



IMT2000 technology in 450MHz

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History & Baseline for startup

TELEMOBIL HISTORY (1)

- **First cellular license in Romania (1993) granted - Telefonica (60%), Radiocomunicatii (20%), Romtelecom (20%)**
 - Nation-wide use of 450 MHz spectrum (453-457.5 & 463-467.5) for NMT
 - 4.5 MHz of spectrum with 10 MHz duplex distance and 25 KHz channel space
 - 900 MHz spectrum conditional allowance
- **Launch - High Power balanced Network (1994-1995)**
 - 1 switch in Bucharest (30K) and several cities covered from remote Base Stations collocating with Radio TV broadcast sites (20 BTS)
 - Transmission support – analog leased lines
 - 15 Watt Portable Class terminals
 - Maximum 1,000 capacity offer (no frequency reuse)
- **Rollout - Medium Power balanced Network (1995-1998)**
 - Second switch in Constanta (10K) and in-city new Base Stations (60 BTS)
 - Transmission support – both analog and digital leased lines plus own MWs
 - 1.5 Watt Handheld Class terminals
 - Maximum 18,000 capacity offer (up to 80% congestion, 5% allowed)
 - 60% of the country covered with Outdoor Level of Service
 - Frequency reuse in Bucharest (Stockholm model) limits offered capacity to 10K.

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TELEMOBIL HISTORY (2)

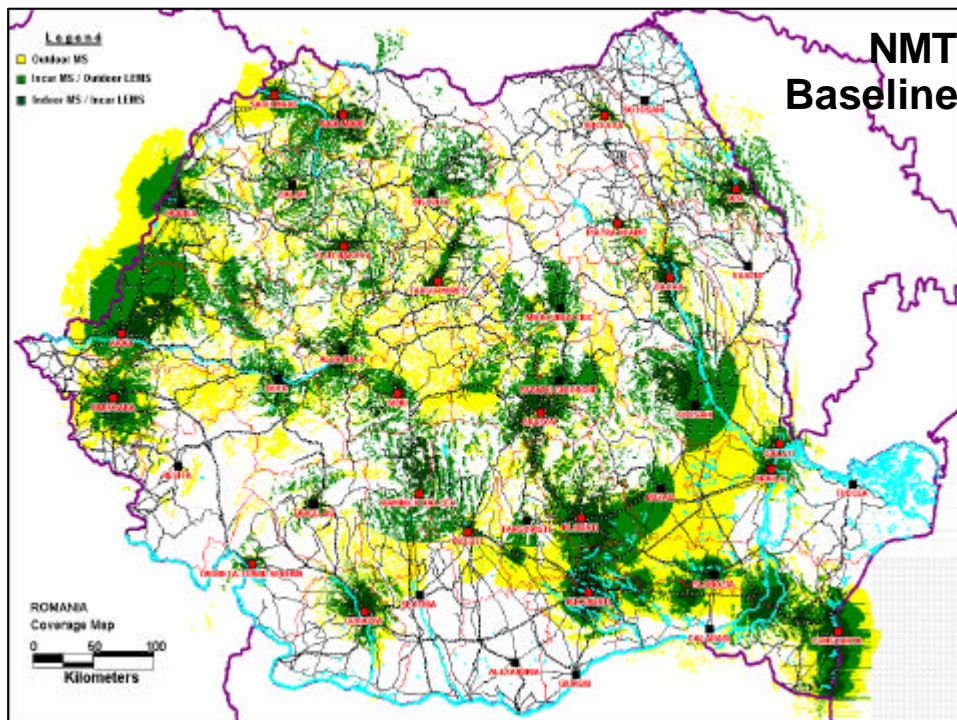
- **Telemobil fails to obtain a GSM900 license (1996)**
 - Monopoly being lost, the profit drops dramatically (1/3 ARPU) starting the 2nd quarter 1997, after the GSM900 begins the price war.
 - Customer base remains almost stationary until the end of 1997 (15,000 subs) when starts dropping due to aggressive migration towards GSM services (-5K/year)
 - First Voice Mail system (30K) was introduced in '97 before GSM.
 - Network Rollout tries accelerating but much slower than GSM expansion (over 10 times faster).
- **Telefonica seeks to sell its shares to Romtelecom (1997)**
 - Romtelecom diverts Telefonica' shares to RDT – Balli, Racebrook and 450 Wirefree Fund (JP Morgan) since was granted with a GSM/DCS1800 license for privatization.
 - Consequently to RDT's capital investment, Romtelecom and Radiocomunicatii shares have decreased accordingly while the license has been extended with 10 years, technology agnostic.
- **RDT vision focuses on LEMS roadmap (1998-2000)**
 - Both Passive & Active Intelligent Antenna (analog) solutions were the steps proposed by Radio Design AB (Sweden) to introduce a competitive Low Power Emission Station (0.15 Watt) handset.
 - Telemobil chooses a lower cost alternative to introduce the LEMS on Romanian Market – the High Gain Antenna (HGA) together with Low Noise Amplifiers (LNA).
 - New Rollout – Low Power balanced network to support 0.1 Watt terminals within the same coverage footprint as for the Medium Power handsets transmitting with 1.5 Watt.
 - Additional sites (50 BTS) were required to provide a seamless GSM-equivalent coverage offer.
 - The entire NMT network was upgraded, sectorized and optimized during 1999 and 2000.

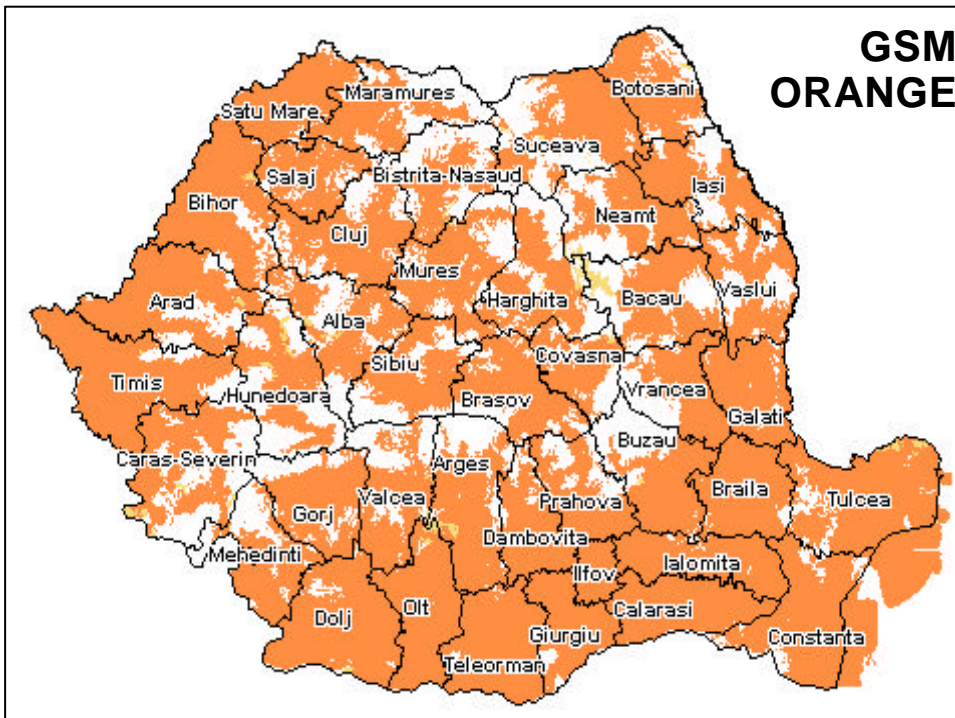
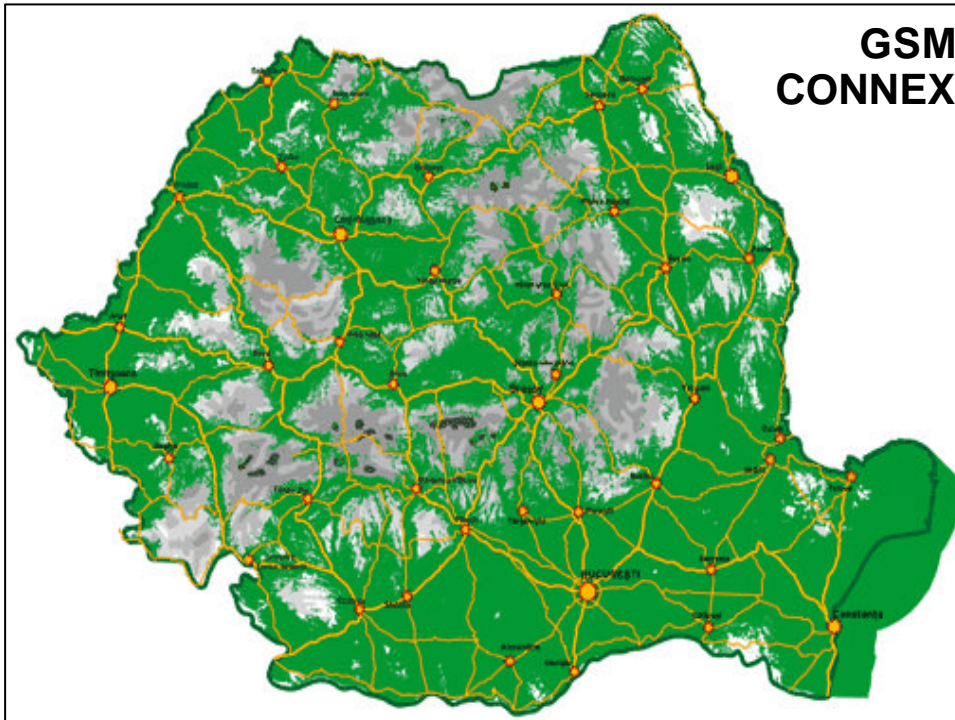
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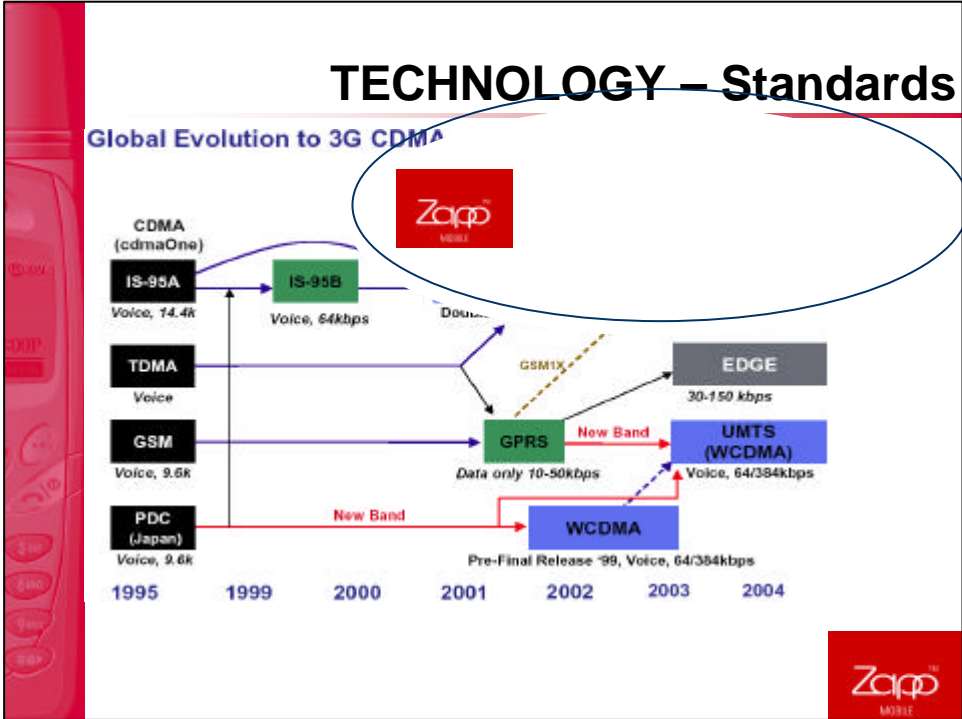
TELEMOBIL HISTORY (3)

- **RDT/Telemobil seeks after digitalization options (2000)**
 - Entire NMT community was looking after vendors proposals to introduce a digital standard into 450 spectrum.
 - Three proposals for a digital standard were submitted to the NMT MOU in 2000:
 - GSM400 – supported by Ericsson and Nokia.
 - Cdma450 – supported by Qualcomm and Lucent.
 - DNMT (replaced by TETRA) – supported by Radio Design & others.
 - Both GSM400 & cdma450 were adopted by the operators and vendors were encouraged to continue the standardization and manufacturing work.
- **Inquam acquires RDT – Qualcomm (45.7%), Omnia (45.7%), RDT parts (8.6%)**
 - After RDT' decision to follow CDMA2000 technology roadmap, Qualcomm and Omnia starts funding Inquam for new licenses acquisition and for the first cdma450 network rollout in Romania.
 - Starting point - the NMT450 network and license with no constrains related to digitalization.
 - The NMT coverage baseline (on the next slide - outdoor level of service), indicates 60% geographical coverage and 40% covered population (in-building).
 - In 2001 the NMT network consists in two switches, 125 Base Stations and 30 Transmission & Repeater sites.
 - At the same time, each GSM900 network have 9 switches, 1,500 Base Stations and 300 Transmission & Repeater sites.
 - The rollout plan targets to match the GSM coverage footprint which requires approximately 500 Base Stations operating at 450 MHz.

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TECHNOLOGY – Key Factors

- **Three key factors to consider while comparing different wireless technologies:**

- Coverage offer – in terms of link budgets comparison
- Capacity offer – in terms of spectral efficiency
- Supported Services – in terms of differentiators for the end user

- **Comparing CDMA against NMT and GSM results in:**

- Superior Coverage based on better Maximum Allowed Path Loss
- Superior Spectrum Efficiency based on 1:1 frequency reuse factor
- High Speed Packet Data capability as a strong differentiator/advantage

Additional advantages:

- increased optimization flexibility (trading coverage for capacity)
- higher transport efficiency (packet based)
- high capacity & throughput for data based services (ATM based QoS)
- VoIP ready: 1x supports PTT (half duplex) and 1xEV-DV (full duplex Telephony & Simultaneous Data)



TECHNOLOGY – Coverage and Capacity

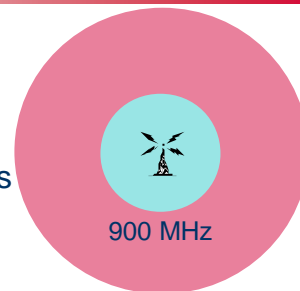
Based on the Free Space Loss calculations, 450 offers 4x larger coverage comparing to 900 for the same technology.

CDMA capacity operating only 3 carriers (3.75MHz) is up to 4x higher than GSM capacity operating 62 channels (12.5MHz).

CDMA link budget is better than GSM even for the same band.

This results in a 4x better efficiency allowing the operator to provide more cost effective services to the end user.

Zapp experience demonstrates the ability to decrease the average investment



450 MHz

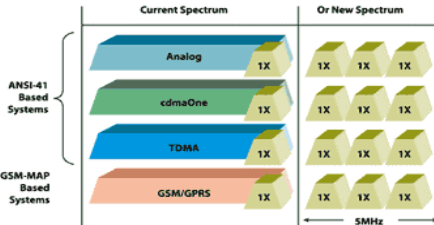


TECHNOLOGY – Strategic considerations

- CDMA2000 can operate in multiple bands

These bands include:

- 450 MHz
- 700 MHz
- 800 MHz
- 900 MHz
- 1700 MHz
- 1800 MHz
- 1900 MHz
- 2100 MHz

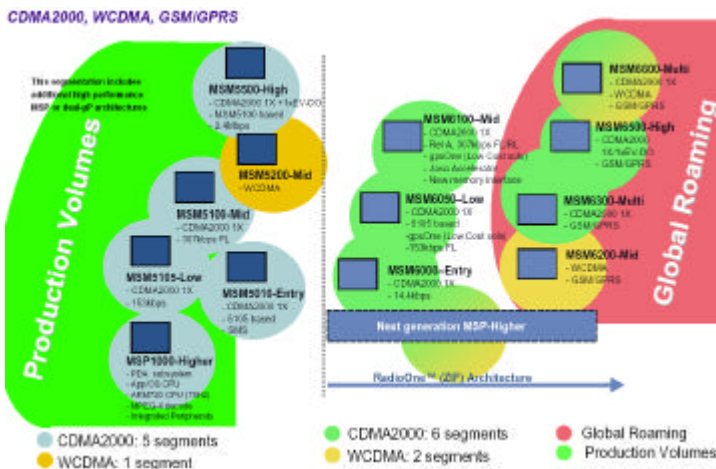


- CDMA needs only 1.8 MHz of spectrum for the first carrier (1.25 MHz plus the guard bands) while 450 MHz spectrum can host up to three CDMA carriers
- Based on its cost efficiency, CDMA2000/450 can cover and serve all the NICHE markets left underserved by GSM due to its capacity and/or coverage limitations (on both mobile voice & data markets).
- Due to the poor fixed infrastructure available in Romania & CEE countries, CDMA2000/450 can provide the most cost effective solution for the “Universal Service” initiative.
- Broadband data capability allows CDMA2000/450 to substitute



TECHNOLOGY – Chipsets roadmap

- CDMA2000 Chipsets Evolution – Global Roaming Support



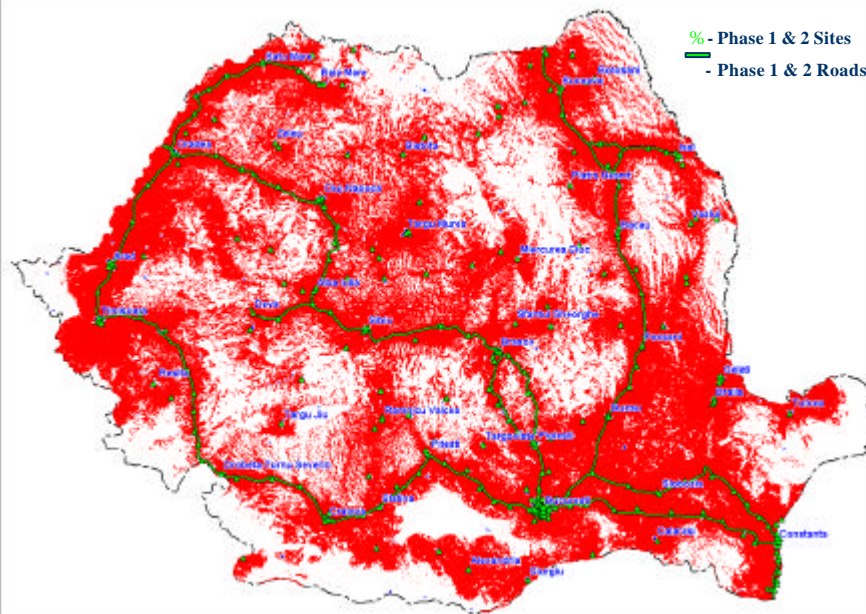
- CDMA2000: 6 segments
- WCDMA: 2 segments
- Global Roaming
- Production Volumes



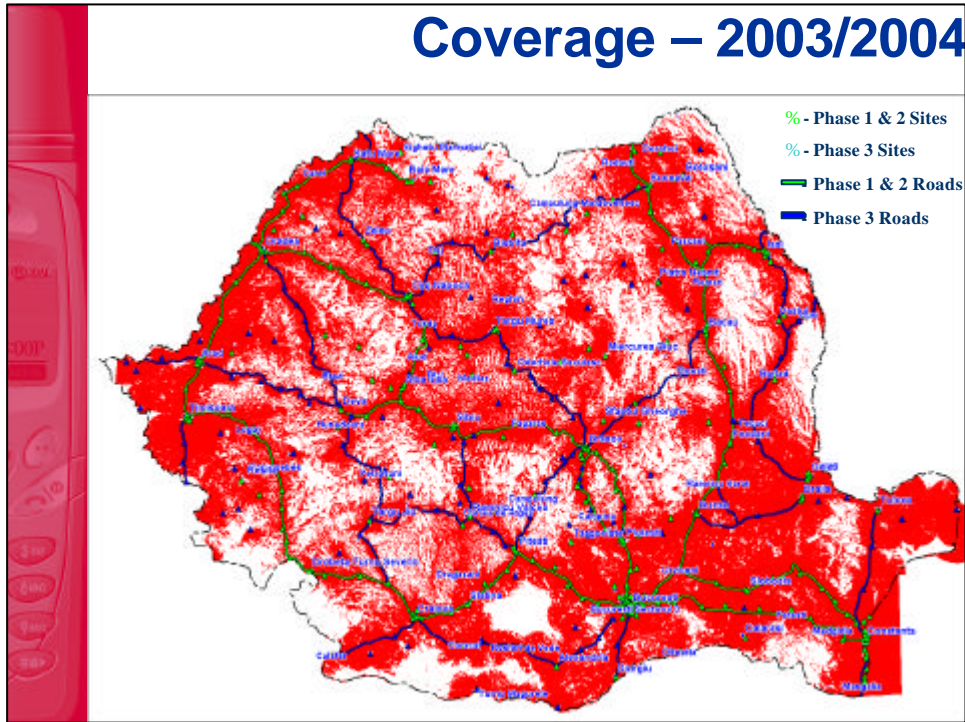


Network Deployment

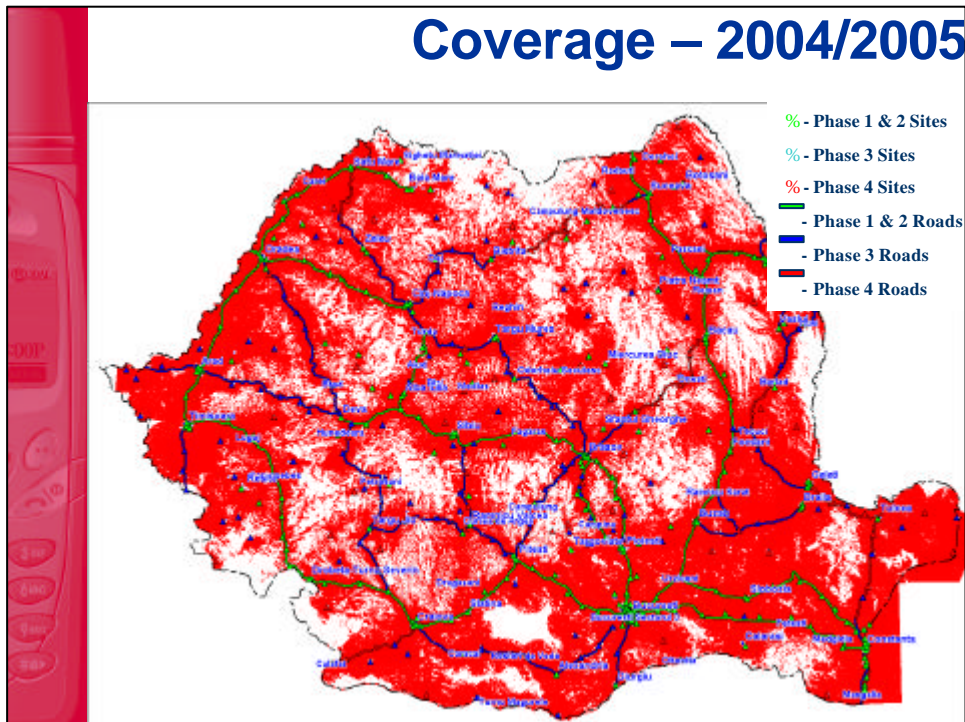
Coverage – 2002/2003



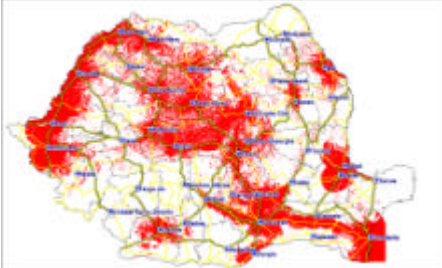
Coverage – 2003/2004



Coverage – 2004/2005

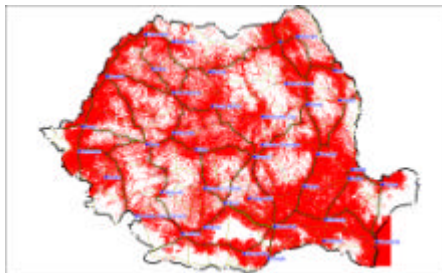


1x Coverage (1)



PHASE I (2001/2002)

- BTS: 180
- DCS: 3
- Population Coverage: 30% (Indoor level of Service)
- Geographical Coverage: 30% (Outdoor level of Service)
- 60% Urban Population covered

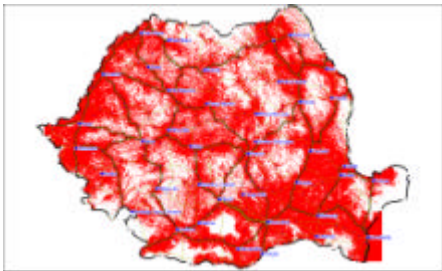


PHASE II (2002/2003)

- BTS: 305
- DCS: 4
- Population Coverage: 60% (Indoor level of Service)
- Geographical Coverage: 60% (Outdoor level of Service)
- 85% Urban Population covered

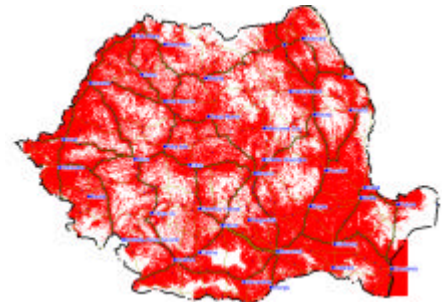
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1x Coverage (2)



PHASE III (2003/2004)

- BTS: 430
- DCS: 5
- Population Coverage: 80% (Indoor level of Service)
- Geographical Coverage: 80% (Outdoor level of Service)
- 98% Urban Population covered



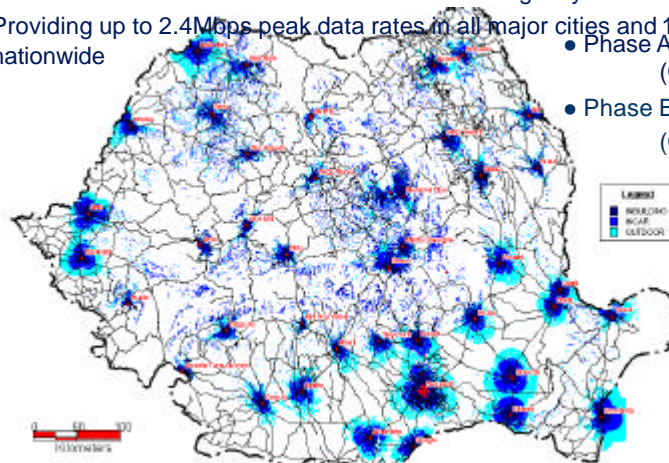
PHASE IV (2004/2005)

- BTS: 490
- DCS: 5
- Population Coverage: 90% (Indoor level of Service)
- Geographical Coverage: 85% (Outdoor level of Service)
- 100% Urban Population covered

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1xEV-DO Coverage (2004)

- The roll-out plan is based on a socio-economic analysis, considering multiple factors: population, employment rate, turnover etc and focuses on the broadband data demands
- 1xEV-DO users can roam onto 1x national coverage layer while traveling
- Providing up to 2.4Mbps peak data rates in all major cities and 153.6kbps nationwide



- Phase A – Bucharest (Q1/04)
- Phase B – other 40 cities (Q2/04)



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Terminals

Z710

1. Z710i - handset

Manufacturer: Giga Telecom - Korea

Market positioning: High – end

Launch date: end of February

Physical Characteristics:

- - Weight: 80 g
- - Size: 45.8 x 84 x 19.9
- - LCD: 262K color TFT
- - MSM: 5100
- - Battery: Li-ion

Main functions:

- - BREW
- - Browser
- - Build in modem
- - GPS One
- - SIWA Telespree OTA
- - Polyphonic ringtones
- - Speaker phone
- - Phone book: 500 entries
- - T9



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Z510

1. Z510/Z510i - handset

Manufacturer: Giga Telecom Inc. – Korea

Market positioning: Middle high

Launch date: available now

Physical Characteristics:

- Weight: 78 g
- Size: 83 x 43 x 20 mm
- LCD: Gray scale
- MSM: 5105
- Battery: Li-ion 600 mAh

Main functions:

- BREW*
- Browser*
- Build in modem
- SIWA Telespree OTA
- Polyphonic ringtones
- Phone book: 200 entries
- Speaker phone
- T9

* Available February 2004



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Z330i

3. Z330i - handset

Manufacturer: Curitel Communications Inc. – Korea

Market positioning: Middle low

Launch date: end of May

Physical Characteristics:

- Weight: 92.5 g
- Size: 108.8 x 47 x 19.6
- LCD: 4096 CSTN color
- MSM: 5000
- Battery: Li-ion 900 mAh

Main functions:

- BREW
- Browser
- Build in modem
- SIWA Telespree OTA
- Polyphonic ringtones
- Phone book: 200 entries
- Speaker phone
- T9



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Z315/325

4. Z315i/Z325i – PTT handset

Manufacturer: Ubiquam - Korea

Market positioning: PAMR

Launch date: end of July

Physical Characteristics:

- Weight: 115 g
- Size: 118 x 44 x 20 mm
- LCD: 65 000 color, STN
- MSM: 5100
- Battery: Li-ion 1000 mAh

Main functions:

- BREW
- Browser
- Build in modem
- SIWA Telespree OTA
- PTT
- GPS
- Polyphonic ringtones
- Phone book: 500 entries
- Speaker phone
- T9



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Z110

5. Z110 - handset

Manufacturer: Gtran Inc. – Korea

Market positioning: Low end

Launch date: end of August

Physical Characteristics:

- Weight: 100 g
- Size: 103 x 44.5 x 17.5
- LCD: STN with blue color backlight
- MSM: 5105
- Battery: Li-ion 950 mAh

Main functions:

- Build in modem
- SIWA Telespree OTA
- Polyphonic ringtones
- Phone book: 100 entries



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H150

6. H150 - handset

Manufacturer: Curitel Communication. – Korea

Market positioning: Low end

Launch date: available now

Physical Characteristics:

- Weight: 145 g
- Size: 124 x 50 x 20 mm
- LCD: STN with blue color backlight
- MSM: 5000
- Battery: Li-ion 950 mAh

Main functions:

- Build in modem
- Browser
- Phone book: 100 entries



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S200

7. S200 – handset

Manufacturer: Synertek Wireless. – Korea

Market positioning: Low end

Launch date: available now

Physical Characteristics:

- Weight: 120 g
- Size: 110 x 44 x 21 mm
- LCD: Gray scale
- MSM: 5000
- Battery: Li-ion 850 mAh

Main functions:

- Build in modem
- Browser
- Phone book: 200 entries



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Z010

1. Z010 – EV-DO modem

Manufacturer: Gtran Inc. – Korea

Market positioning: High speed data users

Launch date: end of March

Physical Characteristics:

- Weight: 96 g
- Size: 116.2 x 47 x 22.2 mm
- LCD: Gray scale
- MSM: 5500
- Battery: Li-ion 1000 mAh

Main functions:

- Wireless connectivity: - up to 307 Kbps in 1xRTT
- up to 2.4 Mbps in 1xEV-DO
- Built in GPS
- Voice
- Simple SMS



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Mobilink – Topex WLL

- Voice and HSPSD capability

- Standard Interfaces:

- POTS RJ11
- Serial RS232C
- USB
- DC in (9 V)

- Optional

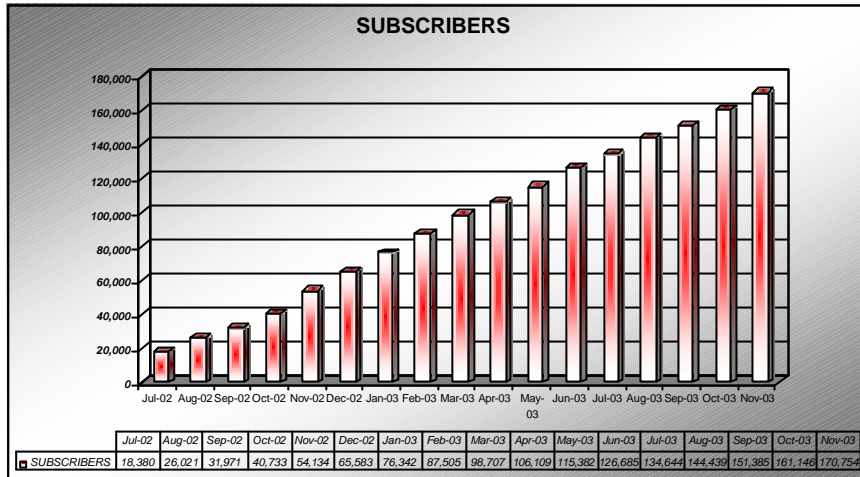
- Ethernet module
- Web Server module
- Handset inside or removable
- External antenna



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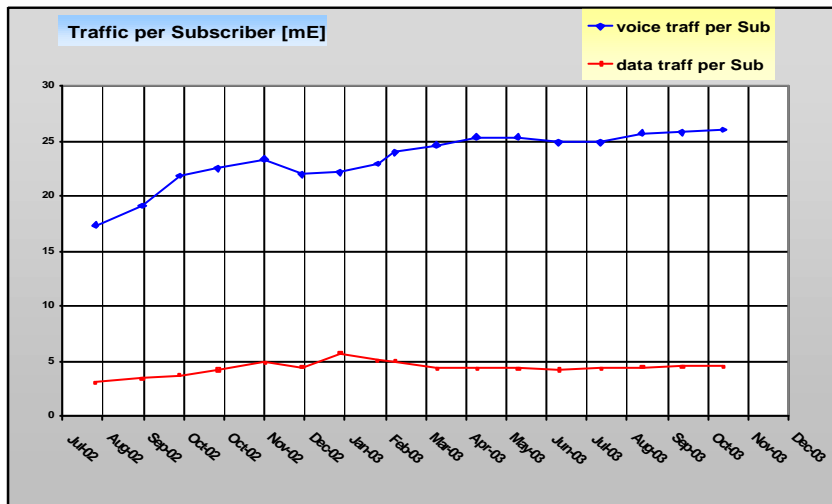
Traffic & Performance

ZAPP - Subscribers



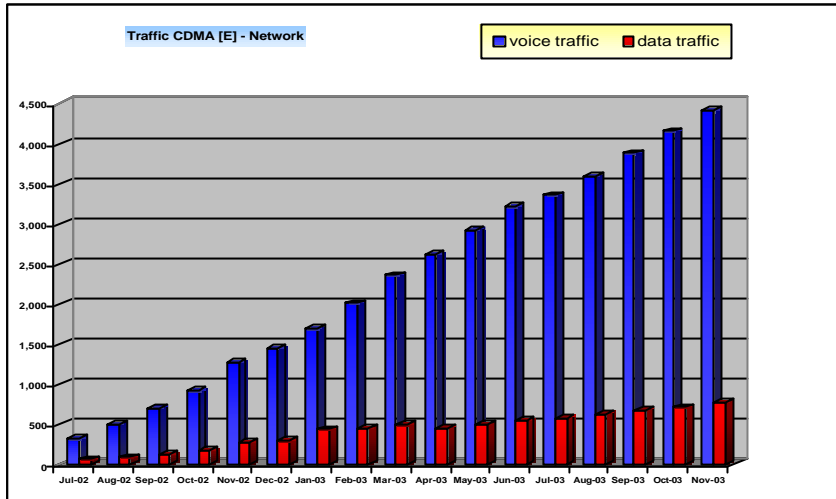
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ZAPP – Traffic/Subscriber - Voice & Data



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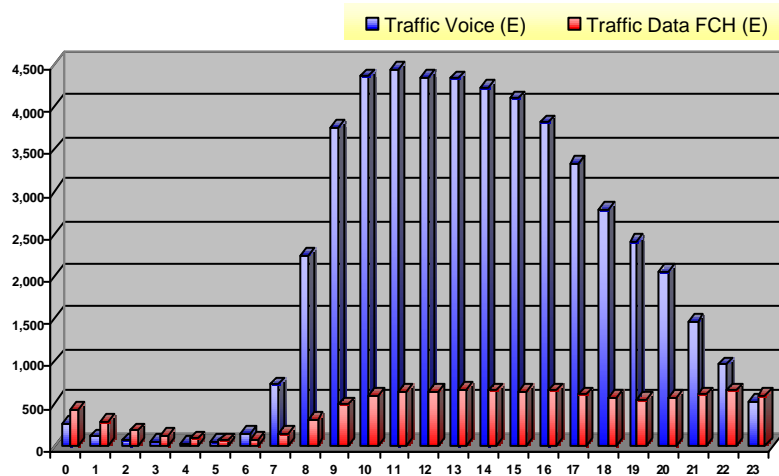
ZAPP – Traffic Voice & Data



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ZAPP - Hourly Traffic Distribution

Network Voice & Data - Busy Day of the Month

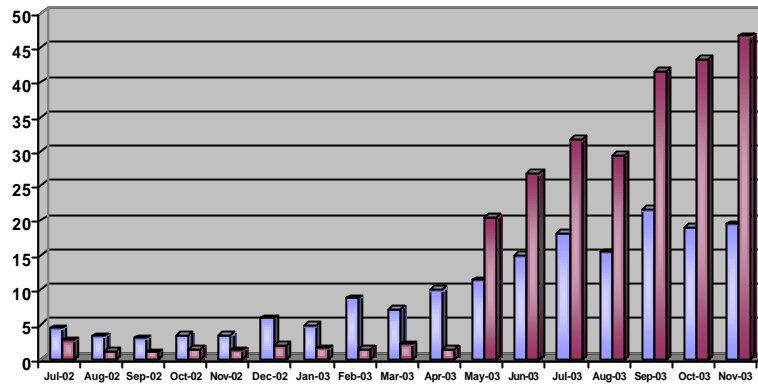


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ZAPP - International Traffic

International Traffic [E]

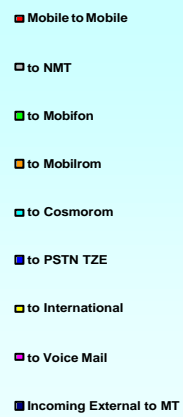
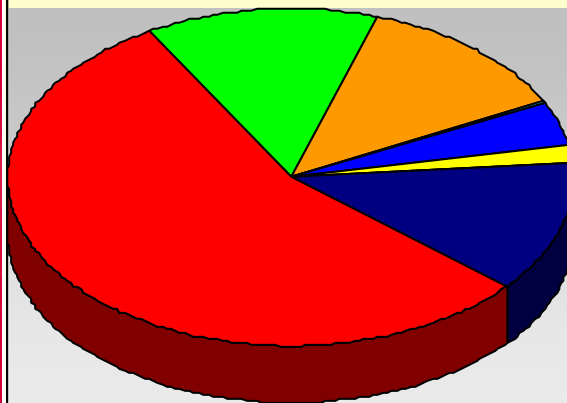
Incoming Outgoing



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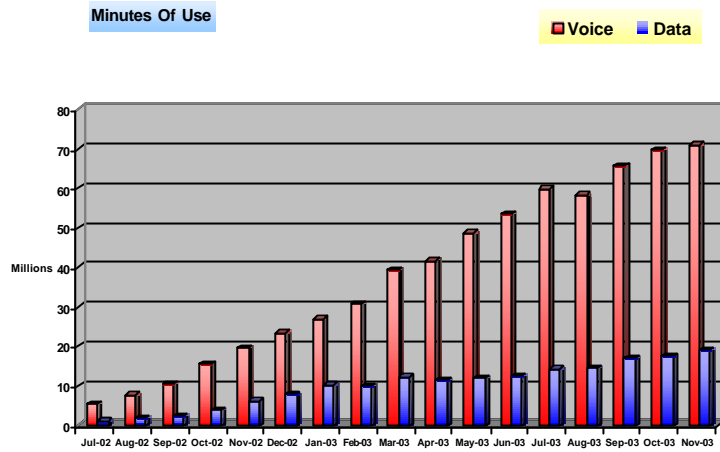
ZAPP – Voice Traffic per Destination

Traffic Distribution Nov-03

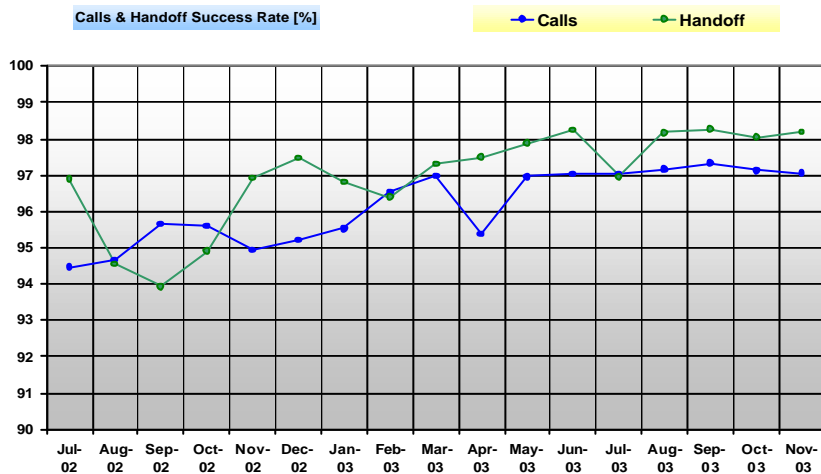


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ZAPP – Minutes Of Usage

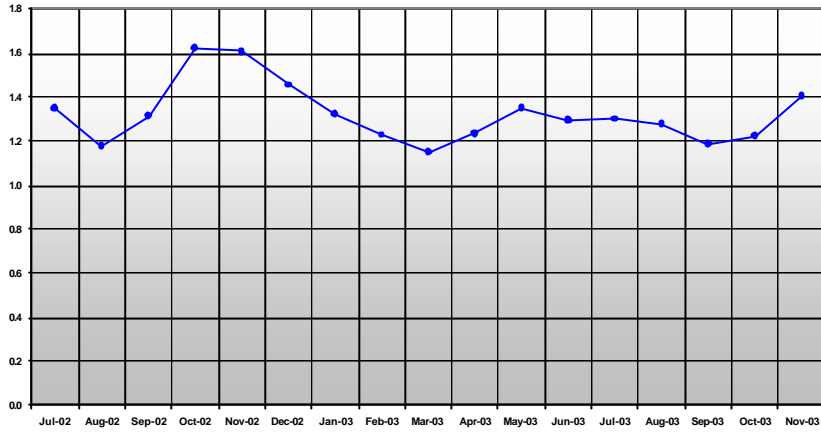


ZAPP – Call Performance



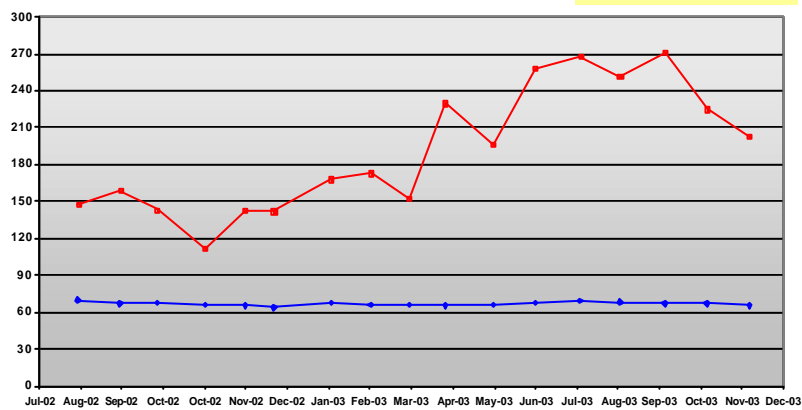
ZAPP – Drop Call Rate

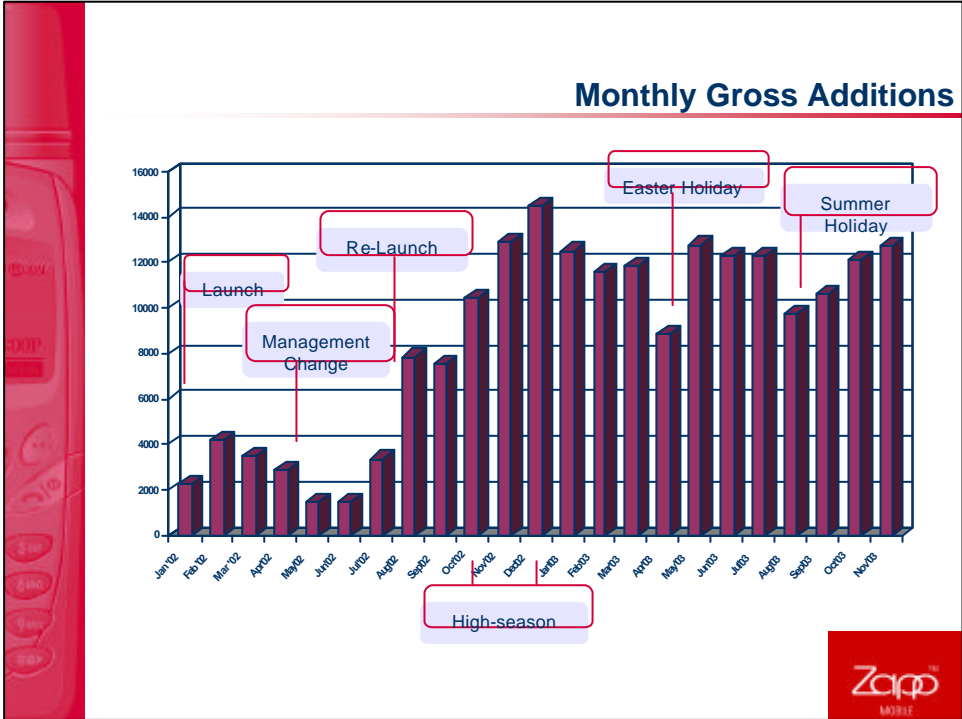
Drop Call Rate [%]



ZAPP – Mean Hold Time

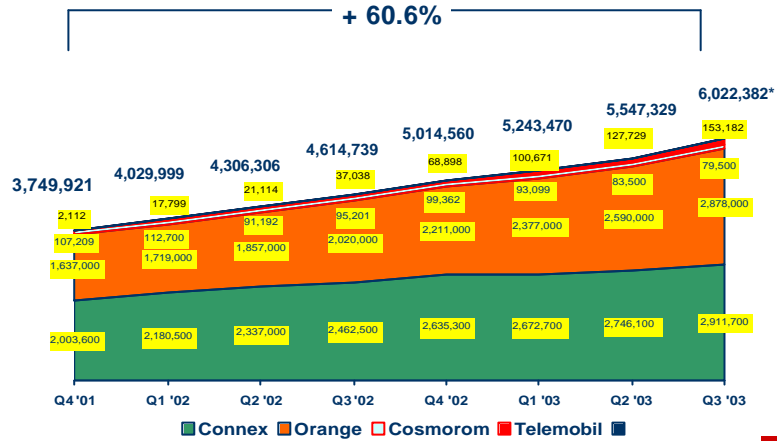
Mean Hold Time [sec]





Mobile Market Evolution

Growth in Customer Base (Postpaid+Prepaid)

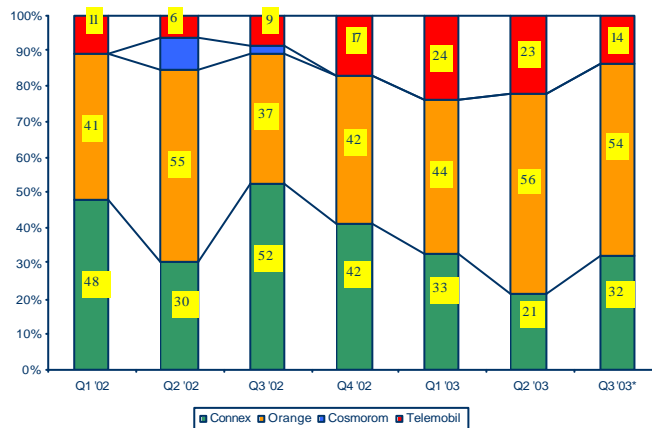


*Estimation

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Mobile Postpaid Market Evolution

Market Share – Net Addition (total market)

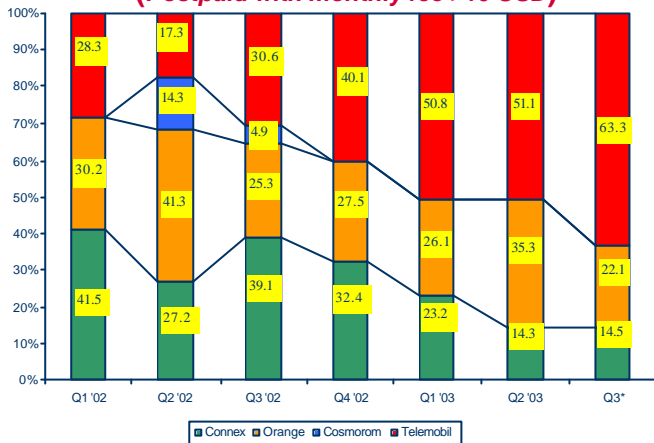


Source: TIW, ORANGE and OTE quarterly financial reports

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Mobile Postpaid Market Evolution

Market Share – Net Addition (Postpaid with monthly fee >10 USD)



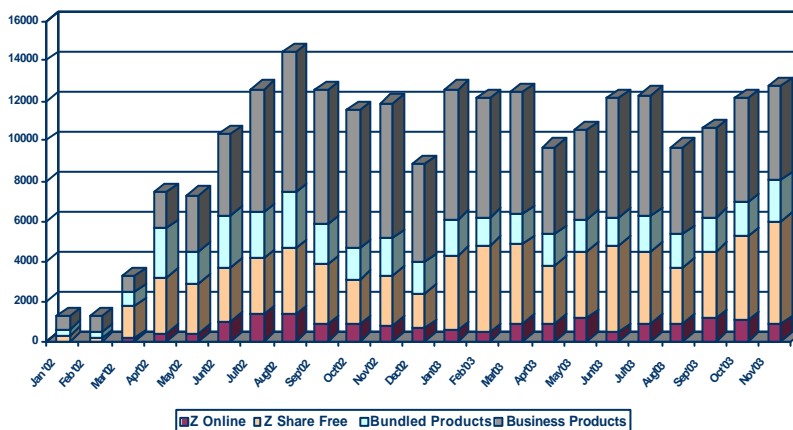
Starting from Q3 2002, Zapp has always acquired over 30% of the post paid market growth (tariff plans over 10 USD)

Source: TIW, ORANGE and OTE quarterly financial reports

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Sales by Products

All Products



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