

WP3 (Nilsbanten, Teich, Klingler, Melis)

CEPT CCH/GSM

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### Preliminary view concerning the impact of hand-held stations

#### 1. Definition

A hand-held station is defined as an easily carried one piece unit which does not restrict the mobility of the user. Such a unit contains its own power source, acoustic transducers and/or appropriate man-machine interfaces, visual display, operating controls and antenna.

#### 2. Introduction

Hand held stations used in a radiocommunications system designed for vehicle mounted stations are likely to have an impact on the system parameters and capacity. For this reason a specific requirement has been mentioned in the GSM working plan approved by CCH (Doc.2/82):

"The system shall be capable of providing for hand held stations, but the consequential impact on the system shall be assessed".

In this document those parameters are identified which may be different for handheld stations as compared to vehicle mounted stations.

There are various ways to provide for handheld stations in a

system. A maximum scenario could be a system entirely designed for hand-held stations (which does not exclude the use of vehicle mounted stations).

A minimum scenario could be a system entirely designed for vehicle mounted stations (which does not exclude the use of hand-held stations within a limited coverage area).

The actual scenario to be used will depend on factors like traffic density and economic factors.

3. Main differences between hand held and vehicle mounted mobile stations

The following parameters are likely to be different from those of vehicle mounted or transportable stations and may have an impact on the system capacity:

a) Size and Weight

The hand held unit per definition needs to be of small physical dimensions. It should be unobtrusive, easily carried and as light as possible.

b) Limited power

As compared to mobile vehicular mounted equipment, a hand-held unit can generate only a restricted amount of RF power which may be in the order of 10dB lower as compared to the vehicle mounted unit. This will lead to reciprocity problems with speech transmission and signalling, particularly in the direction from the mobile to the base station.

c) Limited battery capacity

Hand-held stations have only limited battery capacity. Special precautions need to be considered in the design of these stations in order to prevent exhaustion of batteries without any warning. It is suggested that the battery should keep the

hand-portable station in operational condition for at least 8 hours (5% transmit 95% standby) before recharging becomes necessary.

d) Elevation

By virtue of the fact that a hand-held station is extremely portable, one may use it at elevated sites (e.g. on top of high buildings). This can cause undue co-channel interference with distant cells. Some form of an automatic power control and/or distance measurement may be required to overcome these problems.

e) Losses on the radio path

- Penetration Loss

This loss occurs when hand-held stations are operated within buildings. The mean penetration loss has been found normally to be around 10-12dB and under extreme conditions up to 30dB at 900MHz.

- Losses due to non-ideal operating conditions

A hand held station may be fitted to the body of the user. Under this condition, it may be subjected to proximity effects (losses) due to close contact of the antenna with the human body. The loss resulting from this can be as much as 10dB seen from the backward position of the user.

- The antenna orientation may change from time to time, depending upon the users movement. This may introduce additional losses to the transmitted and received signals.

f) Electromagnetic compatibility

Since a hand-held station may be operated close to sensitive electronic equipment (e.g. television sets, stereo equipment) EMC problems may occur.

g) Radiation hazard

RF power radiated close to the users body (especially the head) can be dangerous. Most articles about RF radiation hazards found in the literature deal with thermal heating effects of body tissue. Non thermal effects on the human body however as well as the effects of discontinuous transmission (e.g. TDMA) require further investigation.

i) Traffic density

The traffic density caused by hand-held stations can be considerably higher as compared to vehicle mounted stations under certain circumstances (e.g. exhibitions).

j) Fraudulent use

Hand-held stations are more prone to be lost or stolen than vehicle mounted stations and may require special measures to prevent unauthorized use (e.g. call barring or tracing facilities to locate such units).

k) Quasi-stationary condition

Hand-held stations will in general be slow moving as compared to vehicle mounted stations. This fact can have an influence on the handover procedure to be used and also causes more extreme shadowing conditions. Some additional signal processing may be required to overcome these problems.

4. Possible scenarios to provide for hand-held stations in the systema) Urban coverage

Full coverage for hand-held stations by the use of small cells (< 2km radius) which are primarily required to cater for the high traffic load.

b) Suburban coverage

The coverage may not be contiguous for hand-held stations. Special measures such as diversity reception and local relay stations could be used to improve the coverage for hand-held stations.

Hand-over may not be possible in non-contiguous cells.

c) Rural coverage

Vehicle mounted stations operating at full power are usually required in large cells in rural areas. Hand-held stations can only be used within a limited area around base stations. A vehicle mounted station could be used as a relay to the hand-held station.

Relay operation could function in the handportable to base station direction via the vehicle mounted station but receive transmissions directly from the base station. This could increase the complexity of the overall system and require additional frequencies. An alternative solution could be the use of cordless telephone in conjunction with the vehicle mounted unit.

5. Technological Considerations

As hand held stations will have a significant impact on the GSM system, due to user requirements and the business interest of large system operators, it is essential that European industry should be fully prepared to take up this technological challenge well in advance. In particular there are two areas which manufacturers will need to address.

These are:

a) delay spread/time dispersion due to propagation effects

b) quasi stationary conditions

In dealing with these problems industry will need to invest in and develop areas of large scale integration of signal processing hardware, especially for handheld stations. This may well need to be accomplished within the GSM time frame.

As an interim measure these factors could be alleviated by operating within a range from the base station where the above effects are reduced (equal to cells of  $\leq 2\text{km}$  radius).

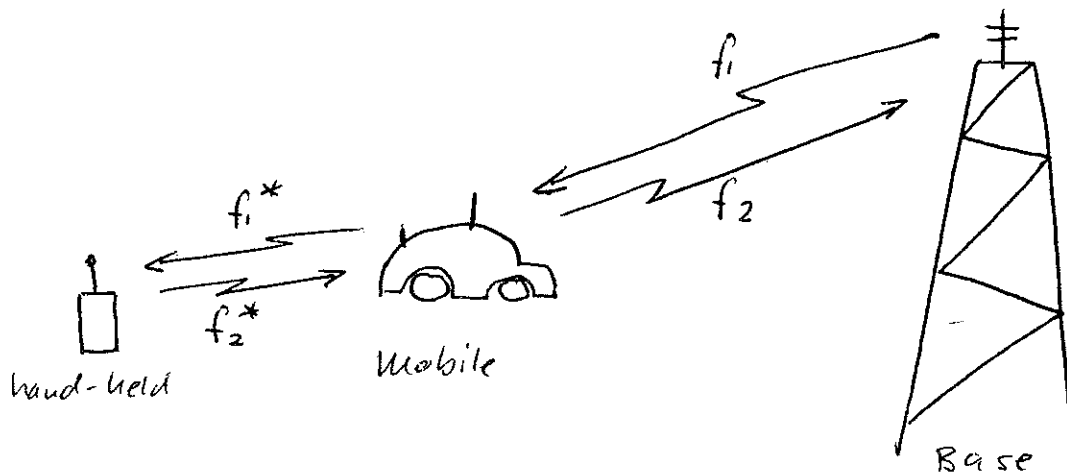
There are also some aspects of the technical requirements of hand held stations which will have an impact on the design of the GSM system and thus need to be considered at the specification stage.

For example the system may need to involve some battery current saving techniques such as:

- a) discontinuous transmission for the signalling system
- b) pager type of preamble in the signalling.

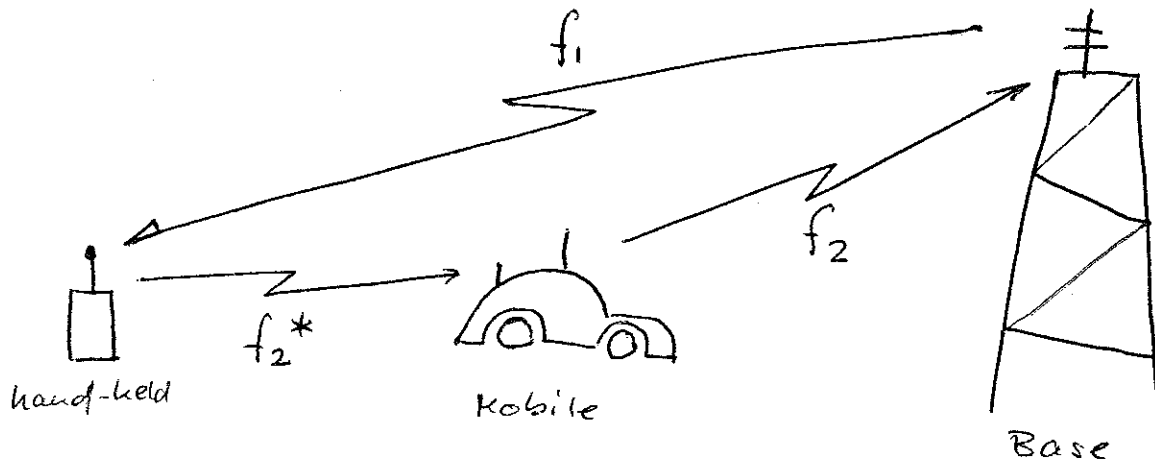
Rural coverage

a) Vehicle mounted station as a two-way relay



$f_1^*$ ,  $f_2^*$  are two frequencies for low power usage (typ 10..100mW)

b) Vehicle mounted station as a one-way relay



$f_2^*$  : additional frequency for low power usage (typ. 10..100mW)