

# IBM Poughkeepsie

## IBM @server zSeries 900

# FICON Channel to CU zSeries Link Addresses and FC Port Addresses

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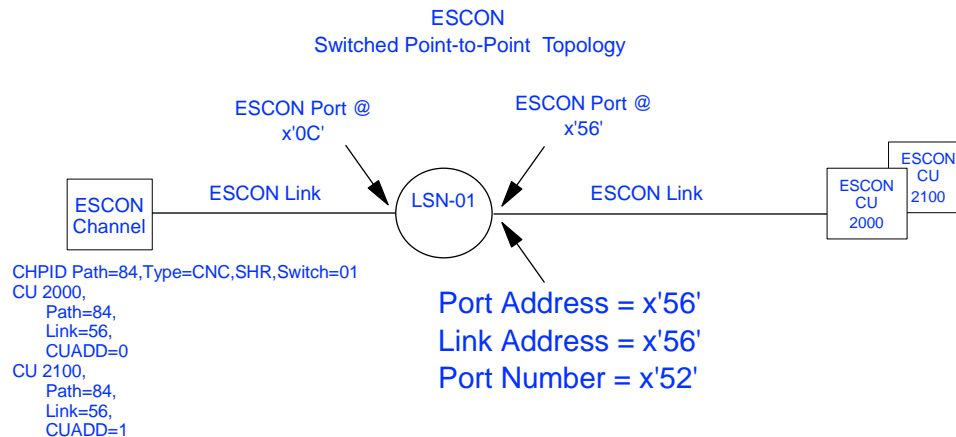
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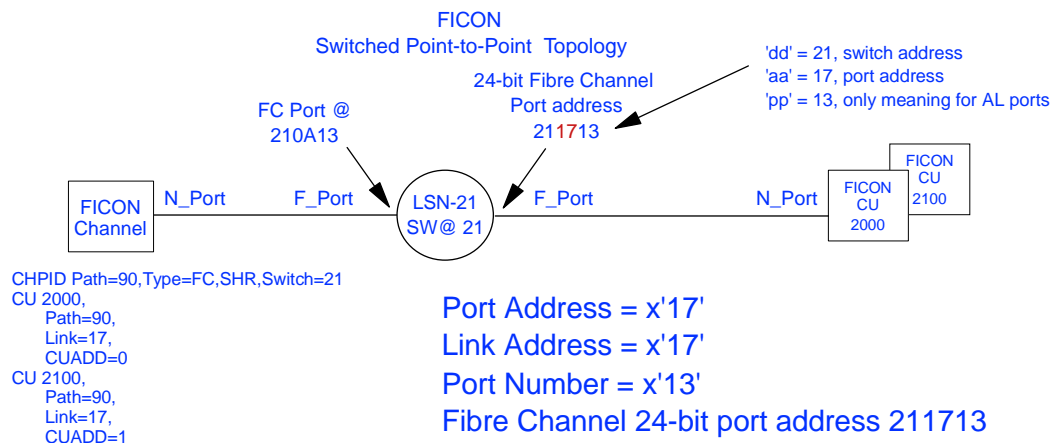
## ESCON Port Addresses and ESCON Link Addresses

- Every port on an ESCON switch has a 1 byte port address
  - The port address is defined in HCD and IOCP as a 1 byte link address



## FC Port Addresses and FICON Link Addresses

- For FICON every Fibre Channel switch F\_Port has a 24-bit fibre channel port address
  - The format of the 24-bit FC port address is 'dd aa pp', where:
    - 'dd' is the switch domain address
    - 'aa' is the area address, or the switches F\_Port port address
    - 'pp' is a meaningful value if the switch port is an Arbitrated Loop, it addresses the AL ports

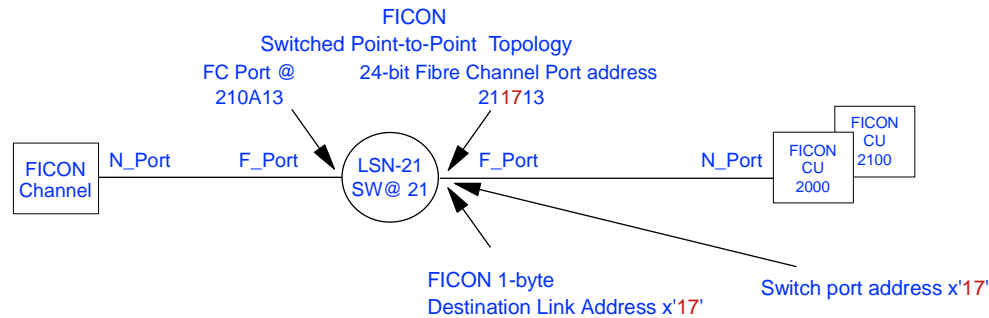


## FICON Port Address Usage

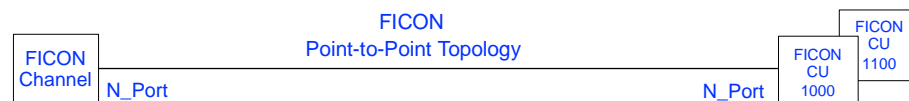
- In both the FCP and FICON environment the FC-4 command/data communication is from a Fibre Channel N\_Port port address (the FC source address S\_ID) and to a Fibre Channel N\_Port port address (the FC destination address D\_ID - the FCP Storage Device or the FICON Control Unit)
- There are two approaches to acquiring a Fibre Channel destination N\_Port port address
  - Discovery approach
    - Use WWN and discover the associated N\_Port port address by querying the Fabric "Name Server"
    - This approach is used by all FCP HBA users that are connected to a switched point-to-point topology (connected to a FC Fabric). This includes the IBM zSeries FICON channels defined in FCP mode.
  - Definition approach
    - Used by the IBM zSeries and 9672 G5/G6 processors for FICON channels defined in FC mode
    - Requires "persistent" and "predictable" F\_Port port address (this is a MUST)
    - This approach is used by FICON channels in SB-2 mode, connected to a switched point-to-point topology (connected to a FC Fabric)
    - zSeries FICON definition tool (HCD/IOCP) refers to the fibre channel port address as a "link address"

## FC Port Addresses and FICON Link Addresses

- In a single-switch definition topology, the FICON channel in FICON native (FC) mode requires that the middle byte of the 3-byte destination port address be defined as the link address
- The FICON channel acquires its 24-bit N\_Port address during the FLOGI-ACCEPT sequence
- The FICON channel then builds the full 24-bit destination FC N\_Port as follows:
  - 'dd' from the channels acquired 'dd' value (FLOGI-ACCEPT)
  - 'aa' the defined 1-byte link address
  - 'pp' from the channels acquired 'pp' value



- In a point-to-point topology the N\_Port addresses are assigned by one of the two N\_Ports (the one that has the higher WWN)



## ESCON and FICON - Link Addresses

- **ESCON Point-to-Point**
  - ▶ No ESCON channel-to-CU LINK address defined
  - ▶ The ESCON channel link initialization obtains/provides ESCON SLA and DLA
- **ESCON Switched Point-to-Point**
  - ▶ Define a 1 byte LINK address for Channel-to-CU Destination-Link-Address (DLA)
  - ▶ Channel link initialization obtains ESCON channel Source-Link-Address (SLA)
  - ▶ ESCON channel uses the defined 1-byte link address as the CUs DLA
- **FICON Point-to-Point**
  - ▶ No FICON channel-to-CU LINK address defined
  - ▶ The FICON channel FC link initialization obtains/provides the required Fibre Channel (FC) Source\_Identifier (S\_ID) and the Fibre Channel (FC) Destination\_Identifier (D\_ID)
    - The N\_Port that has the higher of the two N\_Port WWNs performs a PLOGI and assigns the S\_ID and D\_ID
- **FICON Switched Point-to-Point topology (Fibre Channel Fabric Topology)**
  - ▶ Define a 1-byte LINK address for the CU FC destination port (FC switch-to-CU port address)
  - ▶ Actual switch routing uses a 24-bit FC port address for the FC switch routing
  - ▶ The FICON channel-to-entry-switch FC link initialization
    - Obtains the FC 24-bit Source\_Identifier (S\_ID) from the FICON-channel entry-switch
    - Uses the defined 1-byte link address as byte 2 of the 24-bit FC Destination\_Identifier (D\_ID)
    - Bytes 1 and 3 of the 24-bit FC D\_ID are provided by the FICON channel (same as bytes 1 & 3 of the S\_ID)

## ESCON and FICON - Link Addresses

- All ESCON or FICON frames used for communication between a S/390 (or z/Architecture) channel (N\_Port) and a z/Architecture or S/390 CU interface (N\_Port) are required to have a source and destination frame identifiers.

- ▶ For ESCON end-node to end-node communication, the end-node identifiers are the Destination Logical and Source Logical. These comprises of:

- Destination Link Address (switch port address) and Destination Logical Address (CULA or LP number)
- Source Link Address (switch port address) and Source Logical Address (LP number or CULA)

ESCON Channel to CU communication →

DLA + DLOG (CULA)	SLA + SLOG (LP number)	Device Header (UA)	DIB
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ESCON CU to Channel communication →

DLA + DLOG (LP number)	SLA + SLOG (CULA)	Device Header (UA)	DIB
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- ▶ For FICON FC N\_Port to FC N\_Port communication, the source and destination identifiers are comprised of FC-FS (Fibre Channel - Framing and Signalling) and FC-SB-2 (FICON) addressing information.

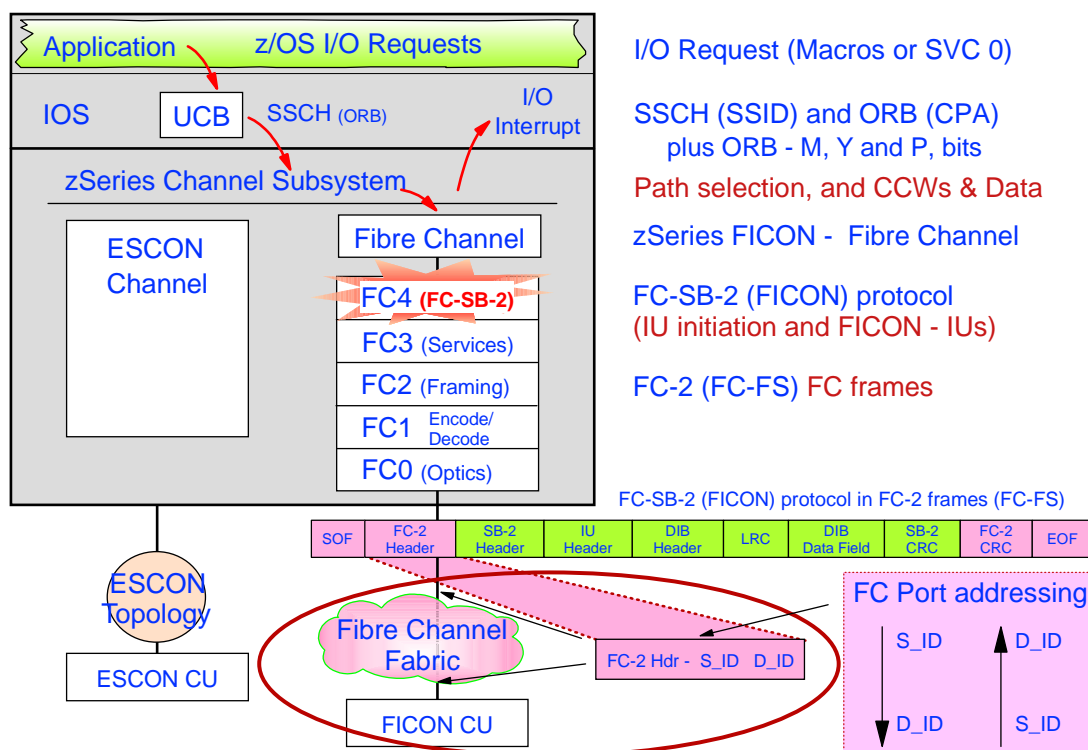
- The FC-FS (FC-2) header holds the Source Identifier (S\_ID a 24-bit FC port address) and the Destination Identifier (D\_ID a 24-bit FC port address)
- The SB-2 header (FICON) holds the Source and Destination logical identifier information, being the server node (processor) Channel Image ID, and the Storage Device (CU/Device) CU Image ID

FICON Channel to CU communication or FICON CU to Channel communication

S_ID + D_ID	Channel Image ID + CU Image ID + UA	DIB
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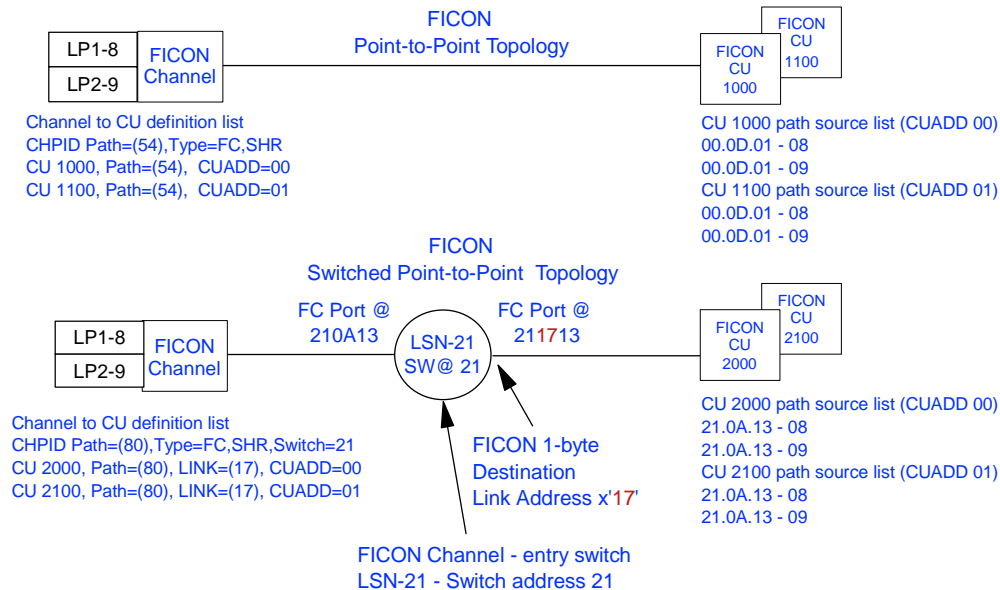
<---- FC-2 ----> <----- FC-2 Protocol Payload ----->  
 Header                      SB-2 Header

## FICON I/O Request to CU D\_ID

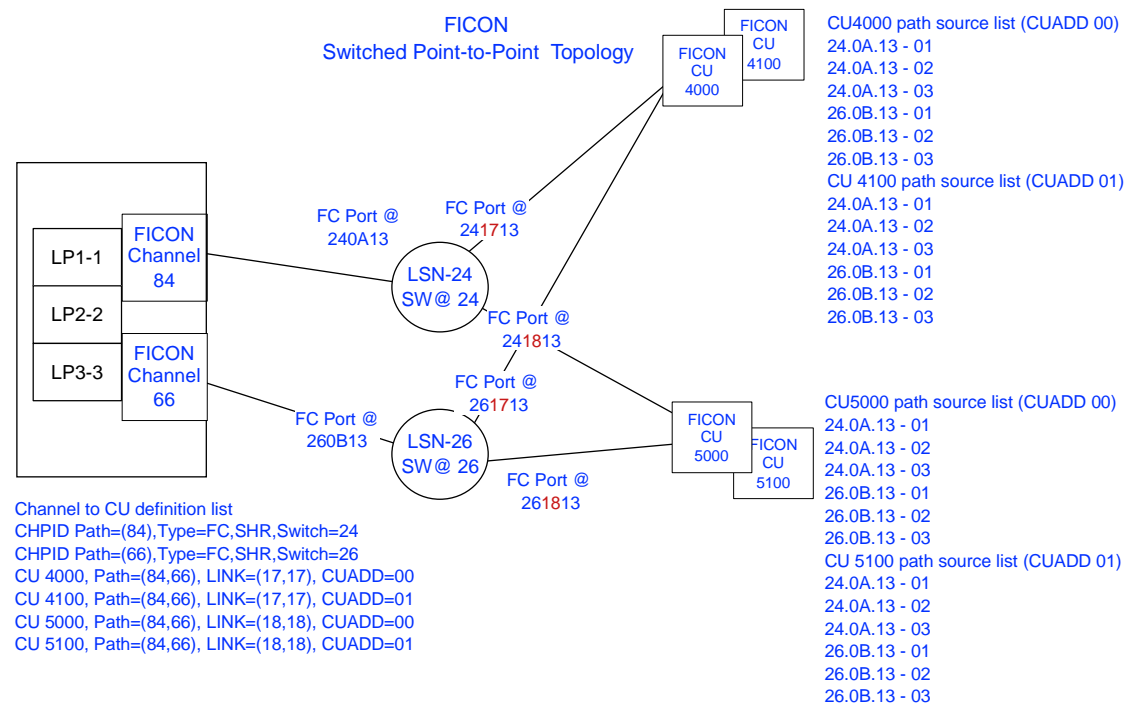


## FC Port Addresses and FICON Link Addresses

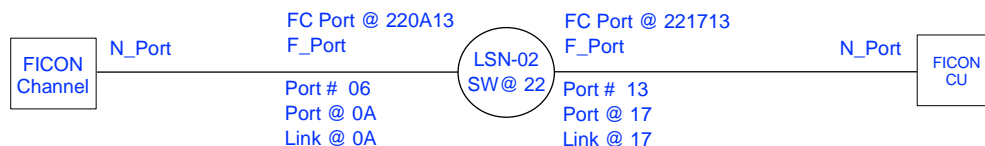
- The FICON channel entry-switch Logical Switch Number and the CU Destination Link address (switch port address) specifications required for a FICON channel to control unit path definition are:
  - Point-to-Point - no logical switch number and no defined CU destination link address are defined
  - Switched Point-to-Point - the channel entry-switch logical-switch-number, and a 1-byte CU destination link address (switch port address)



## FC Port Addresses and FICON Link Addresses



## FICON and Fibre Channel Term Glossary



Users of the information shown in this section need to be aware of the terms used by the: Fibre Channel, FICON channel, S/390 and zSeries processors, definition tools, the 'port', 'switch' and 'fabric', that the FICON channel and the FICON CU is connected to.

F\_Port - FC fabric switch port connected to a FC end node port (N\_Port)

N\_Port - FC end node (FICON channel or FICON CU interface)

E\_Port - FC fabric switch to switch port

G\_Port - undefined port usage

U\_Port - undefined port usage

FC port address - 24-bit port address (domain(dd) - area(aa) - port(pp))

S\_ID - FC-2 header source port ID address (Domain-Area-Port (AL) - dd aa pp)

D\_ID - FC-2 header destination port ID address (Domain-Area-Port (AL) - dd aa pp)

Switch Port number -1 byte number assigned to a port location (it should never change)

Switch Port address -1 byte address assigned to a port (same as the 'aa' field in the FC port address)

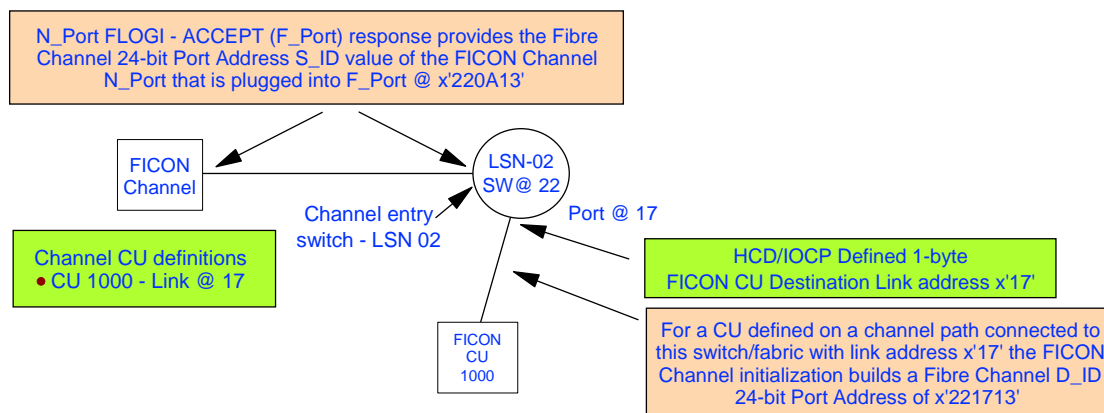
FICON switch Link address -1 or 2 byte address value (same as the 'aa' or 'ddaa' field in the FC port address)

FICON LSN (Logical Switch Number) must be unique value within an I/O definition file (IODF or IOCP deck)

FICON Switch address must be unique value within a fabric (same as the 'dd' field in the FC port address)

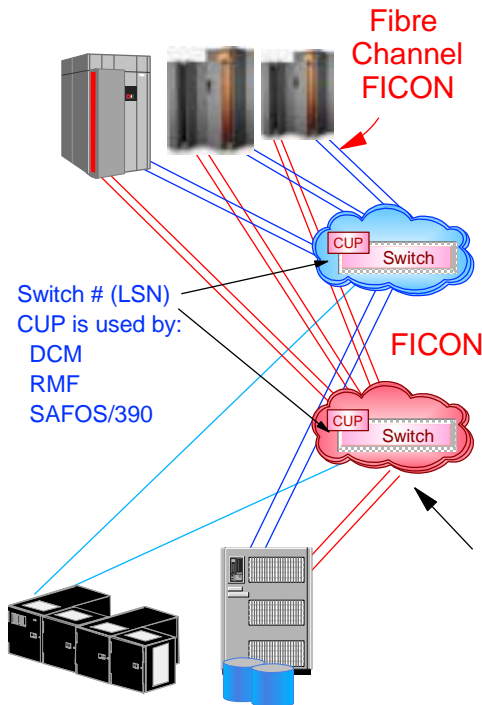
## FICON - Link Addresses - FC N\_Port

### FICON - Switched Point-to-Point Topology



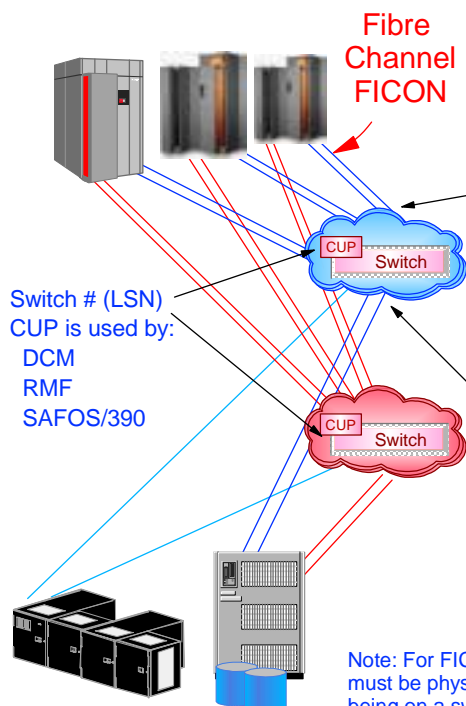
- Logical switch number and Link address specifications, for a channel to control unit path definition:
  - A non-cascade capable G5/G6 or zSeries processor can only support a 1-switch switched point-to-point topology for FICON channels (in FC mode), therefore only a 1 byte link address can be specified
  - A cascade capable zSeries processor can specify a 1 or 2 byte link address for CUs connected to FICON channels (in FC mode). If must be a 2-byte link address for cascading, but a 2-byte link address on a 1-switch switched point-to-point topology will only work if the entry switch is an Enterprise Fabric capable switch (High Integrity - Persistent Fabric)

## FICON - Non-Cascade Switching



- Two single switch Fibre Channel switch fabrics
  - Availability
  - Isolation
- 4 paths from any processor to any DASD CU shown
- z900 uses a one byte CU link @ definition for ESCON. The z900 uses the same definition approach for a FICON single switch topology path. FICON channels (in FC mode) do not use FC port address discovery. Therefore for FICON the z900 maintains the ESCON CU single byte link @ definition approach for FICON switched channel to CU paths (non-cascade switching). The z900 channel uses the 1-byte defined link address in building a required 24-bit FC destination port address.

## FICON - Non-cascade CU 'Link Addressing'



- z900 uses Device and one byte Link @ definition for ESCON. The z900 uses the same definition approach for FICON, it does not use FC port address discovery. Therefore the z900 maintains the ESCON single byte link @ definition approach for FICON 1-switch channel to CU path definitions.

24-bit FC port address

Domain	Area	Port (AL)
Bits 0-7	Bits 8-15	Bits 16-23

- Bits 1-8, 9-16, and bits 17-24 are all obtained by the FICON channel during the channel to fabric initialization (FLOGI-ACCEPT). When accessing a CU, bits 1-8 and 17-24 of the FLOGI-ACCEPT D\_ID FICON channel are used along with the 1-byte link address defined to access the CU, as bits 9-16 of the 24 bit D\_ID, all of which are then used to address N\_Port D\_ID.

24-bit z900 FICON D\_ID port address

Switch @	Link @	Constant
Bits 0-7	Bits 8-15	Bits 16-23

- I/O definition - Switched Point-to-Point (2000)  
CHPID - Path=(cc),Type=FC,Switch(LSN)=Dynamic/Entry Switch  
CU Path=(cc),Link=(LA),Connection Switch  
Where LA = middle 8 bits of the FC D\_ID 24 bit port address

Note: For FICON if the path is defined as being connected to a switched topology it must be physically connected to a switched topology. A channel path is defined as being on a switched topology if there is a CU defined on the channel that has a LINK defined for the CU that uses this path. This is a change from ESCON.

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## FICON Channel to CU zSeries Link Addresses and FC Cascade Switch F\_Port Addresses

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### FICON Port Address Usage

- In both the FCP and FICON environment the FC-4 command/data communication is from a Fibre Channel N\_Port port address (the FC source address S\_ID) and to a Fibre Channel N\_Port port address (the FC destination address D\_ID - the FCP Storage Device or the FICON Control Unit)
- There are two approaches to acquiring the Fibre Channel destination N\_Port port address
  - ▶ Discovery approach
    - Use WWN and discover the associated N\_Port port address by querying the Fabric "Name Server"
    - This approach is used by all FCP HBA users that are connected to a switched point-to-point topology (connected to a FC Fabric). This includes the IBM zSeries FICON channels defined in FCP mode.
  - ▶ Definition approach
    - Used by the IBM zSeries and 9672 G5/G6 processors for FICON channels defined in FC mode, for both 1 switch and multi-switch FICON channel paths
    - Requires "persistent" and "predictable" F\_Port port address (this is a MUST)
    - This approach is used by FICON channels in SB-2 mode, connected to a switched point-to-point topology, and multi-switch FC Fabrics
    - zSeries FICON definition tool (HCD/IOCP) refers to the fibre channel port address as a "link address"



## ESCON and FICON - Link Addresses

### ● ESCON Point-to-Point

- ▶ No ESCON channel-to-CU LINK address defined
- ▶ The ESCON channel link initialization obtains/provides ESCON SLA and DLA

### ● ESCON Switched Point-to-Point

- ▶ Define a 1 byte LINK address for Channel-to-CU Destination-Link-Address (DLA)
- ▶ Channel link initialization obtains ESCON channel Source-Link-Address (SLA)
- ▶ ESCON channel uses the defined 1-byte link address as the CUs DLA

### ● FICON Point-to-Point

- ▶ No FICON channel-to-CU LINK address defined
- ▶ The FICON channel FC link initialization obtains/provides the required Fibre Channel (FC) Source\_Identifier (S\_ID) and the Fibre Channel (FC) Destination\_Identifier (D\_ID)

### ● FICON Switched Point-to-Point topology (Fibre Channel Fabric Topology)

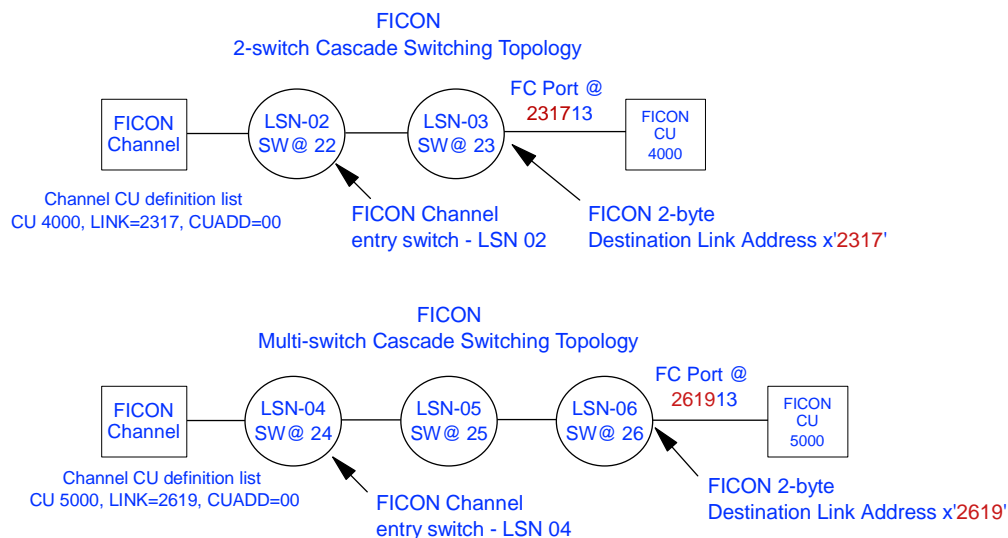
- ▶ Define a 1-byte LINK address for the CU FC destination port (FC switch-to-CU port address)
- ▶ Actual switch routing uses a 24-bit FC port address for the FC switch routing
- ▶ The FICON channel-to-entry-switch FC link initialization
  - Obtains the FC 24-bit Source\_Identifier (S\_ID) from the FICON-channel entry-switch
  - Uses the defined 1-byte link address as byte 2 of the 24-bit FC Destination\_Identifier (D\_ID)
  - Bytes 1 and 3 of the 24-bit FC D\_ID are provided by the FICON channel (same as bytes 1 & 3 of the S\_ID)

### ● FICON 2-switch Cascade Switching or Multi-switch cascade switching

- ▶ Define a 2-byte LINK address for the CU FC destination port (FC destination switch-to-CU port address)
- ▶ Actual switch routing uses a 24-bit FC port address for FC switch fabric routing
- ▶ The FICON channel-to-entry-switch FC link initialization
  - Obtains the FC 24-bit Source\_Identifier (S\_ID) from the FICON channel entry-switch
  - Uses the defined 2-byte link address as bytes 1 and 2 of the 24-bit FC Destination\_Identifier (D\_ID)
  - Byte 3 of the 24-bit FC D\_ID is provided by the FICON channel (same as byte 3 of the S\_ID)

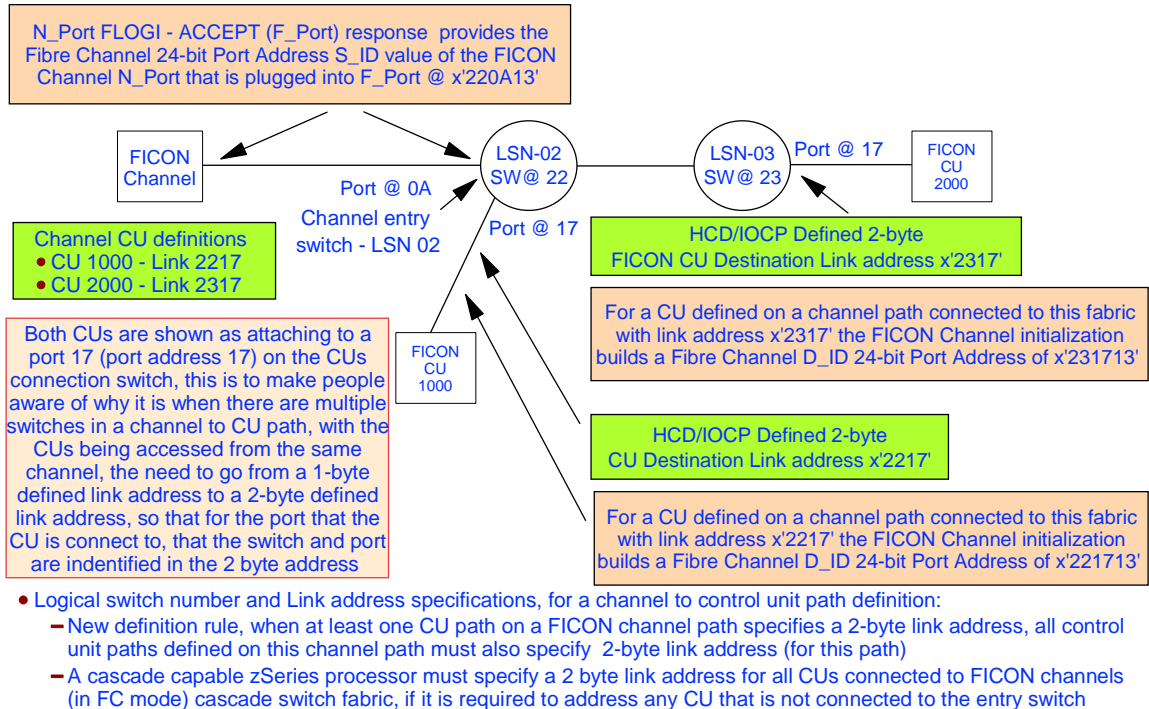
## FC Port Addresses and FICON Link Addresses

- The FICON channel entry-switch Logical Switch Number and the CU Destination Link address (switch port address) specifications required for a FICON channel to control unit path definition are:
  - 2-switch cascade switching - the channel entry switch logical-switch-number, and a 2 byte destination link address (the exit switch, switch domain address and switch port address)
  - Multi-switch cascade switching - the channel entry switch logical switch number, and a 2 byte destination link address (exit switch, switch domain address and switch port address)

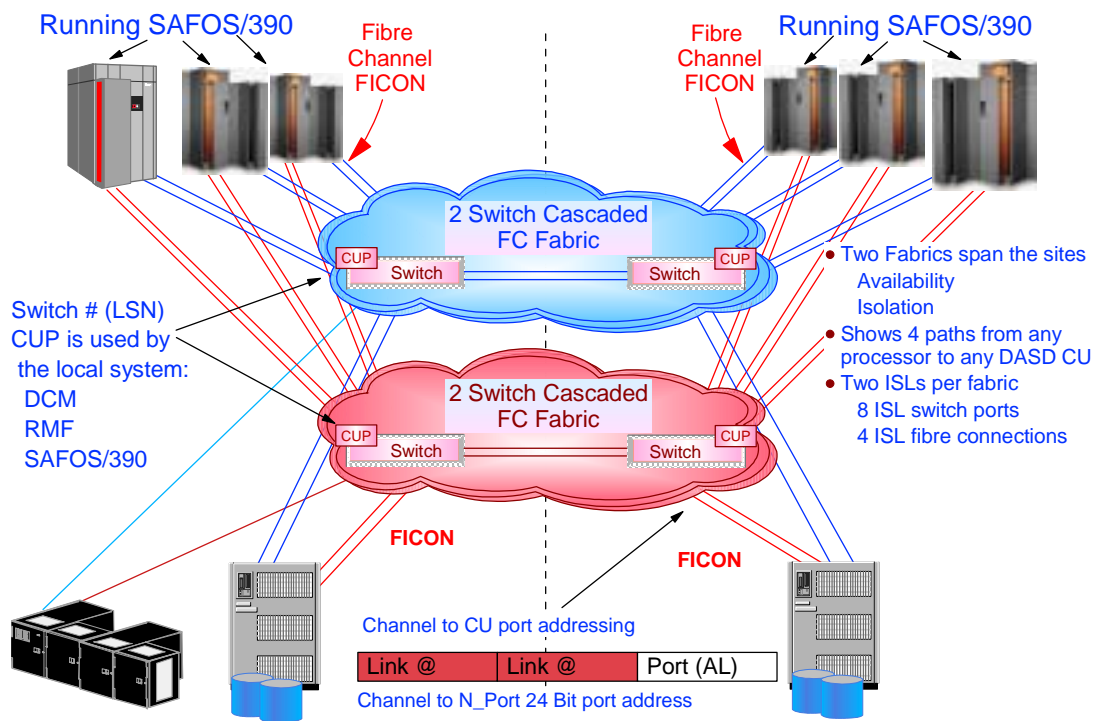


## Cascade Switching - FICON Link Addresses

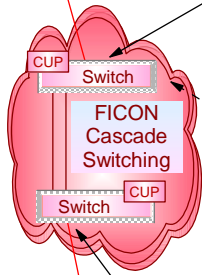
FICON 2-switch Cascade Switching Topology



## Cascade Switching - FICON Link Addresses



## Cascade Switching - FICON Link Addresses



For FICON 2-switch cascade switching the z900 FICON channel uses a **TWO**-byte Link @ definition. The z900 uses the 'definition' approach for FICON Point-to-Point (no link address), Switched Point-to-Point (1-byte link address), and now 2-switch Cascade switching (2-byte link address). The z900 does not use FC port address discovery method for FICON native channels.

24-bit FC port address (Channel to CU FC S\_ID)  
(not defined, it is obtained during the channel to switch link initialization)

Domain	Area	Port (AL)
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The FICON channel attached F\_Port S\_ID bits 0-23 ('dd' 0-7, 'aa' 8-15, 'pp' 16-23) are obtained by the channel during the channel to fabric initialization (FLOGI-ACCEPT).

z900 FICON built 24-bit port address (Channel to CU FC D\_ID)

Link @	Link @	Constant
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When a channel accesses a CU, bits 0-15 of the D\_ID comes from the 2-byte link address defined to access the CU. The channel provides bits 16-23 (the 'pp' value) from the 'pp' value obtained at the channel at the channel FLOGI time. The FICON channel requires that the 'pp' be the same for all switch F\_Port in the Fabric that the FICON channel is connected to.

IOCP definition statements for 2-Switch Cascade Switching - IOCP

CHPID - Path=(cc),Type=FC,Switch(LSN)=**Entry Switch**

Where the **Entry Switch** is the switch that the channel-to-switch-link is connected to

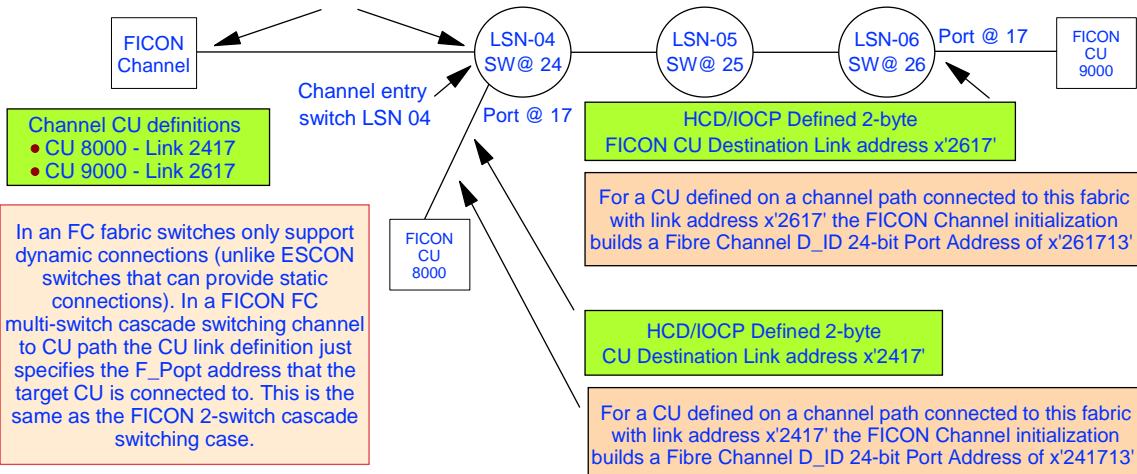
CU Path=(cc),Link=(**LALA**), (HCD also supports the CU Connection LSN switch and Port definition)

Where **LALA** = 1st 16 bits the FC D\_ID 24 bit port address of the F\_Port that the CU is connected to HCD also refers to CU Connection Switch, the LSN switch that the CU is connected to (not defined in IOCP). When using 2-switch cascade switching (or multi-switch) all CUs on the channel path require to be defined with a 2 byte link @. This applies to CUs attached to the 1st switch (channel entry switch) and the 2nd switch (the cascade switch, also known as the CU connected switch)

## Multi-Switch Cascade Switching - Link Addresses

FICON Multi-switch Cascade Switching Topology

N\_Port FLOGI - ACCEPT (F\_Port) response provides the Fibre Channel 24-bit Port Address S\_ID value of the FICON Channel N\_Port that is plugged into F\_Port @ x'240A13'



- Logical switch number and Link address specifications, for a channel to control unit path definition:
  - New definition rule, when at least one CU path on a FICON channel path specifies a 2-byte link address, all control unit paths defined on this channel path must also specify 2-byte link address (for this path)
  - A cascade capable zSeries processor must specify a 2 byte link address for all CUs connected to FICON channels (in FC mode) cascade switch fabric, if it is required to address any CU that is not connected to the entry switch

## FICON - LSNs and Switch Addresses

- A Logical Switch Number (LSN) must be unique in the scope of the I/O definition file
  - ▶ Unique within an HCD IODF
  - ▶ Unique within an IOCP source file
- Fibre Channel switch - Switch Address (FC Domain - bits 0-7 of the 24 bit FC port address) assignment in a Fabric used by FICON channel
  - ▶ A switch @ must be unique within an operational Fabric
- Switches in two *different fabrics* may have the same Switch @ but must have different logical switch numbers (LSN)
- To avoid confusion in this area it is recommended
  - ▶ The first action is assign different switch addresses to each Fibre Channel (FICON Director) when the FC switches are initially installed (hardware action)
  - ▶ Within an enterprise that the LSN be assigned the same number as the Switch @
- FICON channel switch topology requires that switch and port address in a fabric be persistent, and if FC fabric ports in *two different fabrics* with persistent switch and port addressees be connected together in any way and that there is then a conflict in the port addresses between the 2 fabrics that the connected ports enter a 'invalid attachment' state

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# FICON - Definition Support

