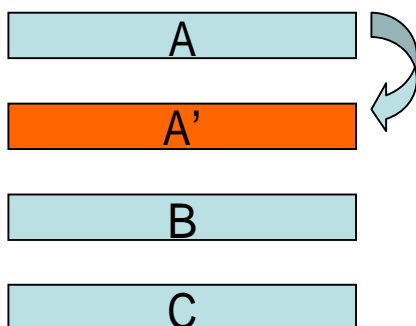


JVT-T028 : CE6 on JVT-S015 XRP (Extended RP)

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Media Lab., Kyunghee University
KOREA

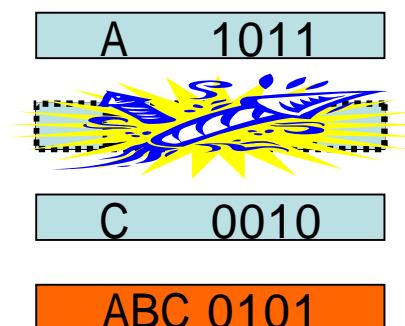
XRP : RP for Multiple Pictures

- Protect multiple pictures by one redundant picture



The current RP protects one by one (1:1).

1:1 → 50% redundancy



XRP protects any loss of A, B, and C pictures. (n:1)

2:1 → 33% redundancy

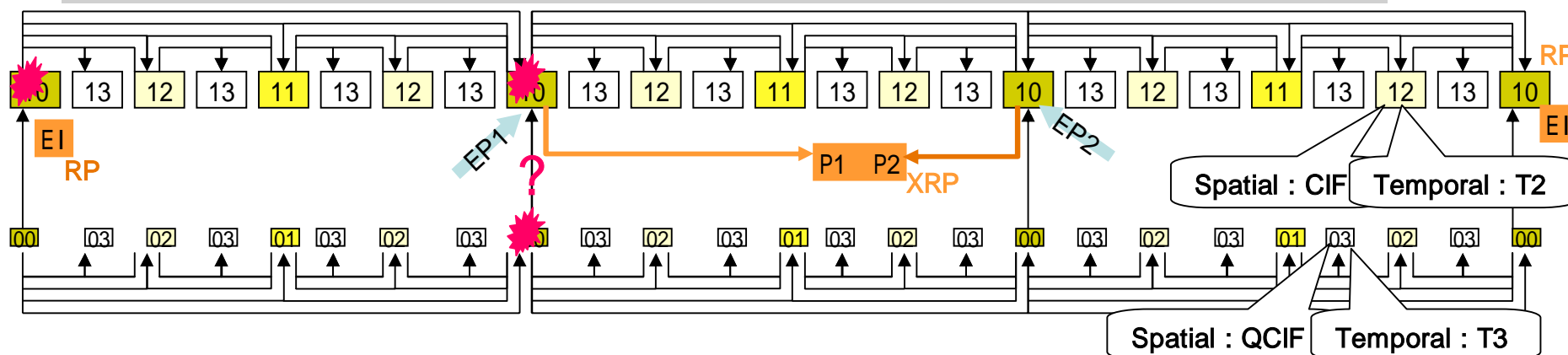
3:1 → 25% redundancy

9:1 → 10% redundancy

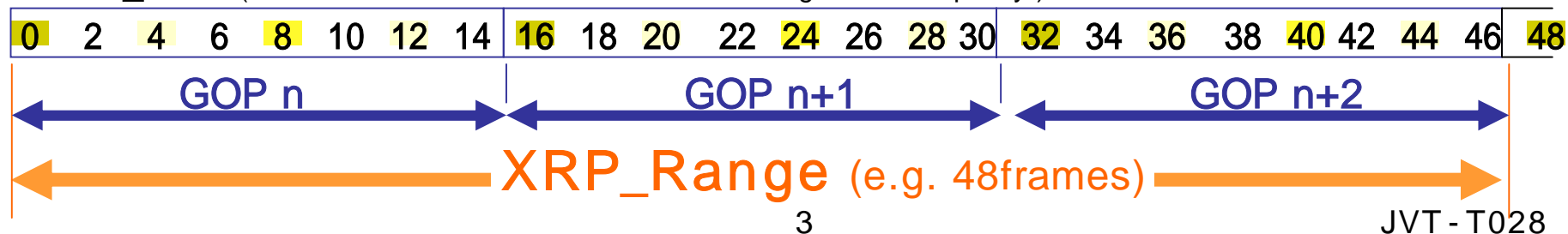
XRP adapts more flexibly to loss condition!!

CE6 : XRP for SVC

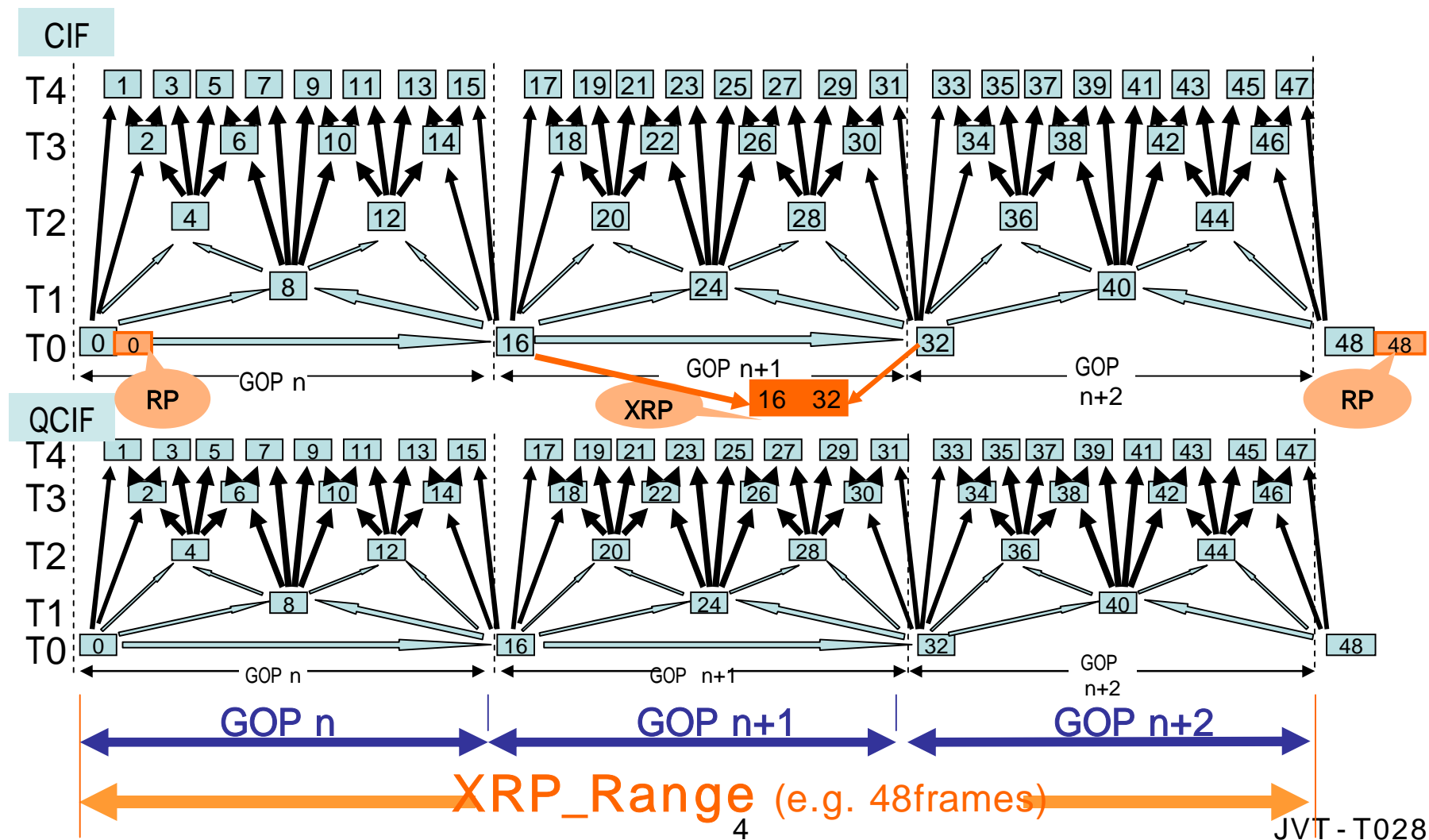
- XRP and RP can be applied to any layer of SVC.
- In the CE, one Intra in every 48 frames, GOP size = 16
 - XRP is applied to Layer10 [spatial 1, temporal 0] of EP1 and EP2
 - JSVM v5.4. does not allow to refer lost primary picture (the base layer).



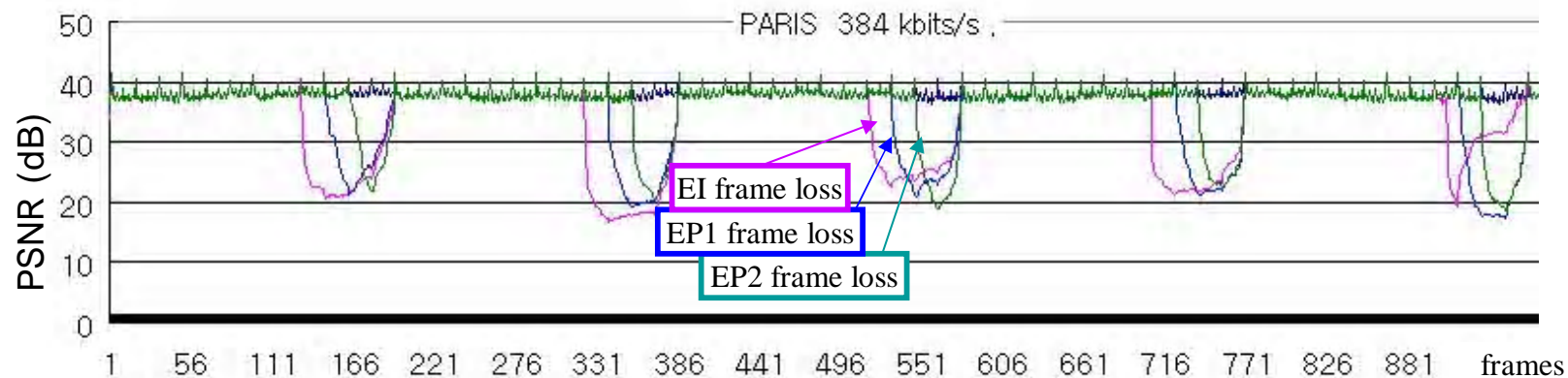
frame_num (Odd numbered frames are omitted in the figure for simplicity.)



CE6 : XRP for SVC



Effect of RP and XRP



- *RP and XRP reduce loss frequency*
 - by increasing redundancy (Original 80%+RP 15%+XRP 5%)
 - Residual PLR : $p \rightarrow RP \rightarrow p^2$, $p \rightarrow XRP \rightarrow p(1-(1-p)^2)$

PLR	I	P	N _{ormal}
3%	3%	3%	3%
5%	5%	5%	5%
10%	10%	10%	10%
20%	20%	20%	20%

RP

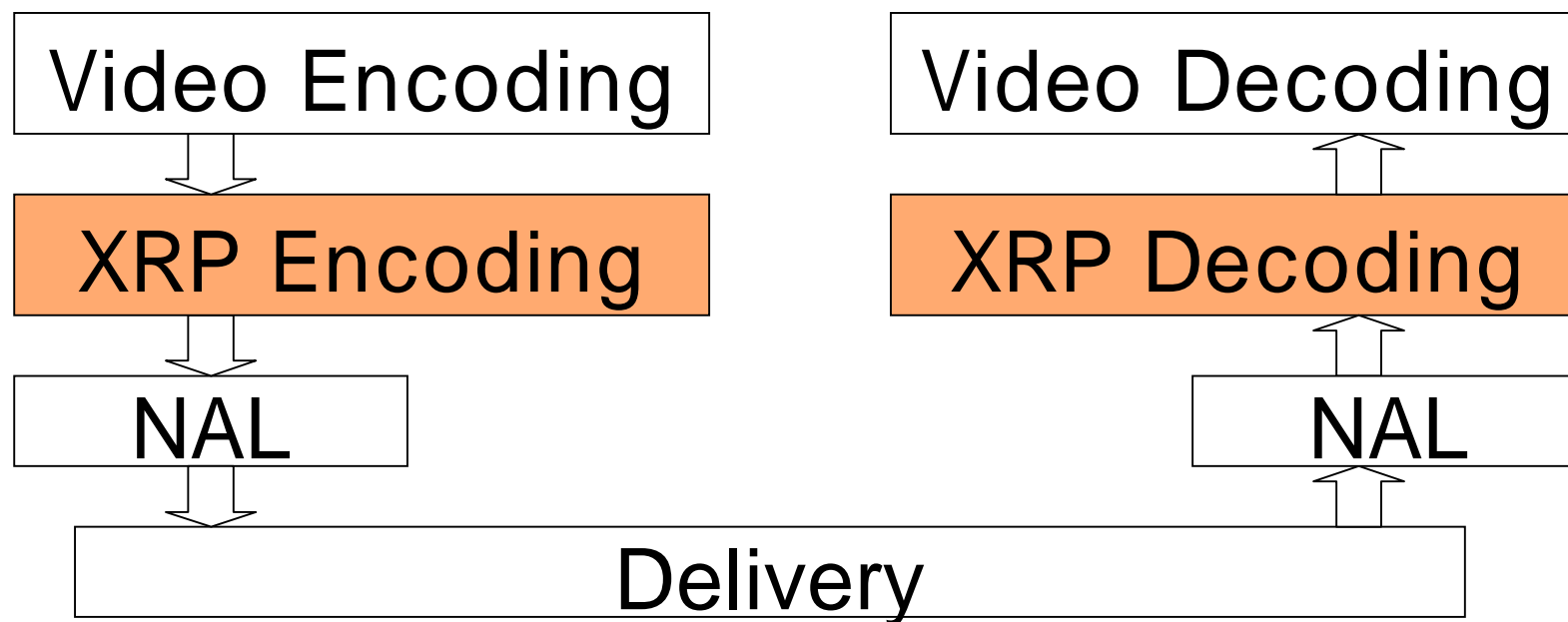
PLR	I (RP)	P	N
3%	0.09%	3%	3%
5%	0.25%	5%	5%
10%	1%	10%	10%
20%	4%	20%	20%

RP & XRP

PLR	I (RP)	P (XRP)	N
3%	0.09%	0.17%	3%
5%	0.25%	0.48%	5%
10%	1%	1.9%	10%
20%	4%	7.2%	20%

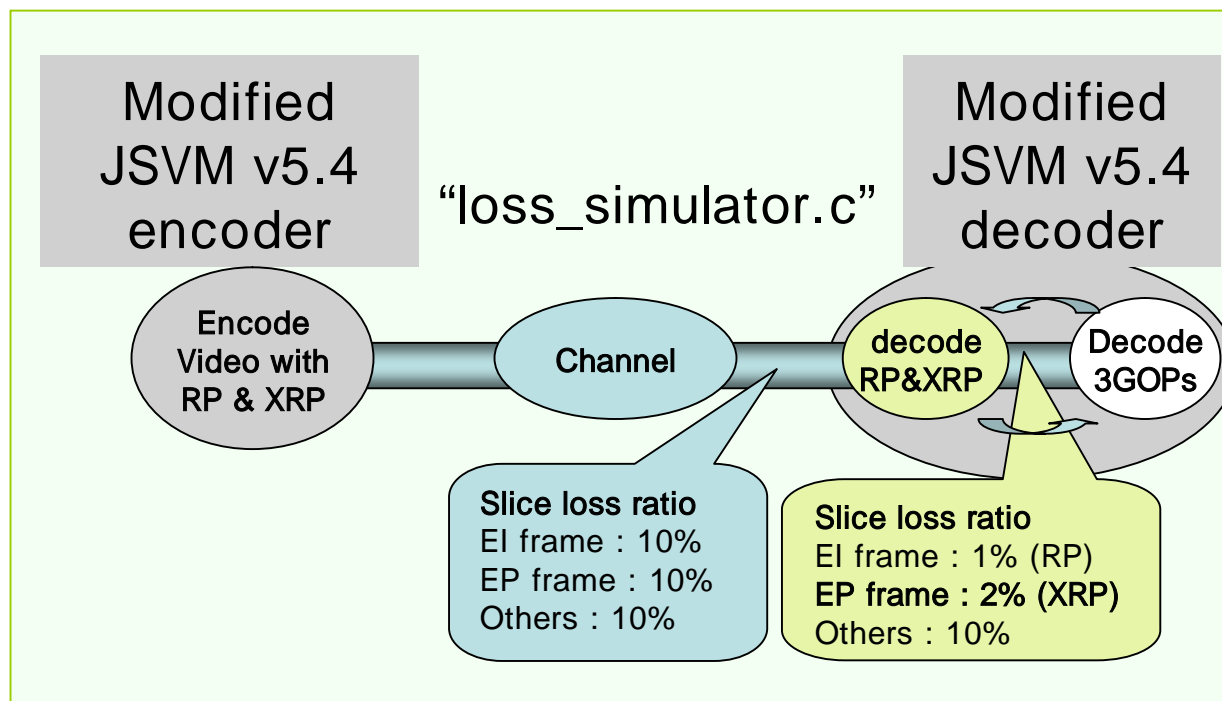
Implementation of XRP

- Well separable!



Test Conditions of XRP on SVC (1)

- 6 test sequences as defined in JVT-P206d1
- 3/5/10/20% loss patterns from ITU-T VCEG Q15-I-16r1

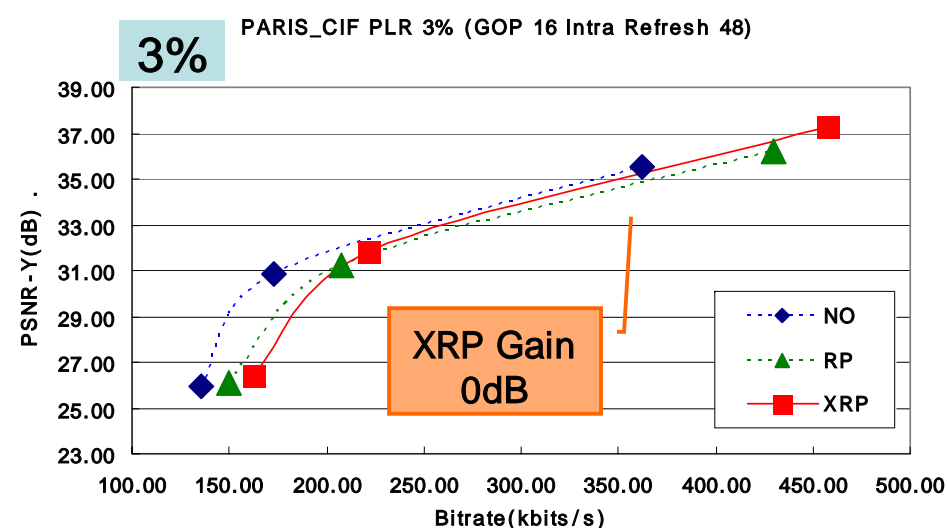
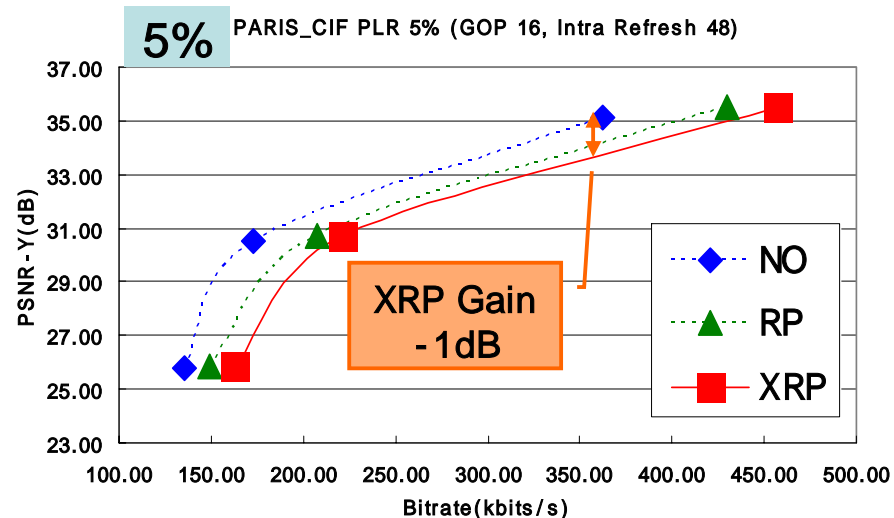
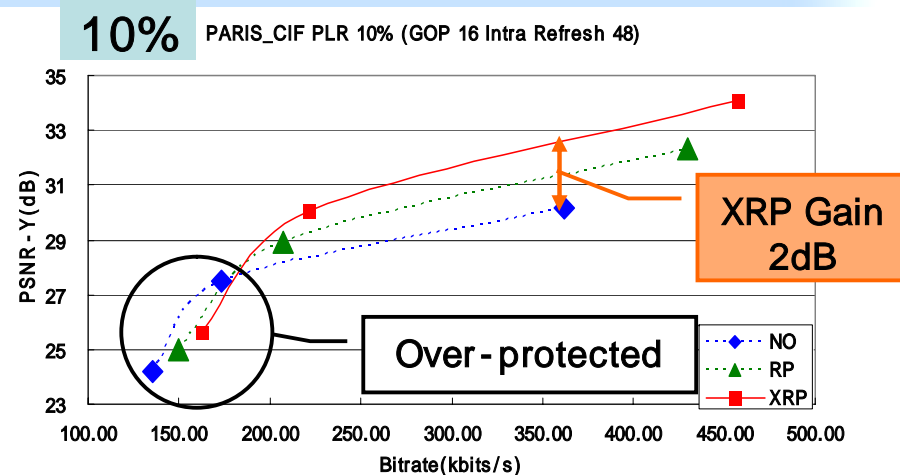
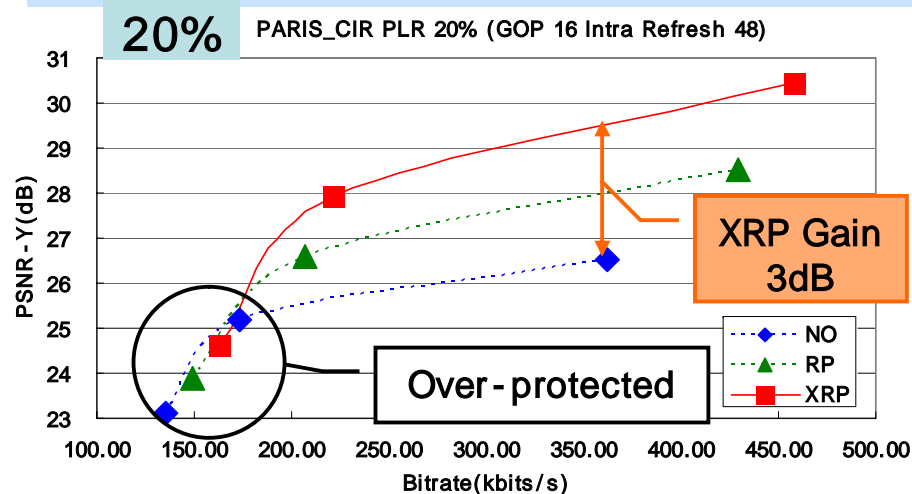


Sequences	Frame Rate	Channel Bitrate
Foreman	7.5 fps	64 kbit/s
Foreman	7.5 fps	144 kbit/s
Football	15 fps	256 kbit/s
Paris	15 fps	384 kbit/s
Paris	15 fps	144 kbit/s
Stefan	30 fps	512 kbit/s

Test Conditions of XRP on SVC (2)

- Modified JSVM 5.4
- Comparison of
 1. No error resilience
 2. RP for I pictures
 3. RP for I pictures and XRP for P pictures
- Two-layer spatial scalability (QCIF/CIF)
- GOP = 16 with one Intra for every 48 frames
- No interlayer prediction
 - The current JSVM does not allow for a spatial enhancement layer to refer lost base layer picture.
- No Slice Groups, no FMO, no ASO
 - XRP will perform better and more flexible if a picture can be encoded/decoded into multiple slices.
- one packet is one NAL Unit and one frame.

Test results for “Paris”



Test results

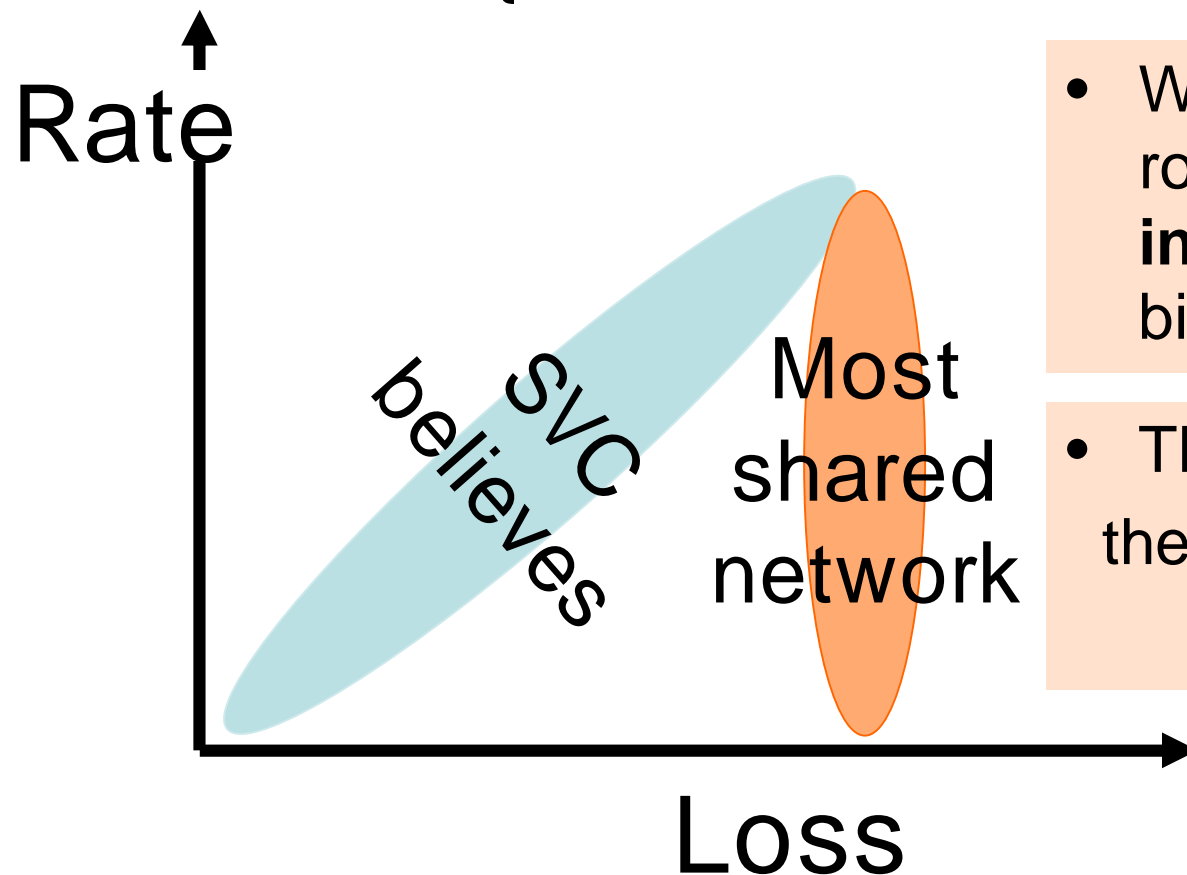
- XRP performs very well in lossy channel (2~3dB gain).
 - If low loss, then negative effect. (Trade-off)
 - Rule of thumb : (redundancy ratio) 2

Conclusion

- **Adopt XRP as an error resilience tool**
 - 2~3 dB Gain in lossy channel (10%~20% loss)
 - Compared to the previous RP method, less redundancy and more flexibility
 - Minor changes in the syntax and the JSVM software
 - Verified by LG(JVT-T066)
- **Suggestion for error resilience requirements**
 - Need to consider loss of the base layer slices
 - Investigate joint source-channel coding against loss
- **Software Issues**
 - Error concealment for the base layer (QCIF)
 - Slice based encoding

Network-awareness of SVC

- Network = {bandwidth, loss, delay}



- We need loss robustness tools **independently** of bitrate adaptation.

- The more loss, the more protection (redundancy).

Modification in the standard

- For configuration of XRP
 - (layer to apply, XRP_range in number of frames)
 - XRP SEI message
- For encoding and decoding XRP
 - XOR operation in the encoder/decoder
 - Buffering coded pictures within XRP_range in the decoder
 - Identification of XRP packet
 - XRP slice header, with the same NAL header as that of XRPed layer

Modification in Syntax (1)

- XRP SEI Message

XRP_Scalable_info(payloadSize) {	C	Descriptor
num_layers_minus1	5	ue(v)
for(i = 0; i <= num_layers_minus1; i++) {		
use_xor_redundant_pic_flag[i]	5	u(1)
range_of_xrp_pic[i]	5	u(8)
}}		

- XRP Slice Header

slice_header_in_scalable_extension() {	C	Descriptor
First_mb_in_slice	2	ue(v)
Slice_type	2	ue(v)
if(Slice_type == X_SLICE) {		
xrp_update_count	2	ue(v)
}		

Modification in Syntax (2)

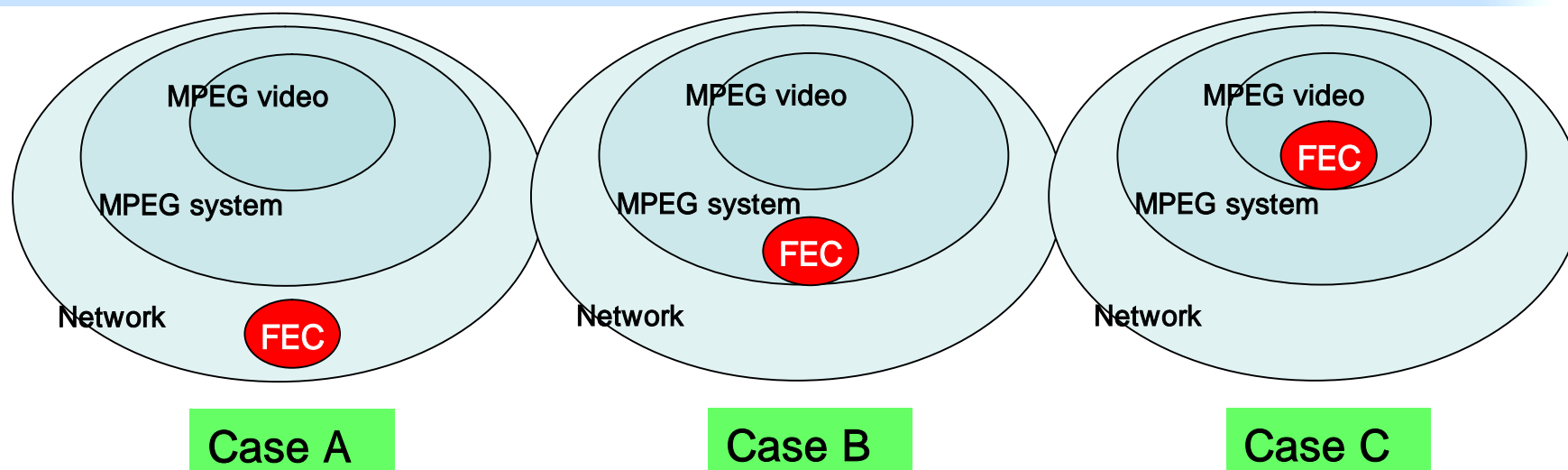
- Slice_type in AVC

slice_type	Name of slice_type
0	P (P slice)
1	B (B slice)
2	I (I slice)
.....
9	SI (SI slice)
10	XRP (XRP slice)

- Slice_type in SVC

slice_type	Name of slice_type
0	EB (B slice in scalable extension)
1	EP (P slice in scalable extension)
2	EI (I slice in scalable extension)
3	PR (progressive refinement slice)
4	XRP (XRP slice in scalable extension)

Where will we put FEC?



- **Q1 :** In lossy channel, PSNR could be dropped by ~10dB when we struggle on matter of ~1dB.
Why do video people let network (or MPEG system) people deal with the matter of ~10dB? Do they even know what 'dB' means?
- **Q2 :** How much detail are network (or MPEG system) people willing to know about individual media? Willingness enough for SVC?

Loss protection for the base layer?

- Loss protection cannot be perfect.
 - The current priority protocols just reduce loss ratio.
 - For higher loss priority, you need to pay more.
 - Loss is inevitable in wireless channel.
- Very important pictures such as key pictures deserve to be protected by video layer as well as by network protocols.
- Network people do not want to know detail about video codec.

Network-awareness of SVC

- Network = {bandwidth, loss, delay}
- Adapt to variable network condition
 - Bandwidth : OK by using SVC
 - Loss : Not much, yet
 - Delay : getting worse in SVC
- Wireless is **lossy**.
- Will loss rate be down if one cut off bitrate?
 - No, in most network.