

Introduction to z17 Channel Performance Management

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Uh oh, there are Channel problems...

Channel Fundamentals Introduction

- What is a Channel?
- What is an I/O Adapter?
- Common I/O Adapters

z17 Channel Architecture Changes

- Network Express Adapter
- FICON Express32-4P Adapter
- Data Processing Unit (DPU)

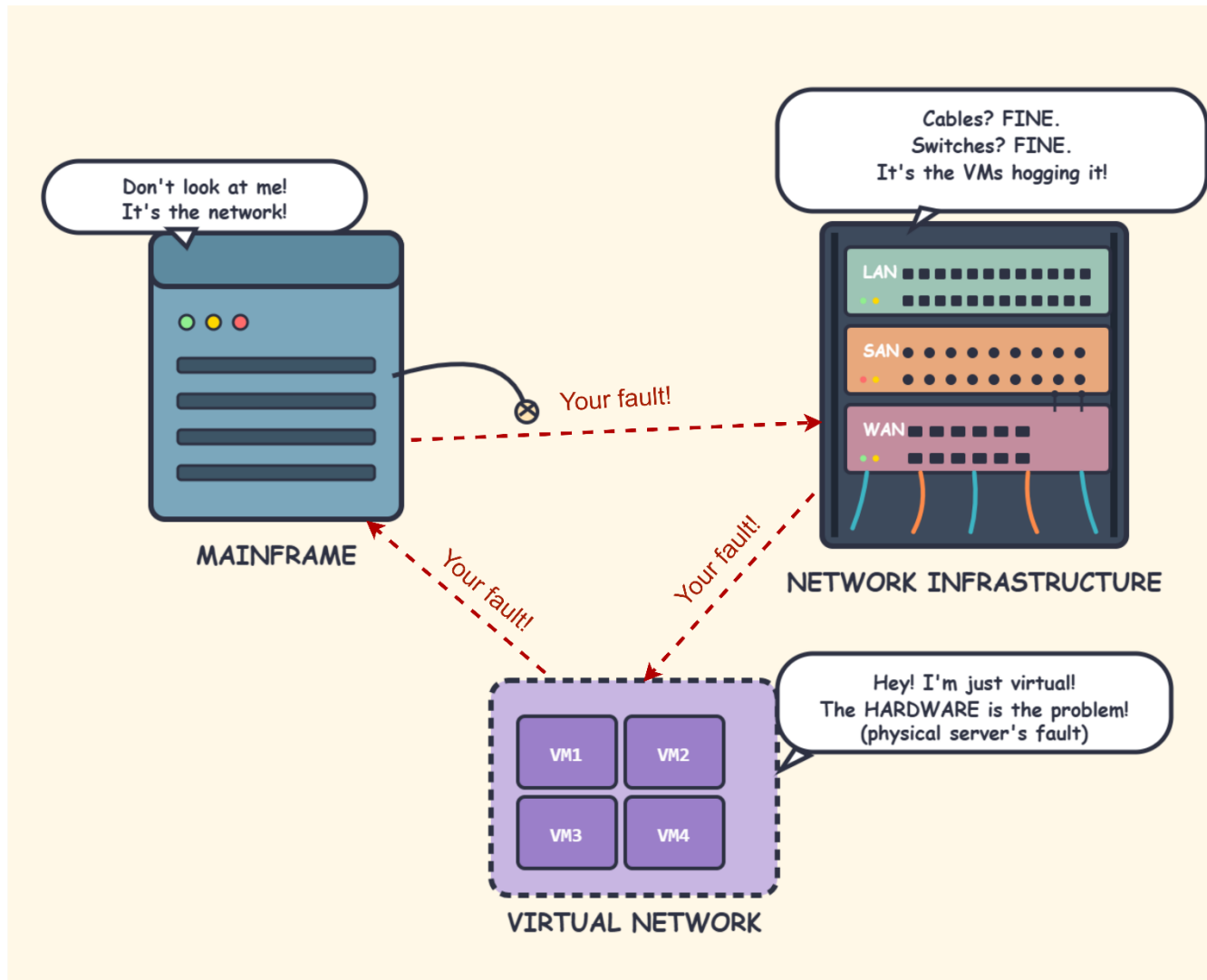
z17 Channel Performance Analysis

- Basis of Channel Performance Analysis
- z17 Channel Components/Metrics

Channel Fundamentals Introduction

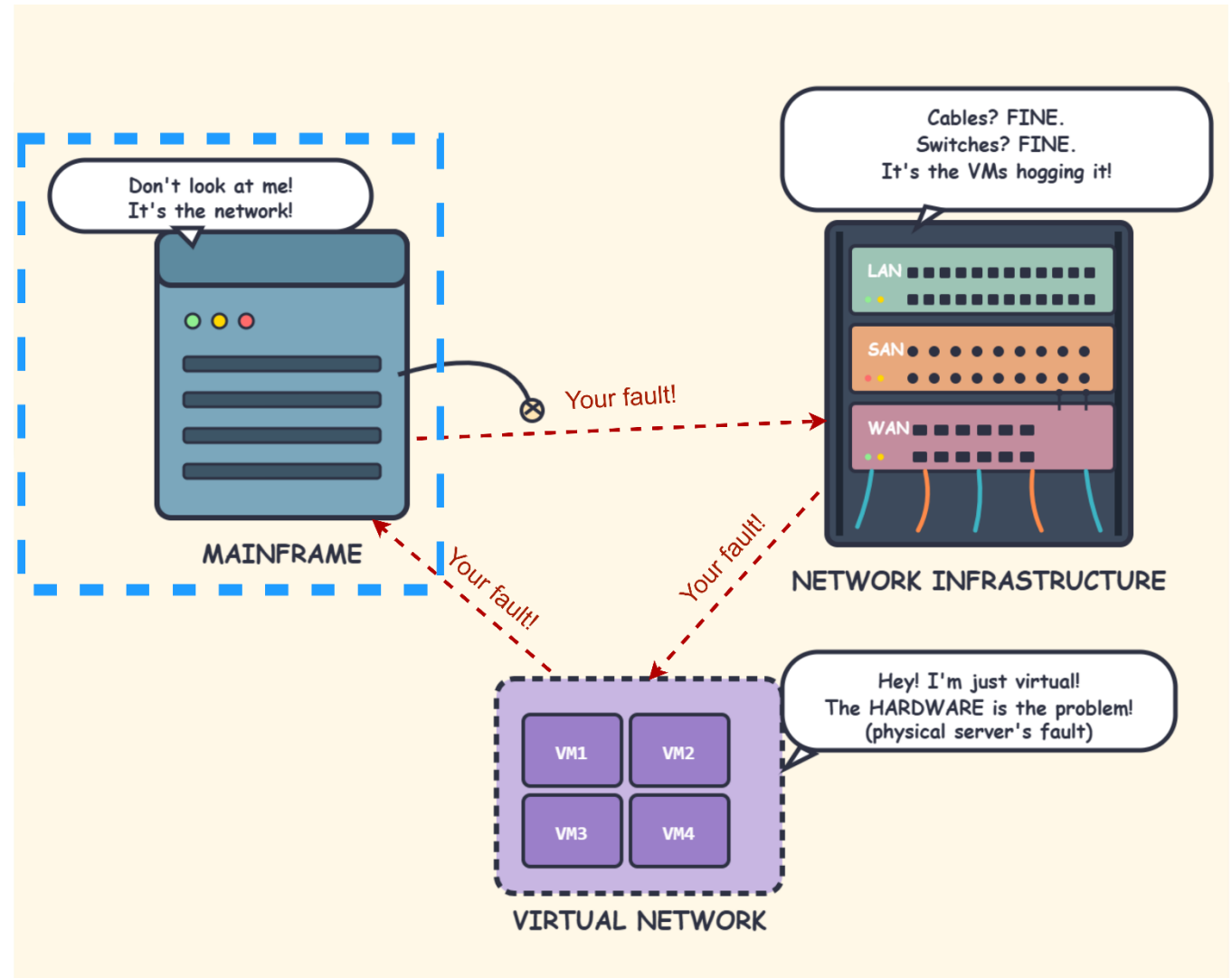
IO related Systems

- Mainframe (Physical)
 - IO Adapters
 - SAPs
 - DPUs
 - PCIEs
- External Network Infrastructure
 - LANs
 - WANs
 - SANs
- Virtual Network
 - Hipersockets/VNICs
 - VSwitch/Guest LANs
- TCP/IP

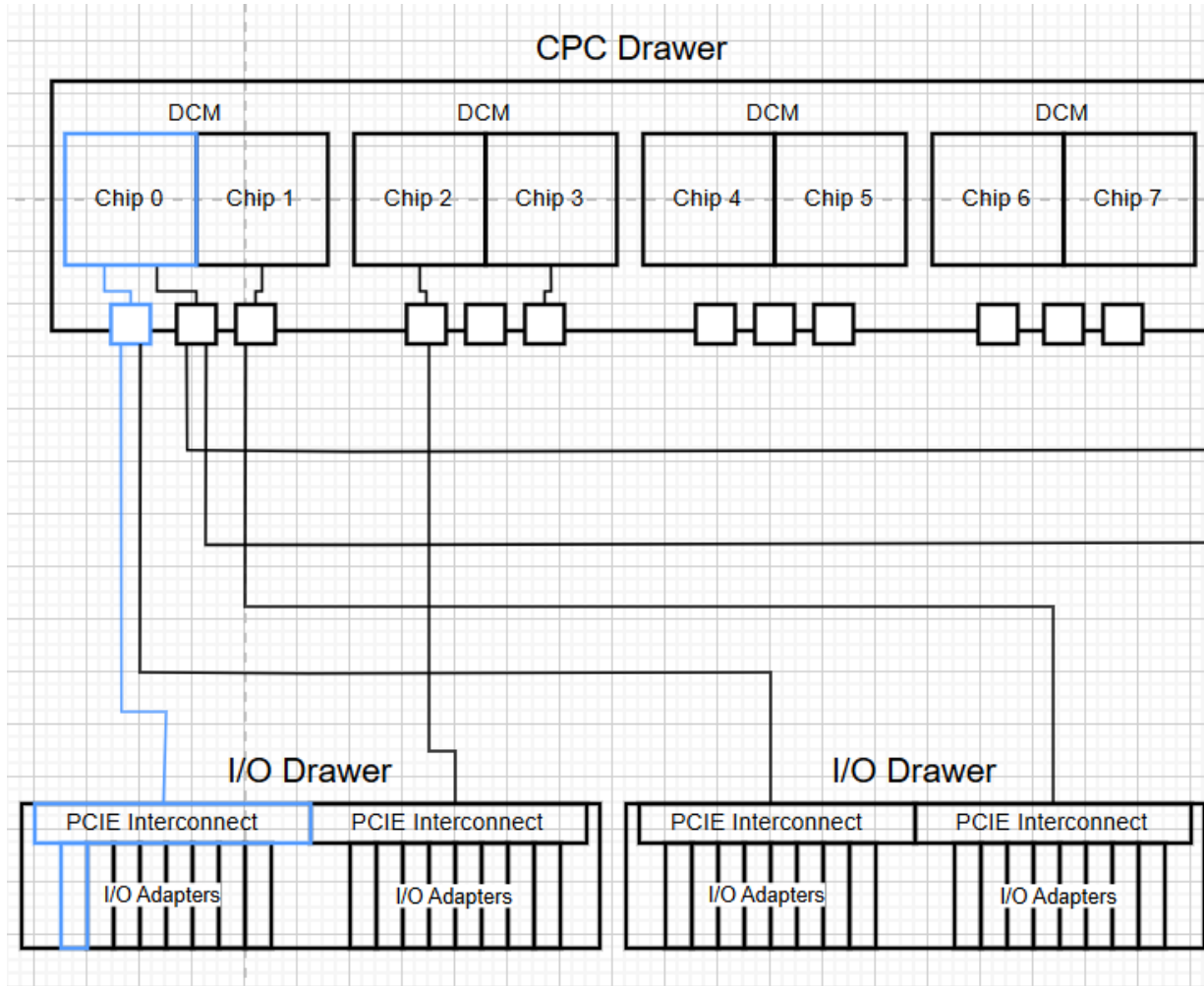


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What is a Channel?



Sample z16 drawer configuration

- **Channel** - a single I/O interface between a channel subsystem (on chip) and one or more control units

Note: FICON channels technically include some components outside of the box however this does not have a large effect on channel performance management

I/O adapter – A mechanism for connecting two unlike parts or machines (z/OS Communications Server Glossary)

Typical use cases of I/O adapters on the mainframe

- Mainframe to Mainframe
- Mainframe to Storage Area Network
- Mainframe to Local/Wide Area Network

In the context of performance management, why do they matter?

- Different types of I/O adapter and their modes often have their own caveats when it comes to performance management

FICON Express – Adapters which use fibre connections to connect to Storage Units, Storage Area Networks (SAN), tape, and other mainframes. Operates using one of two modes:

- **Fibre Channel Native (FICON)** – Operating in mode allowing it to interface with devices using ECKD-format storage, FICON-attached tape, and FICON channel-to-channel (FCTC) connections. May be configured to have some operations use the zHPF protocol
- **Fibre Channel Protocol (FCP)** – Operating in mode allowing it to interface with fixed block SCSI storage devices and FCP-attached tape libraries. Uses the QDIO architecture



FICON Express 32-4P

OSA Express – Adapters which use ethernet cables to connect to LANs/WANS or other partitions on the same system. Operates using either:

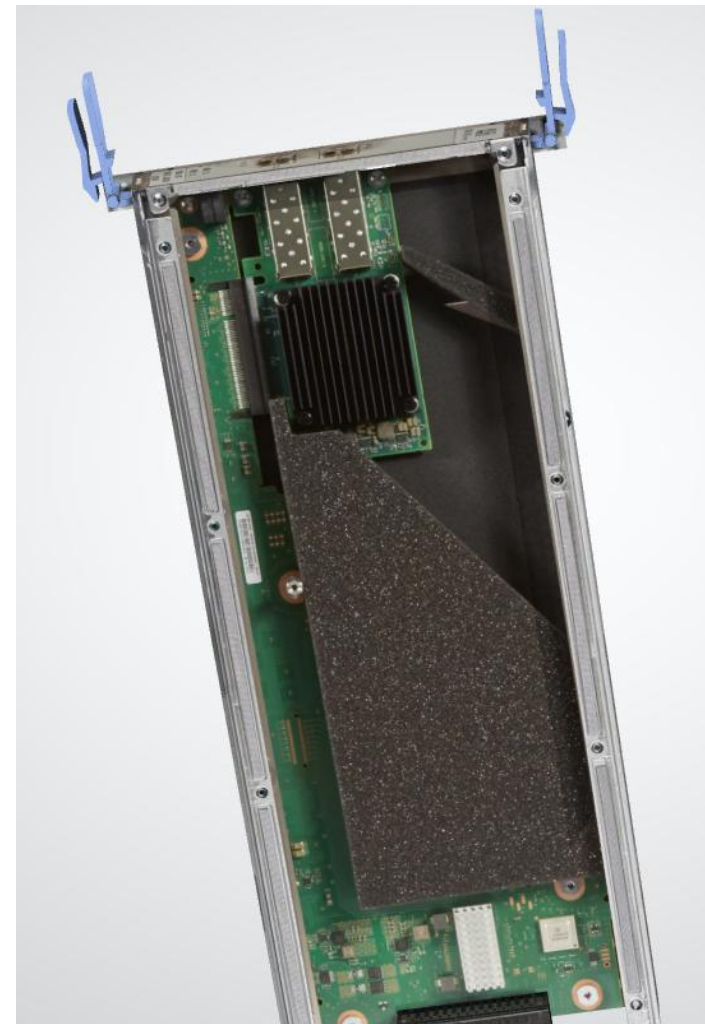
- **QDIO mode**
- **Non-QDIO mode**



OSA Express 7s 1.2

RoCE Express – Adapters allowing for Host-to-host connection between two OS images for RDMA-accelerated TCP traffic (via SMC-R). Utilizes RoCE adapters.

Note: The RoCE does not following traditional channel architecture and in fact there are no channels associated with RoCE cards



RoCE Express3

Network Express – Adapter which can operate in 1 or both of the following modes :

- **OSH** mode giving it the same functionality as OSA Express adapters. Uses the EQDIO architecture.
- **NETH** has the same functionality as RoCE Express adapters

Note: Much like the RoCE card the Network Express operating in NETH mode does not use traditional channel architecture

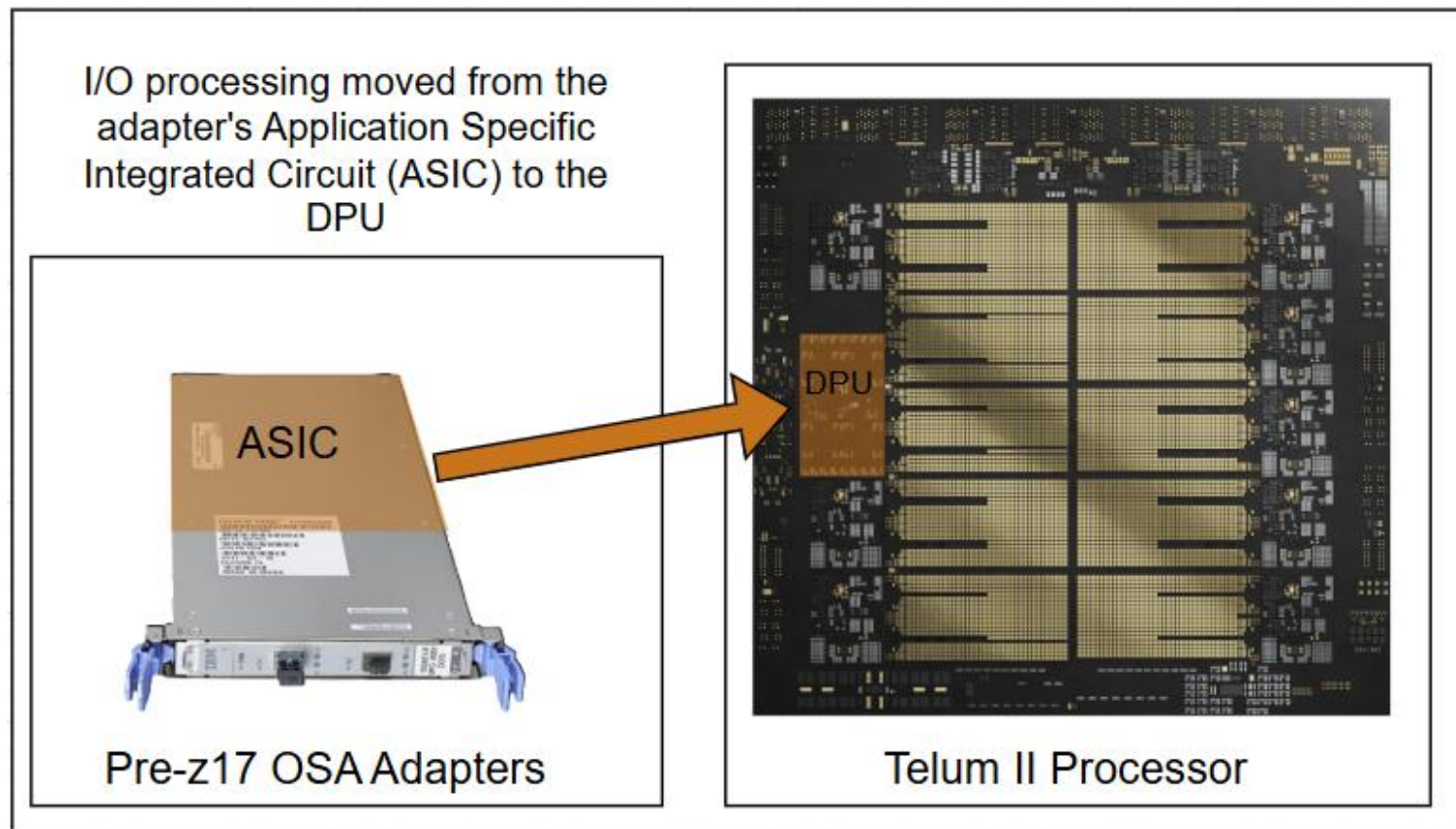


Network Express

z17 Channel Architecture Changes

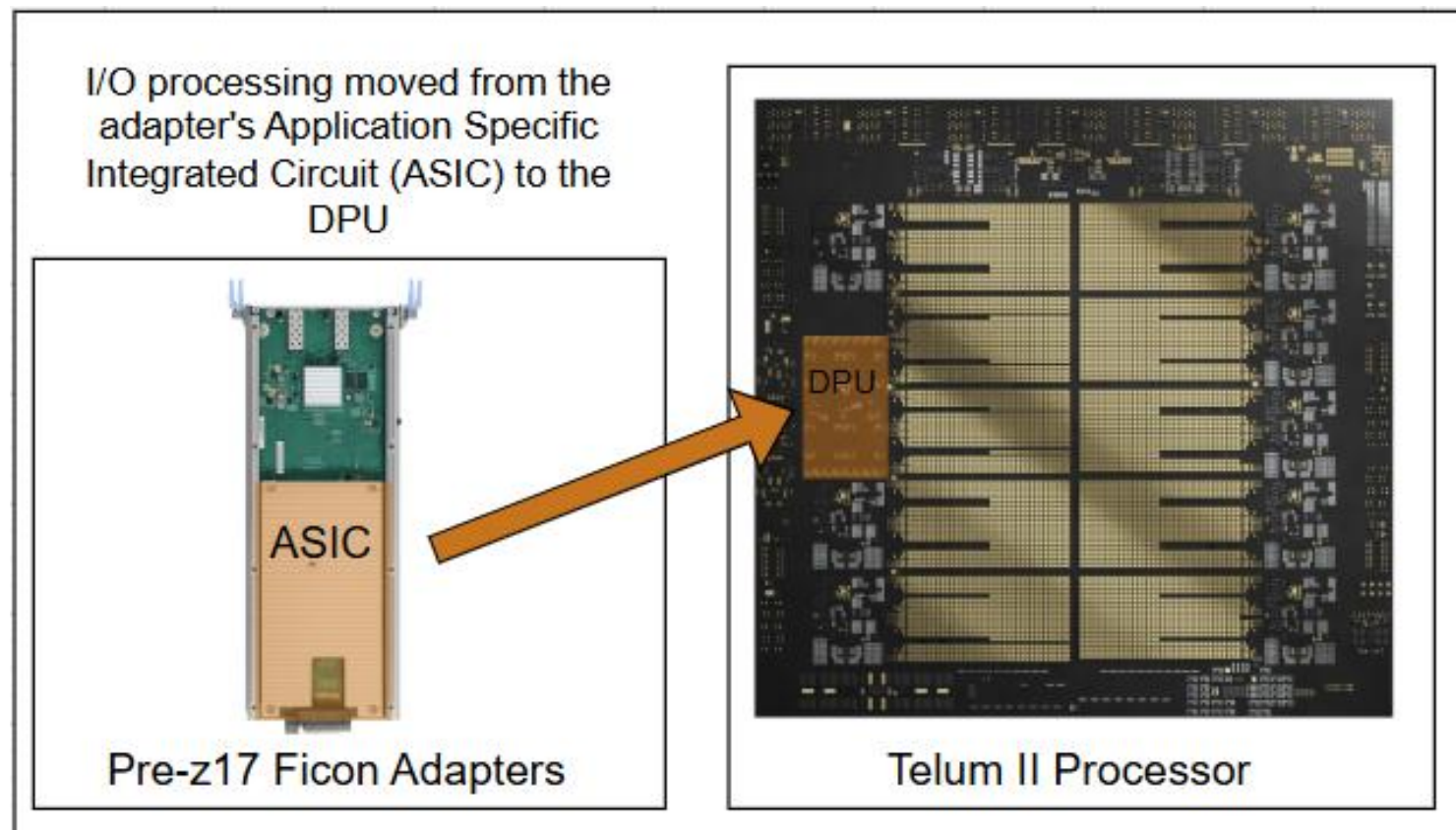
Overview

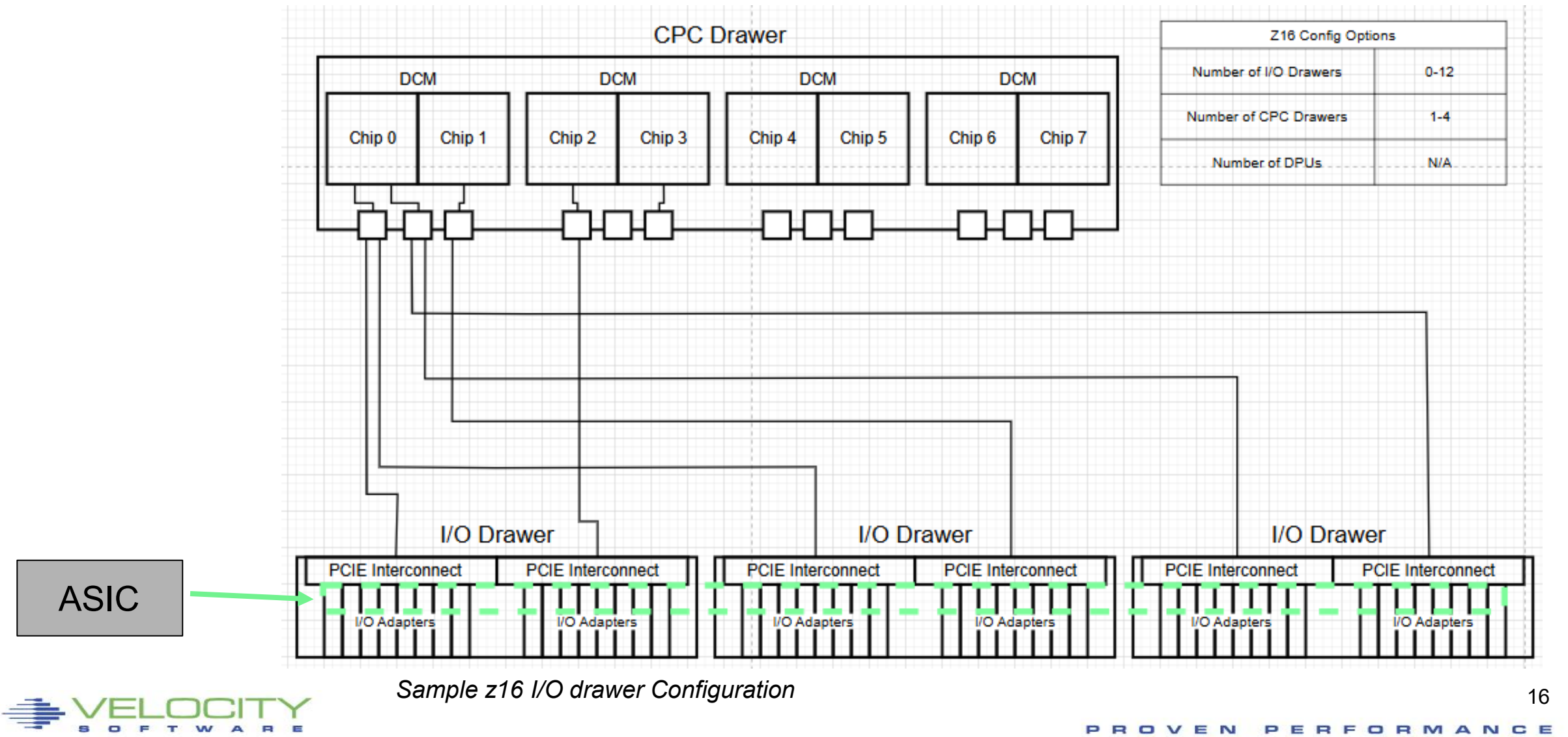
- ASICs removed
- I/O Processing is performed on the Data Processing Unit (DPU) rather than the ASIC

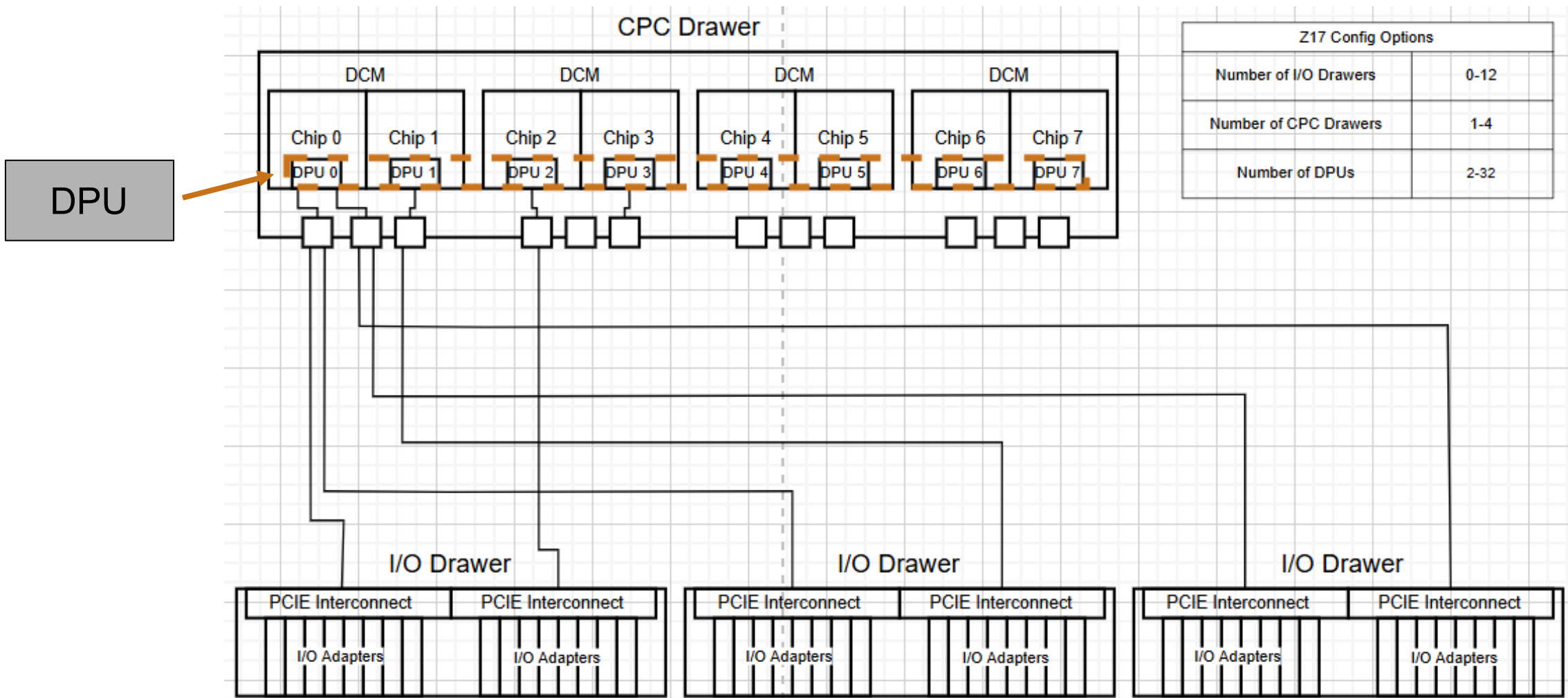


Overview

- Same Functionality as older FICON adapters
- ASICs removed
- I/O Processing is performed on the DPU rather than the ASIC







Z17 Config Options	
Number of I/O Drawers	0-12
Number of CPC Drawers	1-4
Number of DPUs	2-32

Sample z17 I/O drawer Configuration

z17 Channel Performance Analysis

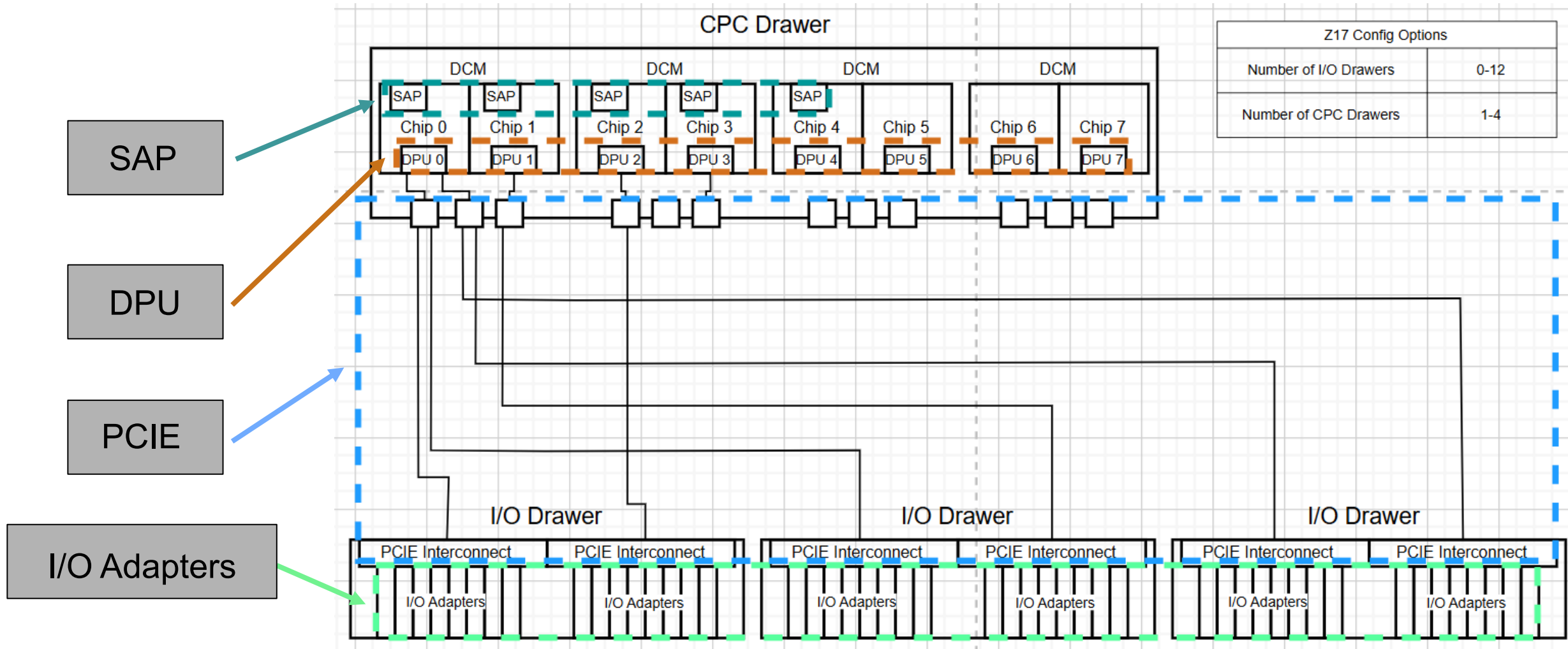
Basis of Channel Performance Analysis

Channels utilize a pipeline of hardware components

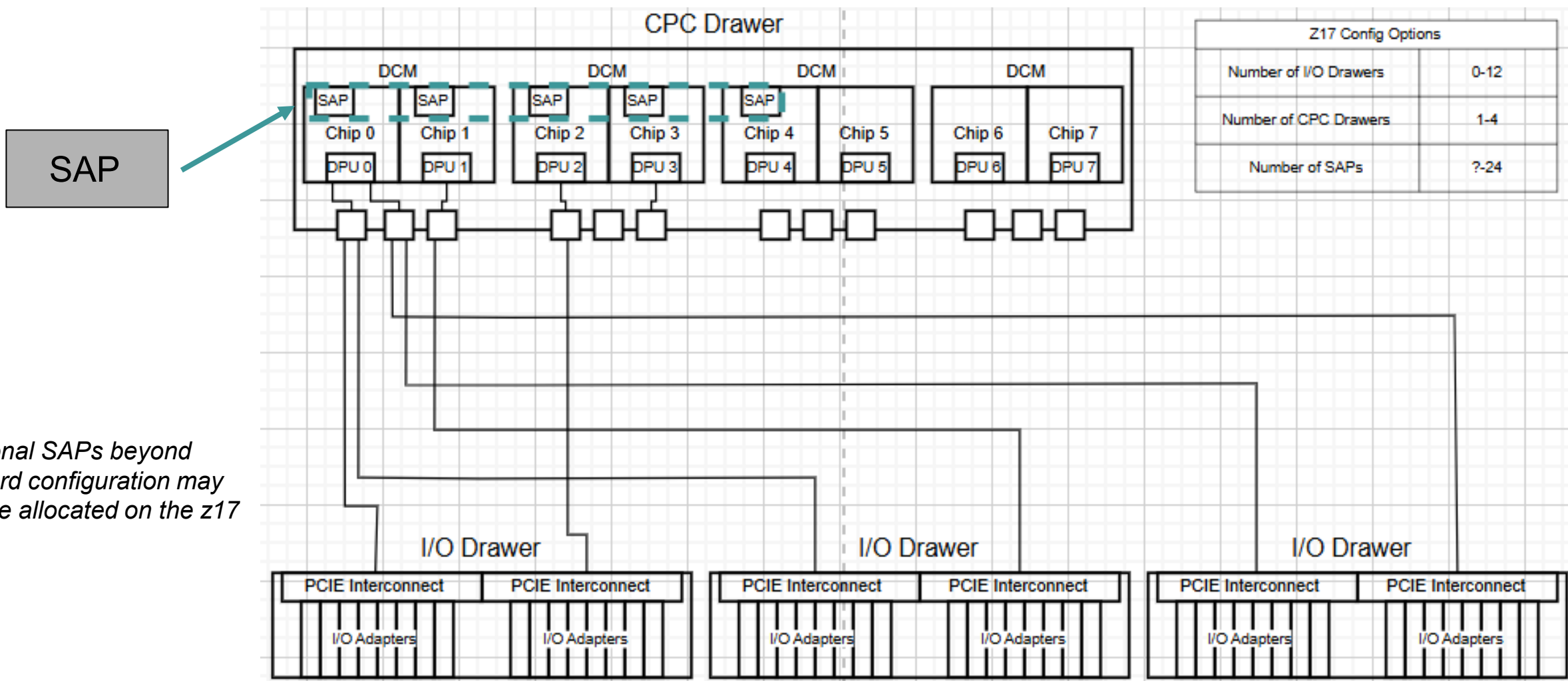
Data can only travel as fast as the slowest component

Channel performance analysis is based of understanding each of these components and finding which components are/will be bottleneck





z17 Channel Components - SAP



Note:
Additional SAPs beyond
standard configuration may
NOT be allocated on the z17

Sample z17 I/O drawer Configuration

Description

- Processor configured to run the Channel Subsystem Licensed Internal Code and controls I/O operations

Relevant Performance Details

- SAPs are not utilized by channels using the QDIO/EQDIO protocols
 - OSAs in QDIO mode
 - Network Express Adapters in OSH mode
 - Ficon Express in FCP mode
- SAPs share the total workload amongst themselves

Notes:
 SAP – System Assist Processor
 There are some minor exceptions where SAP workload is not shared

Report: ESAIOP

-----I/O Processor----->									
Proc	<Pct Util>	<Rate/Second>	<-Percent of Strts busy-->						
Nmbr	Busy	Idle	SSCH	Intrpts	Chan	Switch	CtlUnit	Device	
0	5.2	94.8	8213	16152	0.0	0	0	0	0
1	2.1	97.9	8213	163	0	0	0	0	0
2	5.9	94.1	8214	16605	0.0	0	0	0	0
3	1.8	98.2	8213	172	0	0	0	0	0
4	6.3	93.7	8213	20014	0	0	0	0	0
5	1.8	98.2	8213	182	0	0	0	0	0
6	3.7	96.3	8214	8191	0	0	0	0	0
7	1.7	98.3	8213	96	0	0	0	0	0
8	7.5	92.5	8214	23119	0	0	0	0	0
9	1.7	98.3	8213	113	0	0	0	0	0
10	8.1	91.9	8213	20384	0	0	0	0	0
11	2.3	97.7	8214	118	0	0	0	0	0
12	7.9	92.1	8214	16308	0.0	0	0	0	0
13	2.3	97.7	8213	210	0.0	0	0	0	0
14	5.9	94.1	8213	13491	0.0	0	0	0	0
15	2.2	97.8	8213	209	0.0	0	0	0	0
16	8.4	91.6	8213	22863	0.0	0	0	0	0
17	2.5	97.5	8213	213	0	0	0	0	0
18	4.4	95.6	8213	8253	0.0	0	0	0	0
19	2.3	97.7	8213	86	0	0	0	0	0
20	6.8	93.2	8213	16016	0	0	0	0	0
21	2.2	97.8	8214	150	0.0	0	0	0	0
22	6.7	93.3	8213	16512	0.0	0	0	0	0
23	2.4	97.6	8214	169	0.0	0	0	0	0
24	6.8	93.2	8214	14858	0.0	0	0	0	0
25	2.1	97.9	8214	168	0.0	0	0	0	0
26	8.6	91.4	8214	20623	0.0	0	0	0	0
27	2.3	97.7	8214	143	0.0	0	0	0	0
28	7.2	92.8	8214	20537	0.0	0	0	0	0
29	2.3	97.7	8213	152	0.0	0	0	0	0

Report displaying, I/O Processor Metrics by Processor Number 22

How will a bottleneck look?

- High number of channels in FICON mode
- Smaller I/O block sizes
- High AVERAGE SAP utilization

Interpreting the associated report...

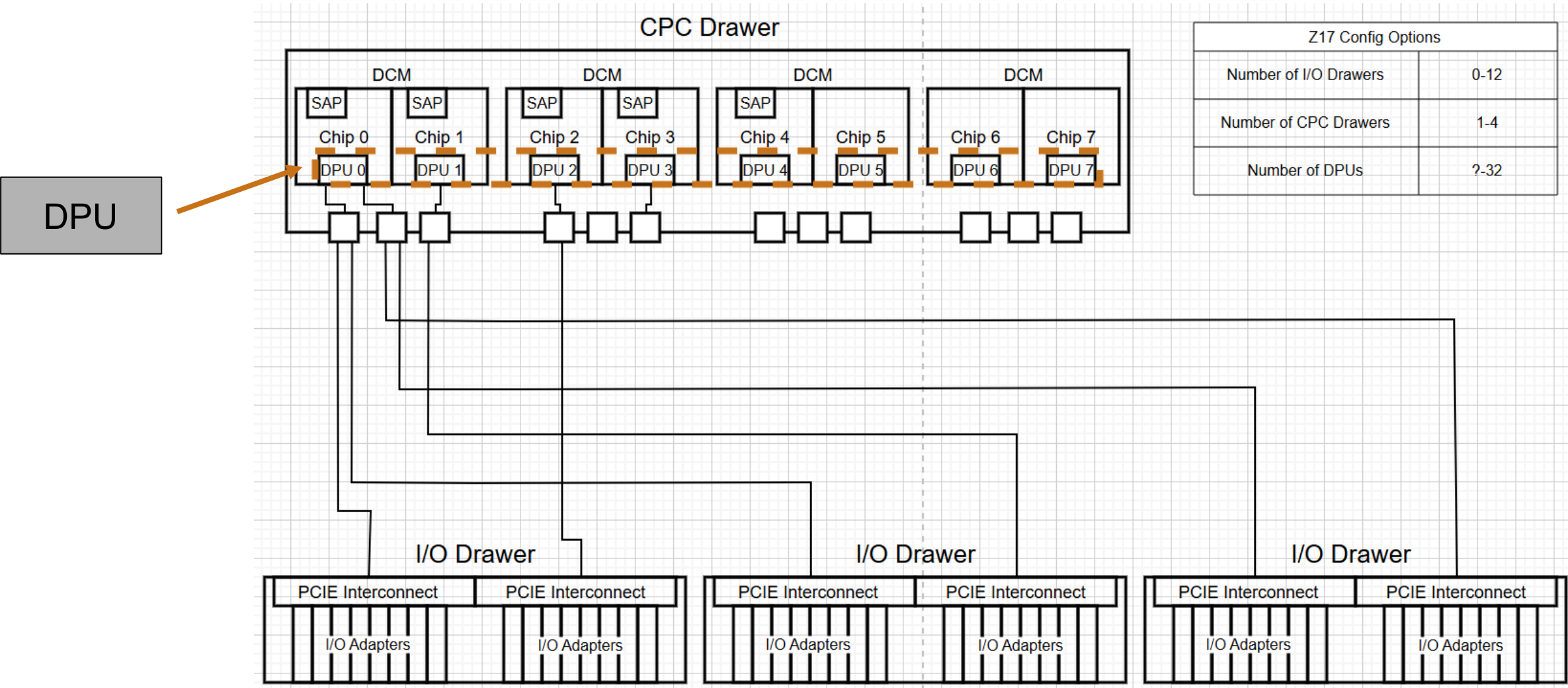
Note:

Each physical SAP is represented by 2 logical processors as a result of SMT

Report: ESAIOP

I/O		-----I/O Processor----->							
Proc	<Pct Util>	<Rate/Second>	<-Percent of Strts busy-->						
Nmbr	Busy	Idle	SSCH	Intrpts	Chan	Switch	CtlUnit	Device	
0	5.2	94.8	8213	16152	0.0	0	0	0	0
1	2.1	97.9	8213	163	0	0	0	0	0
2	5.9	94.1	8214	16605	0.0	0	0	0	0
3	1.8	98.2	8213	172	0	0	0	0	0
4	6.3	93.7	8213	20014	0	0	0	0	0
5	1.8	98.2	8213	182	0	0	0	0	0
6	3.7	96.3	8214	8191	0	0	0	0	0
7	1.7	98.3	8213	96	0	0	0	0	0
8	7.5	92.5	8214	23119	0	0	0	0	0
9	1.7	98.3	8213	113	0	0	0	0	0
10	8.1	91.9	8213	20384	0	0	0	0	0
11	2.3	97.7	8214	118	0	0	0	0	0
12	7.9	92.1	8214	16308	0.0	0	0	0	0
13	2.3	97.7	8213	210	0.0	0	0	0	0
14	5.9	94.1	8213	13491	0.0	0	0	0	0
15	2.2	97.8	8213	209	0.0	0	0	0	0
16	8.4	91.6	8213	22863	0.0	0	0	0	0
17	2.5	97.5	8213	213	0	0	0	0	0
18	4.4	95.6	8213	8253	0.0	0	0	0	0
19	2.3	97.7	8213	86	0	0	0	0	0
20	6.8	93.2	8213	16016	0	0	0	0	0
21	2.2	97.8	8214	150	0.0	0	0	0	0
22	6.7	93.3	8213	16512	0.0	0	0	0	0
23	2.4	97.6	8214	169	0.0	0	0	0	0
24	6.8	93.2	8214	14858	0.0	0	0	0	0
25	2.1	97.9	8214	168	0.0	0	0	0	0
26	8.6	91.4	8214	20623	0.0	0	0	0	0
27	2.3	97.7	8214	143	0.0	0	0	0	0
28	7.2	92.8	8214	20537	0.0	0	0	0	0
29	2.3	97.7	8213	152	0.0	0	0	0	0

Report displaying, I/O Processor Metrics by Processor Number 23



Sample z17 I/O drawer Configuration

Description

- I/O processor responsible for packet construction, inspection and routing

Relevant Performance Details

- DPU's do NOT share compute with each other
- Each channel is processed by a single DPU
- DPU channel links determined by hardware configuration
- Each DPU can be linked to 128 Channels max
- The ONLY channels which use the DPU are the channels associated with the FICON Express 32-4p and the Network Express adapters

Report: ESACHAN

<----DPU Util Pct----->						
Time/ CHPID	Chnl Type	<-Channel-> LPAR	Total	<-Overall-> LPAR	Total	DPU Num
06:02:00						
20	FCS	0.000	0.005	0.003	0.064	22
21	FCS	0.000	0.005	0.002	0.045	30
22	FCS	0.000	0.005	0.003	0.064	22
23	FCS	0.000	0.005	0.002	0.044	30
24	FCS	0.000	0.005	0.003	0.064	22
25	FCS	0.000	0.005	0.002	0.045	30
26	FCS	0.000	0.005	0.003	0.064	22
27	FCS	0.000	0.005	0.002	0.045	30
C8	FCP	0	0.003	0	0.058	14
CA	FCP	.	.	.	.	.
CB	FCP	0	0.003	0	0.058	14
CD	FCP	0	0.003	0	0.064	22
E0	OSD	.	.	.	.	.
E1	OSD	.	.	.	.	.
E2	OSD	.	.	.	.	.
E3	OSD	.	.	.	.	.
E5	OSD	.	.	.	.	.
E7	OSD	.	.	.	.	.
E8	OSD	.	.	.	.	.
E9	OSD	.	.	.	.	.
Totals	FICON	0.002	0.042	0.020	.	.
Totals	FCP	0	0.036	0	.	.
Totals	OSA	0	0	0	.	.

How will a bottleneck look?

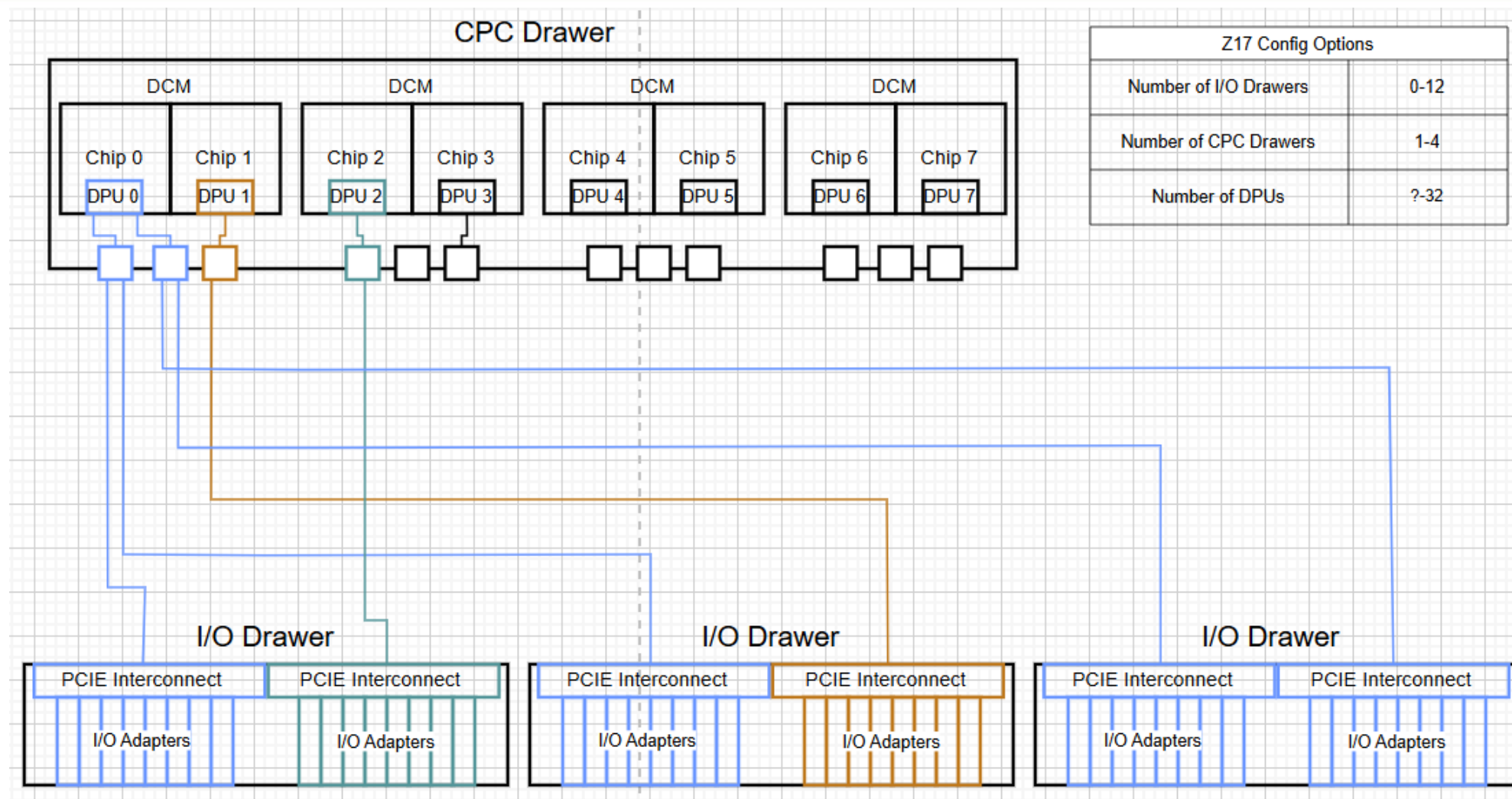
- High number of Ficon Express 32-4P/Network Express adapters linked to a given DPU
- Smaller I/O block sizes
- Heavy use of non-zHPF operations
- A single overutilized DPU

Interpreting the associated report...

Report: ESACHAN

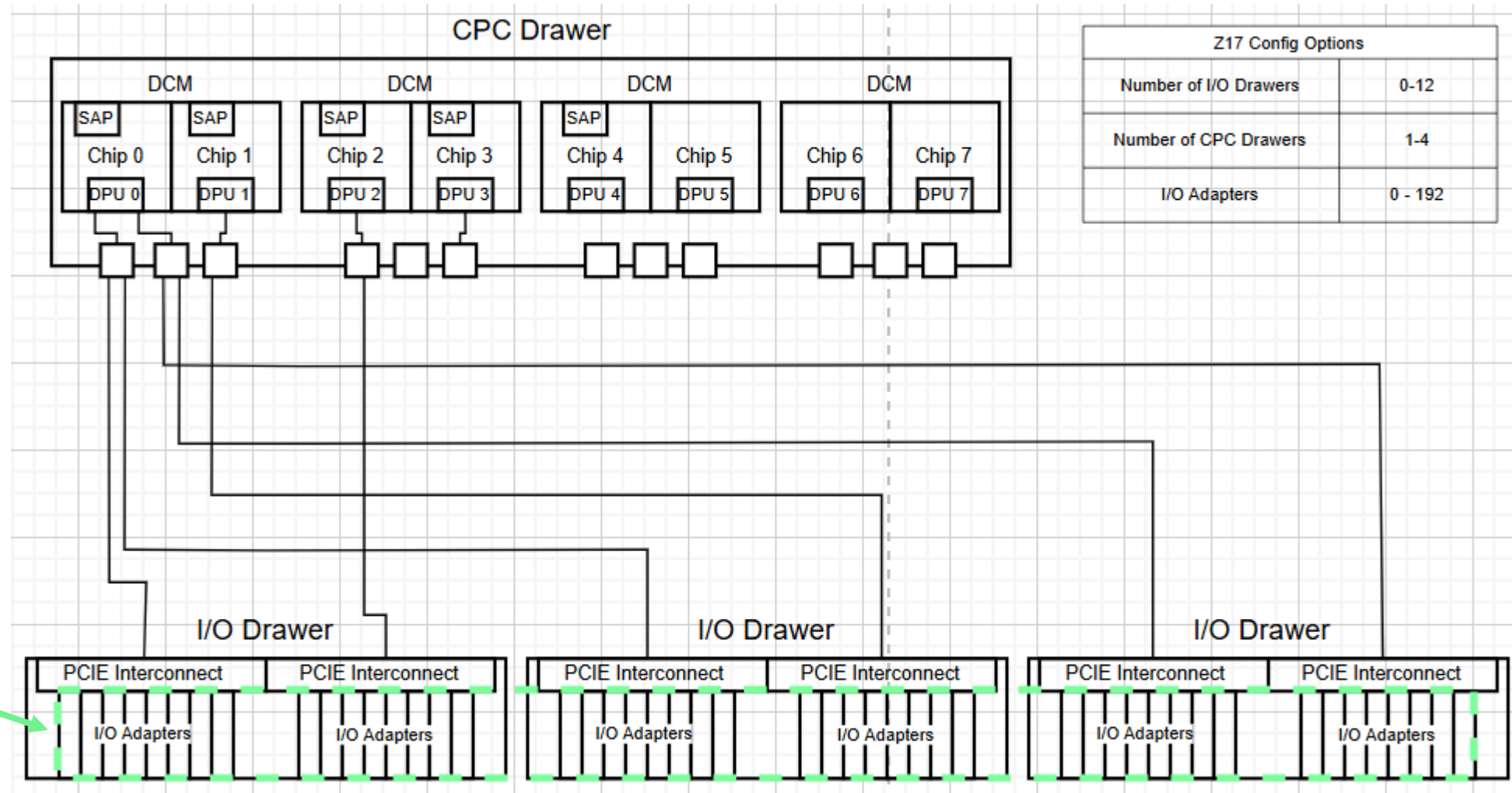
<----DPU Util Pct----->						
Time/ CHPID	Chnl Type	<-Channel-> LPAR	Total	<-Overall-> LPAR	Total	DPU Num
06:02:00						
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21	FCS	0.000	0.005	0.002	0.045	30
22	FCS	0.000	0.005	0.003	0.064	22
23	FCS	0.000	0.005	0.002	0.044	30
24	FCS	0.000	0.005	0.003	0.064	22
25	FCS	0.000	0.005	0.002	0.045	30
26	FCS	0.000	0.005	0.003	0.064	22
27	FCS	0.000	0.005	0.002	0.045	30
C8	FCP	0	0.003	0	0.058	14
CA	FCP	.	.	.	.	.
CB	FCP	0	0.003	0	0.058	14
CD	FCP	0	0.003	0	0.064	22
E0	OSD	.	.	.	.	.
E1	OSD	.	.	.	.	.
E2	OSD	.	.	.	.	.
E3	OSD	.	.	.	.	.
E5	OSD	.	.	.	.	.
E7	OSD	.	.	.	.	.
E8	OSD	.	.	.	.	.
E9	OSD	.	.	.	.	.
Totals	FICON	0.002	0.042	0.020	.	.
Totals	FCP	0	0.036	0	.	.
Totals	OSA	0	0	0	.	.

z17 Channel Components - DPU



Sample z17 I/O drawer Configuration

z17 Channel Components – I/O Adapter



I/O Adapters

Sample z17 I/O drawer Configuration

Description

- Facilitates data transfer between the mainframe box and outside networks/devices

Relevant Performance Details

- Maximum reads/writes is based on I/O Adapter model
- Separate maximums for read and write

Note:
Maximum reads/writes may be negotiated down

Report: ESACHAN								
<-----Data Units----->								
Time/	Chnl	<-Reads/Sec->			<Writes/Sec->			
CHPID	Type	LPAR	Totl	Pct	LPAR	Totl	Pct	

15:45:								
18	OSD	0	3757	0.2	0	9062	0.6	
1A	OSD	0	3621	0.2	0	954	0.1	
1B	OSD	0	3859	0.2	0	8900	0.5	
1C	OSD	0	4033	0.2	0	8771	0.5	
1D	OSD	4170	16K	1.0	2225	13K	0.8	
1E	OSD	3872	29K	1.8	3961	21K	1.3	
37	OSD	0	196	0.0	0	167	0.0	
38	OSD	0	170	0.0	0	158	0.0	
3C	OSD	651	651	0.1	809	809	0.1	
67	FCS	3	1781	0.1	207	5881	0.4	
69	FCP	514	514	0.0	1299	1299	0.1	
6C	FCP	513	513	0.0	1300	1300	0.1	
7A	FCS	3	35	0.0	232	799	0.1	
8C	FCP	201K	201K	12	4687	4687	0.3	
8D	FCP	513	513	0.0	1301	1301	0.1	

Totals	FICON	7	1816	0.1	439	6680	0.4	
Totals	FCP	203K	203K	12	8588	8588	0.5	
Totals	OSA	9900	63K	10	7653	64K	3.9	

Report displaying, I/O Control Unit Read/Write Utilization by CHPID

How will a bottleneck look?

- External network limitations
- Older adapters
- Overutilization of either a channel's reads or writes or both

Interpreting the associated report...

Note:
 Max reads/writes may be seen in the ESACHNC report

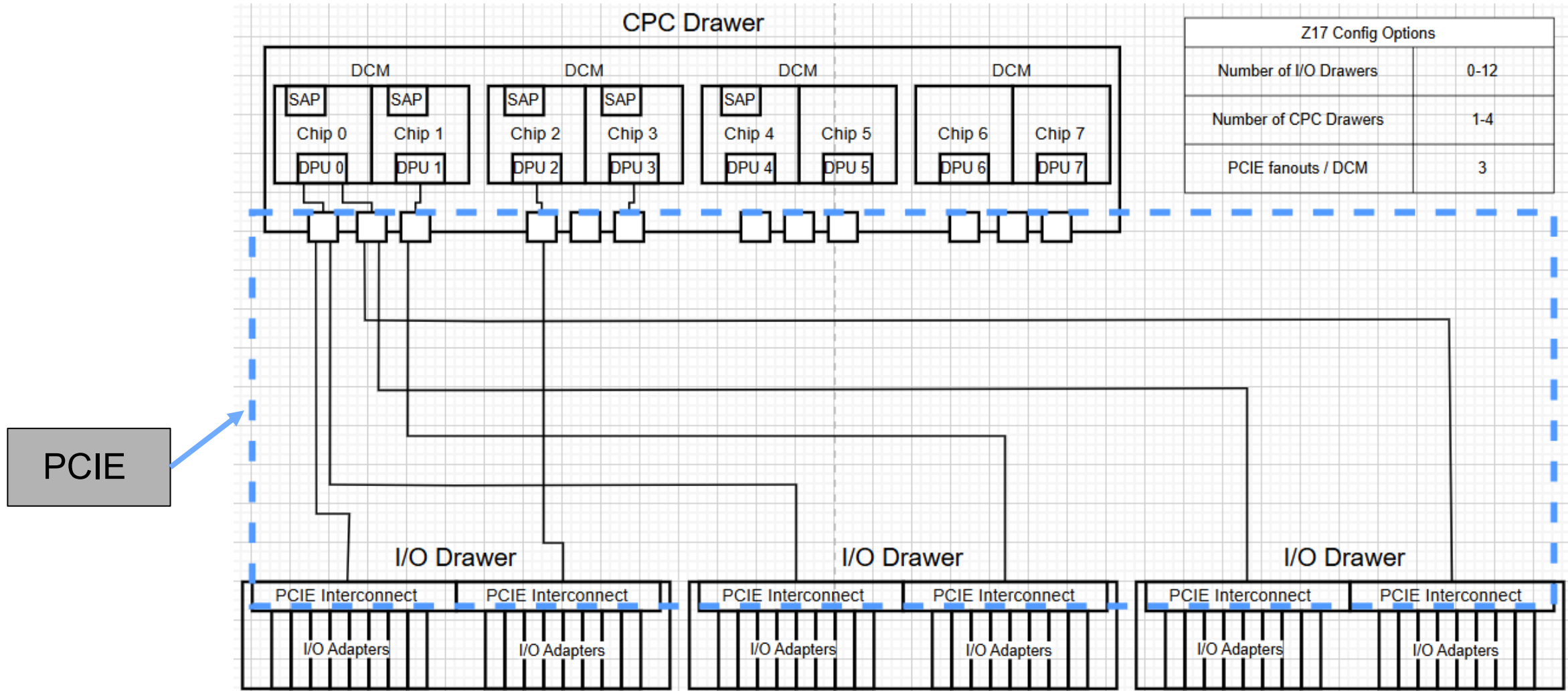
Report: ESACHAN

		<-----Data Units----->					
Time/	Chnl	<-Reads/Sec->			<Writes/Sec->		
CHPID	Type	LPAR	Totl	Pct	LPAR	Totl	Pct

15:45:							
18	OSD	0	3757	0.2	0	9062	0.6
1A	OSD	0	3621	0.2	0	954	0.1
1B	OSD	0	3859	0.2	0	8900	0.5
1C	OSD	0	4033	0.2	0	8771	0.5
1D	OSD	4170	16K	1.0	2225	13K	0.8
1E	OSD	3872	29K	1.8	3961	21K	1.3
37	OSD	0	196	0.0	0	167	0.0
38	OSD	0	170	0.0	0	158	0.0
3C	OSD	651	651	0.1	809	809	0.1
67	FCS	3	1781	0.1	207	5881	0.4
69	FCP	514	514	0.0	1299	1299	0.1
6C	FCP	513	513	0.0	1300	1300	0.1
7A	FCS	3	35	0.0	232	799	0.1
8C	FCP	201K	201K	12	4687	4687	0.3
8D	FCP	513	513	0.0	1301	1301	0.1

Totals	FICON	7	1816	0.1	439	6680	0.4
Totals	FCP	203K	203K	12	8588	8588	0.5
Totals	OSA	9900	63K	10	7653	64K	3.9

Report displaying, I/O Control Unit Read/Write Utilization by CHPID



Sample z17 I/O drawer Configuration

Description

- Expansion bus connecting chips on the CPC drawer to devices (I/O adapters) on the I/O drawer

Relevant Performance Details

- PCIEs have 1 set of wires transmitting data and 1 set of wires for receiving data
- Typically, not overutilized

Report: ESACHAN

Time/	Chnl	<Bus Cy>	
CHPID	Type	<cl/Sec>	Used Pct

12:24:			
70	OSD	.	.
71	OSD	.	.
80	OSD	.	.
84	OSD	.	.
86	OSD	.	.
C1	FCS	17K	0.5
C3	FCS	83K	2.7
C6	FC	83K	2.7
C7	FCS	17K	0.5
C9	FCS	83K	2.7
CB	FCS	17K	0.5
CD	FCS	84K	2.7
CE	FCS	83K	2.7
CF	FCS	17K	0.5

Totals	FICON	484K	15
Totals	OSA	0	0

Report displaying PCIE bus cycle utilization by CHPID 32

How will a bottleneck look?

- Overutilization of either data transmitted or received or both

Interpreting the associated report...

Note:

Bus utilization metrics are not produced for OSAs even though OSAs DO utilize the PCIE

Report: ESACHAN

Time/	Chnl	<Bus Cy>	
CHPID	Type	<cl/Sec>	Used Pct

12:24:			
70	OSD	.	.
71	OSD	.	.
80	OSD	.	.
84	OSD	.	.
86	OSD	.	.
C1	FCS	17K	0.5
C3	FCS	83K	2.7
C6	FC	83K	2.7
C7	FCS	17K	0.5
C9	FCS	83K	2.7
CB	FCS	17K	0.5
CD	FCS	84K	2.7
CE	FCS	83K	2.7
CF	FCS	17K	0.5

Totals	FICON	484K	15
Totals	OSA	0	0

Report displaying PCIE bus cycle utilization by CHPID 33

So, what do you do when there is a channel problem?

Thank you for listening!

Questions?

Tyler Rossi

Software Engineer / Performance Apprentice

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Exciting News!!

Velocity Software is now your place for z/VM education!

- **Self-Study and Instructor-led classes**
- **Upcoming Instructor-led Class:**
 - **July 8-10 2026 – Modules 1, 2 and 3 (from our education page)**

Ask about it here at the workshop!

See our website – [VelocitySoftware.com/Educate/Training](https://velocitysoftware.com/Educate/Training)

Send an email to – education@velocitysoftware.com