# Mobile Communications

## TCS 455

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## Lecture 10

**Office Hours:**
**BKD 3601-7**
**Tuesday 14:00-16:00**
**Thursday 9:30-11:30**

# Announcements

- Read
  - Chapter 3: 3.1 – 3.2, 3.5.1, 3.6, 3.7.2
    - Posted on the web
  - Appendix A.1 (Erlang B)

# Recall

- We spent a few lectures now studying Poisson process.
- This will be used to model call arrivals.
- Along the way, we review many facts from probability theory.
  - pmf – Binomial, Poisson, Geometric
  - pdf - Exponential
  - Independence
  - Expectation, characteristic function
  - Sum of independent random variables and how to analyze it by characteristic functions
- You have seen that Poisson process (PP) connects many concepts that you learned from introductory probability class.

# Big Picture

$S$ = total # available duplex radio channels for the system

Frequency reuse with **cluster size $N$**

"Capacity" $C = \frac{A_{\text{total}}}{A_{\text{cell}}} \times \frac{S}{N}$

Tradeoff $\frac{S}{I} \approx \frac{kR^{-\gamma}}{K \times (kD^{-\gamma})} = \frac{1}{K}\left(\frac{D}{R}\right)^{\gamma} = \frac{1}{K}\left(\sqrt{3N}\right)^{\gamma}$

m = # channels allocated to each cell.

Omni-directional: K = 6
120° Sectoring: K = 2
60° Sectoring: K = 1

Trunking

Call blocking probability $P_b = \frac{\frac{A^m}{m!}}{\sum_{i=0}^{m} \frac{A^i}{i!}}$. Erlang-B formula

$\lambda$ = Average # call attempts/requests per unit time

$A$ = traffic intensity or load [Erlangs] = $\frac{\lambda}{\mu}$

$\frac{1}{\mu} = H$ = Average call length

# Assumption

- **Blocked calls cleared**
  - Offers no queuing for call requests.
  - For every user who requests service, it is assumed there is no setup time and the user is given immediate access to a channel if one is available.
  - If no channels are available, the requesting user is blocked without access and is free to try again later.
- **Calls arrive as determined by a *Poisson process*.**
- There are memoryless arrivals of requests, implying that all users, including blocked users, may request a channel at any time.
- There are an infinite number of users (with finite overall request rate).
  - The finite user results always predict a smaller likelihood of blocking. So, assuming infinite number of users provides a conservative estimate.
- **The duration of the time that a user occupies a channel is exponentially distributed**, so that longer calls are less likely to occur.
- There are $m$ channels available in the trunking pool.
  - For us, $m$ = the number of channels for a cell (C) or for a sector