Arrive Technologies Inc.

PSEUDOWIRE CODECHIP™

Payload Size AndJitter Buffer Constrains

Revision 1.2

Document History

Issue	Date	Description
1.0	Nov. 10th, 2015	Initial Version
1.1	Mar. 14th, 2019	Correct some titles
1.2	May. 25th, 2020	Update supported minimum payload of DS1/E1 SAToP is 64 bytes

Contents

1. Pseudowire payload size supported range

Pseudowire payload size is configured in number of bytes in case of SAToP and CEP or number of DS1/E1 frame in case of CESoP. In the case of CESoP, payload size in bytes is calculated by number of DS0 slots in encapsulating NxDs0 multiplied with number of DS1/E1 frame configured for Pseudowire:

CESoP payload size in bytes = N * Number of DS1/E1 frames

Where: N isnumber of DS0 slots in encapsulating NxDs0

Minimum payload size in byte for each product and service is listedbelow.

Maximum payload size in byte of Pseudowire depends on how many bytes Ethernet header occupies in entire Ethernet packet and the maximum transmit unit (MTU) supported for each kind of service. Ethernet header includes DA, SA, Ethernet type, VLAN tags and PSN header (MPLS, UDP-IPv4, UDP-IPv6, …).

MTU is computed by Pseudowire payload plus Ethernet header. MTU for each product and service is also listed in below table.

For example, let calculate maximum Pseudowire payload size for OCN card in case of DS3 SAToP service running with MPLS 1 label and 1 VLAN tag.

Ethernet header bytes = DA + SA + Ethernet type (2 bytes) + Vlan tag (4 bytes) + MPLS label (4 bytes)

= 22 bytes

Maximum payload size = 2048 – 22 = 2026 bytes

1.1.1. OCN cards

Services	Minimum payload size in bytes	MTU (Note 2)
CESoP	8 (Note 1)	2048
DS1 SAToP	64	2048
E1 SAToP	64	2048
E3SAToP	256	2048
DS3SAToP	256	2048
VC11/VT1.5 CEP	104	2044
VC12/VT-2 CEP	140	2044
VC3/STS-1 CEP	256	2044
VC4/STS-3c CEP	783	4092
VC4_4c/STS-12C CEP	783	4092
VC4_16c/STS-48C CEP	783	4092

1.1.2. DS3/E3 card

Services	Minimum payload size in bytes	MTU (Note 2)
CESoP	8 (Note 1)	2048
DS1 SAToP	64	2048
E1 SAToP	64	2048
E3SAToP	256	2048
DS3SAToP	256	2048
VC11/VT1.5 CEP	104	2044
VC12/VT-2 CEP	140	2044
VC3/STS-1 CEP	256	2044

1.1.3. DS1/E1 card

Services	Minimum payload size in bytes	MTU (Note 2)
CESoP	8 (Note 1)	2048
DS1 SAToP	64	2048
E1 SAToP	64	2048

Note 1:

In the case of CESoP, the payload size must satisfy 2 constrains, CESoP payload size in bytes >= 8 bytes AND number of DS1/E1 frame>= 4 frames

Note 2:

MTU does not include FCS bytes

Payload size is not always configured successfully even when it's value is in supported range, payload size and jitter buffer size strictly depend on each other and also depend on remaining RAM resources using for jitter buffer.

2.   Payload size and Jitter buffer dependency

In hardware view, jitter buffer size is configured in packets unit reflects the number of packets received from PSN side, temporarily stored in buffer before playing-out to TDM circuit. SDK allows user to configure jitter buffer in both microsecond unit and packets unit.

When user configures buffer size in microsecond unit, if it is accepted by supported range of microsecond,it is convertedfrom microsecondunit to packets unitthen configure to hardware by formula:

NumBytes = Rate * BufferSizeUs

Jitter buffer size in packet unit = (NumByte / PayloadSize) + 1 if remaining of NumByte / PayloadSize is greater than or equal to one third of PayloadSize

Where:

- NumByte: The number of bytes corresponding to buffer size in microsecond and circuit rate
- Rate: Rate of Pseudowire's TDM circuit in byte per microsecond
- BufferSizeUs: Size of jitter buffer in microsecond
- PayloadSize: Pseudowire'spayload size in bytes

For example, assume that there is a DS1 SAToP service running on OCN card with payload size 200 bytes, jitter buffer size 16ms and user would like to modify jitter buffer size for this Pseudowire to 32ms. New buffer size in packets is computed as below:

DS1 rate is 193 bytes per millisecond

The number of bytes corresponding to 32 ms is 193 * 32 = 6144 bytes

Jitter buffer size in packets unit is 6144 / 200 + 1 = 31 packets

Anytime user wants to change Pseudowire payload size or jitter buffer size in microsecond, new buffer size in packets unit isre-calculated from new payload size withcurrent jitter buffer size (changing payload size) or new jitter buffer size with current payload size (changing jitter buffer size).This new buffer size in packets unit must satisfy the range that products support, otherwise, configuration will not be successful.

When user configure jitter buffer in packets unit, it must satisfy the supported range in packets, then it is converted from packets unit into micro second unit to double check with supported range in microsecond. Input buffer size in packets unit isapplied to hardware if it is accepted by both two constrains.

Formula to convert buffer in packets to microsecond unit:

NumBytes = BufferInPacket * PayloadSize

BufferInUs = NumBytes / Rate + 1 if remaining of NumBytes / Rate is larger than 0

Where:

- NumBytes: The number of bytes corresponding to buffer size in packets and payload size in bytes
- Rate: Rate of Pseudowire's TDM circuit in byte per microsecond
- BufferInUs: Jitter buffer size in mircosecond

The implementation limits the range of number of packets as jitter buffer size differently for each product and each service type as below.

2.1.1.   OCN cards

Services	Minimum buffer size in packets	Minimum buffer size in microsecond	Maximum buffer size in packets	Maximum buffer size in microsecond
CESoP	6	250	2048	256000
DS1 SAToP	6	250	2048	256000
E1 SAToP	6	250	2048	256000
E3SAToP	6	250	2048	256000
DS3SAToP	6	250	2048	256000
VC11/VT1.5 CEP	6	250	2048	256000
VC12/VT-2 CEP	6	250	2048	256000

Services	Minimum buffer size in packets	Minimum buffer size in microsecond	Maximum buffer size in packets	Maximum buffer size in microsecond
VC3/STS-1 CEP	6	250	8191	256000
VC4/STS-3c CEP	6	250	8191	256000
VC4_4c/STS-12C CEP	6	250	8191	128000
VC4_16c/STS-48C CEP	6	250	8191	64000

2.1.2.   DS3/E3 card

Services	Minimum buffer size in packets	Minimum buffer size in microsecond	Maximum buffer size in packets	Maximum buffer size in microsecond
CESoP	4	250	511	256000
DS1 SAToP	4	250	511	256000
E1 SAToP	4	250	511	256000
E3SAToP	4	250	511	256000
DS3SAToP	4	250	511	256000
VC11/VT1.5 CEP	4	250	511	256000
VC12/VT-2 CEP	4	250	511	256000
VC3/STS-1 CEP	4	250	511	256000

2.1.3.   DS1/E1 card

Services	Minimum buffer size in packets	Minimum buffer size in microsecond	Maximum buffer size in packets	Maximum buffer size in microsecond
CESoP	4	250	512	256000
DS1 SAToP	4	250	512	256000
E1 SAToP	4	250	512	256000

When jitter buffer size of a Pseudowireis configured, a part of RAM will be allocated with size corresponds with that buffer size, RAM allocation implementation is described in following part. Because RAM resourcesare limited, buffer size in packets unit (a combination of payload size and jitter buffer size in microsecond or size in packets directly input by user) will NOT always be successfully applied to hardware, it strictly depends on how much free RAM resources remain.

3.   RAM resources for Jitter Buffer

The implementation divides RAM part which is dedicated to the use of Pseudowirejitter buffer into memory blocks. Number of memory blocks occupied by a Pseudowireis calculated from payload size and Jitter Buffer size by formula:

BlocksPerPacket = (PayloadSize / BlockSize) + 1 if remaining of PayloadSize / BlockSizeis larger than 0

BlocksForBuffer = BlocksPerPacket * BufferSizeInPackets

Where

- BlocksPerPacket: Number of blocks occupied by each packet
- PayloadSize: Pseudowire payload size in bytes
- BlockSize: Memory block size in bytes
- BufferSizeInPackets: Jitter buffer size in packets
- BlocksForBuffer: Number of blocks occupied by Pseudowire

Total number of memory blocks and size in bytes of each block of each product are listed in table below.

Product	Total number of blocks	Block size in bytes	Total RAM
OCN card	524288	1024	512 Mbytes
DS3/E3 card	262144	256	64 Mbytes
DS1/E1card	16384	64	1 Mbytes

For example, table below demonstratestotal in-used RAM resources, there are some cases (cells in gray) payload size and buffer size in packets satisfy the range that product supports but total in-used RAM exceed the limitation. These values are computed with DS3/E3 card (64Mbytes), 1008 E1 SAToP services.

Sevice	Payload size in bytes	Number of blocks per packet	Jitter buffer size in packets	Occupied blocks by buffer	Total blocks of 1008 services	Total RAM usage [MB]
E1 SAToP	128	1	200	200	201,600	49.22
	256	1	200	200	201,600	49.22
	384	2	200	400	403,200	98.44
	512	2	200	400	403,200	98.44
	640	3	200	600	604,800	147.66