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z/OS Communications Server and NetView for z/OS DVIPA (Dynamic Virtual IP Addressing) Management

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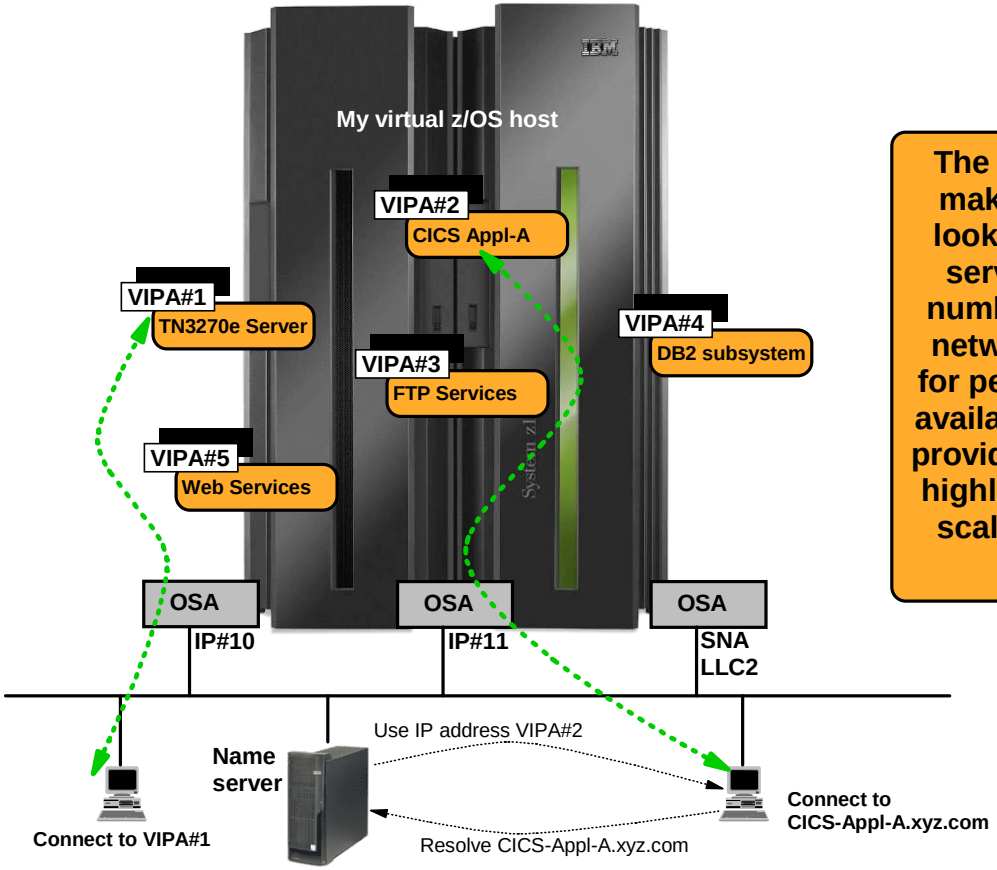
Agenda

- **Sysplex Distributor – How is workload distributed? What are the varying distribution methods and factors that comprise the load balancing decision?**
- **Monitoring workload distribution, detecting problems and anomalies**
- **Overview of NetView for z/OS DVIPA management/monitoring features**
- **How can NetView for z/OS help with specific Sysplex Distributor workload balancing problem scenarios**

The network view of a Parallel Sysplex - a single large server with many network interfaces and many application services

- The promises of the Parallel Sysplex cluster environment are:
  - Application location independence
  - Ability to shift application workload between LPARs
  - Application single system image from the network
  - Application capacity on-demand
  - Component failure does not lead to application failure
- Gaining the benefits, depend on:
  - Carefully designed redundancy of all key hardware and software components in symmetric configurations
  - Supporting functions in z/OS and middleware
  - Cooperation by applications
  - Operations procedures



The objective is to make the Sysplex look like one large server that has a number of physical network interfaces for performance and availability - and that provides a number of highly available and scalable services.

SNA and TCP/IP

✓Single-system image (SSI)
✓Scalable
✓Highly available
✓Secure

A summary of the different types of z/OS VIPA addresses

- **Static VIPA**
  - Belongs to one TCP/IP stack. Manual configuration changes are needed to move it.
    - No dependencies on Sysplex functions – can be used in non-Sysplex LPARs
    - Required for certain functions such as Enterprise Extender
    - Beneficial for interface resilience, source IP addressing, etc.

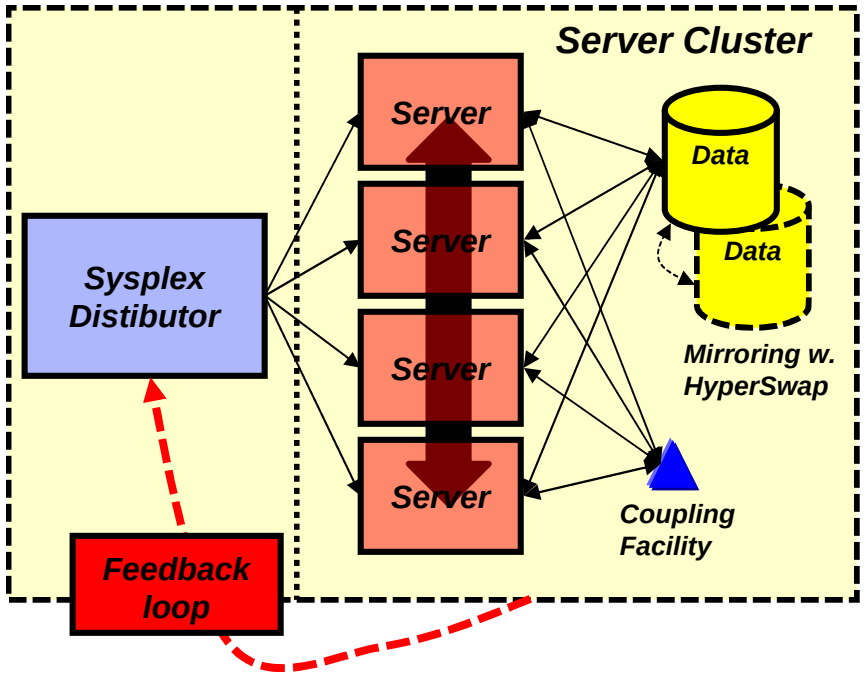
- **Dynamic VIPA (DVIPA)**
  - **Stack-managed (VIPADEFINE/VIPABACKUP)**
    - Belongs to one TCP/IP stack, but backup policies govern which TCP/IP stack in the Sysplex takes it over if the primary TCP/IP stack leaves the Sysplex
    - Individual stack-managed dynamic VIPAs can be moved between primary and backup stacks using MVS operator commands
  - **Application-specific also known as bind-activated (VIPARANGE)**
    - Belongs to an application. Becomes active on the TCP/IP stack in the Sysplex where the application is started. Moves with the application.
  - **Command- or utility activated (VIPARANGE)**
    - Belongs to whatever TCP/IP stack in the Sysplex on which a MODDVIPA utility to activate the address has been executed.
    - Moves between TCP/IP stacks based on execution of the MODDVIPA utility.
  - **Distributed also known as a DRVIPA or sometimes DDVIPA (VIPADEFINE/VIPABACKUP + VIPADISTRIBUTE)**
    - Used with Sysplex Distributor as a cluster IP address that represents a cluster of equal server instances in the Sysplex.
    - From a routing perspective it belongs to one TCP/IP stack.
    - From an application perspective it is distributed among the TCP/IP stacks in the Sysplex where an instance of the server application is executing.

Sysplex Distributor Overview and Workload Balancing Considerations

What are the main objectives of network workload balancing with Sysplex Distributor?

- **Performance**
  - Workload management across a cluster of server instances
  - One server instance on one hardware node may not be sufficient to handle all the workload
- **Availability**
  - As long as one server instance is up-and-running, the "service" is available
  - Individual server instances and associated hardware components may fail without impacting overall availability
- **Capacity management / horizontal growth**
  - Transparently add/remove server instances and/or hardware nodes to/from the pool of servers in the cluster
- **Single System Image**
  - Give users one target hostname to direct requests to
  - Number of and location of server instances is transparent to the user

All server instances must be able to provide the same basic service. In a z/OS Sysplex that means the applications must be Sysplex-enabled and be able to share data across all LPARs in the Sysplex.



In order for the load balancing decision maker to meet those objectives, it must be capable of obtaining feedback dynamically, such as server instance availability, capacity, performance, and overall health.

Sysplex Distributor Distribution Methods

Distribution method	Description	Key attributes
BASEWLM	Uses WLM recommendations that are based on the available and displaceable capacity available on a target z/OS System	Dynamic updates, responds to changes in system wide utilization, also has several sources of additional health information that can be incorporated
SERVERWLM	Uses WLM recommendations that are based on available and displaceable capacity for the target application server, whether the application is meeting service class goals and facilities that allow for the incorporation of application specific health	Dynamic updates, responds to changes in system wide utilization and changes in performance and available capacity for the specific target application, also has several sources of additional health information that can be incorporated. Generally, the preferred distribution method!

Sysplex Distributor Distribution Methods (cont)

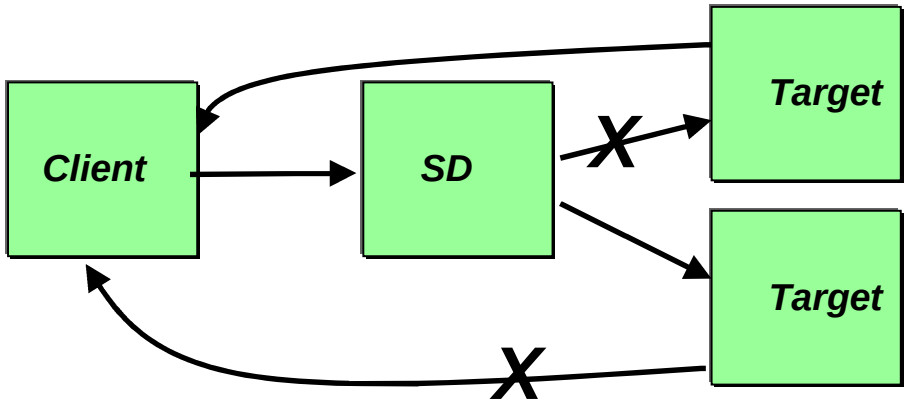
Distribution method	Description	Key attributes
ROUNDROBIN	Static Round Robin Distribution across all eligible targets	Static distribution, awareness of target servers being up or not, limited ability to incorporate other health factors
WEIGHTEDACTIVE	Round Robin distribution based on user specified fixed weights, accounts for active connections already distributed	Largely a static distribution, awareness of target servers/applications being up or not, also takes into consideration real time information on number of active connections on each target, ability to incorporate other health factors

Sysplex Distributor Distribution Methods (cont)

Distribution method	Description	Key attributes
HOTSTANDBY	Targets primary target system as long as the system and application are active, otherwise selects the highest ranked backup target	Real time detection of failures to the primary system/application and switch to backup, limited ability to incorporate other health factors
TARGETCONTROLLED	Can be used to dynamically load balance connections to a cluster of IBM DataPower appliances (standalone appliances in the network or the integrated XI50z DataPower appliances in the zBX). Uses dynamic feedback on CPU utilization obtained from DataPower.	Dynamic load balancing based on DataPower availability and CPU utilization.

Sysplex Distributor built-in awareness of abnormal conditions

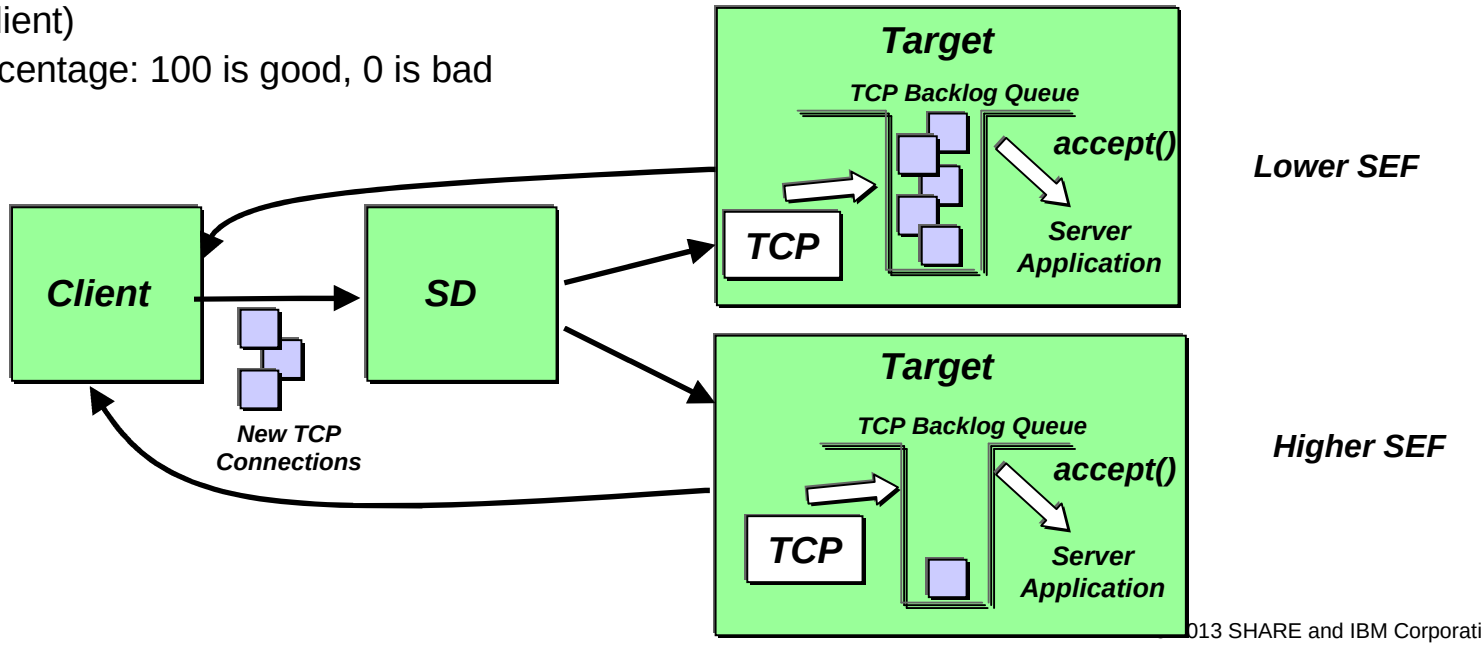
- TSR – Target Server Responsiveness
  - How healthy is the target system and application from an SD perspective? A percentage, 0-100%
  - Comprised of several individual health metrics:
    - TCSR – Target Connectivity Success Rate
      - Are connections being sent to the Target System making it there?
      - A Percentage: 100 is good, 0 is bad



    - CER – Connectivity Establishment Rate
      - Is connectivity between the target system and the client ok?
      - By monitoring TCP Connection Establishment state (requires 3 way handshake between client and server) we can detect whether a connectivity issue exists
      - A percentage: 100 is good, 0 is bad
      - Note: CER no longer part of TSR directly but is included in SEF and continues to be calculated and reported separately

Sysplex Distributor built-in awareness of abnormal conditions

- TSR – Target Server Responsiveness (cont)
  - SEF – Server Efficiency Fraction
    - Is the target server application server keeping up with new connections in its backlog queue?
      - > Is the new connection arrival rate higher than the application accept rate? (i.e. is backlog growing over time)
      - > How many connections in the TCP backlog queue? How close to maximum backlog queue depth? Did we have to drop any new connections because the backlog queue max was exceeded?
      - > Is the server application hung? (i.e. not accepting any connections)
      - > Are the number of half-open connections on the backlog queue growing? (Similar to CER – One such scenario is when the target system does not have network connectivity to the client)
    - A Percentage: 100 is good, 0 is bad



Middleware/Application Issues and the "Storm Drain Problem"

- TCP/IP and WLM are not aware of all problems experienced by load balancing targets (middleware/applications) – Examples:
  - The server application needs a resource such as a database, but the resource is unavailable
  - The server application is failing most of the transactions routed to it because of internal processing problems
  - The server application acts as a transaction router for other back-end applications on other system(s), but the path to the back-end application is unavailable
- In each of these scenarios, the server may appear to be completing the transactions quickly (using little CPU capacity) when they are actually being failed
- This is sometimes referred to as the *Storm Drain* Problem
  - The server is favored by WLM since it is using very little CPU capacity
  - As workloads increase, the server is favored more and more over other servers
  - All this work goes "down the drain"

Improving WLM awareness of Application Health - Avoiding "Storm Drain" Issues

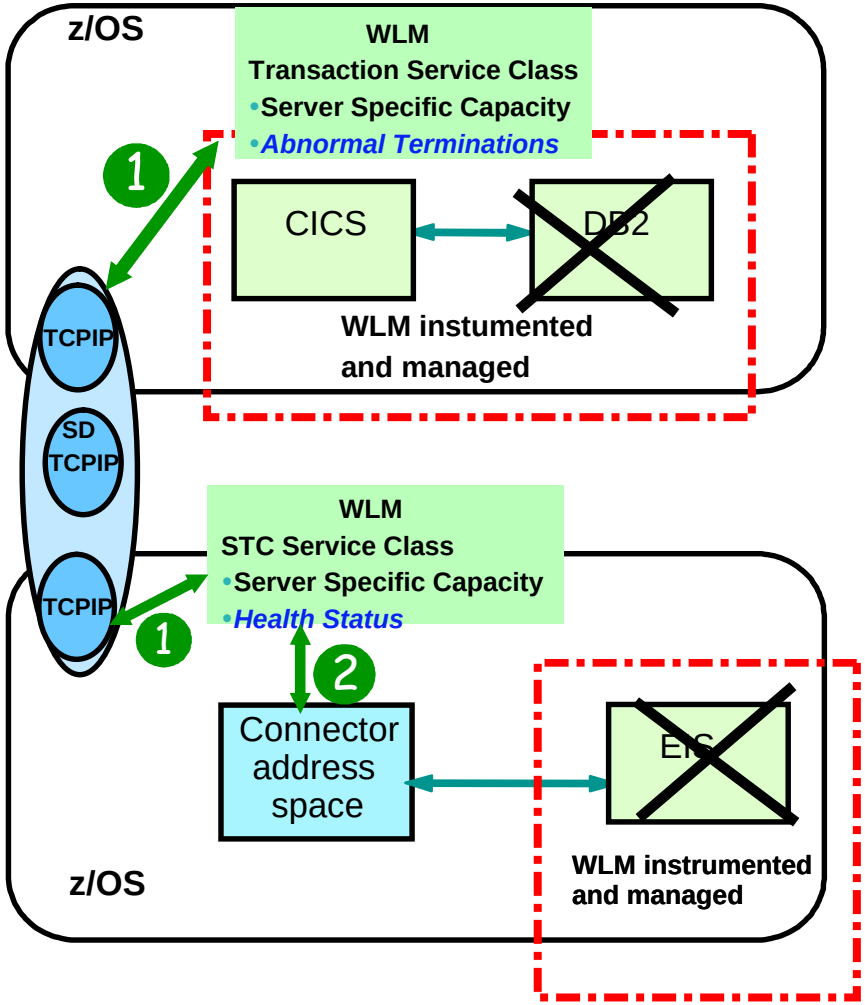
Server Scenarios

1 IWM4SRSC WLM Service

- Used by Sysplex Distributor to obtain WLM recommendations
- Abnormal Termination information: Reported by 1st tier server when transactions can not complete because back end resource managers are not available
  - WLM uses this information to reduce the recommendation for ailing server

2 IWM4HLTH WLM Service

- Allows address spaces which are not instrumented with WLM to set a a health status which is also returned by IWM4SRSC
- The ServerWLM recommendations are reduced when the health is <100%
- Exploited by CICS Transaction Gateway, DB2 and LDAP



What impacts the final selection of a target server instance?

Technology	Target LPAR displaceable capacity as seen by WLM	Server instance performance as seen by WLM	Server instance self-perceived health (as reported to WLM)	Server instance TCP/IP perceived health (the TSR value)	QoS perceived network performance (the QoS fraction)
SD ROUNDROBIN	No	No	No	Yes (if TSR=zero)	No
SD WEIGHTEDACTIVE	No	No	Yes	Yes	No
SD BASEWLM	Yes	No	No	Yes	Yes
SD SERVERWLM	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
SD TARGETCONTROLLED	Yes (SD agent)	No	No	No	No
SD HOTSTANDBY	No	No	Yes	Yes	No
PORT SHAREPORT	No	No	No	Yes (Only SEF value)	No
PORT SHAREPORTWLM	No	Yes	Yes	Yes (Only SEF value)	No

Using Netstat VDPT Detail display to monitor Sysplex Distributor

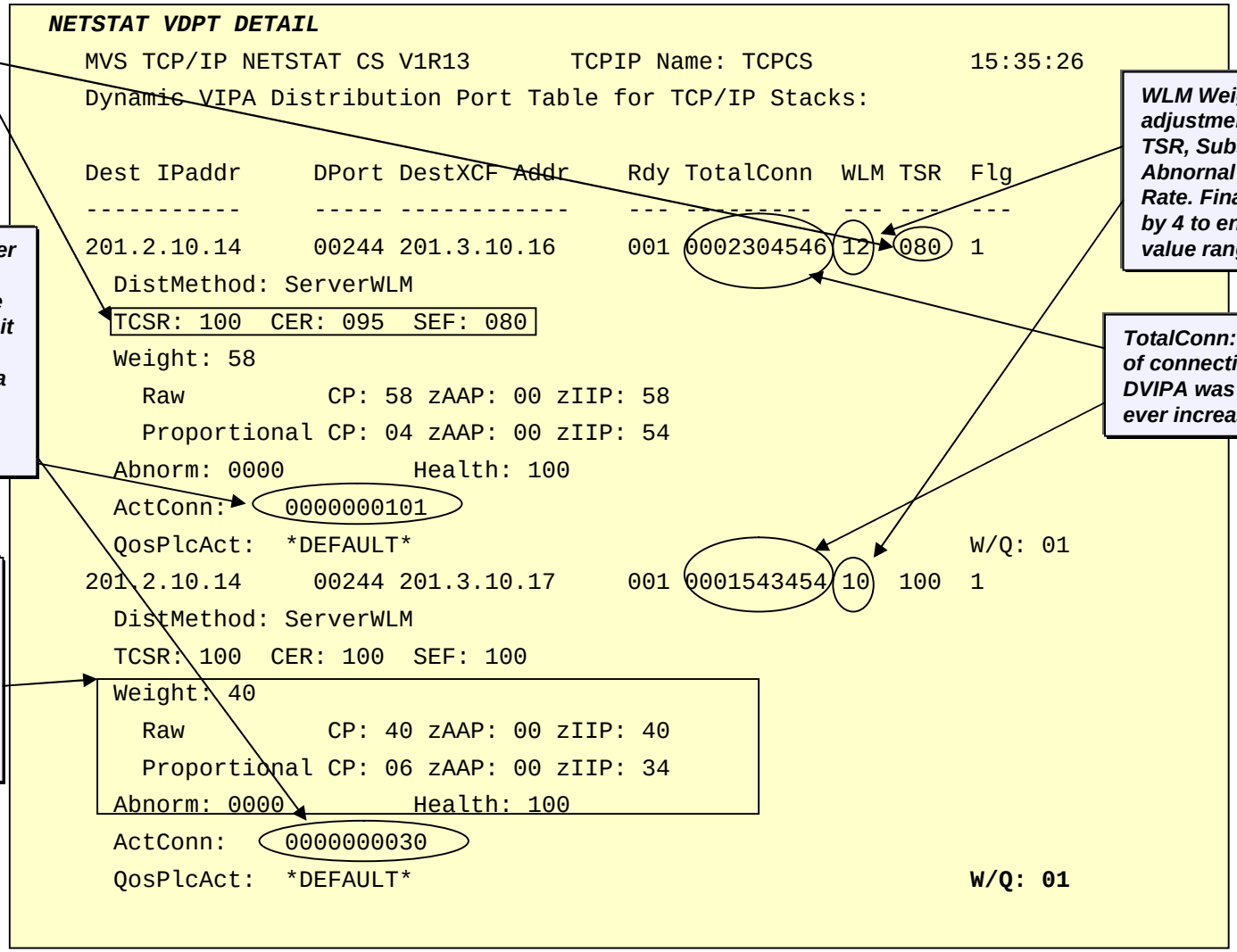
Target Server Responsiveness (TSR) and subcomponents (applied to WLM weight)

ActConn: Active number of connections to this target at this time. Note connections in Timewait or Finwait states also show up here. This is a snapshot, can vary significantly across netstat invocations

WLM Information: Raw Weights, Proportional Weights, Abnormal Transaction Rate and Midleware reported health

WLM Weight after all adjustments TSR, Subsystem Health, Abnornal Connection Rate. Final value divided by 4 to end up with 0-16 value range

TotalConn: Total number of connections since DVIPA was activated – ever increasing value



Monitoring Sysplex Distributor – Sample Scenarios

- While Sysplex Distributor provides many autonomic functions that optimize load balancing based on the current Sysplex conditions there are scenarios where monitoring changes in workload distribution can help identify problems so that corrective actions can be taken
  - TCP/IP provided facilities like the Netstat VDPT Detail report can be very useful for gaining insight into the current state of the system and Sysplex Distributor
    - Provides a lot of detail if you know what you are looking for
    - A snapshot of the current state of the system (no historical perspective is provided)
    - And it depends on the user issuing the command to detect problems (no automated notification of problem conditions)
  - Next we will examine NetView for z/OS and its advanced management functions for DVIPAs and how it can improve your monitoring operations for DVIPAs
    - With a focus on its support for Sysplex Distributor and how can it can help reduce problem resolution time and make monitoring the environment more efficient

NetView for z/OS
DVIPA Management Overview

DVIPA Management Capabilities

- NetView provides a lot of DVIPA information for use in managing and diagnosing problems in your sysplex:
  - Sampled, real-time, and historical monitoring capabilities
  - DVIPA events
  - Distributed DVIPA statistics
- DVIPA information can be viewed at the:
  - Local NetView domain
  - Sysplex master NetView domain
    - Displays DVIPA information available from all NetView domains in the sysplex
      - NetView domains must all participate in the same NetView XCF group
      - DVIPA connection information is not forwarded to the sysplex master NetView for performance reasons
- DVIPA information is displayed in the:
  - Tivoli Enterprise Portal (TEP) using the NetView for z/OS Enterprise Management Agent
  - NetView 3270 console

DVIPA Monitoring

- NetView provides the following DVIPA information:
  - DVIPA Definition and Status, including views for:
    - Application-instance DVIPAs
    - Stack-defined DVIPAs
  - Sysplex Distributors
  - Distributed DVIPA (DDVIPA) Targets
  - DDVIPA Server Health,including a view for:
    - DDVIPA Unhealthy Servers
  - DVIPA Connections
  - VIPA Routing
  - DDVIPA Connection Routing
- TEP displays sampled and historical data, which can be updated using DVIPA events
  - *Historical data collection must be enabled*
  - Long term history requires Tivoli Data Warehouse.
- NetView 3270 commands and samples display real-time DVIPA information

DVIPA Events

- DVIPA Events can be used to provide a better “real time” view of DVIPA information. NetView has automation for three types of DVIPA Events:
  - Real-time DVIPA changes
    - DVIPA status change and DVIPA removed
    - DVIPA target added and removed
    - DVIPA target server started and ended
      - *Requires z/OS V1R12 Communications Server*
      - *Equivalent data can be retrieved from DVIPA SNMP traps*
  - DVIPA Configuration Changes
    - *Requires z/OS V1R11 Communications Server*
  - Sysplex Autonomics messages
- When a DVIPA event is received:
  - NetView will bundle the events using configurable delays
  - Notify the master that this system needs rediscovering
    - The master NetView also has a delay to bundle the event messages
  - Send rediscovery commands to all systems in the sysplex impacted by the event

Distributed DVIPA Statistics

- Provides the capability to collect workload distribution for each distributed DVIPA target
  - Used for problem determination
  - Used for historical data
- Collects and calculates data after each DDVIPA sampled data collection
- Starts during NetView initialization or using DVIPALOG command
- Writes data to a sequential data set
  - Primary and secondary data sets allocated
  - Messages indicate data set switching
- Sample CNMSDVST shows data in both data sets on NetView 3270 console
- Forwards data to master NetView, if configured to do so
- Reports (not provided by NetView) can be written against the data

DDVIPA Statistics Information Provided

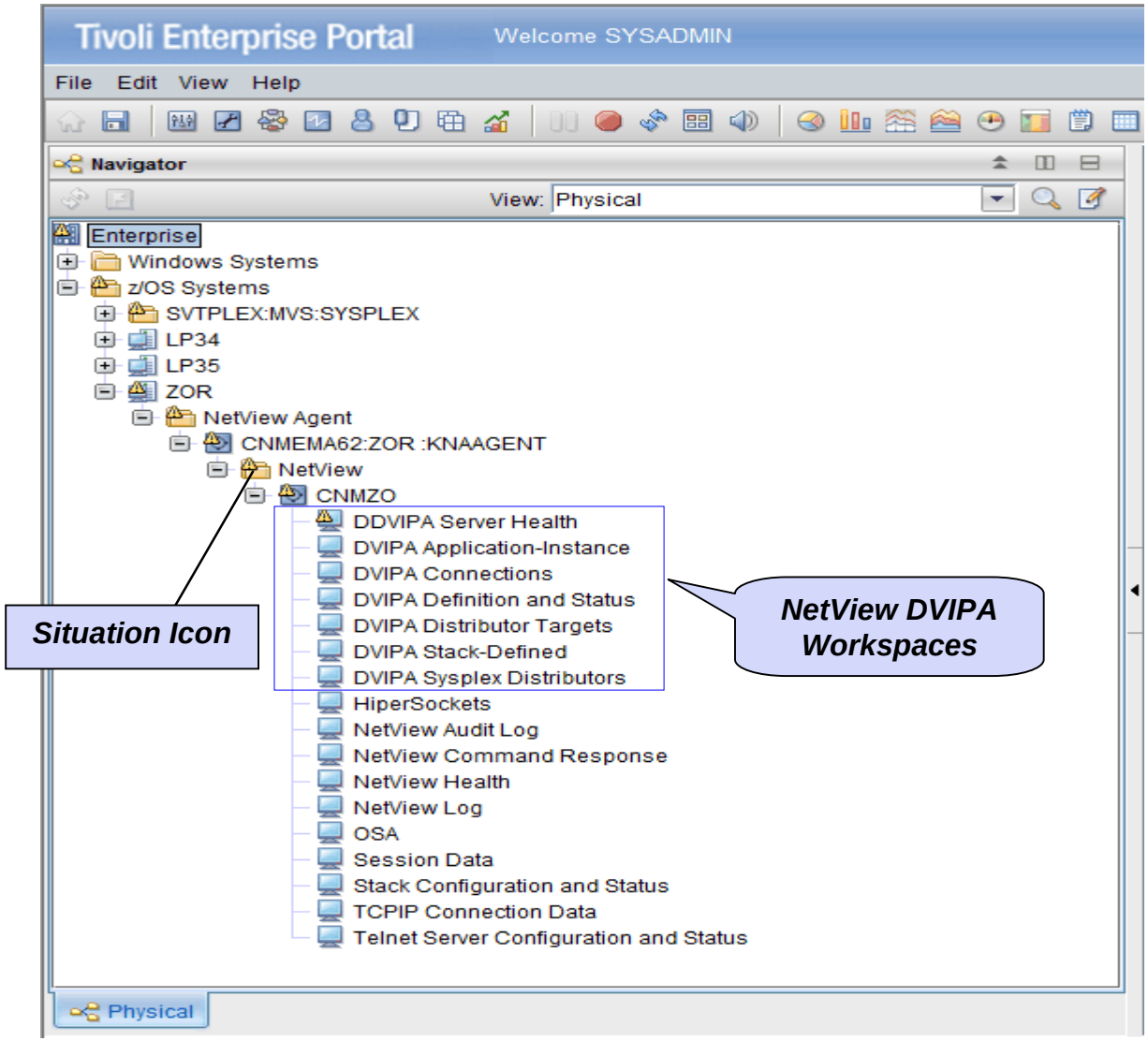
- STCK
- Date
- Time
- System
- TCP Job Name
- DDVIPA
- DDVIPA Port
- Target System
- Target TCP Job Name
- Distribution Method
- Total Connections
- Delta Connections
- WLM Weight
- SD Percentage TCP Connections
- Percentage WLM Weight

DVIPA 3270 Commands and Samples

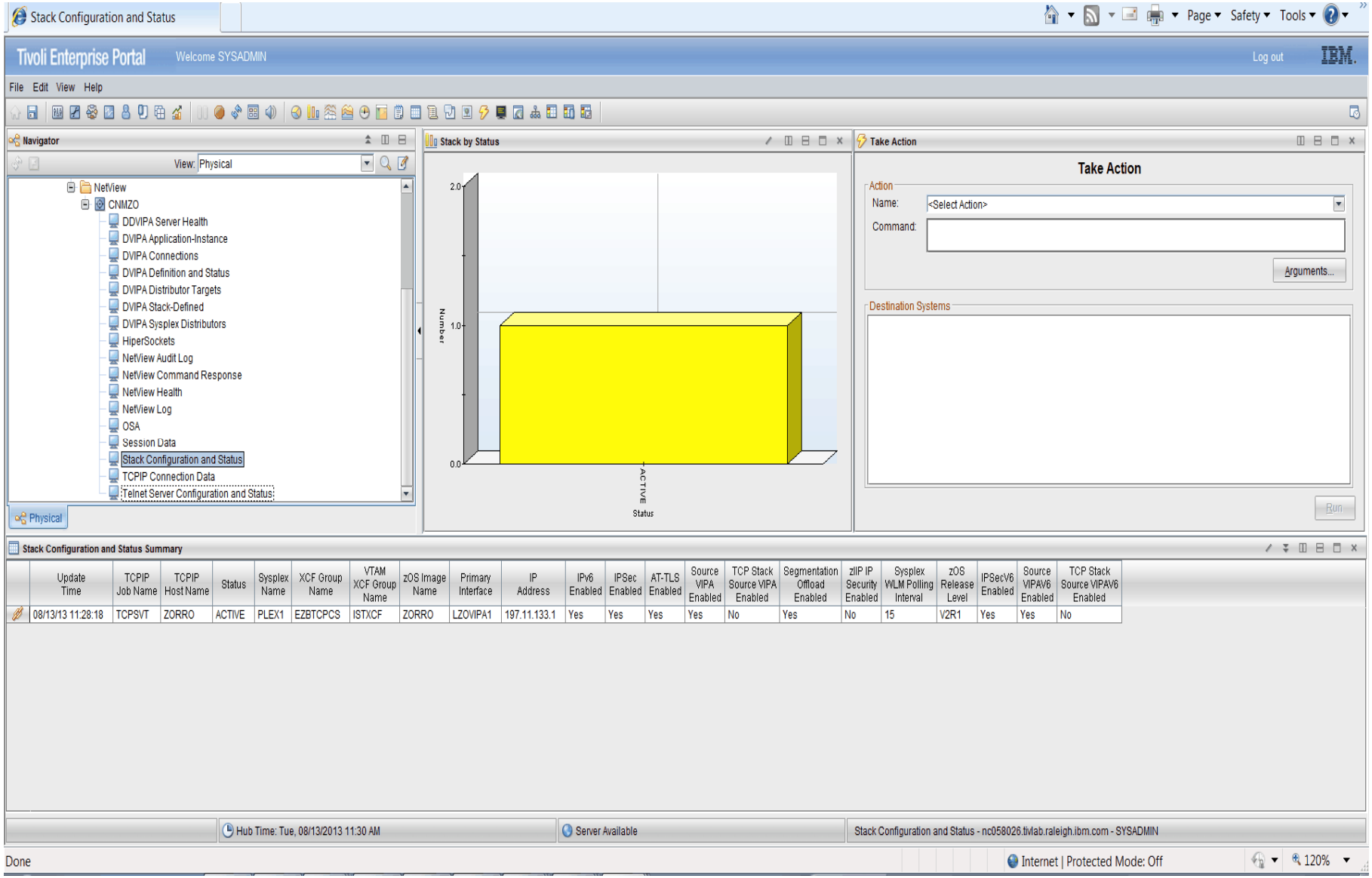
- DVIPSTAT (CNMSDVIP)
  - Displays DVIPA definition and status information
- DVIPPLEX (CNMSPLEX)
  - Displays Distributed DVIPA (DDVIPA) information
- DVIPTARG (CNMSTARG)
  - Displays Distributed DVIPA targets information
- DVIPHLTH (CNMSDVPH)
  - Displays DDVIPA server health information
- DVIPCONN (CNMSDVPC)
  - Displays DVIPA connections
- VIPAROUT (CNMSVPRT)
  - Displays VIPA route information
- DVIPDDCR (CNMSDDCR)
  - Displays distributed DVIPA connection routing information

NetView for z/OS
DVIPA Workspaces

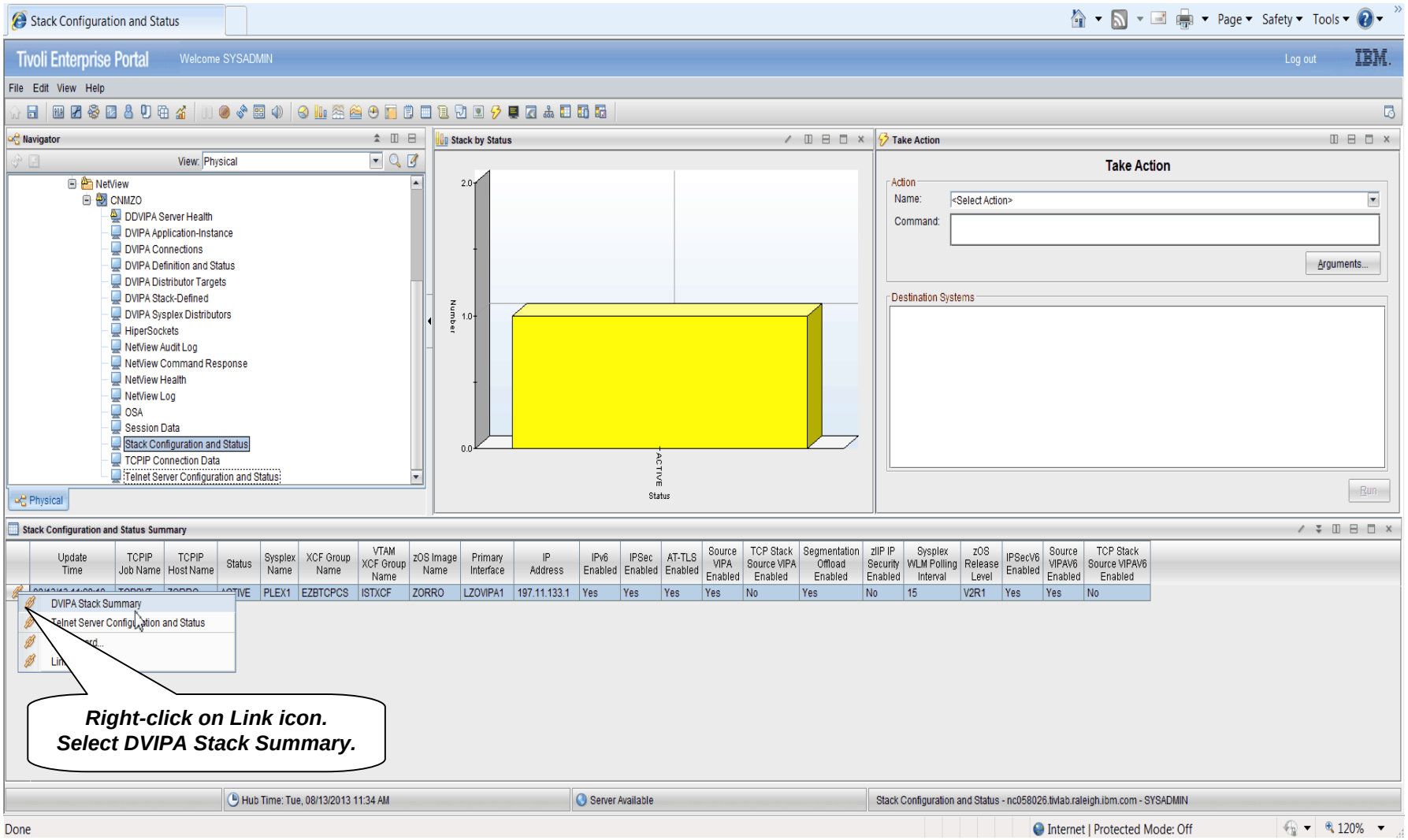
TEP Navigation Tree



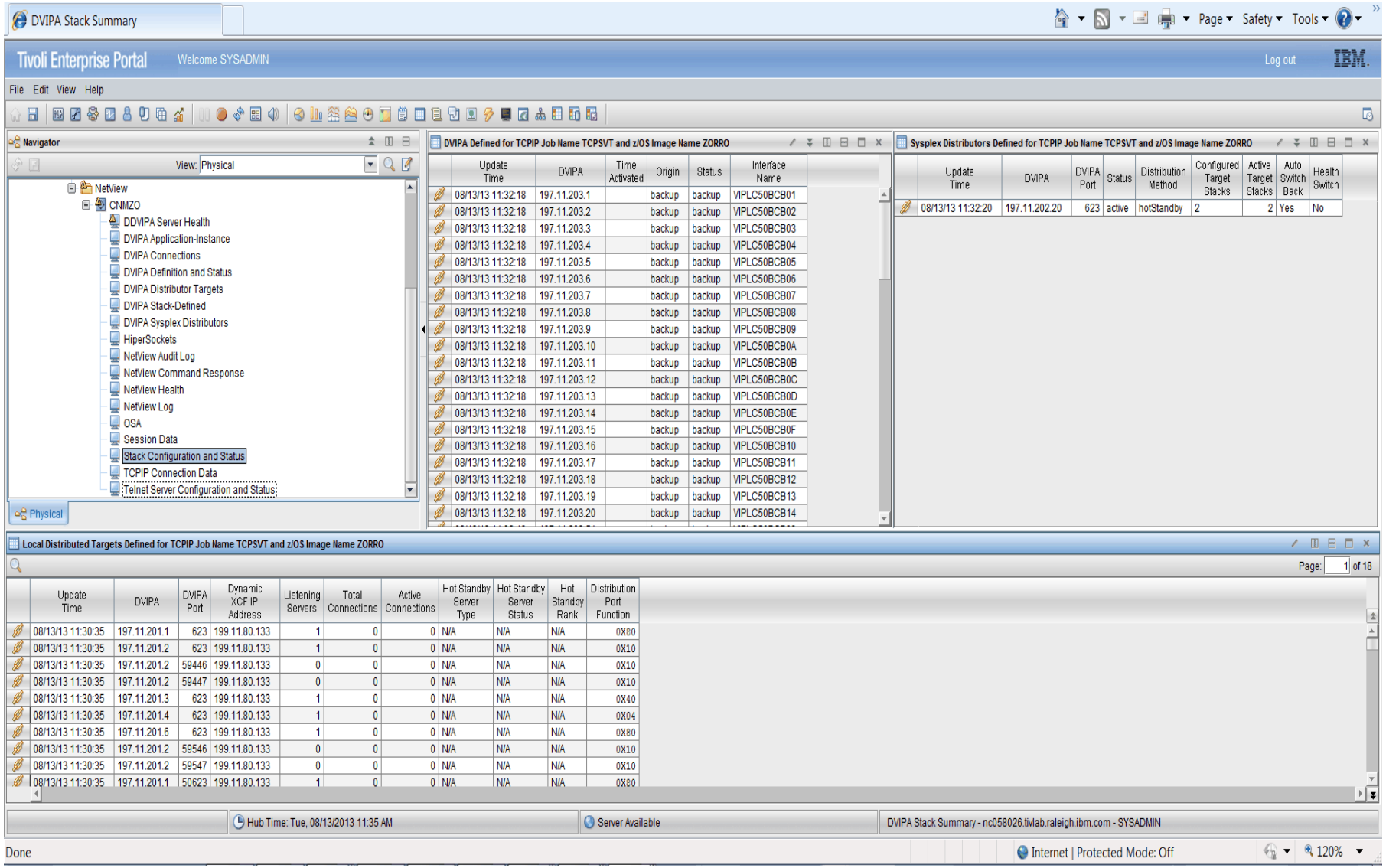
Stack Configuration and Status



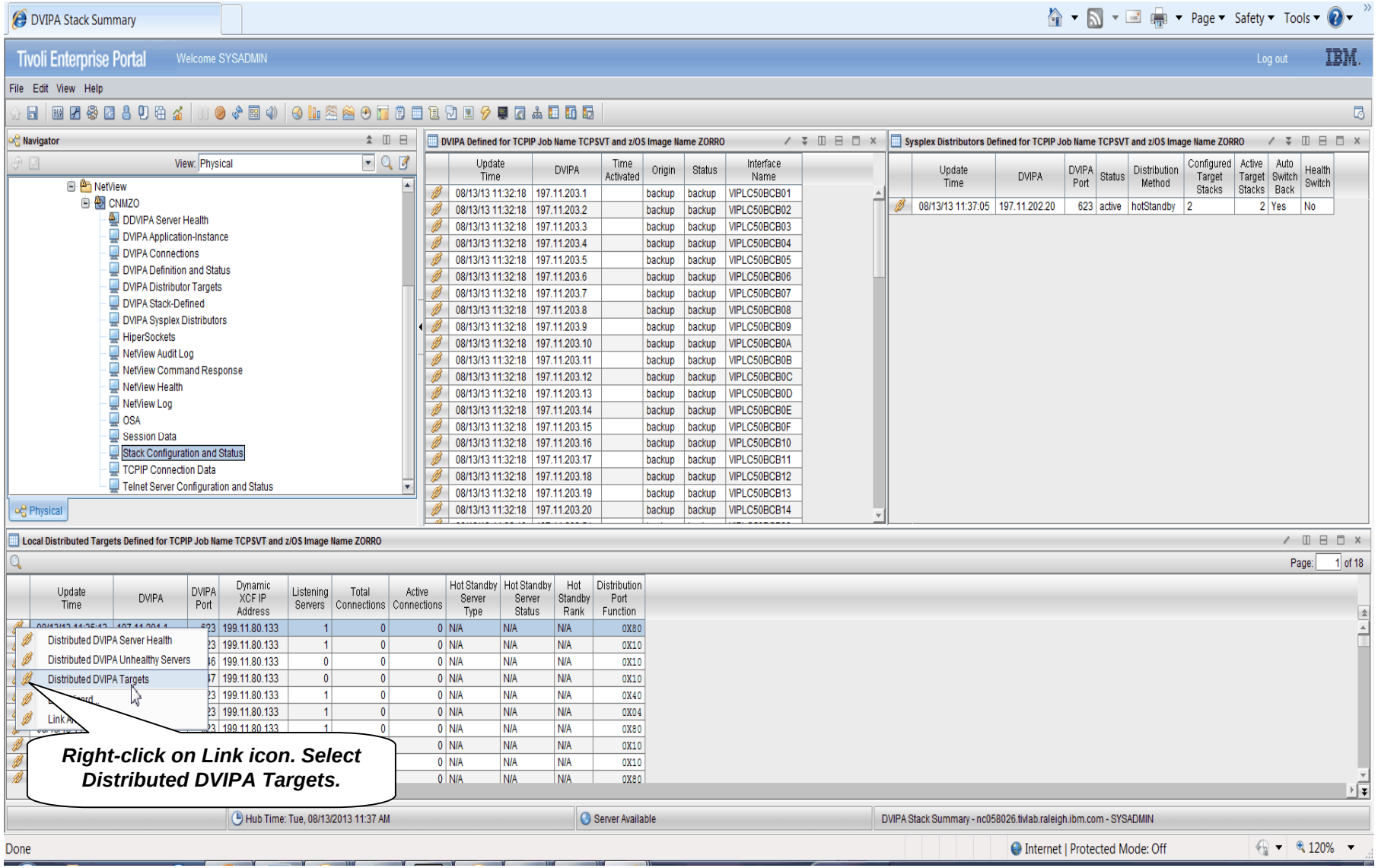
DVIPA Stack Summary Link



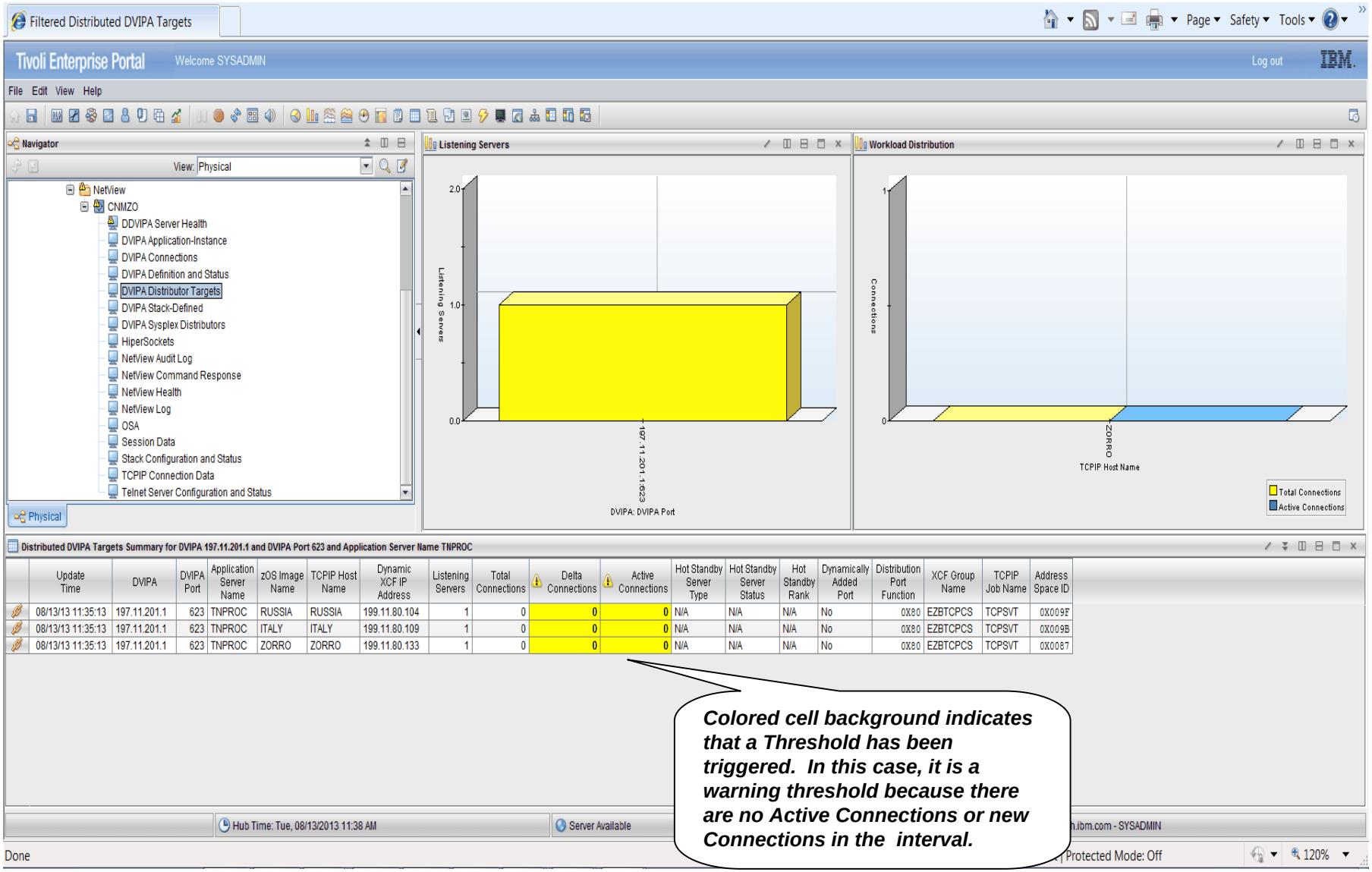
DVIPA Stack Summary Workspace



Distributed DVIPA Targets Link

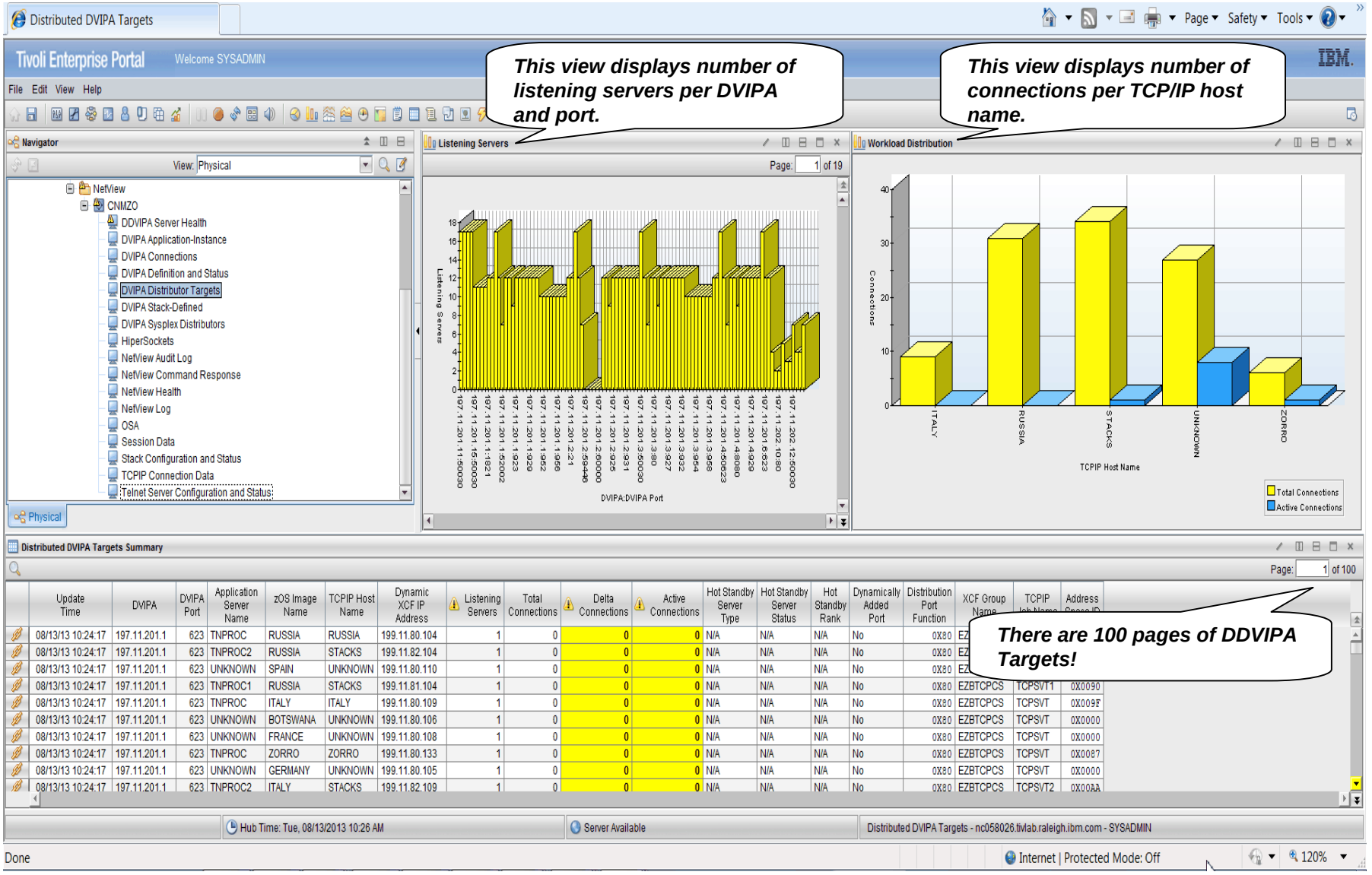


Filtered Distributed DVIPA Targets Workspace



Colored cell background indicates that a Threshold has been triggered. In this case, it is a warning threshold because there are no Active Connections or new Connections in the interval.

Distributed DVIPA Targets Workspace (not filtered)



Update Time	DVIPA	DVIPA Port	Application Server Name	zOS Image Name	TCPIP Host Name	Dynamic XCF IP Address	Listening Servers	Total Connections	Delta Connections	Active Connections	Hot Standby Server Type	Hot Standby Server Status	Hot Standby Rank	Dynamically Added Port	Distribution Port Function	XCF Group Name	TCPIP Job Name	Address Space ID
08/13/13 10:24:17	197.11.201.1	623	TNPROC	RUSSIA	RUSSIA	199.11.80.104	1	0	0	0	N/A	N/A	N/A	No	0X80	EZ		
08/13/13 10:24:17	197.11.201.1	623	TNPROC2	RUSSIA	STACKS	199.11.82.104	1	0	0	0	N/A	N/A	N/A	No	0X80	EZ		
08/13/13 10:24:17	197.11.201.1	623	UNKNOWN	SPAIN	UNKNOWN	199.11.80.110	1	0	0	0	N/A	N/A	N/A	No	0X80	EZ		
08/13/13 10:24:17	197.11.201.1	623	TNPROC1	RUSSIA	STACKS	199.11.81.104	1	0	0	0	N/A	N/A	N/A	No	0X80	EZBTCPCS	TCPSVT1	0X0090
08/13/13 10:24:17	197.11.201.1	623	TNPROC	ITALY	ITALY	199.11.80.109	1	0	0	0	N/A	N/A	N/A	No	0X80	EZBTCPCS	TCPSVT	0X009F
08/13/13 10:24:17	197.11.201.1	623	UNKNOWN	BOTSWANA	UNKNOWN	199.11.80.106	1	0	0	0	N/A	N/A	N/A	No	0X80	EZBTCPCS	TCPSVT	0X0000
08/13/13 10:24:17	197.11.201.1	623	UNKNOWN	FRANCE	UNKNOWN	199.11.80.108	1	0	0	0	N/A	N/A	N/A	No	0X80	EZBTCPCS	TCPSVT	0X0000
08/13/13 10:24:17	197.11.201.1	623	TNPROC	ZORRO	ZORRO	199.11.80.133	1	0	0	0	N/A	N/A	N/A	No	0X80	EZBTCPCS	TCPSVT	0X0087
08/13/13 10:24:17	197.11.201.1	623	UNKNOWN	GERMANY	UNKNOWN	199.11.80.105	1	0	0	0	N/A	N/A	N/A	No	0X80	EZBTCPCS	TCPSVT	0X0000
08/13/13 10:24:17	197.11.201.1	623	TNPROC2	ITALY	STACKS	199.11.82.109	1	0	0	0	N/A	N/A	N/A	No	0X80	EZBTCPCS	TCPSVT2	0X00AA

Using NetView for z/OS DVIPA Management functions for specific Sysplex Distributor workload balancing scenarios

Monitoring Sysplex Distributor – Sample Scenarios

1. ***Help desk is receiving calls indicating performance issues using an application that is distributed via Sysplex Distributor. You want to understand how TCP connections have been distributed for given Distributed DVIPA over the past 30 minutes.***

2. Sysplex Distributor seems to be favoring one z/OS System significantly more than others for new TCP connections? Why is that?

3. Sysplex Distributor Health metrics are great, they help detect problems and adjust load balancing to avoid systems/applications that have issues. But how do I know that this is happening so I can take corrective actions?

Scenario 1: Application Performance Issues

- Distributed DVIPA Statistics will show you how your DDVIPA connections have been distributed for the application with performance issues for DDVIPA 197.11.211.1 on port 52002.

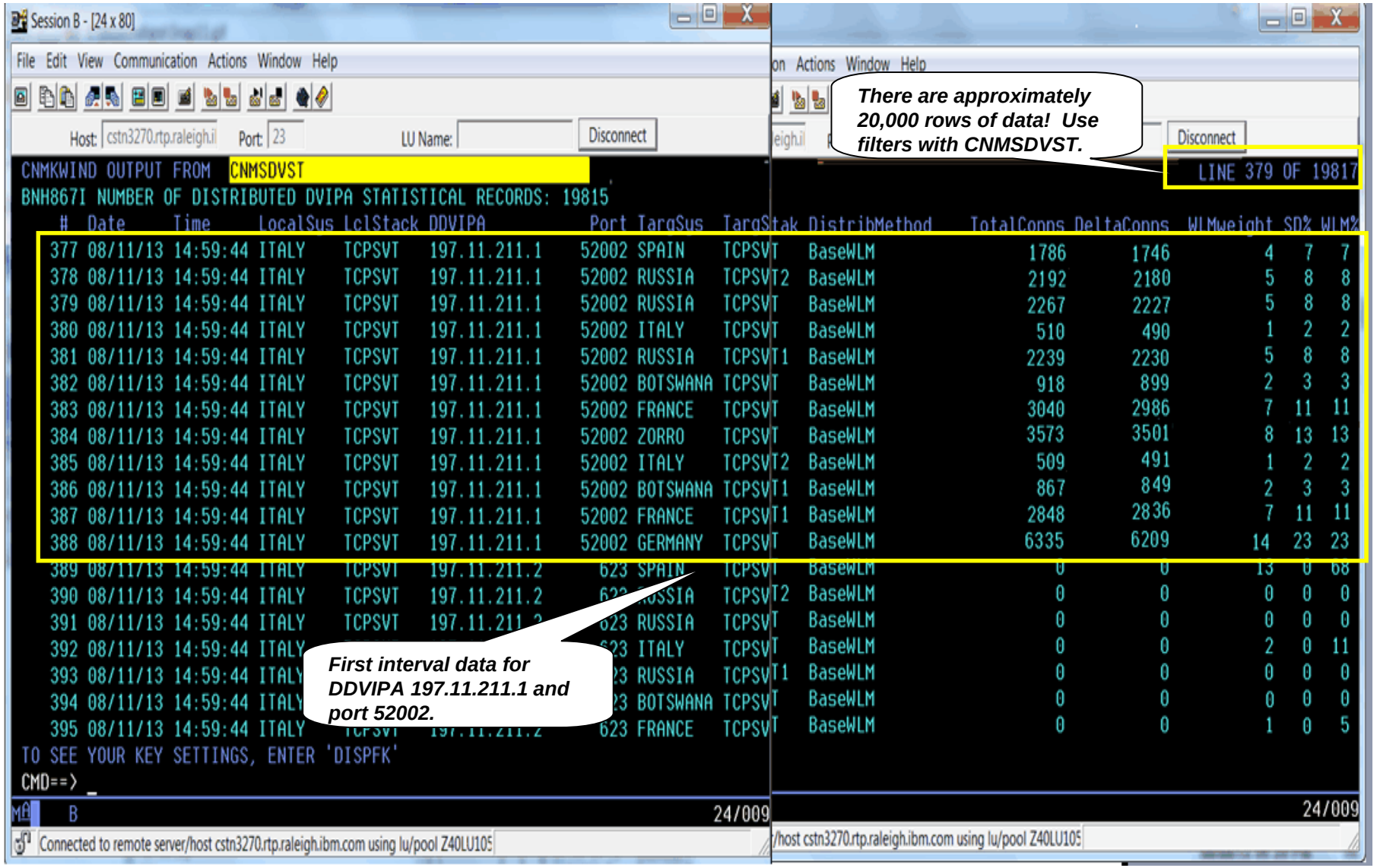
- Scenario information
  - Your DDVIPA sampling interval is 5 minutes (DVIPA.DVTAD tower)
  - DDVIPA Statistics is enabled and started across all systems in your sysplex
    - If not started, start it dynamically with the DVIPALOG command and filters, as desired
  - Once the next sampling interval passes, issue NetView sample command: **CNMSDVST**

    or

    wait for 30 minutes and issue:

    CNMSDVST DVIPA=197.11.211.1 PORT=52002 and scroll through the output.

Scenario 1: CNMSDVST output

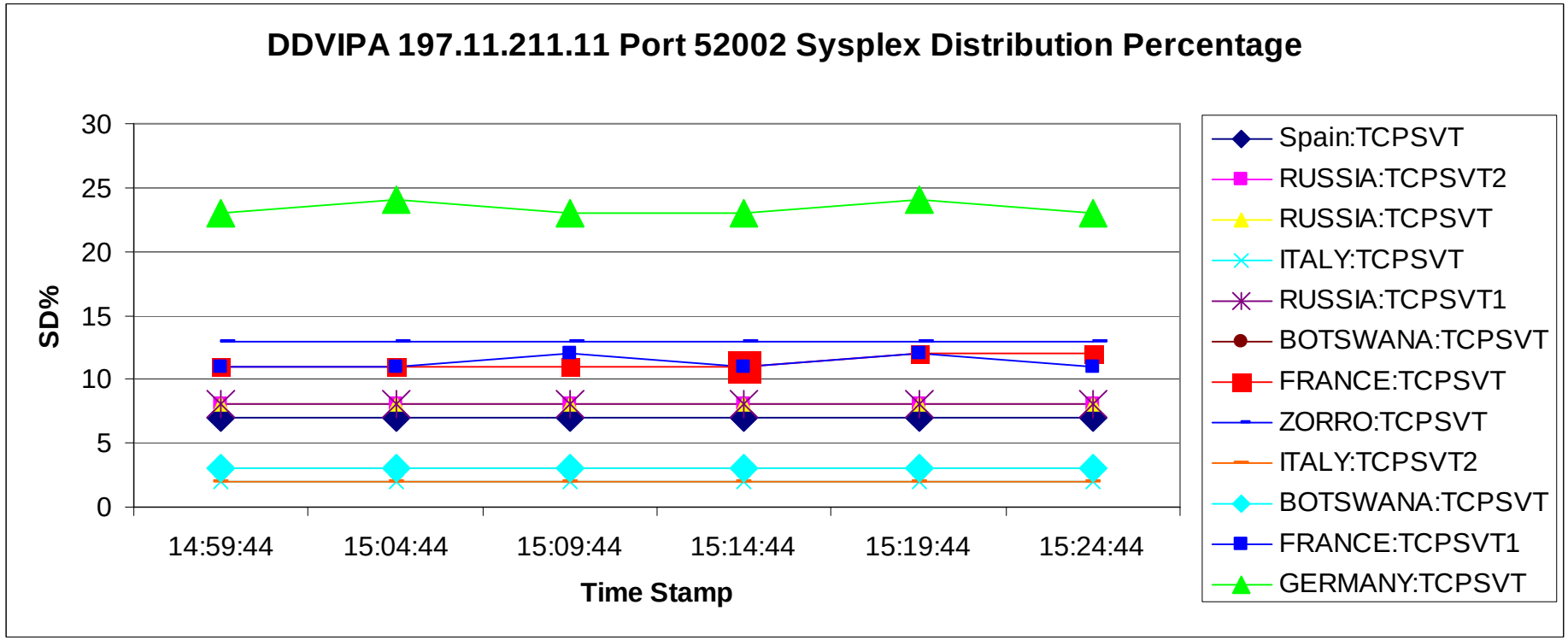


Scenario 1: DDVIPA Sysplex Distribution Percentage

Using the data from DDVIPA Statistics, you can track DDVIPA connection distribution. The graph below maps the Sysplex Distributor Connection Information provided by DDVIPA Statistics over 30 minutes.

- *NetView for z/OS does not provide this function.*

For our scenario, the connections are being distributed consistently across all target stacks. However, there is a wide disparity in the number of connections per stack.



Monitoring Sysplex Distributor – Sample Scenarios

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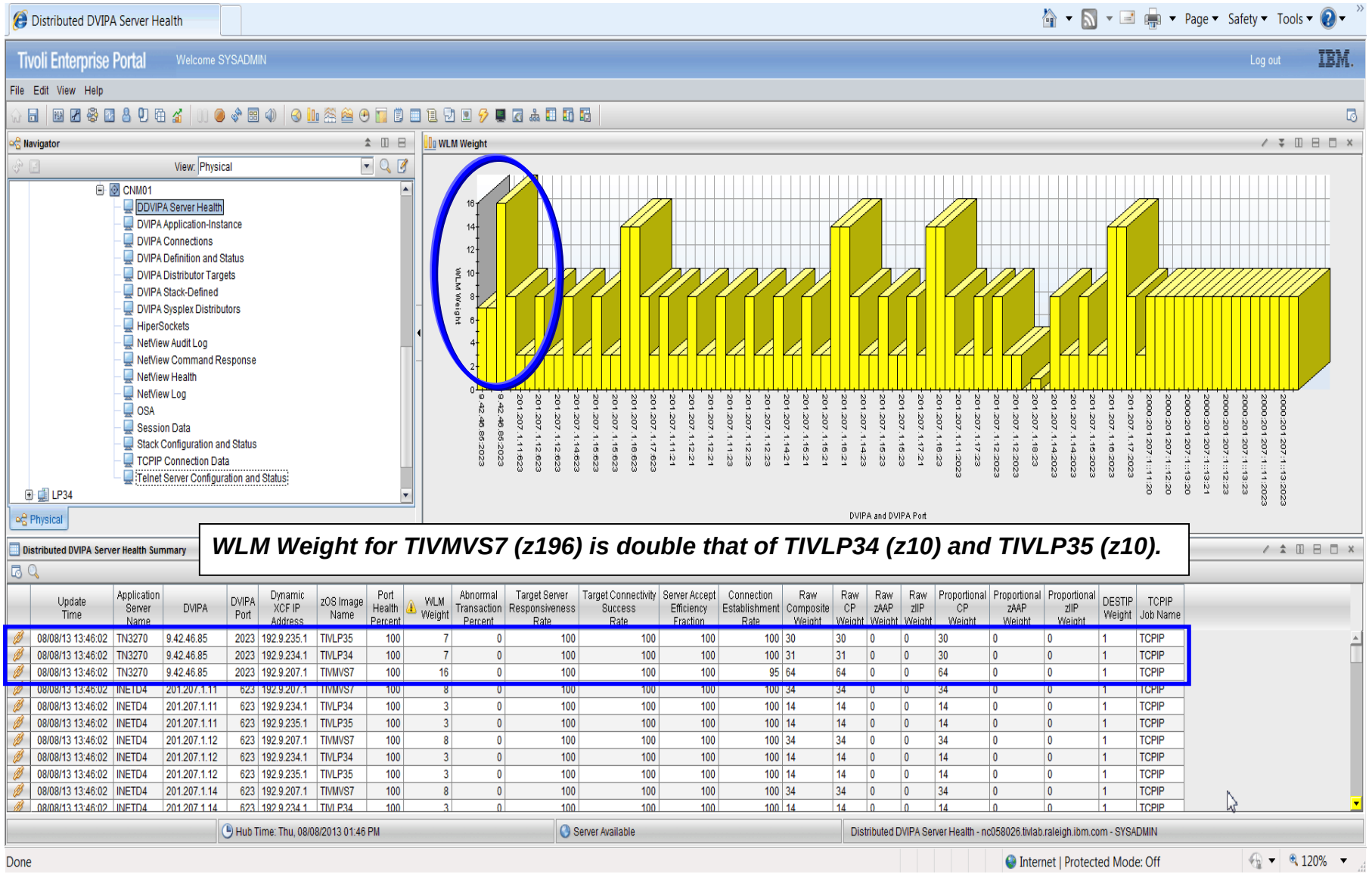
Scenario 2: Sysplex Distributor Favoring a System

- The NetView DDVIPA Server Health workspace displays the WLM weight for DDVIPA targets. WLM weight is a key metric for DDVIPA connection distribution.
- Scenario information:
  - DVIPA 9.42.46.85 on port 2023

Scenario 2: WLM Weight and DDVIPA Server Health



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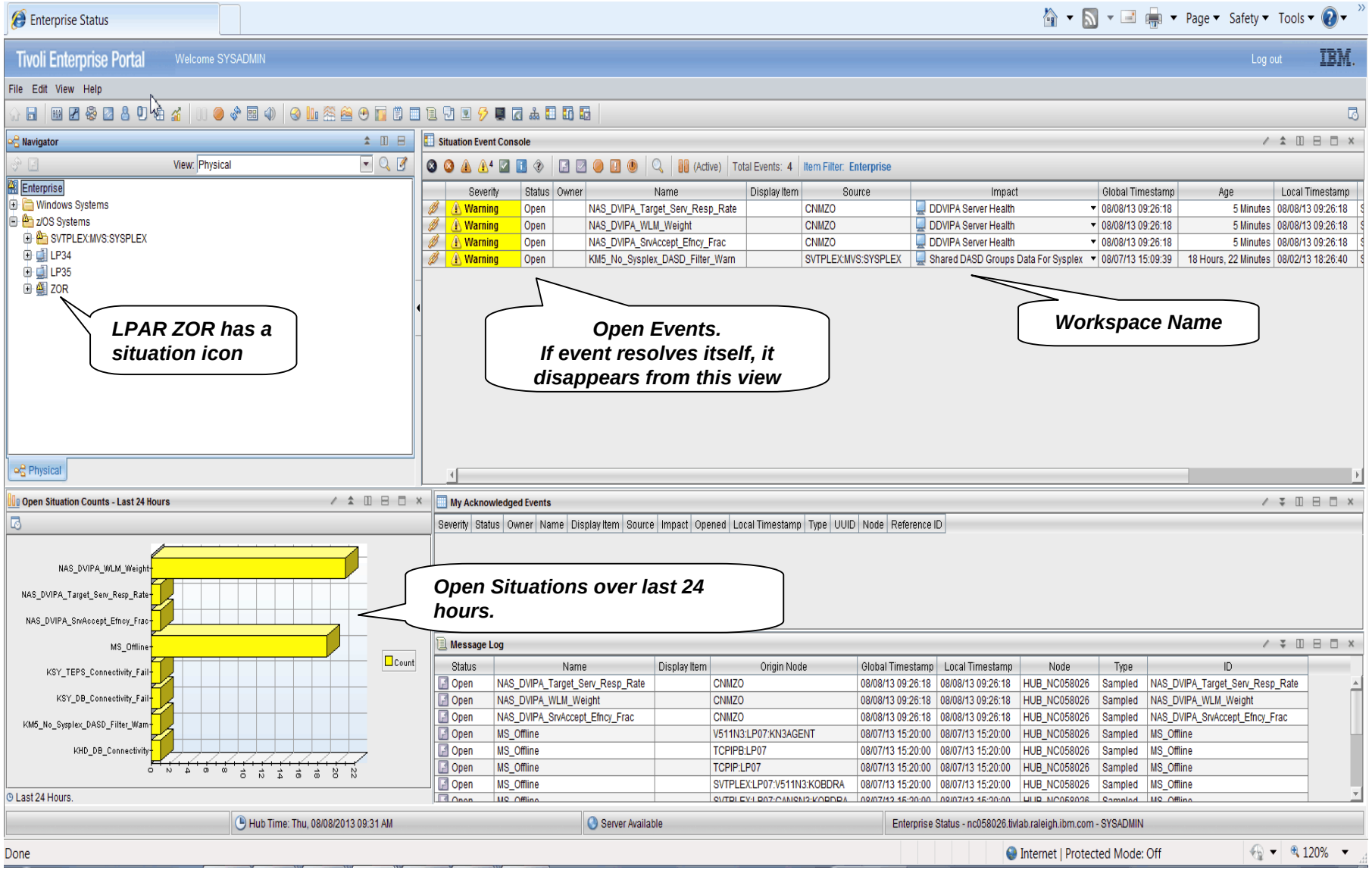
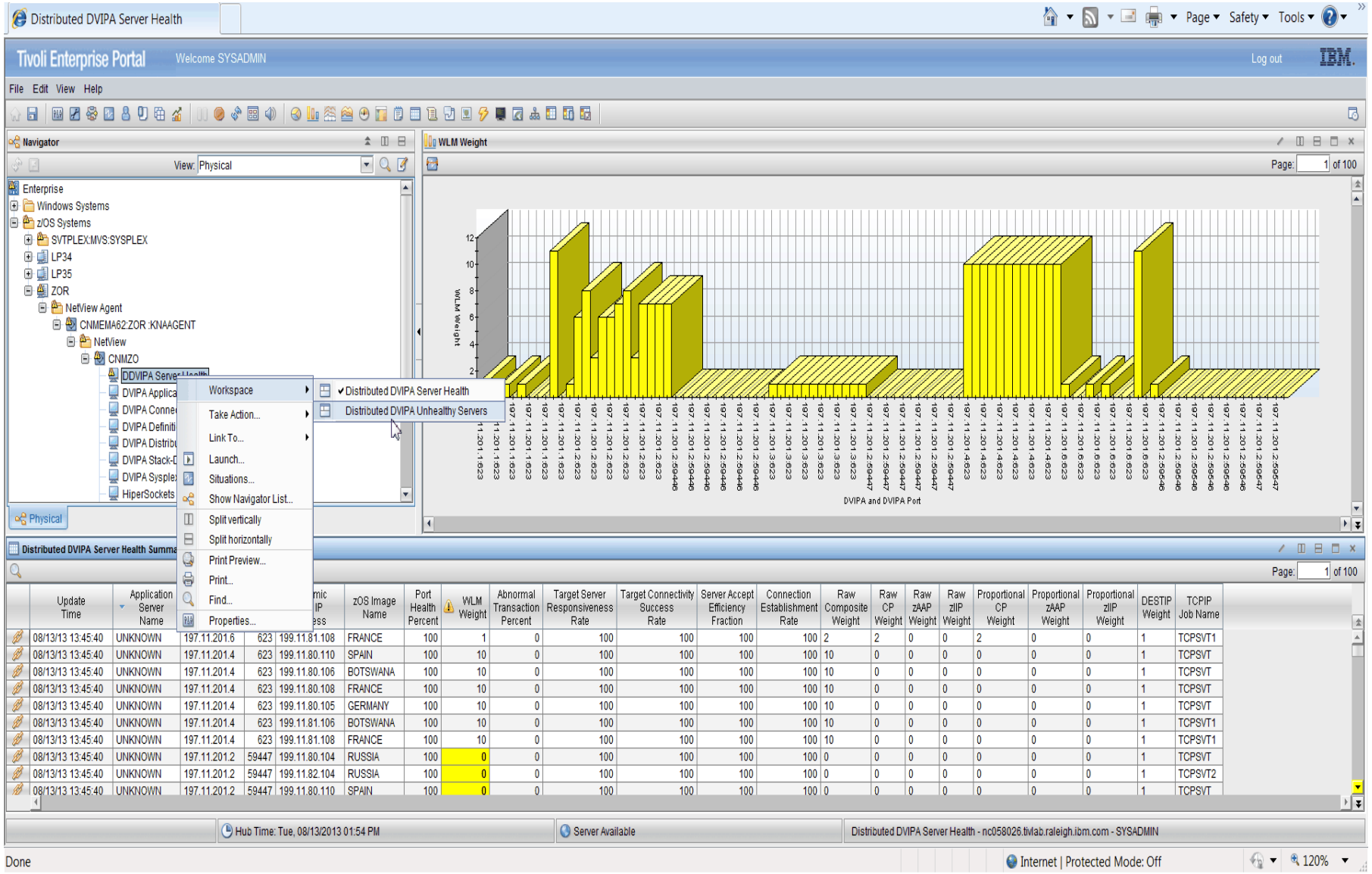
Scenario 3: Sysplex Distributor Health Notifications

- NetView provides situations with the NetView Agent.
  - Disabled by default
  - “Shipped” situations can be customized
  - New situations can be created
- Scenario information:
  - Operator has 3 open situations on the TEP for Distributed DVIPAs for domain CNMZO related to DDVIPA Server Health
    - Server Accept Efficiency Fraction (SEF) < 70%
      - Created for this scenario
    - Target Server Responsiveness Rate (TSR) < 80%
    - WLM Weight = 0
  - Looking at the Navigator Tree, LPAR ZOR, shows the situation icon, so we’ll start there.
  - We also have a DDVIPA Unhealthy Servers workspace
    - Let’s look at that

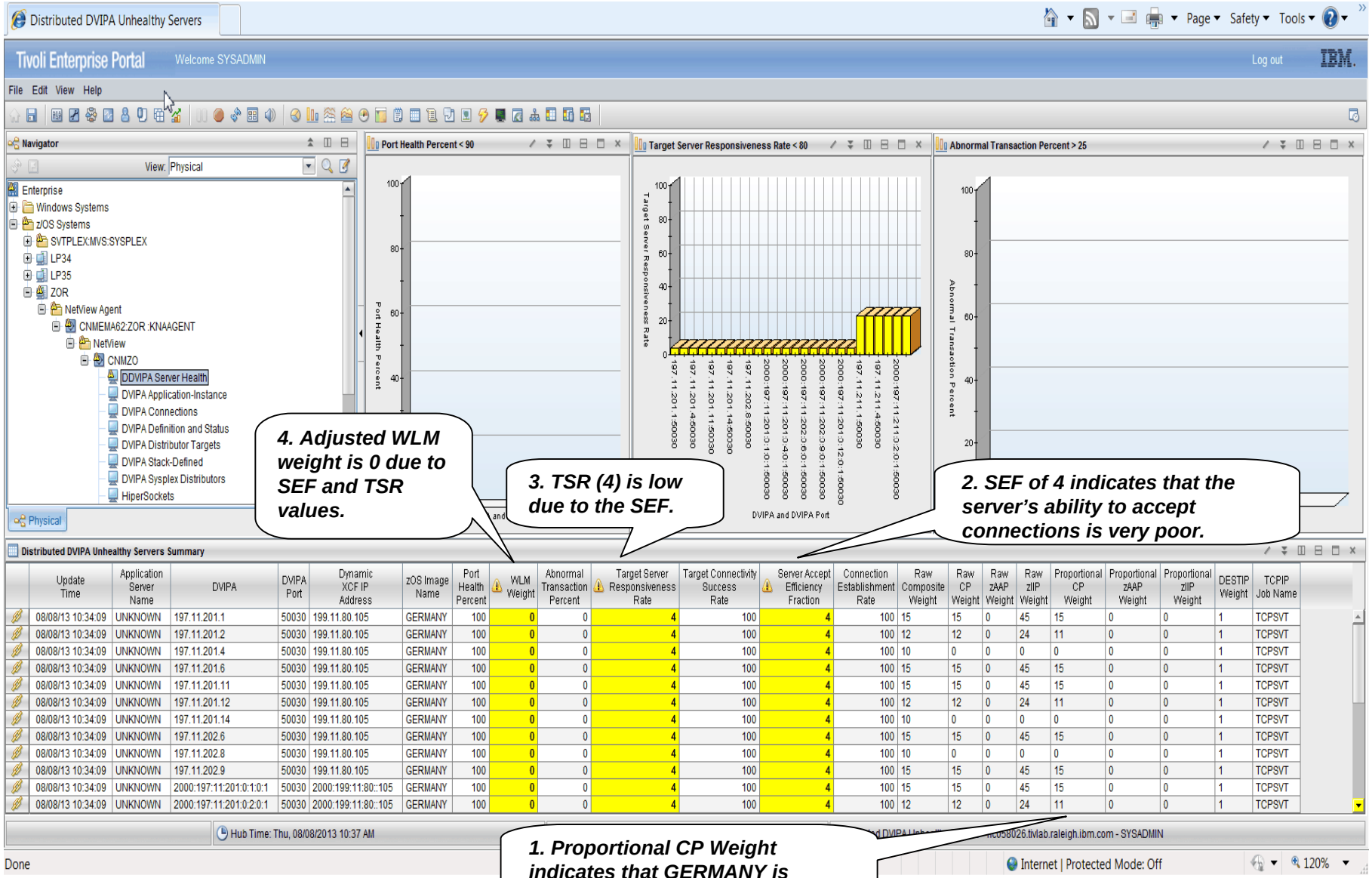
Scenario 3: Enterprise Status View



Scenario 3: DDVIPA Server Health Navigation



Scenario 3: DDVIPA Unhealthy Servers



Update Time	Application Server Name	DVIPA	DVIPA Port	Dynamic XCF IP Address	zOS Image Name	Port Health Percent	WLM Weight	Abnormal Transaction Percent	Target Server Responsiveness Rate	Target Connectivity Success Rate	Server Accept Efficiency Fraction	Connection Establishment Rate	Raw Composite Weight	Raw CP Weight	Raw zAAP Weight	Raw zIIP Weight	Proportional CP Weight	Proportional zAAP Weight	Proportional zIIP Weight	DESTIP Weight	TCPIP Job Name
08/08/13 10:34:09	UNKNOWN	197.11.201.1	50030	199.11.80.105	GERMANY	100	0	0	4	100	4	100	15	15	0	45	15	0	0	1	TCPSVT
08/08/13 10:34:09	UNKNOWN	197.11.201.2	50030	199.11.80.105	GERMANY	100	0	0	4	100	4	100	12	12	0	24	11	0	0	1	TCPSVT
08/08/13 10:34:09	UNKNOWN	197.11.201.4	50030	199.11.80.105	GERMANY	100	0	0	4	100	4	100	10	0	0	0	0	0	0	1	TCPSVT
08/08/13 10:34:09	UNKNOWN	197.11.201.6	50030	199.11.80.105	GERMANY	100	0	0	4	100	4	100	15	15	0	45	15	0	0	1	TCPSVT
08/08/13 10:34:09	UNKNOWN	197.11.201.11	50030	199.11.80.105	GERMANY	100	0	0	4	100	4	100	15	15	0	45	15	0	0	1	TCPSVT
08/08/13 10:34:09	UNKNOWN	197.11.201.12	50030	199.11.80.105	GERMANY	100	0	0	4	100	4	100	12	12	0	24	11	0	0	1	TCPSVT
08/08/13 10:34:09	UNKNOWN	197.11.201.14	50030	199.11.80.105	GERMANY	100	0	0	4	100	4	100	10	0	0	0	0	0	0	1	TCPSVT
08/08/13 10:34:09	UNKNOWN	197.11.202.6	50030	199.11.80.105	GERMANY	100	0	0	4	100	4	100	15	15	0	45	15	0	0	1	TCPSVT
08/08/13 10:34:09	UNKNOWN	197.11.202.8	50030	199.11.80.105	GERMANY	100	0	0	4	100	4	100	10	0	0	0	0	0	0	1	TCPSVT
08/08/13 10:34:09	UNKNOWN	197.11.202.9	50030	199.11.80.105	GERMANY	100	0	0	4	100	4	100	15	15	0	45	15	0	0	1	TCPSVT
08/08/13 10:34:09	UNKNOWN	2000:197:11:201:0:1:0:1	50030	2000:199:11:80::105	GERMANY	100	0	0	4	100	4	100	15	15	0	45	15	0	0	1	TCPSVT
08/08/13 10:34:09	UNKNOWN	2000:197:11:201:0:2:0:1	50030	2000:199:11:80::105	GERMANY	100	0	0	4	100	4	100	12	12	0	24	11	0	0	1	TCPSVT

NetView Sysplex Distributor Management Summary

- NetView provides:
  - Quick insights to help you diagnosis problems related to Sysplex Distributor problems
  - Data to help you do capacity planning
  - Sampled, real-time, and historical data
  - Programmable command interface

Questions?

Please fill out your session evaluation

- z/OS Communications Server and NetView for z/OS DVIPA (Dynamic Virtual IP Addressing) Management
- Session # 13547
- QR Code:

For more information

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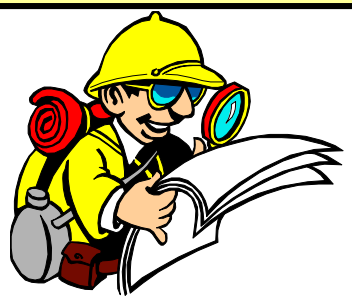
https://www.ibm.com/developerworks/servicemanagement/z/index.html	Service Management Connect: System z community



For pleasant reading ….