Selective Encryption of H.264/AVC Based on Block Weight Model

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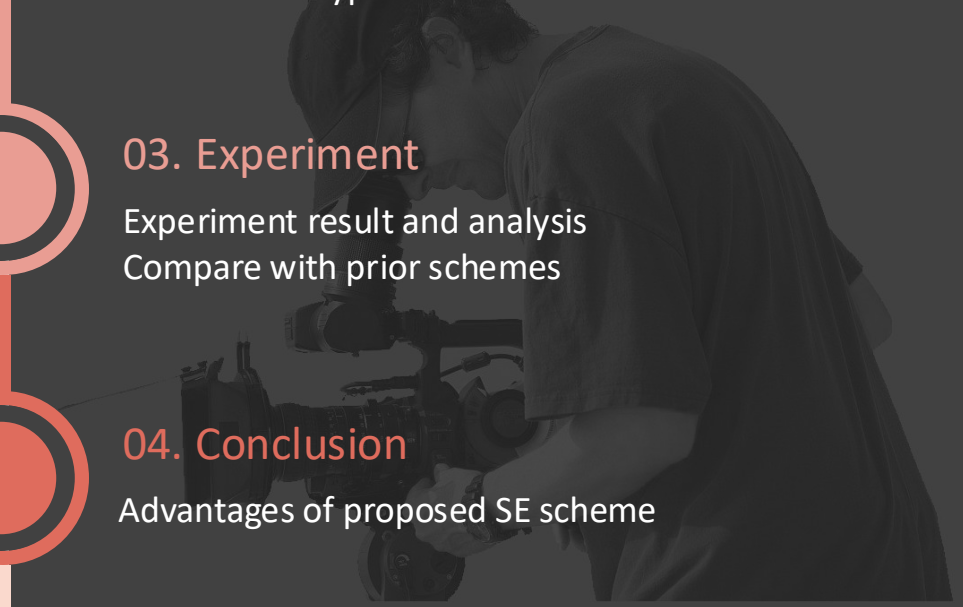
CONTENT

Consist of four parts

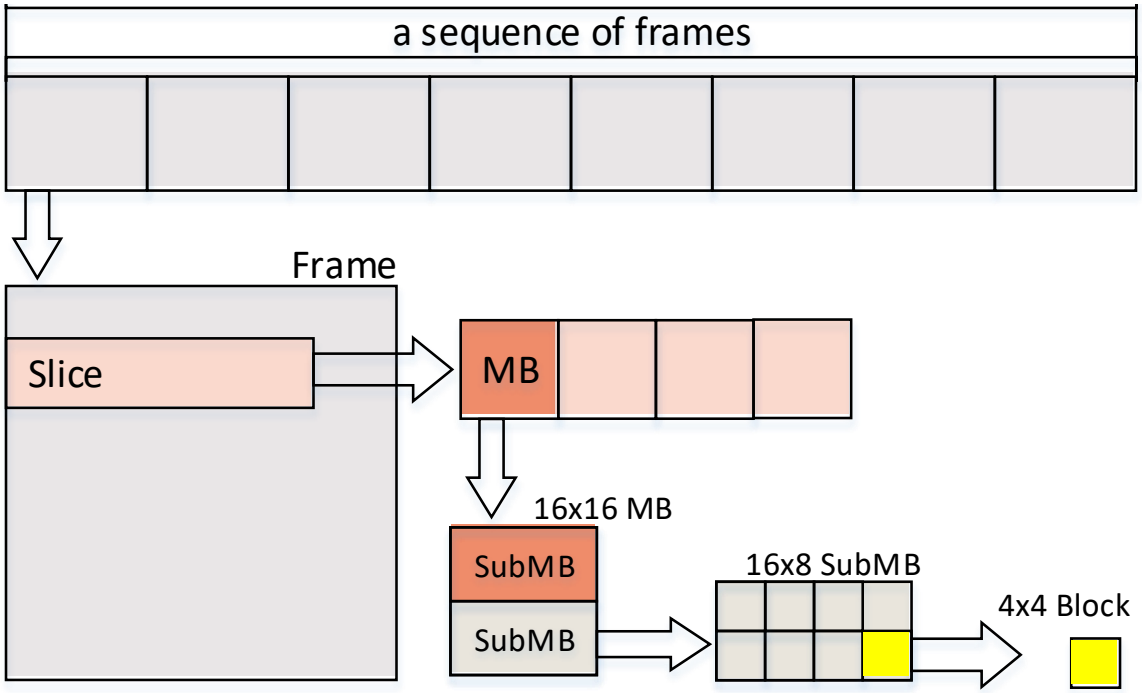


video meeting

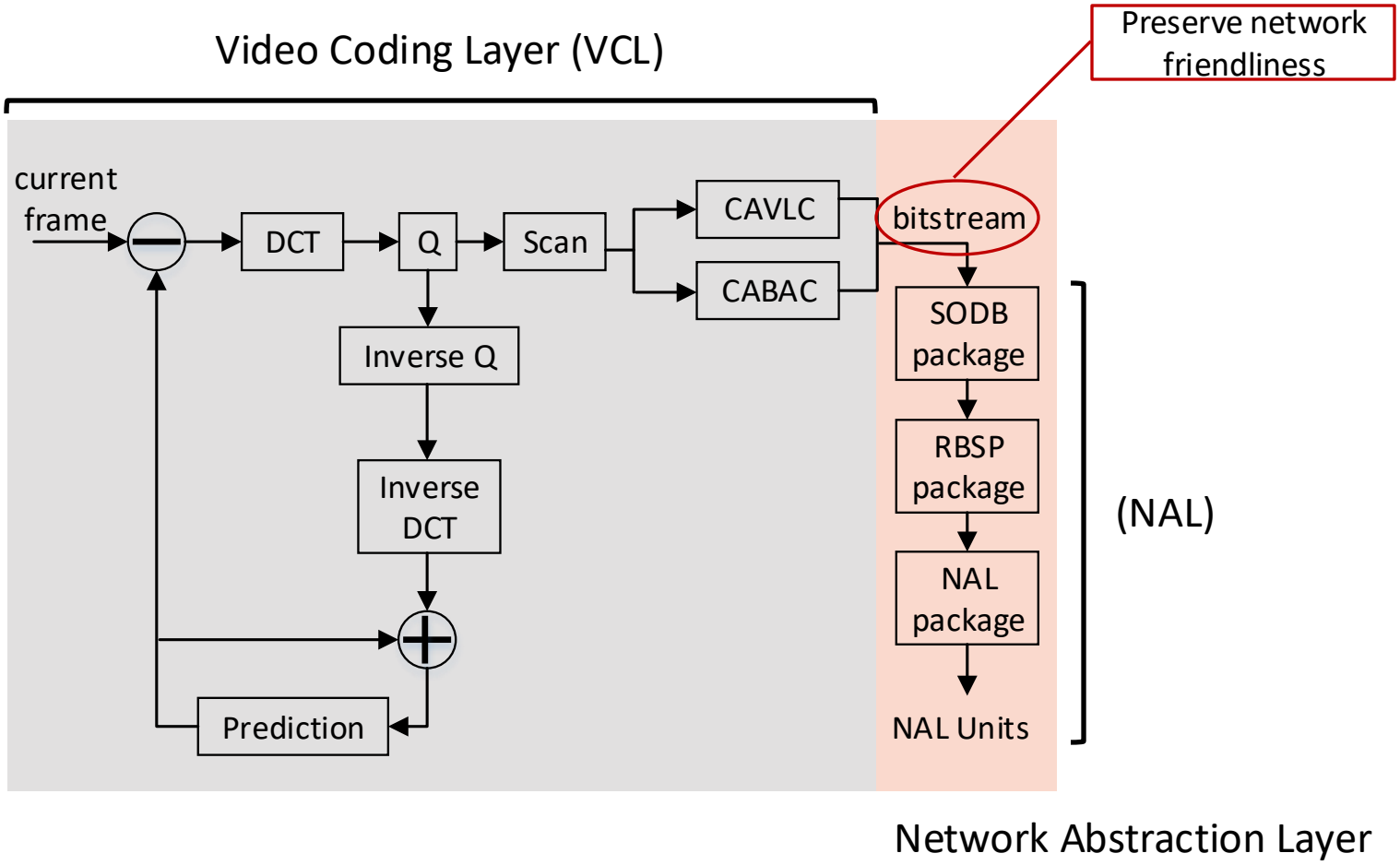
legal viewing of surveillance video

Video Security Problem

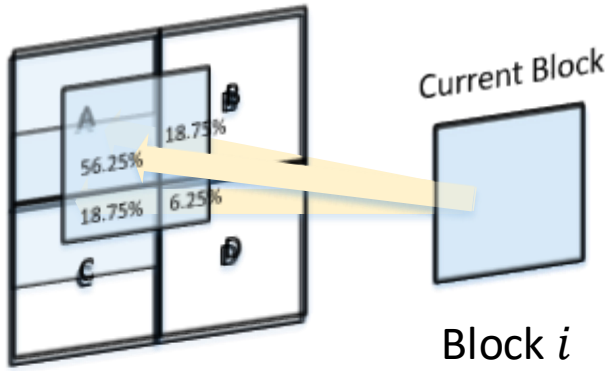
H.264/AVC Bitstream Structure



H.264/AVC Coding Process



Proposed Block Weight (BW) Model



Block i

The proportion of block x referenced by block i is defined as

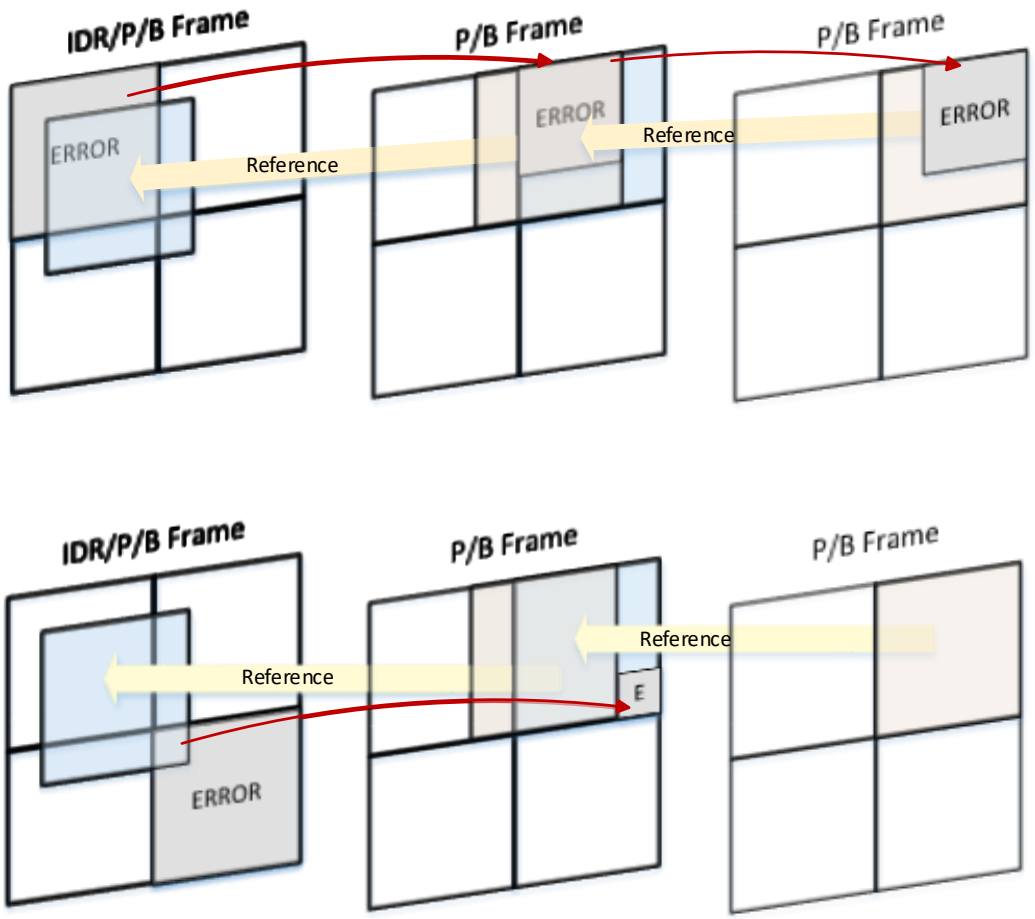
$$P_{(x,i)} = \frac{S_{(x,i)}}{16}$$

e.g. If current block is block i , the proportion is calculated as

$$P_{(A,i)} = \frac{S_{(A,i)}}{16} = \frac{3 \times 3}{16} = 56.25\%$$

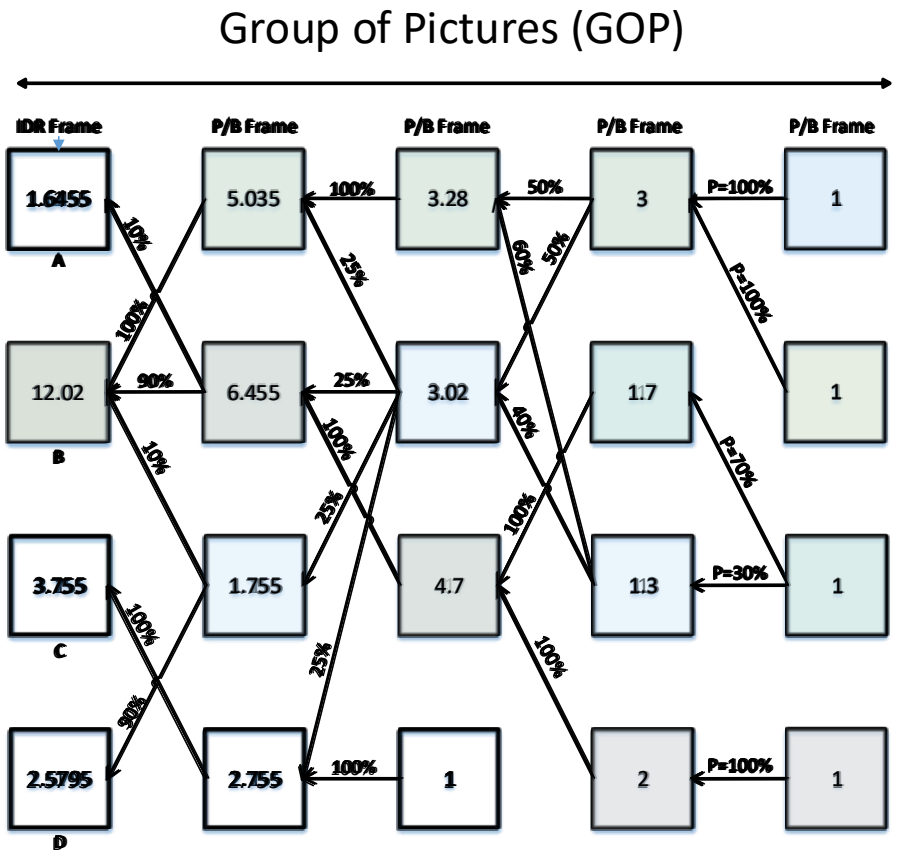
$$P_{(D,i)} = \frac{S_{(D,i)}}{16} = \frac{1 \times 1}{16} = 6.25\%$$

Proposed Block Weight (BW) Model



Proposed Block Weight (BW) Model

4X4 pixels Block



The BW of Block x is defined as

$$W_b(x) = \begin{cases} 1 + \sum_{i=1}^{n} P_{(x,i)} W_b(i), & n \neq 0 \\ 1, & n = 0 \end{cases}$$

Proposed Block Weight (BW) Model

4X4 pixels Block x

$W_b(x,1)$	$W_b(x,2)$	$W_b(x,3)$	$W_b(x,4)$
$W_b(x,5)$	$W_b(x,6)$	$W_b(x,7)$	$W_b(x,8)$
$W_b(x,9)$	$W_b(x,10)$	$W_b(x,11)$	$W_b(x,12)$
$W_b(x,13)$	$W_b(x,14)$	$W_b(x,15)$	$W_b(x,16)$

16X16 pixels MB x

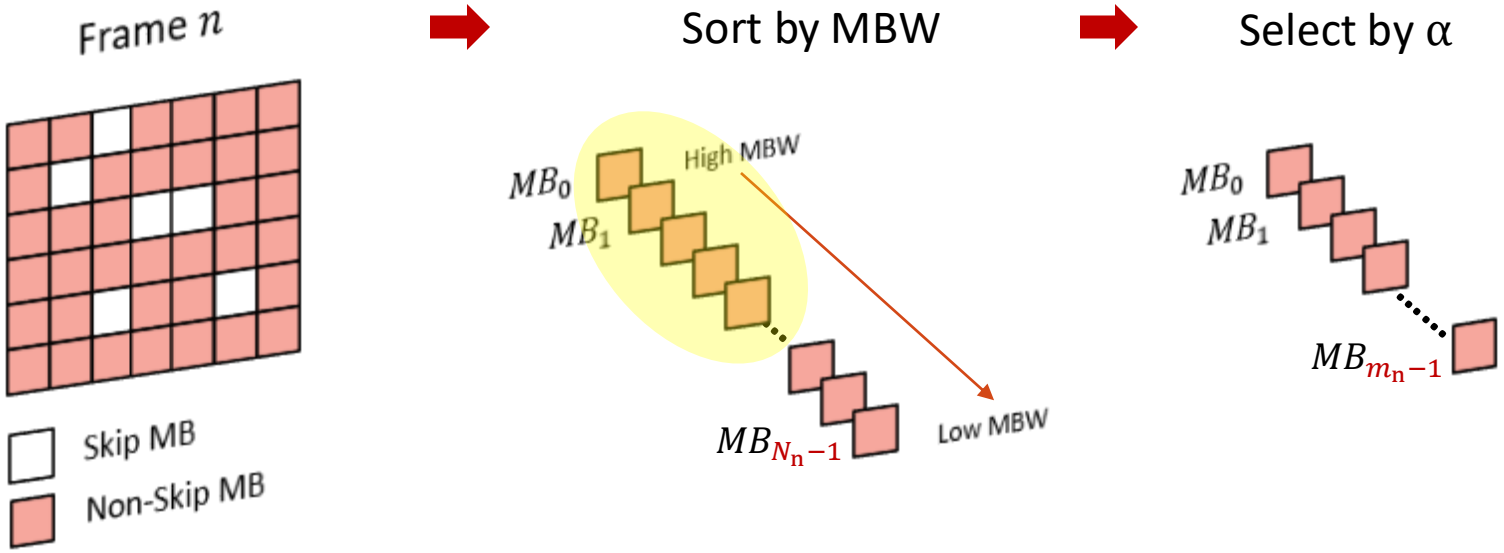
The BW of Block x is defined as

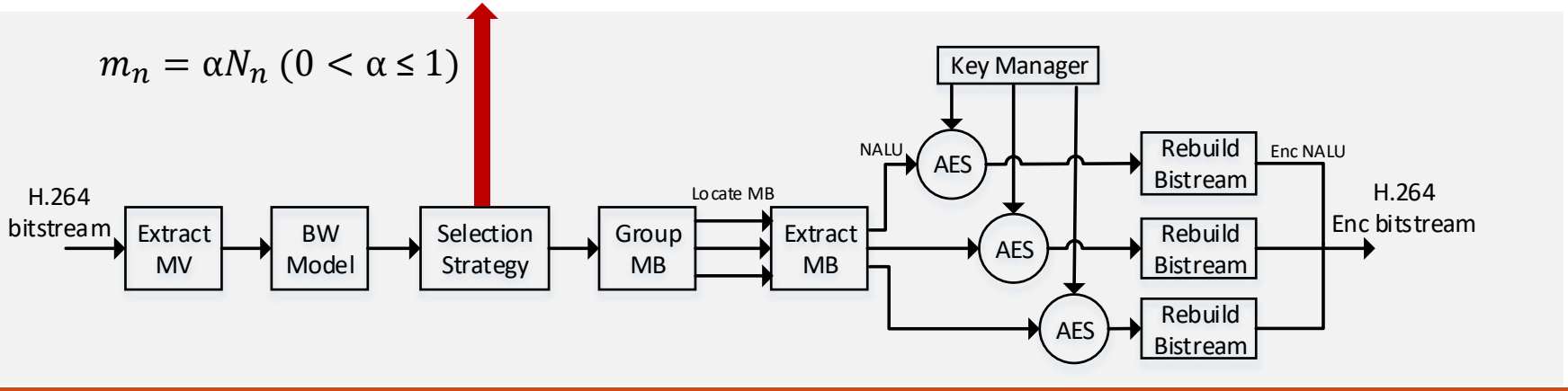
$$W_b(x) = \begin{cases} 1 + \sum_{i=1}^{n} P_{(x,i)} W_b(i), & n \neq 0 \\ 1, & n = 0 \end{cases}$$

The MB Weight (MBW) of MB x is defined as

$$W_{mb}(x) = \frac{\sum_{i=1}^{16} W_b(x,i)}{16}$$

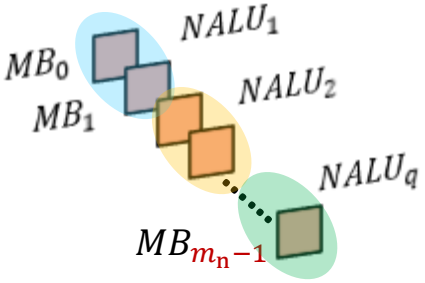
Proposed Selective Encryption (SE) Method



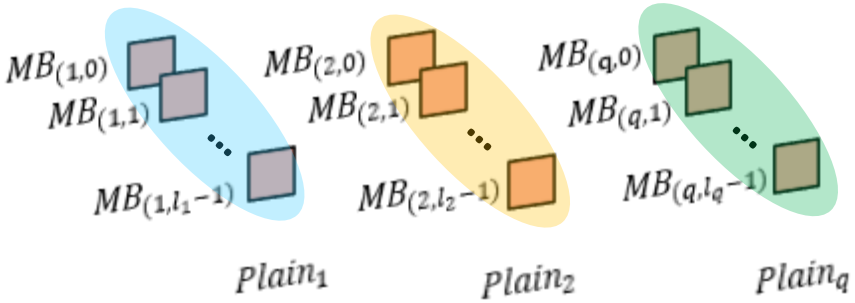


Proposed Selective Encryption (SE) Method

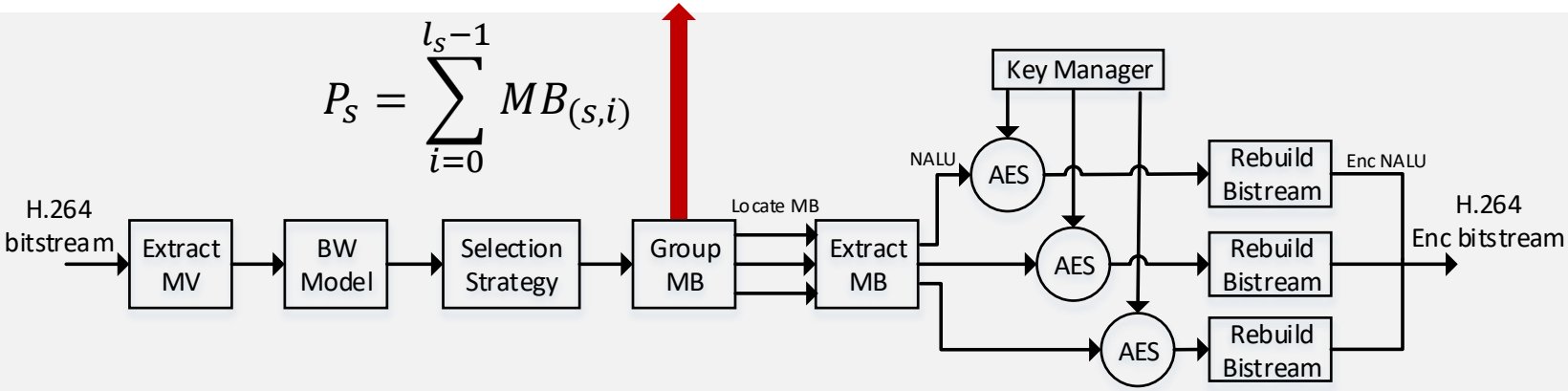
Selected MBs



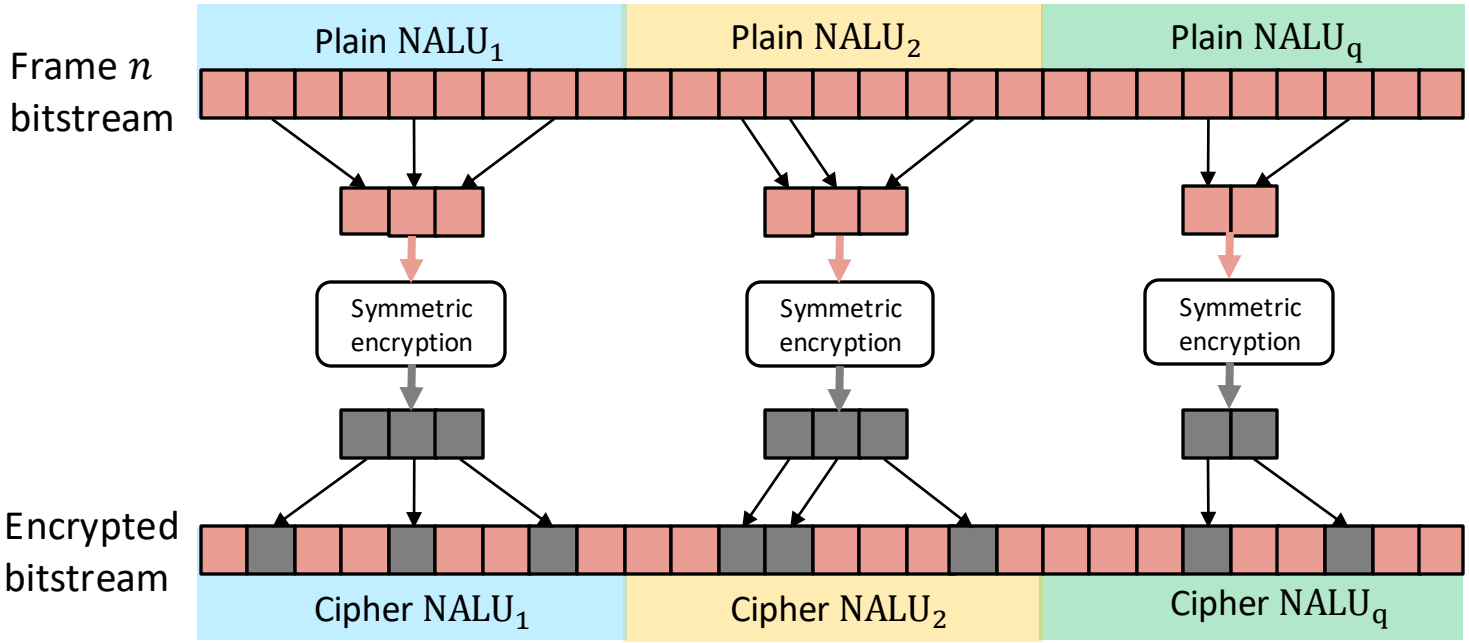
Group by NALU



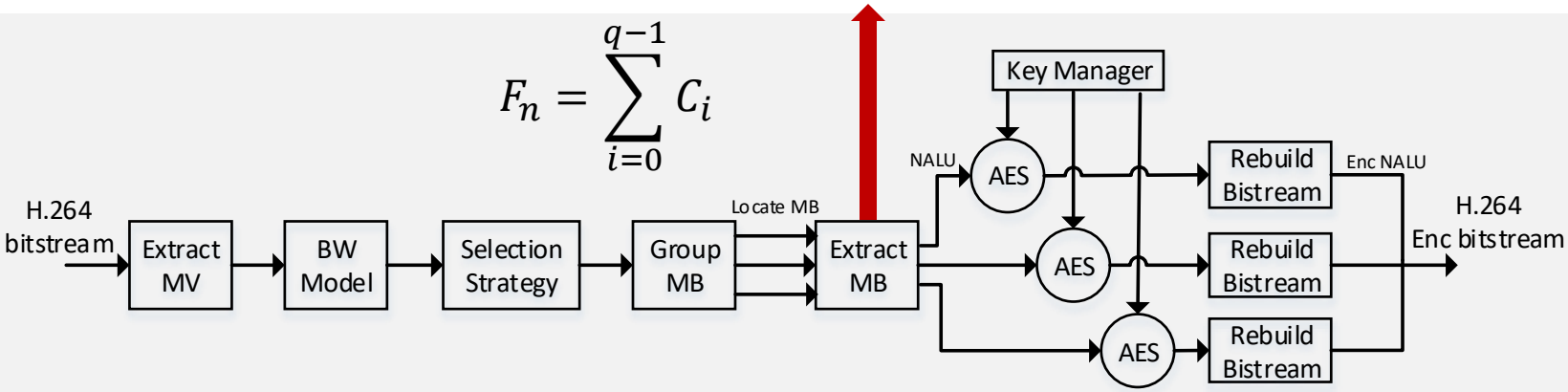
$$P_s = \sum_{i=0}^{l_s-1} MB_{(s,i)}$$



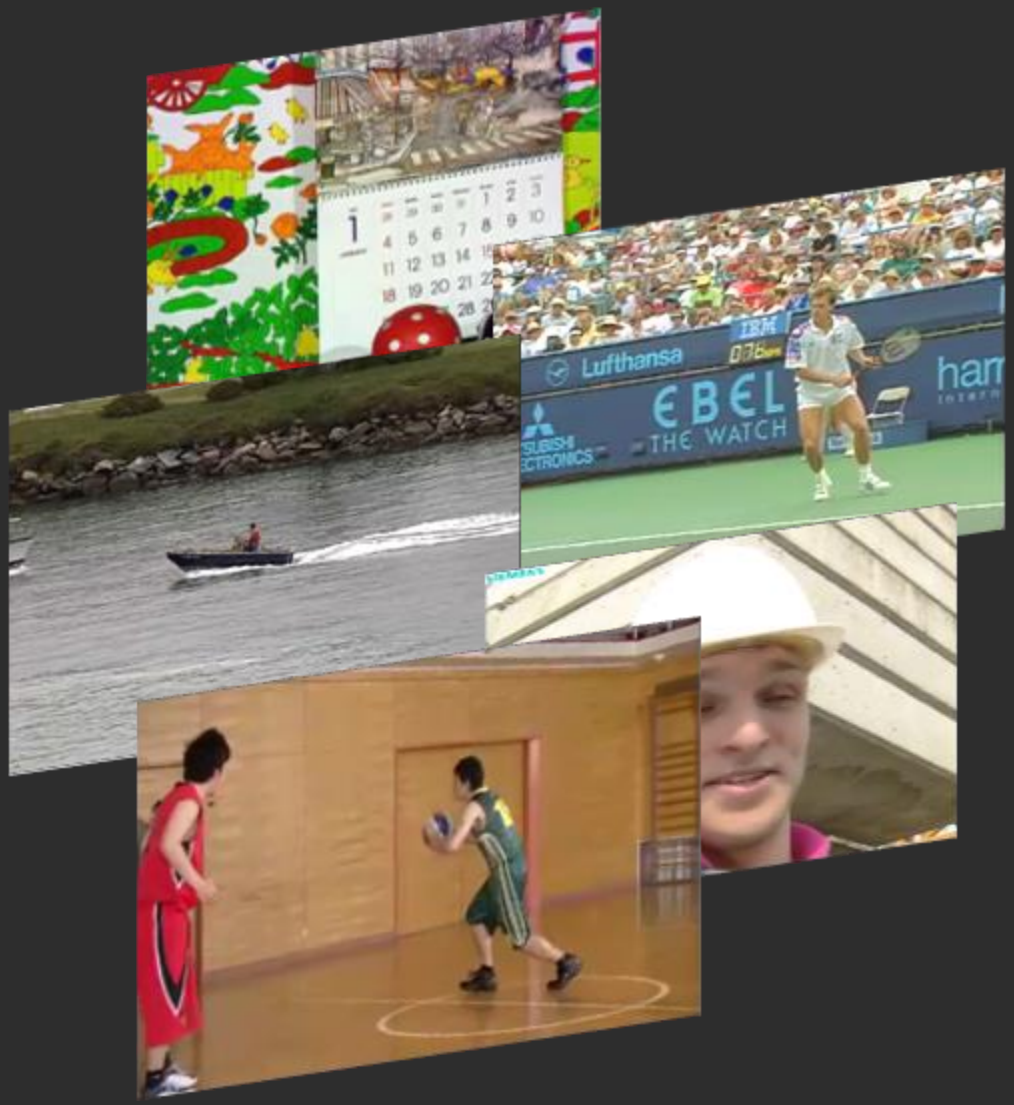
Proposed Selective Encryption (SE) Method



$$F_n = \sum_{i=0}^{q-1} C_i$$



Experiment



- CIF benchmark videos
- *Mobile, Stefan, Coastguard, Basketball Pass, Foreman*
- JM18.6
- Parameter setting

  GOP period 50 frames

Experient Result

Original Video

Proposed Method

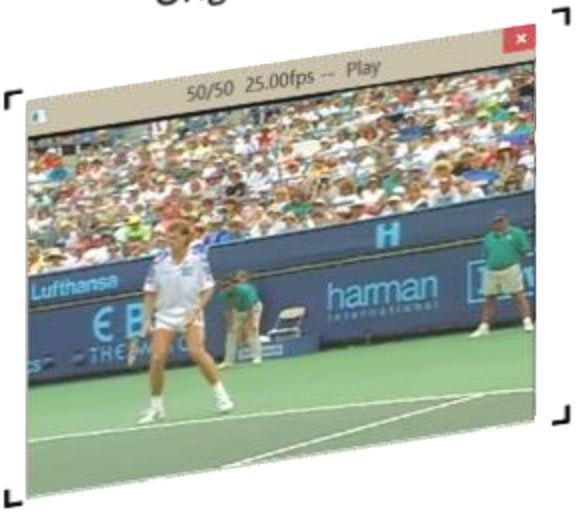
IDR Frame: α=0.5

Last Frame:α=0.5

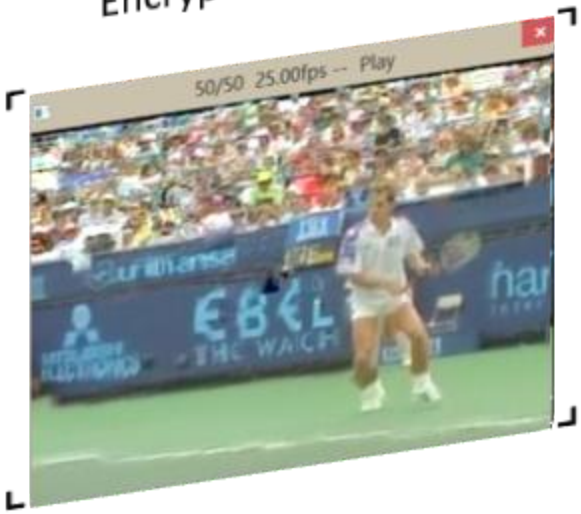
Other Frames:α=0.05

Experient Result

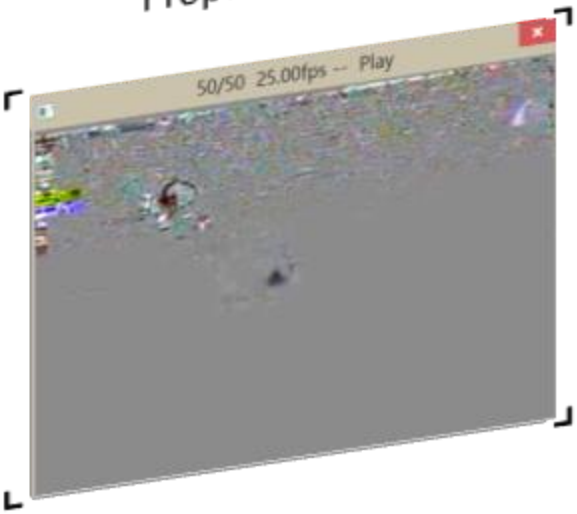
Original Video



Encrypted P/B Frames



Proposed Method



IDR Frame: α=0.5

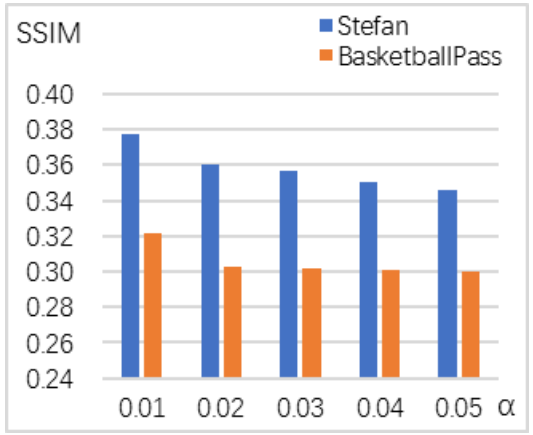
Last Frame:α=0.5

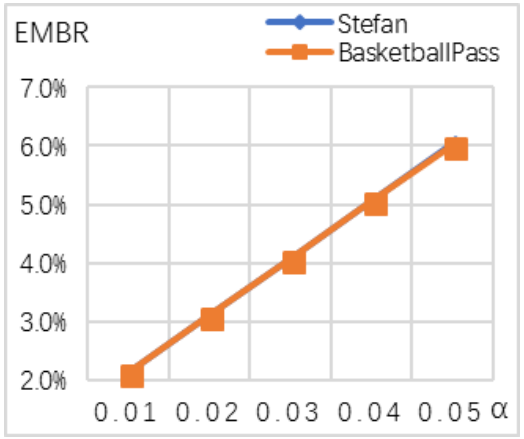
Other Frames:α=0.05

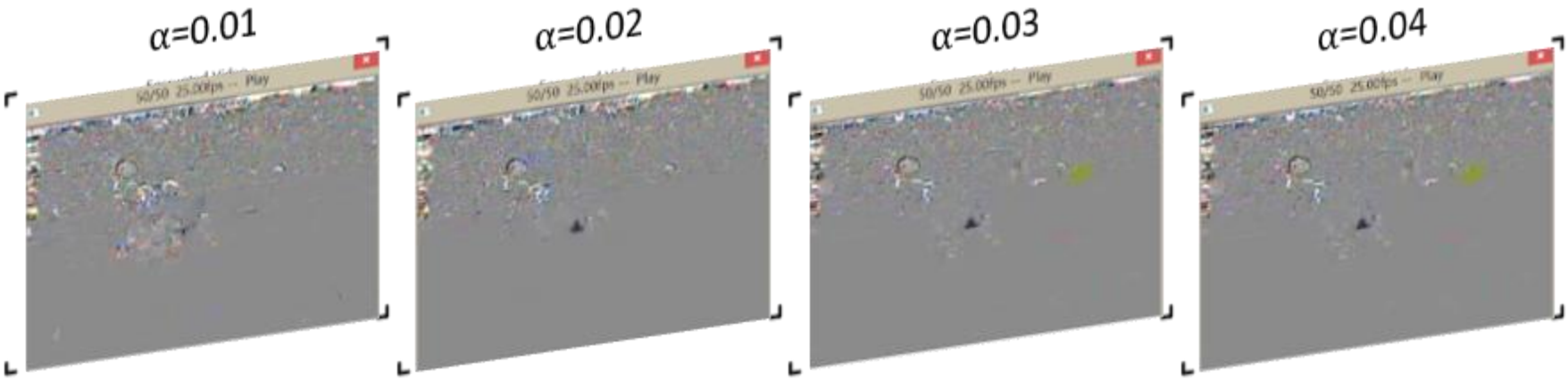
Experient Result

- Adjust parameter α
- Encrypted MB ratio is defined as

$$EMBR = \frac{Enc\ MB\ number}{sum\ MB\ number}$$







Comparison with Prior SE Methods

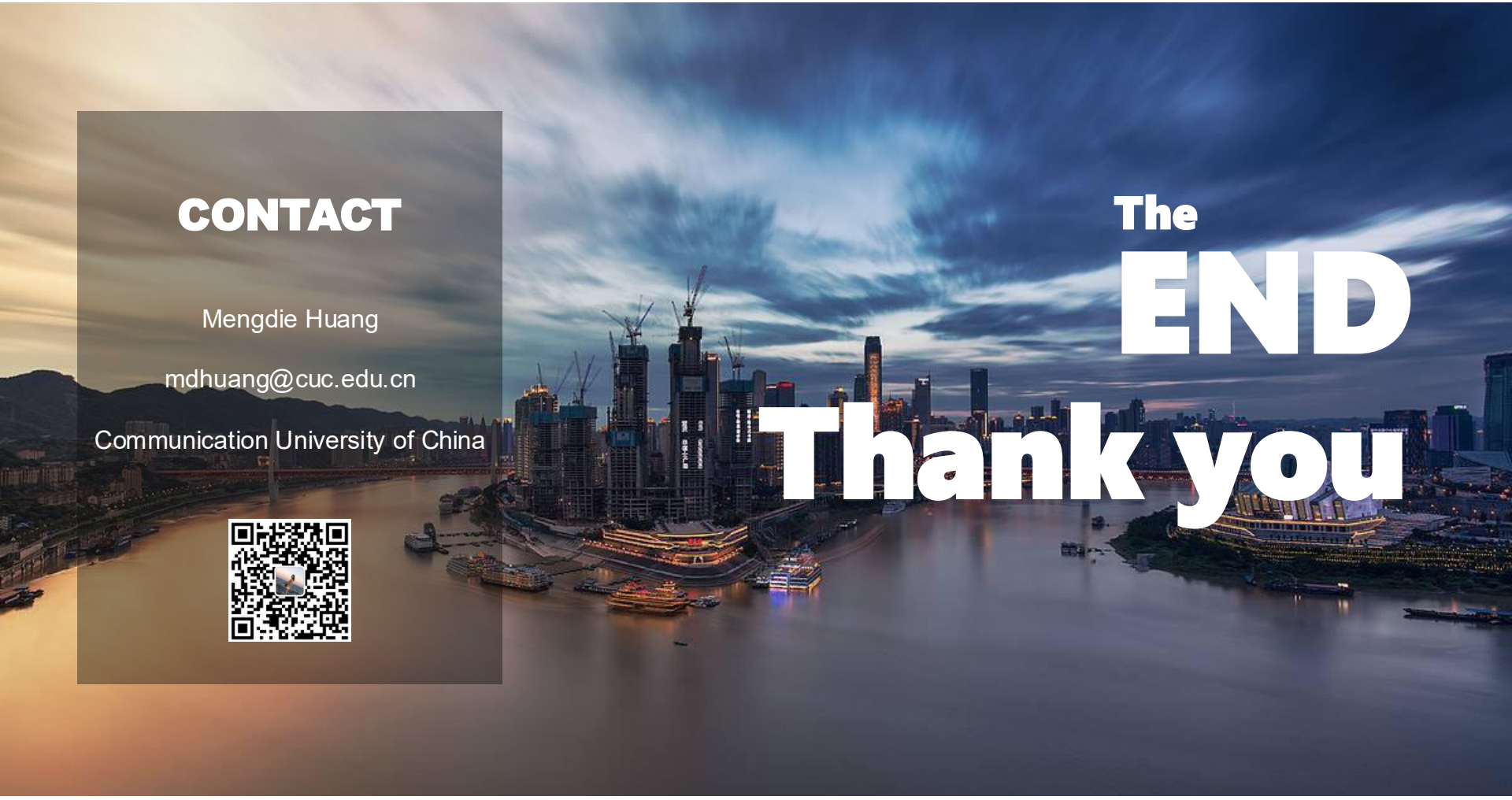
Sequence	Shen SE		Proposed SE	
	EMBR (%)	EDR (%)	EMBR (%)	EDR (%)
Mobile	54.0	5.30	**5.97**	6.07
Stefan	33.0	5.15	**6.03**	7.03
Foreman	42.7	8.86	**6.10**	9.94

Sequence	Khlif SE		Proposed SE	
	Mobile	*Foreman*	*Mobile*	*Foreman*
Original PSNR	29.84	35.92	35.264	37.603
Encrypted PSNR	8.99	10.67	12.003	12.109
EDR (%)	49.640	49.175	**6.07**	**9.94**
PSNR Difference	20.850	25.250	**23.261**	**25.584**

Conclusion

A novel SE method for H.264/AVC video bitstream

- ✓ Non-information leakage
- ✓ Network friendliness
- ✓ No effect on compressed efficiency
- ✓ Support custom security level
- ✓ Resist brute force attack and sketch attack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Thank you