

Exercise – Dimensioning of data and voice capacity

Operator Blue in the country T has acquired a competitor with an already build-out 2G and 4G network and 5 MHz of spectrum in the 1800 MHz band. Operator Blue plans to use this band to launch a service package for smartphone users with GSM voice services and 4G data services. Market surveys shows that there is a very large unmet demand for this kind of service offers in the country T. Two options are to be investigated: a consumer offer and an offer for business users.

The initial approach and plan is that the consumer service should be offered for 30 €per month, including up to 5 GB of data traffic per month and 300 voice minutes.

The business user service is to be offered for 80 €per month, including up to 10 GB of data traffic per month and 600 voice minutes.

When the network planning group and consumer behavior group meets to discuss the new offers the following guidelines are recommended for dimensioning of the two offers:

* Assumptions for the consumer service

- data usage during 16 hours per day for 30 days of the month.
- voice usage 25 mE per user during busy hour to be dimensioned for blocking rate 5%

* Assumptions for the business user service

- data usage during 8 hours per day for 30 days of the month.
- voice usage 100 mE per user during busy hour to be dimensioned for blocking rate 1%

The network planning group starts to compare these options and make the following initial assumptions:

- 3 MHz is allocated for the LTE data services and 1,8 MHz for GSM voice services
- The base station site equipment support 3 sectors
- For LTE a reuse factor 1 is assumed and for GSM the reuse factor is 3
- The average spectrum efficiency for LTE is 1,67 bps/Hz

Question 5.1 (2 points)

What is the number of users for the two types of offers that can be supported by a base station site where both the data and voice requirements are met? Calculate and explain!

Question 5.2 (1point)

With these assumptions should operator Blue go for the consumer or business service? Motivate!

Question 5.3 (1point)

Is the spectrum used in an optimum way or should operator Blue consider another relative allocation of spectrum resources for voice and data services? Motivate!

Note:

The GSM carriers are 200 kHz and consist of 8 time slots (voice channels). Assume that all GSM time slots can be used for voice traffic (i.e. neglect control channels)
Use attached Erlang Traffic table

Solution – Dimensioning of data and voice capacity

Data services

First calculate capacity

Site capacity for data: $3 \text{ sectors} * 3 \text{ MHz} * 1,67 \text{ bps/Hz} = 15 \text{ Mbps per site}$

Consumers 16 hours per day $\Rightarrow \sim 25 \text{ kbps (23 kbps)} \Rightarrow \sim 600 \text{ users (653)}$

Business users 8 hours per day $\Rightarrow \sim 100 \text{ kbps (92 kbps)} \Rightarrow \sim 150 \text{ users (163)}$

Voice services

$1,8 \text{ MHz} \Rightarrow 9 \text{ carriers}$, with re-use factor 3 $\Rightarrow 3 \text{ carriers per sector}$

$\Rightarrow 24 \text{ voice channels (3 carriers} * 8 \text{ time slots)}$ per sector (blocking occurs in sectors)

Consumers: 25 mE with 5% blocking $\Rightarrow \sim 19 \text{ Erlang}$

$19 \text{ Erl} / 25 \text{ mErl} \Rightarrow 760 \text{ users per sector} \Rightarrow 2280 \text{ users per site}$

Business: 100 mE with 1% blocking $\Rightarrow 15,3 \text{ Erlang}$

$15,3 \text{ Erl} / 1000 \text{ mErl} \Rightarrow 153 \text{ users per sector} \Rightarrow 459 \text{ users per site}$

Answer Q5.1)

Number of consumers per site = $\min(653, 2280) = 653$

Number of business users per site = $\min(163, 459) = 163$

Answer Q 5.2) Choose consumer service

Revenues from consumers = $653 * 30 \text{ €} = 19\,590 \text{ €}$

Revenues from business users = $163 * 80 \text{ €} = 13\,040 \text{ €}$

Answer Q5.3)

The dimensioning based on the assumptions indicates more voice users than data users.

It implies un-used voice capacity. Hence allocate more spectrum to data services, then more data users (and total number of users) can be served meaning larger revenues.