Solutions to Exam IK2514 - 2012

Problem 1 - Value of spectrum

This question deals with the value of spectrum assets and can be considered from a cost saving perspective and a revenue perspective. Since it is about auctions prices it is also related the market situation and competition.

Q1.1)

Lower frequencies (700-900 MHz) provide better coverage, i.e. less number of sites are need to cover an area which makes these bands very attractive from a cost perspective. In addition “less” bandwidth is available below 1 GHz than above

Q1.2)

The EUR/MHz/pop normalizes the value with respect on potential revenues. More MHz means higher capacity and more users that can be served. Higher population means a larger market and potential revenues.

In the same way the revenues for operators depend on the time period (the license period) and the willingness (ability) to pay by end-users (how wealthy the country or users are). Hence, two aspects could be the GDP per capita and the length of the license period.

Problem 2 - Spectrum and spectrum efficiency

Demand per user 21,6 GB/month = 0,4 Mbps

Q2.1)

The femtocells support max 20 users, 20 * 0,4 = 8 Mbps need to be supported

With a spectral efficiency of 4 bps/Hz this means that 2 MHz is needed.

Q2.2)

The macro sites can support 300 users => site capacity 300 * 0,4 = 120 Mbps

Spectral efficiency = Site capacity / (Bandwidth*No sectors) = 120/(20*3) = 2 bps/Hz

Problem 3 -Termination charges, traffic balance, profitability and CAPEX

Q3.1)

In order to calculate the relation between termination revenues and voice revenues a number of calculations have to be made as the table shows. The termination balance is calculated by taking termination revenues minus termination cost. The numbers are a result of a series of calculations on total minutes as the table exhibits.

Q 3.2)

EBITDA is calculated by taking the average number of customers for each year multiplied with EUR 80, adding Opex, which is calculated by taking the Opex ratio multiplied with total revenues. EBITDA is then the resulted of revenues minus total cost, and the EBITDA margin is the ratio between EBITDA and total revenues.

Q3.3)

Capex is a combination of maintenance capex and capex for new installations. The accumulated capex is developed as the table shows and the annual maintenance is the ratio of 5% which should be multiplied with the accumulated capex. Capex for new installations is the relation between the capex ratio and total revenues for each year. Finally, the free cash flow is the sum of EBITDA minus total capex for each year.

The table below shows all the necessary calculations to answer the three questions.

	2007	2008	2009	2010	2011
Subscribers	3 900 000	4 000 000	4 200 000	4 410 000	4 630 500
Change y-o-y			5%	5%	5%
ARPU EUR		20	19	17	16
Change y-o-y			-7%	-7%	-7%
Non-voice services as a share of revenues		15%	17%	19%	21%
Minutes of Use (incoming and outgoing)		200	210	221	232
Change y-o-y			5%	5%	5%
Traffic balance voice calls					
Outgoing from mobile to fixed networks		15%	15%	13%	10%
Outgoing from mobile to mobile networks		15%	17%	20%	23%
On-net-traffic		30%	33%	37%	40%
Incoming from fixed networks		30%	25%	20%	15%
Incoming from mobile networks		10%	10%	10%	12%
Termination rates per minute					
Mobile termination rates EUR		0,030	0,020	0,015	0,010
Fixed termination rates EUR		0,009	0,007	0,006	0,005

Calculations to answer the questions						Question	Calculation formula
ARPU		20	19	17	16		
Revenues		948 000 000	915 120 000	893 614 680	872 614 735		ARPU * average number of subscribers per year * 12
Non-voice		142 200 000	155 570 400	169 786 789	183 249 094		Share non-voice reveneus * revenues
Voice revenues		805 800 000	759 549 600	723 827 891	689 365 641		
Total minutes		9 480 000 000	10 332 000 000	11 391 030 000	12 558 610 575		MoU * average number of subsribers * 12
Outgoing from mobile to fixed networks		1 422 000 000	1 549 800 000	1 480 833 900	1 255 861 058		Share of calls mobile to fixed networks * total minutes
Outgoing from mobile to mobile networks		1 422 000 000	1 756 440 000	2 278 206 000	2 888 480 432		Share of calls mobile to mobile networks * total minutes
Incoming from fixed networks		2 844 000 000	2 583 000 000	2 278 206 000	1 883 791 586		Share of calls fixed to mobile networks * total minutes
Incoming from mobile networks		948 000 000	1 033 200 000	1 139 103 000	1 507 033 269		Share of calls mobile to mobile networks * total minutes
Total minutes		6 636 000 000	6 922 440 000	7 176 348 900	7 535 166 345		
Termination cost							
Outgoing from mobile to fixed networks		12 798 000	10 848 600	8 885 003	6 279 305		Termination rate * outgoing minute to fixed networks
Outgoing from mobile to mobile networks		42 660 000	35 128 800	34 173 090	28 884 804		Termination rate * outgoing minute to mobile networks
Net outgoing		55 458 000	45 977 400	43 058 093	35 164 110		
Incoming from fixed networks		25 596 000	18 081 000	13 669 236	9 418 958		Termination rate * ingoing minute from fixed networks
Incoming from mobile networks		28 440 000	20 664 000	17 086 545	15 070 333		Termination rate * ingoing minute from mobile networks
Net incoming		54 036 000	38 745 000	30 755 781	24 489 291		
Termination revenue as a share of voice revenues		**5,7%**	**4,2%**	**3,4%**	**2,8%**	**Q1a**	**Net incoming termation / voice revenues**
Termination balance		**-1 422 000**	**-7 232 400**	**-12 302 312**	**-10 674 819**	**Q1b**	**Net incoming - net outgoing**
Direct cost per customer per year		80	80	80	80		
Opex (excluding direct customer cost)		50%	49%	48%	45%		
Total cost for customers		316 000 000	328 000 000	344 400 000	361 620 000		Average number of subscribers * 80
Opex		474 000 000	448 408 800	428 935 046	392 676 631		Opex margin * revenues
Total cost		790 000 000	776 408 800	773 335 046	754 296 631		
EBITDA		158 000 000	138 711 200	120 279 634	118 318 104		total cost - total revenues
EBITDA margin		**16,7%**	**15,2%**	**13,5%**	**13,6%**	**Q2**	**EBITDA / revenues**
Capex-to sales new installations		8%	8%	9%	9%		
Capex		75 840 000	73 209 600	80 425 321	78 535 326		Capex-to-sales ratio * revenues
Accumulated capex	1 500 000 000	1 500 000 000	1 575 840 000	1 649 049 600	1 729 474 921		Maintenance capex ratio * accumulated capex
Maintenace capex ratio		5%	5%	5%	5%		
Maintenace capex		75 000 000	78 792 000	82 452 480	86 473 746		
Total capex		**150 840 000**	**152 001 600**	**162 877 801**	**165 009 072**	**Q3a**	**Capex + maintenance capex**
Total capex-to-sales		**15,9%**	**16,6%**	**18,2%**	**18,9%**	**Q3b**	
Free cash flow		**7 160 000**	**-13 290 400**	**-42 598 168**	**-46 690 968**	**Q3b**	**EBITDA - Total capex**
Cash flow yield		1%	-1%	-5%	-5%		

Problem 4 - Operator strategies

Q 4.1)

The main challenge for DTAC is to decide if the 3G deployment should be made in the own and new 2.1 GHz network to be built - with no revenue sharing, or in the existing 850 MHz network with existing sites and better coverage – but with the revenue sharing

Q 4.2)

Any well motivated strategy that applies to the DTAC situation provides some points. Examples are: to focus on deployment of 2.1 GHz or 850 MHz depending on demand, Key issue is that customers have to be moved to the new 2.1 GHz network

Q 4.3)

Any well motivated strategy that applies to TOTA and CAT provides some points.

If the state owned operators TAT and CAT do not get new spectrum they can:

- Use existing spectrum and offer capacity on a whole sale basis to other MNOs and/or offer end-user services, marketing needed since low market share
- Start network sharing business for wholesale or consumer business
- Start tower companies and offer services to other MNOs
- Sell everything and withdraw from the market

Problem 5 – Dimensioning of data and voice capacity

Data services

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

Consumers 16 hours per day => ~ 25 kbps (23 kbps) => ~600 users (653)

Business users 8 hours per day => ~100 kbps (92 kbps) => ~150 users (163)

Voice services

1,8 MHz => 9 carriers, with re-use factor 3 => 3 carriers per sector

=> 24 voice channels (3 carriers*8 time slots) per sector (blocking occurs in sectors)

Consumers: 25 mE with 5% blocking => ~19 Erlang

19Erl/25mErl => 760 users per sector => 2280 users per site

Business: 100 mE with 1% blocking => 15,3 Erlang

15,3 Erl/1000 mErl => 153 users per sector => 459 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 € = 19 590 €

Revenues from business users = 163 * 80 € = 13 040 €

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.