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OBS

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A contention resolution based on segment redundant recombination in OBS networks

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Abstract To decrease the byte loss probability of data burst reduce the time delay cost and grantee the high usage efficiency of channel resource a novel contention resolution was proposed based on segment redundant recombination in optical burst switching OBS networks. In this scheme a special channel type called back-off channel was classified. When two bursts contents the lower priority one will be separated and the segments will be sent back to upstream node by back-off channels. To grantee high efficient usage of channel resources the segments will be cloned as many copies to fill the void of data channels. These copies will be recombined with the original data burst as virtual burst which can be separated flexibly. Moreover the priority of the burst on back-off contention was set to the lowest to balance out the cost of segmentation copies. The simulation results show that this contention resolution method reduces packet loss rate and time delay in OBS networks effectively and use the channel resources efficiently.

Key words optical communication optical burst switching contention resolution back-off channel redundant

dense wavelength division multiplexing DWDM [1] 3 optical circuit switching OCS [2] optical packet switching OPS [3] optical burst switching OBS [4] OCS OBS

OPS OBS OBS

OBS burst data packet BDP burst control packet BCP BCP BDP OBS BCP BDP [5-6] BCP

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1

OBS

[8] OBS

[9] [10] [11]

burst segmentation BS [12]

BCP

100%

50%

[13]

14

back-off channel contention resolution BCCR

[15]

15

contention resolution

based on segment redundant recombination CRSRR

2 CRSRR

2.1 CRSRR

1 CRSRR

i $i+1$

1

t

i

n

feedback burst FB

i

BDP

virtual burst VB FB_1

BDP_1 FB_1 BDP_1

FB_1

FB_1

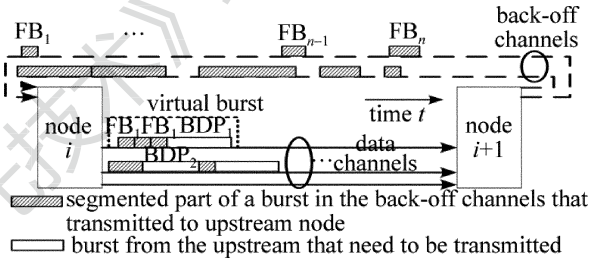

Fig. 1 Principle diagram of CRSRR

2.2 CRSRR

2.2.1 完整数据包冲突阶段 t

[11]

[13]

N

K M

class 1 class 2

class 1 class 2

λ_1 λ_2 A_1

A_2 $1/\mu_1$ $1/\mu_2$

ϕ_1 ϕ_2

$$\lambda = \lambda_1 + \lambda_2 \quad (1)$$

$$N = M + K \quad (2)$$

class 1 class 2

$$\begin{cases} f(A_1) = \lambda_1 \exp(-\mu_1 t_1) \\ f(A_2) = \lambda_2 \exp(-\mu_2 t_2) \end{cases} \quad (3)$$

Erlang-B 1

P_1

$$P_1 = \phi_q^M / M \Big/ \sum_{j=0}^{M} \phi_q^j / j \qquad 4$$

2 P_2

$$P_2 = P_{12} - {}_1 \cdot P_1 \sum_{j=1}^{2} {}_j \Big/ {}_2 \qquad 5$$

1 2 P_{12}

$$P_{12} = \sum_{j=1}^{2} {}_2{}^M / M \Big/ \sum_{i=0}^{M} \sum_{j=1}^{2} {}_j{}^t / t \qquad 6$$

$$\acute{a} = {}_1 \Big/ \sum_{j=1}^{2} {}_j \qquad 7$$

2.2.2 突发包碎片回退阶段

i $i+1$

T_t

T_d $T_d = 2T_t$ 8

M Ø

$M = N$ 9

K $K = 1 - N$ 10

2.2.3 增加冗余合并阶段

i $i+1$

class 3

class 3 i

2 T i

$i-1$

FB 4

1 2 3 4 $i-1$

A B C 4 class 3

A B C class 1 class 2

A B C 1 2 3

4 4

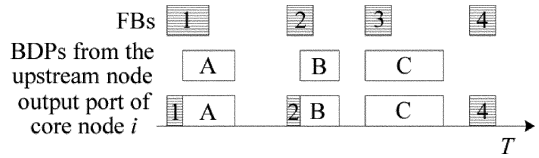

Fig. 2 The normal contention resolution occurring between FBs and BDPs

CRSRR

FB

3

class 3

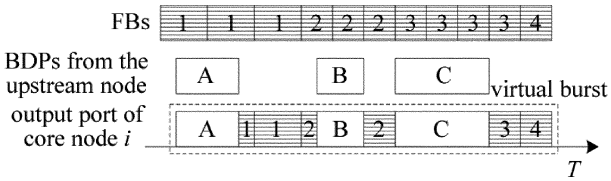

Fig. 3 Contention resolution occurring between FBs and BDPs in CRSRR

i

A B C

1 2 3 4

2.2.4 组合虚拟包竞争阶段

BDP 1

4

2

5

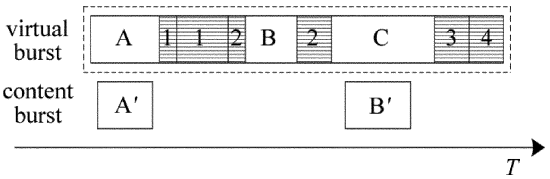

Fig. 4 Contentions occurring among normal BDPs

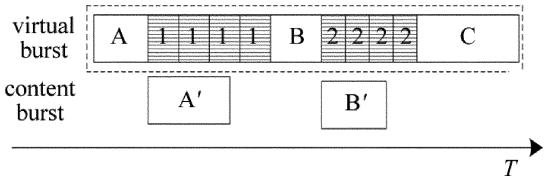

Fig. 5 Contentions occurring between normal BDPs and FBs

class 3

$\grave{N}_s$

$1/{}_3$

T_d FB

$\check{Z}$ x 0 $\grave{N}_s \times T_d$

i

$$\grave{N}_s' = {}_x \cdot \grave{N}_s \qquad 11$$

$\check{Z}/{}_3$

$$P_3 = \sum_{j=1}^{3} \quad _j / \quad _3 \cdot \sum_{j=1}^{3} \quad _j' \quad / \quad _3 /$$

$$M^{T_d - K} \cdot K \quad - \quad _2 / \quad _3 \cdot P_2 \qquad 12$$

$$\text{Ø} = P_j \cdot \text{Ø} \qquad 13$$

$$\text{Ġ} = \sum_{j=1}^{M-1} \sum_{l=1}^{3} \quad _l' \quad ^j / j \quad +$$

$$\sum_{j=M}^{T_d} \sum_{l=1}^{3} \quad _l' \quad ^j / \quad K^{j-M} \cdot K \quad ^{-1} \qquad 14$$

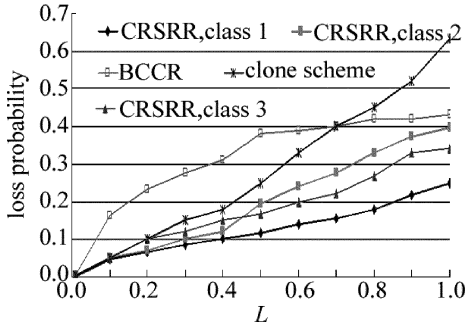

Fig. 6 Burst loss probability of BCCR clone scheme and CRSRR with different loads

3

OBS-NS NS-2

2. 28

linux

national science foundation networks NSFNET

14 21

BCP

64 64 ×

10Gbit/s

1250byte

0. 0001s

0. 0001s 0s 2s

3 class 1 class 2

class 3 class 1 class 3

class 3

L $0 \leqslant L \leqslant 1$

6 CRSRR BCCR

BCCR

20%

BCCR

BCCR

BCCR

CRSRR

CRSRR

class 3

class 2

class 3

class 2 class 1

7 BCCR CRSRR

BCCR

CRSRR

BCCR

BCP BDP

CRSRR

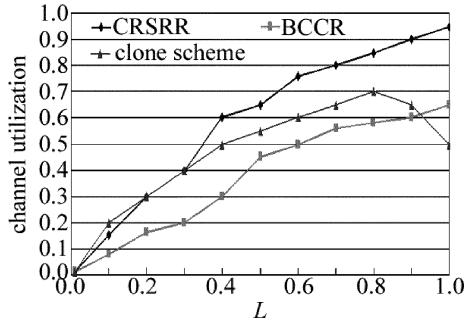

Fig. 7 Channel utilization of BCCR clone scheme and CRSRR with different loads

8
BCCR CRSRR

ns

BCCR

3 CRSRR
CRSRR

1 100%

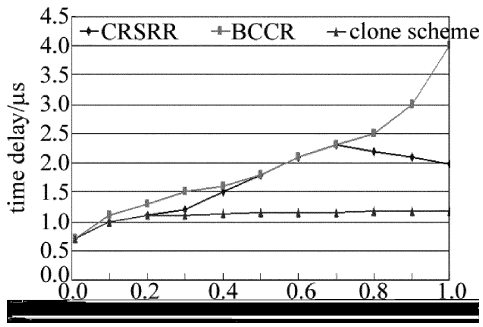

Fig. 8 Time delay of BCCR clone scheme and CRSRR with different loads

4

CRSRR

“
”

BCCR CRSRR

CRSRR

OBS

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