TSG-RAN Working Group 1 Meeting #18 **TSG*R1#18(01)0129***

Boston, MA., USA
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Agenda Item: **AH24: High Speed Downlink Packet Transmission**
Source: **SONY Corporation**
Title: **Updated Text Proposal for AMCS complexity evaluation section of TR25.848**
Document for: **Approval**

1. Introduction

This document proposes initial AMCS complexity evaluation content for the TR25.848. The analysis presented in R1-01-0059 is reflected in this proposal.

2. Text Proposal

7.1.2.1. Complexity Evaluation <UE and RNS impacts>

7.1.2.1.1. Complexity Impacts to UE

7.1.2.1.1.1. Introduction

The Adaptive modulation and coding scheme applied on DSCH will require UE to have following capabilities in addition to release'99 UE functions.

?? Detection capability for MCS applied by Node-B
?? Demodulation capability for higher order modulation
?? Decoding capability for lower/higher rate turbo code
?? Measurement/Reporting capability for downlink channel quality

A complexity evaluation on each of listed functionalities is presented in this section.

7.1.2.1.1.2. Detection of MCS applied by Node-B

UE needs to be able to determine modulation and coding scheme applied at the transmitter (Node B) prior to decoding DSCH data. It is expected that MCS mode be explicitly transmitted to UE. Explicit signaling is also required to indicate OVSF codes being assigned to UE if dynamic code allocation scheme is to be applied. A sufficient time (Tind) need to be allocated for mode indication transmission prior to HS-DSCH data transmission in order to avoid unnecessary chip/symbol buffering at UE.

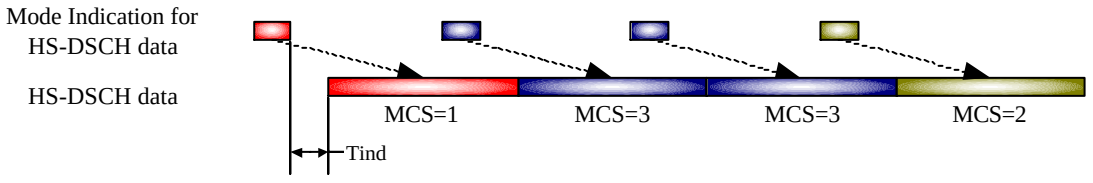

Figure 1 Timing relations for mode indicator and HS -DSCH data

7.1.2.1.1.3. Demodulation of higher order modulation

The use of higher order modulations such as 64QAM, 16QAM, and 8PSK has been proposed for HSDPA. Introduction of QAM requires UE to be able to estimate the amplitude reference along with phase reference. It is assumed that the phase reference is obtained from CPICH as in QPSK demodulation, and amplitude reference is obtained from converting CPICH power measurement to DSCH power as shown in equation below.

$$amplitude\_ref = k \cdot \frac{G\_dsch}{G\_pilot} \cdot \frac{SF\_dsch}{SF\_pilot} \cdot pow\_pilot$$

Here, pow_pilot is an estimated CPICH power, $\frac{G\_dsch}{G\_pilot}$ is a gain setting for DSCH respect to CPICH, $\frac{SF\_dsch}{SF\_pilot}$ is a ratio of DSCH and CPICH spreading factor, and k is a constant dependent on modulation order. $\frac{G\_dsch}{G\_pilot}$ is expected to be signalled from UTRAN by higher layer message. Further more, the introduction of new modulation schemes adds complexity in a way that UE is required to support multiple demodulation schemes.

It is also expected that a higher order modulation is more sensitive to interference caused by non-ideal receiver structure of UE. Performance degradation due to non-ideal sample timing is shown in Figure 2, and degradation due to phase/amplitude estimation error is shown in Figure 3. For demodulation of higher order modulations (16-QAM, 64-QAM), UE will be required to have higher over-sampling rate, more refined synchronization tracking mechanism, and more sophisticated channel estimation means than a release'99 terminal in order to achieve sufficient performance.

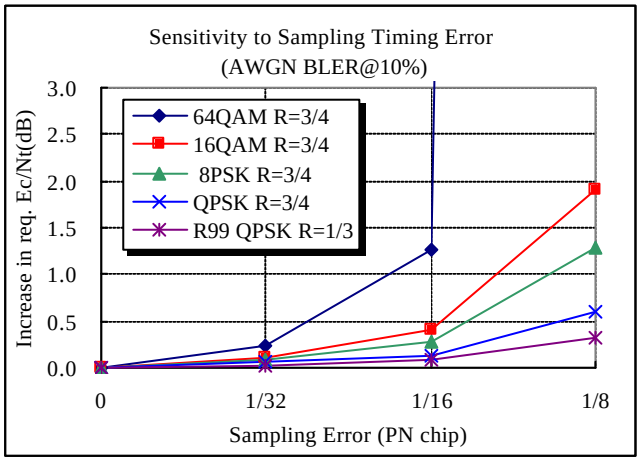

Figure 2. Performance degradation due to sample timing error

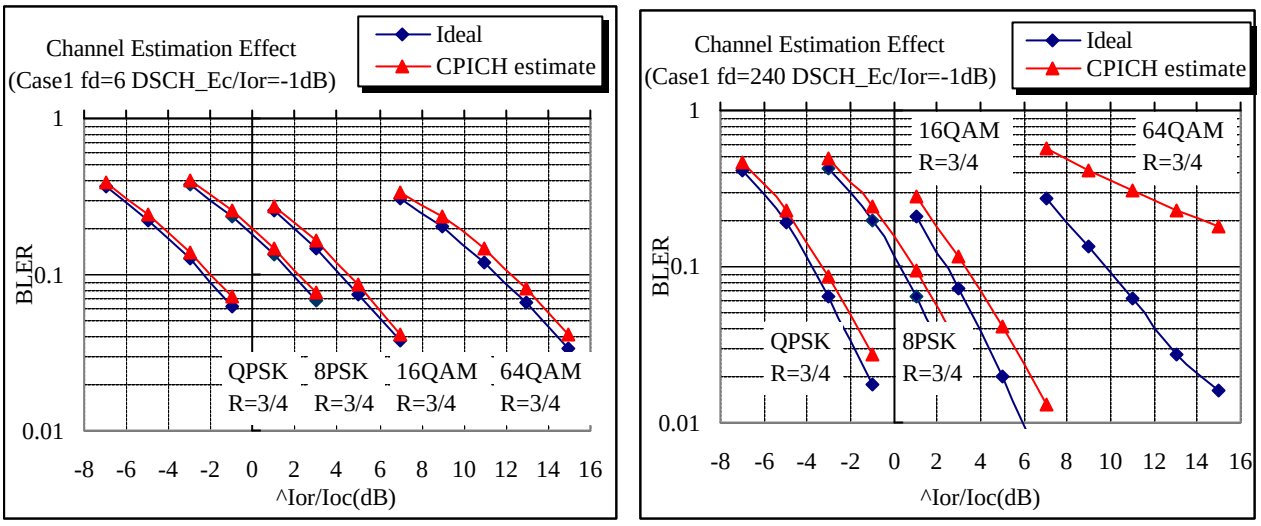

Figure 3 Performance degradation due to Phase/Amplitude estimation error

7.1.2.1.1.4. Decoding of turbo code

In addition to rate 1/3 turbo coder used for release'99 terminals, use of rate 1/4, 1/2, and 3/4 coder has been proposed for HSDPA. Decoding complexity will depend on how the Hybrid-ARQ is implemented, as timing requirement for ACK transmission will determine processing power and re-transmission scheme will determine memory capability of UE. Detailed analysis for Hybrid-ARQ is given in section 7.2. Nevertheless, regardless of H-ARQ scheme, the use of lower rate coder with new mother code will increase the decoding complexity, and support for higher data rate will increase processing and memory capability of UE compared to a release'99 terminal.

7.1.2.1.1.5. Measurement/Reporting of downlink channel quality

UE may be required to report downlink channel quality to UTRAN in order to assist link adaptation criteria by Node-B. It has not been decided what is to be measured and reported by UE as a downlink channel quality. One proposal is to use CPICH RSCP/ISCP measure that has direct link to received data quality. Additional complexity required at UE for its calculation is considered to be relatively small considering that CPICH RSCP/ISCP is only needed for primary Node-B among all active set and monitoring of CPICH is anyway needed for DPCH demodulation. With continuously transmitted CPICH, sufficient accuracy of the measure can be established as shown in Figure 4.

Node-B may also estimate the downlink channel quality from the transmit power control commands (TPC) for associated DPCH. TPC may be used directly or in conjunction with reported value to estimate downlink channel quality. The use of TPC to estimate downlink channel quality is not expected to influence UE complexity, as the transmission of TPC for associated DPCH is already available for release'99 terminals.

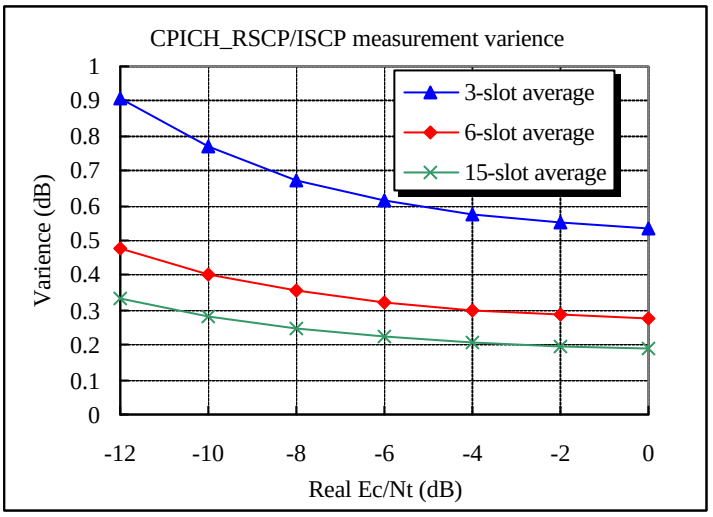

Figure 4 Accuracy for CPICH_SIR/ISCP estimation

7.1.2.1.1.6. Conclusions

A complexity evaluation for AMCS on UE is analyzed in this section. Demodulation of higher order modulations will lead to higher receiver complexity compared to release'99 UE. For an example, more refined synchronization tracking mechanism and more sophisticated channel estimation means may be required especially for 64QAM. Utilization of 64QAM may also require more advanced receivers utilizing techniques such as interference cancellers and equalizers.

7.1.2.1.2. Complexity Impacts to RNS

7.1.2.1.3. References

[1] SONY: "UE complexity issues for AMCS", TSGR1#18(01)0059, Jan. 2001