3DNR Parameter Configuration Description

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1 Parameter Configuration of Advanced VPSS 3DNR Interfaces

1.1 Data Structure

```
typedef struct
{
    int  ISO;
    HI_U8   SFC, TFC, _reserved_B_[3];
    HI_U8   SHPi, SBSi,SBTi, SDSi,SDTi, MDZi;
    HI_U8   SHPj, SBSj,SBTj, SDSj,SDTj, MDZj;
    HI_U8   SHPk, SBSk,SBTk, SDSk,SDTk;
    HI_U16  SBFi : 2, SBFj : 2, SBFk : 2, MATH : 10;
    HI_U16  TFSi : 4, TFSj : 4, TFSk : 4, PSFS : 4;
    HI_U16  TFRi : 5, TFRj : 5, TFRk : 5, Post : 1;

} tVppNRbCore;

typedef struct
{
    tVppNRbCore  iNRb;

    HI_U8   MDAF : 3, PostROW : 5;
    HI_U8   MATW : 2, ExTfThr : 5;
    HI_U8   MABW : 1, TextThr;
    HI_U8   MTFS;
 } tVppNRbEx;
```

It is necessary to describe the internal structure of the 3DNR module before introducing the VppNRbEx interface.

The 3DNR module consists of five physical sub modules: UNITi, UNITj, UNITk, DeSand, and NRc (for color difference noise reduction).

According to the naming convention of the tVppNRbCore data structure, members with the subscript i, j, and k control the behavior of the UNITi, UNITj, and UNITk sub modules respectively. **.MATH** also controls the behavior of UNITk. **.PSFS** controls the behavior of the DeSand sub module and its value is the desand strength.

.Post is a switch. If **.Post** is set to **0**, the 3DNR module works in front-end enhanced mode. In this case, the luminance of the source picture is processed by the UNITi, UNITj, UNITk, and DeSand submodules of the 3DNR module in sequence. If **.Post** is set to **1**, the 3DNR module works in back-end enhanced mode. In this case, the luminance of the source picture is processed by the UNITi, UNITk, UNITj, and DeSand submodules of the 3DNR module in sequence. In front-end enhanced mode, UNITi is allowed (not necessarily) to enter the edge enhanced mode. In back-end enhanced mode, UNITj is allowed to enter the edge enhanced mode. However, UNITk is always in NR mode.

UNITi and UNITj can be in NR mode at the same time, but cannot be in edge enhanced mode at the same time.

In the following sections, UNITx represents UNITi, UNITj, and UNITk, and .SBSx represents .SBSi, .SBSj, and .SBSk.

.SHPx ranges from 0 to 127. When **.SHPx** is greater than 64, UNITx enters the edge enhanced mode; when **.SHPx** is less than or equal to 64, UNITx enters the NR mode. Therefore, the value range of **.SHPk** is 0−64 because UNITk is always in NR mode.

When **.SHPx** is greater than 64, the behavior of UNITx is affected only by **.SHPx**. The values of **.SBSx** and **.SBTx** have no impact on the UNITx output. When **.SHPx** is greater than 64 (that is, in edge enhanced mode), the value of **.SHPx** is the enhanced strength of the UNITx input picture. When **.SHPx** is **65**, the strength is the weakest; when **.SHPx** is **127**, the strength is the greatest. When **.SHPx** is less than or equal to 64, **.SHPx** indicates the relative definition of the static zone. After the spatial-domain filter (its behavior is controlled by **.SBSx**, **.SBTx**, **.SDSx**, **.SDTx**, and **.SBFx**) is configured, **.SHPx** indicates the highest definition of the static zone when its value is 64 and the lowest definition of the static zone when its value is 0.

When the definition is high, there are many details in the static zone whereas granular noises are obvious. When the definition is low, there are few details in the static zone whereas granular noises are not obvious and the picture is smooth.

.MDZx ranges from 0 to 127 and it is a threshold. UNITx estimates the motion intensity of each pixel in the input picture and obtains the motion index of each pixel. When the motion index of a pixel is less than or equal to **.MDZx**, this pixel is considered to be in the static zone. When the motion index of a pixel is greater than **.MDZx**, this pixel is considered to be in the motion zone. Therefore, a larger **.MDZx** indicates more pixels in the static zone and fewer noises in the output picture; a smaller **.MDZx** indicates fewer pixels in the static zone and more noises in the output picture.

Similar to **.MDZx** (**.MDZi** and **.MDZj**), **.MATH** is also a threshold and it ranges from 0 to 511. **.MATH** affects the motion estimation of UNITk. UNITk estimates the motion intensity of each pixel in the input picture more precisely than UNITi and UNITj, and obtains the motion index of each pixel. When the motion index of a pixel is less than or equal to **.MATH**, this pixel is considered to be in the static zone. When the motion index of a pixel is greater than **.MATH**, this pixel is considered to be in the motion zone. Therefore, a larger **.MATH** indicates more pixels in the static zone and fewer noises in the output picture; a smaller **.MATH** indicates fewer pixels in the static zone and more noises in the output picture.

The motion estimation of UNITk is more precise than that of UNITi/UNITj. Therefore, the risk of smearing occurrence caused by increasing **.MATH** (to reduce picture noises) is lower than that of smearing occurrence caused by increasing **.MDZx** (to reduce picture

noises). **.MATH** is the most important parameter of the time-domain filter, and the strength of time-domain filtering is mainly determined by **.MATH**.

.TFSx ranges from 0 to 15 and it determines the fewest noises in the output picture and it is typically set to **12**. **.MDZx** and **.MATH** determine the number of pixels in the static region; **.TFSx** determines the strength upper limit of UNITx time-domain filtering on the static region.

.TFRx ranges from 0 to 31 and it determines the strength of the UNITx anti-smearing mechanism. A larger value indicates weaker anti-smearing strength and greater time-domain filtering strength. UNITk does not require a powerful anti-smearing mechanism because its motion estimation is precise. Therefore, **.TFRk** is typically set to the maximum value **31**. For UNITi and UNITj, smaller **MDZi** and **MDZj** indicate higher requirement on the anti-smearing mechanism and larger configured values of **.TFRi** and **.TFRj**.

.SBSx, **.SBTx**, **.SDSx**, **.SDTx**, and **.SBFx** determine the strength of the spatial-domain filter. UNITx implements only spatial-domain filtering on the motion region and implements a blending of spatial-domain filtering and time-domain filtering on the static region (the blending ratio is determined by **.SHPx**).

The spatial-domain filtering implemented on the static region is the same as that implemented on the motion region, and the filtering strength is determined by the preceding five parameters. However, the static region is clearer than the motion region in any case. There are two reasons. On the one hand, even if **.SHPx** is set to **0**, there is still a probability that the output of the time-domain filter is selected for static region filtering. On the other hand, if **.SHPx** is set to **64**, only the output of the time-domain filter is used for static region filtering.

.SBSx and **.SBTx** take effect on the bright region of the picture.

- **.SBSx** ranges from 0 to 255 and it indicates the relative filtering strength of the spatial-domain filter on the bright region.
- **.SBTx** ranges from 0 to 64 and it indicates the threshold of the spatial-domain filter for detecting edges in the bright region. When the value of **.SBSx** is determined, a larger **.SBTx** indicates that fewer pixels are considered as edges and protected and more texture details are lost.

.SDSx and **.SDTx** take effect on the dark region of the picture.

- **.SDSx** ranges from 0 to 255 and it indicates the absolute filtering strength of the spatial-domain filter on the dark region.
- **.SDTx** ranges from 0 to 64 and it indicates the threshold of the spatial-domain filter for detecting edges in the dark region. When the value of **.SDSx** is determined, a larger **.SDTx** indicates that fewer pixels are considered as edges and protected and more texture details are lost.

Noises in the dark region are significantly larger than those in the bright region. Therefore, the values of **.SDSx** and **.SDTx** should be greater than those of **.SBSx** and **.SBTx**. Typically the values of **.SDSx** and **.SDTx** are twice (or more) those of **.SBSx** and **.SBTx**.

```
.MDAF = 3, .PostROW = 0;
.MATW = 1, .ExTfThr = 12;
.MABW = 1, .TextThr = 16;
.MTFS = 255;
```

The preceding seven parameters are internal parameters and are set to constants after calibration. Therefore, configuration is not required.

s.SFC ranges from 0 to 255 and indicates the spatial-domain filtering strength on the color difference component. **.TFC** ranges from 0 to 32 and indicates the time-domain filtering strength on the color difference component. **.TFC** must be set to a value less than or equal to **15**; otherwise, color smearing may occur.

The recommendations on 3DNR parameter configuration are as follows:

- It is recommended that the edge enhanced mode be enabled in any case. To be specific, **.SHPi** must be greater than **64** (front-end enhanced mode) or **.SHPj** must be greater than **64** (back-end enhanced mode). Once the edge enhanced mode is enabled, only the spatial-domain filtering is implemented for the UNITi or UNITj sub module, and the filtering performance is affected only by **.SHPx**.

  Front-end enhanced mode

```
_G___SBS_(-1, 32, 16);    _PostSFS_(  0 );
_G___SBT_(-1, 8, 8);
_G___SDS_(-1,64, 32);
_G___SDT_(-1, 8,  8);
_G___SBF_(-1, 1,  0);    _G___SFC_(   8 );
_G___SHP_(85, 64, 32);    _G___TFC_(   0 );
_G___TFS_(-1, 12, 12);
_G___TFR_(-1, 12, 31);
_G___MDZ_(-1, 0, 128);    _G__Post_(   0 );
```

  Back-end enhanced mode

```
_G___SBS_(32,  -1, 16);    _PostSFS_(   0 );
_G___SBT_(8, -1,  8);
_G___SDS_(64, -1, 32);
_G___SDT_(8, -1, 8);
_G___SBF_(1, -1, 0);    _G___SFC_(   8 );
_G___SHP_(64, 127, 32);    _G___TFC_(   0 );
_G___TFS_(12, -1, 12);
_G___TFR_(12, -1, 31);
_G___MDZ_(0, -1, 128);    _G__Post_(   1 );
```

- For the remaining two sub modules in NR mode, the one that is before the other in the luminance processing procedure is called the auxiliary UNIT (UNITj in front-end enhanced mode and UNITi in back-end enhanced mode); the one that is after the other in the luminance processing procedure is called the master UNIT (UNITk). Typically, the **TFS** of both the auxiliary UNIT and the master UNIT should be 12. If picture noises are obvious, **.TFSk** can be set to **14**.
- **.TFRx** of the auxiliary UNIT should be fixed at 12. It is recommended that **.TFRx** not be improved unless noises fail to be suppressed.
- **.TFRk** should be fixed at 31.

- To reduce picture noises, increase **.MATH**. If picture noises fail to be suppressed when **.MATH** is large, the **MDZ** of the auxiliary UNIT can be increased but it must be less than or equal to 20; otherwise, smearing may occur.
- **.SDSx** should be twice **.SBSx**. **.SBSx** and **.SDSx** of the auxiliary UNIT should be twice those of the master UNIT.
- **.SBFx** of the auxiliary UNIT should be fixed at 1, and it can be set to **3** if it is difficult to remove sharp noises.
- **.SBFk** should be fixed at 0.
- **.SHPx** of the auxiliary UNIT should be fixed at 64.
- **.SHPk** can be decreased to 0 if granular noises are obvious.

/**********/

2 iq_debug

The iq_debug tool is developed for configuring the preceding 3DNR parameters.

```
>iq_debug NR B -sbs 32 -1 16
```

```
_G___SBS_(32, -1,16);    _PostSFS_(   0 );
_G___SBT_(8,  -1,   8);
_G___SDS_(64,  -1,  32);
_G___SDT_(8,  -1,   8);
_G___SBF_(1,  -1,   0);    _G___SFC_(   8 );
_G___SHP_(64, 127,  32);    _G___TFC_(   0 );
_G___TFS_(12,  -1,  12);
_G___TFR_(12,  -1,  31);
_G___MDZ_(0,  -1, 128);    _G__Post_(   1 );
```

In the preceding example, **.SBSi** and **.SBSk** are set to **32** and **16** respectively by using the **-sbs** command. **.SBSj** is not affected because the mode is the back-end enhanced mode.

2.1 Command List

Command	Parameters and members	Output
-sbs	.SBSx	_G___SBS_
-sdt	.SBTx	_G___SBT_
-sds	.SDSx	_G___SDS_
-sdt	.SDTx	_G___SDT_
-sbf	.SBFx	_G___SBF_
-shp	.SHPx	_G___SHP_
-tfs	.TFSx	_G___TFS_
-tfr	.TFRx	_G___TFR_
-mdz	.MDZx	_G___MDZ_
-sfc	.SFC	_G___SFC_
-tfc	.TFC	_G___TFC_

```
-psfs          .PSFS                  _PostSFS_
```