z/OS Communications Server Hints and Tips

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Session: 15519
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Agenda

- Stalled TCP Connections
- Unresponsive Name Servers
- EE Verify
- Ctrace Writer
- Shark Attack
- QDIO Inbound Workload Queuing (IWQ)
Stalled TCP Connections
Sending side stall

- Window size of zero
- Repeated retransmission of the same segment
- Send buffer is page fixed CSM dataspace
- When a stall is detected or storage constrained
  - New data added to send buffer is marked page-eligible
- When storage constrained
  - All unsent data on send queues of all TCP connections is marked page-eligible
Receiving side stall

• Application not reading

• Read buffer is page-able CSM dataspace or TCPIP private

• Each packet’s data is mapped by a control block

• When a stall is detected during inbound packet processing
  – Read data is consolidated into large buffers

• When storage constrained
  – All connections are scanned
  – Stale data is consolidated into large buffers
**Basic detection**

**NETSTAT ALL/-A**

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OldQDate: 08/06/2014
OldQTime: 01:01:26

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Enhanced detection

- Traffic Regulation Manager daemon (TRMD) must be active
- Messages written to SYSLOGD

EZZ8662I TRMD TCP receive queue constrained entry logged: 08/06/2014 01:06:41.00, connid= 00000059, jobname= USER662, lipaddr= 9.42.104.77, lport= 1033, ripaddr= 192.168.1.99, rport= 1034, correlator= 4, probeid= 040A0001, sensorhostname=MVSF.tcp.raleigh.ibm.com, trigger= BytesQueued, dataage= 300, bytesqueued= 4096, queueSize= S

EZZ8664I TRMD TCP send queue constrained entry logged: 08/06/2014 01:46:49.17, connid= 00000058, jobname= USER662, lipaddr= 192.168.1.99, lport= 1034, ripaddr= 9.42.104.77, rport= 1033, correlator= 5, probeid= 040A0004, sensorhostname= MVSF.tcp.raleigh.ibm.com, trigger= BytesQueued, dataage= 31, bytesqueued= 4096, queueSize= S
Automated actions

• Policy Agent must be active
• Policy action can reset connections
• TCP_QUEUE_SIZE
  – Connection send and receive queue sizes
• GLOBAL_TCPSTALL
  – 50% of active TCP connections with zero window
  – At least 1000 active TCP connections
TCP_QUEUE_SIZE

- IDSRule
  - IDSAAttackCondition
    - TCP_QUEUE_SIZE
      - Very_Short
      - Short
      - Long
      - Very_Long

- IDSAAction
  - Resetconn
  - Noresetconn
TCP_QUEUE_SIZE example

IDSRule
{
  ConditionType Attack
  Priority 2
  IDSAttackCondition
  {
    AttackType TCP_QUEUE_SIZE
    TcpQueueSize Short
    IDSExclusion
    {
      ExcludedAddrPort 192.168.1.0/24
    }
  }
  IDSAction
  {
    ActionType Attack resetconn
  }
}
GLOBAL_TCP_STALL

- IDSRule
  - IDSAttackCondition
    - GLOBAL_TCPSTALL
  - IDSAction
    - Resetconn
    - Noresetconn
    - IDSReportSet
      - TypeActions Log LogDetail Yes
        - EZZ8673I when connection reset
        - EZZ8674I when connection is not reset
GLOBAL_TCPSTALL example

IDSRule
{
  ConditionType Attack
  Priority 2
  IDSAttackCondition
  {
    AttackType GLOBAL_TCPSTALL
  } 
  IDSAction
  {
    ActionType Attack resetconn
    IDSReportSet
    {
      TypeActions Log LogDetail Yes
    }
  }
}
Intrusion detection and prevention services on z/OS

- **Events detected**
  - Scans
  - Attacks against stack
  - Flooding (both TCP and UDP)

- **Defensive methods**
  - Packet discard
  - Limit connections
  - Reset connections

- **Reporting**
  - Logging
  - Event messages to local console
  - IDS packet trace
  - Notifications to Tivoli NetView and Risk Manager

- **IDS Policy**
  - Samples supplied with z/OS CS Configuration Assistant

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Unresponsive Name Servers
Dealing with unresponsive name servers

- Name server or network outages can introduce long resolver delays
- Default setting for the timeout value is 5 seconds
- Application delays
  - Outbound connections to hostnames
  - Inbound connection logging for reverse lookup
Name resolution delayed

query for `host.raleigh.ibm.com`

TCPIP.DATA

`NSINTERADDR 10.1.1.1 10.1.1.2 10.1.1.3`

z/OS LPAR

Name Server (10.1.1.1)

Name Server (10.1.1.2)

Name Server (10.1.1.3)
Resolver monitors name server queries

- Resolver maintains statistics
  - Queries sent to a name server
  - Instances when the name server did not respond to a query
- Resolver examines previous five-minute aggregate of statistics every minute
  - Compares percentage of failures against an acceptable threshold value
    - If percentage exceeds the acceptable threshold, messages are issued to the console
    - Messages are issued when percentage falls below acceptable level
Enabling Resolver’s monitoring function

- Resolver setup statement defined to specify the acceptable failure rate threshold

  `UNRESPONSIVETHRESHOLD (25)`

  `-UNRESPONSIVETHRESHOLD (percentage)-`

  - The default percentage is 25 (on by default)
  - Value can range from 0-100
    - 0 disables the function
  - Value can be modified dynamically using `MODIFY RESOLVER,REFRESH,SETUP=file_name`
Unresponsive name server detected

- Resolver generates two messages per unresponsive name server at first detection of unresponsive state

  EZZ9308E UNRESPONSIVE NAME SERVER DETECTED AT IP ADDRESS 9.43.25.200
  EZZ9310I NAME SERVER 9.43.25.200
  TOTAL NUMBER OF QUERIES SENT 6000
  TOTAL NUMBER OF FAILURES 2100
  PERCENTAGE 35%

- While a name server remains unresponsive, a new instance of EZZ9310I is issued every five minutes to display recent activity

  EZZ9310I NAME SERVER 9.43.25.200
  TOTAL NUMBER OF QUERIES SENT 3000
  TOTAL NUMBER OF FAILURES 1650
  PERCENTAGE 55%

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Name server becomes responsive

- When the error rate falls below the acceptable threshold for a given five minute window, resolver takes action
  - Clears EZZ9308E from the operator console
  - Issues EZZ9309I to indicate name server is responsive
  - Issues EZZ9310I to display responsiveness
- No activity for a name server over a five minute window causes the name server to be considered responsive

EZZ9309I NAME SERVER IS NOW RESPONSIVE AT IP ADDRESS 9.43.25.200
EZZ9310I NAME SERVER 9.43.25.200
  TOTAL NUMBER OF QUERIES SENT 4500
  TOTAL NUMBER OF FAILURES 675
  PERCENTAGE 15%
Enhanced Resolver autonomies

- Resolver continues to maintain statistics
- Monitor interval is reduced to 30 seconds
- When acceptable threshold is exceeded
  - Stop sending application queries to unresponsive name server
  - Resolver periodically sends DNS polling queries to the name server
  - When DNS polling responses falls below acceptable threshold resume sending application queries
Enabling enhanced Resolver autonomic

- AUTOQUIESCE specifies the action the Resolver takes when an unresponsive name server is detected

- UNRESPONSIVETHRESHOLD(25)-----------------

- Percentage must be specified
- Requires GLOBALTCPIPDATA statement
- Requires RESOLVEVIA UDP
- Value can be modified dynamically using MODIFY RESOLVER,REFRESH,SETUP=file_name
Unresponsive name server detected

- Resolver generates two messages per unresponsive name server at first detection of unresponsive state

EZZ9311E STOPPED USING NAME SERVER AT IP ADDRESS 10.42.35.200
EZZ9313I NAME SERVER 10.42.35.200

- TOTAL NUMBER OF QUERIES SENT: 500
- TOTAL NUMBER OF FAILURES: 500
- TOTAL NUMBER OF RESOLVER POLLS SENT: 0
- TOTAL NUMBER OF POLL FAILURES: 0
- PERCENTAGE: 100%
Name server becomes responsive

- When the error rate in response to probes falls below the acceptable threshold for a given thirty second window, resolver takes action
  - Clears EZZ9311E from the operator console
  - Issues EZZ9312I to indicate name server use is resumed

**EZZ9312I RESUMED USING NAME SERVER AT IP ADDRESS 10.42.35.200**
Health Checker for the autonomic quiescing function

- **CSRES_AUTOQ_GLOBALTCPIPDATA**
  - Checks for the GLOBALTCPIPDATA setup statement if AUTOQUIESCE is coded

- **CSRES_AUTOQ_TIMEOUT**
  - Checks, by default, if you have specified a value greater than five seconds (modifiable) for RESOLVERTIMEOUT when autonomic quiescing is enabled

- **CSRES_AUTOQ_RESOLVEVIA**
  - Checks if you have specified RESOLVEVIA TCP when autonomic quiescing is enabled

- Performed when Resolver is started and when MODIFY RESOLVER,REFRESH command is issued
EE Verify
EE connectivity test command

- Useful in debugging various network problems
- Test an existing Enterprise Extender connection
- Assist in diagnosing why an EE connection cannot be established
- The EE connectivity test will verify:
  - EE line availability
  - Address resolution capability
  - EE partner reachability
  - Tests all five UDP ports reserved for EE
  - When MULTIPATH is enabled in the Enterprise Extender TCP/IP stack, the EE connectivity test is repeated for each valid TCP/IP interface which routes EE traffic
IPv4 EE connection is established from HostA to HostB, but HPR performance is poor.

When MULTIPATH is configured, the connectivity test will verify all computed routes from HostA to HostB.
EE connectivity test example...

D NET,EEDIAG,TEST=YES,IPADDR=(9.67.1.1,9.67.1.6),LIST=DETAIL

IST097I DISPLAY ACCEPTED
IST350I DISPLAY TYPE = EEDIAG
IST2119I ENTERPRISE EXTENDER DISPLAY CORRELATOR: EE00000E
IST2067I EEDIAG DISPLAY ISSUED ON 10/04/05 AT 11:05:50
IST1680I LOCAL IP ADDRESS 9.67.1.1
IST1680I REMOTE IP ADDRESS 9.67.1.6
IST2023I CONNECTED TO LINE LN11
IST2126I CONNECTIVITY TEST IN PROGRESS
IST314I END
EE connectivity test example ...
EE connectivity test example...

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<td></td>
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<td>5 9.67.1.6</td>
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IST924I CONNECTIVITY TEST INFORMATION DISPLAYED FOR 2 INTERFACES

IST314I END
EE connectivity test considerations

- Expects ICMP messages from intermediate hops
- Firewalls may be configured to block ICMP messages
  - Intermediate hops past firewall will appear as unresponsive
  - Final destination reachability can still be determined
- Firewalls may be configured to block UDP traffic
- Firewalls must allow UDP traffic on EE UDP ports 12000-12004 (both directions)
- EE Test probe "responder" support
  - Support available for CS/Windows, CS/AIX, CS/Linux, PComm, & Cisco SNASw
Firewalls blocking ICMPs

- z/OS Host A
- Router
- Firewall
- Router
- Firewall
- Router
- z/OS Host B

- Probe(TTL=1)
- ICMP Time Exceeded
- Probe(TTL=2)
- **Timeout/Retries**
- Probe(TTL=3)
- **Timeout/Retries**
- Probe(TTL=4)
- **Timeout/Retries**
- ICMP Time Exceeded
- Probe Reply (UDP)

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Firewall-Friendly EE connectivity test

- The TTL is set to the maximum hop limit
- Intermediate hop analysis is not possible
Firewalls blocking ICMPs

- z/OS Host A
- Router
- Firewall
  - ICMP
- Router
  - ICMP
- Firewall
- Router
- z/OS Host B

Probe(TTL=255) → Probe Reply (UDP)
EE health verification

• The EE Health Verification function will verify the health of a potential EE connection by sending a probe to the remote partner using all five ports during the connection activation
  – VTAM does not activate the EE connection if the remote partner is not reachable on all ports
  – However, if the remote partner does not support the probe, VTAM will still bring up the EE connection

• EE Health Verification will also optionally verify the health of an active EE connection by sending a probe to the remote partner on all five ports at a user-specified interval
  – VTAM issues a warning message if the remote partner is not reachable on all ports, but will keep the connection active
EE health verification …

- EE Health Verification is enabled by the EEVERIFY start option

  ```
  ___EEVERIFY=_ ACTIVATE ______________
  >>___|________________________________|
  |___EEVERIFY=_ NEVER_______________|
  | ___ACTIVATE______________|
  | ___time_interval_value_|
  ```

- Or the EEVERIFY GROUP/PU parameter

  ```
  >>______________ ____________________ ____________ |<
  |___EEVERIFY=_ NEVER_______________|
  | ___ACTIVATE______________|
  | ___time_interval_value_|
EE health verification …

- When health verification fails for an active connection
  - VTAM issues highlighted warning message IST2323E if it is not already present
  - IST2323E remains on the console until the condition is cleared or the message is erased by the operator
- VTAM display EE,LIST=VERIFY is used to determine which connection(s) have failed verification
- Displaying an individual EE connection shows the success or failure of EE Health Verification
- The EEDIAG,TEST=YES command can be used to further diagnose the cause of the failure
EE health verification ...

IST2323E EE HEALTH VERIFICATION FAILED ON ONE OR MORE CONNECTIONS

d net,ee,list=eeverify
IST097I DISPLAY ACCEPTED
IST350I DISPLAY TYPE = EE
IST2000I ENTERPRISE EXTENDER GENERAL INFORMATION
IST1685I TCP/IP JOB NAME = TCPCS
IST2003I ENTERPRISE EXTENDER XCA MAJOR NODE NAME = XCAIP
...
IST924I -------------------------------------------------------------

IST2324I EE HEALTH VERIFICATION: FAILED CONNECTION INFORMATION
IST2325I LINE LNIP1 PU SWIP2A1 ON 12/21/09 AT 15:56:39
IST2326I EE HEALTH VERIFICATION TOTAL CONNECTION FAILURES = 1
IST2017I TOTAL RTP PIPES = 1 LU-LU SESSIONS = 2
IST2018I TOTAL ACTIVE PREDEFINED EE CONNECTIONS = 1
IST2019I TOTAL ACTIVE LOCAL VRN EE CONNECTIONS = 0
IST2020I TOTAL ACTIVE GLOBAL VRN EE CONNECTIONS = 0
IST2021I TOTAL ACTIVE EE CONNECTIONS = 1
IST314I END
EE health verification ...

d net,ee,id=SWIP2A1
IST097I DISPLAY ACCEPTED
IST350I DISPLAY TYPE = EE
IST2001I ENTERPRISE EXTENDER CONNECTION INFORMATION
IST075I NAME = SWIP2A1, TYPE = PU_T2.1
IST1680I LOCAL IP ADDRESS 9.67.1.1
IST1680I REMOTE IP ADDRESS 9.67.1.2
IST2022I EE CONNECTION ACTIVATED ON 12/21/09 AT 16:21:57
IST2114I LIVETIME: INITIAL = 10 MAXIMUM = 0 CURRENT = 10
IST2023I CONNECTED TO LINE LNIP1
IST2327I EE HEALTH VERIFICATION OPTION - EEVERIFY = 2 MINUTES
IST2329I EE HEALTH VERIFICATION SUCCESSFUL ON 12/21/09 AT 16:37:21
IST2341I EE HEALTH VERIFICATION HAS NEVER FAILED FOR THIS CONNECTION
IST2025I LDLC SIGNALS RETRANSMITTED AT LEAST ONE TIME = 0
IST2026I LDLC SIGNALS RETRANSMITTED SRQRETRY TIMES = 0
... IST314I END
CTRACE Writer
CTRACE writer best practices

- Enable striping of data
  - VSAM linear dataset
  - Extended-Format sequential datasets
    - Specify EXTENDED for the DSNTYPE value in the data class
- Multiple sequential dataset
  - TRCOUTnn DD statements where nn is 01-16
  - Do not specify DCB parameters
  - Specify CONTIG on SPACE parameter
- Ensure dispatching priority is equal to or higher than work being traced
VSAM linear dataset

//DEFINE EXEC PGM=IDCAMS
//SYSPRINT DD SYSOUT=*  
//SYSIN DD *

DELETE +
 (hlq.CTRACE.LINEAR) +
 CLUSTER

DEFINE +
 CLUSTER( +
 NAME (hlq.CTRACE.LINEAR) +
 LINEAR +
 MEGABYTES (10) +
 VOLUME (CPDLB0) +
 CONTROLINTERVALSIZE (32768) +
 ) +
 DATA( +
 NAME (hlq.CTRACE.DATA) +
 )
Multiple sequential datasets

//IEFPROC EXEC PGM=ITTTRCWR, REGION=32M
//TRCOUT01 DD DSN=SYS1.CTRACE1, VOL=SER=TRACE1, UNIT=DASD,
  //   SPACE=(CYL,10), DISP=(NEW, KEEP), DSORG=PS
//TRCOUT02 DD DSN=SYS1.CTRACE2, VOL=SER=TRACE2, UNIT=DASD,
  //   SPACE=(CYL,10), DISP=(NEW, KEEP), DSORG=PS
//TRCOUT03 DD DSN=SYS1.CTRACE3, VOL=SER=TRACE3, UNIT=DASD,
  //   SPACE=(CYL,10), DISP=(NEW, KEEP), DSORG=PS
COPYTRC

- Use the IPCS COPYTRC command to copy trace records to a sequential dataset
  - VSAM linear dataset
  - Multiple sequential datasets

COPYTRC TYPE(CTRACE) IDS(dslist) ODS(dsname) SPACE(pppp,ssss)

COPYTRC TYPE(CTRACE) INFILE(ddlist) OUTFILE(ddlist)
Shark Attack
A different way to look at network traces

- IPCS packet trace format utility provides a method to convert the trace into a format that can be viewed by Wireshark
- Wireshark is a freeware network protocol analyzer for Unix and Windows
  - Graphical interface
  - Protocol formatting
  - Protocol analysis
  - Throughput graphing
- Makes packet trace consumable by network performance teams
Converting a packet trace

• Allocate an output dataset
  Logical record length must be larger than the MTU size to accommodate pseudo Ethernet headers.

  TSO ALLOC F(SNIFFER) DATASET('userid.sniffer.CAP') LRECL(1600) RECFM(VB) REUSE TRACK SPACE(15 15)

• Convert the trace in IPCS

  IP CTRACE COMP(SYSTCPDA) SUB((tcpip)) SHORT OPTIONS((SNIFFER NOREASSEMBLY STATS))

• FTP the output dataset in BINARY mode to your PC
Command output

COMPONENT TRACE SHORT FORMAT
COMP (SYSTCPDA) SUBNAME ((TCPIP))
OPTIONS ((SNIFFER NOREASSEMBLY STATS))
z/OS TCP/IP Packet Trace Formatter, Copyright IBM Corp. 2000, 2013; 2013.016
DSNAME ('D74L.H055914A.TCPIP.PKT')
PTRPT04I SNIFFER(ETHERNET) option selected
.
.
.
Sniffer Report
  1,740 records written to X370812.SNIFFER.CAP
  203,683 bytes written
    0 packets were abbreviated
    200 is the maximum data size
    400 packets were truncated from 200 bytes
QDIO Inbound Workload Queuing (IWQ)
What is IWQ

• z/OS Communications Server and OSA Express feature establish a primary input queue and one or more ancillary input queues (AIQ)
• Primary input queue (exists without IWQ) delivers all packets not routed to an AIQ
• AIQs are created for different traffic types
  – Streaming
  – Enterprise Extender
  – Sysplex Distributor
TRLE datapaths

- Each input queue requires a TRLE datapath
- Input queues are unique for IPv4 and IPv6
- OSAENTATA trace requires an input queue
- 9 datapaths required to support IWQ for IPv4 and IPv6 with a datapath available for OSAENTATA

```
OSAQ1 | TRLE | LNCTL=MPC,
      |      | READ=(2D00),
      |      | WRITE=(2D01),
      |      | MPCLEVEL=QDIO,
      |      | DATAPATH=(2D02-2D0A),
      |      | PORTNAME=(OSAQDIO1,0)
```
INTERFACE statement

- IPAQENET or IPAQENET6
  - INBPERF DYNAMIC WORKLOADQ
  - VMAC

- READSTORAGE
  - GLOBAL (default)
    - QDIOSTG VTAM start option value
  - MAX – 4M
  - AVG – 2M
  - MIN – 1M
Storage requirements

• QDIOSTG=???
  – MAX – 4M
  – AVG – 2M
  – MIN – 1M
  – nnn – Number of SBALs
    • Range is 3-126
    • Each SBAL is 64K
    • Maximum of ~8M

• Storage requirement is per active data path
• CMS FIXED dataspace
**CSM Fixed limit**

- Consider increasing the CSM Fixed limit
- **SYS1.PARMLIB(IVTPRMxx)**
  - FIXED MAX nnnK | nnnM
    - 1024K to 30720M
- Can be dynamically modified
  - F vtamproc,CSM,FIXED=value

- One OSA with all 9 datapaths active and 126 SBALs requires
  ~72M of CSM fixed storage
## For more information

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