TSG-RAN Working Group 1(Radio) meeting #3 ***TSGR1#3(99)237***
NYNÄSHAMN, Sweden 22-26, March 1999

**Agenda Item:**

**Source:** **Ad Hoc 12**

**Title:** **Report from Ad Hoc 12: Cell search**

**Document for:**

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## 1. Issues to be discussed in Ad Hoc 12

1) CPM proposed by TTA
2) A new cyclic hierarchical sequences for Secondary SCH proposed by Nortel
3) A new hierarchical correlation sequence for Primary SCH proposed by Siemens

1) is a proposal to alter 1st and 2nd stage of cell search scheme. 2) is a proposal to alter codes used for the Secondary SCH. 3) is a proposal to alter codes used for Primary SCH.
2) cannot apply 1). 3) can apply both of 1) and 2).

## 2. Discussion Status

CPM and Cyclic hierarchical sequences (Nortel proposal) have been discussed in parallel. A new hierarchical correlation sequence was proposed lately and has not been discussed on e-mail.

### 2.1 CPM

#### 2.1.1 E-mail discussion

From complexity, required memory size and performance point of view, there were many discussions to compare CPM with the current cell search scheme on e-mail.
Regarding performance, Shinsegi, Ericsson, and TI showed their simulation results of both CPM and the current scheme. Ericsson and TI showed that current scheme is superior to CPM. Shinsegi showed that CPM is superior to the current scheme.
Complexity and required memory size are depends on optimal period of each stage. Optimal period of each stage is not clear, now. Therefore, comparison of complexity and required memory size has not been completed.
In order to proceed discussion in this Ad Hoc, common simulation parameter set and common simulation conditions/scenarios were determined toward same simulation results among Shinsegi, Ericsson, and TI (see annex A of this report). Considering remaining time before WG1#3, link level simulation was adopted for our study. Shinsegi requested to do system level simulation after the link level simulations.
Mr. Furuya pointed out that optimization of power allocation to P-SCH and S-SCH should be considered for the current scheme. This point will be reflected to the next stage of simulation investigation.

#### 2.1.2 Simulation results

In the physical Ad Hoc, Ericsson, TI, and Shinsegi reported their simulation results. Simulation results were different among the companies since they used different simulation models, and the simulation parameters were not same completely among companies. And Shinsegi proposed revised procedure of second and third stages and did simulations based on the new procedure. Ericsson and TI did not use the new procedure. Followings are overview of the simulation results.

Ericsson

- Two schemes have similar performance for hand over case at SCH loading factor of 10 % and velocity of 5 and 60 km.

TI

- Optimal periods of each stage for two schemes were shown.
- Two schemes have similar performance for initial acquisition case.
- Current scheme has significantly better performance over CPM for hand over case at appropriate reset time.
- Optimal PSCH and SSCH power ratio was shown for current scheme.
- It was pointed out that CPM need complex control rather than current scheme. But this was not clear for other colleagues. Further explanation is needed.
- It was pointed out that the advantage of the time multiplexed SCH are lost for CPM.

Shinsegi

- At high SNR, CPM has similar performance or better performance than current scheme.
- At low SNR, CPM has significantly better performance.

**2.1.3 Future action**

In order to get reliable simulation results among members, common simulation scenario, models and parameters are determined toward consensus before the next WG1 meeting.
Simulation method: Considering remaining time before the next WG1 meeting, link level simulation is selected.
Simulation model: Modified model of Ericsson and TI is selected. Shinsegi insisted the nessesity of additional BS in the model. However, other member could not understand the necessity at the moment. If other member can understand it in this week, the simulation model can be change.
Simulation parameter: Based on simulation results of TI and Shinsegi, simulation parameters were determined (see annex B of this report).

## 2.2 A new cyclic hierarchical sequences for Secondary SCH

Notel pointed out problem of cross correlation between PSC and SSC in current SCH, and proposed new code for Secondary SCH.
TI mentioned the problem pointed out by Nortel is not recognized in their study.
Future plan

Nortel, TI, and Shinsegi will do simulation in order to investigate performance using the parameters and models similar to that of CPM investigation (see annex B). Furthermore, required memory size and complexity will also discussed on e-mail. Simulation results will be sent out from each company in 2 weeks, and will be discuss on e-mail.

**3. A new hierarchical correlation sequence for Primary SCH**

Siemens proposed a new Primary Synchronization code which can lower degradation due to frequency error.

This proposal will discuss on e-mail.

# Annex A

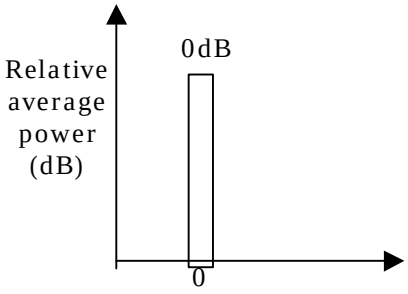
Table 1 Simulation parameters before the physical Ad Hoc.

| Parameter | | 3GPP | CPM |
|---|---|---|---|
| Slots per 10 msec frame | | 16 | |
| Minislots per slot | | - | 20 |
| Alphabet size of R-S code | | 17 | |
| Hopping code | | Refer to [1,2] | Refer to [3,4] |
| Number of scrambling codes | | 512 | |
| Number of code groups | | 32 | |
| Chip rate (Mcps) | | 4.096 (for simulation) / 4.096/8.192/16.384 (for complexity comparison) | |
| Number of samples per chip | | 1, 2 | |
| Data rate | | 64 ks/sec | |
| Data modulation | | QPSK | |
| Downlink PN spreading | | Complex spreading with shortened Gold sequence | |
| Number of users per cell | | 20 | |
| Number of cells | | 7 | |
| Channel model | | 1-path, 2-paths (optionally 4-paths)* | |
| Location of mobile | Initial cell search | Uniform distribution in the cell | |
| | Target cell search | Cell edge | |
| Log-normal shadowing standard deviation | | 10 dB | |
| Path loss decay factor | | 3.8 | |
| Mobile speed | | 3, 60 km/h | |
| Thermal noise | | 0 | |
| SCH power ratio ($\rho_{SCH}$) | | 5, 10, 15% | |
| 1st SCH code | | 16x16 hierarchical code | |
| 2nd SCH code | | Hadamard code multiplied by 1st code | - |
| Cell search parameters (e.g. frame lengths of 3 stages) | | Optimized parameters of proponents | Optimized parameters of proponent |
| Probability of error for 3rd stage | | $10^{-4}$ | |
| L | | - | 4 |
| Parameter for coherent detection | | {1} | |
| Period of each stage | | Optimized in each scheme | |

# Annex A

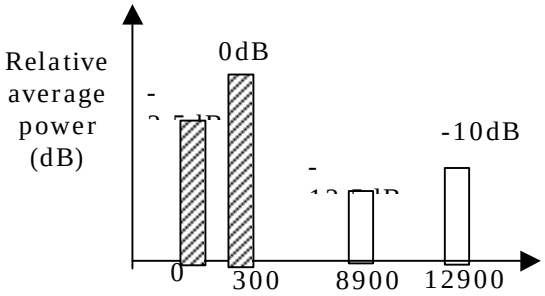
Channel model

< Single path fading >




Relative time delay (ns)

< Multi-path fading >




Relative time delay (ns)

- Only when the algorithm c atches the first or second path signal, the cell searc h is declared to be succes sful. When the algorithm c atches the third or fourth path signal, the cell searc h is declared to fail.
- If 2-path model is adopte d, the first two path signal s (shaded) are used.

# Annex B

Table 2 Simulation parameters determined in the Physical Ad Hoc

| Parameter | 3GPP | CPM |
|---|---|---|
| Channel model | Vehicular B and 1 path | |
| Velosity | 5, 60, and 250 km/h | |
| SCH power | Total SCH power is 5 and 10 % of BS power. Power allocation between PSCH and SSCH is 0.6 and 0.4, respectively. | 5 and 10 % of BS power |
| PCCPCH power | 5 and 10 % of BS power corresponding to Total SCH power | |
| PCCPCH transmission | Discontinuous | Continuous |
| Side information | 10 BSs in the candidate list, whose groues are different and known. Path information of primary BS is known. | |
| Primary Cell/Target cell power ($P_A/P_B$) | 3 and 6 dB | |
| Primary cell power/$I_{oc}$ | Variable, -8 to –2 dB | |
| Stage 1 for initial acquisition | 5 ms | 10 ms |
| Stage 2 for initial acquisition | 10 ms | 10+x ms |
| Stage 3 for initial acquisition | 5 ms | 10 ms |
| Reset time for initial acquisition | 20 ms | - |
| Stage 1 for Hand over | 10 ms | 10 ms |
| Stage 2 for Hand over | 20 ms | 10+x ms |
| Stage 3 for Hand over | 10 ms | 10 ms |
| Reset time for Hand over | 200 ms | - |
| Sampling rate | 1, 2/chip | |

Note
Periods of each stage stated above are mandatory for the simulations. Other values can be selected optionally.
All parameters other than above are selected based on table 1.