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Digital cellular telecommunications system (Phase 2+) (GSM); Feasibility study on Single Antenna Interference Cancellation (SAIC) for GSM networks (3GPP TR 45.903 version 14.0.0 Release 14)

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Contents

Foreword

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Introduction

This document studies the feasibility of utilising Single Antenna Interference Cancellation (SAIC) as a means of increasing the downlink spectral efficiency of GSM networks.

SAIC is a generic name for techniques, which attempt to cancel or suppress interference by means of signal processing without the use of multiple antennas. The primary application is the downlink, where terminal space and aesthetics typically preclude the use of multiple antennas.

Clause 1 of this document defines the scope and objectives of this feasibility study. Clause 4 defines the network scenarios that have been defined to evaluate SAIC performance in GSM networks. These scenarios are representative of typical GSM deployments worldwide today. Clause 5 presents the interference statistics associated with the network scenarios defined in Clause 4. These interference statistics are developed via system simulations, and are defined in terms of the distributions of the parameters which are critical to understanding SAIC performance. These critical parameters include;

- The Carrier to Interference plus noise Ratio (CIR)
- The Dominant to rest of Interferer Ratio (DIR)
- The other interferer ratios, which define the relative power of the dominant co-channel interferer to each of the other considered interferers
- The delay between the desired signal and each of the interferers.

It is important to understand the network statistics of these key parameters since most SAIC algorithms can only cancel one interferer, and their effectiveness in doing this is affected by the 'remaining' interference, and delays between the desired signal and the interferers.

In Clause 6, candidate SAIC algorithms are evaluated at the link level based on the interference statistics defined in Clause 5. Both 'long-term average' and per burst results are generated. The long-term average results represent the classical way of looking at link performance via link simulations, defining the Bit Error Rate (BER) and Frame Error Rate (FER) averaged over the entire simulation run as a function of the CIR. This is the type of performance that is typically specified in the GSM standards. However, to develop a system capacity estimate, it is necessary to define the link performance on a per burst basis. To this end, Clause 6 also defines the average BER over the burst as a function of the burst CIR and burst DIR. This burst performance is used to develop a link-to-system level mapping. This

mapping is used in Clause 7 to develop voice capacity and data throughput estimates for both conventional and SAIC receivers. The voice capacity gain and data throughput gain for SAIC is then deduced from these estimates.

Clause 8 describes the field trials that have been conducted using an SAIC prototype Mobile Station (MS). Clause 9 addresses testing considerations for SAIC capable MSs, while Clause 10 defines a couple of signalling options for identifying an MS as being SAIC capable. Finally, Clause 11 provides the relevant conclusions that can be drawn from this feasibility study, the most important of which is the conclusion that SAIC is a viable and feasible technology, which will support significant voice capacity gains for both synchronous and asynchronous networks when applied to GMSK modulation. In addition, modest increases in GPRS data throughput are also supported for the types of data traffic considered. Clause 11 also identifies those clauses of the core and testing specifications that will be impacted by the inclusion of an SAIC capability.

1 Scope / objectives

The objective of this document, as defined in the work item [2], is to determine the potential of SAIC in typical network layouts. This includes study of the following aspects:

a) Determine the feasibility of SAIC for GMSK and 8PSK scenarios under realistic synchronized and non-synchronized network conditions. Using a single Feasibility Study, both GMSK and 8PSK scenarios will be evaluated individually.

b) Realistic interference statistics including CIR (Carrier to Interference plus noise Ratio) and DIR (Dominant-to-rest of Interference Ratio) levels and distributions based on network simulations and measurements, where possible.

c) Robustness against different training sequences.

d) Determine method to detect/indicate SAIC capability.

2 References

The following documents contain provisions, which, through reference in this text, constitute provisions of the present document.

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[1] ETSI TR 101 112 v3.2.0 (1998-04), "Universal Mobile Telecommunications System (UMTS); Selection procedures for the choice of radio transmission technologies of the UMTS".

[2] 3GPP TSG-GERAN TDOC GP-022891: "Work Item Description, Single Antenna Interference Cancellation", Sophia Antipolis, France, 18-22 November 2002.

[3] 3GPP TSG-GERAN SAIC Workshop TDOC GAHS-030009: "Network level simulation scenarios and assumptions for SAIC", Atlanta, USA, 8-9 January 2003.

[4] 3GPP TSG-GERAN SAIC Workshop TDOC GAHS-030005: "Scenarios and Modelling Assumptions for SAIC in GERAN", Atlanta, USA, 8-9 January 2003.

[5] 3GPP TSG-GERAN SAIC Workshop TDOC GAHS-030002: "Single antenna interference cancellation - evaluation principles and scenarios", Atlanta, USA, 8-9 January 2003.

[6] 3GPP TSG-GERAN SAIC Workshop TDOC GAHS-030020: "Interference Characterization for SAIC Link Level Evaluation", Seattle, USA, 4-5 March 2003.

[7] 3GPP TSG-GERAN SAIC Workshop TDOC GAHS-030022: "Link Level model for SAIC", Seattle, USA, 4-5 March 2003.

Additional references are noted in the individual clauses of this document

3 Abbreviations

ACI	Adjacent Channel Interference
AMR	Adaptive Multi Rate
BEP	Bit Error Probability
BER	Bit Error Rate