ANALITYCAL METHOD FOR DIMENSIONING DYNAMIC WDM OPTICAL NETWORKS

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Basic System

- WDM network.
- Dynamic
- Each node is capable of converting wavelengths.
- Objective: To offer P classes of service
  - Class 1 is highest priority
  - Class P is lowest priority
- QoS definition:
  - Blocking Probability of the class k : B_k; $1 \leq k \leq P$

Analysis for a link

- Model
  - W wavelengths
  - arrival process of class k, $1 \le k \le P$:
    Poisson process with rate λ_k
  - The burst service time follows an exponential distribution of parameter μ, which is independent of the class.

Analysis for a link

- Strategie for offering differents QoS
  - Users of class k, $1 \leq k \leq P$, can transmit using only wavelengths 1 to M_k
  - Users of class k-1, transmit using the wavelengths 1 to M_{k-1} ($>M_k$)
  - ....
  - Users of class 1, transmit using wavelengths 1 to W

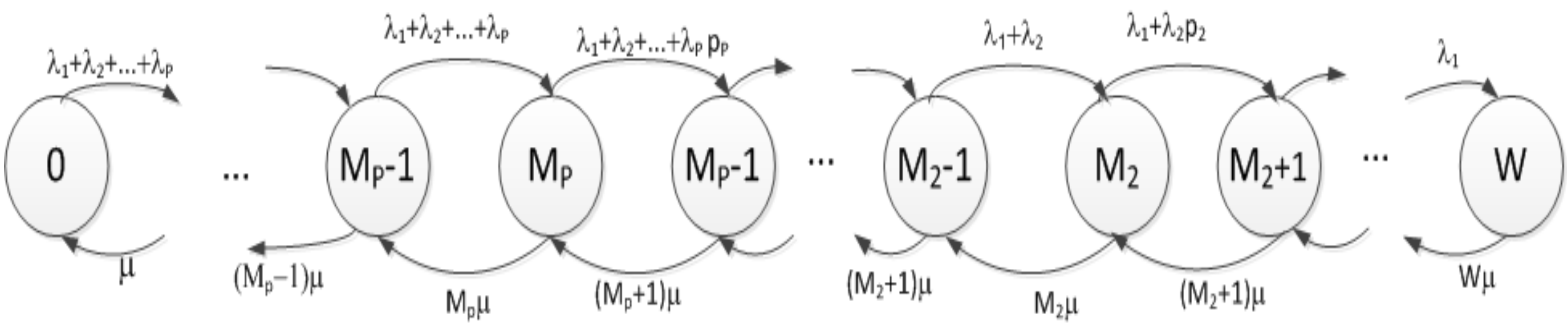
Model Summary

The above considerations can be summarized in a Markovian model M / M / W / W.

State= number of available wavelengths

$$\lambda_k = \begin{cases} \sum_{j=1}^{P} \lambda_j & ; \quad 0 \leq k < M_P \\ \sum_{i=1}^{j} \lambda_i & ; \quad M_{j+1} < k < M_j;\ j \in \{1, \ldots, P\} \\ \sum_{i=1}^{j-1} \lambda_i + \lambda_j p_j & ; \quad k = M_j;\ j \in \{1, \ldots, P\} \end{cases} \qquad (1)$$

$$\mu_k = k\mu$$



Contribution of this work

- The thresholds procedure was published in [1]. However to obtain the results, the authors used Markov Decision Process, which is a complex method to evaluate computationally different thresholds.
- Next we derive a new and efficient way of find the different thresholds

[1] Li Yang and G. Rouskas, «Optimal Wavelength Sharing Policies in OBS networks Subject to QoS constraints, IEEE JSAC, (25) 9, 2007.

Model Solution

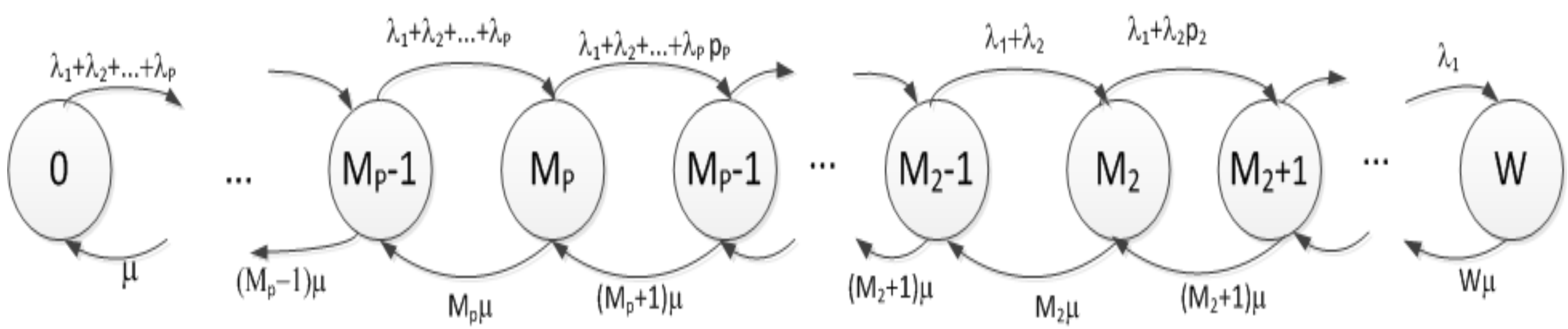
- Considering that the previous markov chain is a birth - death process, it is known that the recurrent solution of this queue is:

- From left to right: $\pi_k = \pi_0 \prod_{j=1}^{k} \frac{\lambda_{j-1}}{\mu_j}$ (2)

- From right to left: $\pi_k = \pi_W \prod_{j=k}^{W-1} \frac{\mu_{j+1}}{\lambda_j}$ (3)

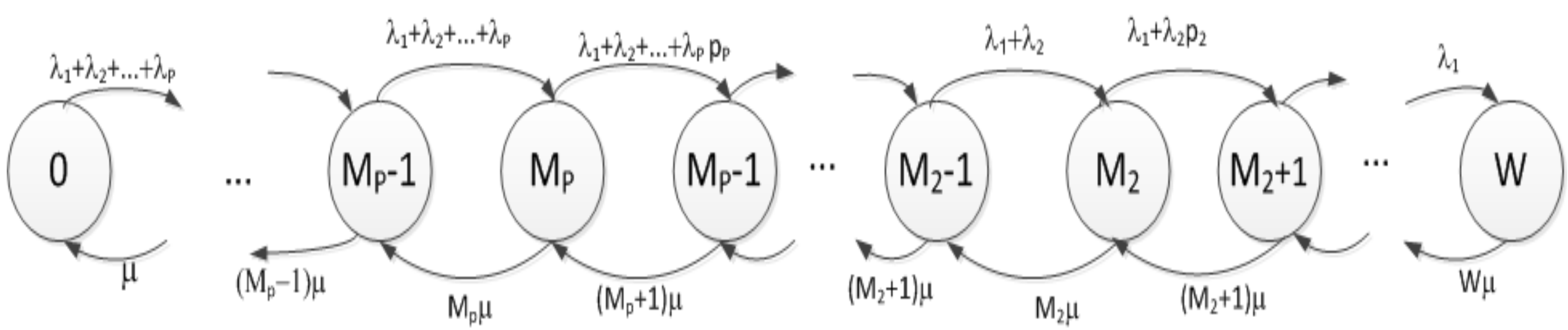
Design Goal

- To find the thresholds M_k, M_{k-1}, …, M_1 such that qualities of service B_k, B_{k-1}, …, B_1 of each class are met.
- For this, we consider the non normalized probabilities Pr(k)



Recurrent procedure

- Initially: Pr(1)=1 ; (or P(W)=1) (4)
- According to equations (2, 3 and 4) and the definitions of the different quality of services, the followig proportion must be satisfied:
- $$\frac{\Pr(M_k)}{B_k} = \frac{\Pr(M_{k-1})}{B_{k-1}} \quad (5)$$



Recurrent procedure

- The previous recurrent procedure allows the evaluation of all the thresholds: M_1, M_2, …, M_P

Final Remarks

- Then, the contribution of this work consists in proposing the previous recurrent method,
- that allows evaluate the same thresholds in a (much) faster and simpler way.
- This is relevant, because the just described procedure must be applied a great number of times to solve more complex problems, like :
- End-to-end quality of service
- Routing problem, etc.