

- CA : 초기 할당된 flow control credit + 처리된 총 FC credit
- CL : 수신 측에 의해 업데이트되는 CA 값
- CR = CC + PTLP
- CC : 송신 측에서 보낸 총 credit
- PTLP : 한번 보낼 때 소모되는 TLP의 credit

$$CL - (CC + PTLP) \bmod 2^{[FieldSize]} \leq 2^{[FieldSize]}/2$$

- FCPs unit : 4DW(16B)
- TLP : Header + Data로 구성
- FC는 P, NP, Cpl로 나누어 진행
- Scaled FC를 지원하지 않을 때, HdrScale과 DataScale : X

[Field Size] for PH, NPH, CplH : 8bit

[Field Size] for PD, NPD, CplD : 12bit

- Scaled FC를 지원하지 않을 때,
PH : 1 unit – credit value of 01h
PD : 1024B/16B = 64d = 40h
NPH : 01h
CplH : RC-Switch -> 1unit – 01h / RC-EP -> infinite units – 0s
CplD : RC-Switch -> 40h / RC-EP -> infinite units – 0s
- Memory Read request : 1NPH -> 01h (header)
Memory Write request : 1PH + 1PD -> 01h (header) + 40h (data)
Memory Read Completion : 1CplH + n*CplD -> 01h (header) + n*40h (data)
- VC0만 사용, Scaled 지원 X
- Scaled FC를 지원하지 않는 수신 측은 data payload를 2047개 units 이상,
header를 127개 units 이상 누적해서는 안된다.
 - Field size와 관련됨($2^{12/2}$, $2^{8/2}$)
- UpdateFC FCP schedule 조건 (Non infinite – NPH, NPD, PH, CplH)
 - Scaled FC 비활성화 시에는 : 특정 유형의 사용 가능한 credit 수가 0이 되고, 해당 유형의 credit이 1개 이상 새로 제공된 경우
- UpdateFC FCP schedule 조건 (Non infinite – PD, CplD)
 - ARI Device(BF) : function 0?
 - Non ARI Device(BDF) : MAX_Payload_Size

Table 2-2 Fmt[2:0] Field Values

Fmt[2:0]	Corresponding TLP Format
000b	3 DW header, no data
001b	4 DW header, no data
010b	3 DW header, with data
011b	4 DW header, with data
100b	TLP Prefix
All encodings not shown above are Reserved (see Section 2.3).	

Table 2-3 Fmt[2:0] and Type[4:0] Field Encodings

TLP Type	Fmt [2:0] ³ (b)	Type [4:0] (b)	Description
MRd	000 001	0 0000	Memory Read Request
TLP Type	Fmt [2:0] (b)	Type [4:0] (b)	Description
MWr	010 011	0 0000	Memory Write Request
CplD	010	0 1010	Completion with Data - Used for Memory, I/O, and Configuration Read Completions. Also used for AtomicOp Completions.

1. Memory Read : Fmt[2:0],Type[4:0] = 000 00000 or 001 00000
2. Memory Write : Fmt[2:0],Type[4:0] = 010 00000 or 011 00000
3. Completion : Fmt[2:0],Type[4:0] = 010 01010

Table 2-4 Length[9:0] Field Encoding

Length[9:0]	Corresponding TLP Data Payload Size
00 0000 0001b	1 DW
00 0000 0010b	2 DW
...	...
11 1111 1111b	1023 DW
00 0000 0000b	1024 DW

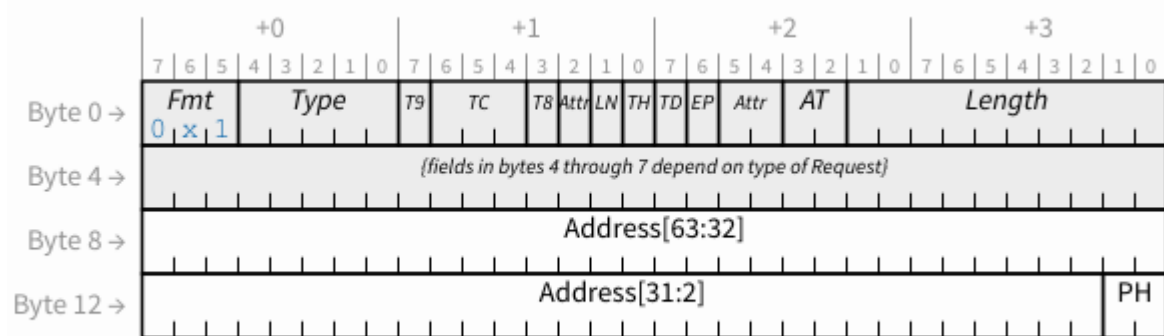


Figure 2-7 64-bit Address Routing

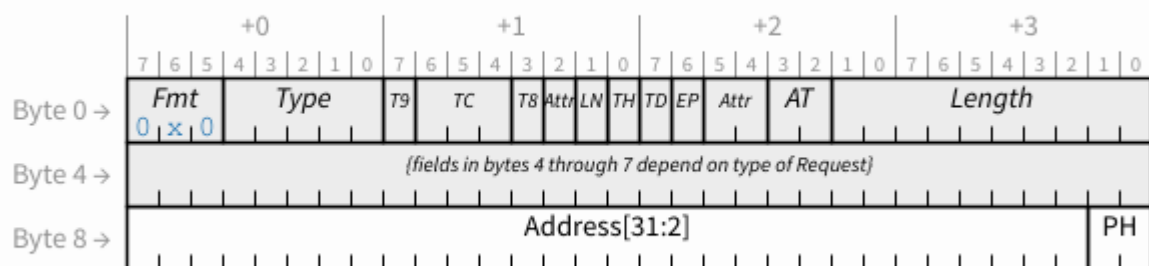


Figure 2-8 32-bit Address Routing

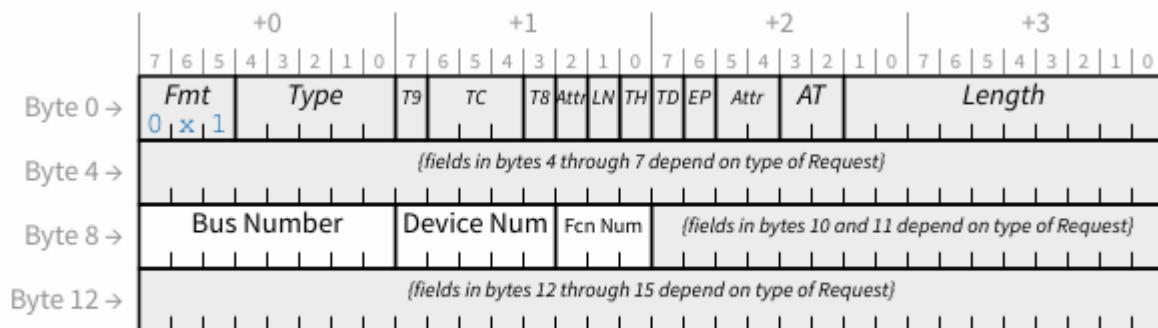


Figure 2-9 Non-ARI ID Routing with 4 DW Header

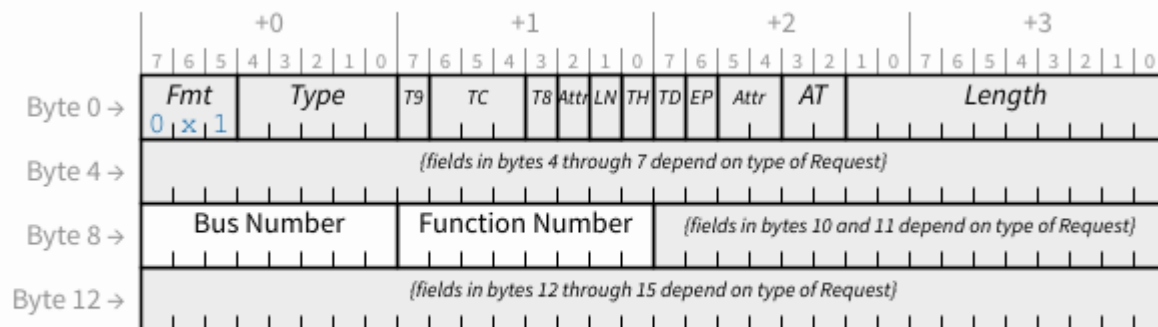


Figure 2-10 ARI ID Routing with 4 DW Header

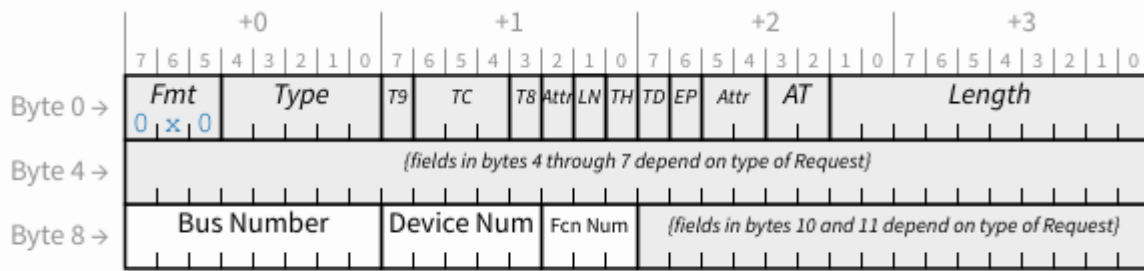


Figure 2-11 Non-ARI ID Routing with 3 DW Header

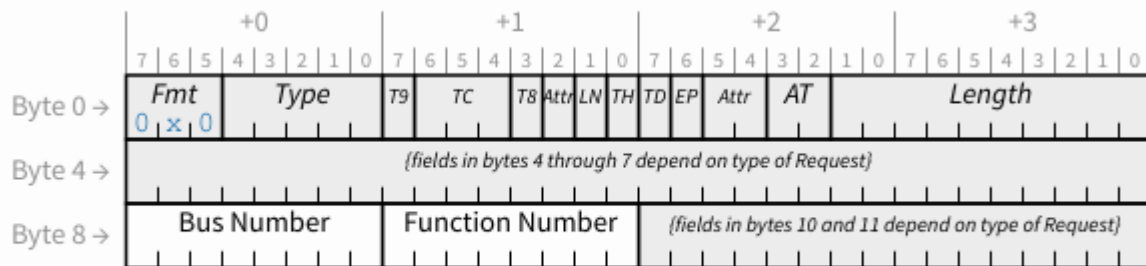


Figure 2-12 ARI ID Routing with 3 DW Header

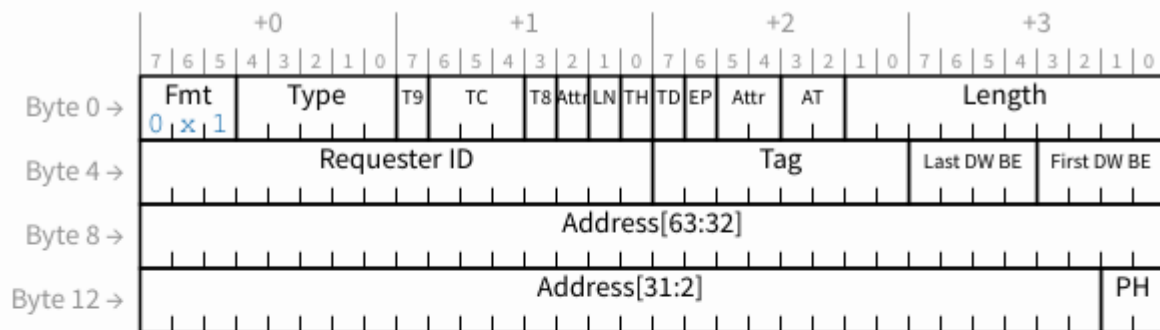


Figure 2-17 Request Header Format for 64-bit Addressing of Memory

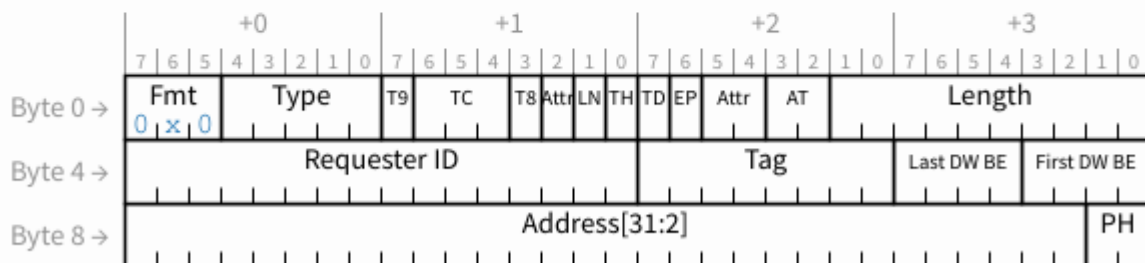
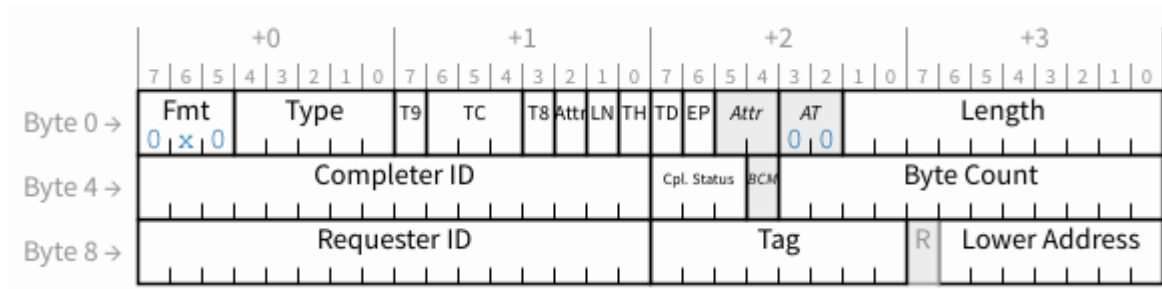


Figure 2-18 Request Header Format for 32-bit Addressing of Memory



Flow control

- ➔ DLLP의 일종인 FCPs(Flow Control Packets)를 이용하여 Flow Control information 전달.
- ➔ FCPs의 unit은 4DW(16B, 128bit) 이다.
- ➔ Flow control은 P, NP, Cpl의 3가지 타입으로 구분된다.
- ➔ Flow control은 Headers와 Data를 구분한다.

Table 2-42 Flow Control Credit Types

Credit Type	Applies to This Type of TLP Information
PH	Posted Request headers
PD	Posted Request Data payload
NPH	Non-Posted Request headers
NPD	Non-Posted Request Data payload
CplH	Completion headers
CplD	Completion Data payload

Table 2-43 TLP Flow Control Credit Consumption

TLP	Credit Consumed ³⁸
Memory, I/O, Configuration Read Request	1 NPH unit
Memory Write Request	1 PH + n PD units ³⁹
I/O, Configuration Write Request	1 NPH + 1 NPD Note: size of data written is never more than 1 (aligned) DW
AtomicOp Request	1 NPH + n NPD units
Message Requests without data	1 PH unit
Message Requests with data	1 PH + n PD units
Memory Read Completion	1 CplH + n CplD units
I/O, Configuration Read Completions	1 CplH unit + 1 CplD unit
I/O, Configuration Write Completions	1 CplH unit
AtomicOp Completion	1 CplH unit + 1 CplD unit Note: size of data returned is never more than 4 (aligned) DWs.

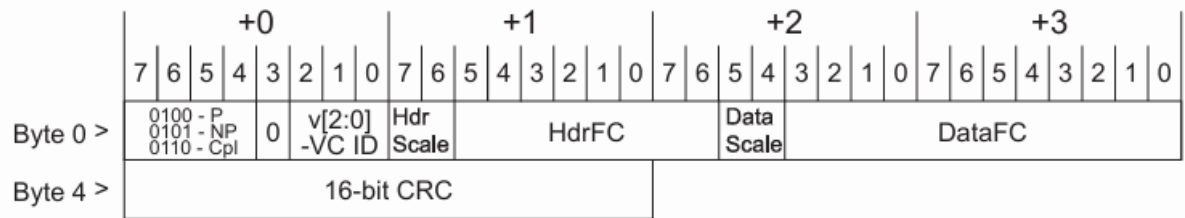
Table 2-44 Minimum Initial Flow Control Advertisements⁴⁰

Credit Type	Minimum Advertisement		
	No Scaling or Scale Factor 1	Scale Factor 4	Scale Factor 16
PH	1 unit - credit value of 01h.	4 Units - credit value of 01h.	16 Units - credit value of 01h.
PD	Largest possible setting of the Max_Payload_Size for the component divided by FC Unit Size. For an MFD, this includes all Functions in the device. Example: If the largest Max_Payload_Size value supported is 1024 bytes, the smallest permitted initial credit value would be 040h.	Ceiling(Largest Max_Payload_Size / (FC Unit Size * 4)) + 1. For an MFD, this includes all Functions in the device. Example: If the largest Max_Payload_Size value supported is 1024 bytes, the smallest permitted initial credit value would be 011h.	Ceiling(Largest Max_Payload_Size / (FC Unit Size * 16)) + 1. For an MFD, this includes all Functions in the device. Example: If the largest Max_Payload_Size value supported is 1024 bytes, the smallest permitted initial credit value would be 005h.
NPH	1 unit - credit value of 01h.	4 Units - credit value of 01h.	16 Units - credit value of 01h.
NPD	Receiver that supports AtomicOp routing capability or any AtomicOp Completer capability: 2 units - credit value of 002h All other Receivers: 1 unit - credit value of 001h.	Receiver that supports AtomicOp routing capability or any AtomicOp Completer capability: 8 units - credit value of 002h All other Receivers: 4 units - credit value of 001h.	Receiver that supports AtomicOp routing capability or any AtomicOp Completer capability: 32 units - credit value of 002h All other Receivers: 16 units - credit value of 001h.
CpLH	Root Complex (supporting peer-to-peer traffic between all Root Ports) and Switch: 1 FC unit - credit value of 01h Root Complex (not supporting peer-to-peer traffic between all Root Ports) and Endpoint: infinite FC units - initial credit value of all 0s. ⁴¹	Root Complex (supporting peer-to-peer traffic between all Root Ports) and Switch: 4 FC units - credit value of 01h Root Complex (not supporting peer-to-peer traffic between all Root Ports) and Endpoint: infinite FC units - initial credit value of all 0s. ⁴²	Root Complex (supporting peer-to-peer traffic between all Root Ports) and Switch: 16 FC units - credit value of 01h Root Complex (not supporting peer-to-peer traffic between all Root Ports) and Endpoint: infinite FC units - initial credit value of all 0s. ⁴³
CpLD	Root Complex (supporting peer-to-peer traffic between all Root Ports) and Switch: Largest possible setting of the Max_Payload_Size for the component divided by FC Unit Size.	Root Complex (supporting peer-to-peer traffic between all Root Ports) and Switch: Ceiling(Largest Max_Payload_Size / (FC Unit Size * 4)) + 1.	Root Complex (supporting peer-to-peer traffic between all Root Ports) and Switch: Ceiling(Largest Max_Payload_Size / (FC Unit Size * 16)) + 1.
Credit Type	Minimum Advertisement		
	No Scaling or Scale Factor 1	Scale Factor 4	Scale Factor 16
	Root Complex (not supporting peer-to-peer traffic between all Root Ports) and Endpoint: infinite FC units - initial credit value of all 0s.	Root Complex (not supporting peer-to-peer traffic between all Root Ports) and Endpoint: infinite FC units - initial credit value of all 0s.	Root Complex (not supporting peer-to-peer traffic between all Root Ports) and Endpoint: infinite FC units - initial credit value of all 0s.

Table 2-45 [Field Size] Values

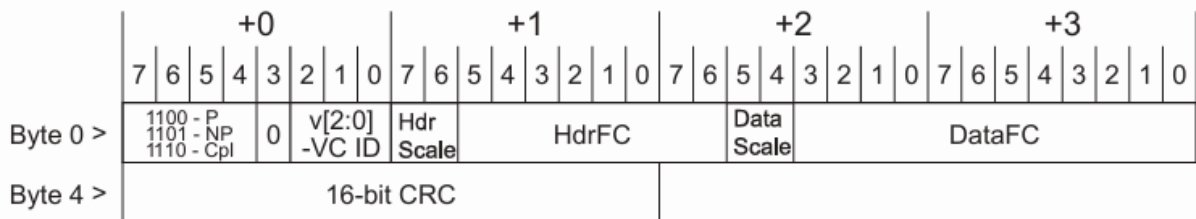
Scaled Flow Control Supported	HdrScale or DataScale	[Field Size] for PH, NPH, CplH	[Field Size] for PD, NPD, CplD
No	x	8	12
Yes	00b	8	12
Yes	01b	8	12
Yes	10b	10	14
Yes	11b	12	16

우리는 scaled flow control 지원X



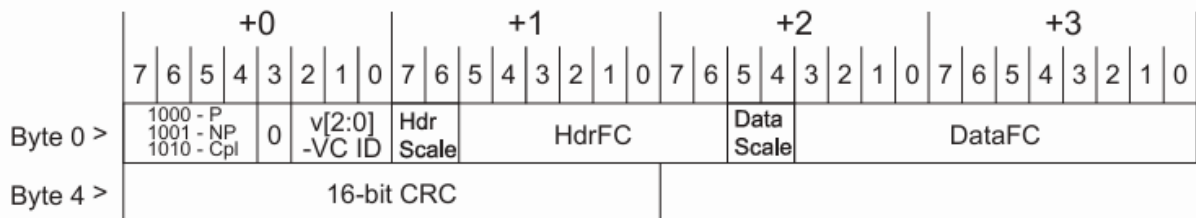
OM13782B

Figure 3-7 Data Link Layer Packet Format for InitFC1



OM13783B

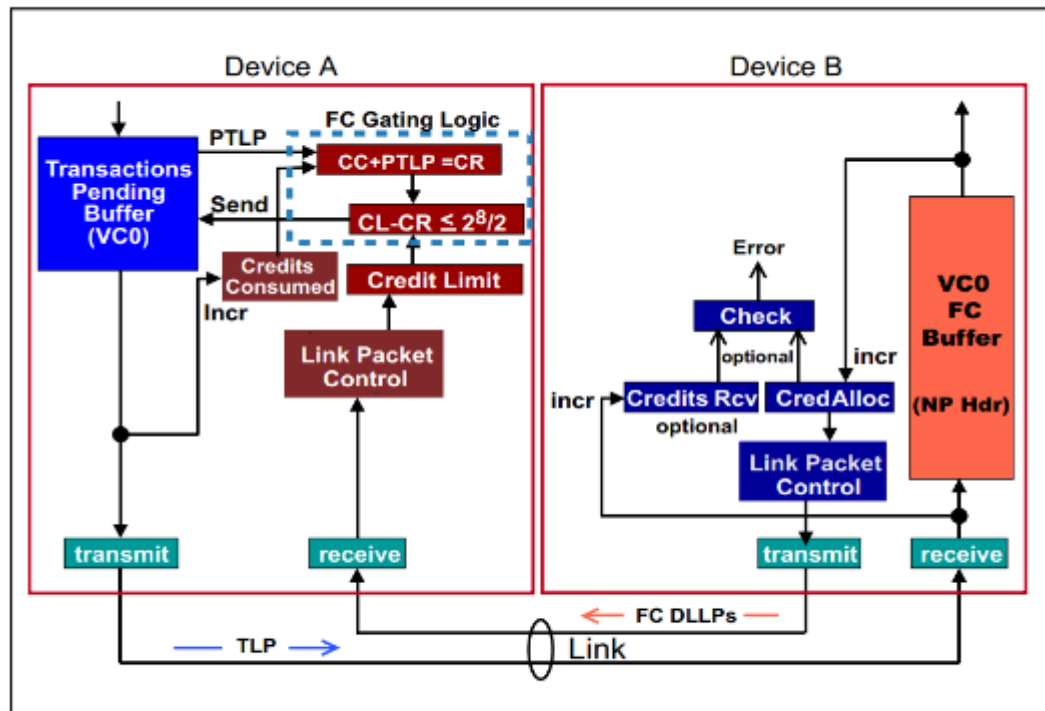
Figure 3-8 Data Link Layer Packet Format for InitFC2



OM13784B

Figure 3-9 Data Link Layer Packet Format for UpdateFC

Figure 6-8: Flow Control Elements



Reference) PCI Express Technology 3.0 [mindshare]