**TSG RAN WG 1#9** **TSGR1#9(99)j47**
**Dresden, Germany**
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**Agenda item**: **AH14**
**Source:** **Golden Bridge Technology**
**Title:** **Second level Collision Resolution for CPCH**
**Document for:** **Discussion and Approval**

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## Background

The throughout efficiency of the basic CPCH access method, i.e, DSMA-CD which involves monitoring is roughly 80% at nD. Where D is the average Packet transmission time and n is a function of simulation environment. Recently other companies have proposed the use of Channel Assignment method to improve performance. However, their proposals have not lead to any performance improvements. There is no conclusive evidence from the proponents that show performance gains with the addition of CA to the basic monitoring method.

## Problem

While the amount of undetected collision is .5-1.5% in all of the these methods, we only achieve a 80% throughput [knee of the curve]. It is quite interesting and exciting to find ways of improving this further. However, we think the currently proposed methods do not bring much performance gains to the table. Since the proposed methods must operate with the Status Monitoring adjunct and fall in the same category as Channel monitoring method with first level collision Resolution. The power and strength of the current access method is all in the Collision Resolution capability. The only way to strengthen the method further is introducing second level collision resolution [not detection]. The real magic in the CPCH access method as compared with RACH all lied in the addition of Collision Resolution and Closed Loop Power Control. How can we extend this further and provide more gain? The key reason why the throughput does not exceed the 80% is due to gaps in channel utilization due to non-arrivals. In other words if we looked at any tie-window [ex: 50 ms], depending on the offered load, there are certain UE arrival probabilities [2] such as:

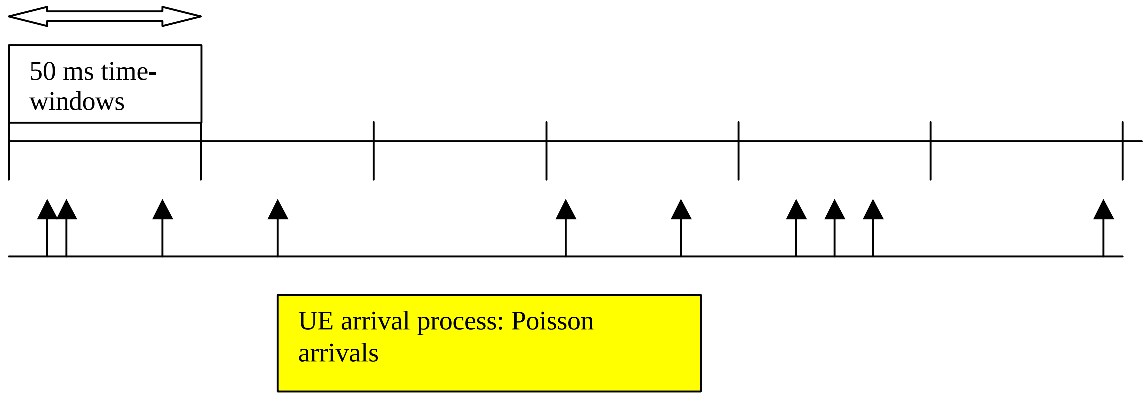
| | ρ= 1 | ρ= 2 | ρ= 3 | ρ= 4 | ρ= 5 |
|---|---|---|---|---|---|
| P(0,T) | .32 | .1 | .034 | .011 | .004 |
| P(1,T) | .37 | .27 | .12 | .05 | .02 |
| P(2,T) | .2 | .24 | .195 | .113 | .06 |
| P(3,T) | .07 | .2 | .22 | .169 | .11 |
| P(4,T) | .02 | .11 | .185 | .19 | .15 |
| P(5,T) | .01 | .05 | .13 | .17 | .17 |

This table shows that there is roughly 30% chance that two or mobiles arrive in a 50 ms time-window and at the same time there is a 32% chance that no UE arrive in the same time window at the offered load of

$\rho=1$. The Poisson arrival assumption is invoked in [2]. However, the motivation in this paper is to show the potential gain.  Therefore:

P { 2 or more arrivals in a 50 ms time-window AND 0 arrival in the next time-window} = .32 x .3 = .1

This means that under these circumstances 10% of the time there are 50- ms-long gaps in this exercise. The figure in the next page illustrates the problem further.




## Proposal

GBT proposes a second level collision resolution which could provide some real advantages in the throughput. We propose to allocate two CPCH resources in the collision detection phase by partitioning the positive and negative CD signatures. Some of the earlier work from other companies also show possible gains [1]. The main reason for the potential gain is that the potential gaps in CPCH usage are filled by allocating the available resources to the contending UEs which were defeated in the collision resolution phase.

In this proposed method, each AP signature is mapped to two CPCH resources. When two UEs pick the same AP signature and arrive at the Collision Resolution phase, they can separately be allocated to the CPCH resources that were originally mapped to that AP signature. Currently the defeated UE backs off and attempts to capture the CPCH resource again.

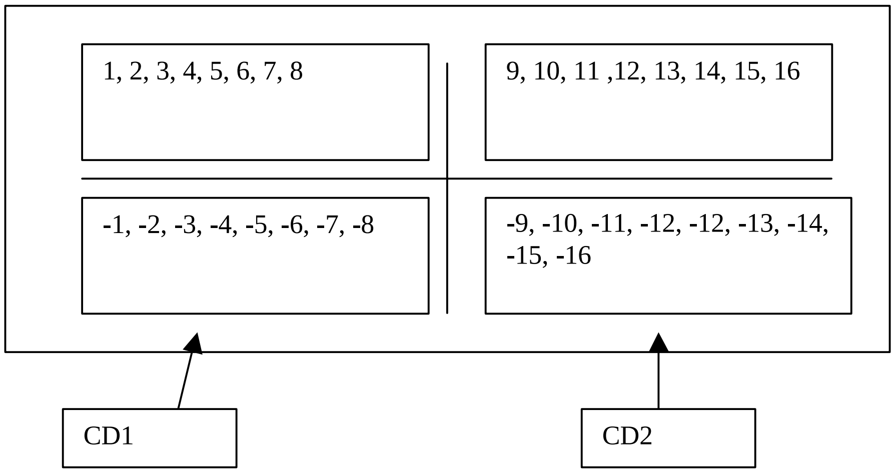
The proposed method has five advantages:

1. Less preamble generation and less excessive unnecessary interference.
2. Less preamble generation and therefore less UE power consumption.
3. Better CPCH channel utilization and less gaps.
4. Better CPCH delay performance due to immediate access to both contending UEs
5. Reduction of the number of required signatures to half (16 to 8).

Currently, when the UEs arrive at the collision resolution phase there is no method of allocating both UEs a separate CPCH resource since the UEs have no way of determining which resource they are assigned. So, this constitutes an ambiguity in the collision resolution phase if the base node was to assign two CPCH resources to both contending UEs at the same time. The proposal in [1] attempts to achieve the objective stated in this paper, however, it does not propose any method to resolve the ambiguity problem in the collision resolution phase.

## How do we remove the ambiguity in the collision resolution phase?

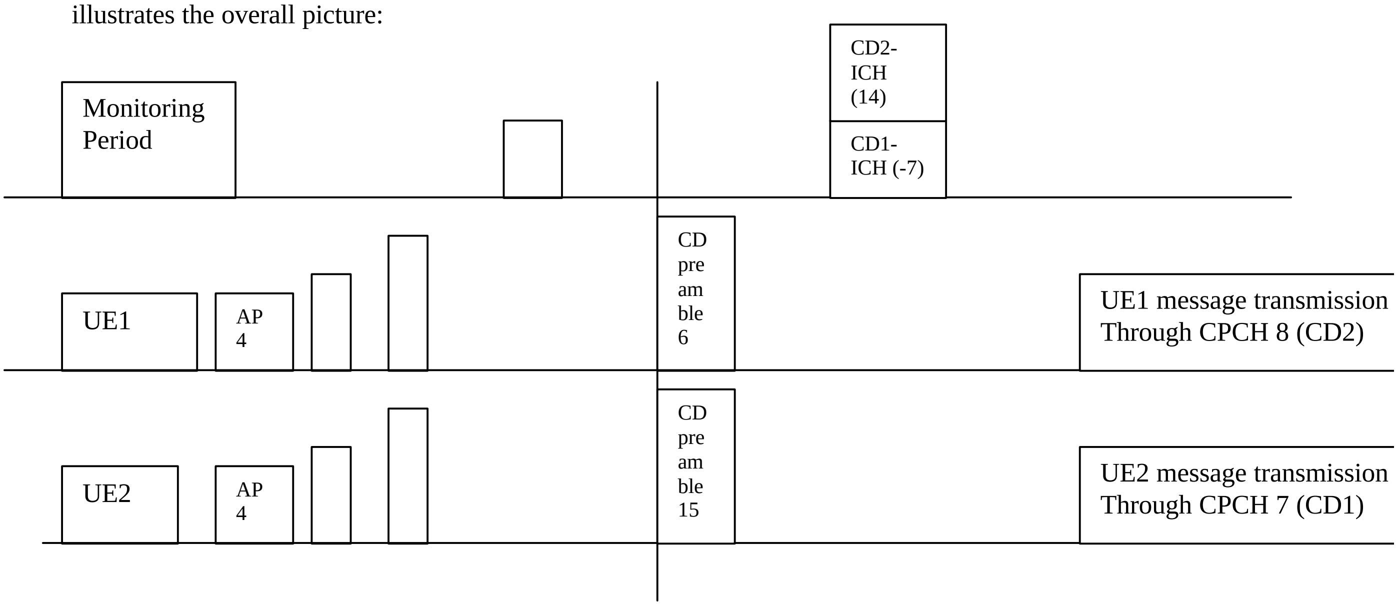
By using the method proposed in [3], we can subdivide the 32 signatures for the CD-ICH into two groups: 1) CD1 associated with a set of CPCH channels and 2) CD2 associated with a different set of CPCH channels. There are 16 positive and 16 negative signatures for CD-ICH. The first eight positive and the first eight negative signatures constitute the CD1 set and the second eight positive and eight negative signatures constitute the CD2 set.




| AP preamble | CPCH resource Assignment | |
|---|---|---|
| AP=1 | CPCH1 | CD1 |
| | CPCH2 | CD2 |
| AP=2 | CPCH3 | CD1 |
| | CPCH4 | CD1 |
| AP=3 | CPCH5 | CD1 |
| | CPCH6 | CD2 |
| 4 | CPCH7 | CD1 |
| | CPCH8 | CD2 |
| 5 | CPCH9 | CD1 |
| | CPCH10 | CD2 |
| 6 | CPCH11 | CD1 |
| | CPCH12 | CD2 |
| 7 | CPCH13 | CD1 |
| | CPCH14 | CD2 |
| 8 | CPCH15 | CD1 |
| | CPCH16 | CD2 |

| CD preamble signatures | CD1-ICH responses signatures | CD2-ICH responses signatures |
|---|---|---|
| 1 | 1 | 9 |
| 2 | 2 | 10 |
| 3 | 3 | 11 |
| 4 | 4 | 12 |
| 5 | 5 | 13 |
| **6** | **6** | **14** |
| 7 | 7 | 15 |
| 8 | 8 | 16 |
| 9 | -1 | -9 |
| 10 | -2 | -10 |
| 11 | -3 | -11 |
| 12 | -4 | -12 |
| 13 | -5 | -13 |
| 14 | -6 | -14 |
| **15** | **-7** | **-15** |
| 16 | -8 | -16 |

So based on these mappings, the UEs determine which CPCH they have been assigned to. The following illustrates the overall picture:



As can be seen in the example shown above, it is possible to resolve any ambiguity in the collision resolution phase and actually allocate resources to the contending mobiles if both resources are avaible. The change proposed here is not drastic and an alternative to the existing CPCH access method. It is an enhancement over the existing CPCH method.

[1] InterDigital, Tdoc 816, "CPCH Channel Allocation".
[2] GBT, Tdoc 226, "Throughput delay analysis of DSMA: Low Collision Feedback Delay for CPCH".
[3] Philips, Tdoce77, "proposal for code assignment for CPCH".