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The Effect of Radio Link Time out on the Mobile Networks Performance

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□ ABSTRACT □

This research is an evaluation study of the changing parameter radio link time out and describes the results of the trial by changing parameters of mobile channel such as radio link time out downlink and uplink and the corresponding effect on the performance stats and mobile channel quality. The idea of changing RLINK parameters is to extend the duration of the calls in bad coverage conditions or high interference before losing the call connection. In areas with quality problems and low signal, calls will have more possibilities to avoid a call drop due to bad quality.

Parameters RLINKT and RLINKUP were changed from 16 to 24 in PLBSC1, PLBSC2 and OXBSC1. The outcome of the trial showed good results. It has been proved good improvement in traffic drop rate results despite a slight increase in the SQI values.

Key Words: GSM, Mobile Communications, Radio Link Time Out, Network Performance

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تأثير زمن ثابت انقطاع الوصلة الخليوية على أداء الشبكة الخليوية

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□ الملخّص □

يهدف هذا البحث إلى دراسة مدى تاثير تغييرزمن ثابت انقطاع الاتصال الخليوي على أداء الشبكة الخليوية حيث تصف نتائج القياسات التجريبية على الشبكة الحقيقية مدى تأثير زمن الثابت المطبق في الوصلة الخليوية الصاعدة وفي الوصلة الهابطة على جودة االاتصال الخليوي وبارامترات الآداء للشبكة . وتعتمد فكرة تغيير زمن الثابت لانقطاع الوصلة على تمديد فترة الاتصال ضمن ظروف التغطية الخليوية السيئة أو التداخل القوي للمحطات حيث إنه في مثل هذة الحالات تكون هناك إمكانيات عديدة لتجنب إمكانيات انقطاع الخط بسبب الجودة الرديئة.

لقد تم تغيير زمن الثابت للوصلة الصاعدة والهابطة من 16 الى 24 في المقاسم الخليوية OXBSC1 PLBSC1 ,PLBSC2,

لقد أظهرت التجارب العملية نتائج جيدة حيث تم إثبات التحسن في نسبة انقطاع الخط على الرغم من بعض الرداءة في الجودة.

كلمات مفتاحية: الاتصالات الخليوية GSM، زمن ثابت انقطاع الاتصال الخليوي، أداء الشبكات.

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Abstract

1. Background and Purpose of the Trial

1.1. Radio Link Supervision.

The mobile station reads the system information messages and retrieves the radio link time out value and sets a counter to this value. If an SACCH message is missed that counter decrements by one, if a SACCH message is received, and can be decoded correctly, the counter is incremented by 2 up to the maximum value set by the radio link time out value. If the mobiles counter ever reaches 0 then a radio link failure has occurred and the radio link is released [2],[3],[4].

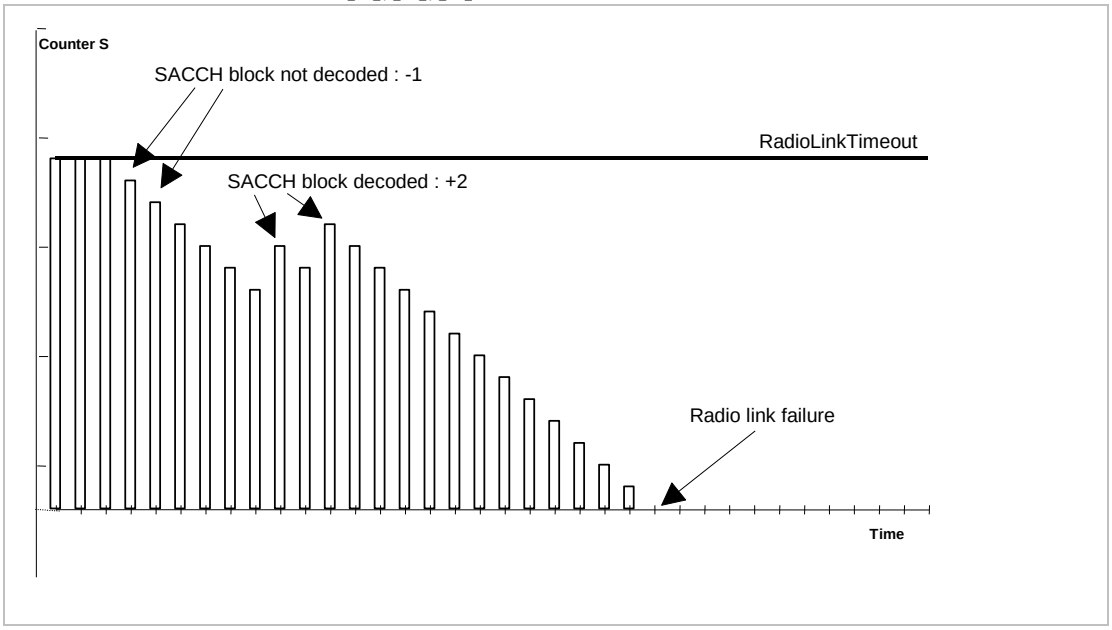

Fig.1

The method used here is also known as the “leaky bucket mechanism” as shown in figure1.

It is worth noting that in case of frequency hopping, there can be a decorrelation between the interference on SACCH and TCH frames. This makes it possible to have good quality calls with high dropped call rates, or bad quality calls with low drop rates [1].

The idea of changing RLINK parameters is to extend the duration of the calls in bad RF conditions before losing the call connection. In areas with quality problems and low signal, calls will have more possibilities to avoid a call drop due to bad quality. The expected outcome of the change would be an improvement on TCH and SDCCH drop rates.

1.2. Radio Link Supervision and Command

The radio link supervision uses a counter S and two thresholds:

- N_BSTXPWR_N : threshold for the radio link recovery
- RADIOLINK_TIMEOUT_BS: threshold for the radio link failure. It is the initial and maximum value of the counter S[15].

Initially the counter S is equal to N_BSTXPWR_N.

For each SACCH not decoded, S is decremented by 1 while for each SACCH decoded, S is incremented by 2. The incrimination or decrimintation is performed if S is in the range between 0 and RADIOLINK_TIMEOUT_BS.

The radio link supervision can sent two different messages to the radio link command function:

- Radio link recovery: as soon as the counter S is equal to the threshold N_BSTXPRW_N, the radio link recovery is triggered.
- Radio link failure: if the radio link recovery is not successful, as soon as the counter S reaches 0, the radio link failure event is sent to the radio link command function. As can be seen from figure2.

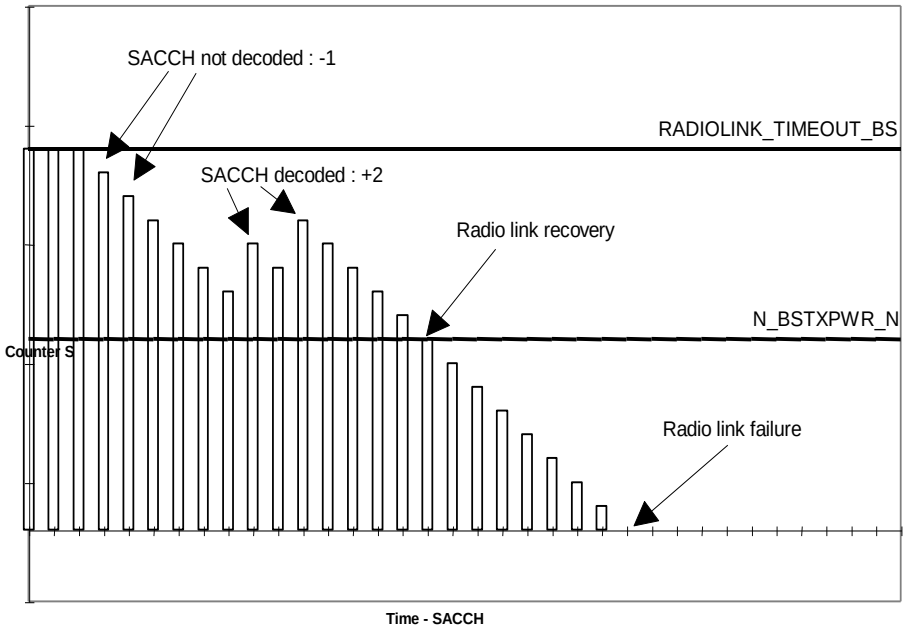

Figure 2: Radio link supervision

The radio link command function performs two different actions depending on the event received from the radio link supervision function: radio link recovery and radio link failure.
Radio link recovery: The BTS sends CONNECTION_FAILURE_INDICATION with cause value "YY-TXPWR-M" to BSC.
The BSC will perform two actions: increasing the power of the MS and of the BTS.

2. **Research Methodology**

Mobile radio channel parameters RLINKT and RLINKUP were changed from 16 to 24 for all the cells in PLBSC1, PLBSC2 and OXBSC1[1]. Using ESPA Ericsson system performance analysing software tool, the impact of the change was captured and analysed comparing the key performance indicator traffic drop rate and speech quality index before and after the change.

3 **Test Setting**

RLINKT and RLINKUP were changed from 16 to 24 for all the cells in PLBSC1, PLBSC2 and OXBSC1.

4. Description of parameters RLINKT and RLINKUP

The counters RLINKT and RLINKUP are used by MS and BSC to control the quality of the communication. Both parameters are increased in 2 units when a correct SACCH frame is decoded and decreased in 1 unit when the frame is not decoded. RLINKT is initiated in the MS and RLINKUP in the BSC. In the event than either RLINKT or RLINKUP falls to 0 the call is released [9],[11].

Currently the value for RLINKT and RLINKUP is set at 16 (16 times SACCH messages equal around 8s). In most cases, the connection is dropped by the system before the end user recovers good RF conditions. We therefore decided to do a trial to evaluate the effects of RLINKT and RLINKUP = 24.

5. Expected Outcome

The TCH and SDCCH drop rates are expected to improve. Degradation in the SQI performance is expected since calls in bad signal or quality conditions will last more in order to recover good speech conditions and this way avoid a call drop.

6. Results of the Trial on BSC Level

6.1 PLBSC1

PLBSC1 RLINKUP, RLINKT were changed from 16 to 24 on August 19:

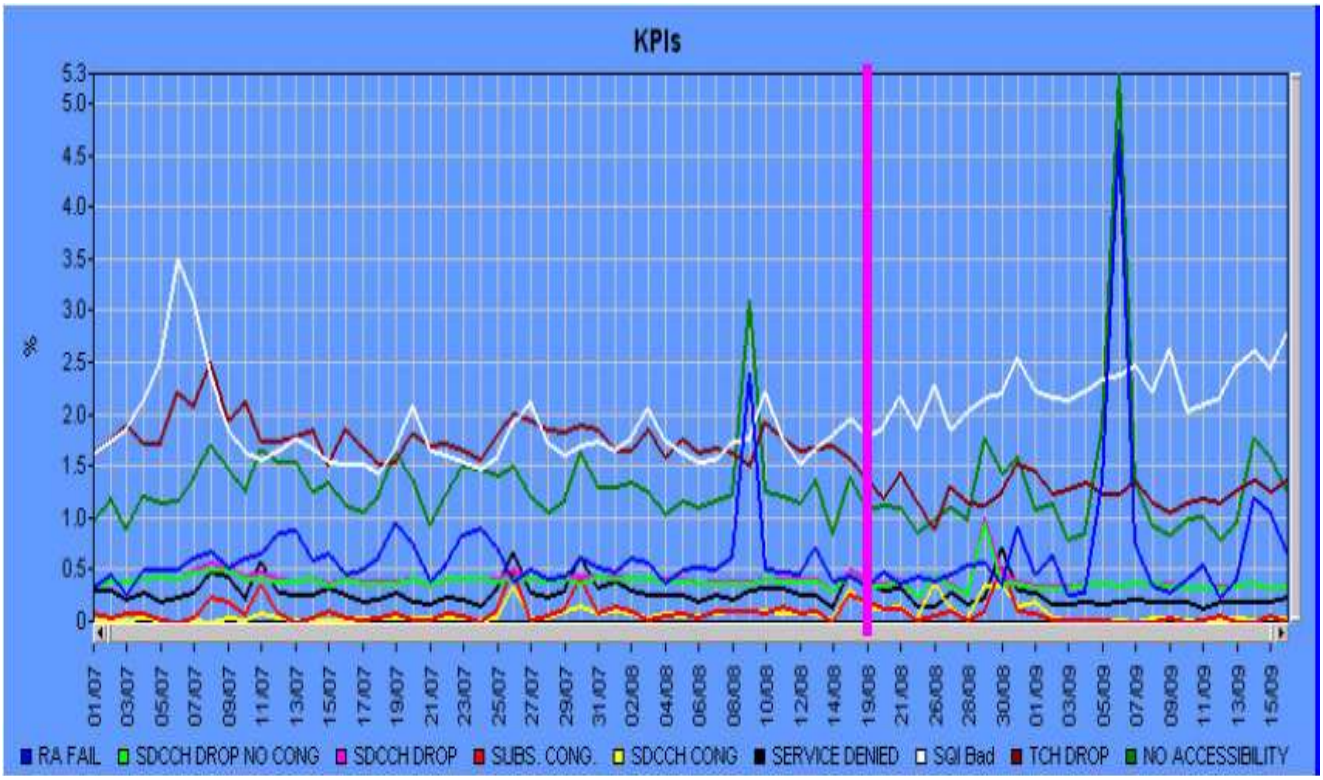

Fig. 3: TCH drop rate, SDCCH drop rate and SQI bad for PLBSC1

We can see a clear decrease in TCH Drop that changes from mean values of 1.8% to 1.2%. It can not be seen an appreciable change in SDCCH drop rate. Regarding SQI we can see a noticeable increase as well but we are still analysing if there are any other causes since we have seen this increase of bad values in SQI in BSCs, where no changes were made in RLINK.

6.2 PLBSC2

RLINKUP, RLINKT were changed from 16 to 24 on August 25th

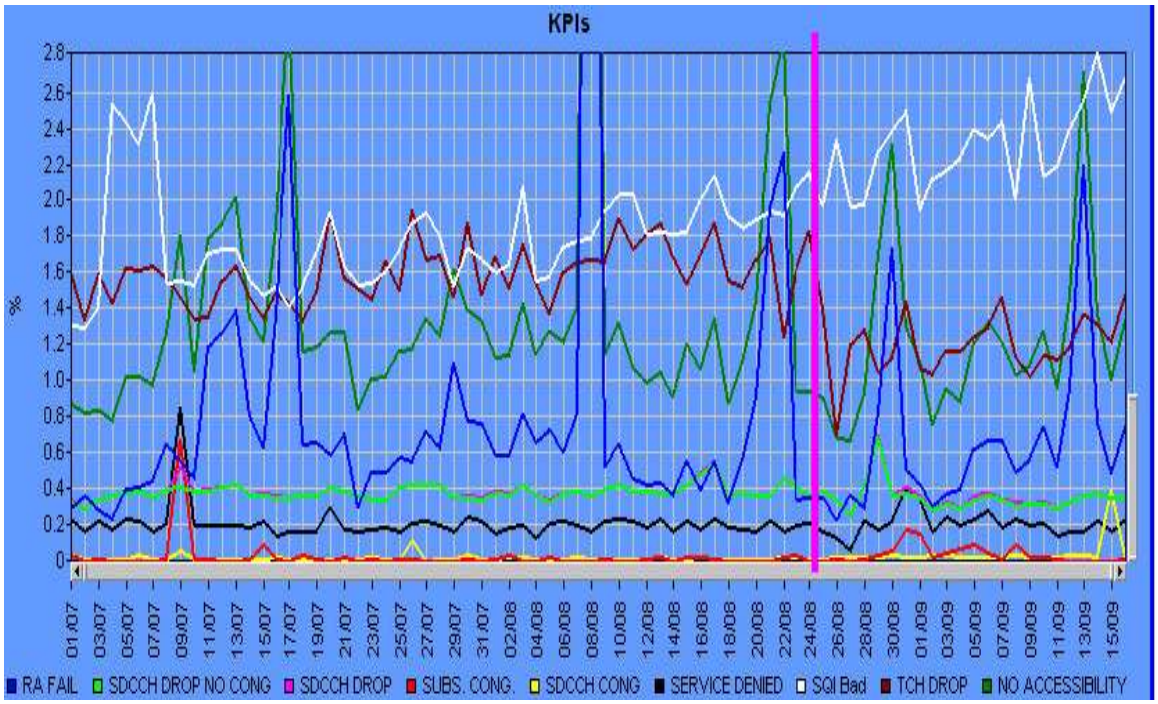

Fig.4 TCH droprate, SDCCH droprate and SQI bad for PLBSC2

It can clearly be seen how the TCH drop rate decreases considerably after the change in RLINKUP and RLINKT on Aug 25. It changes from mean values of 1.6% to 1.2%. We can appreciate a slight decrease in the SDCCH drop call [18],[16].

The SQI values have increased as well but we can see there was an increase in the SQI values previous to the change on August the 25th. The same as in PLBSC1, we are analysing other causes in the increase of SQI values.

6.3 OXBSC1

RLINKUP, RLINKT were changed from 16 to 24 on September 3rd

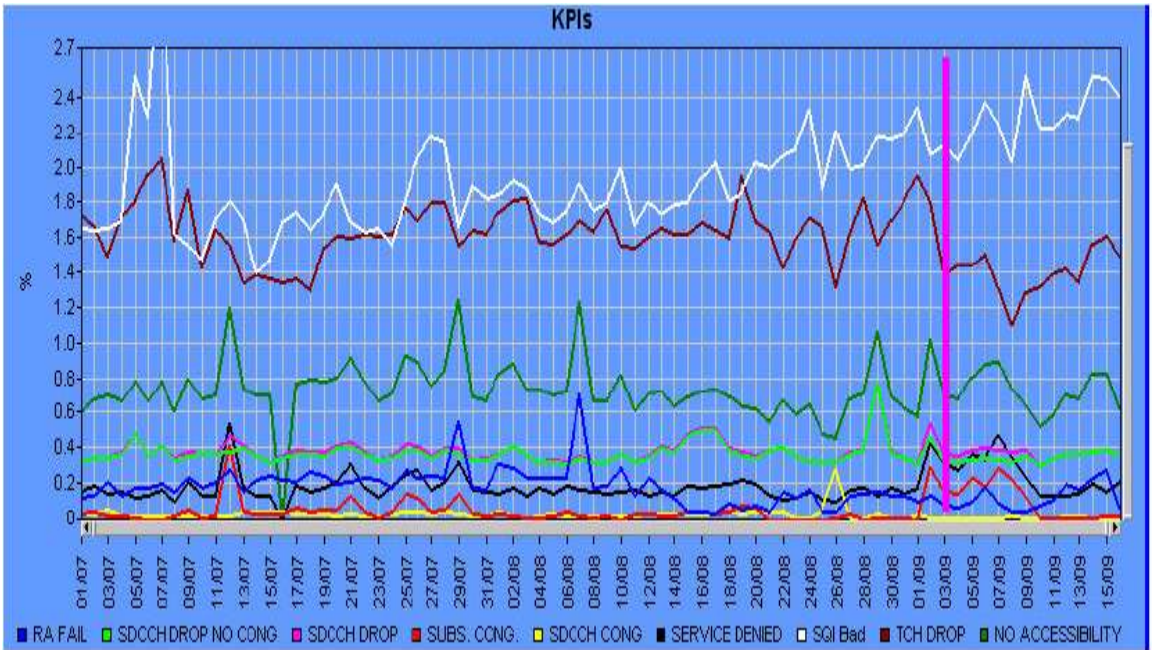

Fig.5 TCH drop rate, SDCCH drop rate and SQI bad for OXBSC1

It can clearly be seen how the TCH drop rate decreases considerably after the change in RLINKUP and RLINKT on Sep 3rd. It changes from mean values of 1.8% to 1.4%. We can not appreciate any change in the SDCCH drop call. The SQI values have increased as well but we can see there was an increase in the SQI values previous to the change on September the 3rd. The same as in PLBSC1 and PLBSC2, we are analysing other causes in the increase of SQI values.

7. Conclusion and Recommendations

The change of radio mobile channel parameters RLINKT and RLINKUP for downlink and uplink showed considerable improvements in terms of decreased TCH and in some cases slight improvements in SDCCH drop rates. On the other hand, it has been experienced an increase in the values of bad SQI but is not easy to breakdown the impact of the RLINK in this increase since we have seen a noticeable increase in the bad SQI values before any changes in the parameter RLINK. Besides some BSCs have suffered an increase in SQI during the last weeks without any changes in RLINK, [1], [7], [12].

We recommend keeping these 3 BSCs with the values of RLINK set to 24 and trying to clear up the causes in the SQI degradation prior to any changes in the other 4 BSCs. In the mean time, it can be very useful to try to set each cell with the most suitable value in RLINK since there must be cells with good improvement in TCH drops and “no” or slight increase in SQI, and there must be cells with a high increase in SQI values without improvement in TCH drop rate.

To conclude, the field trail has shown good results in improving the traffic drop rate which has very good impact on the network performance and consequently an increase in the mobile customer satisfaction and improvement in the mobile operator revenue.

8. Acronyms and Terminology

BSC	base station controller
MS	mobile station
TCH	traffic channel
SQI	speech quality index
RLINKT	radio link time out
RLINKUP	radio link time out uplink
SDCCH	stand alone dedicated control channel
SACCH	slow associated control channel
N_BSTXPWR_N	threshold for the radio link recovery
RADIOLINK_TIMEOUT_BS	threshold for the radio link failure

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