Flow model for a TCP/SIMA-like system with two NBR-classes

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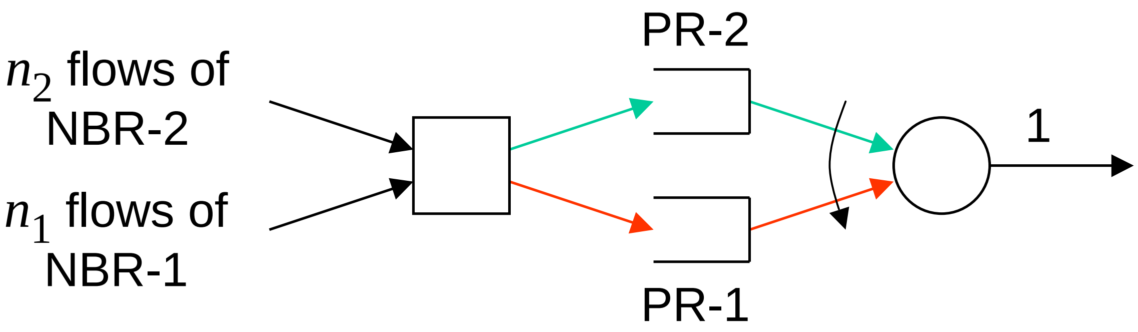
Contents

- Two priority classes
- Three priority classes

Flow model for two priority classes



	NBR-1	NBR-2
PR-2	ABR < b	ABR < ϕb
	b	ϕb
PR-1	ABR > b	ABR > ϕb

Equations for actual bit rates

n_{ij} := nr of flows of NBR-i and PR-j
β_{ij} := ABR of flows of NBR-i and PR-j

$$\beta_{12} = \min\{\frac{1}{n_{12}+n_{22}}, b\}$$

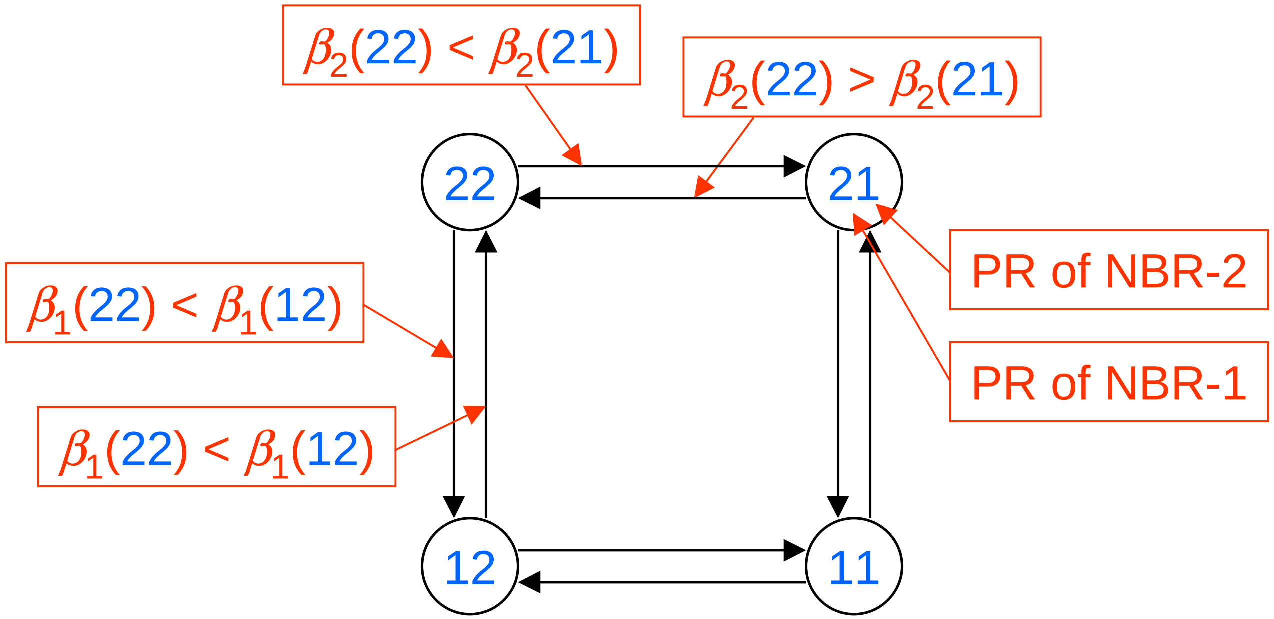
$$\beta_{22} = \min\{\max\{\frac{1}{n_{12}+n_{22}}, \frac{1-n_{12}b}{n_{22}}\}, \phi b\}$$

$$\beta_{11} = \max\{\frac{1-n_{12}\beta_{12}-n_{22}\beta_{22}}{n_{11}+n_{21}}, 0\}$$

$$\beta_{21} = \beta_{11}$$

NBR PR

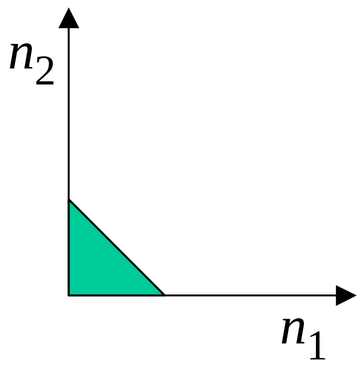
Individually optimal actual bit rates (1)

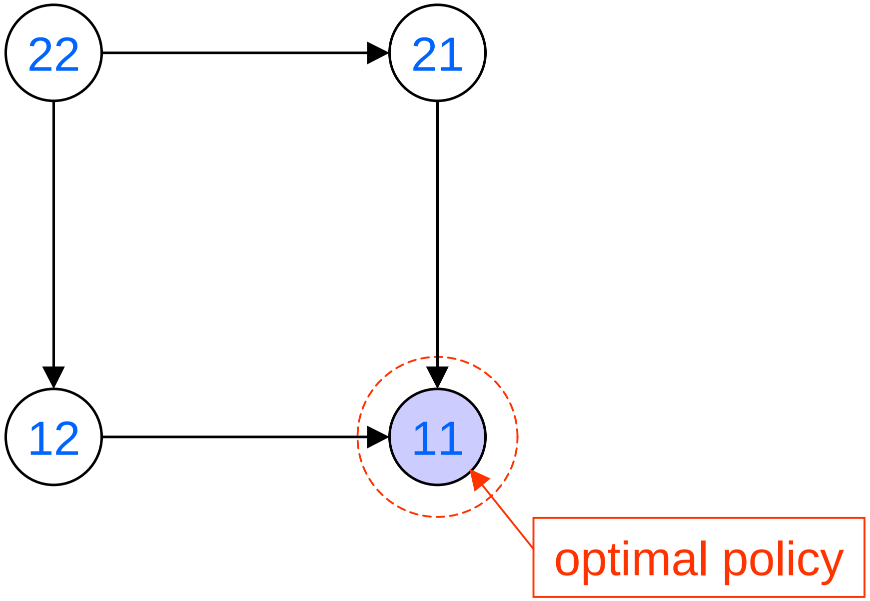


$$\beta_2(22) := \beta_{22}(n_{11}=0,\ n_{12}=n_1,\ n_{21}=0,\ n_{22}=n_2)$$
$$\beta_2(21) := \beta_{21}(n_{11}=0,\ n_{12}=n_1,\ n_{21}=n_2,\ n_{22}=0)$$

Individually optimal actual bit rates (2)

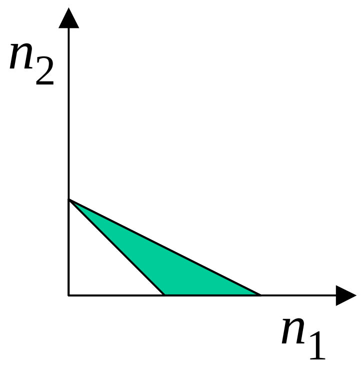
(A) $n_1 \phi b + n_2 \phi b < 1$

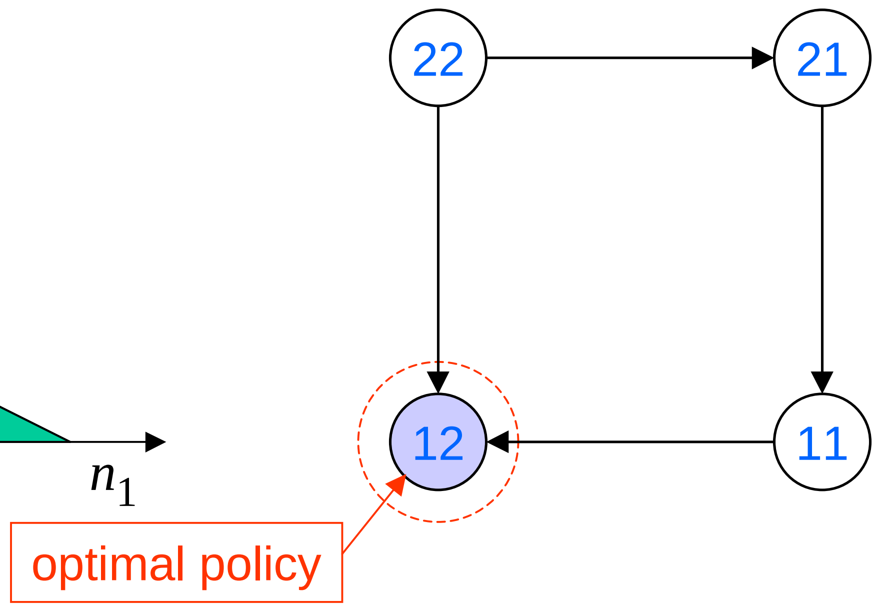




Individually optimal actual bit rates (3)

$$(A^c) \quad n_1\phi b + n_2\phi b > 1$$
$$(B) \quad n_1 b \quad + n_2\phi b < 1$$

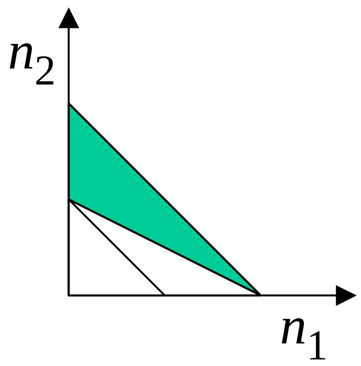


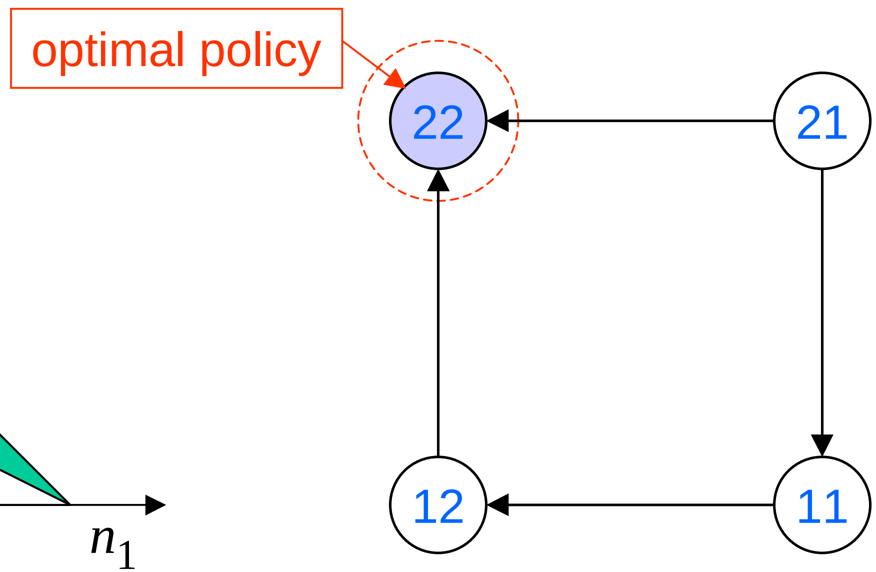


Individually optimal actual bit rates (4)

(B^c) $n_1 b + n_2 \phi b > 1$

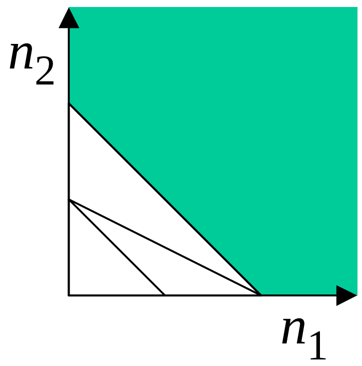
(C) $n_1 b + n_2 b < 1$

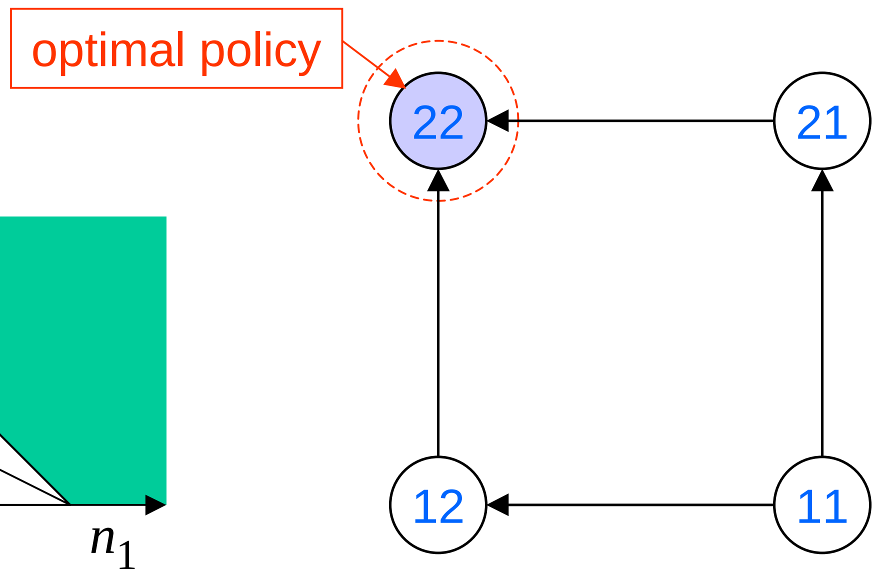




Individually optimal actual bit rates (5)

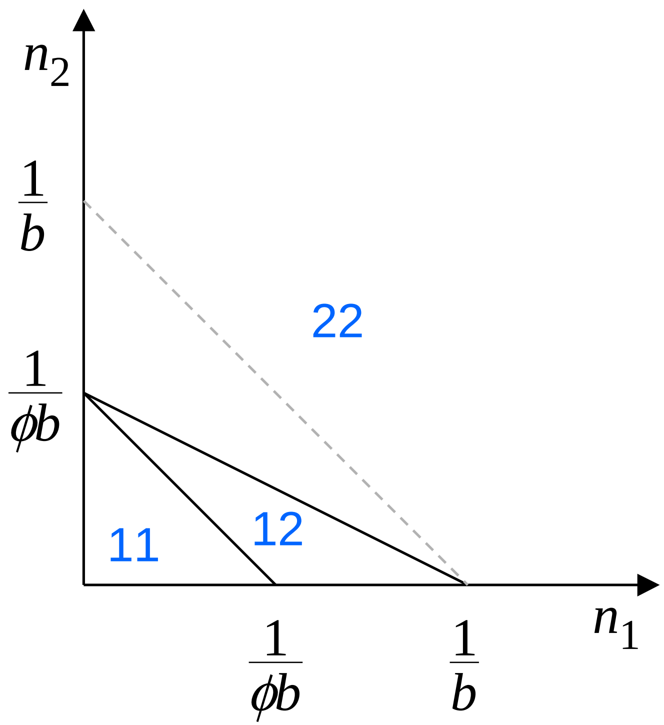
(C^c) $n_1 b + n_2 b > 1$



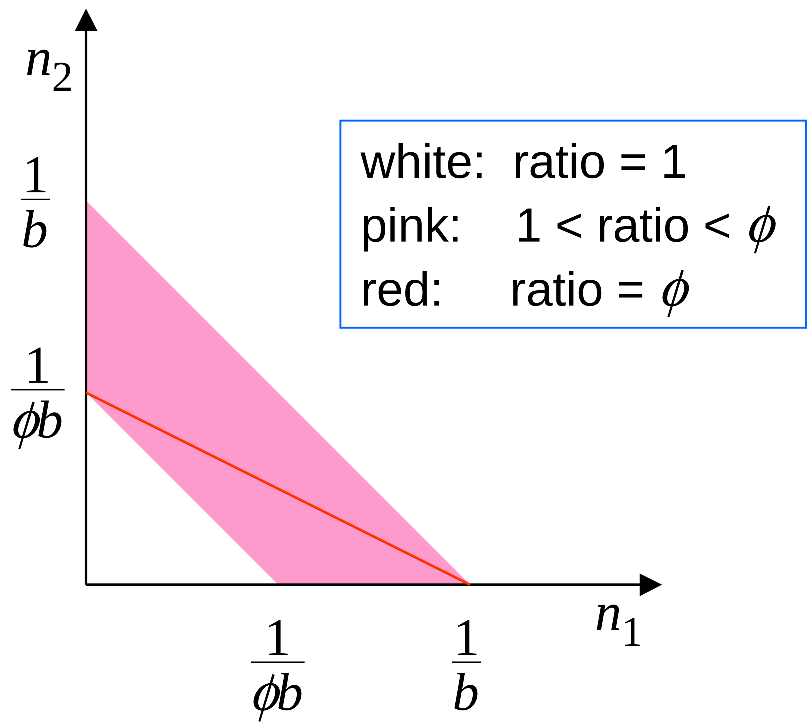


Individually optimal actual bit rates (6)

Optimal policy



Actual bit rate ratio

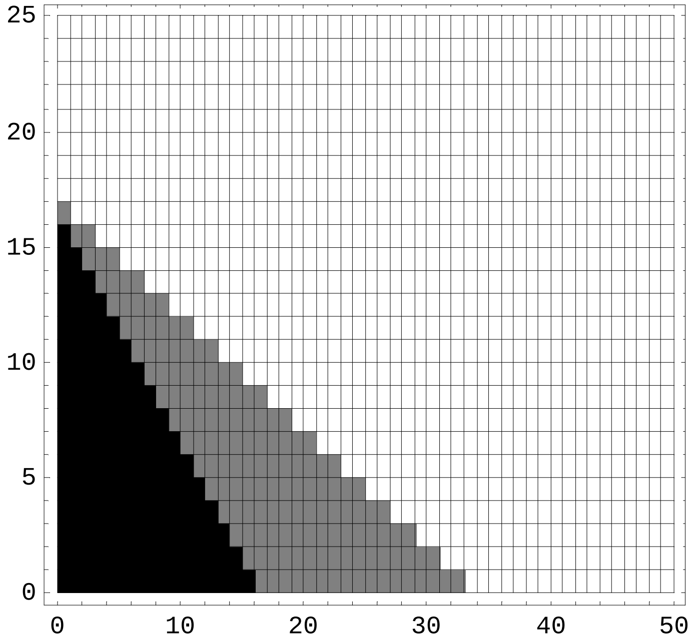


NBR-1 = 0.04
NBR-2 = 0.08

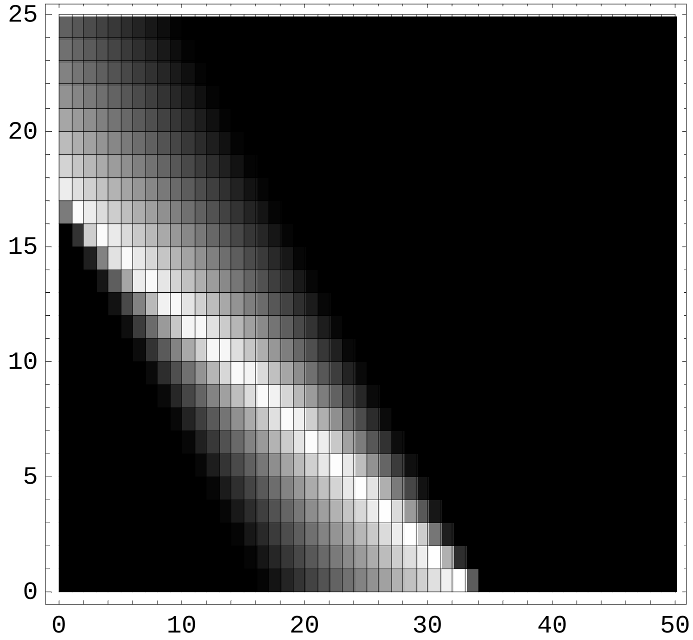
Example 1

$b = 0.04/\sqrt{2}$
$\phi = 2$

Optimal policy



Actual bit rate ratio



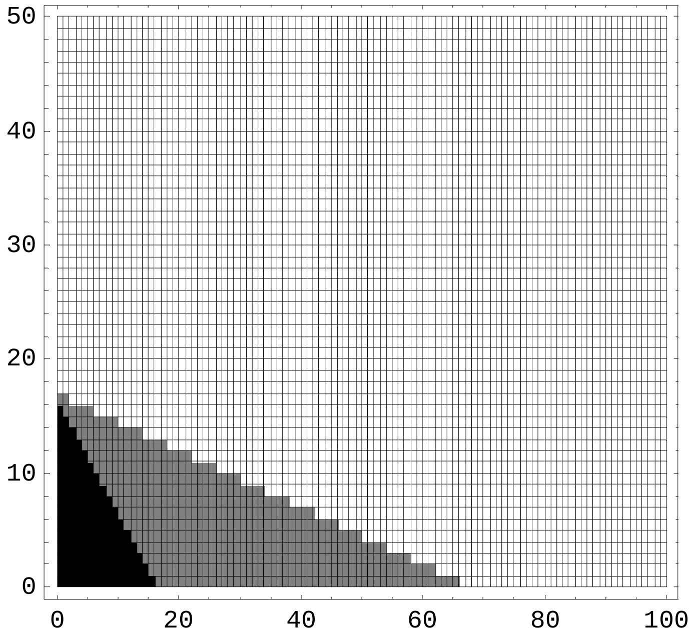
$$\frac{1}{\phi b} = 17.7 \qquad \frac{1}{b} = 35.4$$

NBR-1 = 0.02
NBR-2 = 0.08

Example 2

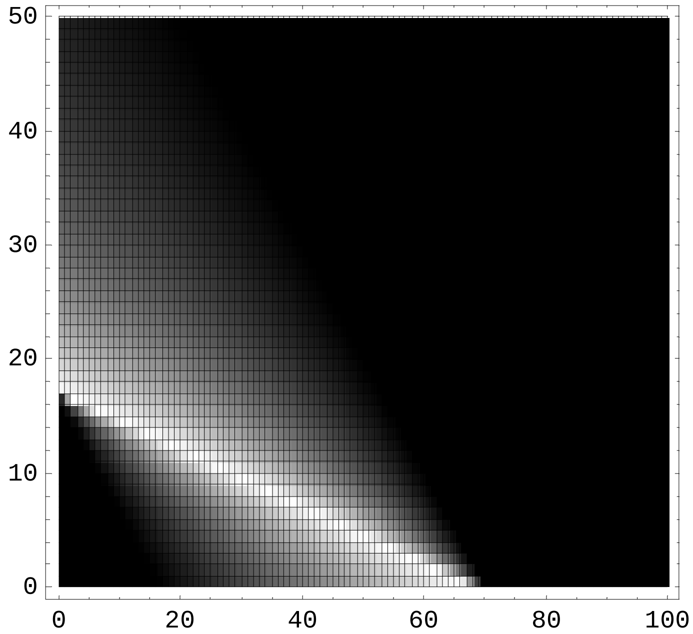
$b = 0.02/\sqrt{2}$
$\phi = 4$

Optimal policy



$$\frac{1}{\phi b} = 17.7 \qquad \frac{1}{b} = 70.7$$

Actual bit rate ratio



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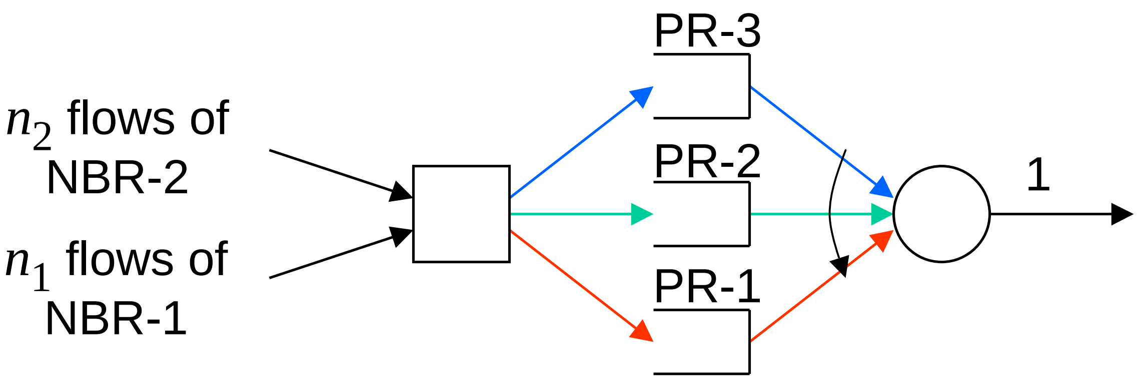
Flow model for three priority classes



	NBR-1	NBR-2
PR-3	ABR < $b/2$	ABR < $(\phi b)/2$
	$b/2$	$(\phi b)/2$
PR-2	$b/2$ < ABR < b	$(\phi b)/2$ < ABR < ϕb
	b	ϕb
PR-1	ABR > b	ABR > ϕb

Equations for actual bit rates

$$\beta_{13} = \min\{\frac{1}{n_{13}+n_{23}}, \frac{b}{2}\}$$

$$\beta_{23} = \min\{\max\{\frac{1}{n_{13}+n_{23}}, \frac{1-n_{13}\frac{b}{2}}{n_{23}}\}, \frac{\phi b}{2}\}$$

$$\beta_{12} = \min\{\frac{1-n_{13}\beta_{13}-n_{23}\beta_{23}}{n_{12}+n_{22}}, b\}$$

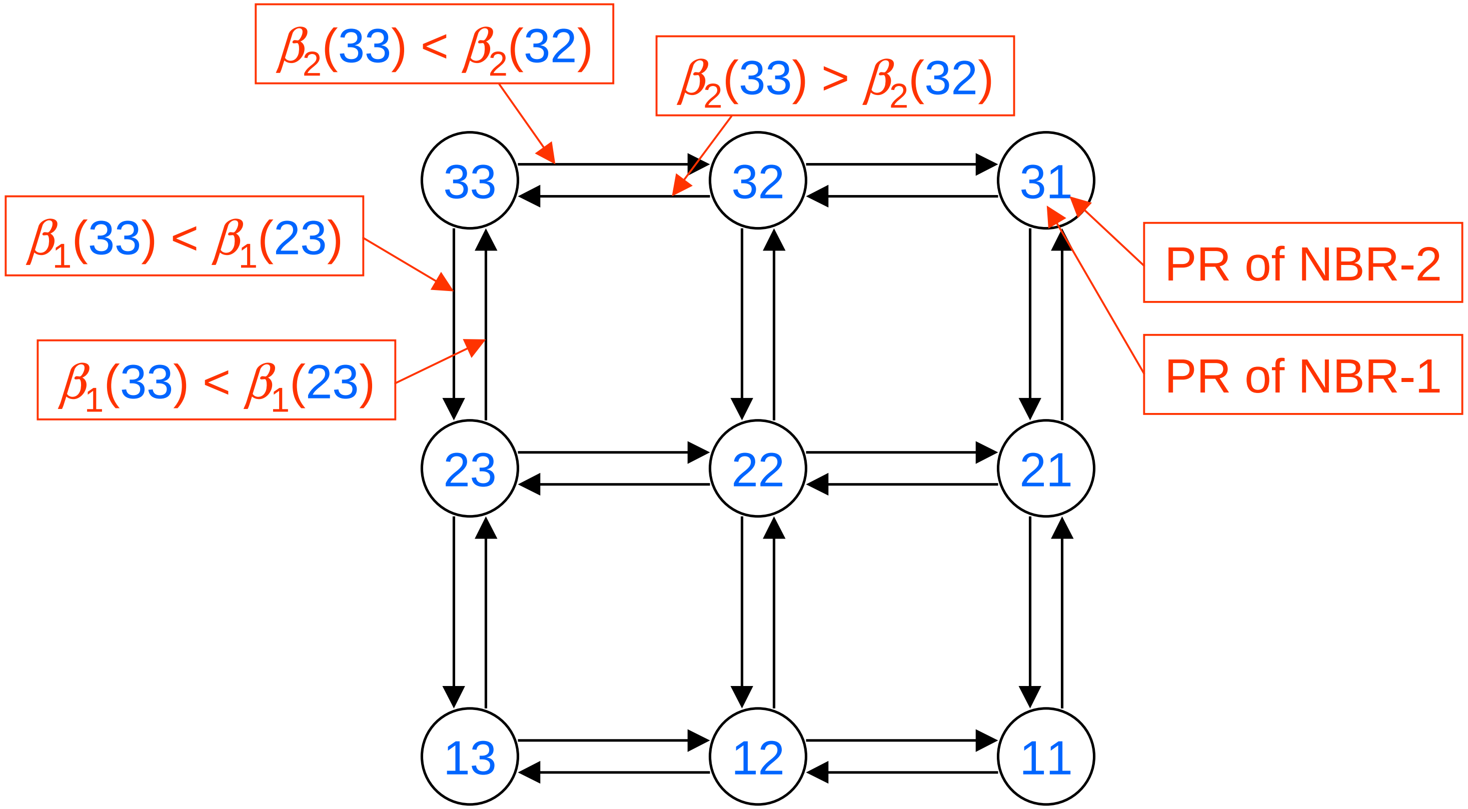
$$\beta_{22} = \min\{\max\{\frac{1-n_{13}\beta_{13}-n_{23}\beta_{23}}{n_{12}+n_{22}}, \frac{1-n_{13}\beta_{13}-n_{23}\beta_{23}-n_{12}b}{n_{22}}\}, \phi b\}$$

$$\beta_{11} = \max\{\frac{1-n_{13}\beta_{13}-n_{23}\beta_{23}-n_{12}\beta_{12}-n_{22}\beta_{22}}{n_{11}+n_{21}}, 0\}$$

$$\beta_{21} = \beta_{11}$$

NBR PR

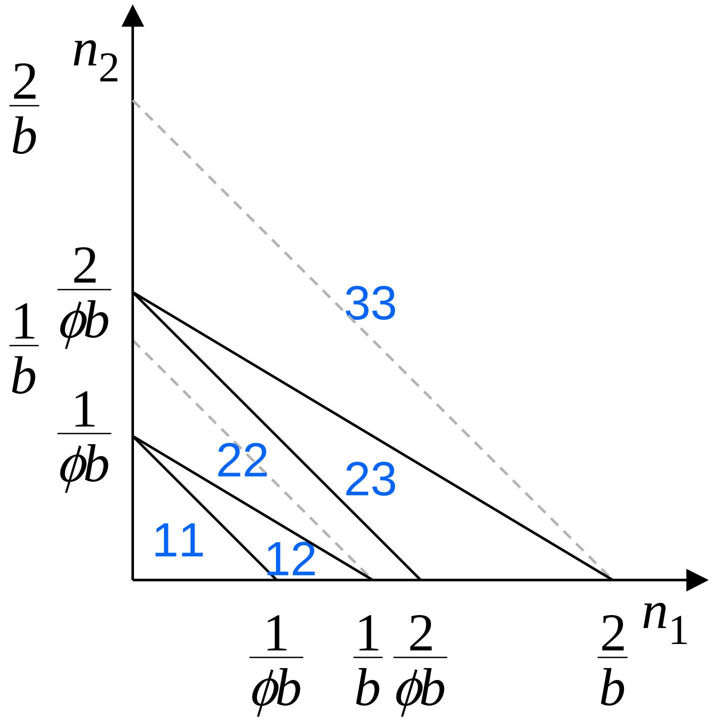
Individually optimal actual bit rates



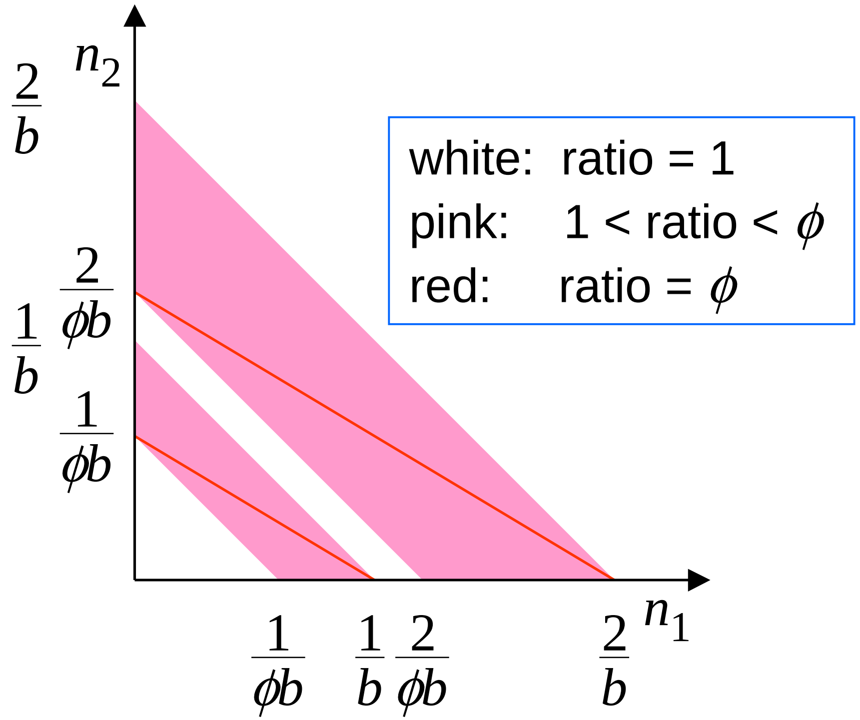
$$\beta_2(33) := \beta_{23}(n_{11}=0,\ n_{12}=0,\ n_{13}=n_1,\ n_{21}=0,\ n_{22}=0,\ n_{23}=n_2)$$
$$\beta_2(32) := \beta_{22}(n_{11}=0,\ n_{12}=n_1,\ n_{13}=0,\ n_{21}= 0,\ n_{22}=0,\ n_{23}=n_2)$$

Case 1: $\phi < 2$

Optimal policy

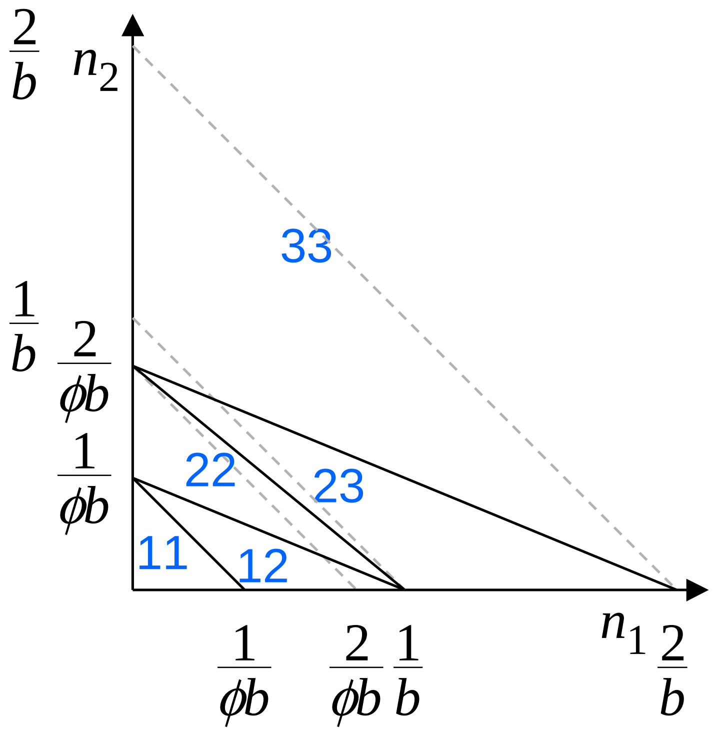


Actual bit rate ratio

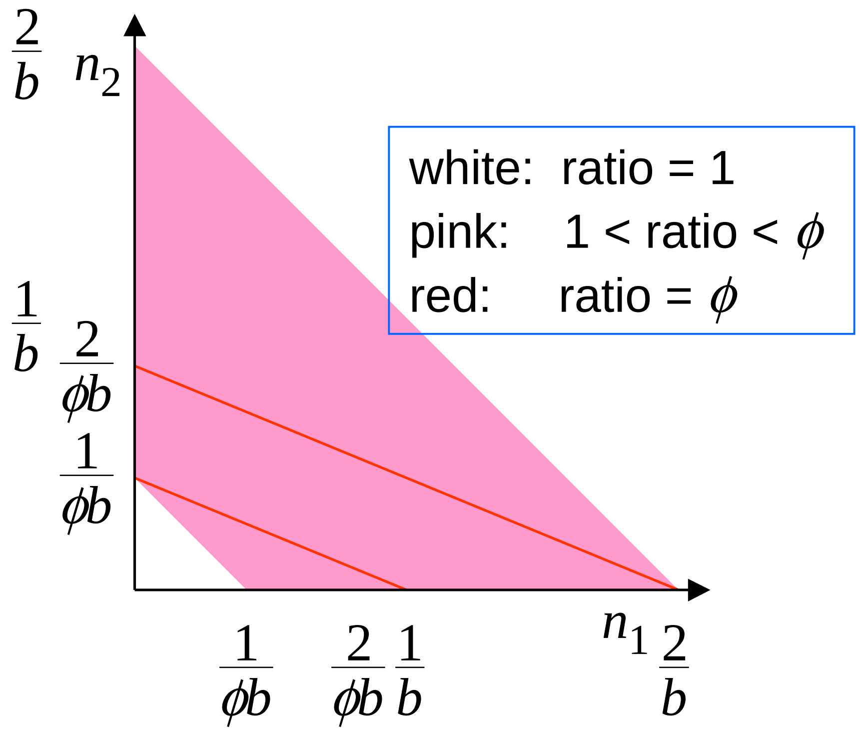


Case 2: $\phi > 2$

Optimal policy



Actual bit rate ratio



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