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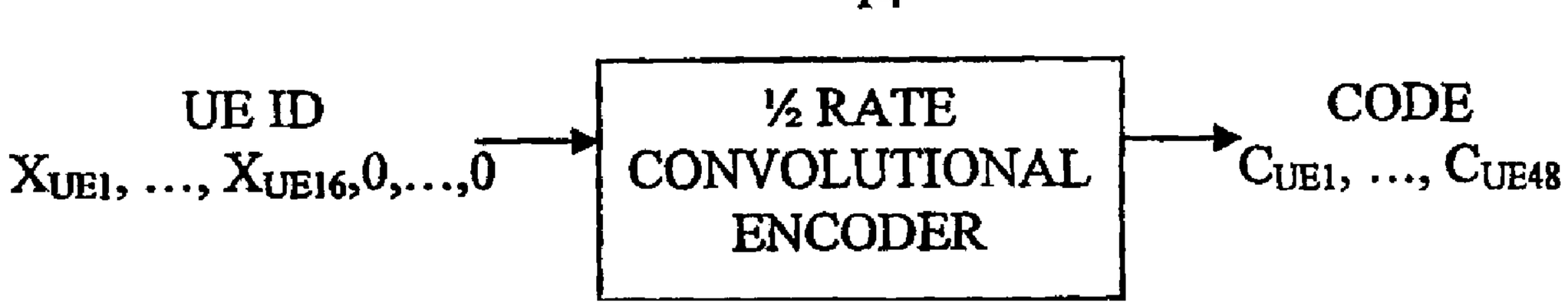
(71) Demandeur/Applicant:
INTERDIGITAL TECHNOLOGY CORPORATION, US

(72) Inventeurs/Inventors:
DICK, STEPHEN G., US;
BOLOURCHI, NADER, US;
SHIN, SUNG-HYUK, US

(74) Agent: RIDOUT & MAYBEE LLP

(54) Titre : PRODUCTION D'UN CODE DE CHIFFREMENT SPECIFIQUE D'IDENTIFICATION D'EQUIPEMENT UTILISATEUR POUR CANAL DE SIGNALISATION PARTAGE A GRANDE VITESSE

(54) Title: GENERATION OF USER EQUIPMENT IDENTIFICATION SPECIFIC SCRAMBLING CODE FOR THE HIGH SPEED SHARED CONTROL CHANNEL



(57) Abrégé/Abstract:
A code is produce for use in scrambling or descrambling data associated with a high speed shared control channel (HS-SSCH) for a particular user equipment. A user identification of the particular user equipment comprises L bits. A 1/2 rate convolutional encoder processes at least the bits of the user identification by a 1/2 rate convolutional code to produce the code.

ABSTRACT

A code is produce for use in scrambling or descrambling data associated with a high speed shared control channel (HS-SSCH) for a particular user equipment. A user identification of the particular user equipment comprises L bits. A ½ rate convolutional encoder processes at least the bits of the user identification by a ½ rate convolutional code to produce the code.

TITLE OF THE INVENTION

GENERATION OF USER EQUIPMENT IDENTIFICATION SPECIFIC SCRAMBLING CODE FOR THE HIGH SPEED SHARED CONTROL CHANNEL

This application is a divisional of Canadian patent application Serial No. 2,484,264 filed internationally on May 5, 2003 and entered nationally on November 4, 2004.

BACKGROUND

The present invention relates to wireless communication systems. More particularly, the present invention relates to user equipment identification specific scrambling sequences for high speed shared control channels (HS-SCCH).

A high speed downlink packet access (HSDPA) is proposed for wideband code division multiple access communication systems. HSDPA allows for high downlink data rates to support multimedia services.

To support HSDPA, high speed shared control channels (HS-SCCHs) are used. The HS-SCCHs are used to signal vital control information to the user equipments (UEs). Each HS-SCCH has two parts, referred to as Part-1 and Part-2. Part-1 carries time critical information needed by the UE. This information includes the channelization code set and the modulation type used by the high speed physical downlink shared control channel (HS-PDSCH) which carries the HSDPA payload. This information is vital to support HSDPA, since HSDPA uses adaptive modulation and coding (AMC).

To obtain its Part-1 information, each HSDPA UE monitors up to four HS-SCCHs for its information. The information for a particular UE is distinguished from other UEs by its UE identification (UE ID) specific scrambling sequence. The UE processes each monitored HS-SCCH with its UE ID specific scrambling sequence to detect the HS-SCCH intended for the UE. After processing, the UE determines on which HS-SCCH, if any, information was

carried using its scrambling sequence. The UE descrambles the data carried on Part-1 of its HS-SCCH using its scrambling sequence.

Until recently, a 10 bit UE ID was used as the basis for the UE ID specific scrambling sequence. In this case, this UE ID was converted into a 40 bit scrambling sequence. To turn the 10 bit UE ID into the 40 bit UE ID specific scrambling sequence, the 10 bit UE ID is processed by a Reed-Muller block to produce a 32 bit code. The first 8 bits of the produced code are repeated and appended onto the back of the 32 bit code to produce a 40 bit code.

Although it is proposed to extend the UE ID length to 16 chips, the current proposal for the HS-SCCHs uses a 10 bit UE ID. This UE ID is converted into a 40 bit scrambling sequence. To turn the 10 bit UE ID into the 40 bit scrambling sequence, the 10 bit UE ID is processed by a Reed-Muller block to produce a 32 bit code. The first 8 bits of the produced code are repeated and appended onto the back of the 32 bit code to produce a 40 bit code.

To reduce the occurrence of false detections, it is desirable to have good separation between the produced scrambling codes for each UE ID. Accordingly, it is desirable to have alternate approaches to producing scrambling codes.

SUMMARY

A code is produced for use in scrambling or descrambling data associated with a high speed shared control channel (HS-SSCH) for a particular user equipment. A user identification of the particular user equipment comprises L bits. A ½ rate convolutional encoder processes at least the bits of the user identification by a ½ rate convolutional code to produce the code.

According to a first aspect, the invention relates to a base station for use in a code division multiple access communication system, the base station comprising: circuitry configured to process a user equipment identification (UE ID) by ½ rate convolutionally encoding the UE ID to produce a code used by the

base station for scrambling a high speed shared control channel (HS-SCCH); and wherein the base station is configured to transmit a wireless signal, the wireless signal providing the user equipment with payload data carried on a high speed physical downlink shared channel (HS-PDSCH), the HS-PDSCH being associated with the HS-SCCH.

According to a second aspect, the invention relates to a base station in a code division multiple access communication system, the base station being configured to transmit control data carried by a plurality of high speed shared control channels (HS-SCCHs), at least one of the plurality of HS-SCCHs being scrambled by the base station for subsequent descrambling at a user equipment associated with the communication system by a descrambling code, the descrambling code being produced by ½ rate convolutionally encoding a user equipment identification (UE ID) associated with the user equipment, wherein the base station is further configured to transmit a wireless signal to the user equipment, the wireless signal providing the user equipment with payload data carried on a high speed physical downlink shared channel (HS-PDSCH), the HS-PDSCH being associated with the HS-SCCH.

According to a third aspect, the invention relates to a code division multiple access system comprising: a base station including means for processing a user equipment identification (UE ID) by ½ rate convolutionally encoding the UE ID to produce a scrambling code used by the base station for scrambling a high speed shared control channel (HS-SCCH), wherein the base station is configured to transmit a wireless signal, the wireless signal providing payload data carried on a high speed physical downlink shared channel (HS-PDSCH), the HS-PDSCH being associated with the HS-SCCH; and a user equipment configured to receive the wireless signal transmitted by the base station, the user equipment including means for processing the UE ID by ½ rate convolutionally encoding the UE ID to reproduce the scrambling code to descramble the scrambled HS-SCCH.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1A is a preferred diagram of a circuit for producing a code associated with a particular user for a HS-SCCH.

Figure 1B is a diagram of a rate matching block used in conjunction with Figure 1A.

Figure 2A is a preferred diagram of a circuit for producing a code associated with a user identification of 16 bits.

Figure 2B is a diagram of a rate matching block used in conjunction with Figure 2A.

Figure 3 is a simplified user equipment using the UE ID specific scrambling code.

Figure 4 is a simplified base station using the UE ID specific scrambling code.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Although the preferred embodiments are described in conjunction with the preferred application of the invention for use with the HSDPA of the third generation partnership project (3GPP) wideband code division multiple access (W-CDMA) communication system, the invention can be applied to other code division multiple access communication systems. Figures 1A and 1B are diagrams of a preferred UE ID specific scrambling sequence circuit. A UE ID, X_{UE}, of length L is input into the circuit. L can be any length, such as 8 bits, 10 bits, 16 bits, etc. The UE ID, $X_{UE} = \{X_{UE1}, \ldots, X_{UEL}\}$, is input into a ½ rate convolutional encoder 10 as shown in Figure 1A. Along with the UE ID, extra bits, such as zeros, may be added to the end of the input string to extend the length of the input string and, accordingly, the output string. The use of a ½ rate convolutional encoder 10 provides for a high level of code separation between the output strings produced by different UE IDs. Additionally, current proposed 3GPP W-CDMA communication systems utilize a ½ rate convolutional encoder 10 for a forward error correction (FEC) technique. Accordingly, no additional

hardware is required to generate the convolutionally encoded UE ID specific scrambling sequence. After encoding, based on the length of the output string, a rate matching stage 12 may be added to puncture bits to obtain a desired string length.

Figures 2A and 2B are diagrams of preferred UE ID specific scrambling sequence circuit for a preferred UE ID codes of length 16, L=16. The 16 bit UE ID, $X_{UE} = \{X_{UE1}, \ldots, X_{UE16}\}$, is input into a ½ rate convolutional encoder 14 along with eight zero bits appended onto the end of the input string. As a result, the input string is $X_{UE1}, \ldots, X_{UE16}, 0, 0, 0, 0, 0, 0, 0, 0$. After being processed by the ½ rate convolutional encoder 14, the output code is 48 bits in length, $C_{UE} = \{C_{UE1}, \ldots, C_{UE48}\}$.

To reduce the length of the code to a preferred length of 40 bits, eight bits are preferably punctured. Figure 2B illustrates the rate matching stage 16 to perform the puncturing. After the rate matching stage 16, the effective length of the scrambling code is 40 bits.

Figure 4 is a simplified diagram of a user equipment descrambling a HS-SCCH using the UE ID specific scrambling code. The UE ID scrambling code is mixed, such as by exclusive-or gate 18, with the received HS-SCCH for use in recovering the encoded HS-SCCH data.

Figure 3 is a simplified diagram of a base station scrambling encoded data with the UE ID specific scrambling code for transfer over the HS-SCCH. The encoded data is mixed with the UE ID scrambling code, such as by an exclusive-or gate 20, for a particular user. The scrambled data is used to produce the HS-SCCH for transfer to the particular user.

WHAT IS CLAIMED IS:

1. A base station for use in a code division multiple access communication system, the base station comprising:

circuitry configured to process a user equipment identification (UE ID) by ½ rate convolutionally encoding the UE ID to produce a code used by the base station for scrambling a high speed shared control channel (HS-SCCH); and

wherein the base station is configured to transmit a wireless signal, the wireless signal providing the user equipment with payload data carried on a high speed physical downlink shared channel (HS-PDSCH), the HS-PDSCH being associated with the HS-SCCH.

2. The base station of claim 1, wherein the HS-SCCH comprises a first part and a second part and wherein the code is used by the base station for scrambling only the first part of the HS-SCCH.

3. The base station of claim 2, wherein the UE ID has a length of 16 bits.

4. The base station of claim 3, wherein the means for processing the UE ID is further configured to process the UE ID and eight zero bits appended to the UE ID to produce the code used by the base station for descrambling the first part of the HS-SCCH.

5. The base station of claim 4, wherein when means for processing the UE ID processes the UE ID and the eight zero bits appended to the UE ID and the means for processing the UE ID produces a 48 bit code and wherein the base station further comprises:

means for puncturing 8 bits of the 48 bit code to produce the code used by the base station for descrambling the first part of the HS-SCCH.

6. The base station of claim 2, wherein the first part of the HS-SCCH includes channelization and modulation information associated with the HS-PDSCH.

7. The base station of claim 1, wherein the base station supports multimedia services.

8. A base station in a code division multiple access communication system, the base station being configured to transmit control data carried by a plurality of high speed shared control channels (HS-SCCHs), at least one of the plurality of HS-SCCHs being scrambled by the base station for subsequent descrambling at a user equipment associated with the communication system by a descrambling code, the descrambling code being produced by ½ rate convolutionally encoding a user equipment identification (UE ID) associated with the user equipment, wherein

the base station is further configured to transmit a wireless signal to the user equipment, the wireless signal providing the user equipment with payload data carried on a high speed physical downlink shared channel (HS-PDSCH), the HS-PDSCH being associated with the HS-SCCH.

9. The base station of claim 8, wherein the at least one of the plurality of HS-SCCHs comprises a first part and a second part and wherein only the first part of the at least one of the plurality of HS-SCCHs has been scrambled by the base station.

10. The base station of claim 9, wherein the first part of the at least one of the plurality of HS-SCCHs includes channelization and modulation information associated with the HS-PDSCH.

11. The base station of claim 8, wherein the UE ID has a length of 16 bits.

12. The base station of claim 8, wherein the base station further comprises:

a ½ rate convolutional encoder configured to process the UE ID and eight zero bits appended to the UE ID to produce a 48 bit code;

means for puncturing 8 bits of the 48 bit code; and

means for mixing the first part of the at least one of the plurality of HS-SCCHs with the punctured 48 bit code to scramble the at least one of the plurality of HS-SCCHs.

13. The base station of claim 12, wherein the mixing means mixes the first part of the at least one of the plurality of HS-SCCHs with the punctured 48 bit code comprises an exclusive-OR gate.

14. The base station of claim 8, wherein the base station supports multimedia services.

15. A code division multiple access system comprising:

a base station including means for processing a user equipment identification (UE ID) by ½ rate convolutionally encoding the UE ID to produce a scrambling code used by the base station for scrambling a high speed shared control channel (HS-SCCH), wherein the base station is configured to transmit a wireless signal, the wireless signal providing payload data carried on a high speed physical downlink shared channel (HS-PDSCH), the HS-PDSCH being associated with the HS-SCCH; and

a user equipment configured to receive the wireless signal transmitted by the base station, the user equipment including means for processing the UE ID

by ½ rate convolutionally encoding the UE ID to reproduce the scrambling code to descramble the scrambled HS-SCCH.

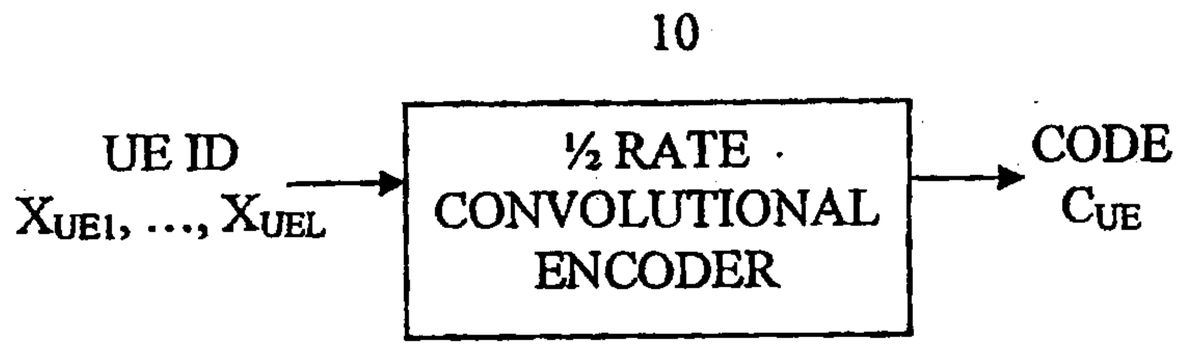


FIG. 1A

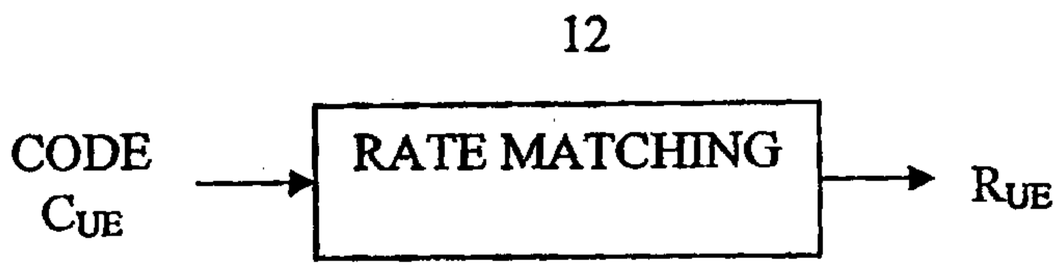


FIG. 1B

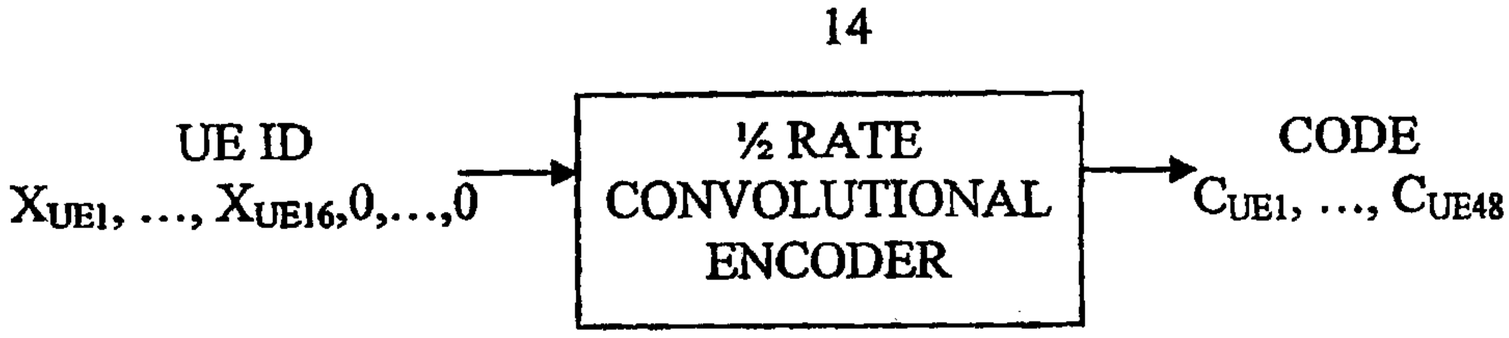


FIG. 2A

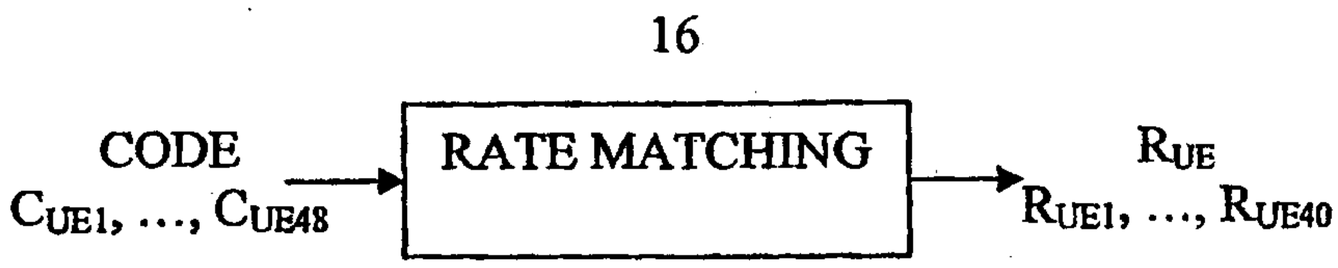


FIG. 2B

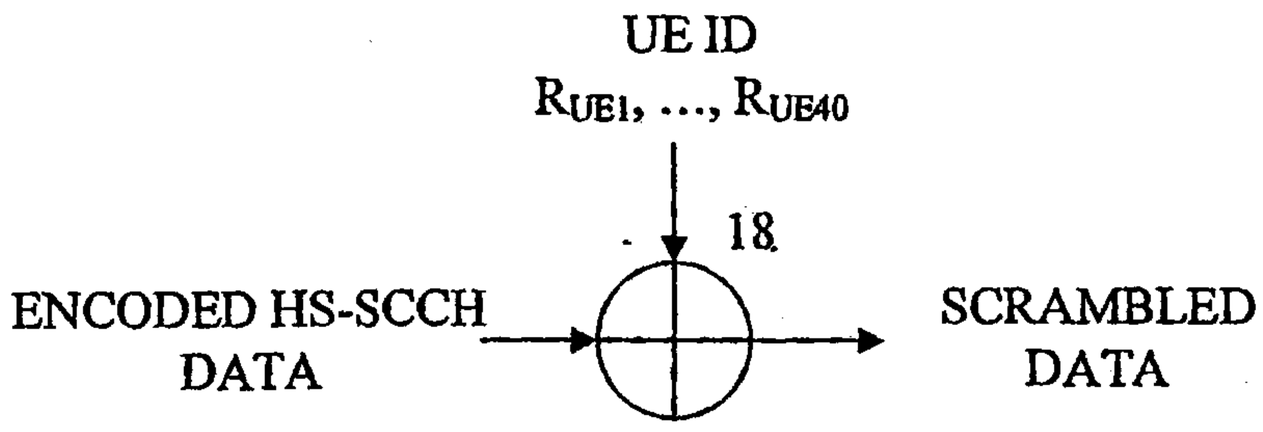

UE ID
$R_{UE1}, \ldots, R_{UE40}$
18
ENCODED HS-SCCH DATA
SCRAMBLED DATA

FIG. 3

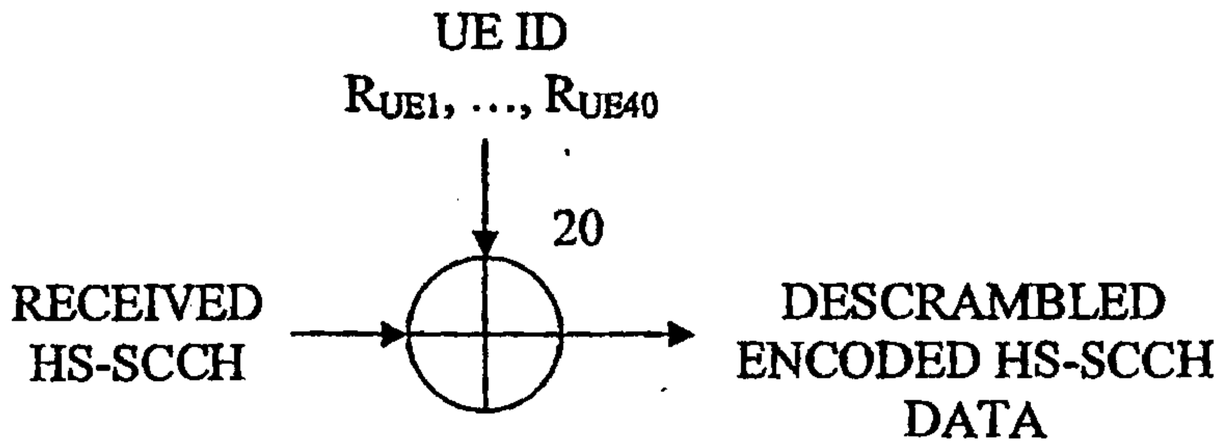
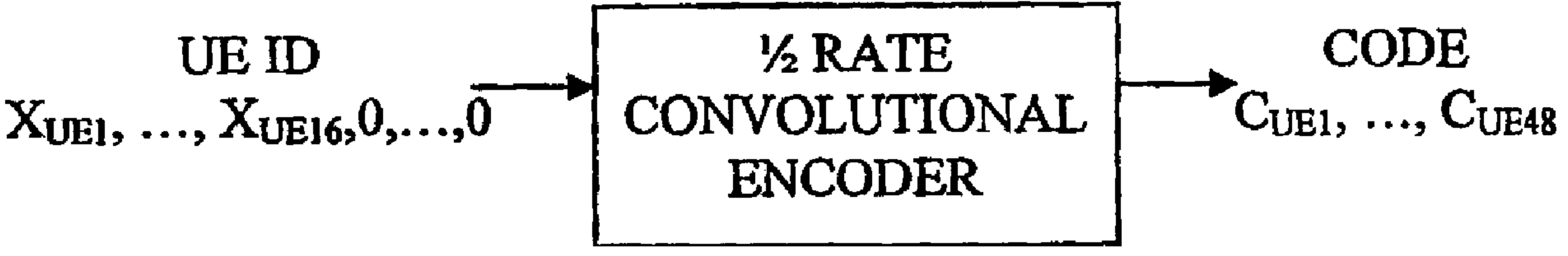

UE ID
$R_{UE1}, \ldots, R_{UE40}$
20
RECEIVED HS-SCCH
DESCRAMBLED ENCODED HS-SCCH DATA

FIG. 4


UE ID
$X_{UE1}, \ldots, X_{UE16}, 0, \ldots, 0$
½ RATE CONVOLUTIONAL ENCODER
CODE
$C_{UE1}, \ldots, C_{UE48}$