WCDMA Network Performance Optimisation Based on Analysis of Network Statistics

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OMNITELE

Contents

- Background
- Research problem
- Research methods
- Optimisation process
- Measuring network performance
- Results
- Case study
- Conclusions
- Future research

Background

- WCDMA network performance needs to be monitored and optimised as traffic in networks is increasing
- Network monitoring is based on correctly defined KPIs
- KPI definitions for WCDMA networks are immature
- Network statistics (KPIs) are needed in network performance optimisation

Research problem

How to monitor WCDMA network performance and how to use the monitoring information to optimise the network performance?

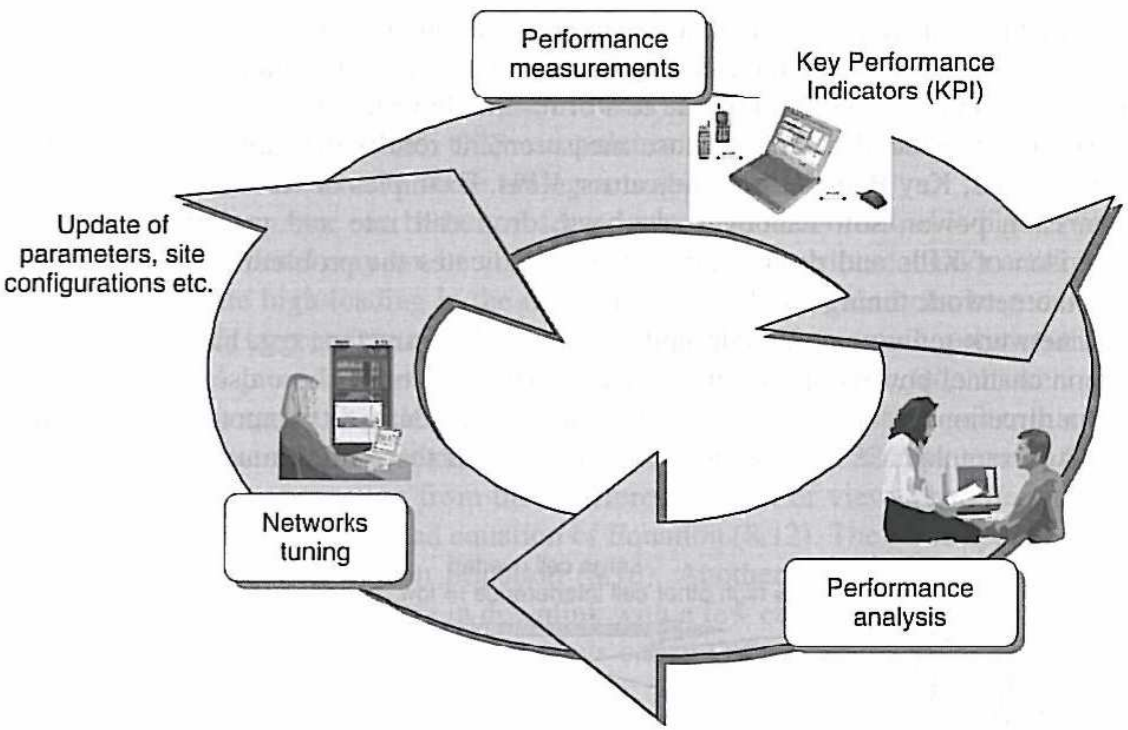
Objectives:

- Define the **KPIs** that measure the radio network performance in WCDMA networks
- Examine how to use the defined KPIs in radio network performance optimisation

Research methods

- Literature study
  - Various technical specifications
  - Several books and publications
- Interviews
  - Radio network planners
  - Radio network experts
- Case study
  - Optimisation of an operator's live network

Optimisation process



- Reasons that lead to optimisation :
  - Improve the performance
  - Business reasons (cost-effective)
  - Troubleshooting

Measuring network performance

- Network statistics
  - Key Performance Indicators (KPI)
- Field measurements
  - Drive tests
  - Interface probes
- End user feedback

Network statistics

- Network statistics are collected from different network elements with counters
- Different types of counters are used
- KPIs are needed to provide information of the network performance
- Raw counter data too detailed to be used in monitoring and optimisation (Some counters can be used as KPIs)

Defining the KPIs

- KPIs are composed from several counters
- KPI categories
  - Accessibility
  - Retainability
  - Integrity
- Documentation of KPIs is important
  - Same KPI can be defined from different counters or formula can be incorrect
- Measurement period must be reasonable
  - Too much averaging if too long
  - Not enough statistical information if too short

Results

- A set of KPIs
- Optimisation based on KPIs:
  - Optimisation is performed for each category
  - Find the worst performing cells
  - Find the reasons behind the poor performance
  - Make the changes in the network
  - Monitor the performance after the changes
- A case study was conducted in order to verify the applicability and practicability of the guideline and the defined set of KPIs

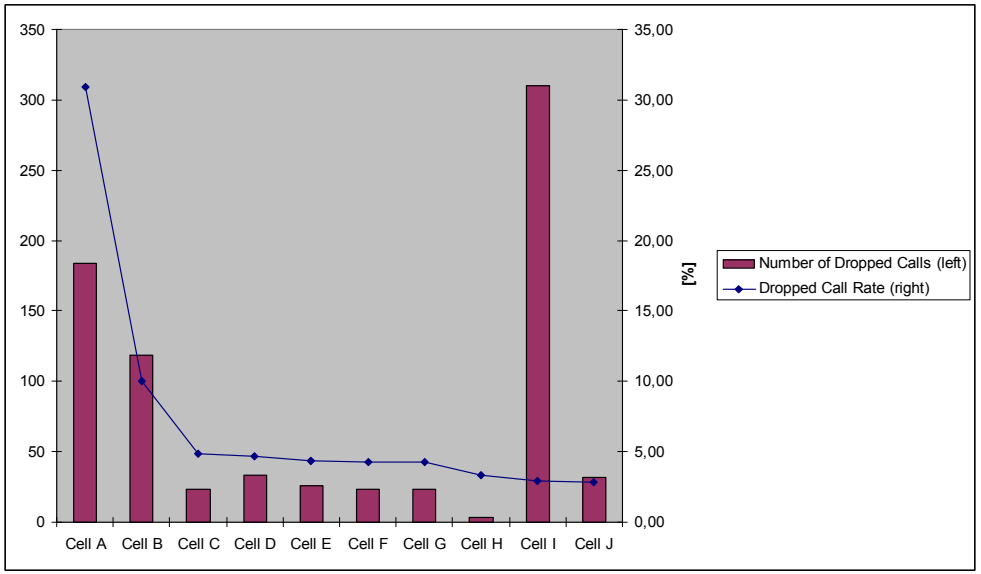
Category	KPI Name
Accessibility	Paging failure rate
	Paging Intensity
	RRC connection setup success rate
	RAB setup success rate
	Setup success rate
	RRC connection blocking rate
	RAB blocking rate
	Congestion
	Cell downtime
Retainability	RRC connection drop rate
	RAB drop rate
	Drop due to system rate
	Active set update success rate
	Soft handover overhead
	Outgoing CS inter-RAT handover success rate
	Incoming CS inter-RAT handover success rate
	Outgoing PS inter-RAT handover success rate
	Incoming PS inter-RAT handover success rate
	Inter-Frequency handover success rate
	Hard HSDPA cell change success rate
	Drop rate for drops due missing neighbours
Integrity	UL DCH BLER before combining
	UL DCH BLER after combining
	UL DPDCH BER
	Retransmission rate
	Total CS traffic
	Total payload traffic
	Throughput
	Spreading factor usage
	Code allocation failure rate
	Number of users
	Total downlink TX power
	Downlink TX power
	Downlink transmitted code power
	Average uplink RSSI
	Uplink RSSI
	Channel switching success rate
	Downswitching due to system
	Compressed mode users
	Compressed mode start to handover rate

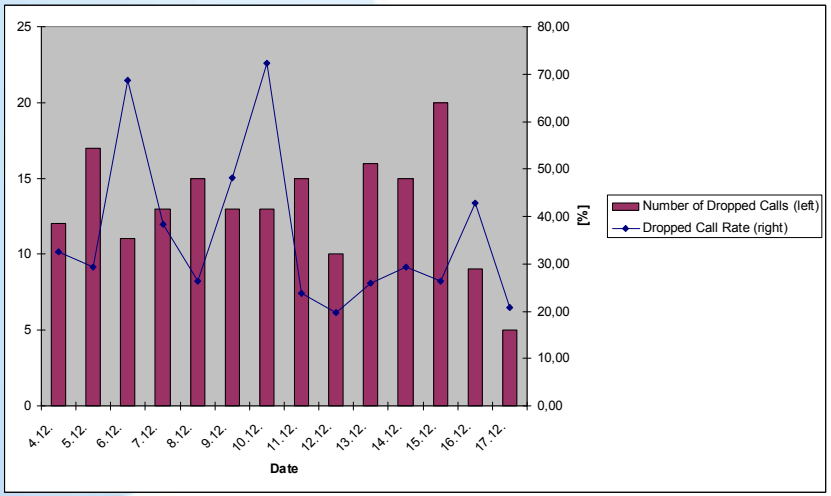
Case Study

- A case study was conducted in live network
- Purpose was to test the KPIs in practise
- The number of KPIs was limited due to operator
- Also field measurements was performed in order to find the reasons for the poor performance, due to limited set of KPIs
- The performance of the network was improved

Case study:High dropped call rate

- Worst performing cells
- Cell A was the worst performing cell





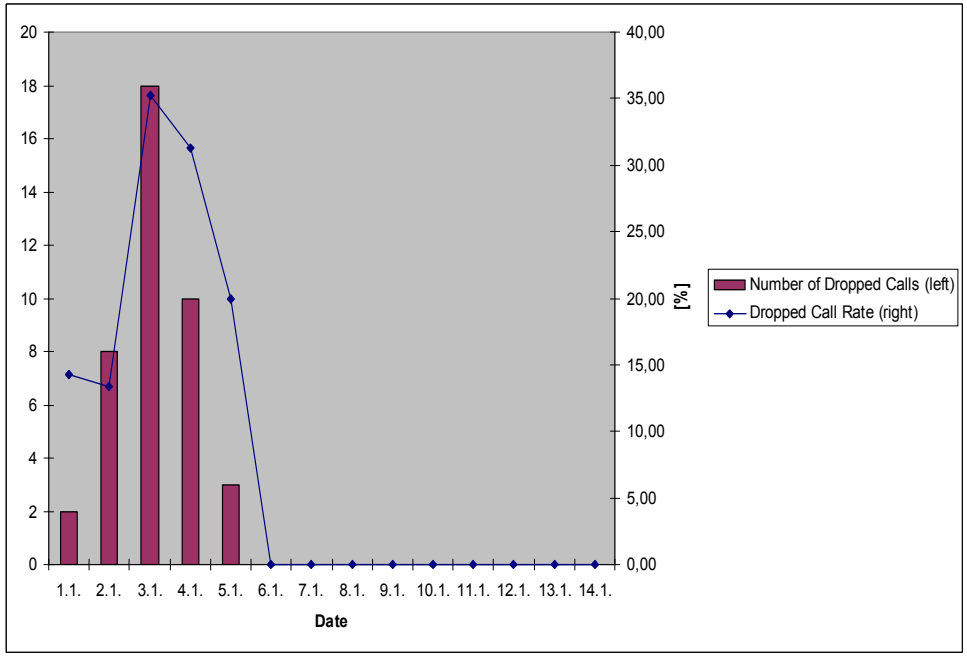
Case study:High dropped call rate

Solution:

- Most common drop reasons are incorrect HO parameters, interference or lack of coverage
- Handover KPIs were checked, but the KPIs were ok→ no incorrect HO parameters
- Since the cell was located in the city area, the coverage was assumed to be ok. The high number of drops indicated that the drops was not caused by lack of indoor coverage.
- Interference was the most probable cause. Since the KPI set was limited, field measurements were performed.
- Field measurements showed that there was a neighbour relation missing between Cell A and a another cell.
  - Every cell that is not defined as neighbour to the serving cell, is seen as interference by the mobile.
  - If the signal strength of the other cell is strong enough, the call is disconnected by the network. The call can also drop due to interference caused by the interfering cell.
- This problem would been possible to detect with the KPI defined for drops due to missing neighbours.

Case study:High dropped call rate

- After the reason for high dropped call rate was found, the missing neighbour relation was defined
- The change improved the performance of the Cell A greatly and also the performance of the other cell was improved
- There are no dropped calls in Cell A after the change



Conclusions

- Monitoring and optimisation is important part of operating and maintaining WCDMA networks
- Increased traffic rises new problems for the operators
- Right KPIs and proper use of the KPIs will help to maintain and improve the performance of WCDMA networks
- Case study showed that the KPIs and the guideline are applicable to be used in practise, however the case study was limited to basic KPIs that the operator had. The use of whole KPI set will give more information on the performance of the WCDMA radio network

Future research

- Performance measurement and KPI standards are quite immature yet, more work needs to be done
- The implementation of counters vary between different vendors, the same KPI definitions are not applicable in different networks
- The set of counters are not as mature as for example in GSM networks. More counters are needed to be able to define more KPIs
- New network features (HSPA) need new counters and new KPIs. The development of the KPIs is needed constantly