TSG-RAN Working Group 3 meeting #6
Sophia Antipolis, France 23rd –27th Aug. 1999

TSGW3#6(99) 830

Agenda Item: **14.1**

Source: **Rapporteur [Telecom Modus Ltd]**

Title: **SSDT impacts on Iub and Iur**

Document for: **Study Item: ARC 6 Status Report**

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1 INTRODUCTION

This contribution presents the result of study item 'Site Selection Diversity Transmit power control' (SSDT) impact on Iub and Iur.

1.1 Current Status

TSG-RAN WG1 and WG2 have already accepted the SSDT for release '99. This document details out the full working explanation on SSDT function. Use of NBAP has been agreed for the SSDT related parameters over the reflector.

1.2 Background

SSDT is a power control scheme for the UE in soft hand-over mode whereby the UE selects one of its cells cites from its active set to be 'primary' in the DL, and all others are classed as 'non-primary'.

Operation is summarised as follows. The UE selects one of the cells from its active set to be 'primary,' all other cells are classed as 'non primary'. The main objective is to transmit on the DL from the best cell, thus reducing the interference caused by multiple transmissions in a soft hand over mode. A second objective is to achieve fast site selection without network intervention, thus maintaining the advantage of the soft hand-over. In order to select a primary cell, each cell is assigned a temporary identification (Coded ID: In SRNC, cell ID is mapped to ID label and is mapped to RL ID) and UE periodically informs a primary cell identification to the connecting cells. The non-primary cells selected by UE switch off the transmission power. The primary cell identity code is delivered via UL DPCCH FBI field.
There are three different lengths of coded ID (temp cell ID) available denoted as "long", "medium" and "short". The SRNC decides which length of coded ID is used and notifies it to Node-B and UE. Two FBI settings FBI with bit1 and FBI with bit2 are supported for UL DPDCH.
When the SRNC makes a decision to enable the SSDT it has to tell node-B which UL DPCCH structure to use. The use of FBI field in UL DPCCH may vary as the other diversity methods such as TxAA may be used in parallel with the SSDT.

Upon receipt of the primary cell ID by all the involved cells, the cells checks its minimum SSDT quality threshold (Min-Qth) value against the received UL quality. If it is above the minimum threshold value and the received Primary ID does not match its own Id (RL) then the non-primary cell switches the transmission power off. Otherwise if the received power is below the Qth then the cells continues to transmit normally. The Decoded temp Id is only validated / acted upon by the Node-B when the link quality is above the minimum SSDT threshold quality value. This minimum threshold value is used so reliable detection of a frame can be achieved.

For further information on SSDT, please refer to reference [1], section 5.2.3.4

1.3 Detail Discussion

Requirements for SSDT

Requirement1: The SSDT function is initiated/terminated in the SRNC.

Requirement2: SSDT once set in one state (ON or OFF) will remain in that state for a considerable period of time and will only be changed as the result of some signaling procedure (for ex. NBAP, RNSAP),

Requirement3: NBAP, RNSAP delays are less than 134ms. RAN WG2's user plane delay value is of 134ms. If NBAP and RNSAP delay is more than this then it may cause problems with many signaling procedures.

Requirement4: SSDT identifier is set by SRNC to 'on' in Node B for each radio link. This will be set only when UE has more than or equal to 2 RLs, as a power control mechanism.

Requirement5: SSDT should be on at Node B upon the SSDT activation at UE and SSDT should be off at UE upon the SSDT termination at Node B.

Requirement6: ID label is mapped to RL ID, when RL ID's are created.

Requirement7: Field of FBI bits is used for sending temp ID [5].

Requirement8: Temp ID must be terminated within a frame [1].

Criteria for Node-B action:

Node B first checks the following and acts upon only if it satisfies all the conditions.

[if (SSDT on &
Qth<= UL RL Received Strength
& Its cell' id ! = Primary Id)] then switch the DL power off for the DL RL.] else
[if (SSDT on &
Qth<= UL RL Received Strength
& Its cell' id = = Primary Id)] then do not switch the DL power off for the DL RL.]

SSDT activation time:

This is required in order to change Cell state from SSDT off to SSDT on (or on to off) at exactly the same point in time (i.e. same radio frame number). This will avoid the problem of some Node-B's encountering the unexpected UL DPCCH bits rather than that they used to handle in the previous frame. For example, if Tx-AA was operated before SSDT and UE send the Primary ID and the SSDT is off at node B then the Node-B may decode FBI bits as Tx-AA weight. In another case, Node-B may handle the FBI bits as pilot bit.

Radio Cell Capabilities:

Node-B SSDT capabilities like any other capabilities would be known by RNC through O&M function, and during soft handover, if the radio cell (Node-B) added can not support SSDT, then SRNC would make a decision to switch the ssdt off in the previous node-B's (cells) and in UE.
If say for ex. A UE has two RL across Nodeb1 and NodeB2, and say NodeB1 supports SSDT and NodeB2 does not support the SSDT and *SRNC does not have the prior knowledge* whether this new cell supports the SSDT or not. In this case SRNC will say sends RL configuration message with SSDT on to both the Node-B's. NodeB'2 would then respond with a RL Reconfiguration Failure message. And to this SRNC has to set the ssdt to off by re-sending the RL Reconfiguration message to NodeB1.
In case when *SRNC has a prior knowledge* then SRNC will not set the ssdt on in this scenario, knowing one of its Node-B does not support the SSDT.

The SSDT support capability of Node-B can be indicted in the NBAP O&M Message Node-B capability Exchange Message or Node-B Resource Notification message.

Quality Threshold:

In the last WG3 meeting it was agreed that the 'Quality threshold' values to be chosen by the network operators. These values (stated as an example) may be chosen from one of following 8 different Qth settings, (0, -5, -10, -15, -20, -30, -40, -Infinity)[dB]. This values would be chosen as perhaps with respect to the code word length, such as

"long" ID code word -> Qth long -> low quality level;
"medium" ID code word -> Qth medium; -> medium quality level;
"short" ID code word -> Qth short -> high quality level

The idea being that errors in decoding a short ID code word are more likely to occur, than when decoding a long code word. So when using a "long" code word the quality threshold can be set to a low value.

Parameters across Iub/Iur:

1. SSDT indicator
2. activation time (for e.g. CFN)
3. ID code length (long, medium, short)
4. UL DPCCH Structure Indicator: 1bit FBI or 2 bit FBI in FBI field of UL DPCCH
5. TxAA mode indicator on/off is FFS

Parameters related with O&M:

1. Qth: Range of Quality Values as discussed above

ID code and associated Quality level		
"Long ID code"	**"Medium ID code"**	**"Short ID code"**
Low Quality Level	Medium Quality Level	Large Quality Level

TABLES IN NODE-B

ID Code tables in Node-B

Table 1 Settings of ID codes for 1 bit FBI

ID label	ID code		
	"long"	**"medium"**	**"short"**
a	000000000000000	0000000(0)	00000
b	111111111111111	1111111(1)	11111
c	000000001111111	0000111(1)	00011
d	111111110000000	1111000(0)	11100
e	000011111111000	0011110(0)	00110
f	111100000000111	1100001(1)	11001

Table 2 Settings of ID codes for 2 bit FBI

ID label	ID code (Column and Row denote slot position and FBI-bit position.)		
	"long"	**"medium"**	**"short"**
a	0000000(0) 0000000(0)	000(0) 000(0)	000 000
b	1111111(1) 1111111(1)	111(1) 111(1)	111 111
c	0000000(0) 1111111(1)	000(0) 111(1)	000 111
d	1111111(1) 0000000(0)	111(1) 000(0)	111 000
e	0000111(1) 1111000(0)	001(1) 110(0)	001 100
f	1111000(0) 0000111(1)	110(0) 001(1)	110 011

NBAP / RNSAP USE for SSDT Indication:

1. NBAP, RNSAP Messages: The following messages have SSDT impact. The required IE's for these messages, namely, RL Reconfiguration Prepare, RL Reconfiguration Commit, and RL Reconfiguration Failure is shown in the following tables.

RL Reconfiguration Prepare		
SSDT Information		O
SSDT Indication	On/off	M
UL DPCCH Structure Indicator	1bit FBI / 2bit FBI	M
ID code length	Short / Long / Medium	M
TxAA Indication	On/off	M [FFS]

RL Reconfiguration commit		
SSDT Information		O
Activation Time	CFN	M

RL Reconfiguration Failure		
RL ID		M
Cause (SSDT not supported)		M

2. NBAP Merits / Demerits

Merits:
a) Assured Delivery.
b) Software impact only.
c) Easy to keep track of node-b hardware status.
d) If TxAA and SSDT are combined together then this justifies the use of NBAP.

Demerits:
a) 3 NBAP/RNSAP messages for each ssdt setting.
b) Increase in processing load & hence delay.

DCH CONTROL FP Use for SSDT indication:

The following is the simplest DCH C FP for SSDT indication triggered by SRNC.

SSDT INDICATION	
RL ID	I/D
SSDT INDICATION	On/off
ID Code length	Long/medium/short
Activation time	CFN
UL DPCCH Structure Indicator	1bit FBI / 2bit FBI
TxAA indication [FFS]	On/off

Merits:
a.) DCH Control frames are very simple.
b.) Lower layer and faster to process.
c.) DCH C-FP for SSDT does not need to with every DCH data frame.

Demerits:
a.) No assured delivery of DCH C-FP.
b.) Hardware as well as software Impact

2 PERFORMANCE EVALUATION

Computer simulations were carried out to investigate the behaviour of SSDT under ETSI&ITU-R guidelines for IMT-2000 RTT evaluation. The results are compared to a conventional power control method, where the transmit power of all BS involved is conrolled so that the correct target SIR value is reached.

Fig.2 shows capacity versus Doppler frequency for SSDT and conventional TPC (normal SHO). The simulations show that SSDT is superior to normal SHO at low speed, and that increases capacity by reducing overall interference. The capacity gains are approximately 40% without UE's diversity and 50% with UE's diversity.

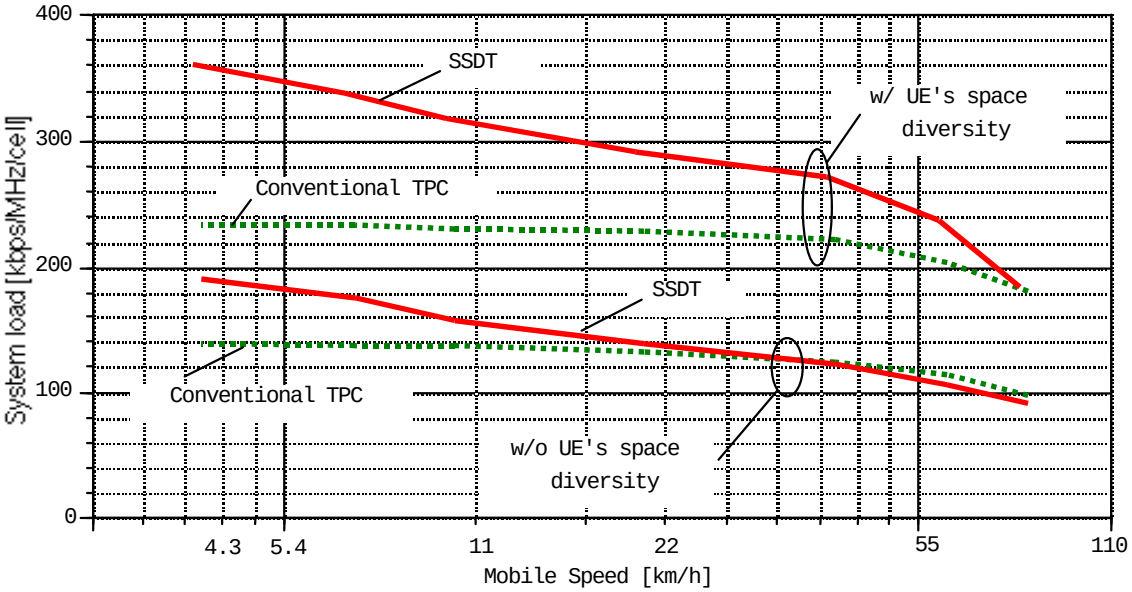

Figure 2: system load versus Doppler frequency. 6 independent path Rayleigh fading model with Vehicular-A profile. 6 finger RAKE reception. Every frame site seleciton (10ms).

3 SIMULATION ASSUMPTIONS

- 1bit FBI
- CW settings are used in Table2 of TS25.214
- Offered number of users is 3.6 users/cell
- Two branch antenna diversity
- 2 path Rayleigh fading model and infinite RAKE fingers implementation
- UE speed of 4km/h

4 SIMULATION RESULTS

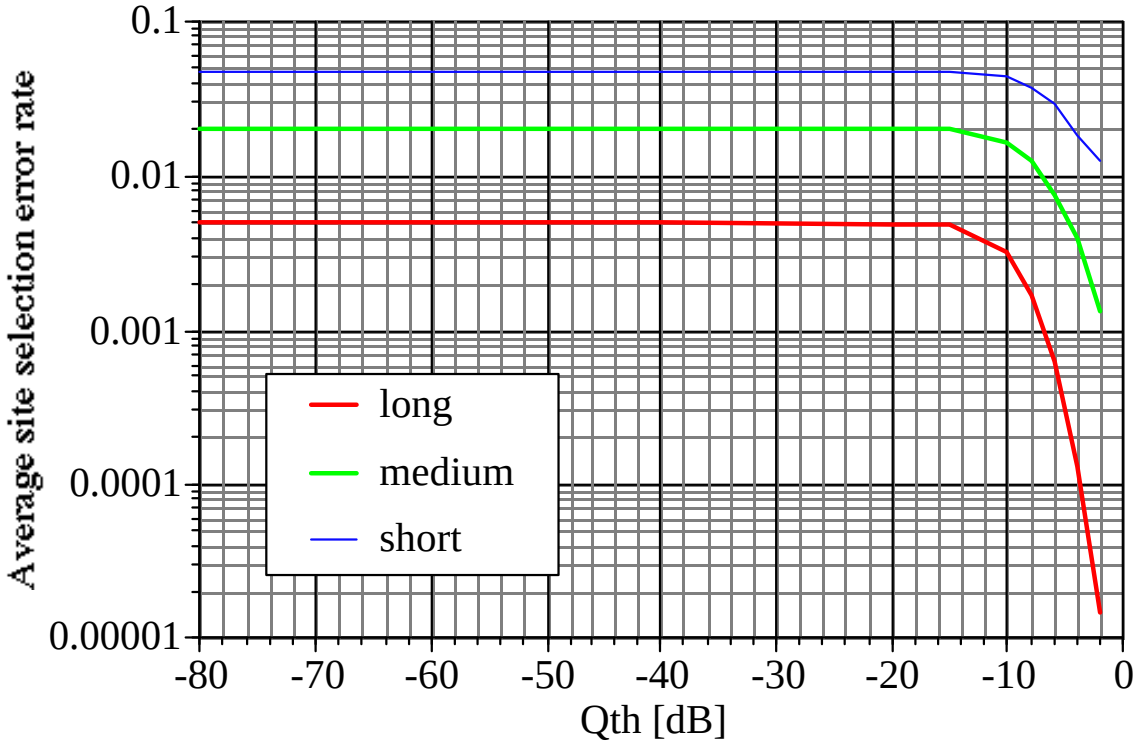

Fig.2 Average site selection error rate vs. Qth. Average site selection error rate means the average probability that NodeB fails to decode the ID CW.

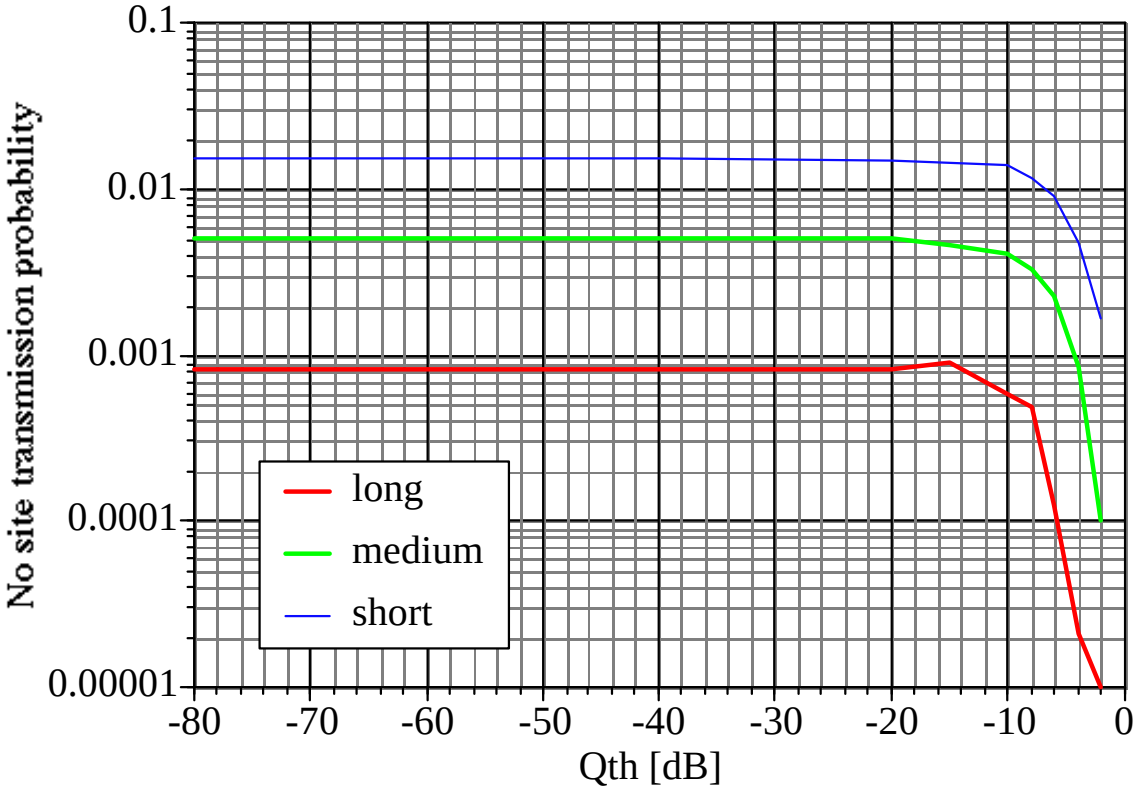

Fig.3 No site transmission probability vs. Qth. No site transmission probability means the probability that no site of active set transmits DL signal as primary cell.

5 FERENCES

[1] 3GPP RAN TS 25.214v1.1.1, Physical layer Procedures
[2] 3GPP RAN TS 25.427v0.2.2, UTRAN Iub/Iur Interface User Plane Protocol for DCH Data Streams
[3] 3GPP RAN TS 25.433V1.1.1, NBAP SPECIFICATIONS
[4] 3GPP RAN TS 25.423V1.2.1, RNSAP SPECIFICATIONS
[5] 3GPP RAN TS 25.211v2.2.1, Physical Channel and Mapping of Transport channel onto Physical channel.