Performance of Small Mobile Terminal Antennas

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Overview of presentation

1. Introduction
2. Basic Mobile Antennas
3. Communication performance of Mobile Terminals
4. Multi Antennas on Mobile Terminals

Directional or omni-directional radiation

But head makes directional radiation

First measurements
@ 900 MHz
What is a good antenna for mobile terminal?

- A Good Communication Performing Antenna is Defined by: Transmitting and Receiving Relative high amount of power to/from the other end.
- Measured in realistic environment.
- Measured in typical use.
- Measurements of Mean Effective Gain (MEG). [Andersen 1977]

MEG measurements for phone with 3 antennas

- Including 200 users.
- 1800 MHz
- outdoor-to-indoor environment in a city.
- 4 stories building, measurements on each floor from basement to third floor.
- Basestation located outdoor at rooftop level
- Basestation antenna vertical polarised and some 60 deg. beamwidth
- 3 antennas, Dipole, Patch & Helix.

Basestation site in Aalborg

Received power, 50 users, 3 antennas

Handset and user

Free-space Measurements

Each measurement repeated 5 times, the min. and max. values are plotted as error bars
Why the large variation in the MEG?

- Height of person/phone? No.
- Warring glasses? No.
- Left or right hand side of the head? Some.
- ?

Bodyloss is caused by
1. Additional Antenna mis-match due to the Body (lower total antenna efficiency).
2. Absorption in the Body (lower total antenna efficiency).
3. Radiation Direction Changed by the Body (MEG change).
4. Polarisation Changed By the Body (MEG change).

Measurement setup made in anechoic Room to investigate the prime source of the Bodyloss/MEG variations.

Radiation measurements in anechoic room

Setup in control room
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Antenna mis-match

Influence of the hand on the efficiency

Efficiency vs. position of hand
Mock-up phone vs. Real phones

- How about real phones – shapes, sizes and antennas?
- What about the connected measuring cable
- Real call may change holding position

Real phones in a real network

- Using the GSM network itself as measuring system for MEG.
- Using 4 commercial mobile phones.
- Including 20 test users.
- Measure on two levels - basement and second floor.
- Outdoor base station, small cell.

GSM network setup

One user, during the in-net measurements.

Measured MEG (received power)

Bodyloss for left/right hand side

Bodyloss is defined as the difference between the power received without the user present and with the user present.
Summary on communication performance

- Very large variation among users.
- Absorption in the hand the largest problem.
- Large variation among phones (antennas).
- Good performance can be obtained if the antenna design gets special attention.