3GPP TSG GERAN #18
Reykjavik, Iceland
2 - 6 February 2004
Source: Nokia

TDoc GP-040409
Agenda Item 7.1.5.12

The effect of SAIC on GPRS performance

1. Introduction

An important part of the present effort to evaluate the impact of SAIC technology on system performance is to study how SAIC affects the performance of GPRS. This contribution presents network level simulation results that show how GPRS throughput is affected by the penetration of SAIC terminals in the network.

2. Simulation assumptions

The simulation scenario was based on Network Configuration 3 (2.4 MHz bandwidth with 12 hopping frequencies). The traffic consisted of 70 % speech and 30 % GPRS. Multislot class 3+1 was used (only downlink was simulated).

In GPRS simulations, LLC segmentation was taken into account and the RLC layer was modeled in quite good detail (RLC segmentation, retransmissions, sliding windows, bitmaps etc.). TBF establishment and release procedures were also modeled (delayed TBF release was used).

Since the GERAN SAIC interference model *for speech* was applied to the link level mapping tables in these simulations, we wanted to use a traffic model that does differ too much from the characteristics of speech. Hence, an FTP/MMS traffic model was used for GPRS (file size was fixed to 120 kBytes). This traffic model produces long-lasting TBFs with only one TBF per session (unless cell reselection occurs).

The speech traffic used DTX and the AMR 5.9 codec. A speech call was regarded as successful when its average downlink frame error rate was 2 % or less. Call dropping was not taken into account, since it was not relevant to this study. Other simulation parameters included the following: A downlink power control algorithm based on RxQual/RxLev was employed for speech [1] whereas no power control was applied to GPRS. Link adaptation with coding schemes CS1 and CS2 was employed for GPRS. A 65-degree antenna pattern was used. Only the hopping layer was simulated.

Simulations were done with two different SAIC penetration rates: 50% and 100% (with 50% SAIC proportion, both speech and GPRS users had 50% probability to have SAIC).

3. Results of the network simulations

The simulation results are shown in the figures below. For speech, the quality indicator was the proportion of bad quality calls; for GPRS it was the average net throughput over the session.

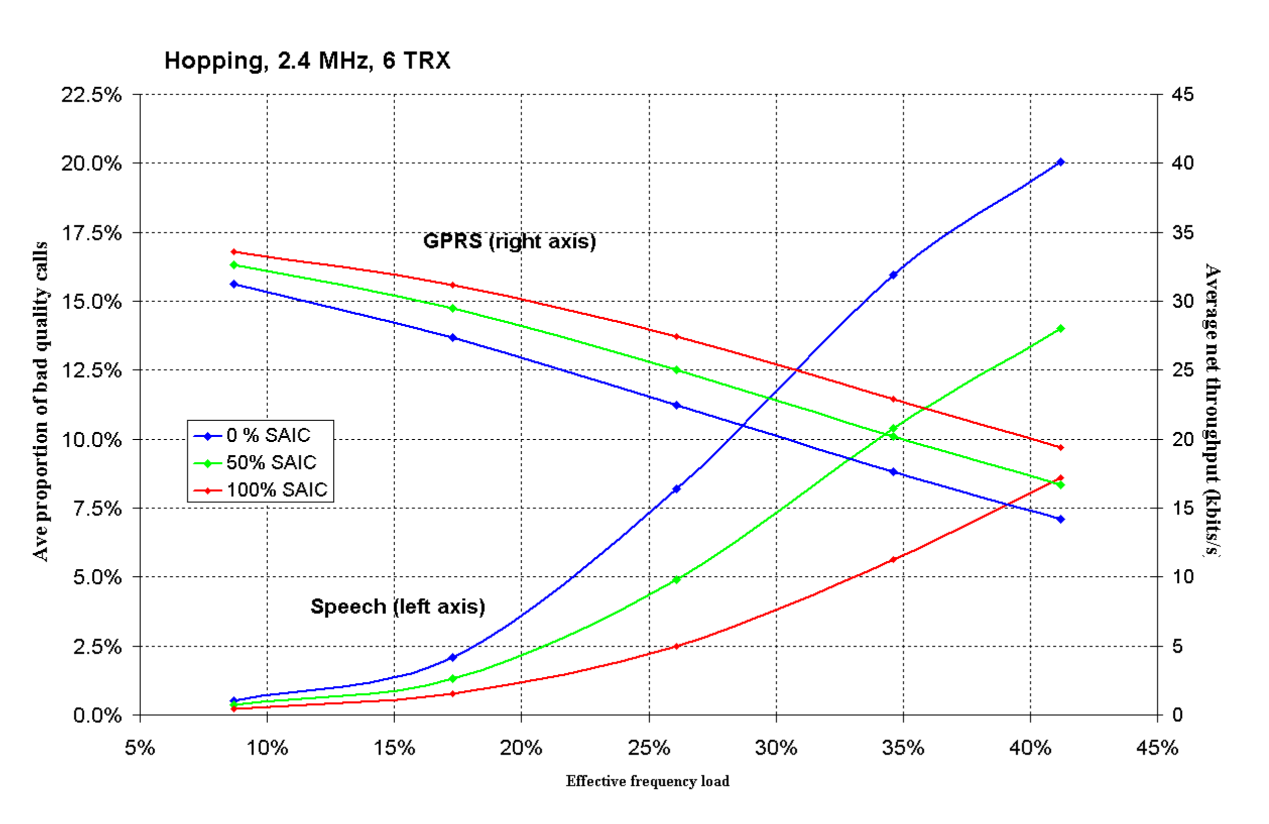

Figure 1. Speech and GPRS quality indicators versus load with three different SAIC proportions.

Figure 1 depicts speech call quality and GPRS throughput as a function of the effective frequency load and the proportion of SAIC terminals in the network. The speech quality is given in terms of the proportion of bad quality calls, averaged over the SAIC and non-SAIC terminals. The GPRS throughput is averaged over the duration of the session (and over SAIC and non-SAIC terminals). It is clearly seen how both the speech and GPRS users benefit from SAIC.

Figure 2 depicts the gain in GPRS throughput as a function of the effective frequency load and the proportion of SAIC terminals in the network. It can be seen how the relative gain increases almost linearly with the increased network load.

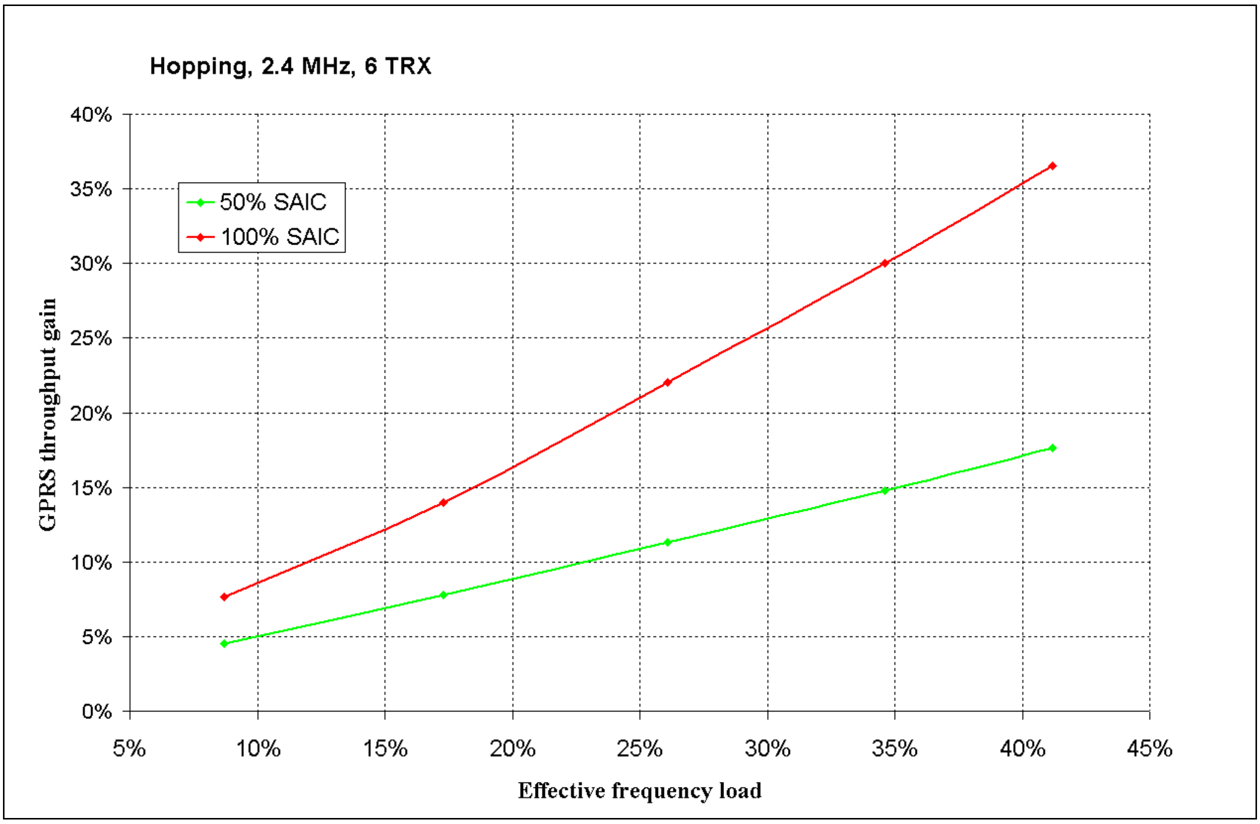

Figure 2. Relative GPRS throughput gain versus load with two different SAIC proportions.

4. Conclusion

This document shows clearly that SAIC does not help only speech, but also GPRS. In a realistic mixed speech/GPRS traffic scenario, the relative throughput gains were up-to 37%, although the absolute gains were only few kbps. Results are summarized in Table 1 below.

SAIC penetration rate	50%	100%
Relative GPRS throughput gain	5% - 17%	7% - 37%
Absolute GPRS throughput gain [kbit/s]	1.4 – 2.5	2.4 – 5.2

Table 1. GPRS throughput gains with SAIC.

The primary reason for GPRS gains is naturally the better receiver performance of SAIC terminals. But as shown in [2], both SAIC and non-SAIC users benefit also from the lower transmission powers of SAIC terminals (less interference for others).

To conclude, SAIC seems to give clear quality benefits for all the users in the network, no matter they use GPRS or speech.

5. References

[1] A proposal for common power control algorithm to be used in SAIC network simulations", sent to 3GPP_TSG_GERAN_WG1 mailing list on 29 April 2003. Source: Nokia.

[2] GP-032648 "The effect of SAIC terminal penetration on non-SAIC terminal performance". 3GPP TSG GERAN #17: Budapest, Hungary, 17-21 Nov. 2003. Source: Nokia.