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# Cellular Concepts Formulas

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# List of 16 Cellular Concepts Formulas

## Cellular Concepts

### 1) Average Calling Time

$$\text{fx } T_{\text{avg}} = \frac{A \cdot 60}{Q_i}$$

[Open Calculator !\[\]\(a870788d6ed9b8fd294b7654a8c8526b\_img.jpg\)](#)

$$\text{ex } 200\text{s} = \frac{60 \cdot 60}{18}$$

### 2) Bandwidth Efficiency

$$\text{fx } \eta_{\text{BW}} = \frac{R_b}{\text{BW}}$$

[Open Calculator !\[\]\(c50c8b7b2cc2cf9ff925edec0ee94c0d\_img.jpg\)](#)

$$\text{ex } 0.694286 = \frac{48.6\text{kbps}}{70\text{kHz}}$$

### 3) Bandwidth of M-Ary PSK

$$\text{fx } \text{BW}_{\sqrt{M}} = \frac{2 \cdot f_b}{B_{\text{sym}}}$$

[Open Calculator !\[\]\(f60b7a900783ac3fd531bfd9c111be6d\_img.jpg\)](#)

$$\text{ex } 30\text{kHz} = \frac{2 \cdot 120\text{kbps}}{8\text{bits}}$$



4) Cell Radius 

$$fx \quad r = \frac{D}{Q}$$

Open Calculator 


$$ex \quad 2.907407km = \frac{9.42km}{3.24}$$

5) Co-Channel Interference 

$$fx \quad Q = \frac{D}{r}$$

Open Calculator 


$$ex \quad 3.248276 = \frac{9.42km}{2.9km}$$

6) Distance between Co-Channel Cells 

$$fx \quad D = \left( \sqrt{3 \cdot K} \right) \cdot r$$

Open Calculator 

$$ex \quad 9.397074km = \left( \sqrt{3 \cdot 3.5} \right) \cdot 2.9km$$

7) Frequency Reuse Distance 

$$fx \quad D = Q \cdot r$$

Open Calculator 

$$ex \quad 9.396km = 3.24 \cdot 2.9km$$




8) Hamming Distance 

$$fx \quad d = 2 \cdot t + 1$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95\_img.jpg\)](#)


$$ex \quad 15 = 2 \cdot 7 + 1$$

9) Maximum Calls per Hour per Cell 

$$fx \quad Q_i = \frac{A \cdot 60}{T_{avg}}$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2\_img.jpg\)](#)


$$ex \quad 18 = \frac{60 \cdot 60}{200s}$$

10) New Cell Area 

$$fx \quad A_{cn} = \frac{A_{co}}{4}$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7\_img.jpg\)](#)

$$ex \quad 16km^2 = \frac{64km^2}{4}$$

11) New Cell Radius 

$$fx \quad r_{cn} = \frac{r_{co}}{2}$$

[Open Calculator !\[\]\(899d8b7697d64725bf017d3296cfcf1b\_img.jpg\)](#)

$$ex \quad 4.5km = \frac{9km}{2}$$



## 12) New Traffic Load

$$fx \quad TL_N = 4 \cdot TL_O$$

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a\_img.jpg\)](#)

$$ex \quad 20 = 4 \cdot 5$$

## 13) Offered Load

$$fx \quad A = \frac{Q_i \cdot T_{avg}}{60}$$

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021\_img.jpg\)](#)

$$ex \quad 60 = \frac{18 \cdot 200s}{60}$$

## 14) Old Cell Area

$$fx \quad A_{co} = A_{cn} \cdot 4$$

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd\_img.jpg\)](#)

$$ex \quad 64km^2 = 16km^2 \cdot 4$$

## 15) Old Cell Radius

$$fx \quad r_{co} = r_{cn} \cdot 2$$

[Open Calculator !\[\]\(7bc43b319a082987e20f7bf78f4bab80\_img.jpg\)](#)

$$ex \quad 9km = 4.5km \cdot 2$$

## 16) Traffic Load

$$fx \quad TL_O = \frac{TL_N}{4}$$

[Open Calculator !\[\]\(4a7b4ce770af8456e11a71f9565c8c2b\_img.jpg\)](#)

$$ex \quad 5 = \frac{20}{4}$$









## Variables Used

- **A** Offered Load
- **A<sub>cn</sub>** New Cell Area (Square Kilometer)
- **A<sub>co</sub>** Old Cell Area (Square Kilometer)
- **B<sub>sym</sub>** Number of Bits per Symbol (Bit)
- **BW** Bandwidth (Kilohertz)
- **BW<sub>√M</sub>** M-Ary PSK Bandwidth (Kilohertz)
- **d** Hamming Distance
- **D** Frequency Reuse Distance (Kilometer)
- **f<sub>b</sub>** Transmitting Frequency (Kilobit per Second)
- **K** Frequency Reuse Pattern
- **Q** Co Channel Reuse Ratio
- **Q<sub>i</sub>** Maximum Calls Per Hour Per Cell
- **r** Radius of Cell (Kilometer)
- **R<sub>b</sub>** Data Rate (Kilobit per Second)
- **r<sub>cn</sub>** New Cell Radius (Kilometer)
- **r<sub>co</sub>** Old Cell Radius (Kilometer)
- **t** Capability of Error Correction Bits
- **T<sub>avg</sub>** Average Calling Time (Second)
- **TL<sub>N</sub>** New Traffic Load
- **TL<sub>O</sub>** Old Traffic Load
- **η<sub>BW</sub>** Bandwidth Efficiency








## Constants, Functions, Measurements used

- **Function:** **sqrt**, sqrt(Number)  
*Square root function*
- **Measurement:** **Length** in Kilometer (km)  
*Length Unit Conversion* 
- **Measurement:** **Time** in Second (s)  
*Time Unit Conversion* 
- **Measurement:** **Area** in Square Kilometer (km<sup>2</sup>)  
*Area Unit Conversion* 
- **Measurement:** **Frequency** in Kilohertz (kHz)  
*Frequency Unit Conversion* 
- **Measurement:** **Data Storage** in Bit (bits)  
*Data Storage Unit Conversion* 
- **Measurement:** **Data Transfer** in Kilobit per Second (kbps)  
*Data Transfer Unit Conversion* 



## Check other formula lists

- [Cellular Concepts Formulas](#) 
- [Data Analysis Formulas](#) 
- [Data Transmissions and Error Analysis Formulas](#) 
- [Frequency Reuse Concept Formulas](#) 
- [Mobile Radio Propagation Formulas](#) 

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