Node for Enterprise Extender at the time when TCP/IP is not started. This display was done on an OS/390 V2R8 system without APARs OW43814 and PQ38173 which allow the EE XCA Major Node to be activated when TCP/IP is not available. Without the enhanced code, the activation of the XCA Major Node causes VTAM to issue IST380I with SENSE 081C0000 for each LINE contained in the XCA Major Node:

```
V NET,ACT, ID=XCAEE
IST097I VARY ACCEPTED
IST093I XCAEE ACTIVE
IST380I ERROR FOR ID = LNEE000 - REQUEST: ACTLINK, SENSE: 081C0000
IST380I ERROR FOR ID = LNEE001 - REQUEST: ACTLINK, SENSE: 081C0000
```

A display of the XCA Major Node after this failure shows that each LINE is NEVAC. One TCP/IP is started, the XCA Major Node needs to be recycled or reactivated to clear up this condition. With the enhanced code, the XCA LINES should stay PENDING and automatically become ACTIVE when TCP/IP becomes available.

```
D NET, ID=XCAEE
IST097I DISPLAY ACCEPTED
IST075I NAME = XCAEE, TYPE = XCA MAJOR NODE 938
IST486I STATUS= ACTIV, DESIRED STATE= ACTIV
IST1679I MEDIUM = HPRIP
IST1685I TCP/IP JOB NAME = TCPIP1
IST1680I LOCAL IP ADDRESS *****NA*****
IST654I I/O TRACE = OFF, BUFFER TRACE = OFF
IST1656I VTAMTOPO = REPORT, NODE REPORTED - YES
IST170I LINES:
IST232I LNEE000  NEVAC
...
```

EE Operations - TG Activation, Page 29

The connection between Enterprise Extender partners can be initiated by either partner by specifying a link is to be activated where the destination is the IP address of the Enterprise Extender partner. In the case of OS/390, this is done through a "DIAL-OUT" operation by activating a Switched Major Node where DWACT=YES (dial when activated = YES) is coded as well as a PATH statement indicating the IP address or HOSTNAME of the partner. If HOSTNAME is used, it must resolve to the proper IP address (recall this is a VIPA for OS/390) of the EE partner. If DWACT=YES is NOT coded, or the original dial-out fails and is later requested again, the VARY NET, DIAL command can be used indicating the proper PUNAME as coded in the Switched Major Node.

Refer to page 36 to see the Switched Major Node coded at S183CDRM indicating DWACT=YES, the VIPA of CSS2 on the PATH statements, the Matching NETID and CPNAME for CSSNET.CSS2 to identify the partner during XID3 exchange, as well as two different SAP values which need to be used on one of the partners in order to bring up two EE connections.

When this Major Node is activated on S183CDRM, the messages that are issued are the same as happen when any other type of APPN connection is made. There is nothing that indicates these are EE connections:

```
V NET,ACT, ID=CSS2SWN
IST097I VARY ACCEPTED
IST093I CSS2PU ACTIVE
IST093I CSS2PUB ACTIVE
IST093I CSS2SWN ACTIVE
```

Enterprise Extender Planning, Migration, and Implementation

```
IST1086I APPN CONNECTION FOR CSSNET.CSS2 IS ACTIVE - TGN = 21
IST1086I APPN CONNECTION FOR CSSNET.CSS2 IS ACTIVE - TGN = 22
IST1096I CP-CP SESSIONS WITH CSSNET.CSS2 ACTIVATED
```

Display EE Connected PU, Page 30

On S183CDRM, one of the PUs coded in the Switched Major Node is displayed after it is active. This display of the PU looks very similar to the display of any APPN linkstation (the TG number, link characteristics, etc. are shown on message IST1106I, for example). For EE PUs, there are additional messages, IST1680I, which indicate both the LOCAL IP address (9.82.25.9, the VIPA on S183CDRM) as well as the REMOTE IP address (9.82.67.170, the VIPA on CSS2).

```
D NET, ID=CSS2PU, E
IST097I DISPLAY ACCEPTED
IST075I NAME = CSS2PU, TYPE = PU_T2.1 285
IST486I STATUS= ACTIV, DESIRED STATE= ACTIV
IST1043I CP NAME = CSS2, CP NETID = CSSNET, DYNAMIC LU = YES
IST1589I XNETALS = YES
IST1105I RESOURCE STATUS TGN CP-CP TG CHARACTERISTICS
IST1106I CSS2PU AC/R 22 YES 9875000000000000000017100808080
IST1482I HPR = RTP - OVERRIDE = N/A - CONNECTION = YES
IST1510I LLERP = NOTPREF - RECEIVED = NOTALLOW
IST1680I LOCAL IP ADDRESS 9.82.25.9
IST1680I REMOTE IP ADDRESS 9.82.67.170
IST136I SWITCHED SNA MAJOR NODE = CSS2SWN
IST081I LINE NAME = LNEE000, LINE GROUP = GRPEE, MAJNOD = XCAEE
IST654I I/O TRACE = OFF, BUFFER TRACE = OFF
IST1500I STATE TRACE = OFF
IST1656I VTAMTOPO = REPORT, NODE REPORTED - YES
IST1657I MAJOR NODE VTAMTOPO = REPORT
IST172I NO LOGICAL UNITS EXIST
IST314I END
```

VTAM - Display Adjacent CPs, Page 31

On CSS2, the Adjacent Control Points are displayed. Note that this display is the same regardless of whether the Adjacent Control Point is using an EE connection or a regular APPN connection. On this display, CSSNET.CPWS3, CSSNET.CPWS1, and USIBMWZ.S183CDRM are all connected to CSS2 using Enterprise Extender. CSSNET.CP2216D and CSSNET.CP900 are using an APPN channel (MPC+ for the 2216 and CDLC for the 3746-900) to connect to CSS2. CSSNET.CSS1 has four different connections to CSS2 -- AHHC, two NCP channel attachments and a VRTG.

One anomaly on this display is the fact that CSS2 is showing 1 in the column marked connections for USIBMWZ.S183CDRM, even though both TG21 and TG22 are active as shown on the preceding few visuals. Issuing this display at S183CDRM showed the same results, 1 connection to CSSNET.CSS2, even though TG21 and TG22 were active.

```
D NET, ID=ISTADJCP, E
IST097I DISPLAY ACCEPTED
IST075I NAME = ISTADJCP, TYPE = ADJCP MAJOR NODE 041
IST486I STATUS= ACTIV, DESIRED STATE= ACTIV
IST1100I ADJACENT CONTROL POINTS FROM MAJOR NODE ISTADJCP
IST1102I NODENAME          NODETYPE CONNECTIONS CP CONNECTIONS NATIVE
IST1103I CSSNET.CPWS3      EN          1          1          *NA*
IST1103I CSSNET.CPWS1      NN          1          1          YES
IST1103I USIBMWZ.S183CDRM  NN          1          1          NO
IST1103I CSSNET.CP2216D    NN          1          1          YES
```

Enterprise Extender Planning, Migration, and Implementation

```

IST1103I  CSSNET.CP900      NN      1      1      YES
IST1103I  CSSNET.CSS1      NN      4      4      YES
IST1493I  RTP SUMMARY FOR CSSNET.CPWS3 COUNT = 5
IST1493I  RTP SUMMARY FOR CSSNET.CPWS1 COUNT = 2
IST1493I  RTP SUMMARY FOR USIBMWZ.S183CDRM COUNT = 2
IST1493I  RTP SUMMARY FOR CSSNET.CP2216D COUNT = 2
IST1493I  RTP SUMMARY FOR CSSNET.CSS1 COUNT = 4
IST314I  END

```

Display Topology about CSS2, Page 32

On CSS2, the DISPLAY TOPO, ID=CSS2 command shows the list of TGs originating at CSS2 to other APPN nodes. Note that the TGs to the EE connected nodes (CSSNET.CPWS1, CSSNET.CPWS3, and USIBMWZ.S183CDRM) look like any other APPN TGs on this display. TG21 from CSS2 to CSSNET.CPWS1 shows TGTYPE of INTERM, since CPWS1 is an NN. TG21 from CSS2 to CSSNET.CPWS3 shows TGTYPE of ENDPT, since CPWS3 is an EN. TGs 22 and 21 from CSS2 to USIBMWZ.S183CDRM show as INTERCLUST since these are Extended Subnet Boundary connections.

```

D NET, TOPO, ID=CSS2, LIST=ALL
IST1295I  CP NAME          NODETYPE  ROUTERES  CONGESTION  CP-CP  WEIGHT
IST1296I  CSSNET.CSS2      NN        128       NONE        *NA*   *NA*
IST1579I
IST1297I          ICN/MDH   CDSERV   RSN          HPR
IST1298I          YES      NO       300         RTP
IST1579I
IST1223I          BN        NATIVE   TIME LEFT   LOCATE SIZE
IST1224I          YES      YES     15          16K
IST1299I  TRANSMISSION GROUPS ORIGINATING AT CP CSSNET.CSS2
IST1357I          CPCP
IST1300I  DESTINATION CP    TGN       STATUS     TGTYPE     VALUE  WEIGHT
IST1301I  CSSNET.CSS1      255      OPER      INTERM VRTG YES    *NA*
IST1301I  USIBMWZ.S183CDRM 22       OPER      INTERCLUST YES    *NA*
IST1301I  CSSNET.CPWS1     21       OPER      INTERM     YES    *NA*
IST1301I  CSSNET.CSS1      22       OPER      INTERM     YES    *NA*
IST1301I  CSSNET.CSS1      21       OPER      INTERM     YES    *NA*
IST1301I  CSSNET.CP2216D   21       OPER      INTERM     YES    *NA*
IST1301I  CSSNET.CP900     21       OPER      INTERM     YES    *NA*
IST1301I  CSSNET.CSS1      23       OPER      INTERM     YES    *NA*
IST1301I  USIBMWZ.S183CDRM 21       OPER      INTERCLUST YES    *NA*
IST1301I  CSSNET.CPWS3     21       OPER      ENDPT      YES    *NA*
IST314I  END

```

APING Using EE Route, Page 33

An APING issued at CSS2 for USIBMWZ.S183CDRM uses the Enterprise Extender connectivity as the route between the two nodes. Note that message IST1461I shows that TG 22, an ISL, was used for this session. Nothing on this display shows that this is an EE link -- it displays just like any other APPN TG.

```

D NET, APING, ID=USIBMWZ.S183CDRM
IST097I  DISPLAY ACCEPTED
IST1489I  APING SESSION INFORMATION 055
IST1490I  DLU=USIBMWZ.S183CDRM SID=FD87C059B5EFB39E
IST933I  LOGMODE=#INTER , COS=*BLANK*
IST875I  APPNCOS TOWARDS SLU = #INTER
IST1460I  TGN  CPNAME          TG TYPE     HPR
IST1461I  22  USIBMWZ.S183CDRM  ISL         RTP

```

Enterprise Extender Planning, Migration, and Implementation

IST314I END

Display EE Connected Control Point, Page 34

A display of S183CDRM at CSS2, shows information about the resource, S183CDRM, including the sessions that exist, listed under the names of the HPR connections they are using -- CNR0001A, which one of the CP-CP sessions is using, CNR0001D, which the SNASVCMG session is using, and CNR00019, which the other CP-CP session is using. As in the prior displays, there is nothing different here, even though these HPR connections are flowing over the IP network.

```
D NET, ID=S183CDRM, E
IST097I DISPLAY ACCEPTED
IST075I NAME = USIBMWZ.S183CDRM, TYPE = ADJACENT CP 059
IST486I STATUS= ACT/S---Y, DESIRED STATE= ACTIV
....
IST231I CDRSC MAJOR NODE = ISTCDRDY
IST479I CDRM NAME = CSS2, VERIFY OWNER = NO
IST1184I CPNAME = USIBMWZ.S183CDRM - NETSRVR = ***NA***
IST1044I ALSLIST = ISTAPNPU
....
IST171I ACTIVE SESSIONS = 0000000003, SESSION REQUESTS = 0000000000
IST206I SESSIONS:
IST1081I ADJACENT LINK STATION = CNR0001A
IST634I NAME      STATUS      SID          SEND RECV VR TP NETID
IST635I CSS2      ACTIV/CP-S  D88F047ABF181205 0006 0001 0 0 CSSNET
IST1081I ADJACENT LINK STATION = CNR0001D
IST634I NAME      STATUS      SID          SEND RECV VR TP NETID
IST635I CSS2      ACTIV/SV-P  FD87C059B5EFB3B3 0001 0001 0 0 CSSNET
IST1081I ADJACENT LINK STATION = CNR00019
IST634I NAME      STATUS      SID          SEND RECV VR TP NETID
IST635I CSS2      ACTIV/CP-P  FD87C059B5EFB3AE 0001 0009 0 0 CSSNET
```

Display EE HPR Connection at CSS2, Page 35

A display of one of the HPR connections that is flowing over the IP network looks exactly the same as an HPR connection flowing over APPN connections. A new message added with the ability to use Responsive Mode ARB (the newer algorithm which is available on any node that supports Enterprise Extender) is IST1697I, which shows that this particular HPR connection is using Responsive Mode ARB. Any HPR connection, one that uses EE or doesn't use EE, can use Responsive Mode ARB as long as both RTP endpoints support it. If both do not, the HPR connections should use the original ARB algorithm. Note that CNR0001D is using APPN TG21 (as shown in message IST1461I):

```
D NET, ID=CNR0001D, E
IST075I NAME = CNR0001D, TYPE = PU T2.1 104
IST1392I DISCNTIM = 00010 DEFINED AT PU FOR DISCONNECT
IST486I STATUS= ACTIV--LX-, DESIRED STATE= ACTIV
IST1043I CP NAME = S183CDRM, CP NETID = USIBMWZ, DYNAMIC LU = YES
IST1589I XNETALS = YES
IST875I APPNCOS TOWARDS RTP = SNASVCMG
IST1476I TCID X'1984255200000223' - REMOTE TCID X'0E6DB38700000190'
IST1481I DESTINATION CP USIBMWZ.S183CDRM - NCE X'D000000000000000'
IST1587I ORIGIN NCE X'D000000000000000'
IST1477I ALLOWED DATA FLOW RATE = 400 KBITS/SEC
IST1516I INITIAL DATA FLOW RATE = 200 KBITS/SEC
```

Enterprise Extender Planning, Migration, and Implementation

```
IST1511I MAXIMUM NETWORK LAYER PACKET SIZE = 548 BYTES
IST1478I NUMBER OF UNACKNOWLEDGED BUFFERS = 0
IST1479I RTP CONNECTION STATE = CONNECTED - MNPS = NO
IST1697I RTP PACING ALGORITHM = ARB RESPONSIVE MODE
IST1480I RTP END TO END ROUTE - PHYSICAL PATH
IST1460I TGN CPNAME TG TYPE HPR
IST1461I 21 USIBMWZ.S183CDRM ISL RTP
IST231I RTP MAJOR NODE = ISTRTPMN
....
IST355I LOGICAL UNITS:
IST080I S183CDRM ACT/S----Y
```

ARB-2 and EE Connections, Page 36

To test the ability to use either Responsive Mode ARB (ARB-2) or the original HPR algorithm for EE connections, CSS2's HPRARB Start Option is dynamically modified to change it from RESPMODE to BASE:

```
F CSSVTAM,VTAMOPTS,HPRARB=BASE
IST097I MODIFY ACCEPTED
IST223I MODIFY COMMAND COMPLETED
```

After this, the EE connection between CSS2 and CSSNET.CPWS3 is taken down, brought back up, and a session to TSO is established using CPWS3's 3270 emulator. This session uses HPR connection CNR0002D which is displayed here. Note that IST1697I is not shown on this display (because BASE mode ARB is being used). IST1697I is only shown on an HPR connection display if Responsive Mode ARB is being used, as seen on the previous page.

```
D NET,ID=CNR0002D,E
IST097I DISPLAY ACCEPTED
IST075I NAME = CNR0002D, TYPE = PU_T2.1 010
IST1392I DISCNTIM = 00010 DEFINED AT PU FOR DISCONNECT
IST486I STATUS= ACTIV--LX-, DESIRED STATE= ACTIV
IST1043I CP NAME = CPWS3, CP NETID = CSSNET, DYNAMIC LU = YES
...
IST1479I RTP CONNECTION STATE = CONNECTED - MNPS = NO
IST1480I RTP END TO END ROUTE - PHYSICAL PATH
IST1460I TGN CPNAME TG TYPE HPR
IST1461I 21 CSSNET.CPWS3 APPN RTP
IST231I RTP MAJOR NODE = ISTRTPMN
IST654I I/O TRACE = OFF, BUFFER TRACE = OFF
IST1500I STATE TRACE = OFF
IST355I LOGICAL UNITS:
IST080I DSWWS302 ACT/S
IST314I END
```

CSS2 NETSTAT BYTEINFO Command, Page 37

The DISPLAY TCPIP NETSTAT BYTEINFO command is issued at CSS2. The command shows information about the number of bytes, in and out, that have flowed using various PORTS/Sockets. Note the Enterprise Extender PORTs -- 12000, 12001, 12002, 12003, 12004 (User ID is CSSVTAM, the procedure name for VTAM on CSS2). Note that PORTS 12002 and 12004 both show zeros in the BYTES IN and BYTES OUT. This means that no low or high priority traffic has flowed as of this time.

```
D TCPIP,NM2ATCP,NETSTAT,BYTEINFO
EZZ2500I NETSTAT CS V2R8 NM2ATCP 900
MVS TCP/IP REAL TIME NETWORK MONITOR
USER ID B OUT B IN L PORT FOREIGN SOCKET STATE
```

Enterprise Extender Planning, Migration, and Implementation

```
BPXOINIT 0000000000 0000000000 10007 0.0.0.0..0 LISTEN
NM2ADRST 0000000000 0000000000 00513 0.0.0.0..0 LISTEN
.....
CSSVTAM 0000533766 0000054809 12003 *..* UDP
CSSVTAM 0000000000 0000000000 12002 *..* UDP
CSSVTAM 0000000000 0000000000 12004 *..* UDP
CSSVTAM 0000958133 0001136664 12001 *..* UDP
CSSVTAM 0000020461 0000017840 12000 *..* UDP
NM2ASNMP 0000017657 0000006026 00161 *..* UDP
25 OF 25 RECORDS DISPLAYED
```

Next an APING is done from CSS2 for CPWS3 using the MODE #BATCH. This mode has an associated APPN Class of Service of #BATCH which is low priority.

```
D NET,APING,ID=CPWS3,LOGMODE=#BATCH
IST097I DISPLAY ACCEPTED
IST1489I APING SESSION INFORMATION 903
IST1490I DLU=CSSNET.CPWS3 SID=FD87C059B7AAB0E7
IST933I LOGMODE=#BATCH , COS=*BLANK*
IST875I APPNCOS TOWARDS SLU = #BATCH
IST1460I TGN CPNAME TG TYPE HPR
IST1461I 21 CSSNET.CPWS3 APPN RTP
IST314I END
```

NETSTAT BYTEINFO Again, Page 38

After the APING causing low priority traffic to flow between the two EE connected nodes, the DISPLAY TCPIP NETSTAT BYTEINFO command is again issued at CSS2. Note that PORT 12004 now indicates the number of BYTES that have flowed OUT and IN using this PORT.

```
D TCPIP,NM2ATCP,NETSTAT,BYTEINFO
EZZ2500I NETSTAT CS V2R8 NM2ATCP 900
MVS TCP/IP REAL TIME NETWORK MONITOR
USER ID B OUT B IN L PORT FOREIGN SOCKET STATE
BPXOINIT 0000000000 0000000000 10007 0.0.0.0..0 LISTEN
NM2ADRST 0000000000 0000000000 00513 0.0.0.0..0 LISTEN
.....
CSSVTAM 0000533766 0000054809 12003 *..* UDP
CSSVTAM 0000000000 0000000000 12002 *..* UDP
CSSVTAM 0000001474 0000001343 12004 *..* UDP
CSSVTAM 0000963758 0001143755 12001 *..* UDP
CSSVTAM 0000020637 0000018016 12000 *..* UDP
NM2ASNMP 0000017657 0000006026 00161 *..* UDP
25 OF 25 RECORDS DISPLAYED
```

References, Page 39

Listed here are a number of good references on Extended Border Node and Enterprise Extender. There are three excellent Redbooks:

1. SG24-5291 SNA and TCP/IP Integration (Chapter on Enterprise Extender)
2. SG24-5957 Migrating Subarea to an IP Infrastructure (this is recently published)

The Parallel Sysplex Test Report, GC28-1963-11, contains a Chapter on Poughkeepsie's experiences with implementing Enterprise Extender.

The standard CS/390 publications also contain descriptions of these two technologies as well as descriptions of the various definitions/parameters that are involved with their implementation. The standard CS/390 publications are:

Enterprise Extender Planning, Migration, and Implementation

1. IP Migration (SC31-8512-4), use the R8 or higher level of this publication
2. IP Configuration (SC31-8513) , R6 or higher
3. SNA Migration (SC31-8622-1), R6 or higher
4. SNA Network Implementation Guide (SC31-8563-03), R6 or higher

For More Information, Page 40

This visual lists various URLs which may be helpful in obtaining more information. On the right hand side is a brief description of the type of information that is available at that particular URL.

Summary, Page 41

This completes the presentation. The summary below shows the topics that were covered in this session:

- What is Enterprise Extender ?
- Planning for Enterprise Extender
- Using EE with other Technologies
- EE Implementation
- EE Operations