RAN WG1 meeting #6 **TSGR1#5(99) 883**

Place	**:**	**Korpilampi in Finland**
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Title	**:**	**Parameters for rate matching negotiation**
Source	**:**	**Mitsubishi Electric (MCRD)**
Paper for	**:**	**Discussion**

1 Introduction

In [5] a rule has been proposed to compute the rate matching ratios. However this rule is using a set of parameters SRF_t. If these parameters were those to be negotiated there would be a problem : because of the observance of maximum puncturing ratios, then when one TrCH is modified (added, released, given more/less Eb/I power) the whole set of $\{SRF_t\}$ would have to be retransmitted by upper layers.
In [4] a method was proposed to avoid this problem, however [4] was attacking several other problems such has handling of rounding errors, and quantification of negotiated coefficients.
Most of the problem attacked by [4] were included in a more clear way in [5], except the parameter negotiation method that was not discussed nor presented. Also the notations used in [4] were not inline with those used up to now.

The subject of this paper is to present and explain the method of [4] for parameter negotiation.

In this paper we do not address the rounding error problem that was addressed already in [5].

2 References

[1] TS 25.212 V1.0.0: 'Multiplexing and channel coding (FDD)', Source: Editor

[2] TS 25.222 V1.0.0: 'Multiplexing and channel coding (TDD)', Source: Editor

[3] Tdoc 3GPP WG1 R(99)612: 'Singe-step Rate Matching for Service Multiplexing' , Source: Siemens

[4] Tdoc 3GPP WG1 R(99)538: 'A rule to determine the rate matching ratio', Source: Mitsubishi Electric

[5] Tdoc 3GPP WG1 R(99)710: 'Determination of Rate Matching Parameters for Service Multiplexing', Source: Mitsubishi Electric+Siemens

3 Terminology

In this paper we use the term "channel coded channel" or ChCCH to refer to the channel at the output of one channel encoder. In other word a ChCCH is resulting of the multiplexing by "1st multiplexer" of one or several TrCH. We use the term ChCCH to avoid the confusion with TrCH when several TrCH "have the same QoS" as in the old terminology for the 1st multiplexer.

4 Parameters used for negotiation

The crux of the method presented in this paper is that for one ChCCH t instead of having one parameter SRF_t we have two parameters P_t and BRF_t. So when one ChCCH t is modified only the couple (BRF_t,P_t) for **this** t needs to be updated by signalling instead of the whole set of $\{ SRF_t \}$ for **all** t.

Note : for information to those who read [4] P_t is $\dfrac{P_c}{PBASE}$ in [4], and BRF_t is E_t in [4].

Now just after negotiation the first step is to compute the set of SRF_t from the set of couples (BRF_t, P_t).

We have the following definitions :

- P_t is the maximal puncturing ratio of t, for instance $P_t = 0.2$ if maximum puncturing is 20%.

- BRF_t is a coefficient that has no meaning for *one* ChCCH, but the set of $\{ BRF_t \}_t$ has a meaning for the set of ChCCH, that is to say the proportions between the parameters BRF_t defines the correct balancing between the ChCCHs, without any attention to the puncturing constraint. This is why BRF_t can be integers.
- SRF_t is the minimal ratio that both
  - fulfils the puncturing constraint, and
  - such that the proportion between the SRF_t is correct for balancing.
- RF_t is the actual rate matching factor
- MRF is such that $SRF_t = MRF \cdot BRF_t$ (see equation (2))
- DRF is such that $RF_t = DRF \cdot SRF_t$

Now P_t, BRF_t, SRF_t are semi-static. DRF and RF_t are be dynamic in DL and semi-static in DL.

Note : for information to those who read [4] MRF is $\dfrac{LMAX}{PBASE \cdot LBASE}$ in [4].

Computation of the set of SRF_t factors is needed in order to select the appropriate physical channel composite in UL and in DL. In UL this selection is described by the equation (4) for [5] that is reminded below :

$$m_{sel} = \min\left\{ m' \text{ such that } \sum_{i=1}^{n} N_{C,i} \cdot SRF_i \quad \leq \quad \sum_{j=1}^{m'} N_{data,j} \right\} \qquad \text{([5]/4)}$$

4.1 Definition of the set of SRF_t

Now MRF is simply defined by the equation :

$$MRF = \max_{\mathrm{t}} \left\{ \frac{1 - P_t}{BRF_t} \right\} \qquad (1)$$

So when we define SRF_t by the equation :

$$SRF_t = MRF \cdot BRF_t \qquad (2)$$

we are sure that :

a) SRF_t is makes the appropriate rate matching, because SRF_t is proportional to BRF_t by a factor MRF that is common to all of the ChCCH

b) fulfils the puncturing constraint that is expressed by equation (3) below :

$$SRF \geq 1 - P_t \qquad (3)$$

c) is minimal with respect of the two constraints a) and b) above.

4.2 Definition of the set of RF_t for DL

In DL a semi-static constant DRF is defined so that $RF_t = DRF \cdot SRF_t$ we have of course $DRF \geq 1$ so that the puncturing constraints are fulfilled.

So the definition of DRF involves the step of :

- Finding the physical channel composite with least maximal payload per radio-frame that can carry the CCTrCH at maximum bit rate if they were rate matched with the SRF_t;
- Set DRF so that when the CCTrCH bit rate is maximal, that is to say when the payload per radio frame of CCTrCH is maximal, then DRF is maximal (so that the number of DTX inserted in that case is minimal)

Note that the steps above were implicitely assumed in [5]. Note also that this computation is not done dynamically, that is to say the physical channel composite (one or several DPDCH to which the CCTrCH is mapped) is not selected for some radio frame. Instead we just consider which physical channel composite is needed when CCTrCH bit rate is maximal, and this is done prior connection/modification of the CCTrCH.

4.3 Definition of the set of RF_t for UL

In UL a dynamic constant DRF is defined so that $RF_t = DRF \cdot SRF_t$ for all radio frames we have of course $DRF \geq 1$ so that the puncturing constraints are fulfilled.

So the definition of *DRF* involves the step of :

- For all transport format combination TFC do :
    - Finding the physical channel composite with least maximal payload per radio-frame that can carry the CCTrCH at this TFC ;
    - Set *DRF* so that when the CCTrCH is at the current TFC then *DRF* is maximal (so that the number of DTX inserted in that case is minimal)

Note that typically this computation is not done dynamically, that is to say the physical channel composite (one or several DPDCH to which the CCTrCH is mapped) is not selected for some radio frame during this computation. Instead we just consider which physical channel composite is needed for all possible TFC, and we derive one *DRF* value for this TFC. So *DRF* is then dynamically selected among the computed ones radio frame per radio frame depending on the TFC of the radio frame.

Note that this is just the principle, but that in fact instead of computing *DRF* for all TFC, we rather compute the $\{\Delta N_t\}$ set for all the TFC and we select one $\{\Delta N_t\}$ dynamically radio frame per radio depending on the TFC.

Finally note that the $\{\Delta N_t\}$ set might depend not only on the TFC but also on the radio frame number, because the “radio frame segmentation” step sometimes makes segments whose size is differing by one bit. So even two radio frame with same TFC might have slightly different set of payloads $\{N_{C,t}\}$ before rate matching, and in consequence slightly different sets of $\{\Delta N_t\}$.

5 Conclusion

In this paper we have presented a method in which instead of negotiating one parameter SRF_t per channel coded channel, we negotiate two of them BRF_t and P_t. This yields the claimed advantage of easier subsequent negotiation of adjustments of Eb/I balancing.