**Agenda Item:**

**Source:**         Panasonic

**Title:**          Simulation Results on Down-Link Variable Rate Packet Transmission

**Document for:**

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# 1   Introduction

Variable Rate Packet Transmission was proposed and in principal accepted at the last WG2 meeting (Tdoc R2-99298). In this scheme each high rate user is allocated a power threshold. When either shadow fading or inter-cell interference increase a user's power requirements above the set limit, the data rate is reduced. The lower data rate has lower power requirements and the user's power can remain under the set threshold. When channel conditions improve the user's data rate is increased allowing transmission of any data that may have been buffered.

This paper provides some simulation results on down-link variable rate packet transmission and shows its effectiveness.

# 2   Simulation assumption

The simulation model is based on the ARIB's model used for RTT proposal.  Following are detailed assumptions.

- down-lilnk, vehicular environment system-level simulation (ITU model)

- perfect SIR estimation (no delay on SIR estimation)

- UDD144k users and SPEECH users are considered

- voice activation of 50 % for SPEECH service

- traffic call model is not introduced for UDD service (continuous transmission)

Other simulation parameters are shown in Tables 1 and 2.

**Table 1. Environment models**

| | |
|---|---|
| Cell radius | 1000 m |
| Site to site separation | 3000 m |
| Cell layout | wrap around |
| Data sample cell | all cells |
| # of sectors | 3 |
| UE speed | 120 km/h |

**Table 2. Power setting and other parameters**

|  | SPEECH 8kbps | UDD 144kbps |
|---|---|---|
| Diversity | No | No |
| Processing gain | 512 (27.1dB) | 67.4 (18.3dB) |
| TCH max. Tx power | 30 dBm | 30 dBm |
| TCH min. Tx power | 10 dBm | 10 dBm |
| BCH Tx power | 30 dBm | 30 dBm |
| *HO algorithm settings* <br> DHO windows | <br> 3 dB | <br> N/A |
| Active set update rate | 0.5 second | 0.5 second |
| Active set max. size | 2 | 1 |
| Required Eb/No | 8.8 dB | 2.9 dB |
| TCH allowable Tx power (TXPOW_ALLOWABLE) | - | 30, 27, 24 dBm |
| Number of users | 60, 62, 64, 68, 70 | 5 |

## 3  Simulation results

Tables 3, 4 and 5 are simulation results for TXPOW_ALLOWABLE of 30, 27 and 24 dBm, respectively. In these tables, 'satisfied user' means the user having sufficiently good quality, i.e., the required Eb/No is satisfied, more than 95% of the session time.  The results shows that:

- Compared with "Fixed Rate", "Variable Rate" can achieve the same or higher data rate as well as better quality for both services.

- "Variable Rate" can accommodate more users by allocating a lower power threshold for high-rate packet users.

- "Variable Rate" can control the average transmission power not only for UDD144k users but also for SPEECH users. This means that "Variable Rate" can keep the system stable by allocating an appropriate power threshold (TXPOW_ALLOWABLE).

Because of these advantages, the system may tolerate hith-power emergent users.

## 4  Conclusion

In this contribution we provided some simulation results on down-link variable rate packet transmission. The results show that the variable rate packet transmission can manage the radio resource effectively. However, we assumed perfect SIR estimation (no delay) in this simulation. The performance with SIR estimation delay is FFS. How and how often the system determines the power threshold are also FFS.

**Table 3. Simulation results for TXPOW_ALLOWABLE = 30 dBm**

| number of users (SPEECH + UDD144k) | Fixed Rate | | | | Variable Rate | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | SPEECH | | UDD144k | | SPEECH | | UDD144k | | |
| | satisfied user | average TXPOW [dBm] | satisfied user | average TXPOW [dBm] | satisfied user | average TXPOW [dBm] | satisfied user | average TXPOW [dBm] | average data rate [times] |
| 60 + 5 | 100 % | 21.9 | 93.6 % | 25.8 | 97.58 % | 23.8 | 90.82 % | 28.6 | 1.59 |
| 62 + 5 | 100 % | 22.8 | 41.6 % | 26.6 | 99.59 % | 28.6 | 97.26 % | 28.6 | 1.44 |
| 64 + 5 | - | - | - | - | 99.97 % | 28.6 | 99.54 % | 28.6 | 1.31 |
| 66 + 5 | - | - | - | - | 100 % | 28.6 | 100 % | 28.6 | 1.18 |
| 68 + 5 | - | - | - | - | 100 % | 28.6 | 99.98 % | 28.6 | 1.04 |
| 70 + 5 | - | - | - | - | 99.94 % | 28.6 | 100 % | 28.6 | 0.91 |

**Table 4. Simulation results for TXPOW_ALLOWABLE = 27 dBm**

| number of users (SPEECH + UDD144k) | Fixed Rate | | | | Variable Rate | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | SPEECH | | UDD144k | | SPEECH | | UDD144k | | |
| | satisfied user | average TXPOW [dBm] | satisfied user | average TXPOW [dBm] | satisfied user | average TXPOW [dBm] | satisfied user | average TXPOW [dBm] | average data rate [times] |
| 60 + 5 | 100 % | 21.9 | 93.6 % | 25.8 | 99.98 % | 25.6 | 99.92 % | 25.6 | 1.29 |
| 62 + 5 | 100 % | 22.8 | 41.6 % | 26.6 | 100 % | 25.6 | 100 % | 25.6 | 1.19 |
| 64 + 5 | - | - | - | - | 100 % | 25.6 | 100 % | 25.6 | 1.08 |
| 66 + 5 | - | - | - | - | 100 % | 25.6 | 100 % | 25.6 | 0.97 |
| 68 + 5 | - | - | - | - | 100 % | 25.6 | 100 % | 25.6 | 0.85 |

**Table 5. Simulation results for TXPOW_ALLOWABLE = 24 dBm**

| number of users (SPEECH + UDD144k) | Fixed Rate | | | | Variable Rate | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | SPEECH | | UDD144k | | SPEECH | | UDD144k | | |
| | satisfied user | average TXPOW [dBm] | satisfied user | average TXPOW [dBm] | satisfied user | average TXPOW [dBm] | satisfied user | average TXPOW [dBm] | average data rate [times] |
| 60 + 5 | 100 % | 21.9 | 93.6 % | 25.8 | 100 % | 22.6 | 100 % | 22.6 | 0.97 |
| 62 + 5 | 100 % | 22.8 | 41.6 % | 26.6 | 100 % | 22.6 | 100 % | 22.6 | 0.88 |
| 64 + 5 | - | - | - | - | 100 % | 22.6 | 100 % | 22.6 | 0.79 |