

## Blocked Calls Delayed

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ECE 4823

## Blocked (or Lost) Calls Delayed

- In a previous module, we considered Blocked Calls Cleared, and the grade-of-service (GOS) was probability of blocking
- In a Blocked Calls Delayed system, if all channels are busy, a new user goes into a queue to wait for service
- Private mobile radio (PMR) systems are often the Blocked Calls Delayed type [Hernando and F. Pérez-Fontán, 1999]

## Erlang C Formula

- The GOS is given by  $P(\text{delay} > t)$ , where  $t$  is some specified time limit, like 20 seconds  
 $P(\text{delay} > t) = P(\text{delay} > t \mid \text{delay} > 0)P(\text{delay} > 0)$
- $P(\text{delay} > 0)$  shall be denoted  $C(A, N)$ , and is given by the Erlang C formula:

$$C(A, N) = \frac{\left(\frac{A^N}{N!}\right)\left(\frac{N}{N-A}\right)}{\sum_{k=0}^{N-1} \frac{A^k}{k!} + \left(\frac{A^N}{N!}\right)\left(\frac{N}{N-A}\right)}$$

## Alternative Expression for Erlang C

- $C(A, N)$  can be expressed in terms of the blocking probability  $B(A, N)$ :

$$C(A, N) = \frac{NB(A, N)}{N - A[1 - B(A, N)]}$$

## Full GOS Formula

- The final expression for the GOS is  
 $P(\text{delay} > t) = C(A, N) \exp\left[-(N - A)\frac{t}{H}\right]$   
where  $H$  is the average call duration.

## Summary

- In Blocked Calls Cleared, if all channels are busy, the new user is denied service
- In Blocked Calls Delayed, if all channels are busy, the new user waits for service
- Erlang B is used for the former, Erlang C for the latter