



**Faculty of Engineering and Technology**

**Department of Electrical and Computer Engineering**

**Wireless and Mobile Networks, ENCS5323**

**Project – Online Calculator for Wireless and Mobile Networks**

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**Prepared by:**

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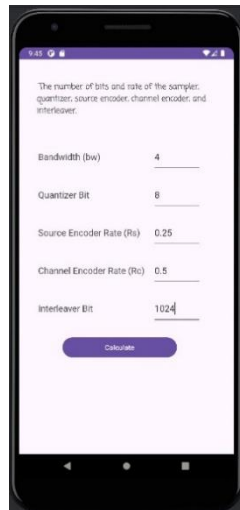
**instructor:**

**Dr. Mohammad K. Jubran**

**23 Jun 2024**

Q1)

- **Test Case 1:**



The number of bits and rate of the sampler, quantizer, source encoder, channel encoder, and interleaver.

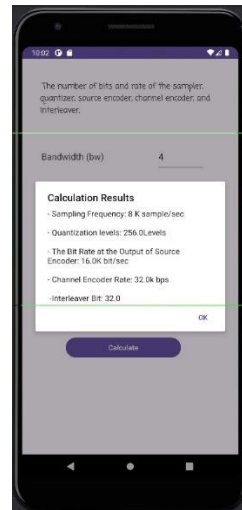
Bandwidth (bw)

Quantizer Bit

Source Encoder Rate (Rs)

Channel Encoder Rate (Rc)

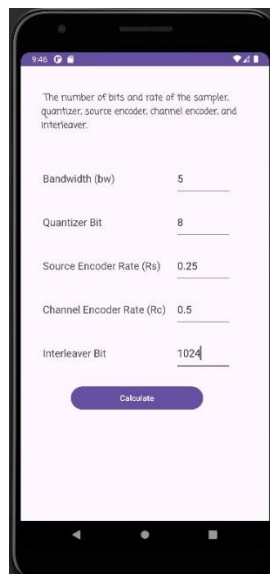
Interleaver Bit



Calculation Results

- Sampling Frequency: 8 K sample/sec
- Quantization levels: 256.0 levels
- The Bit Rate at the Output of Source Encoder: 16.0K bit/sec
- Channel Encoder Rate: 32.0k bps
- Interleaver Bit: 32.0

- **Test Case 2:**



The number of bits and rate of the sampler, quantizer, source encoder, channel encoder, and interleaver.

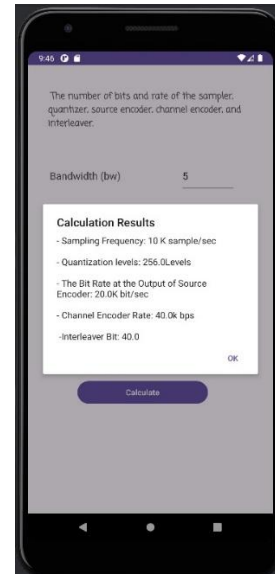
Bandwidth (bw)

Quantizer Bit

Source Encoder Rate (Rs)

Channel Encoder Rate (Rc)

Interleaver Bit



Calculation Results

- Sampling Frequency: 10 K sample/sec
- Quantization levels: 256.0 levels
- The Bit Rate at the Output of Source Encoder: 20.0K bit/sec
- Channel Encoder Rate: 40.0k bps
- Interleaver Bit: 40.0

- **Test Case 3:**

The number of bits and rate of the sampler, quantizer, source encoder, channel encoder, and interleaver.

Bandwidth (bw) 4

Quantizer Bit 6

Source Encoder Rate ( $R_s$ ) 0.5

Channel Encoder Rate ( $R_c$ ) 0.25

Interleaver Bit 1024

Calculate

The number of bits and rate of the sampler, quantizer, source encoder, channel encoder, and interleaver.

Bandwidth (bw) 4

**Calculation Results**

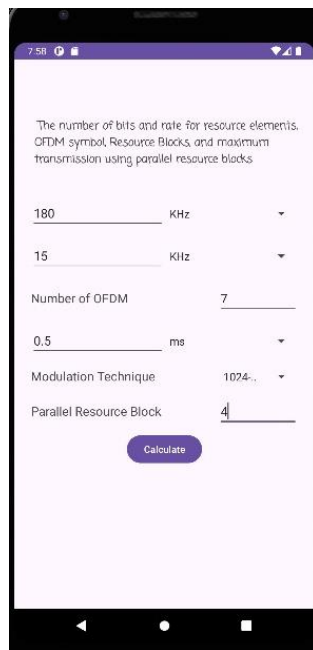
- Sampling Frequency: 8 K sample/sec
- Quantization levels: 64.0 Levels
- The Bit Rate at the Output of Source Encoder: 24.0K bit/sec
- Channel Encoder Rate: 96.0k bps
- Interleaver Bit: 96.0

OK

Calculate

Q2)

- **Test Case 1:**



The number of bits and rate for resource elements, OFDM symbol, Resource Blocks, and maximum transmission using parallel resource blocks.

180 KHz

15 KHz

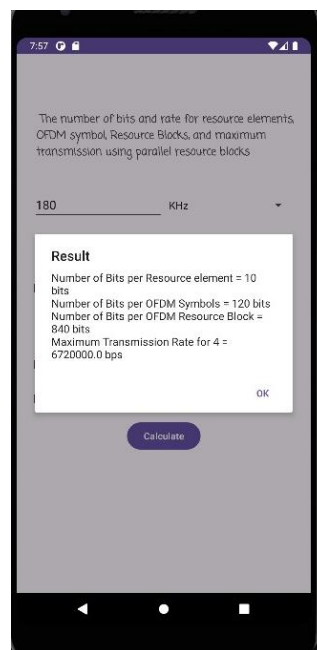
Number of OFDM 7

0.5 ms

Modulation Technique 1024-QAM

Parallel Resource Block 4

Calculate



The number of bits and rate for resource elements, OFDM symbol, Resource Blocks, and maximum transmission using parallel resource blocks.

180 KHz

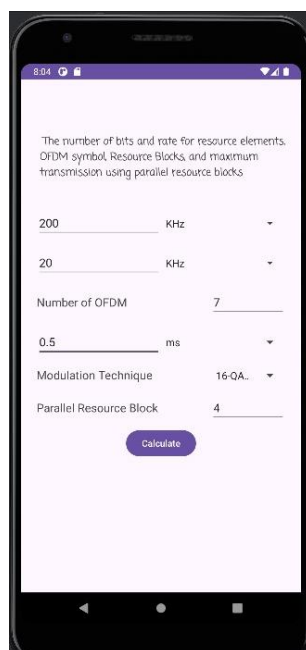
**Result**

Number of Bits per Resource element = 10 bits  
Number of Bits per OFDM Symbols = 120 bits  
Number of Bits per OFDM Resource Block = 840 bits  
Maximum Transmission Rate for 4 = 6720000.0 bps

OK

Calculate

- **Test Case 2:**



The number of bits and rate for resource elements, OFDM symbol, Resource Blocks, and maximum transmission using parallel resource blocks.

200 KHz

20 KHz

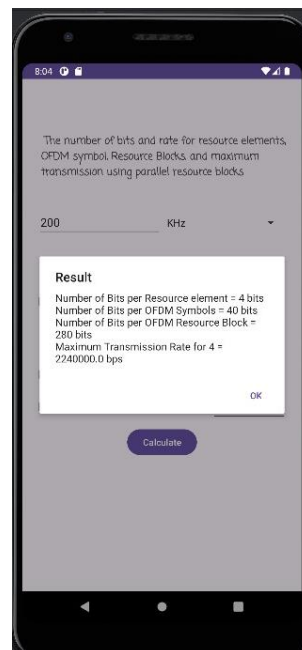
Number of OFDM 7

0.5 ms

Modulation Technique 16-QAM

Parallel Resource Block 4

Calculate



The number of bits and rate for resource elements, OFDM symbol, Resource Blocks, and maximum transmission using parallel resource blocks.

200 KHz

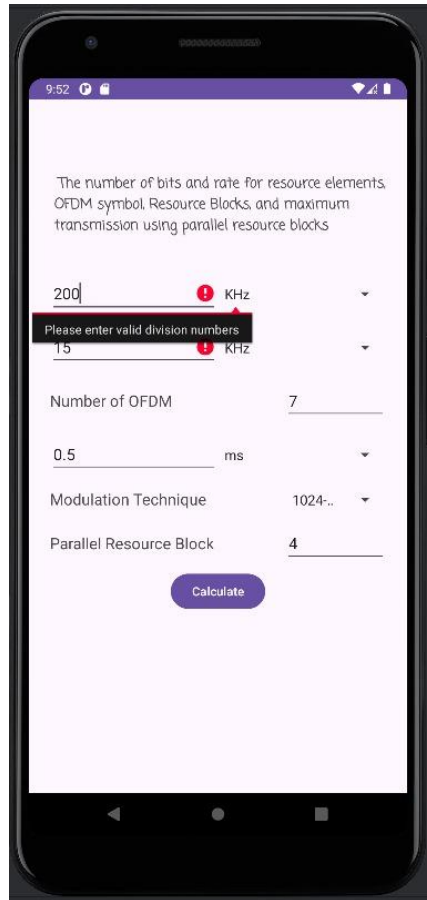
**Result**

Number of Bits per Resource element = 4 bits  
Number of Bits per OFDM Symbols = 40 bits  
Number of Bits per OFDM Resource Block = 280 bits  
Maximum Transmission Rate for 4 = 2240000.0 bps

OK

Calculate

- **Test Case 3:**
  - **Error case when entering invalid values.**



Q3)

- **Test Case 1:**

140 dB  
8 dB  
0 dB  
9.6 kbps  
12 dB  
20 dB  
8 dB  
24 dB  
6 dB  
290 No Unit  
8 dB  
Modulation Technique: 8-PSK  
BER: 1e-4  
Calculate

Result  
Pt in db = 9.34548317339761  
Pt in Watt = 8.600987516688477 Watt  
Eb\_No = 11.5  
OK

- **Test Case 2:**
  - **Note:** here we just change modulation technique.

140 dB  
8 dB  
0 dB  
9.6 kbps  
12 dB  
20 dB  
8 dB  
24 dB  
6 dB  
290 No Unit  
8 dB  
Modulation Technique: 16-PSK  
BER: 1e-4  
Calculate

- **Test Case 3:**

- **Note:** here we change unit to dbm to ensure that the convert is correct.

140 dB

8 dB

0 dB

9.6 kbps

12 dB

50 dBm

8 dB

24 dB

36 dBm

290 No Unit

8 dB

Modulation Technique 8-PSK

BER 1e-4

Calculate

Result

Pt in db = 9.3454831739761

Pt in Watt = 8.600987516688477 Watt

Eb\_No = 11.5

OK

Q4)

- **Test Case 1:**

Throughput in percent of Multiple Access techniques.

20 Mbps

40  $\mu$ s

10 Kb

5 Kframe..

MAC System Unslotted Non-Per..

Calculate

Throughput Result

Throughput: 67.22186073650829%

OK

- **Test Case 2:**

Throughput in percent of Multiple Access techniques

10 Kbps

5 ms

1 Kb

100 frames..

MAC System Pure Aloha

Calculate

Throughput Result

Throughput: 2.061153622438558E-6%

OK

- **Test Case 3:**

Throughput in percent of Multiple Access techniques

10 Kbps

5 ms

1 Kb

100 frames..

MAC System Slotted Aloha

Calculate

Throughput Result

Throughput: 0.04539992976248486%

OK



Q5)

- **Test Case 1:**

4 Km<sup>2</sup>

8

80 Thousands

8 Day

3 Minutes

Call Drop Probability 0.02

13 dB

-22 dB

10 Meters

3

0.000007 Watts

80 Thousands

**Result**

- Maximum distance between transmitter and receiver for reliable communication = 96.596
- Maximum cell size assuming hexagonal cells ( $A_{Cell}$ ) = 24243.0
- The number of cells in the service area = 165
- Traffic load in the whole cellular system in Erlangs ( $A = U \times Au$ ) = 1333.333
- Traffic load in each cell in Erlangs 8.08
- Number of cells in each cluster = 9.0
- Minimum number of carriers needed (in the whole system) to achieve the required Quality of Service = 2 for number of channels = 14
- Minimum number of carriers needed (in the whole system) to achieve the required Quality of Service if QoS has changed to 0.05 = 2 for number of channels = 13

OK

Calculate

- **Test Case 2:**

5 Km<sup>2</sup>

8

60 Thousands

10 Day

2 Minutes

Call Drop Probability 0.02

15 dB

-20 dB

10 Meters

3

0.000007 Watts

60 Thousands

**Result**

- Maximum distance between transmitter and receiver for reliable communication = 112.625
- Maximum cell size assuming hexagonal cells ( $A_{Cell}$ ) = 32954.9
- The number of cells in the service area = 152
- Traffic load in the whole cellular system in Erlangs ( $A = U \times Au$ ) = 833.333
- Traffic load in each cell in Erlangs 5.48
- Number of cells in each cluster = 12.0
- Minimum number of carriers needed (in the whole system) to achieve the required Quality of Service = 2 for number of channels = 11
- Minimum number of carriers needed (in the whole system) to achieve the required Quality of Service if QoS has changed to 0.05 = 2 for number of channels = 9

OK

Calculate

- **Test Case 3:**

A screenshot of a mobile application interface for Test Case 3. The screen displays a list of input fields with their respective units and values. The inputs are: 4 Km², 8, 60 Thousands, 10 Day, 2 Minutes, Call Drop Probability 0.02, 13 dB, -20 dB, 12 Meters, 3, and 0.000006 Watts. Each input field has a dropdown arrow on the right side.

Input	Unit	Value
4	Km²	4
8		8
60	Thousands	60
10	Day	10
2	Minutes	2
Call Drop Probability		0.02
13	dB	13
-20	dB	-20
12	Meters	12
3		3
0.000006	Watts	0.000006

A screenshot of a mobile application interface showing the results of a calculation. A green 'Calculate' button is at the bottom. A white box titled 'Result' contains the following text:

**Result**

- Maximum distance between transmitter and receiver for reliable communication = 142.276
- Maximum cell size assuming hexagonal cells (A\_Cell) = 52591.3
- The number of cells in the service area = 77
- Traffic load in the whole cellular system in Erlangs [A = U \* Au] = 833.333
- Traffic load in each cell in Erlangs 10.82
- Number of cells in each cluster = 9.0
- Minimum number of carriers needed (in the whole system) to achieve the required Quality of Service = 3 for number of channels = 18
- Minimum number of carriers needed (in the whole system) to achieve the required Quality of Service if QoS has changed to 0.05 = 2 for number of channels = 16

OK