

---

**Rule WLM356: Device PEND time was a major cause of DASD I/O delay**

---

**Finding:** CPEXpert has determined that device PEND time was a major cause of delay in DASD response for the I/O operations of the service class.

This finding applies only to MVS versions prior to OS/390 Release 3, and to MVS versions with OS/390 Release 3 if I/O Priority Management has **not** been specified.

**Impact:** This finding may have a MEDIUM IMPACT or HIGH IMPACT on the performance of the service class.

**Logic flow:** The following rules cause this rule to be invoked:

Rule WLM350: I/O activity may have caused significant delays

Rule WLM351: I/O activity may have caused significant delays

Rule WLM352: I/O activity may have caused significant delays for server service class

Rule WLM353: I/O activity may have caused significant delays for server service class

**Discussion:** PEND time is the time from the issuance of the StartSubChannel (SSCH) instruction until the device is selected by the control unit and physical positioning commands (such as seek and set sector, or define extent) are transferred to the device.

With modern fixed block architecture (FBA) devices, the PEND time ends when the physical positioning commands are presented to the *logical volume control block* within the control unit. The PEND time is caused by queuing for the path (wait for channel, wait for director port, wait for control unit, or wait for device, or wait for “other” reasons)<sup>1</sup>.

PEND is measured by the channel subsystem. After IOS issues the Start Subchannel command, the channel subsystem may not be able to initiate the I/O operation if any path or device busy condition is encountered:

---

<sup>1</sup>PEND time is significantly reduced with FICON channels. FICON channels can have multiple I/O operations concurrently active, which reduces the potential PEND time caused by channel busy. There is no port busy time with FICON switches, and control unit time is significantly reduced. This statement regarding PEND time is not necessarily correct if a large number (more than 5) I/O operations are concurrently executing on a FICON channel. Dr. H. Pat Artis and Mr. Robert Ross have presented the results of research indicating that performance can degrade significantly when more than 5 I/O operations (Open Exchanges) are concurrently active on a FICON channel (see “Understanding FICON Channel Path Metrics” at [www.perfassoc.com](http://www.perfassoc.com)).

---

C The channel selected for the I/O operation could be busy with another I/O operation from another system image in the same CEC.

C The director port could be busy with another I/O operation<sup>2</sup>.

C The control unit could be busy with another I/O operation from another system.

C The device could busy with I/O from another system.

There can be “other” PEND time not reflected in the above descriptions. For many systems, “other” PEND time is zero or very small. For some systems, the “other” PEND time is dramatically large (often, 75% or more of the average response time).

One possible cause of the “other” PEND time is PEND for channel busy. If all channels between the MVS image and the device are busy, the channel subsystem must wait until a channel becomes available. This wait for channel is reflected in PEND time. Depending on the number of MVS images using the channels to the device, channel activity could be high. This activity could (and often would) be caused by activity to other logical volumes, rather than the device exhibiting poor performance.

At present, there is only conjecture<sup>3</sup> about additional cause of this “other” PEND time. Perhaps either IBM will better describe this “other” PEND time in future, or perhaps research will reveal likely causes of the “other” PEND time.

PEND time can be significant with shared systems. If one system does an I/O request to a device while the storage subsystem is already processing an I/O to that device that came from another system, then the storage subsystem will send back a *device busy* indication, resulting in PEND time. This delays the new request and adds to processor and channel overhead.

The following example illustrates the output from Rule WLM356:

---

<sup>2</sup>Director port busy can occur only on an ESCON channel. The use of buffer credits on a FICON native channel eliminates director port busy.

<sup>3</sup>According to MXG (ADOC74 comments), Dr. H. Pat Artis believes that the “other” PEND is often the internal response time of the subsystem, i.e., the time it takes the subsystem to accept, validate, and acknowledge the first Channel Control Word (CCS) of the channel program.

---

**RULE WLM356: DEVICE PEND TIME WAS A MAJOR CAUSE OF DASD DELAYS**

A major part of the potential I/O delay to the ST\_USER Service Class could be attributed to device pending (PEND) time. Pending time is caused by queuing for the path (wait for channel, wait for control unit or wait for head-of-string). The queuing can be caused by other systems sharing the device (wait for device). Large PEND times for devices that are not shared may mean that there are insufficient paths available to the device. Please refer to the WLM Component User Manual for advice on how to minimize device PEND time.