



Software Group | Enterprise Networking and Transformation Solutions (ENTS)

z/OS IP Load Balancing Advisor (LBA) for External Load Balancers: Advisor and Agent console Commands Migration and Coexistence

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z/OS Load Balancing Advisor (LBA) - agenda

- **Advisor and Agent console commands**
- **Migration and coexistence**
- **Cisco CSM configuration sample**





Advisor and agent console commands

Notes - starting the advisor and agent

NOTES

```
S LBADV
IEF695I START LBADV WITH JOBNAME LBADV IS ASSIGNED TO USER LBADV
, GROUP SYS1
EZD1231I LBADV STARTING
EZD1232I LBADV INITIALIZATION COMPLETE
EZD1261I LBADV AGENT CONNECTED FROM 10.67.1.10
EZD1263I LBADV LOAD BALANCER CONNECTED FROM 10.67.1.11
```

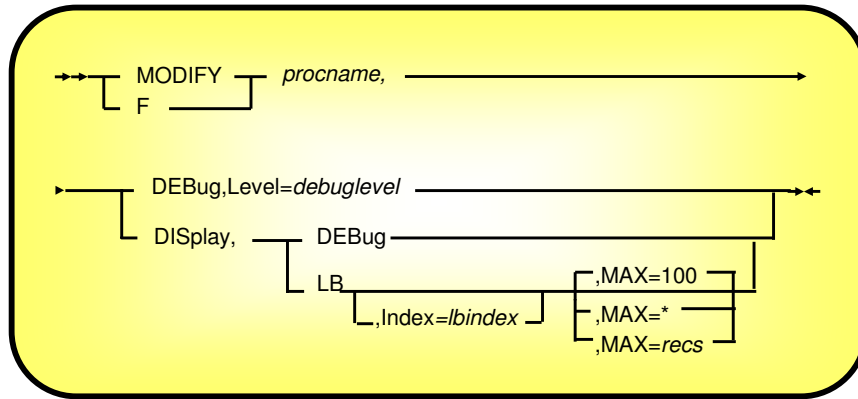
```
S LBAGENT
IEF695I START LBAGENT WITH JOBNAME LBAGENT IS ASSIGNED TO USER LBAGENT
, GROUP SYS1
EZD1231I LBAGENT STARTING
EZD1232I LBAGENT INITIALIZATION COMPLETE
EZD1261I LBADV AGENT CONNECTED FROM 10.67.1.2
EZD1259I LBAGENT CONNECTED TO ADVISOR 10.67.5.1
```

The advisor and agent can be started in any order.
LBADV is an alias of the sample start procedure, EZBLBADV
LBAGENT is an alias of the sample start procedure, EZBLBAGE
This example shows...

- One LB connecting to the advisor from 10.67.1.11
- Two agents connecting to the advisor
 - One remotely from 10.67.1.10
 - One locally from 10.67.1.2

Both the agent and advisor issue messages when they successfully connect to each other
Netstat displays can be used to determine which agents have active connections to the advisor (not shown)

Advisor console command syntax



Advisor console command examples

```
1 F LBADV,DISP,LB
2 EZD1242I LOAD BALANCER SUMMARY
3 LB INDEX      : 00          UUID       : 637FFF175C
4 IPADDR..PORT : 10.42.154.105..50005
5 HEALTH       : 20          FLAGS      : NOCHANGE PUSH TRUST
6 LB INDEX      : 01          UUID       : 207FFF175C
7 IPADDR..PORT : 10.42.154.160..50006
8 HEALTH       : 7F          FLAGS      : PUSH TRUST
9 2 OF 2 RECORDS DISPLAYED

10
11 F LBADV,DISP,LB,I=0
12 EZD1243I LOAD BALANCER DETAILS
13 LB INDEX      : 00          UUID       : 637FFF175C
14 IPADDR..PORT : 10.42.154.105..50005
15 HEALTH       : 20          FLAGS      : NOCHANGE PUSH TRUST
16 GROUP NAME    : SYSTEMFARM
17 GROUP FLAGS   : BASEWLM
18 IPADDR..PORT : 10.42.105.154..0
19 SYSTEM NAME   : MVS209     PROTOCOL   : 000 AVAIL    : YES
20 WLM WEIGHT    : 00021     CS WEIGHT  : 100 NET WEIGHT: 00001
21 FLAGS        :
22 IPADDR..PORT : 10.42.105.60..0
23 SYSTEM NAME   : VIC007     PROTOCOL   : 000 AVAIL    : YES
24 WLM WEIGHT    : 00045     CS WEIGHT  : 100 NET WEIGHT: 00002
25 FLAGS        :
... continued on following page ...
```

Advisor console command examples (*continued*)

... continued from previous page ...

```
26 IPADDR..PORT: 10.42.105.22..0
27 SYSTEM NAME: N/A      PROTOCOL : 000 AVAIL   : NO
28 WLM WEIGHT : 00000    CS WEIGHT : 000 NET WEIGHT: 00000
29 FLAGS      : NOTARGETSYS
30 IPADDR..PORT: 10:1::4:5..0
31 SYSTEM NAME: MVS209   PROTOCOL : 000 AVAIL   : NO
32 WLM WEIGHT : 00021    CS WEIGHT : 000 NET WEIGHT: 00000
33 FLAGS      : NOTARGETIP
34 GROUP NAME  : UDP_SERVER_FARM
35 GROUP FLAGS : SERVERWLM
36 IPADDR..PORT: 10.42.105.154..7777
37 SYSTEM NAME: MVS209   PROTOCOL : UDP AVAIL   : YES
38 WLM WEIGHT : 00021    CS WEIGHT : 100 NET WEIGHT: 00001
39 FLAGS      :
40 IPADDR..PORT: 2001:DB8::10:5:6:2..7777
41 SYSTEM NAME: MVS209   PROTOCOL : UDP AVAIL   : YES
42 WLM WEIGHT : 00021    CS WEIGHT : 100 NET WEIGHT: 00001
43 FLAGS      :
44 IPADDR..PORT: 10.42.105.60..7777
45 SYSTEM NAME: VIC007   PROTOCOL : UDP AVAIL   : YES
46 WLM WEIGHT : 00045    CS WEIGHT : 100 NET WEIGHT: 00002
47 FLAGS      :
48 7 OF 7 RECORDS DISPLAYED
```

Notes - advisor console command examples

NOTES

- **Line 1: Command issued on the advisor system to display all LBs connected to the advisor**
 - ⌋ Two LBs displayed, one starting on line 3 and one on line 6
 - ⌋ Line 3: LB with UID=637FFF175C was assigned an LB Index of '00' by the Advisor
 - ⌋ Line 4: The LB connected from 10.42.154.105, port 50005
 - ⌋ Line 5: Shows information set by the LB
 - 'Health' is assigned by the LB and not used by the z/OS Load Balancing Advisor
 - 'Flags' are set by the LB
 - 'NOCHANGE' indicates the LB is requesting that only new and changed data be sent to it rather than a complete set of data
 - 'PUSH' indicates that the LB requests the Advisor to periodically send it data rather than to have to request it
 - 'TRUST' is not used by the z/OS Load Balancing Advisor
 - ⌋ Line 9: Indicates there are two LBs connected presently

- **Line 11: Command issued on the advisor system to display details about the LB that is assigned the LB Index of '00'**
 - ⌋ Line 16: Shows a group by the name of 'SYSTEMFARM' which this LB registered. This group is a system group as opposed to an application group
 - Line 17: Flags for this group. BASEWLM indicates group is using System WLM recommendations rather than Server-specific WLM recommendations
 - Line 18: Shows the first member of the group which is at 10.42.105.154, port 0
 - Line 19: Details on this member
 - SYSTEM NAME is the MVS name of the system where the member resides
 - PROTOCOL is 0, requirement of a system member
 - AVAIL = YES indicates the member is available for load balancing
 - Line 20: More details on the member
 - WLM returned a system weight of 21 on a scale of 0-64 for system, MVS209. Higher weights mean higher capacity.

Notes - advisor console command example - (Continued)

NOTES

>Line 11: Continued, display details of LB with Index of 00

└Line 16: Continued, Group, SYSTEMFARM

–Line 20: Continued, Member IP =10.42.105.154, Port 0, Protocol 0

- The Agent returned a Comm Server Weight (CS Weight) of 100. For system members, this is always 100.
- The Net Weight that will be sent to the load balancer is 1. This is the relative capacity of the member when compared to the other Net Weights in the group.
- Line 21: Flags for this member. Flags are only displayed if they are on. No flags are on for this member. Possible flags are...
 - LBQ - meaning the load balancer administrator quiesced the member
 - OPQ - meaning the Agent operator quiesced the member
 - NOTARGETSYS - meaning no Agents have reported any information on this member
 - NOTARGETIP - meaning this is an invalid system member
 - NOTARGETAPP - meaning this is an invalid application member
 - NODATA - meaning not enough time has elapsed for the Agent to calculate a CS Weight for the member

–Line 26: Shows the start of the member with IP address 10.42.105.22

- Line 27: AVAIL = NO indicates the member is unavailable
- Line 28: Unavailable members will have a Net Weight of 0
- Line 29: Flag of NOTARGETSYS indicates this member has not been reported by any Agent

–Line 33: Flag of NOTARGETIP indicates this member is not a valid system member. See bullet, "Should NOT contain the following types of addresses" very early in the presentation for types of IP addresses that can cause this

└Line 34: Begin display of the group, UDP_SERVER_FARM

–Line 35: Group Flags = serverwlm indicates server-specific WLM recommendations are used for this group instead of system WLM weights

–Line 36: Port is non-zero (7777) and protocol is non-zero (line 37), so these are application members and not system members

–Lines 36, 40, and 44: Each represents a member. So this group contains three members.

–Lines 37 and 41: Both members are on the same MVS system, MVS209, using the same port, but different addresses. These members represent two applications bound to different addresses.

–Lines 38, 42, 46: Net Weights of 1, 1, and 2, respectively indicate the last member will get 50% of the connections, while the other two will get 25% each.

└Line 48: Indicates 7 members were displayed

Notes - displayed weights

NOTES

➤ Advisor display of members shows three weights

• WLM (WorkLoad Manager) weight

- May be system or server-specific. Group flag will indicate which.
- Range is 0-64.
- Higher value means more capacity and possibly WLM policy goal attainment level

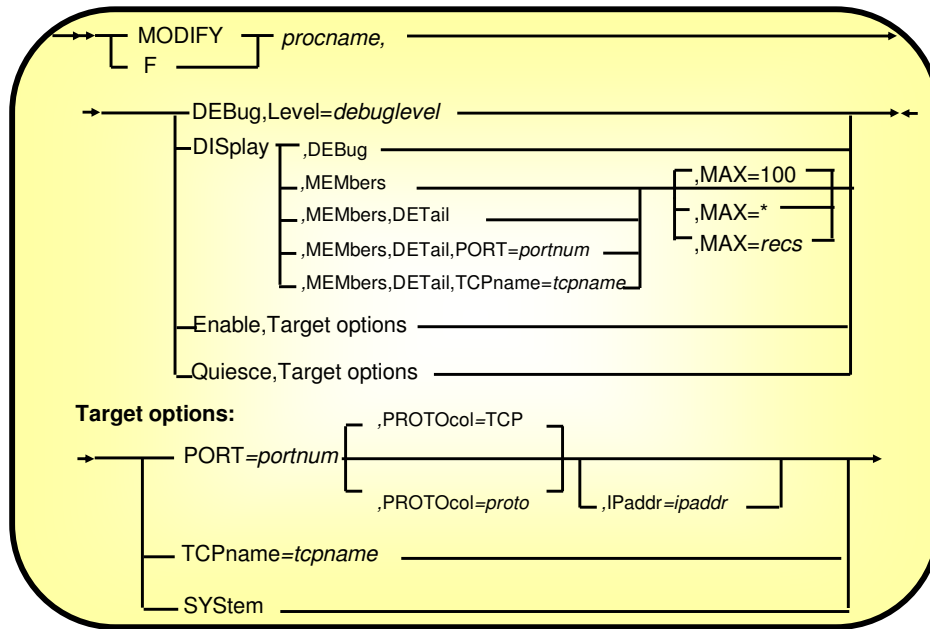
• CS (Comm Server) weight

- Derived by agent and represents the server's health
- Used as a scaling factor to apply to the WLM weight
 - e.g. WLM weight is reduced to 75% of its value if CS weight is 75
- Range is 0-100
- Higher value means healthier server

• Net weight

- Above computation is made and then results are normalized within each group
- If only one available member in group, then result is not normalized
- The only weight that is sent to the load balancer
- Has meaning only within the group. Cannot be compared to members of other groups
- The collective net weights for a group represent the suggested ratios for distributing workload
 - Higher numbers relative to other members in group suggest more workload requests be routed to that member

Agent console command syntax



Agent console command examples

```
1 F LBAGENT,DISP,MEM,DET
2 EZD1245I MEMBER DETAILS
3 LB INDEX      : 00          UUID      : 637FFF175C
4 GROUP NAME    : SYSTEMFARM
5 IPADDR..PORT : 10.42.105.154..0
6 TCFNAME      : TCPCS      MATCHES   : 001  PROTOCOL : 000
7 FLAGS        :
8 JOBNAME      : N/A        ASID       : N/A   RESOURCE : N/A
9 IPADDR..PORT : 10:1::4:5..0
10 TCFNAME     : TCPCS5     MATCHES   : 001  PROTOCOL : 000
11 FLAGS       :
12 JOBNAME     : N/A        ASID       : N/A   RESOURCE : N/A
13 GROUP NAME  : UDP_SERVER_FARM
14 IPADDR..PORT : 10.42.105.154..7777
15 TCFNAME     : TCPCS      MATCHES   : 001  PROTOCOL : UDP
16 FLAGS       : ANY
17 JOBNAME     : TESTD1     ASID       : 0035  RESOURCE : 000000A3
18 IPADDR..PORT : 2001:DB8::10:5:6:2..7777
19 TCFNAME     : TCPCS2     MATCHES   : 001  PROTOCOL : UDP
20 FLAGS       : ANY V6
21 JOBNAME     : TESTD2     ASID       : 002A  RESOURCE : 00000031
22 4 OF 4 RECORDS DISPLAYED
```

Notes - agent console command example

NOTES

- Line 1: Command issued on an Agent system to display details about all of the members owned by this Agent
- ┆ Line 3: This Agent owns at least one member registered by the LB with an Index of 00.
 - Line 4: This Agent owns at least one member in the group, SYSTEMFARM
 - Line 5: This Agent owns the member described on this line. A port of 0 indicates this is a system member.
 - Lines 6, 7, and 8: Contain detailed member information
 - TCPNAME indicates the TCP/IP stack named TCPCS owns the IP address for this member
 - MATCHES is a count of how many applications are listening on this port. Will be greater than 0 only when the member represents a port sharing group
 - PROTOCOL is zero because this is a system member
 - FLAGS is empty because none of the flags are on. Possible values are...
 - -- ANY indicates the target is bound to the unspecified address (0.0.0.0 or ::)
 - -- V6 indicates the target application was bound using the IPV6_V6ONLY socket option
 - -- APPQ indicates the target application is quiesced
 - -- TCPQ indicates the target TCP/IP stack is quiesced
 - -- SYSQ indicates the target system is quiesced
 - JOBNAME, ASID, and RESOURCE are N/A because this is a system member
- Line 13: This agent owns at least one member in the group, UDP_SERVER_FARM
 - Line 14: This Agent owns the member described on this line. A non-zero port indicates this is an application member.
 - Line 16: FLAGS = ANY indicates this application is bound to the unspecified address
 - Line 17:
 - -- JOBNAME = TESTD1 is the jobname the application is running under
 - -- ASID = 0035 is the address space ID the application is running in
 - -- RESOURCE = 000000A3 is the resource ID assigned to the application by the TCP/IP stack
- ┆ Line 22: Indicates 4 members are owned by this Agent

Managing workload distribution

➤ Quiesce/Enable

- ⌋ "Quiesce" removes member from future workload distribution eligibility
- ⌋ "Enable" restores member's eligibility for workload balancing
- ⌋ Only affects workload arriving through external load balancer
- ⌋ Uses:
 - Planned outage of an MVS system, TCP/IP stack, application, or homogeneous group of applications
 - Misbehaving application
- ⌋ Two points of Quiesce/Enable control
 - MVS operator
 - Load balancer administrator
 - Availability may be implementation dependent

Managing workload distribution (*continued*)

➤ **MVS operator Quiesce/Enable**

- ┆ Available as MODIFY command on agents
- ┆ Scope
 - All members owned by the MVS system of the agent
 - All members belonging to a particular TCP/IP stack
 - Port level (i.e. all members sharing a port, or all members using port on multi-stack system)
 - An individual member

➤ **Load balancer administrator Quiesce/Enable**

- ┆ SASP protocol allows for this function. Availability may be implementation dependent
- ┆ Scope
 - Implementation dependent

➤ **MVS operator vs. load balancer administrator Quiesce/Enable interaction**

- ┆ Quiesce by either makes member unavailable for load balancing - no hierarchy
- ┆ Enable by one cannot undo Quiesce by the other

Managing workload distribution (*continued*)

➤ Temporary issues of Quiesce (inheritance)

- ┆ Quiesce at SYSTEM and TCPNAME (stack) levels apply to existing members and any newly registered members that fall within that scope
- ┆ Quiesce at the PORT level will apply to newly registered members only if a member matching the Quiesce criteria currently exists at the time of the command

➤ Rejected Quiesce/Enable commands

- ┆ Whole command is rejected if it fails for a single member

➤ MVS Quiesce/Enable interactions

- ┆ Quiesce/Enable are hierarchical
 - SYSTEM = highest
 - TCPNAME (stack) = middle
 - PORT (member) = lowest
- ┆ Enable must be done at the same level of the most recent Quiesce that affected the member
- ┆ Already quiesced member may only be quiesced at a higher level
 - Corollary: Quiesce will be rejected if any affected member is already quiesced at a higher level
 - Quiesce level is "promoted" to the higher level if accepted

Managing workload distribution *(continued)*

➤ Quiesce/Enable sequences allowed according to scope

• The following table shows which Quiesce and Enable commands are valid if a prior Quiesce command had affected one of the same members

• A "dot" at the intersection of a row and column indicates that the combination is valid

– Example: A 'Quiesce,Tcpname' command is issued which affects member 'A' (middle column). If a subsequent Quiesce or Enable command were issued that also affected member 'A', only the 'Quiesce,System' command (first row) and the 'Enable,Tcpname' command (5th row) would be allowed.

• This table summarizes the rules under "MVS Quiesce/Enable Interactions" bullet on the previous page.

		Prior Command		
		Quiesce,System	Quiesce,Tcpname	Quiesce,Port
Current Command	Quiesce,System		OK	OK
	Quiesce,Tcpname			OK
	Quiesce,Port			
	Enable,System	OK		
	Enable,Tcpname		OK	
	Enable,Port			OK

Notes - operator Quiesce/Enable examples

NOTES

>System 1
 /Stack 1
 -Member 1 : Port=21, @=1.1.1.1
 -Member 3 : Port=80, @=1.1.1.1

>System 1
 /Stack 2
 -Member 2 = Port=21, @=2.2.2.2

Command	Member 1	Member 2	Member 3	Comment
	Enabled	Enabled	Enabled	
Q,Port=21	Quiesced	Quiesced	Enabled	
E,Stack 1	Quiesced	Quiesced	Enabled	Rejected, must be enabled at same (port) level
Q,Stack 1	Quiesced	Quiesced	Quiesced	Member 1 promoted to stack level
Q,Port=21	Quiesced	Quiesced	Quiesced	Rejected, already quiesced at a higher (Mem 1) and same (Mem 2) level
E,Port=21	Quiesced	Quiesced	Quiesced	Rejected, Member 1 quiesced at higher level. Must be enabled at same level
E,Stack 1	Enabled	Quiesced	Enabled	

Common INET considerations

> Advisor

- AUTOLOG on multiple TCP/IP stacks may cause the advisor to start on an unpredictable stack since only one instance may be active in the Sysplex.
- Defining listening sockets/ports
 - If using a unique application-instance DVIPA (recommended), all TCP/IP stacks on that system must code the VIPARANGE statement for that DVIPA
 - Using optional (but not recommended) stack affinity to an application-instance DVIPA instead may be done but can be administratively difficult
 - Both the IPv4 and IPv6 load balancer listening sockets should belong to the same TCP/IP stack to keep administration simple

> Agent

- Address in host_connection statements should be DVIPAs
- If using unique application-instance DVIPAs, same recommendations as advisor
- Optional (but not recommended) stack affinity will restrict workload balancing to that stack. Remainder of stacks on that system will not participate in workload balancing.



Migration and coexistence

Things to think about

➤ z/OS Load Balancing Advisor PTFed back

- / PTFs only support system WLM recommendations
- / PTFs do NOT support server-specific WLM recommendations
- / PTFed back to V1R4, V1R5, and V1R6
 - V1R4 APAR
 - PQ90032
 - V1R5 and V1R6 APAR
 - PQ96293
- / APAR publications doc at...
 - <http://www.ibm.com/support/docview.wss?rs=852&uid=swg27005585>

Things to think about (*continued*)

➤ **Server-specific WLM recommendations**

- / V1R7 supports server-specific WLM recommendations
- / Previous releases use system WLM recommendations exclusively
- / Server-specific vs. system WLM recommendations are determined on a group basis
- / Server-specific WLM recommendations will be used when all of the following are true:
 - Advisor is V1R7
 - All members of a group are owned by V1R7 agents
 - Group only contains application members (vs. system members)
- / Otherwise, system WLM recommendations are used for the group
- / Server-specific WLM will usually result in better workload distribution
 - e.g. HTTP
 - Exception: Servers that serve as access points to applications that run in their own address space (thus use a different WLM service class). Examples:
 - TN3270
 - FTP
 - INETD

➤ **IPv6**

- / If using IPv6 and DVIPA for the advisor-load balancer connection or an advisor-agent connection, movement of the advisor will be limited to those z/OS releases that support IPv6 DVIPAs (V1R6 and higher)

Things to think about (*continued*)

➤ **EWLM**

- A group defined to a load balancer may not contain mix of members managed by EWLM and z/OS Load Balancing Advisor. All Members of a group must be managed by one or other.

➤ **Sysplex Distributor**

- May coexist with z/OS Load Balancing Advisor
- Typically you would not use both methodologies to distribute workload to the same applications

➤ **Swappable vs. non-swappable**

- V1R7 runs non-swappable by default
 - Prior to V1R7, customization is required to run non-swappable
 - See "PPT Entries to Make Non-swappable" (earlier Notes page)
 - When migrating from pre-V1R7 releases, manually added PPT entries should be removed

Notes - Sysplex Distributor and z/OS Load Balancing Advisor coexistence

NOTES

- Sysplex Distributor and z/OS Load Balancing Advisor may coexist within the same Sysplex
- Typically, each would manage workload to disjointed sets of target applications. However, nothing prevents you from using both for the same workload.
 - ┆ Possible scenario: When testing one workload distribution methodology while the other is currently deployed.
 - ┆ Requirements:
 - Target applications must bind to INADDR_ANY instead of the DVIPAs configured for Sysplex Distributor
 - Only Sysplex Distributor should use the target application DVIPAs, that is - do not code the DVIPAs Sysplex Distributor uses in the members defined to the external load balancers.
 - ┆ Coding the distributed DVIPA in a member in a load balancer would result in workload distributed to the distributed DVIPA being redistributed by Sysplex Distributor. This is not recommended.



Cisco CSM configuration sample

Enabling SASP on a Cisco CSM load balancer

➤ **Enabling SASP on an existing CSM configuration is a simple operation. The following changes were required:**

Each load balancer connecting to a z/OS Load Balancing Advisor must have a unique ID. By default, the CSM will have the same ID; therefore, if multiple CSMs are deployed using the same z/OS Load Balancing Advisor, a unique ID needs to be configured for each (see variable `SASP_CSM_UNIQUE_ID`)

```
module ContentSwitchingModule 5
variable ROUTE_UNKNOWN_FLOW_PKTS 1
variable SASP_CSM_UNIQUE_ID Cisco-CSM-6509A
```

The BINDID associates each serverfarm with the configured DFP agent. Each vserver must utilize separate serverfarms in order to register application-specific members; otherwise the CSM will only register system members.

```
serverfarm TN3270
nat server nat client
ZOS bindid 65520
real 9.42.88.9 inservice
real 9.42.88.13 inservice
real 9.42.88.1 inservice
```

The DFP agent is configured with the IP address and listening port of the z/OS Load Balancing Advisor along with the BINDID.

```
dfp agent 9.42.88.217 3860 65520
```



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