

**Les Réseaux à Acheminement avec Débordement**

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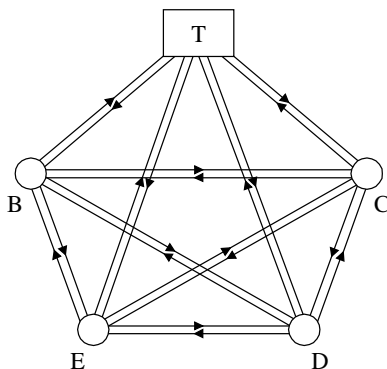
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Exemple:

Un petit réseau.  
4 centres terminaux.  
1 tandem.



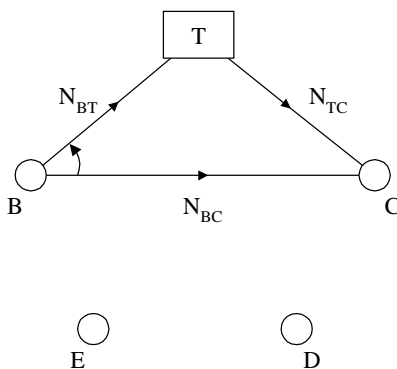
	B	C	D	E	T
B					
C					
D					
E					
T					

Considérons le cas de trafic

B→C!

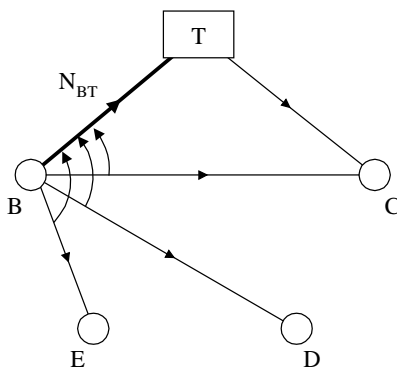
Tâches:

- 1) Optimiser  $N_{BC}$
- 2) Dimensionner  $N_{BT}$  et  $N_{TC}$



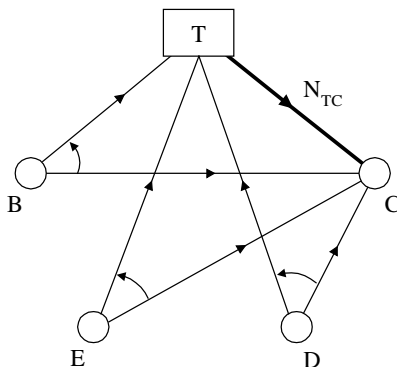
	B	C	D	E	T
B		X			X
C					
D					
E					
T		X			

Mais  $N_{BT}$  écoule également le trafic de débordement (trafic du fond) à partir des cas de trafic B→D et B→E!

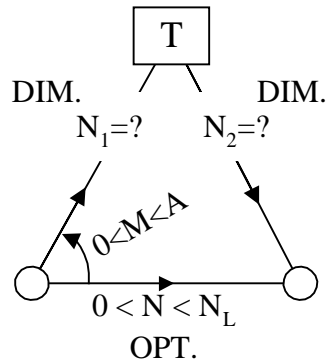
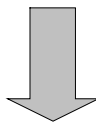
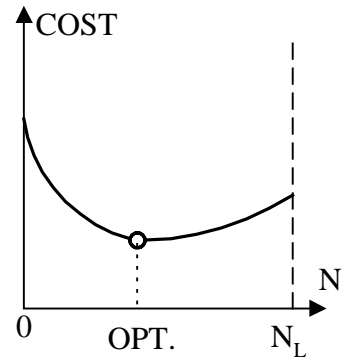
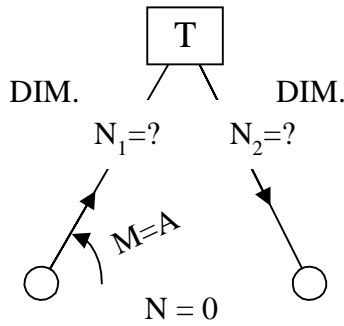
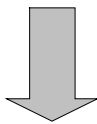
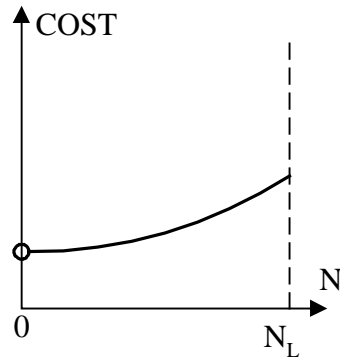
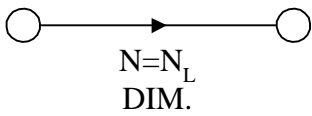
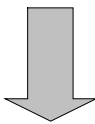
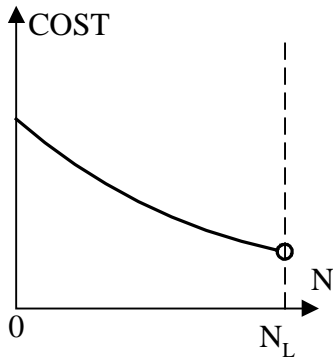
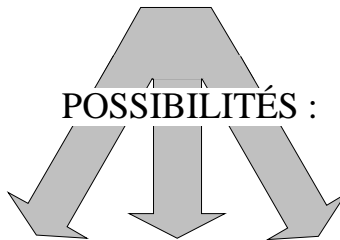
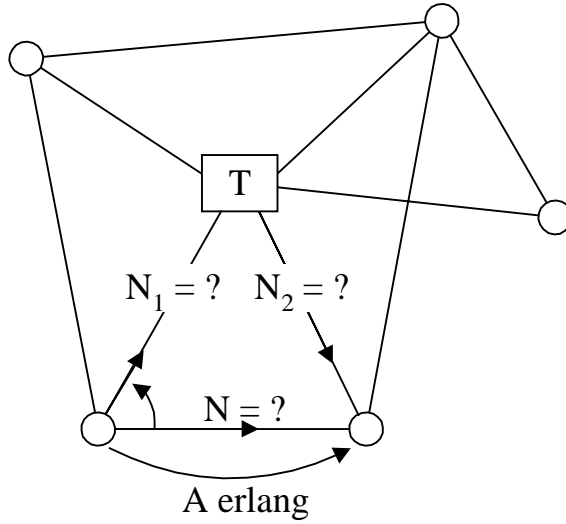


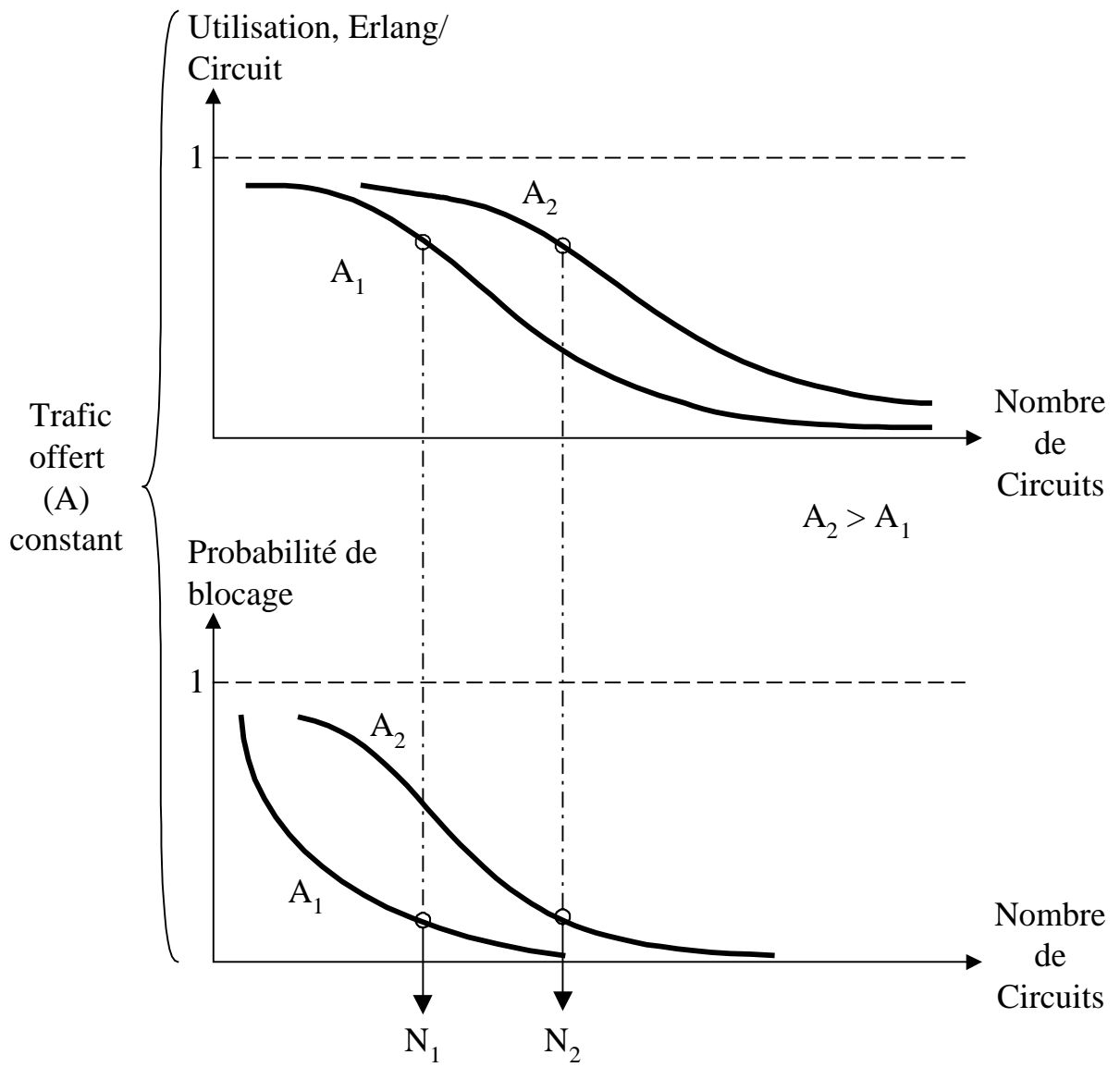
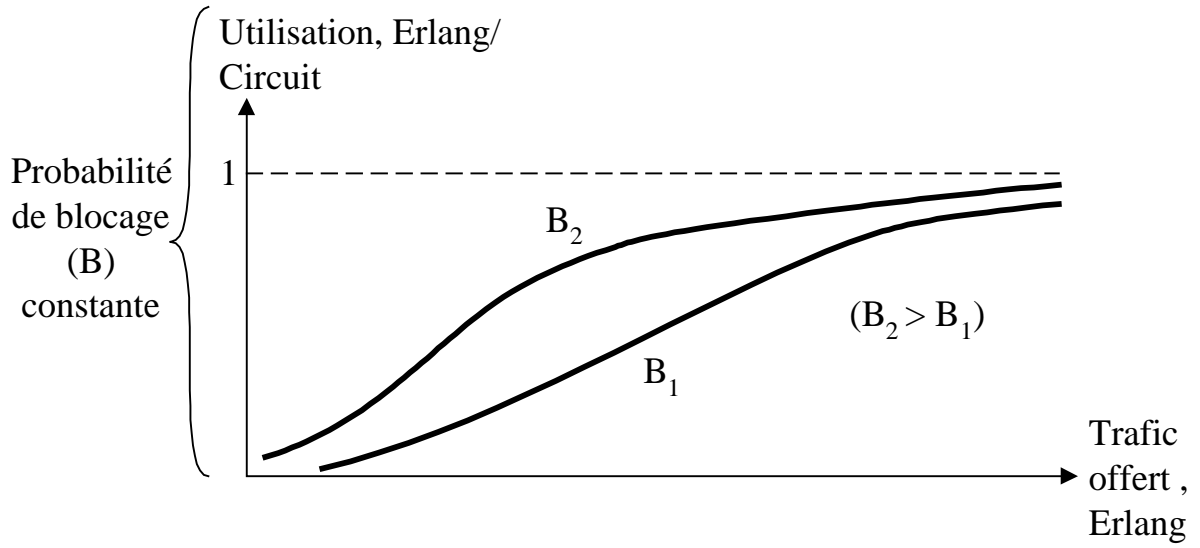
	B	C	D	E	T
B		X	X	X	X
C					
D					
E					
T					

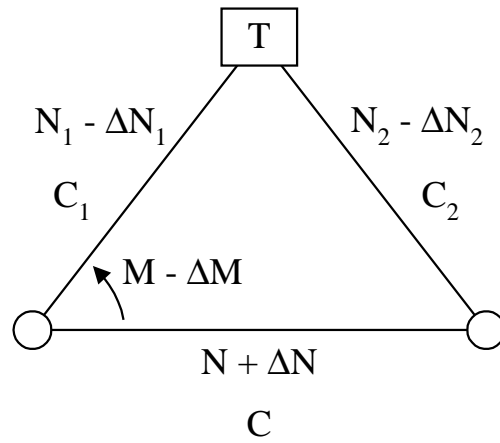
Et  $N_{TC}$  écoule également le trafic de débordement (trafic du fond) à partir des cas de trafic D→C et E→C



	B	C	D	E	T
B		X			
C					
D		X			
E		X			
T		X			







$$N + \Delta N \Rightarrow C_{TOT} + \Delta C_{TOT}$$

$$\Delta C_{TOT} = C \cdot \Delta N - C_1 \cdot \Delta N_1 - C_2 \cdot \Delta N_2$$

$$\Delta C_{TOT} = 0 \text{ quand :}$$

$$C \cdot \Delta N = C_1 \cdot \Delta N_1 + C_2 \cdot \Delta N_2$$

Divisé par  $\Delta M$  :

$$C \cdot \frac{\Delta N}{\Delta M} = C_1 \cdot \frac{\Delta N_1}{\Delta M} + C_2 \cdot \frac{\Delta N_2}{\Delta M}$$

où:

$$\frac{\Delta M}{\Delta N} = \frac{C}{C_1 \cdot \frac{\Delta N_1}{\Delta M} + C_2 \cdot \frac{\Delta N_2}{\Delta M}}$$

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Si  $\Delta N = 1$ , alors :

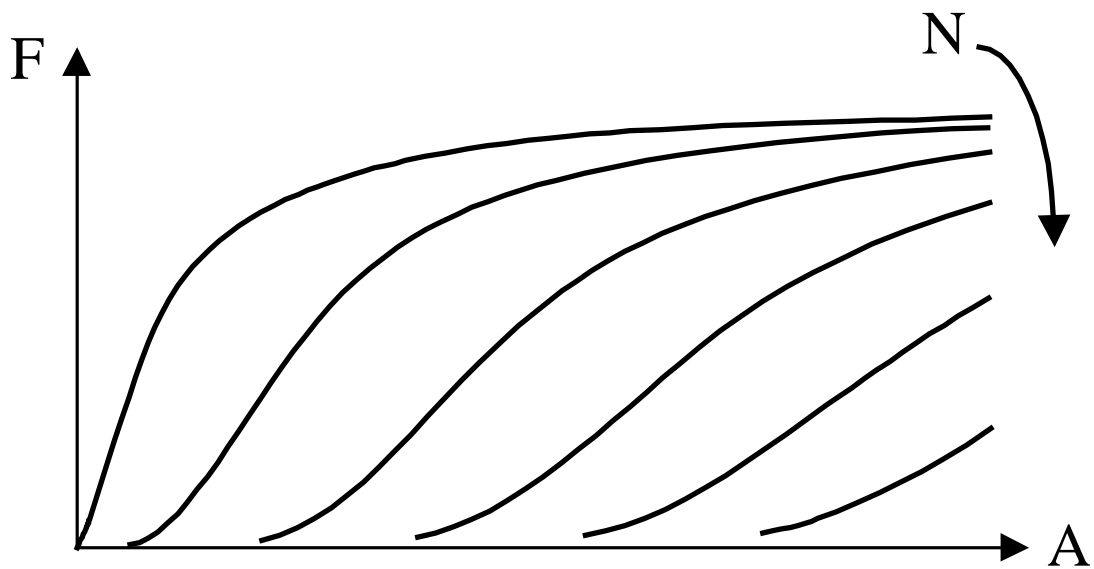
$$\frac{\Delta M}{\Delta N} = F = \text{Facteur d'amélioration}$$

F est calculé comme

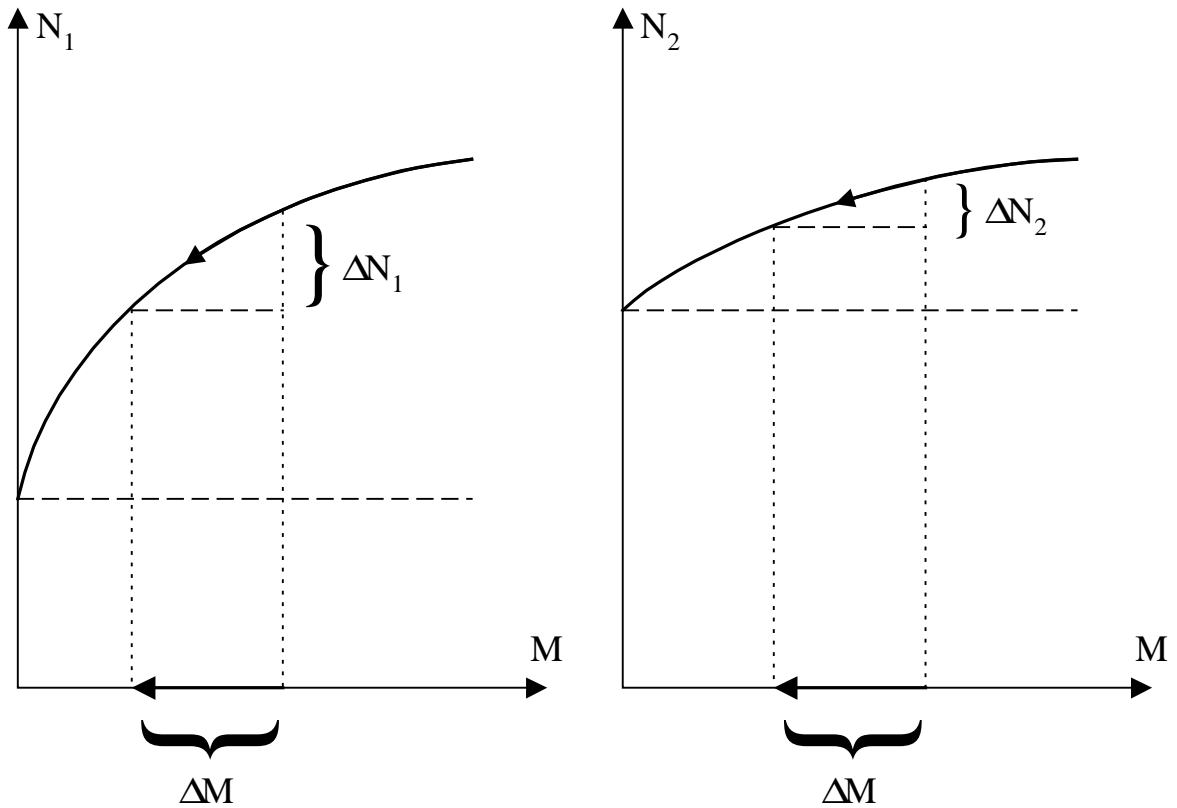
$$F = A \cdot [B_N(A) - B_{N+1}(A)]$$

Quand  $B_N(A)$  est une expression générale de la congestion dans un groupe de circuits avec  $N$  circuits et  $A$  erl. offerts.

Diagramme pour F:



$$\frac{\Delta M}{\Delta N} = F = \frac{C}{C_1 \cdot \frac{\Delta N_1}{\Delta M} + C_2 \cdot \frac{\Delta N_2}{\Delta M}}$$



Approximations de Rapp:

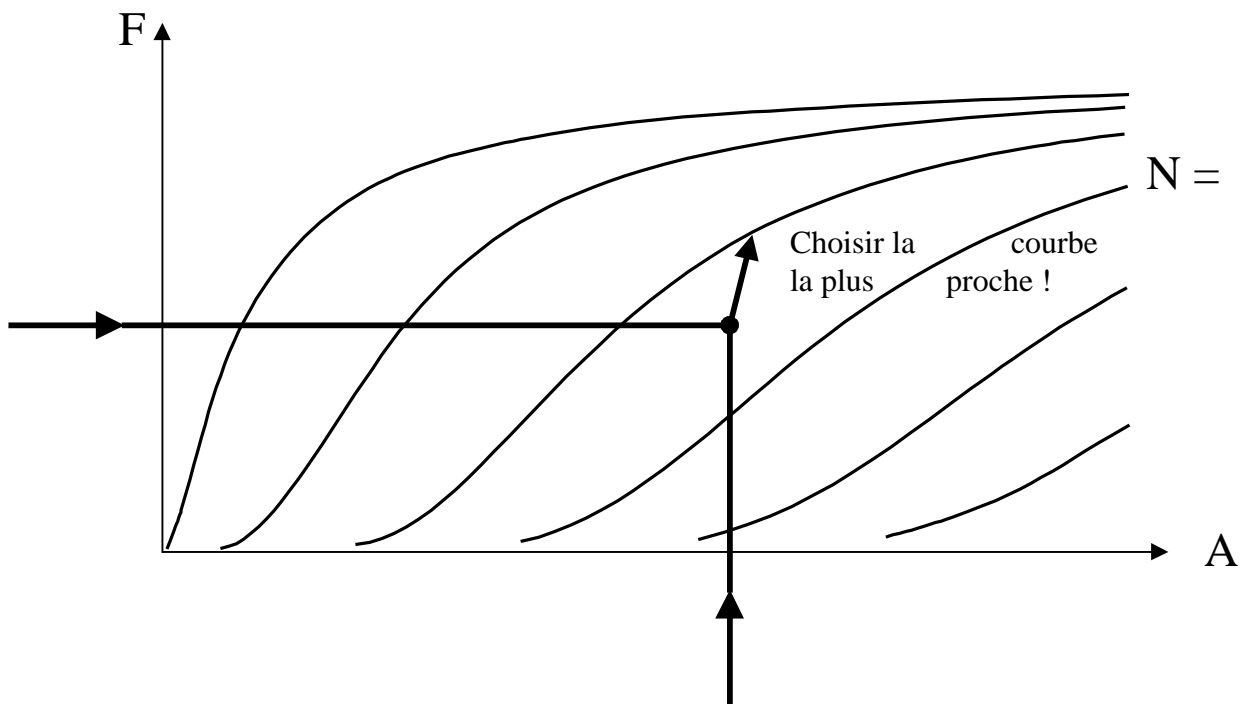
$$F = \varepsilon \cdot [0.7 + 0.3 \cdot \varepsilon^2]$$

où

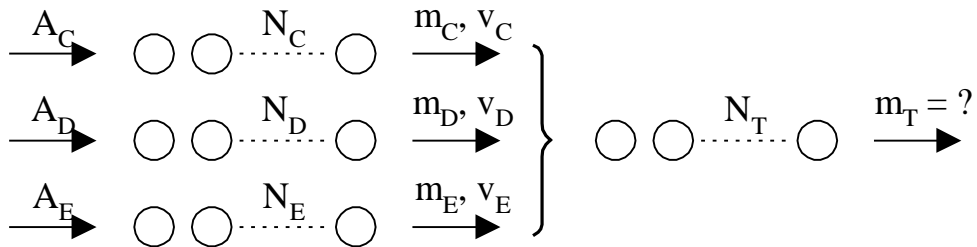
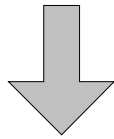
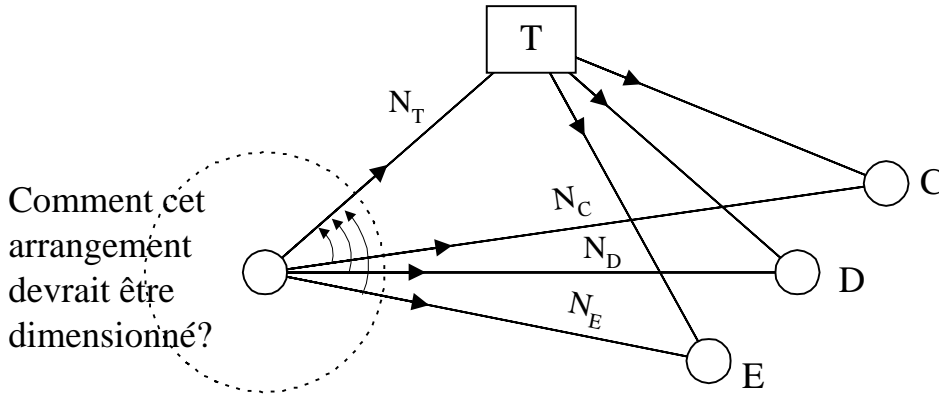
$$\varepsilon = \frac{C}{C_1 + C_2}$$

## Procédures d'Optimisation:

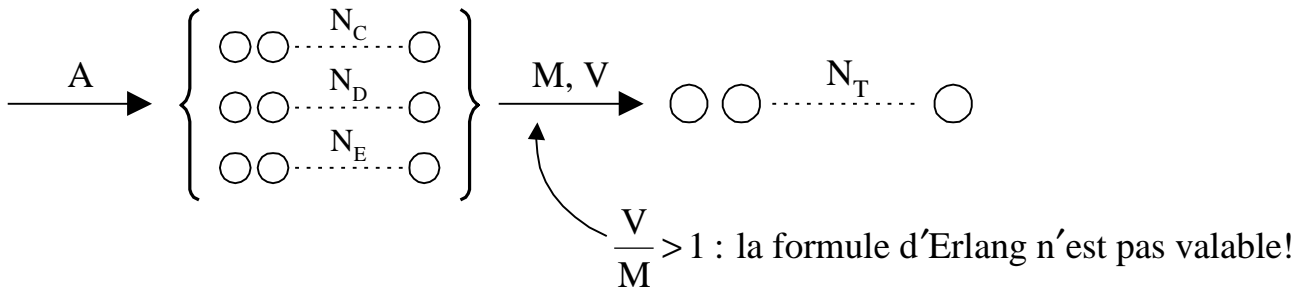
- 1) Calculer  $F$  en utilisant les approximations de Rapp.
- 2) Utiliser la valeur de  $F$  calculée et le trafic total  $A$ , entrer le diagramme de  $F$  approprié et lire ;  $N$  = Nombre de circuits optimal dans le faisceau à forte utilisation.



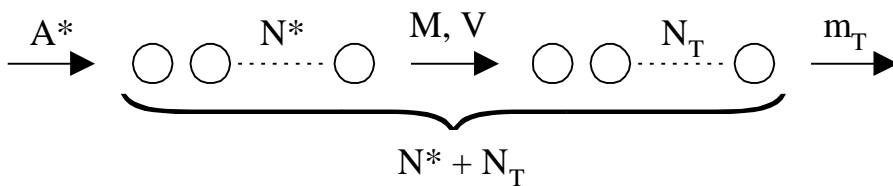
Methode de Wilkinson:



On fait la somme de tout:



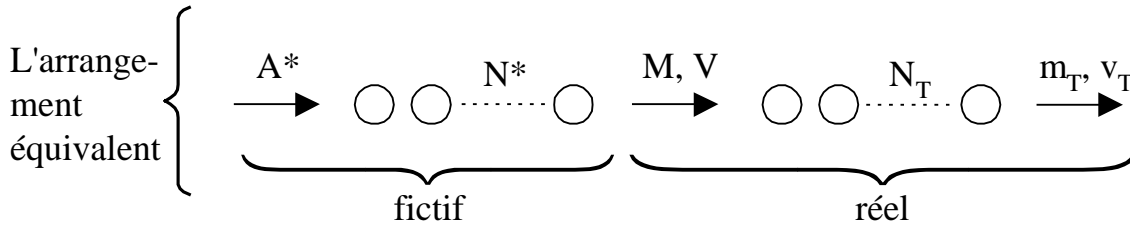
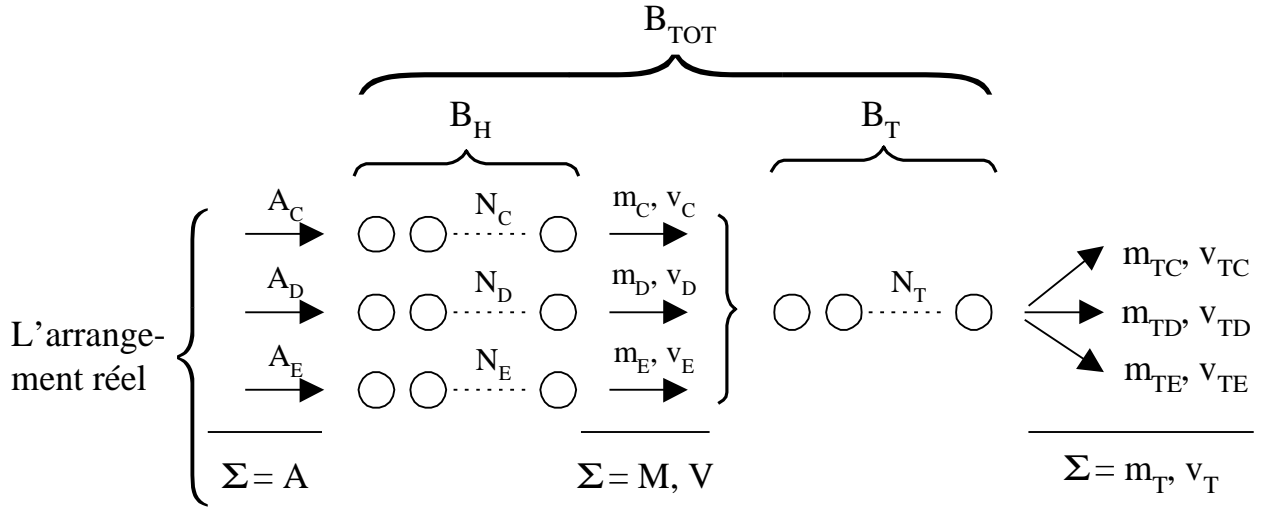
Solution: trouver le trafic fictif  $A^*$ , offert d'un groupe de circuit fictif  $N^*$ , alors que la moyenne et la variance du trafic rejeté est exactement égal à  $M$  resp.  $V$  !



La formule d'Erlang est maintenant valable:

$$m_T = A^* \cdot E_{N^*+N_T}(A^*)$$

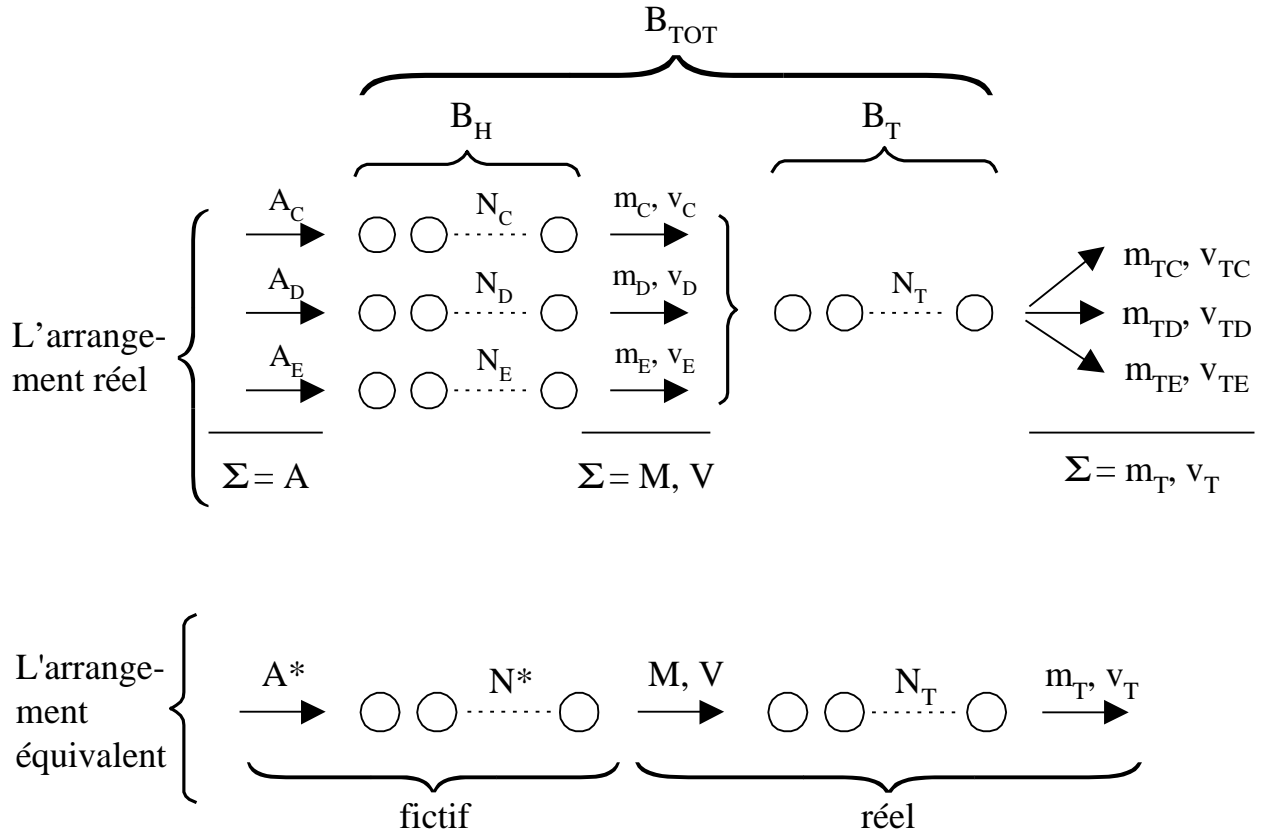
Probabilités de blocage:



$$1. \bar{B}_H = \frac{m_C + m_D + m_E}{A_C + A_D + A_E} = \frac{A_C \cdot E_{N_C}(A_C) + A_D \cdot E_{N_D}(A_D) + A_E \cdot E_{N_E}(A_E)}{A_C + A_D + A_E} = \frac{M}{A}$$

$$2. \bar{B}_T = \frac{m_{TC} + m_{TD} + m_{TE}}{m_C + m_D + m_E} = \frac{m_T}{M} = \frac{A^* \cdot E_{N^*+N_T}(A^*)}{M} = \frac{E_{N^*+N_T}(A^*)}{E_{N^*}(A^*)}$$

$$3. \bar{B}_{TOT} = \frac{m_T}{A_C + A_D + A_E} = \frac{A^* \cdot E_{N^*+N_T}(A^*)}{A}$$



$$4. B_{HC} = \frac{m_C}{A_C} = E_{N_C}(A_C)$$

$$5. B_{TC} = \bar{B}_T = \frac{E_{N^*+N_T}(A^*)}{E_{N^*}(A^*)}$$

$$6. B_{TOTC} = \frac{m_{TC}}{A_C} = \frac{m_C \cdot \bar{B}_T}{A_C} = \frac{E_{N_C}(A_C) \cdot E_{N^*+N_T}(A^*)}{E_{N^*}(A^*)}$$

$$7. B'_{TC} = \frac{v_C \cdot M}{V \cdot m_C} \cdot \bar{B}_T$$

$$8. B'_{TOTC} = \frac{m'_{TE}}{A_C} = \frac{m_C \cdot B'_{TC}}{A_C} = \frac{v_C \cdot M}{V \cdot m_C} \cdot B_{TOTC} =$$

$$= \frac{v_C \cdot M}{V \cdot m_C} \cdot \frac{E_{N_C}(A_C) \cdot E_{N^*+N_T}(A^*)}{E_{N^*}(A^*)}$$

1. (Approx.)  $n_v$  à partir de

$$\begin{cases} F(n_v, A_v) \approx \varepsilon \cdot \left[ 1 - 0.3 \cdot (1 - \varepsilon^2) \right] \\ \varepsilon = C_{ij} / (C_{it} + C_{Tj}) \\ F(n, A) = A \cdot [E(n, A) - E(n+1, A)] \quad (\text{exact}) \end{cases}$$

2. (Exact)

$$m_v = A_v \cdot E_{n_v}(A_v)$$

$$v_v = m_v \cdot \left( 1 - m_v + \frac{A_v}{1 + n_v + m_v - A_v} \right)$$

3. (Exact)

$$M = \sum_v m_v \quad V = \sum_v v_v$$

4. (Exact)

$A^*$  et  $n^*$  de

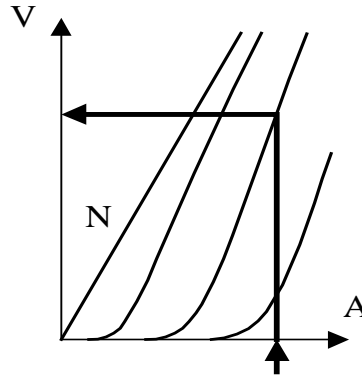
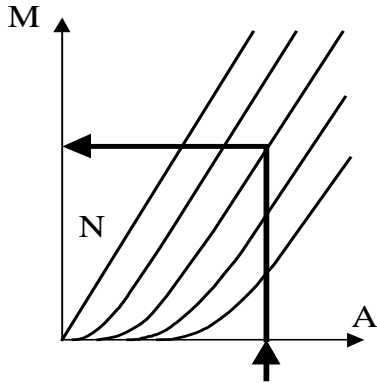
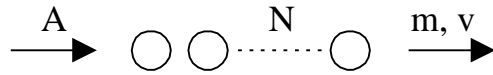
$$\begin{cases} M = A^* \cdot E_{n^*}(A^*) \\ V = M \cdot \left( 1 - M + \frac{A^*}{1 + n^* + M - A^*} \right) \end{cases}$$

4. (Approx.)

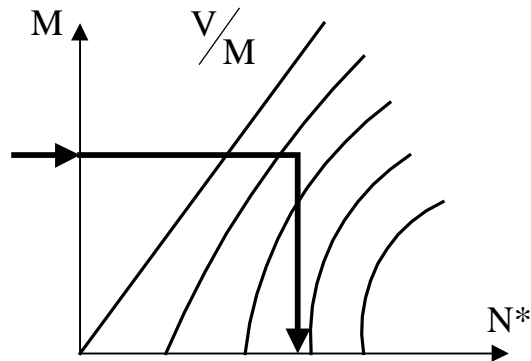
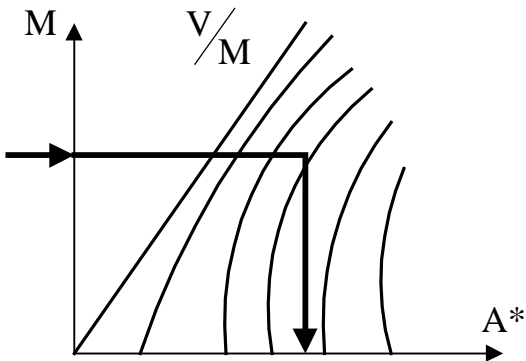
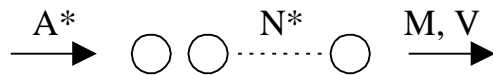
$$A^* \approx V + 3 \cdot \frac{V}{M} \cdot \left( \frac{V}{M} - 1 \right)$$

$$n^* \approx \frac{A^*}{1 - \frac{1}{M + \frac{V}{M}}} - M - 1$$

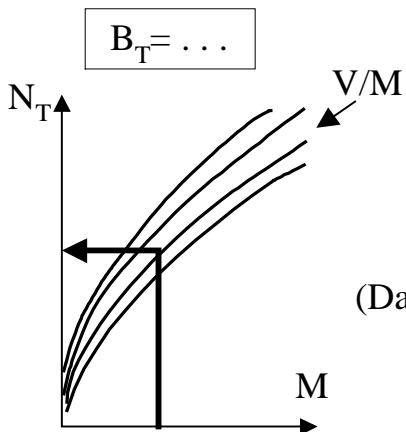
Il y a des diagrammes de calcul de  $m$  et  $v$  des faisceaux de forte utilisation...



et autres diagrammes pour le calcul du trafic fictif et le faisceau de circuits fictif:



Si le faisceau tandem devrait être dimensionné pour une valeur de congestion standard (fixe), alors les diagrammes peuvent être utilisés (au lieu des calculs).



(Dans ce cas, A\* et N\* ne sont pas nécessaires !)