TSG-RAN Working Group1 meeting #12 TSGR1#11(00)0457

Seoul, Korea., April 10 ~ April 13, 2000

Agenda Item	**:**	**AH04 + AH08**
Source	**:**	**Mitsubishi Electric(MCRD)**
Title	**:**	**TrCH Eb/I balancing by power offset in DL, TrCH on different beams**
Document for	**:**	**Discussion and Decision**

Introduction

In this paper we present methods allowing a better use of radio resource transparently for the UE. The proposal in this paper is that implementations of the UE making the assumption that all the TrCH have the same power should be prevented by the specs from release 99 so that the schemes presented in this paper can be introduced later.

The method presented in this paper are based on TrCH-wise power offsets, and they have two applications :

- the first application is to reduce the code shortage
- the second application would be to allow beamforming on the FACH in a FACH+PCH S-CCPCH

TrCH power offsets, and code shortage

Why rate matching can increase the code shortage problem

Let us assume that we have 2 TrCH 1 and 2, both have the same bit rate D after channel coding, both can be punctured down to 80%, RM_1 = 15, and RM_2 = 20. So when you puncture to the minimum the CCTrCH bit rate you can obtain is :

$$0.8 \cdot D + \frac{20}{15} \cdot 0.8 \cdot D$$

The $\frac{20}{15}$ factor comes from this that you must ensure Eb/I balancing by rate matching.

If now you can balance the TrCH by power offsets, then both TrCH can be punctured to the maximum, the minimum the CCTrCH bit rate you can obtain is :

$$0.8 \cdot D + 0.8 \cdot D$$

Now consider the maximum bit rate you can achieve at some SF, and assume that $0.8 \cdot D + 0.8 \cdot D$ is below this limit, while $0.8 \cdot D + \frac{20}{15} \cdot 0.8 \cdot D$ is above this limit and needs an SF/2 code.

In such a situation, making the Eb/I balancing not only by rate matching, but also with the help of power offsets can bring benefits in terms of code shortage.

When you are using power offsets between different TrCH, you can have $RM_1 = RM_2$ because the balancing can be done by the sole help of power offsets. So both TrCH can be punctured down to the maximum puncturing rate.

Application to compressed mode

Making additional room for more puncturing

In case of compressed mode by puncturing we could have different rate matching attributes RM_i for the normal mode, and rate matching attributes RM_i^{cm} for the compressed mode. The rate matching attributes RM_i would be such that the Eb/I balancing is done only by rate matching, whereas, the rate matching attributes RM_i^{cm} for compressed mode would take into account the participation to the Eb/I balancing provided by the power offset. In this way, more room for additional puncturing could be made.

Maintaining the balance when different TTI durations are used.

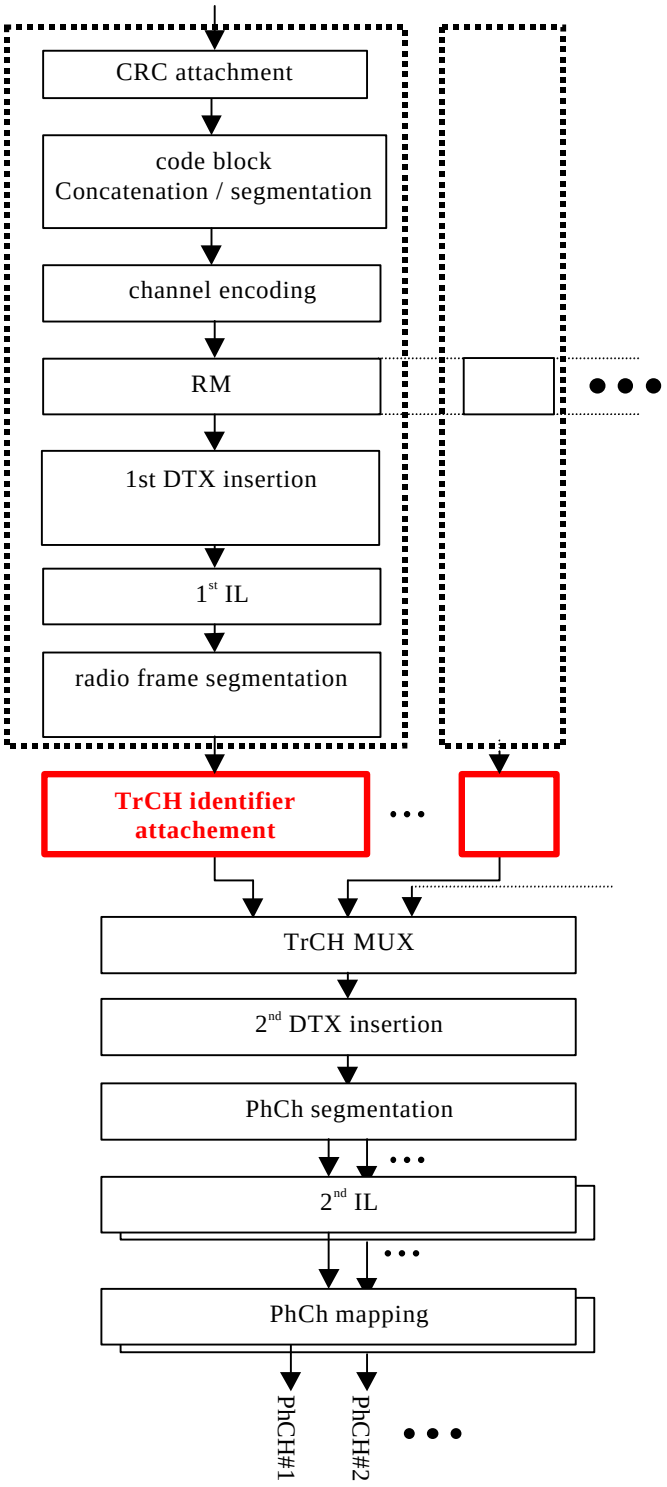
It was commented several times that with some methods already proposed for the CM by puncturing, in the case when different TrCH TTI duration exist, then the TrCH Eb/I balancing is not ensured during the whole duration of the gap.

The PO offset Eb/I balancing can be used in to maintain the balancing in such a situation.

TrCH-wise power offsets.

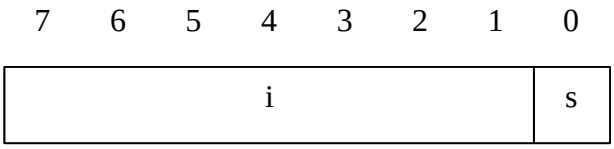
Here we explain what kind of impact you would have on the coding chain.

The idea is to attach to each bit {0,1,δ} an TrCH identifier as on the figure below :



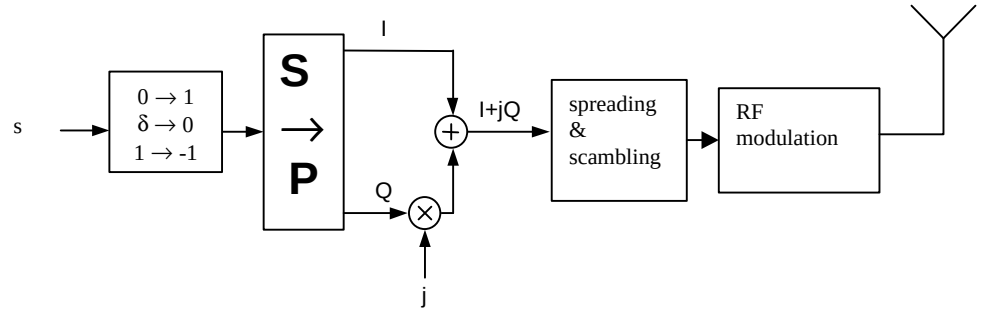
So each symbol s in {0,1,δ} is replaced by a 2-tuple (s,*i*) where s is the symbol and *i* the TrCH id. *i* is from 1 to *I* for TrCH bits {0,1} and *i* takes the special value 0 for DTX indicators.

This can be coded in an octet as follows for instance:

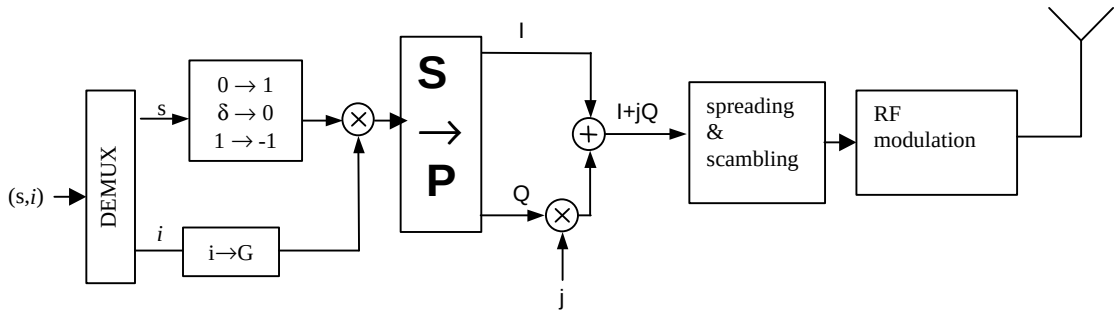


When this is a DTX symbol, the octet is zero, that is to say all the bits are zero. When this is a bit s in {0,1}, the party bit tells the value of s, whereas the bits from weigh 1 up to 7 tells the value of *i* in {1, 2, …, *I* }

The current modulation is done as below



With the power offset Eb/I balancing we would have the following modulation :



TrCH-wise beam forming

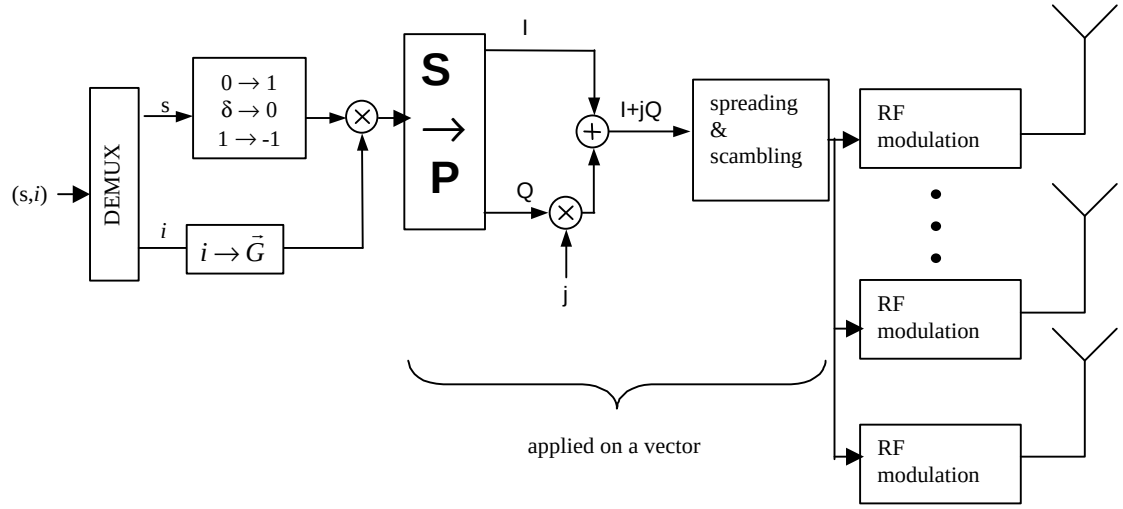
Generally speaking FACH can be beam formed, while PCH cannot be beam formed. So, with the current state of the specs when FACH and PCH are joined on the same FACH+PCH S-CCPCH, this prevents the FACH to be beam formed, especially as it is possible to have simultaneously, on the same radio frame PCH and FACH data.

On the figure below we show we show that it is possible to have separate beam forming on different TrCH. Each bit +1, 0 (DTX) or –1 is multiplied by a vector $\vec{G} = G \cdot \vec{\Phi}$. This vector is the product of a gain G proper to the TrCH, and of a normalised vector $\vec{\Phi}$ also proper to the TrCH and giving the beam direction and aperture.

$\vec{\Phi}$ is a vector in a complex space vector of finite dimension. This vector defines the relative phase on each elementary antenna in an antenna array, and so it defines a

beam as formed be the antenna array. This beam is characterised by a power density function that can be deduced from $\vec{\Phi}$. The power density function gives the power per elementary solid angle in each possible direction of the 3 dimensional usual real space where the antenna is placed. $\vec{\Phi}$ is normalised is in this that the corresponding power density, , is equal to a reference constant power density in the direction of maximal power density.

So the spreading and scrambling are carried out on a complex vector rather than on a simple complex number, then the complex vector is converted to complex RF signals respective to each elementary antenna.



The intent is that the UE can use the same channel estimates for the PCH and for the FACH, so that it is completely transparent for the UE. This possibility depends on the beam shape and on the network beam-forming antenna construction.

Proposal and Conclusion

In this paper we have presented a method that allows to balance TrCHs in the DL by power offsets. Also we have shown that it is possible to have different TrCH on respective beams. It seems that such schemes could provide some benefit in the future. These schemes impact mainly the network complexity, and seems to have no impact on the UE complexity.

So we propose that, from release 99 sufficient hooks are put in the specification so that the introduction of such schemes is possible later. In particular, we would like mandated that the UE shall make no such assumption as that the TrCH of a same CCTrCH have all the same power.

This way, the scheme can still be introduced later for release 99 UEes.