TSG-RAN Working Group 1 meeting #18 *TSGR1(01)0097*
Boston, USA, Jan. 15 - 18, 2001

Agenda Item: AH21

Source: Siemens AG

To: TSG RAN WG1

Title: Transmission of SS commands in 1.28Mcps TDD

Document for: Decision

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1. Summary

The SS is utilised to command a timing adjustment each M sub-frames for uplink synchronization. In 3.84 Mcps TDD, SS information is not transmitted as L1 signal on each frame. In 1.28 Mcps TDD, the SS information is transmitted ~~once~~ at least once per 5 ms sub-frame in the downlink. Different UL time slot are controlled independently by uplink synchronisation control.

2. Introduction

In 3.84 Mcps TDD option, the SS command is not used. However the SS is utilised to command a timing adjustment (k/8)Tc each M sub-frames in 1.28Mcps TDD option, where Tc is the chip period. The default k and M values are signalled by the network by means of system information that is broadcast in the cell. The SS information is to be transmitted directly after the midamble in downlink. Figure 1 shows the position of the SS in a burst. The SS, as one of L1 signals, is to be transmitted once per 5ms sub-frame.

M (1-8) and k (1-8) can be adjusted during call setup or readjusted during the call.

Note: The smallest step for the SS signalled by the UTRAN is 1/8 Tc. For the UE capabilities regarding the SS adjustment of the UE it is suggested to set the tolerance for the executed command to be [1/9;1/7] Tc (to be defined in TSG RAN WG4).

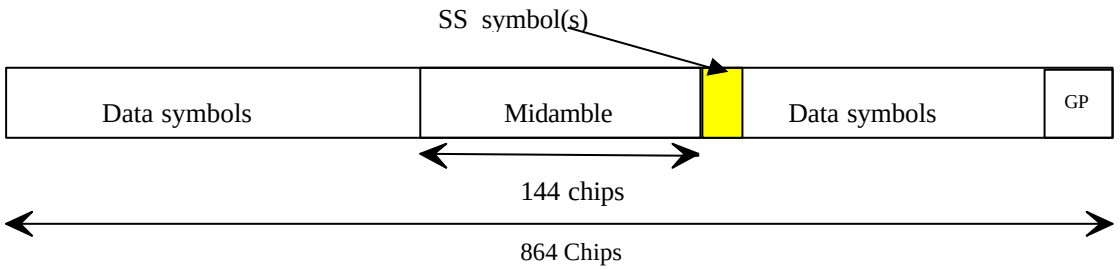

Figure 1 SS information in a burst in downlink and uplink

Note that for the uplink where there is (are) no SS symbol(s) used. However, the SS symbol(s) space is(are) reserved for future use. This ensures the UL and DL slots have the same structure.

For the number of layer 1 symbols per channelisation code there are 3 possibilities configurable for each channelisation code during the call setup:

?? one SS symbol
?? no SS symbol
?? 16/SF SS symbols

So, in case 3, when SF=1, there are 16 SS symbols which correspond to 32 bits (for QPSK) and 48 bits (for 8PSK).

For every user the SS information is to be transmitted at least once per 5ms sub-frame. If applied, transmission of SS is done in the data parts of the traffic burst and it can be transmitted using the first allocated channelisation code and the first allocated timeslot (according to the order in the higher layer allocation message). Other allocations (more than one SS transmission in one sub-frame) of SS are also possible. The SS is spread with the same spreading factor (SF) and spreading code as the data parts of the respective physical channel.

Each of the SS symbols in the DL will be associated with an UL time slot depending on the allocated UL time slots and the allocated SS symbols in the DL.

The synchronisation shift commands for each UL time slot (all channelisation codes on that time slot have the same SS command) will be distributed to the following rules:

1. The UL time slots the SS commands are intended for will be numbered form the first to the last UL time slot occupied by the regarded UE (starting with 0) considering all CCTrCHs allocated to that UE.

2. The commanding SS symbols on all downlink CCTrCHs allocated to one UE are numbered consecutively starting with zero according to the following rules:

    a) The numbers of the SS commands of a regarded DL time slot are lower than those of DL time slots being transmitted after that time slot

    b) Within a DL time slot the numbers of the SS commands of a regarded channelisation code are lower than those of channelisation codes having a ~~bigger~~ higher spreading code number

    The spreading code number is defined by the following table: (see TS 25.223)

Spreading code number	SF (Q)	Walsh code number (k)
0	16	$\mathbf{c}_{Q?16}^{(k?1)}$
	...	
15	16	$\mathbf{c}_{Q?16}^{(k?16)}$
	Spreading factors 2-8 are nor used in DL	
30	1	$\mathbf{c}_{Q?1}^{(k?1)}$

    c) Within a channelisation code numbers of the SS commands are lower than those of SS commands being transmitted after that time

The following equation is used to determine the UL time slot which is controlled by the regarded SS symbol:

$$UL_{pos} ? (SFN'?N_{SSsymbols} ? SS_{pos}) \bmod (N_{ULslot}),$$

where

UL_{pos} is the number of the controlled uplink time slots.

SFN' is the system frame number counting the sub-frames. The system frame number of the radio frames (SFN) can be derived from SFN' by

SFN=SFN' div 2, where div is the reminder free division operation.

$N_{SSsymbols}$ is the number of SS symbols in a sub-frame.

SS_{pos} is the number of the regarded SS symbol within the sub-frame.

N_{ULslot} is the number of UL slots in a sub-frame.

Note: Even though the different time slots of the UE are controlled with independent SS commands, the UE is not in need to execute SS commands leading to a deviation of more than [5] chip with respect to the average timing advance applied by the UE (to be defined in TSG RAN WG4).

In the following two examples of the association of DL SS commands to UL ~~uplink~~ time slots are shown:

Table 11 ~~1~~ Two examples of the association of DL SS commands to UL uplink time slots with N_{ULslot}=3

Case 1: $N_{SSsymbols}$=2; Case 2: $N_{SSsymbols}$=4

Sub-Frame Number	Case 1 (2 DL SS symbols)		The order of the served UL time slot (UL time slot number)	Case 2 (4 DL SS symbols)	
	The order of DL SS symbols			The order of DL SS symbols	
SFN'=0	(1^{st} UL_{pos}=0)	0	0 (TS3)	0	(1^{st} UL_{pos}=0)
		1	1 (TS4)	1	
			2 (TS5)	2	
			0 (TS3)	3	
SFN'=1	(1^{st} UL_{pos}=2)	0	0 (TS3)	0	(1^{st} UL_{pos}=1)
		1	1 (TS4)	1	
			2 (TS5)	2	
			0 (TS3)	3	
			1 (TS4)		
SFN'=2	(1^{st} UL_{pos}=1)	0	0 (TS3)	0	(1^{st} UL_{pos}=2)
		1	1 (TS4)	1	
			2 (TS5)	2	
			0 (TS3)	3	
			1 (TS4)		
			2 (TS5)		
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3. Proposal

We propose to add following paragraphs in the working CR for TS25.221 as the description of the transmission of SS commands in the 1.28Mcps TDD.

---------- Beginning of text proposal for working CR for 25.221 ----------

6.2.2.3 Transmission of SS

The burst type for dedicated channels provides the possibility for transmission of uplink synchronisation control (ULSC).

The transmission of ULSC is done in the data parts of the traffic burst. Hence the midamble structure and length is not changed. The ULSC information is to be transmitted directly after the midamble. Figure XX shows the position of the SS command in a traffic burst.

For every user the ULSC information shall be transmitted at least once per transmitted sub-frame. By default the following rules apply:

1. If TFCI is applied for a CCTrCH, the SS command(s) shall be transmitted using the same channelisation code and the same timeslots as the TFCI.

2. If no TFCI is applied for a CCTrCH, the SS command(s) shall be transmitted using the first allocated channelisation code and the first allocated timeslot, according to the order in the higher layer allocation message.

Apart from the default rules other allocations of SS commands are possible according higher layer signalling – e.g. the transmission of more then one SS command (on more than one time slot).

The SS command is spread with the same spreading factor (SF) and spreading code as the data parts of the respective physical channel.

The SS is utilised to command a timing adjustment by (k/8) Tc each M sub-frames, where Tc is the chip period. The default k and M values are signalled by the network by means of system information that is broadcast in the cell. The SS, as one of L1 signals, is to be transmitted once per 5ms sub-frame.

M (1-8) and k (1-8) can be adjusted during call setup or readjusted during the call.

Note: The smallest step for the SS signalled by the UTRAN is 1/8 Tc. For the UE capabilities regarding the SS adjustment of the UE it is suggested to set the tolerance for the executed command to be [1/9;1/7] Tc (to be defined in TSG RAN WG4).

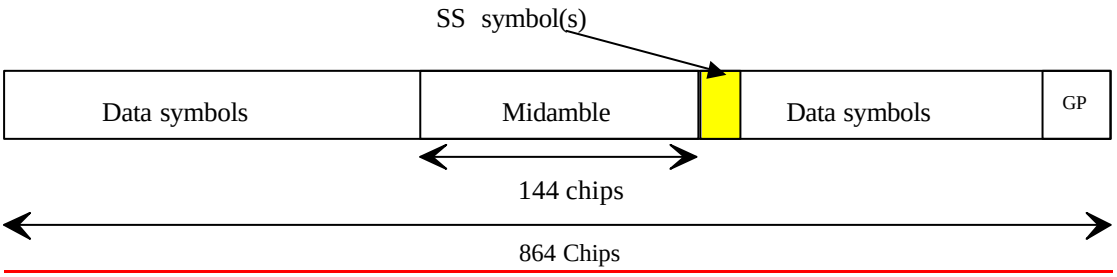

Figure XX Position of ULSC information in the traffic burst (downlink and uplink)

*Note that for the uplink where there's no SS symbol used, the SS symbol space is reserved for future use. This can keep UL and DL slots the same structure.

For the number of layer 1 symbols there are 3 possibilities configurable for each channelisation code during the call setup:

?? one SS symbol

?? no SS symbol

?? 16/SF SS symbols

So, in case 3, when SF=1, there are 16 SS symbols which correspond to 32 bits (for QPSK) and 48 bits (for 8PSK).

Each of the SS symbols in the DL will be associated with an UL time slot depending on the allocated UL time slots and the allocated SS symbols in the DL.

The synchronisation shift commands for each UL time slot (all channelisation codes on that time slot have the same SS command) will be distributed to the following rules:

1. The UL time slots the SS commands are intended for will be numbered form the first to the last UL time slot occupied by the regarded UE (starting with 0) considering all CCTrCHs allocated to that UE.

2. The commanding SS symbols on all downlink CCTrCHs allocated to one UE are numbered consecutively starting with zero according to the following rules:

   a) The numbers of the SS commands of a regarded DL time slot are lower than those of DL time slots being transmitted after that time slot

   b) Within a DL time slot the numbers of the SS commands of a regarded channelisation code are lower than those of channelisation codes having a ~~bigger~~higher spreading code number

   The spreading code number is defined by the following table: (see TS 25.223)

Spreading code number	SF (Q)	Walsh code number (k)
0	16	$\mathbf{c}_{Q?16}^{(k?1)}$
	...	
15	16	$\mathbf{c}_{Q?16}^{(k?16)}$
	Spreading factors 2-8 are nor used in DL	
30	1	$\mathbf{c}_{Q?1}^{(k?1)}$

c) Within a channelisation code numbers of the SS commands are lower than those of SS commands being transmitted after that time

The following equation is used to determine the UL time slot which is controlled by the regarded SS symbol:

$$UL_{pos} = (SFN' \cdot N_{SSsymbols} + SS_{pos}) \bmod (N_{ULslot}).$$

where

UL_{pos} is the number of the controlled uplink time slots.

SFN' is the system frame number counting the sub-frames. The system frame number of the radio frames (SFN) can be derived from SFN' by

SFN=SFN' div 2, where div is the reminder free division operation.

$N_{SSsymbols}$ is the number of SS symbols in a sub-frame.

SS_{pos} is the number of the regarded SS symbol within the sub-frame.

N_{ULslot} is the number of UL slots in a sub-frame.

Note: Even though the different time slots of the UE are controlled with independent SS commands, the UE is not in need to execute SS commands leading to a deviation of more than [5] chip with respect to the average timing advance applied by the UE (to be defined in TSG RAN WG4).

In Annex F two examples of the association of SS commands to UL time slots are shown.

Coding of SS for QPSK:

The SS command is an identifier sent in downlink transmission only, to instruct the UE whether the synchronisation shift has to be increased or decreased by k/8 Tc or has to remain unchanged. The length of the SS command is one symbol. The coding of the SS command is shown in table XX.

The default value of k (1-8) is broadcast in the BCH. The value of k can also be adjusted during call setup or readjusted during the call.

Note: The smallest step for the SS signalled by the UTRAN is 1/8 Tc. For the UE capabilities regarding the SS adjustment of the UE it is suggested to set the tolerance for the executed command to be [1/9;1/7] Tc (to be defined in TSG RAN WG4).

Table XX: Coding of the SS for QPSK

SS	SS Bits	Meaning
'Down'	00	Decrease synchronisation shift by k/8 Tc
'Up'	11	Increase synchronisation shift by k/8 Tc
'Do nothing'	01	No change

Coding of SS for 8PSK:

The SS command is an identifier sent in downlink transmission only, to instruct the UE whether the synchronisation shift has to be increased or decreased by k/8 Tc or has to stay unchanged. The length of the SS command is one symbol. The coding of the SS command is shown in table XXX.

The default value of k (1-8) is broadcast in the BCH. The value of k can also be adjusted during call setup or readjusted during the call.

Note: The smallest step for the SS signalled by the UTRAN is 1/8 Tc. For the UE capabilities regarding the SS adjustment of the UE it is suggested to set the tolerance for the executed command to be [1/9;1/7] Tc (to be defined in TSG RAN WG4).

Table XXX: Coding of the SS for 8PSK

SS	SS Bits	Meaning
'Down'	000	Decrease synchronisation shift by k/8 Tc
'Up'	110	Increase synchronisation shift by k/8 Tc
'Do nothing'	011	No change

Annex ~~E~~F (Informative):

Examples of the association of DL SS commands to UL uplink time slots

In the following two examples of the association of ~~DL~~ SS commands to UL ~~uplink~~ time slots are shown (see 6.2.2.3):

Table E.1 Two examples of the association of DL SS commands to UL uplink time slots with N_{ULslot}=3

Case 1: $N_{SSsymbols}$=2; Case 2: $N_{SSsymbols}$=4

Sub-Frame Number	Case 1 (2 DL SS symbols)	The order of DL SS symbols	The order of the served UL time slot (UL time slot number)	Case 2 (4 DL SS symbols)	The order of DL SS symbols
SFN'=0	(1st UL_{pos}=0)	0	0 (TS3)	0	(1st UL_{pos}=0)
		1	1 (TS4)	1	
			2 (TS5)	2	
			0 (TS3)	3	
SFN'=1	(1st UL_{pos}=2)	0	0 (TS3)	0	(1st UL_{pos}=1)
		1	1 (TS4)	1	
			2 (TS5)	2	
			0 (TS3)	3	
			1 (TS4)		
SFN'=2	(1st UL_{pos}=1)	0	0 (TS3)	0	(1st UL_{pos}=2)
		1	1 (TS4)	1	
			2 (TS5)	2	
			0 (TS3)	3	
			1 (TS4)		
			2 (TS5)		
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Annex FE (informative):

Change history

<No changes will be made in this chapter in this CR, only the numbering has to be changed. >

Textproposal for working CR for 25.221

---------- End of text proposal for working CR for 25.221 ----------