White Paper

Packet Voice Digital Signal Processor Module (PVDM3) Provisioning for IPSLA Video Operation (VO) in Cisco 2900/3900 Series Routers

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IP SLA Video Operation[1] is a new type of IP SLA probe that generates video traffic with the intention of stressing the network with the same traffic characteristics as a real video endpoint/application would. IP SLA VO is a Cisco Medianet[2] media monitoring[3] technology that enables synthetic traffic generation and monitoring using Cisco routers and switches. Together with other Medianet technologies like Performance Monitor and Mediatrace[4], IP SLA VO can be used for:

- Pre-deployment assessment of video applications
- Troubleshooting application performance both from an end-to-end as well as from a per-hop perspective
- Understand the effect of additional video traffic on a production network as well as competing forms of traffic

IPSLA VO is presently supported on the platforms listed in table 1 below:

Table 1. Platforms Supporting IPSLA VO

Platform	Sender Requirements	Responder Requirements	Starting from Image	License Requirements (Sender/Responder)
Cisco Catalyst 3k Series	No platform-specific requirement	No platform-specific requirement	Release 12.2(58)SE2	IPBase/IPBase
Cisco Catalyst 4k Series	SUP-7E, SUP-7LE	SUP-7E, SUP-7LE, SUP-6E	Release 15.1(1)G	IPBase/IPBase
Cisco ISR G2 Series	PVDM3[5] available on 2900, 3900 platforms	No DSP requirement; 1900, 2900, 3900, series	Release 15.2(2)T	UCk9/IPbase

The purpose of this paper is to provide sizing information for the procurement/allocation of PVDM3 DSPs for IPSLA VO on the Cisco 2900/3900 series (for the sender side).

DSP Sizing Information on 2900/3900 Series Routers

Table 2. PVDM3 Sizing Information

SKU	PVDM3-16	PVDM3-32	PVDM3-64	PVDM3-128	PVDM3-192	PVDM3-256
# of cores	1	1	2	3	5	6
Clock frequency (MHz)	300	400	550	550	550	550

[1] White Paper: Cisco IP Service Level Agreement Video Operation
[2] Cisco Medianet Homepage on Cisco.com
[3] Cisco Medianet Media Monitoring on Cisco.com
[4] White Paper: Cisco IOS Performance Monitor and Mediatrace Quick Start Guide
[5] Data sheet: High-Density Packet Voice Video Digital Signal Processor Module for Cisco Unified Communications Solutions

SKU	PVDM3-16	PVDM3-32	PVDM3-64	PVDM3-128	PVDM3-192	PVDM3-256
Credits per core	240	480	480	645	480, 645*	645
Total credits	240	480	960	1935	2895	3870
****Traffic max bit rate ≤ 1 Mbps**	30 credits per channel					
# channels per core	8	16	16	21	16, 21*	21
# channels per PVDM3	8	16	32	63	95	126
****Traffic max bit rate ≤ 2 Mbps**	40 credits per channel					
# channels per core	6	12	12	16	12, 16*	16
# channels per PVDM3	6	12	24	48	72	96
****Traffic max bit rate ≤ 4 Mbps**	60 credits per channel					
# channels per core	4	8	8	10	8, 10*	10
# channels per PVDM3	4	8	16	30	46	60

1. The user can use any of the PVDM3 choices listed in table 2 for generating IPSLA VO traffic. Each DSP has a number of cores with a fixed number of credits. The DSP as a whole has a number of credits available.
2. For traffic rate <= 1 Mbps, IPSLA VO needs 30 credits per stream/channel; for traffic rate<=2 Mbps. IPSLA VO would need 40 credits; and for traffic rate <=4 Mbps, IPSLA VO would need 60 credits.
3. From the above table (table 2), PVDM3-256 can support 126 1Mbps streams, 96 2Mbps streams and 60 4Mbps streams.
4. For bandwidth used by each IPSLA VO stream, refer to table 3 below:

Bandwidth Requirements for IPSLA VO Profiles on Cisco 2900/3900 Series

Table 3. Traffic Rate of Each IPSLA VO Profile

Platform	Pre-Packaged Profile Name	Pre-Packaged Profile Characteristics
Cisco ISR 2900/3900 Series	CP-9900-CIF-15-384kbps	Cisco Phone 9900 series BW=384Kbps, Resolution = CIF, Frames/Second = 15
	CP-9900-CIF-30-1000kbps	Cisco Phone 9900 series BW=1000Kbps, Resolution = CIF, Frames/Second = 30
	CP-9900-QCIF-10-79kbps	Cisco Phone 9900 series BW=79Kbps, Resolution = QCIF, Frames/Second = 10
	CP-9900-QCIF-15-99kbps	Cisco Phone 9900 series BW=99Kbps, Resolution = QCIF, Frames/Second = 15
	CP-9900-QCIF-30-249kbps	Cisco Phone 9900 series BW=249Kbps, Resolution = QCIF, Frames/Second = 30
	CP-9900-VGA-15-1000kbps	Cisco Phone 9900 series BW=1000Kbps, Resolution = VGA, Frames/Second = 15
	CP-9900-VGA-30-1000kbps	Cisco Phone 9900 series BW=1000Kbps, Resolution = VGA, Frames/Second = 30
	CTS-1080P-Best	Telepresence BW=4Mbps, Resolution = 1080P, Frames/Second = 30
	CTS-1080P-Better	Telepresence BW=3.5Mbps, Resolution = 1080P, Frames/Second = 30
	CTS-1080P-Good	Telepresence BW=3Mbps, Resolution = 1080P, Frames/Second = 30
	CTS-720P-Best	Telepresence

Platform	Pre-Packaged Profile Name	Pre-Packaged Profile Characteristics
		BW=2.2Mbps, Resolution = 720P, Frames/Second = 30
	CTS-720P-Better	Telepresence BW=1.5Mbps, Resolution = 720P, Frames/Second = 30
	CTS-720P-Good	Telepresence BW=1Mbps, Resolution = 720P, Frames/Second = 30
	CTS-720P-Lite	Telepresence BW=936Kbps, Resolution = 720P, Frames/Second = 30

PVDM3 Allocation Limitations for IPSLA VO

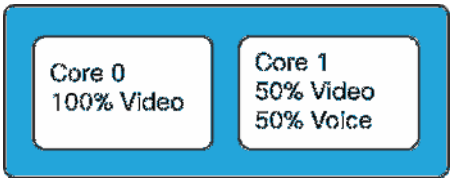
There are some limitations for the allocation of PVDM3 for IPSLA VO that the user needs to be aware of. PVDM3 is reserved on the router using the IOS® command below:

```
voice-card 0
 voice-service dsp-reservation <percentage>
#The above is for voice while the remaining DSP resources will be used for Video
```

IPSLA VO presently cannot use fragmented cores. A fragmented core is one that is allocated for both voice and video. This needs to be taken into consideration when procuring/provisioning PVDM3.

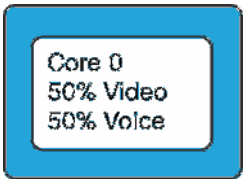
For illustration purposes, let us allocate 25% of DSP resources for voice. Video will be allocated 75% of DSP resources. In Figure 1 below, the PVDM3 has 2 cores: 100% of core 0 and 50% of core 1 is allocated for video; and 50% of core 1 is allocated for audio. Core 1 is therefore fragmented. IPSLA VO can reserve only Core 0 of the PVDM3. So in essence, even though we allocated 75% of DSP resources for video, we can only use 50% of the DSP resources (for this example).

Figure 1. PVDM3 with 1 un-fragmented and 1 fragmented DSP core



In Figure 2 below, the PVDM3 has a single core and is fragmented. Thus, this PVDM3 cannot be used for IPSLA VO.

Figure 2. PVDM3 with 1 fragmented core



PVDM3 Sizing Example

Let's work through an example for PVDM3 resource allocation for IPSLA VO, see below.

1. For this example, we have a Cisco 2921 router with 2 PVDM3 installed; PVDM3-64 and PVDM3-256.

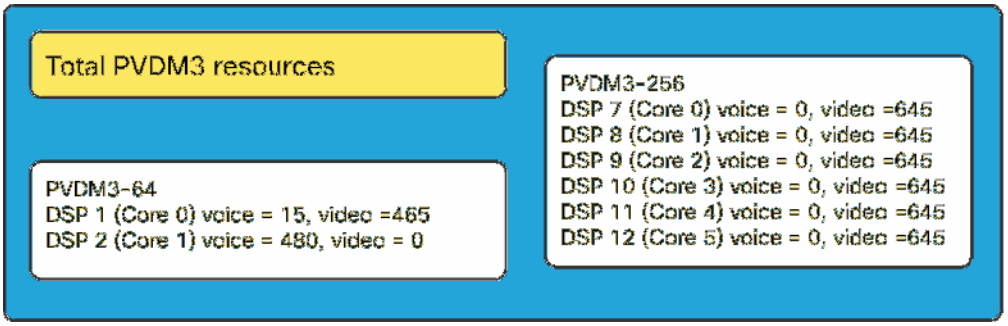
```
2921-AA0105#sh inventory
NAME: "CISCO2921/K9 chassis", DESCR: "CISCO2921/K9 chassis"
PID: CISCO2921/K9      , VID: V01 , SN: FTX1418AMSL

NAME: "VWIC2-1MFT-T1/E1 - 1-Port RJ-48 Multiflex Trunk - T1/E1 on Slot 0 SubSlot
0", DESCR: "VWIC2-1MFT-T1/E1 - 1-Port RJ-48 Multiflex Trunk - T1/E1"
PID: VWIC2-1MFT-T1/E1  , VID: V01 , SN: FOC14162Y38

NAME: "PVDM3 DSP DIMM with 64 Channels on Slot 0 SubSlot 4", DESCR: "PVDM3 DSP
DIMM with 64 Channels"
PID: PVDM3-64          , VID: V01 , SN: FOC14173WDU

NAME: "PVDM3 DSP DIMM with 256 Channels on Slot 0 SubSlot 5", DESCR: "PVDM3 DSP
DIMM with 256 Channels"
PID: PVDM3-256         , VID: V01 , SN: FOC133429NV

NAME: "SM-ES3G-24-P: EtherSwitch SM L3 + POE + 24 10/100/1000 on Slot 1", DESCR:
"SM-ES3G-24-P: EtherSwitch SM L3 + POE + 24 10/100/1000"
PID: SM-ES3G-24-P      , VID: V01 , SN: FOC14451GPD

NAME: "C2921/C2951 AC Power Supply", DESCR: "C2921/C2951 AC Power Supply"
PID: PWR-2921-51-AC    , VID: V01 , SN: QCS1414H198
```

2. Let's reserve 10% of PVDM3 resources for voice. This will allocate 90% of PVDM3 resources for video.

```
voice-card 0
 voice-service dsp-reservation 10
```

3. The voice and video credits will be split among multiple cores of the PVDM3-64 and PVDM3-256. Let's do a "show dsp-group all" to see this partition.

Figure 3. Allocation of PVDM3 resources between voice and video




```
2921-AA0105#show dsp-group all
DSP groups on slot 0:
dsp 1:
```

```
  State: UP, firmware: 31.1.0
  Max signal/voice channel: 32/32
  Max credits: 480, Voice credits: 15, Video credits: 465
  num_of_sig_chnls_allocated: 0
  Transcoding channels allocated: 0
  Group: FLEX_GROUP_VIDEO_POOL, complexity: FLEX
    Video Credits Max: 465, Share: 465, Reserved (rounded-up): 0
    num_video_bridge: 0, num_video_codec: 0
    num_audio_xcoder: 0, num_synvideo: 0, num_vqm: 0
  Group: FLEX_GROUP_VOICE, complexity: FLEX
    Shared credits: 15, reserved credits: 0
    Signaling channels allocated: 0
    Voice channels allocated: 0
    Credits used (rounded-up): 0
  Slot: 0
  Device idx: 0
  PVDM Slot: 0
  Dsp Type: SP2600

dsp 2:
  State: UP, firmware: 31.1.0
  Max signal/voice channel: 32/32
  Max credits: 480, Voice credits: 480, Video credits: 0
  num_of_sig_chnls_allocated: 0
  Transcoding channels allocated: 0
  Group: FLEX_GROUP_VOICE, complexity: FLEX
    Shared credits: 480, reserved credits: 0
    Signaling channels allocated: 0
    Voice channels allocated: 0
    Credits used (rounded-up): 0
  Slot: 0
  Device idx: 0
  PVDM Slot: 0
  Dsp Type: SP2600

dsp 7:
  State: UP, firmware: 31.1.0
  Max signal/voice channel: 43/43
  Max credits: 645, Voice credits: 0, Video credits: 645
  num_of_sig_chnls_allocated: 0
  Transcoding channels allocated: 0
  Group: FLEX_GROUP_VIDEO_POOL, complexity: FLEX
    Video Credits Max: 645, Share: 645, Reserved (rounded-up): 0
    num_video_bridge: 0, num_video_codec: 0
    num_audio_xcoder: 0, num_synvideo: 0, num_vqm: 0
  Slot: 0
```

```
  Device idx: 0
  PVDM Slot: 1
  Dsp Type: SP2600

dsp 8:
  State: UP, firmware: 31.1.0
  Max signal/voice channel: 43/43
  Max credits: 645, Voice credits: 0, Video credits: 645
  num_of_sig_chnls_allocated: 0
  Transcoding channels allocated: 0
  Group: FLEX_GROUP_VIDEO_POOL, complexity: FLEX
    Video Credits Max: 645, Share: 645, Reserved (rounded-up): 0
    num_video_bridge: 0, num_video_codec: 0
    num_audio_xcoder: 0, num_synvideo: 0, num_vqm: 0
  Slot: 0
  Device idx: 0
  PVDM Slot: 1
  Dsp Type: SP2600

dsp 9:
  State: UP, firmware: 31.1.0
  Max signal/voice channel: 42/43
  Max credits: 645, Voice credits: 0, Video credits: 645
  num_of_sig_chnls_allocated: 0
  Transcoding channels allocated: 0
  Group: FLEX_GROUP_VIDEO_POOL, complexity: FLEX
    Video Credits Max: 645, Share: 645, Reserved (rounded-up): 0
    num_video_bridge: 0, num_video_codec: 0
    num_audio_xcoder: 0, num_synvideo: 0, num_vqm: 0
  Slot: 0
  Device idx: 0
  PVDM Slot: 1
  Dsp Type: SP2600

dsp 10:
  State: UP, firmware: 31.1.0
  Max signal/voice channel: 43/43
  Max credits: 645, Voice credits: 0, Video credits: 645
  num_of_sig_chnls_allocated: 0
  Transcoding channels allocated: 0
  Group: FLEX_GROUP_VIDEO_POOL, complexity: FLEX
    Video Credits Max: 645, Share: 645, Reserved (rounded-up): 0
    num_video_bridge: 0, num_video_codec: 0
    num_audio_xcoder: 0, num_synvideo: 0, num_vqm: 0
  Slot: 0
  Device idx: 1
```

```
  PVDM Slot: 1
  Dsp Type: SP2600

dsp 11:
  State: UP, firmware: 31.1.0
  Max signal/voice channel: 43/43
  Max credits: 645, Voice credits: 0, Video credits: 645
  num_of_sig_chnls_allocated: 0
  Transcoding channels allocated: 0
  Group: FLEX_GROUP_VIDEO_POOL, complexity: FLEX
    Video Credits Max: 645, Share: 645, Reserved (rounded-up): 0
    num_video_bridge: 0, num_video_codec: 0
    num_audio_xcoder: 0, num_synvideo: 0, num_vqm: 0
  Slot: 0
  Device idx: 1
  PVDM Slot: 1
  Dsp Type: SP2600

dsp 12:
  State: UP, firmware: 31.1.0
  Max signal/voice channel: 42/43
  Max credits: 645, Voice credits: 0, Video credits: 645
  num_of_sig_chnls_allocated: 0
  Transcoding channels allocated: 0
  Group: FLEX_GROUP_VIDEO_POOL, complexity: FLEX
    Video Credits Max: 645, Share: 645, Reserved (rounded-up): 0
    num_video_bridge: 0, num_video_codec: 0
    num_audio_xcoder: 0, num_synvideo: 0, num_vqm: 0
  Slot: 0
  Device idx: 1
  PVDM Slot: 1
  Dsp Type: SP2600
slot 0: total video credits: 4335; reserved/used: 0 (0%)

DSP groups on slot 1:
 This command is not applicable to slot 1

  0 DSP resource allocation failure
```

4. PVDM3-64 cannot be used for IPSLA VO because of a fragmented core and another core allocated only for audio. Only PVDM3-256 can be used for IPSLA VO.
5. Let's configure an IPSLA VO session to generate 1080P-Best quality TelePresence traffic, which has a traffic rate of 4 Mbps. Each operation can either reserve DSP resource, or use best-effort to grab a DSP resource when the operation is started. In this example, we reserve DSP statically. For more information, refer to Figure 6 in the IP SLA Video Operation Across Platforms white paper[6]

[6] White Paper: IPSLA Video Operation Across Platforms

```
ip sla 1
 video 10.10.1.6 20000 source-ip 10.10.1.5 source-port 30000 profile CTS-1080P-
Best
 duration 120
 reserve dsp
 frequency 200
ip sla schedule 1 life forever start-time now
```

6. DSP 12 core has been allocated for this operation and 60 credits have been reserved (as listed in table 2).

```
2921-AA0105#show dsp-group all
dsp 12:
  State: UP, firmware: 31.1.0
  Max signal/voice channel: 42/43
  Max credits: 645, Voice credits: 0, Video credits: 645
  num_of_sig_chnls_allocated: 0
  Transcoding channels allocated: 0
  Group: FLEX_GROUP_VIDEO_POOL, complexity: FLEX
    Video Credits Max: 645, Share: 585, Reserved (rounded-up): 60
    num_video_bridge: 0, num_video_codec: 0
    num_audio_xcoder: 0, num_synvideo: 1, num_vqm: 0
  Group: FLEX_GROUP_SYNVIDEO:
    DSP reservation status:
      Operation 1041797457 - slot 0, dsp_id 12, credit reserved 60, codec
voipCodecSynvideo4Mbps
  Slot: 0
  Device idx: 1
  PVDM Slot: 1
  Dsp Type: SP2600

slot 0: total video credits: 4335; reserved/used: 60 (1%)
```

Summary

1. This document listed the number of IPSLA VO traffic streams supported per PVDM3 type on the Cisco 2900/3900 Series.
2. Limitations of PVDM3, when allocating DSP resources for voice and video, need to be considered for provisioning/allocation.
3. A working example was considered and IOS® commands were introduced for a better understanding of PVDM3 allocation for IPSLA VO.

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