Example: Using Erlang B table determine the amount of traffic that can be supported at 8% of 24% in a

1) Omnidirectional configuration with 24 voice channels
2) In sector configuration at 12 voice channels per sector

Using Erlang B table: 60% = 24 C = 12

\[ A = 21.9 \quad A_{\text{sector}} = 6.61 \]
\[ A_{\text{cell}} = 19.83 \]

Loss of ranking efficiency \( L = \frac{A(\text{omni}) - A(\text{sector})}{A(\text{omni})} = \frac{21.9 - 19.83}{21.9} = 9.43\% \)

Example: Consider GSM deployment in 5 MHz of spectrum. Calculate the maximum capacity per cell if the system is deployed with

a) \( N = 7 \) in omnidirectional configuration
b) \( N = 4 \) in tri-sectored configuration

Assume 100 kHz quad bands.

Voices = \( \frac{5000 \text{ kHz} \times 5 \times 100 \text{ kHz}}{100 \text{ kHz}} = 24 \text{ channels} \)
a) N=7

\# Channel /cell = \frac{24}{7} = 3.42 Channel /cell (same cells have 3 same cells have 4)

\# trunks /cell = 3.42 \times 8 = 27.36 \Rightarrow 27 \text{ trunks /cell}

Using Elnag and et al. \(6.5 = 5\% \Rightarrow \text{Acell} = 19.8 \text{ E /cell}

b) N=4

\# Channel /cell = \frac{24}{4} = 6 \text{ Channel /cell}

\# channels /sector = \frac{6}{3} = 2 \text{ Channel /sector}

\# trunks /sector = 2 \times 8 = 16 \text{ trunks /sector}

Using Elnag and et al. \(6.5 = 5\% \Rightarrow \text{Asector} = 9.13 \text{ E /sector}

Capacity per cell: \text{Acell} = 2 \times \text{Asector} = 2 \times 9.13 = 18.26 \text{ E /cell}

Increase in cell capacity: \Delta \text{Acell} = \text{Acell}(N=4) - \text{Acell}(N=7)

\Rightarrow \Delta \text{Acell} = \frac{29.44 - 19.3}{19.3} \approx 0.528 \approx 52.8\% 

Cell Splitting & Microcell Deployment

* Cell splitting \( \Rightarrow \) divide coverage area of existing cell sites and introducing new smaller cells.
Before cell splitting

After cell splitting

New cell added to perform traffic offloading

*New cell serves some portion of the traffic that used to be served by the busy blocking cells.*

**Example:** Section B.4 C in the figure are experiencing high blocking probability. To eliminate traffic congestion, cell split (CS) is proposed. Before the cell split, the configuration had following parameters:

\[
C_B = 10 \quad G_{BS} = 5\%
\]

\[
C_C = 12 \quad G_{BS} = 7\%
\]

Assuming that the traffic is distributed uniformly among

1. BS at Section B.4 C with splitting
2. Required number of resources at S1, S2 and S3 to maintain G_{BS} of 17%

After cell splitting

Offered traffic \( A^o = G_{BS} \)

\( A = 8.91 \) (Using Eqs of B table)
Area of an equilateral triangle \( \Delta \), \( A_\Delta = \frac{a^2 \sqrt{3}}{4} \)

1) Consider sector B,

\[
A_{\text{sector}} = \frac{3}{2} \left( \sqrt{\frac{3}{4}} \right) A_B
\]

It is obvious that \( r = \frac{R}{2} \). Therefore,

\[
A_{\text{sector}} = \frac{3}{2} \left( \frac{R}{2} \right)^2 \frac{\sqrt{3}}{4} = \frac{3}{8} \times 2.22 = 0.83 E
\]

Triangle formed by after cell split

\[ A_{B_1} = 6.22 - 2.33 = 3.89 E \]

GOS at B after cell split (using Euler's B, C=10, A=3.89)

GOS_{B_1} ≤ 0.5 %

2) Consider sector C

\[
A_{\text{sector}} = \frac{3}{2} \times 8.61 E = 3.24 E
\]

Optimal value of C after cell splitting

\[ A_{C_1} = 8.61 - 3.22 = 5.38 E \]

GOS at C after cell splitting (using Euler's B, C=12, A=5.38 E)

GOS_{C_1} ≤ 1 %
8) Traffic added to new cell

Sewr 51: \[ A_1 = \frac{1}{3} \times 2.32 + \frac{1}{2} \times 8.24 = 2.073 E \]

52: \[ A_2 = 2.83 = 1.55 E \]

55: \[ A_3 = 2/3 \times 3.81 = 2.53 E \]

To achieve 6% ≤ 1% number of channels that needs to be allocated to each of the sectors is given by:

- \[ C_1 = 7 \quad (\text{Next } 7\%\; \text{of } 7\%\; \text{of } A = 2.50 E) \]
- \[ C_2 = 6 \quad (\text{Next } 6\%\; \text{of } 7\%\; \text{of } A = 1.91 E) \]
- \[ C_3 = 2 \quad (\text{Next } 2\%\; \text{of } 7\%\; \text{of } A = 0.23 E) \]

_Homeworks_