TSG-RAN WG1 **R1-00-1107**

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**Agenda Item:** AH27, RL Perf Enhancements

**Source:** Mitsubishi Electric (Trium RD)

**Title:** Pseudo Dynamic Rate Matching for Downlink flexible positions

**Document for:** Discussion

# Introduction (1/2)

- Currently Semi Static RM is used in DL
- Semi Static RM is good at
  - Optimizing RM pattern even in variable TF conditions
  - Allowing BTFD with same transmission chain
- Semi Static RM is not so good at minimising number of DTX.

# Introduction (2/2)

- Pseudo Dynamic RM is a new scheme keeping the known advantage of semi static RM, while enhancing the DTX minimisation.
- Pseudo Dynamic RM is applicable only for the flexible position case.

# Abbreviations

| | |
|---|---|
| RM | Rate Matching |
| TB | Transport Block |
| TrCH | Transport Channel |
| TTI | Transmit Time Interval |

# RM paradigms (1/4)

Dynamic RM paradigm can read as

"Minimise DTX for **one** TFC *j*.
TFC *j* is **exactly** known"

# RM paradigms (2/4)

Semi Static RM paradigm can read as

"Minimise DTX for worst case **over all** TFC *j* in TFCS.

TFC *j* is **not** known"

# RM paradigms (3/4)

Pseudo Dynamic RM paradigm can read as

"Minimise DTX for worst case over all TFC *j* in a **Subset** of TFCS.

This subset can dynamically vary.

TFC *j* is **partially** known"

# RM paradigms (4/4)

Pseudo Dynamic RM enhancement depends on how small the subset is

- When a singleton, pseudo dynamic does **as good as dynamic**
- When it’s the whole TFCS, there is **no enhancement**
- Situations **in-between** happen.

# Basic idea (1/2)

- A **RM interval** is considered. A first simple approach is that the RM interval be equal to the longest used TTI.
- The subset of the TFCS is the **set of TFC's for which the TF's of the TrCH's with a TTI comprising or equal to the RM interval are fixed to some known value**.

# Basic idea (2/2)

- In other words, the TrCH's fall into 2 categories:
  - those with a TTI comprising the RM interval
  - those with a TTI strictly comprised in the RM interval
- For the 1st category, the TF's are exactly known
- For the 2nd category, they are not known

# Refinement

- The RM interval has a variable length. The next RM interval is dynamically decided at the end of the current one.
- The TrCH being ordered in descending TTI duration order, the RM interval is the TTI of the 1st TrCH transmitting at least one TB, or the smallest used TTI if no TrCH transmit a TB.

# How does it go ?

- For each TrCH, at the beginning of each TTI, the amount of rate matching $\Delta N_{i,j}^{TTI}$ to be done is determined based on the TFC *j* at that instant.
- RM is performed a on TTI basis as currently
- Note that TFC *j* replaces TF *l* in $\Delta N_{i,j}^{TTI}$

# Why does it work ?

- It works because $\Delta N_{i,j}^{TTI}$ does not really depend on the full TFC *j*, but on some partial TFC.
- In other words $\Delta N_{i,j}^{TTI}$ does not vary when the TFC *j* is restricted to vary in one of the possible *TFCS* subsets.

# Little Impact on the Specs

- Define the RM interval determination rule
- Define the TFCS subset determination rule
- Replace TFCS by “TFCS subset” in the current flexible position RM algorithm.

# Impact on UE and UTRAN (1/2)

- Bad news :

  Memory requirements for storing RM parameters $\Delta N_{i,l(\text{resp. } j)}^{TTI}$ goes from $\sum_{i=1}^{i=I} \left| TFS(i) \right|$ to $I \times \left| TFCS \right|$

  where $\left| X \right|$ denotes the number of elements in a set $X$.

# Impact on UE and UTRAN (2/2)

- Good news :

  The UTRAN will be able to reduce the power of DPDCH on occasions when the DTX number is decreased compared to current scheme. This is beneficial in dimensioning Node B Power Amp.

# Benefits (1/3)

- Best case is when all the TrCH's have the same TTI duration. In this case pseudo-dynamic is as good as dynamic
- Worst case is when you have a very low bit rate on the longest TTI and very high bit rate on shorter TTI's
- Middle case is when the bit rate on the longest TTI is not negligible on the whole.

# Benefits (2/3)

Let’s take a simple example in not so favourable a case. Assume a CCTrCH with a 20ms TTI DTCH 40ms TTI DCCH. At full rate TFC, the DCCH is 21% of the CCTrCH channel bits.

Assume also that the DCCH has a 20% duty cycle.

# Benefits (3/3)

This means that 80% of the time the DTX corresponding to DCCH bits can be used to increase the RM gain of the DTCH. So the average power relative to current scheme would be to (1-0.21) (power)×0.8(time) + 1(power)×0.2(time) = 83%,  so 0.8dB gain.

# Conclusion

We have presented a new scheme for RM in DL flexible position.

This scheme allows a better DTX minimisation than the current scheme under some conditions.