Rule WLM601: XCF transport class may need to be split

Finding: CPExpert has determined that a large percent of the cross system coupling facility (XCF) messages were smaller than the buffer size defined for the transport class, while a significant percent of the messages were too large. Consequently, CPExpert believes that you should consider splitting the transport class.

Impact: This finding can have a LOW IMPACT or MEDIUM IMPACT on the signalling performance of the sysplex.

Logic flow: This a basic finding. There are no predecessor rules.

Discussion: The XCF component of MVS/ESA allows authorized programs on one MVS system in a sysplex to communicate with programs on the same system or with programs on other systems. A typical example of this communication is between CICS regions; CICS regions often communicate with other CICS regions in the same system or with CICS regions on other systems in the sysplex.

Within the XCF terminology, authorized programs are termed *XCF members*, and the XCF members are logically a part of specific *XCF Groups*. For example, CICS regions are considered XCF members, and the regions are logically associated with the **DFHIR000** XCF Group. RMF is logically associated with the **SYSRMF** XCF Group, the MVS Workload Manager is associated with the **SYSWLM** XCF Group, etc. One purpose of associating members with XCF groups is to facilitate system management control for similar applications.

XCF group members communicate with each other using the XCF *signalling* mechanism. The communication is done via signalling paths consisting of ESCON channels operating in channel-to-channel (CTC) mode, a coupling facility list structure (beginning with MVS/ESA Version 5), or 3088 Multisystem Channel Communication Unit. Messages are sent over the signalling paths, and the paths have one or more buffers associated with them to hold the messages as they are sent or received.

Different XCF groups have different signalling characteristics and different signalling performance requirements.

- For example, the Workload Manager group (SYSWLM) sends a message approximately every 10 seconds. The message is 300 bytes * the

number of service class periods with a response time or velocity goal. For a typical installation, this message might be less than 5,000 bytes. Although it is *desirable* that the Workload Manager have up-do-date information, it is not *critical* that the SYSWLM message be received at once.

- On the other hand, global resource serialization (GRS) sends such messages as the RSA-message to provide information about the serialization of global resources. The RSA-message can be sent frequently, and can be up to 32K bytes of data. It is critical to the performance of applications that the GRS message be received at once.

Optimal signalling performance requires that XCF groups have access to adequate signalling resources. These resources consist of signalling paths and buffers. Since different XCF groups have different signalling requirements, performance usually is improved if signalling resources are assigned to the XCF groups based on their requirements.

A *transport class* is the mechanism used by MVS to allow resources to be assigned to XCF groups. Resources (signalling paths, buffers, etc.) are assigned to one or more transport classes, and XCF groups are assigned to the transport classes. Thus, resources can be made available to the XCF groups as they are needed.

A particular MVS system has limited resources, and not all XCF groups require the same amount of resources. Consequently, one performance tuning consideration is the balance between (1) the resources available, (2) the resources required by different XCF groups, and (3) the value (or importance) to the installation of the various XCF group members.

The two major transport class resources to be tuned are (1) the message buffers assigned to transport classes and (2) the number of signalling paths assigned to transport classes.

The following discussion relates to the *message buffers*. Other rules in the WLM600(series) relate to the signalling paths.

Message buffers are assigned to transport classes[1] in two ways: (1) the basic assignment to the transport class via the CLASSLEN and MAXMSG parameters on the CLASSDEF statement and (2) the MAXMSG parameter on the PATHOUT statement.

[1]Message buffers are assigned to transport classes only for **outbound** traffic since only outbound traffic can be separated into transport classes. Inbound traffic cannot be separated by transport classes; buffers are assigned to inbound traffic based on the total buffer space defined on the PATHIN statement.

- The CLASSLEN parameter defines the message length for the transport class. MVS allocates *fixed-length buffers* at the size specified in the CLASSLEN parameter for the transport class.

  If no CLASSLEN parameter is specified, MVS uses the value of the CLASSLEN parameter specified on the COUPLE statement (with a default value of 956 bytes).

  The message length specified by the CLASSLEN parameter should be large enough to accommodate most messages, but not so large as to waste storage. Selecting the correct buffer length is a tradeoff between (1) overhead incurred by having buffers too small, (2) wasted storage incurred by having buffers too large, and (3) the performance implications of mixing large and small messages in the same transport class.

  - If the fixed-length buffers are too small to hold a message, MVS acquires additional buffers to accommodate the message. Increased system overhead is caused when MVS must acquire additional buffers.

    In order to minimize this overhead, MVS may dynamically increase the length of the buffers if (1) the number of over-sized messages message traffic warrants the increase and (2) the increase in buffer length would not exceed the maximum buffer space specified on the receiving system.

  - If the buffers are too large for a message, the unused storage remaining in the buffer is wasted. This is an inefficient use of storage. Additionally, MVS could exhaust the supply of buffer space associated with a transport class if the space is wasted by specifying a buffer length that is too large for most messages. In the later case, XCF messages would be rejected if the supply of buffer space is exhausted.

  - If large and small messages are mixed in the same transport class, the small messages tend to be delayed simply because the large messages take longer to process.

- The MAXMSG parameter defines the amount of message buffer space allocated for messages sent in the transport class. The MAXMSG parameter can be specified on the PATHOUT or PATHIN statements, or on the CLASSDEF statement.

  If no MAXMSG value is specified for the paths associated with a transport class or for the CLASSDEF statement, MVS uses the value of

the MAXMSG parameter specified on the COUPLE statement (with a default of 750K bytes of buffer space).

SMF Type 74 (Subtype 2) records provide statistics about the number of messages sent by XCF groups in a transport class, where the messages are sent, how many messages were too small for the defined buffer size, how many messages fit the defined buffer size, how many messages were too big for the defined buffer size, and how many messages were over the message length for which XCF was optimized.

CPExpert analyzes this information to determine whether the correct buffer allocation has been defined. CPExpert computes the total outbound message traffic for a transport class. CPExpert concludes that the message length specified for the transport class is inappropriate under the following conditions:

- Less than 10% of the messages **fit** the buffer length specified for the transport class. This situation, by itself, is not serious, since message lengths may be only a small amount less than the allocated buffer space.

- More than half of the messages were **smaller** than the buffer length specified for the transport class.

- A significant percent of the messages were **larger** than the buffer length specified for the transport class. This situation generates additional overhead, since MVS must either prepare additional buffer space or send additional signals to deliver the oversized messages.

  The value considered a "significant percent" of the large messages is controlled by the **PCTBIG** guidance variable. Please refer to Section 2 of this document for a discussion of the PCTBIG guidance variable.

- Additionally, CPExpert applies a "reality check" by ensuring that a reasonable number of messages were sent in the transport class.

When the above conditions are met, CPExpert produces Rule WLM601 to alert you that there is a mismatch between the buffer length specified for the transport class and the lengths of messages sent in the transport class.

The following example illustrates the output from Rule WLM601:

```
RULE WLM601: TRANSPORT CLASS MAY NEED TO BE SPLIT

   You should consider whether the DEFAULT transport class should be split.
   A large percentage of the messages were too small, while a significant
   percentage of messages were too large.  Storage is wasted when buffers
   are used by messages that are too small, while unnecessary overhead is
   incurred when XCF must expand the buffers to fit a message. The CLASSLEN
   parameter establishes the size of each message buffer, and the CLASSLEN
   parameter was specified as 16,316 for this transport class.
   This finding applies to the following RMF measurement intervals:

                           SENT    SMALL     MESSAGES   MESSAGES    TOTAL
   MEASUREMENT INTERVAL     TO    MESSAGES   THAT FIT   TOO  BIG  MESSAGES
   10:00-10:30,26MAR1996   JA0     4,296          0         57      4,353
   12:00-12:30,26MAR1996    Z0     2,653          6        762      3,421
   12:30-13:00,26MAR1996    Z0     2,017          0        109      2,126
   13:00-13:30,26MAR1996    Z0     2,543          2        180      2,743
```

Suggestion: If Rule WLM601 is regularly produced, CPExpert suggests that you consider the following alternatives[2]:

- You should evaluate the message length specified for the transport class and the message lengths of the XCF groups assigned to the transport class. You should consider "splitting" the transport class into two transport classes. Each transport class should have buffer lengths defined (using the CLASSLEN parameter) such that most of the outbound messages fit the buffer lengths defined for their respective transport classes.

  With z/OS Version 1 Release 2 (V1R2), Message IXC344I has been changed to provide more insight into the requirements of transport classes. In response to a DISPLAY XCF,CLASSDEF command, Message IXC344I displays detailed data for specific transport classes. With z/OS V1R2, the message has been enhanced to provide counts of messages sent at **each different signal size that was used**. By examining the count of messages sent at the appropriate signal size, you can determine whether the transport class should be split, and what the new sizes should be.

  If most of the outbound messages do not fit the buffer lengths, it normally is better for the buffer lengths to be slightly larger than the outbound messages. A small amount of wasted storage usually has less performance impact than the unnecessary overhead caused by messages being larger than the buffer length.

[2]**WARNING**: There exists little practical experience with analyzing coupling facility data and with selecting proper values for the controlling parameters. The CPExpert analysis and suggestions are based on (1) the information contained in the referenced documents and (2) our analysis of data provided by IBM or CPExpert users. Please keep this paucity of knowledge in mind when considering the alternatives. Additionally, **please** provide Computer Management Sciences with feedback!

A major disadvantage of this approach is that signalling paths are associated with transport classes. If you "split" the transport class, you must either (1) divide the signalling paths between the new transport classes or (2) acquire additional signalling paths.

- The performance impact of having to split the signalling paths into two transport classes may outweigh the performance impact of having a mismatch between message length and buffer length.

- You may be unable to acquire additional signalling paths. However, you may find that excess signalling paths may have been assigned to **other** transport classes, and simply reassigning the signalling paths may be an acceptable alternative.

- You should evaluate whether the XCF groups are properly assigned to transport classes. XCF groups are assigned to transport classes via the GROUP parameter on the CLASSDEF statement.

  - XCF groups can be assigned to more than one transport class. When evaluating which transport class to use (when XCF groups are assigned to more than one transport class) XCF will select the transport class with the smallest buffer that will hold the message being sent. You potentially can "optimize" the buffer space used by assigning XCF groups to more than one transport class.

    All groups assigned to a transport class have equal access to the signalling resources of that class. Consequently, you should make sure that you do not assign "low priority" groups to transport classes that have high performance requirements if the "low priority" groups could cause performance degradation to the "high priority" groups.

    Fortunately, SMF Type 74 (Subtype 2) records contain information about the XCF groups and XCF members, including the number of signals sent and received by each member. This information is in the **Member Data Section** of the Type 74 records, and can be analyzed to assess the impact of message traffic of the XCF members and XCF groups.

  - Alternatively, it may be preferable to reassign XCF groups to transport classes. In practice, this situation is unlikely to occur as most installations will have a relatively small number of transport classes.

- You can adjust CPExpert's analysis by altering the value specified for the **PCTBIG** guidance variable in USOURCE(WLMGUIDE). The default value for PCTBIG is intended to cause Rule WLM601 to be produced

when more than a modest number of the messages cause MVS to incur unnecessary overhead for over-sized messages.

- If Rule WLM601 occurs frequently and there is no action you wish take, you can exclude the transport class from CPExpert's analysis, using the **EXCLASSn** guidance variables. The EXCLASSn guidance variables allow you to exclude one or more transport classes from analysis.

Reference: MVS/ESA: Setting Up a Sysplex (GC28-1449)
Section 5: Planning Signalling Services in a Sysplex

MVS/ESA: Initialization and Tuning Reference (GC28-1452)
COUPLExx (Cross-System Coupling Facility Parameters)

OS/390: Setting Up a Sysplex (GC28-1779)
Section 5: Planning Signalling Services in a Sysplex

OS/390: Initialization and Tuning Reference (GC28-1752)
COUPLExx (Cross-System Coupling Facility Parameters)

z/OS: Setting Up a Sysplex (SA22-7625)
Section 5: Planning Signalling Services in a Sysplex

z/OS: Initialization and Tuning Reference (SA22-7592)
COUPLExx (Cross-System Coupling Facility Parameters)

"Parallel Sysplex Performance: tuning tips and techniques,"
Kelley, Joan (IBM, Poughkeepsie, NY), SHARE 86, February 1996.

z/OS V1R2: MVS System Messages, Volume 10 (IXP-IZP), SA22-7640

z/OS V1R3: MVS System Messages, Volume 10 (IXP-IZP), SA22-7640

z/OS V1R4: MVS System Messages, Volume 10 (IXP-IZP), SA22-7640 |