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Welcome to the Winter 2015/2016 issue of Enterprise Tech Journal!



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FICON CUP Diagnostics and the z/OS Health Checker

By David J. Lytle

As z Systems environments have grown, and configurations become more complex, FICON fabric issues can result in unacceptable I/O service times.

Resource Management Facility (RMF) device activity reports might show average service times higher than normal, while matching I/O queuing reports show abnormally high “initial command response” times on a subset of the paths to a device. In fact, it has been very problematic to identify a single root cause for these issues or where in the I/O fabric a problem might have originated.

This article will explore the CUP function, how it works, why some fabric issues cannot be identified and a solution that will enable you to more easily identify an issue.

Introduction

The well-known CUP function allows a z/OS system to communicate with the FICON Director through standard channel program protocols. This includes control functions like blocking and unblocking ports, performance monitoring and error reporting functions.

The CUP device is implemented as a standard device control unit via firmware implementation on a Brocade switch that then allows a z/OS system to issue appropriate channel program channel command word (CCW) commands to it. The CUP device is defined in the I/O configuration as a switch device and is brought online to z/OS. The

control unit definition for the CUP device consists of one or more channel paths attached to the switch with the reserved port address destination of 0xFE, which is defined by the FICON architecture as the address of the control unit port (CUP). Therefore, I/O requests routed to this destination port are directed to the CUP.

FICON CUP is a direct architectural descendant of the CUP that ran on ESCON Directors. The IBM 9032-5 ESCON Directors had an in-band management capability that utilized an embedded port in the control processing cards to provide a communications path to an MVS console. This was used for three primary purposes:

- Reporting hardware (FRU) errors up to MVS (helpdesk)
- Allowing and prohibiting ports (the world’s first “zoning” mechanism) by using Prohibit Dynamic Connectivity Mask (PDCM)
- Basic performance monitoring.

When switched FICON was being introduced, IBM wanted to make certain its mainframe customers would have a consistent management look and feel between ESCON and FICON, so CUP was carried forward to FICON.

Today, FICON CUP support is provided by all mainframe storage and SAN vendors, but the customer must implement the optional

CUP license (i.e., Brocade's FMS license) to make it functional on their FICON switches and/or directors. Today's more advanced CUP is still used for those three primary functions listed above but has been enhanced to also provide RMF reporting for the FICON switching devices and to be used to help implement FICON Dynamic Channel Path Management (DCM).

CUP's Use by Resource Measurement Facility (RMF)

RMF provides online, interactive performance monitoring and long-term overview reporting with post-processor reports. Some RMF reports that can assist in analysis of fabric problems are:

- Channel path activity report
- Device activity report
- I/O queueing activity report
- FICON Director activity report
- Enterprise Disk Systems (ESS) Link Statistics report.

However, RMF is not so effective at helping a user troubleshoot problems such as fabric congestion, device congestion, bad cables, failing optics or field replaceable unit (FRU) problems in a switched fabric. What is really needed is broader architecture that defines a richer set of data that can be supplied from fabric components to z System components. That can be accomplished through a tighter integration of the CUP on switching devices and enhanced host-based management programs.

Host-based management programs can manage FICON switches by sending CCW commands to the switch control unit defined in the I/O Configuration Data Set (IOCDS) and hardware configuration definition (HCD). A FICON switching device (i.e., FICON Director-class or fixed configuration switch) that supports a CUP can be controlled by one or more host-based management programs or switch consoles. Control of the FICON

switches can be shared between these options. CUP commands, which are channel command words (CCWs), monitor and control FICON switch functions. There are 42 CUP commands, or CCWs, for monitoring and control of FICON switch device functions. The CUP commands have generally been oriented toward management of a single switch even though the use of a CUP in a cascaded FICON environment is fully supported.

It has become very apparent over time that as fabrics become more complex, it is essential they become proactively monitored by a z System. Although very mature and robust by most standards, there are a few challenges in the way z/OS has traditionally defined and worked with fabrics. For example, the z/OS IOCDS definitions include F_Ports, relative to control units and devices, but there are no definitions for ISLs, routing topologies or distance extension facilities. Subsequently, these fabric components are essentially invisible to z/OS, and z/OS can do nothing to react to specific problems in the fabric. Rather, z/OS just suffers performance degradations and reliability exposures until the problems manifest in a secondary manner, such as a serious degradation of I/O performance or reliability, that it is capable of detecting. The Brocade CUP Diagnostics is a facility that enables the Control Unit Port to notify the z/OS Health Checker host management program about fabric events while also supporting subsequent queries by the host to provide detailed information about its fabric topologies (i.e., domains, ISLs, routing groups) and the location and details of errors within those topologies.

z/OS Health Checker and CUP Diagnostics

The z/OS Health Checker is an IBM software component used to monitor and detect performance and Reliability, Availability and Serviceability (RAS) issues in datacenter components, including both the computer electronics complex (CEC) and its peripherals.

Health Checker reports problems to various system operations components (i.e., automation components) as well as initiating further analysis actions and remedial actions.

FICON switching devices (i.e., a storage networking fabric) sit in the middle, between the computing and storage components, so switches have a critical role in transporting data between the CEC and its peripherals. But, as described earlier, the preponderance of fabric operations are invisible to z/OS, which cannot quickly react to nor troubleshoot those issues.

Errors within the fabric can be caused by either software or hardware problems or by frame traffic rates that exceed available capacity. Some of the potential issues that can cause problems in the fabric are:

- Defective cables or optics
- Congestion within the fabric
- I/O or switch configuration problems, such as incorrect cabling or routing
- Channel or control unit hardware or firmware issues
- I/O configuration definition errors.

IBM, in a cooperative effort with Brocade, defined a new architectural component to be implemented in Brocade's Fabric OS (FOS) FMS code, the "CUP Diagnostics" function, which are the newest CUP CCWs and payloads that enable the z Systems host to receive direct alerts about fabric problems, and then proactively gather additional, detailed information about the fabric (e.g., components, topologies, ISL routing and fabric problems).

Brocade's initial implementation of CUP Diagnostics came in FOS version 7.1, which initiated the CUP Diagnostics function by providing some basic, but limited, responses to the z Systems host.

Changing the IBM Display Matrix Command to Support CUP Diagnostics

The first of the new CUP Diagnostics functions provide ROUTE and HEALTH

keywords to be functional with the Display Matrix (e.g., D M=) z/OS command. This modified command will expose newly available fabric diagnostic data, provided directly from the switch, and make some of the fabric operations that were invisible to z/OS in the past now become evident.

The ROUTE function provides important information back to the command issuer regarding the specific path frames are traversing between a mainframe CHPID and a device (i.e., the to device "TODEV" keyword) or from a device to a mainframe CHPID (i.e., FROMDEV keyword). These functions are supported on all Brocade switches beginning with the FOS 7.1.0c and Brocade Network Advisor (BNA) 12.0.2 software levels or higher.

On the z Systems side, z/OS 1.12 and higher, plus some required APARs and PTFs, is used with FOS 7.1.0c to support the CUP Diagnostics and z/OS Health Check features added in at that firmware level. IBM z/OS Health Check uses a previously undefined bit in the Sense data. The user must implement the required Health Check APARs and PTFs or risk error messages, indicating an invalid command code, being posted to the z/OS console.

Conclusion

CUP Diagnostics provides new fabric wide diagnostic command channel programs to enable z/OS to obtain fabric topology, collect diagnostic information such as performance data, determine the health of the fabric, generate a diagnostic log on the switch and help users resolve problems in their I/O fabrics. **ETJ**

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