3G NETWORK PLANNING

Mobitel's Approach

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THERE IS MORE TO LIFE THAN WORDS

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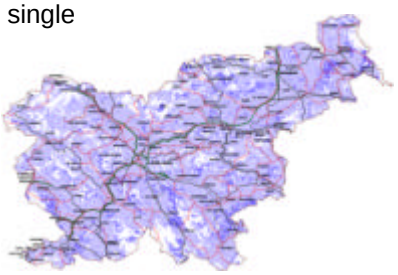
Slovenian mobile market is developed...

- Population - 2 million
- Capital - Ljubljana, 280 000 citizens
- Joining EU in 2004
- GDP 75% of EU average - higher than some EU members
- Total mobile penetration - 93% (source EMC World Cellular Database), the highest in CEE
- Three mobile operators on the market, plus 1 service provider
- Single UMTS licence granted (Mobitel, only bidder) in the end 2001

Mobitel today...

- Operates NMT, GSM900&1800, GPRS and (pre-commercial) UMTS network
- Extremely fast growth, today 76% of market share
- 1,34 mio users, 67% of population in one single network
- First EU network to pass 50% of penetration in one single network
- 670 GSM sites, 5100 TRXs,
- Excellent coverage
- Ericsson BSC, SS and GPRS
- 5 MSC and 2 GMSC
- We offer almost all available services (HSCSD, MVPN, ALS, MPS, MMS, WAP, streaming)



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Roll-out Phases: Initially Focusing on Coverage

- First goal: Creating good initial user-perception
- Second goal: Seamless 2G/2,5G/3G idle & active mode performance
- 3G is an evolution – Inter-RAT HO and idle mode reselection is needed
- Where covered, support for fast RABs, up to PS384kb/s downlink and 64kb in uplink
- Special attention to indoor – CS(PS)64 RAB offered indoor
- Phase 1 (2003): Coverage in Ljubljana and Airport (deployment to be concluded by the end of 2003)
- Phase 2 (2004): Urban areas and highway coverage countrywide, 62% of population covered

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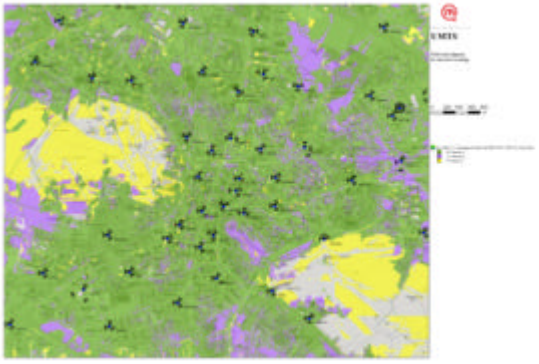
Ljubljana and Airport Structure - Phase 1

- **106 sites for 280k inhabitants - dense and regular cell structure**
- **Indoor coverage, ensuring speech CS12.2 , PS64 RAB, outdoor PS64/384**

tor tuned separately



TCPU 5.0: result of Monte Carlo analysis on urban model:
phase 1 WCDMA
loaded with 5000 users
– 95% served
- Green: PS384 DL
- Magenta: fallback PS128
- Yellow: fallback PS64
15% of population covered

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Ljubljana & Airport Cell Structure

- Re-using of existing sites is a must. In Ljubljana 70% of GSM sites re- used for WCDMA
- What can be reused: Today's dense sites (GSM 900&1800) in regular structures on macro level (roof-top).
- Co-site distance in urban environment vary from 600-1000m.
- Typical antenna height above floor level: 15-25m
- Phase 1: 50% GSM/WCDMA
- combined antennas

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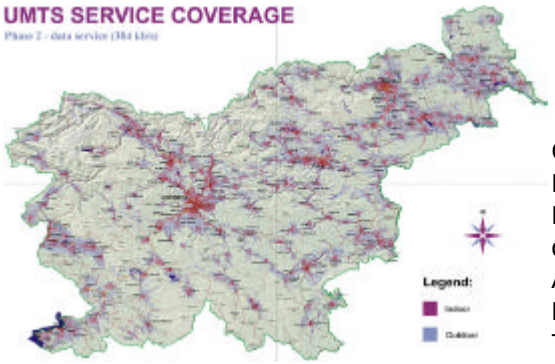
Phase 2 - 384 Sites Already in Deployment

- **Ljubljana: Capacity & coverage improvement using micro cells, repeaters, 3D cells, RRUs, antenna de-commision**
- **Coverage extension countrywide acc. to licence obligation**



Coverage at the end of 2004:
PS384
End 2004: 62% pop. covered
All towns down to 1500 pop.
Highway cross: CS(PS)64
Tourist centers

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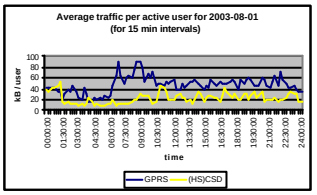
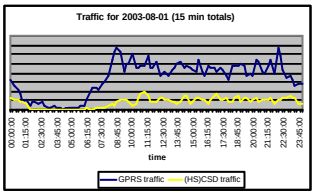
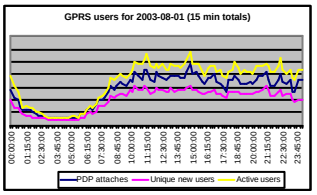
2,5G Data User Profile ...

- Hypothesis: UMTS data user not much different from GPRS/CSD user
- GPRS peak traffic: 90kB/user/15min
- Average 800bits/s/user/BH
- 250kB/user/day







... and prediction for 3G, based on 2,5G

~~Service~~	~~Basic~~	~~Reduced~~
~~CS12.2 (mErl)~~	~~16~~	~~15~~
~~CS64 (mErl)~~	~~4~~	~~2~~
~~PS384/64 (kB/user/BH)~~	~~200/20~~	~~100/10~~

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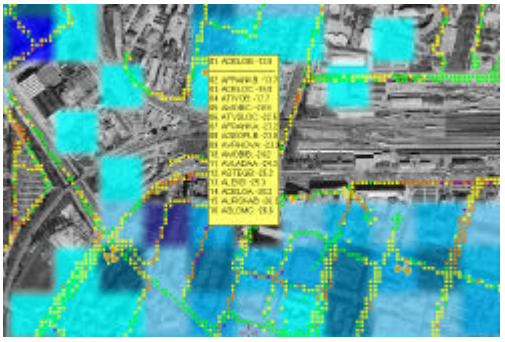
Challenge: Development of Own PP/OPTIM tool

Optimisation is a very complex task, where we need best engineers
The main goal - for GSM/GPRS/WCDMA network - is common platform for system statistics, predictions and field measurements

- Best way to learn is developing our own tool
- Tool based on powerful ntranet GIS platform
- Own alghoritms added
- Statistics added in next step
- Goal: over-RET self-configuring intelligent high capacity 2G/3G network



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First Optimisation Alghorithms

- Finding cells with too much overlapping
- Finding cells with too less overlapping
- Excluding measured bins with distant best server
- Tuning of each cell-best server individually
- Finding pilot pollution: focusing on strong interferers
- Finding areas with insufficient uplink coverage
- Analysing the effects of changing (up, down) tilts, azimuths, CPICHs power, antenna replacements: iterative process
- Waiting for usable PM – to close the optimisation loop
- Finding neighbour relations, WCDMA and WCDMA-GSM
- Comparison between TCPU analyses and drive tests

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Overlapping Cost Function: Example

Calculation cost (penalty per cell), calculated from RSCP data for each measured bin:

*cost = 1/10 * Fsi * (1+Ri/Rmin)^2*

Fsi = 4 for RSCP1 - RSCPi < 3

3 for 3 =< RSCP1 - RSCPi < 6

1 for 6 =< RSCP1 - RSCPi <12

0,3

Where is...

Ri - distance to i- cell

Rmin – distance to the closest cell in the air

1 - best server i – i-cell

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Measurements & Initial Tunings

- Autumn 2003: three meas., tuning and optim. campaigns performed
- Measurement campaign – for over 1000 km over all Ljubljana streets takeing 4 days and nights
- After measurement campaign, follows post-processing of data collected and action: changing of tilts, azimuths and system parameters
- R&S test measurement system for RAN (ESPI; ROMES) for optimisation of DL and to prevent pilot pollution
- TEMS Investigation WCDMA 2.1: testing functionality in dedicated mode, RAN behaviour, HO, PS/CS RAB's, LLC&RLC, inter-RAT HO..
- We are seeking the optimum: sharp cell borders, best Ec/Io distribution, pilot pollution, lowest transmitted power needed
- Dedicated mode measurements: uplink, call set up, drop call, neighbours, L3 investigations…

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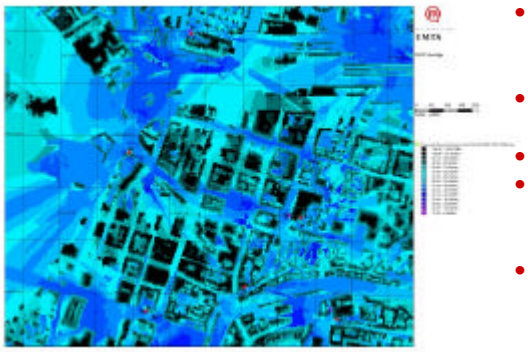
Indoor/Outdoor Correlation: Current Results

Indoor much different, RSCP distribution has no correlation to outdoor. Uplink is worth considering



- Ec/Io comparable to outdoor, slightly lower (1-3dB) on ground level
- On 1-4 storeys, Ec/Io same or higher
- On higher storey Ec/Io plunges
- TEMS / R&S field measurements performed with vehicle – not indoor!
- After post- processing, buildings for indoor measurements selected - planning tool can be useful

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Current Problems & Field Experiences

- Network & terminal performance improves rapidly
- Reasonable drop call rate
- High CS call set up failure rate
- Long PDP context activation times
- Missing neighbours – no SHO or inter-RAT HO
- UEs capabiliy: Inter-RAT HO?
- Uplink coverage for CS64 – low UE Tx Pwr?
- Videotelephony: poor moving picture quality : poor UE video processing?
- Low throughput – high BLER?

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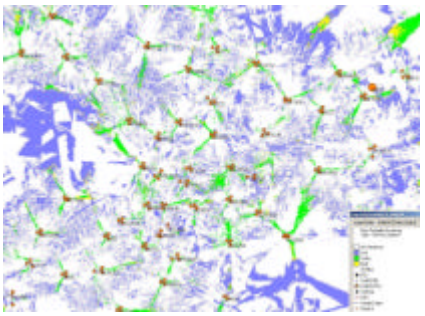
Cell overlapping - SHO candidates meas. results

RscpDif3 [dB]

RscpDif6 [dB]

DIFF		# meas. bins	%
<= 3		22250	26,31%
>= 0	<= 1	8422	9,96%
> 1	<= 2	7264	8,86%
> 2	<= 3	6564	7,76%
> 3	<= 4	5863	6,93%
> 4	<= 5	5448	6,44%
> 5	<= 6	4966	5,87%

Tuned to TCPU SHO candidates:



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Further Deployment Phases: Capacity?

When network load is going to increase:

- from deployed regular macro structure, can expect only limited capacity, due to too high factor *i* and α.
- UL and DL: completely separate story, connected only through balancing. Both UL and DL (loading, interferences) should be carefully considered.

How to extend radio network capacity?

A. Adding new sites: Q: WHERE? Macro, micro, indoor, repeaters
B. Adding new carriers: WHERE? LAYERS? 3D problem?
C. Adding additional power on DL? IS IT WORTH TO DO IT?
D. Adding new cells/sectors?
E. Introducing of new technologies: MUD, Smart antennas

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Capacity: Carriers vs. Layer structure

Capacity (and coverage) improvement steps:

1. Carrier 1 FDD: macro layer (deployed)
2. Carrier 1 FDD: micro layer (in testing)
3. Carrier 1 FDD: 3D & repeaters (both in testing)
4. Carrier 2 FDD: macro layer (capacity pool)
5. Carrier 2 FDD: micro layer (capacity pool)
6. Carrier 3 and TDD: indoor and/or micro layer

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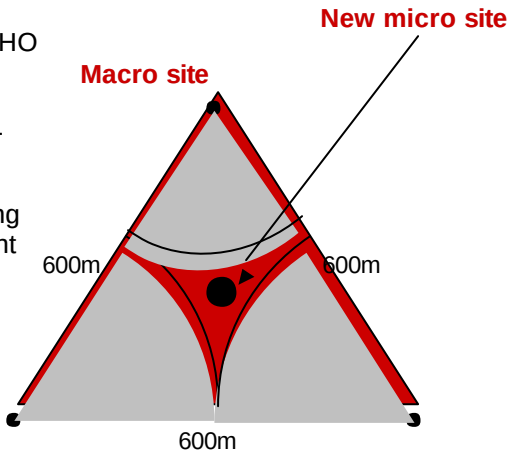
Fill-in criteria: Micro site selection

- Micro layer has to be isolated from macro layer to prevent extensive SHO areas and/or high UL interference
- Micro site feasible, where low (bad) RSCPs and Ec/Io from macro layer
- Micro site in the center of traffic
- Test transmitter is a good idea, using tems for UL noise rise measurement



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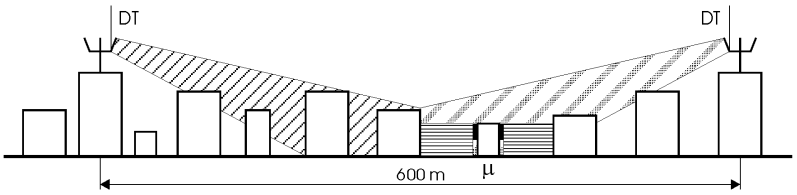
Fill-in Strategy: Combined macro/ micro structureon single carrier



- Macro/micro structure on single carrier is a necessity – inter-frequency handover is (too) slow
- Less than 400m of macro site distance in dense urban not feasible – no gain from further densification anymore
- Problem: micro site has to be selected extremely carefully
- Hypothesis: low # of users in similar RSCPs from micro and macro layer, in order to prevent high UL interference

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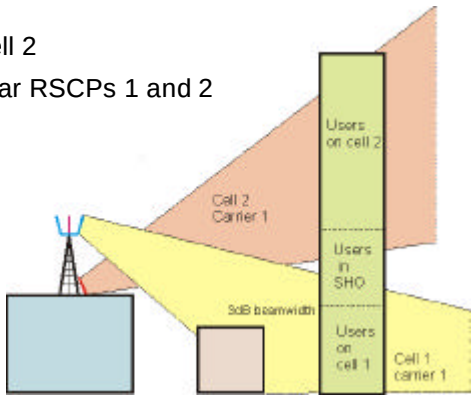
3D problem

Highey storeys need special attention, users cause of lot of UL interference

- Bad Qos, Ec/Io, BLER
- Critical antenna placement for cell 2
- DEF: Only low # of users in similar RSCPs 1 and 2
- DEF: Only low # of users in SHO



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Conclusion

Few days till commercial launch...

3G NETWORK IS READY !

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Our slogan for 3G: There's more to life than words ...

Thank you for your attention

THERE IS MORE TO LIFE THAN WORDS

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