

FILE HISTORY

60/979,860

INVENTORS: Jin Sam KWAK

TITLE: TRANSMISSION METHODS FOR
SCHEDULING REQUEST THROUGH
TIME/FREQUENCY SPREADING
CONTROL CHANNELS

APPLICATION NO: 60/979,860

FILED: 14 OCT 2007

COMPILED: 18 AUG 2016

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Application Number:	60979860
International Application Number:	
Confirmation Number:	8080
Title of Invention:	TRANSMISSION METHODS FOR SCHEDULING REQUEST THROUGH TIME/FREQUENCY SPREADING CONTROL CHANNELS
First Named Inventor/Applicant Name:	Jin Sam KWAK
Customer Number:	67487
Filer:	Andrew S. Park/Soojin KIM
Filer Authorized By:	Andrew S. Park
Attorney Docket Number:	UT07-0084-USP0
Receipt Date:	14-OCT-2007
Filing Date:	
Time Stamp:	22:17:17
Application Type:	Provisional

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes) /Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	UT07-084_USP0_ADS.pdf	1515884 eb997651e4720245d68fc03c7570a86c2eab7664	no	7
Warnings:					
Information:					
2	Specification - Not in English	UT07-084_SPEC.pdf	4064867 9b13b2dc04eb1bb5b2c614baec3a3e66a90943ec	no	20
Warnings:					
The page size in the PDF is too large. The pages should be 8.5 x 11 or A4. If this PDF is submitted, the pages will be resized upon entry into the Image File Wrapper and may affect subsequent processing					
Information:					
3	Fee Worksheet (PTO-06)	fee-info.pdf	8183 98060b2e6f0ee63f711b493bc6d147937423d1d7	no	2
Warnings:					
Information:					
Total Files Size (in bytes):			5588934		
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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	UT07-0084-USP0
		Application Number	
Title of Invention	TRANSMISSION METHODS FOR SCHEDULING REQUEST THROUGH TIME/FREQUENCY SPREADING CONTROL CHANNELS		
<p>The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.</p> <p>This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.</p>			

Secrecy Order 37 CFR 5.2

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Applicant Information:

Applicant 1					Remove
Applicant Authority <input checked="" type="radio"/> Inventor		<input type="radio"/> Legal Representative under 35 U.S.C. 117		<input type="radio"/> Party of Interest under 35 U.S.C. 118	
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Jin	Sam	KWAK		
Residence Information (Select One) <input type="radio"/> US Residency <input checked="" type="radio"/> Non US Residency <input type="radio"/> Active US Military Service					
City	Gunpo	Country Of Residenceⁱ	KR		
Citizenship under 37 CFR 1.41(b)ⁱ		KR			
Mailing Address of Applicant:					
Address 1		LG ELECTRONICS INC. IP GROUP			
Address 2		533 Hogye-1dong, Dongan-gu, Anyang-si, Gyeonggi-do			
City	Anyang	State/Province			
Postal Code	431-080	Countryⁱ	KR		
Applicant 2					Remove
Applicant Authority <input checked="" type="radio"/> Inventor		<input type="radio"/> Legal Representative under 35 U.S.C. 117		<input type="radio"/> Party of Interest under 35 U.S.C. 118	
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Yeong	Hyeon	KWON		
Residence Information (Select One) <input type="radio"/> US Residency <input checked="" type="radio"/> Non US Residency <input type="radio"/> Active US Military Service					
City	Suwon	Country Of Residenceⁱ	KR		
Citizenship under 37 CFR 1.41(b)ⁱ		KR			
Mailing Address of Applicant:					
Address 1		LG ELECTRONICS INC. IP GROUP			
Address 2		533 Hogye-1dong, Dongan-gu, Anyang-si, Gyeonggi-do			
City	Anyang	State/Province			
Postal Code	431-080	Countryⁱ	KR		
Applicant 3					Remove
Applicant Authority <input checked="" type="radio"/> Inventor		<input type="radio"/> Legal Representative under 35 U.S.C. 117		<input type="radio"/> Party of Interest under 35 U.S.C. 118	
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Seung	Hee	HAN		
Residence Information (Select One) <input type="radio"/> US Residency <input checked="" type="radio"/> Non US Residency <input type="radio"/> Active US Military Service					
City	Seoul	Country Of Residenceⁱ	KR		

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	UT07-0084-USP0
		Application Number	
Title of Invention	TRANSMISSION METHODS FOR SCHEDULING REQUEST THROUGH TIME/FREQUENCY SPREADING CONTROL CHANNELS		

Citizenship under 37 CFR 1.41(b) i		KR	
Mailing Address of Applicant:			
Address 1		LG ELECTRONICS INC. IP GROUP	
Address 2		533 Hogye-1dong, Dongan-gu, Anyang-si, Gyeonggi-do	
City	Anyang	State/Province	
Postal Code	431-080	Countryⁱ	KR
Applicant 4			Remove
Applicant Authority		<input checked="" type="radio"/> Inventor <input type="radio"/> Legal Representative under 35 U.S.C. 117 <input type="radio"/> Party of Interest under 35 U.S.C. 118	
Prefix	Given Name	Middle Name	Family Name
	Min	Seok	NOH
Residence Information (Select One) <input type="radio"/> US Residency <input checked="" type="radio"/> Non US Residency <input type="radio"/> Active US Military Service			
City	Anyang	Country Of Residenceⁱ	KR
Citizenship under 37 CFR 1.41(b) i		KR	
Mailing Address of Applicant:			
Address 1		LG ELECTRONICS INC. IP GROUP	
Address 2		533 Hogye-1dong, Dongan-gu, Anyang-si, Gyeonggi-do	
City	Anyang	State/Province	
Postal Code	431-080	Countryⁱ	KR
Applicant 5			Remove
Applicant Authority		<input checked="" type="radio"/> Inventor <input type="radio"/> Legal Representative under 35 U.S.C. 117 <input type="radio"/> Party of Interest under 35 U.S.C. 118	
Prefix	Given Name	Middle Name	Family Name
	Hyun	Woo	LEE
Residence Information (Select One) <input type="radio"/> US Residency <input checked="" type="radio"/> Non US Residency <input type="radio"/> Active US Military Service			
City	Anyang	Country Of Residenceⁱ	KR
Citizenship under 37 CFR 1.41(b) i		KR	
Mailing Address of Applicant:			
Address 1		LG ELECTRONICS INC. IP GROUP	
Address 2		533 Hogye-1dong, Dongan-gu, Anyang-si, Gyeonggi-do	
City	Anyang	State/Province	
Postal Code	431-080	Countryⁱ	KR
Applicant 6			Remove
Applicant Authority		<input checked="" type="radio"/> Inventor <input type="radio"/> Legal Representative under 35 U.S.C. 117 <input type="radio"/> Party of Interest under 35 U.S.C. 118	
Prefix	Given Name	Middle Name	Family Name
	Dong	Cheol	KIM
Residence Information (Select One) <input type="radio"/> US Residency <input checked="" type="radio"/> Non US Residency <input type="radio"/> Active US Military Service			
City	Uiwang	Country Of Residenceⁱ	KR
Citizenship under 37 CFR 1.41(b) i		KR	

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	UT07-0084-USP0
		Application Number	
Title of Invention	TRANSMISSION METHODS FOR SCHEDULING REQUEST THROUGH TIME/FREQUENCY SPREADING CONTROL CHANNELS		

Mailing Address of Applicant:

Address 1	LG ELECTRONICS INC. IP GROUP		
Address 2	533 Hoge-1dong, Dongan-gu, Anyang-si, Gyeonggi-do		
City	Anyang	State/Province	
Postal Code	431-080	Countryⁱ	KR

Applicant 7[Remove](#)

Applicant Authority	<input checked="" type="radio"/> Inventor	<input type="radio"/> Legal Representative under 35 U.S.C. 117	<input type="radio"/> Party of Interest under 35 U.S.C. 118
Prefix	Given Name	Middle Name	Family Name
	Ki	Ho	NAM
Residence Information (Select One) <input type="radio"/> US Residency <input checked="" type="radio"/> Non US Residency <input type="radio"/> Active US Military Service			
City	Gunpo	Country Of Residenceⁱ	KR
Citizenship under 37 CFR 1.41(b)ⁱ	KR		

Mailing Address of Applicant:

Address 1	LG ELECTRONICS INC. IP GROUP		
Address 2	533 Hoge-1dong, Dongan-gu, Anyang-si, Gyeonggi-do		
City	Anyang	State/Province	
Postal Code	431-080	Countryⁱ	KR

Applicant 8[Remove](#)

Applicant Authority	<input checked="" type="radio"/> Inventor	<input type="radio"/> Legal Representative under 35 U.S.C. 117	<input type="radio"/> Party of Interest under 35 U.S.C. 118
Prefix	Given Name	Middle Name	Family Name
	Sung	Gu	CHO
Residence Information (Select One) <input type="radio"/> US Residency <input checked="" type="radio"/> Non US Residency <input type="radio"/> Active US Military Service			
City	Gunpo	Country Of Residenceⁱ	KR
Citizenship under 37 CFR 1.41(b)ⁱ	KR		

Mailing Address of Applicant:

Address 1	LG ELECTRONICS INC. IP GROUP		
Address 2	533 Hoge-1dong, Dongan-gu, Anyang-si, Gyeonggi-do		
City	Anyang	State/Province	
Postal Code	431-080	Countryⁱ	KR

Applicant 9[Remove](#)

Applicant Authority	<input checked="" type="radio"/> Inventor	<input type="radio"/> Legal Representative under 35 U.S.C. 117	<input type="radio"/> Party of Interest under 35 U.S.C. 118
Prefix	Given Name	Middle Name	Family Name
	Hong	Won	PARK
Residence Information (Select One) <input type="radio"/> US Residency <input checked="" type="radio"/> Non US Residency <input type="radio"/> Active US Military Service			
City	Gunpo	Country Of Residenceⁱ	KR
Citizenship under 37 CFR 1.41(b)ⁱ	KR		

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	UT07-0084-USP0
		Application Number	
Title of Invention	TRANSMISSION METHODS FOR SCHEDULING REQUEST THROUGH TIME/FREQUENCY SPREADING CONTROL CHANNELS		

Mailing Address of Applicant:				
Address 1		LG ELECTRONICS INC. IP GROUP		
Address 2		533 Hoge-1dong, Dongan-gu, Anyang-si, Gyeonggi-do		
City	Anyang	State/Province		
Postal Code	431-080	Countryⁱ	KR	
Applicant 10				<input type="button" value="Remove"/>
Applicant Authority		<input checked="" type="radio"/> Inventor <input type="radio"/> Legal Representative under 35 U.S.C. 117 <input type="radio"/> Party of Interest under 35 U.S.C. 118		
Prefix	Given Name	Middle Name	Family Name	Suffix
	Jae	Hoon	CHUNG	
Residence Information (Select One) <input type="radio"/> US Residency <input checked="" type="radio"/> Non US Residency <input type="radio"/> Active US Military Service				
City	Daegu	Country Of Residenceⁱ	KR	
Citizenship under 37 CFR 1.41(b)ⁱ		KR		
Mailing Address of Applicant:				
Address 1		LG ELECTRONICS INC. IP GROUP		
Address 2		533 Hoge-1dong, Dongan-gu, Anyang-si, Gyeonggi-do		
City	Anyang	State/Province		
Postal Code	431-080	Countryⁱ	KR	
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button. <input type="button" value="Add"/>				

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).			
<input type="checkbox"/> An Address is being provided for the correspondence Information of this application.			
Customer Number	67487		
Email Address	info@kpatent.com	<input type="button" value="Add Email"/>	<input type="button" value="Remove Email"/>
Email Address	sjpark@kpatent.com	<input type="button" value="Add Email"/>	<input type="button" value="Remove Email"/>

Application Information:

Title of the Invention	TRANSMISSION METHODS FOR SCHEDULING REQUEST THROUGH TIME/FREQUENCY SPREADING CONTROL CHANNELS		
Attorney Docket Number	UT07-0084-USP0	Small Entity Status Claimed <input type="checkbox"/>	
Application Type	Provisional		
Subject Matter	Utility		
Suggested Class (if any)		Sub Class (if any)	
Suggested Technology Center (if any)			
Total Number of Drawing Sheets (if any)		Suggested Figure for Publication (if any)	

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	UT07-0084-USP0
		Application Number	
Title of Invention	TRANSMISSION METHODS FOR SCHEDULING REQUEST THROUGH TIME/FREQUENCY SPREADING CONTROL CHANNELS		

Publication Information:

<input type="checkbox"/> Request Early Publication (Fee required at time of Request 37 CFR 1.219)
<input type="checkbox"/> Request Not to Publish. I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application has not and will not be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Enter either Customer Number or complete the Representative Name section below. If both sections are completed the Customer Number will be used for the Representative Information during processing.			
Please Select One:	<input checked="" type="radio"/> Customer Number	<input type="radio"/> US Patent Practitioner	<input type="radio"/> Limited Recognition (37 CFR 11.9)
Customer Number	67487		

Domestic Benefit Information:

This section allows for the applicant to claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c). Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78(a)(2) or CFR 1.78(a)(4), and need not otherwise be made part of the specification.			
Prior Application Status		Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
Additional Domestic Priority Data may be generated within this form by selecting the Add button.			Add

Foreign Priority Information:

This section allows for the applicant to claim benefit of foreign priority and to identify any prior foreign application for which priority is not claimed. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(a).			
Remove			
Application Number	Country ⁱ	Parent Filing Date (YYYY-MM-DD)	Priority Claimed
			<input checked="" type="radio"/> Yes <input type="radio"/> No
Additional Foreign Priority Data may be generated within this form by selecting the Add button.			Add

Assignee Information:

Providing this information in the application data sheet does not substitute for compliance with any requirement of part 3 of Title 37 of the CFR to have an assignment recorded in the Office.	
Assignee 1	Remove

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	UT07-0084-USP0
		Application Number	
Title of Invention	TRANSMISSION METHODS FOR SCHEDULING REQUEST THROUGH TIME/FREQUENCY SPREADING CONTROL CHANNELS		

If the Assignee is an Organization check here. <input checked="" type="checkbox"/>			
Organization Name	LG Electronics Inc.		
Mailing Address Information:			
Address 1	20 Yeouido-dong, Yeongdeungpo-gu		
Address 2			
City	Seoul	State/Province	
Country	KR	Postal Code	150-721
Phone Number		Fax Number	
Email Address			
Additional Assignee Data may be generated within this form by selecting the Add button. <input type="button" value="Add"/>			

Signature:

A signature of the applicant or representative is required in accordance with 37 CFR 1.33 and 10.18. Please see 37 CFR 1.4(d) for the form of the signature.					
Signature	/Andrew S. Park/			Date (YYYY-MM-DD)	2007-10-14
First Name	Andrew	Last Name	Park	Registration Number	47841

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

**PROVISIONAL APPLICATION FOR UNITED STATES PATENT
IN THE NAMES OF**

Jin Sam KWAK, Yeong Hyeon KWON, Seung Hee HAN, Min Seok
NOH, Hyun Woo LEE, Dong Cheol KIM, Ki Ho NAM, Sung Gu CHO,
Hong Won PARK and Jae Hoon CHUNG

for

**TRANSMISSION METHODS FOR SCHEDULING REQUEST
THROUGH TIME/FREQUENCY SPREADING CONTROL CHANNELS**

prepared by:

KORPAT, P.C.

Customer Number: 67487

Attorney Docket Number: UT07-0084-USP0

Total Number of pages: 20 (including cover)

명 세 서	
1. 발명(고안)의 명칭 -	
시간 또는 주파수 영역 확산으로 구성된 제어채널을 통해 scheduling request 전송 방식 (Transmission Methods for Scheduling Request Through Time- or Frequency Spreading Control Channels)	
2. 발명(고안)의 상세한 설명	
1) 발명(고안)의 목적	
<p>본 발명은 시간 또는 주파수 영역 확산으로 구성된 제어신호 전송 채널을 통해 scheduling request (SR) 전송이 요구되는 경우 기존 제어채널 구조를 고려한 부가 정보를 전송하는 방식에 대해 제안한다. 특히, 기존의 확산 제어 채널 구조를 유지하고, 동일한 시간-주파수 자원에서 제어신호와 SR을 동시에 지원 가능한 전송방식을 제안한다. 이를 위해 크게 확산 부호를 활용한 SR 채널 생성 방식과, 기할당된 제어신호용 확산부호를 사용하지 않으면서 부가 SR 채널 생성방식을 제안한다. 구체적으로는 제어신호와 SR 신호의 구별을 위한 부호할당 방식과 할당된 부호를 통해 SR 정보 전송을 위한 채널 구성방식 및 coherent/non-coherent 복조방식을 제안하고, 이와 별도로 제어 채널 구성을 위한 부호 할당방식을 유지하면서 주파수 도약을 통한 추가적인 SR 정보전송이 가능한 방식을 제안한다.</p>	
<p>2) 종래 기술에 대한 설명 - 본 발명(고안)에 대해 가장 최근에 공지된 기술의 문제점을 설명한다. 종래의 예로서 문헌 또는 특허 공보 등 간행물이 있을 때는 첨부토록 하고 첨부된 도면에 의거 부호 일치하여 설명한다. (동 공지자료는 본 발명(고안)의 청구범위 작성에 중요함)</p>	
(1) 종래 기술 구성	
<p>광대역 통신 시스템의 경우 한정된 무선자원의 효율성을 극대화하기 위해서는 시간, 공간, 및 주파수 영역에서 보다 효과적인 송수신 기법 및 활용방안들이 제안되어 왔다. 특히, 다중반송파 기반의 OFDM 방식은 광대역 채널에서의 발생하는 주파수 선택적 페이딩 (frequency selective fading) 환경에서 수신단의 복잡도 감소와 함께 반송파의 상이한 채널 특성을 활용하여 주파수 영역에서의 선택적 스케줄링 등을 통해 주파수 효율 (spectral efficiency)를 극대화할 수 있는 장점을 가지고 있어 주파수 영역에서의 무선자원의 효율성 증대를 위해 각광받고 있다. 공간영역에서의 효율성 극대화를 위해 다중안테나 기술의 적용이 요구되고, 공간영역에서의 복수의 시간 및 주파수영역 생성을 통해 고속 멀티미디어 데이터 전송에 적합한 기술로 활용되고 있다. 또한, 시간영역의 효율적 자원활용을 위해 채널 부호화 및 복수의 사용자간의 채널 선택적 특성을 활용한 스케줄링 뿐만 아니라 패킷 데이터 전송에 적합한 HARQ 기법 등을 적용하고 있다.</p> <p>위와 같이, 광대역 시공간 고속 패킷전송을 위한 다양한 송수신 기법들을 구현하기 위해서는 시간, 공간, 및 주파수 영역에 대한 downlink/uplink 제어 신호 전달이 필수불가결한 요소이며, 이를 위해서 기할당된 제어채널을 활용하여 제어신호를 전송하고 있다. 구체적인 실시 예로서 LTE의 상향링크 제어신호 전송구조를 고려하여 설명하고자 한다. LTE에서의 소량의 데이터 신호 전송으로 ACK/NACK 전송방식을 살펴보자. 단말이 전송하는 신호의 대역폭은 크지 않은 대신에 파워를 한곳에 집중하여 전송하는 방식이 중요하며, 또한 전송 신호의 변화폭 (PAPR)도 작아야 한다. 이를 위하여 LTE에서는 uplink신호 전송으로 SC-FDM을 기본으로 사용하고 있다. SC-FDM은 신호의 변화량이 작도록 만들어주는 전송 방식으로 같은 power amp를 사용했을</p>	

때 더 넓은 coverage효과를 갖는다. SC-FDM의 기본 구조는 그림 1에 표시하였다. SC-FDM의 가장 큰 특징은 전송신호가 먼저 DFT로 spreading한 다음에 전송 신호를 생성하는 부분에서 frequency band에 집중하여 매핑하는 방식으로, 생성된 신호가 single carrier와 같은 효과가 있다. 따라서 생성된 신호는 작은 PAPR을 갖는 특징이 있다.

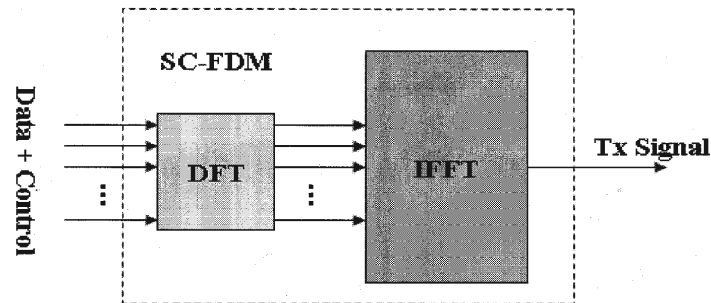


그림 1. SC-FDM 형식

이러한 SC-FDM구조 형식에서 control 신호를 전송할 때 고려해야 되는 부분이 발생한다. 우선 제어신호를 전송할 때, 데이터가 있는지 없는지에 따라서 다른 방식을 취한다. 제어신호를 전송할 때, 같이 보낼 데이터가 없는 경우는 그림 2와 같이 제어신호를 전송할 때, 제어신호는 시스템 대역중에 일부를 FDM으로 구분하여 할당해두고 제어신호만 전송하는 단말은 이 할당된 영역에 제어신호를 SC-FDM 형식으로 복조해서 전송한다. 이 할당된 영역에서 제어신호를 전송하는 방식은 이 영역 안에서 단말간에 FDM혹은 CDM방식을 취할 수 있다.

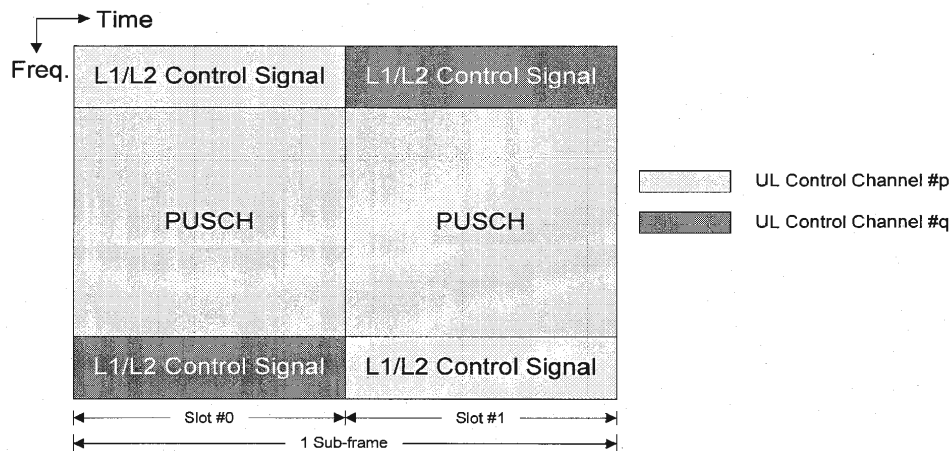


그림 2. 데이터가 없을 경우 제어신호를 전송하는 형태

그림 2와 같이 기할당된 대역내에서 제어신호를 전송할 때, 소량의 데이터 전송이 가능한 UE capability를 극대화하기 위해 주파수영역 뿐만 아니라 시간영역 확산을 동시에 적용하는 방안이 고려되고 있고, 그림 3에서는 coherent ACK/NACK전송을 위한 제어채널 구조를 보이고 있다. 그림에서는 하나의 slot에서의 전송구조를 보이고 있고, 그림 2에서와 같이 하나의 sub-frame에서 slot-based 주파수도약을 통해 동일신호를 반복하여 전송함으로써 주파수 다이버시티 이득을 획득하게 된다.

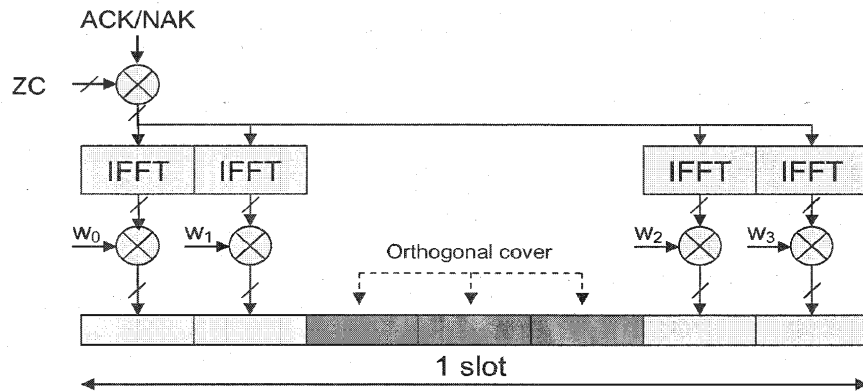


그림 3. LTE에서 Coherent ACK/NACK을 위한 상향링크 제어신호 전송 구조

위와 같은 시간-주파수 확산 ACK/NACK 신호 전송을 위해 기할당된 제어채널 영역은 단말이 상향링크 데이터 전송을 위한 scheduling request 전송시에 함께 고려되어야 한다. 특정 시간/주파수/부호 자원을 할당하여 dedicated SR 채널은 구성 가능하고, 이 때, 임의의 단말이 특정 전송구간에서 SR 신호 및 제어신호가 동시에 전송하여야 하는 경우 상이한 주파수영역을 갖는 복수의 채널을 통해 전송할 때 SC-FDMA 특성을 유지하기 어렵게 되어 궁극적으로는 SR 채널 또는 제어채널 중 단일 채널을 선택하여 단일 정보를 전송해야 하는 경우가 발생한다. 그러나, 제어신호 또는 SR 신호의 경우 특정 신호 선택을 위한 priority가 명확히 구분되기 어렵고, 특히, 소량의 제어신호를 기반으로 하향링크에서 효과적인 재전송을 수행함으로써 한정된 무선자원의 효율을 극대화하는 데에 필수적인 ACK/NACK 제어신호의 경우 하향링크의 성능에 직접적인 영향을 주게 되므로, high priority SR 전송이 요구되는 경우라도 ACK/NACK전송을 drop하는 것은 하향링크의 성능열화 및 자원효율성 저하를 야기하게 된다. 따라서, 특정 단말이 SR 신호 및 제어신호 전송이 요구되는 상황에서 기존 제어채널을 통한 효과적인 SR 전송방식의 제안이 요구된다.

(2) 종래 기술장치의 동작설명

(3) 종래 기술의 문제점

<p>3) 본 발명(고안)에 대한 설명 - 본 발명(고안)의 목적을 해결하기 위한 것과 관련하여 총괄적으로 설명한다.</p> <p>(1) 본 발명(고안)의 구성</p> <p>본 발명에서는 시간-주파수영역 확산으로 구성된 제어채널에서 SR 전송을 위한 효과적인 SR 채널 구성방식을 제안한다. 구체적인 접근방법으로 LTE ACK/NACK 채널과 같이 시간 및 주파수 확산을 고려한 2D spreading 채널구조에서 SR 신호 전송 방안을 제안한다. 이를 위해 아래와 같은 요구조건을 고려하여 SR 신호 전송용 채널 구조를 설계한다.</p> <p>(1) 그림 3과 같은 기존 ACK/NACK 채널 구조와 호환가능한 채널 설계가 필요하다.</p> <p>(2) SR 신호만을 전송하는 경우에도 동일한 채널 구조 지원이 가능하여야 한다.</p> <p>(3) ACK/NACK 신호만을 전송하는 경우 기존 ACK/NACK 채널에서의 UE capability 및 전송용량을 유지한다.</p> <p>(4) SR 신호와 제어신호가 동시에 전송되는 경우 UE multiplexing capability를 최대화하여야 한다.</p> <p>(5) ACK/NACK 신호와 SR 신호의 동시 전송 여부에 관계없이 동일한 SR 채널 구성이 이루어져야 한다.</p> <p>(6) 할당된 시간-주파수 자원에서 ACK/NACK 채널 및 SR 채널 구성이 유연하여야 한다.</p> <p>(7) 부호화당을 통한 dedicated SR 채널 구성시 부호화당의 유연성을 높여야 한다.</p> <p>(8) 협대역에서 지원가능한 최소 주파수 자원 할당에서 제어신호 및 SR 신호전송이 가능하여야 한다.</p> <p>(9) SR 신호 검출 후 ACK/NACK 신호 검출 성능 열화가 발생하지 않아야 한다.</p> <p>(10) ACK/NACK 신호의 존재여부에 관계없이 동일한 SR 신호 검출방식의 적용이 필요하다.</p> <p>(11) 기존 제어신호 (ACK/NACK 또는 CQI) 전송 방식과 공존 가능한 구조여야 하고, 이 때 기존 제어신호 전송 방식에 제약사항을 주지 않아야 한다.</p> <p>위와 같은 요구사항을 고려하여 SR 채널 구성방안을 고려하기 위해 부호화당을 통한 SR 채널 및 ACK/NACK 채널 구성방식을 제안하고, 이를 활용하여 coherent 또는 non-coherent SR 검출방식에 따른 구체적인 SR 채널 구조를 제안한다. 또한, 기존 ACK/NACK 구조를 활용하여 주파수 도약을 통한 SR 전송 방식을 제안한다. 본 발명에서 제안한 SR 채널 구조는 ACK/NACK 신호와 같이 특정 제어신호와 동시에 전송하는 경우에만 적용되는 것을 한정되지 않으면, 임의의 제어신호의 존재여부와 관계없이 일반적인 SR 채널 구성방식으로 확장 적용가능하다.</p> <p>A. SR Channel Generation by Allocating the Spreading Codes for Control Channels</p> <p>그림 3에서와 같이 기존 ACK/NACK 제어신호 전송 채널의 경우 2D spreading으로 주파수영역에서 ZC 부호와 시간영역에서 ACK/NACK 데이터를 위한 길이 4(short CP의 경우) 또는 RS를 위한 길이 3의 직교부호를 이용하여 제어채널을 구성하고 있다. 구체적으로는 1 RB의 주파수영역에서 길이 12의 ZC root sequence에 대해 circular shift로 6개의 직교부호 생성이 가능한 경우 1 slot에서 지원 가능한 ACK/NACK UE capability는 18로 coherent 복조를 위한 RS의 길이에 의해 multiplexing 용량이 결정된다. 이 때, SR 전송을 위해 ACK/NACK에서의 2D 확산부호를 효과적으로 reservation하여 SR용으로 할당함으로써 SR 전용 채널 구성이 가능하다. 이와 같이 dedicated SR 채널을 통한 SR 신호 전송은 ACK/NACK 신호의 검출 여부와 관계없이 dedicated SR 할당 부호를 통한 non-coherent 신호 검출로 SR 신호 획득이 가능하고, SR 신호와 ACK/NACK 신호가 동시에 전</p>

송하는 경우에 대해서는 기지국에서 알고 있으므로, 매 ACK/NACK 신호 검출 시 마다 SR 신호 검출을 위한 dedicated SR 부호 검출을 시도할 필요가 없으며, 동시 전송이 이루어 지는 경우에만 SR 신호 검출을 시도하게 된다.

ACK/NACK 채널과 Dedicated SR 채널 구성을 위한 부호할당 방식은 다음과 같다.

- (1) ACK/NACK 채널에 할당된 임의의 frequency-domain spreading code (e.g. ZC root sequence)에 대해 하나 또는 그 이상의 특정 부호 (e.g. circular shift)를 dedicated SR을 위해 할당하는 방법
- (2) ACK/NACK 채널에 할당된 시간영역 확산부호(time covering) 중 하나 또는 그 이상의 직교부호를 dedicated SR을 위해 할당하는 방법
- (3) ACK/NACK 채널에 할당된 시간-주파수 2D 확산부호 중 하나 또는 그 이상의 직교부호를 dedicated SR을 위해 할당하는 방법

상기의 3가지 부호할당방식은 부호 도약(hopping) 방식을 적용한 제어채널 구조에 대해서는 하나 또는 그 이상의 심볼마다 정의된 확산 도약 패턴의 할당으로 확장하여 적용 가능하다. 위와 같은 부호할당방식을 기반으로 구체적인 SR 채널 구성 방식에 대해 dedicated RS의 존재 여부에 따라 coherent SR 구조와 non-coherent SR 구조로 나누어 다음과 같은 전송 방식의 제안이 가능하다.

B. Coherent SR Structure with Dedicated RS

Dedicated RS를 갖는 coherent SR 구조는 앞 절에서 설명한 바와 같이 확산부호 할당 방식에 따라 상이한 채널 구성이 가능하다. 본 발명에서 제안하고 있는 SR 채널 구성 방식은 확산부호를 적용한 임의의 제어채널 구조에서 적용가능하고, 구체적인 실시 예로서 그림 3에서의 ACK/NACK 채널 구성 방식을 고려하여 설명하고자 한다.

- (1) ACK/NACK 채널에 할당된 임의의 frequency-domain spreading code (e.g. ZC root sequence)에 대해 하나 또는 그 이상의 특정 부호 (e.g. circular shift)를 dedicated SR을 위해 할당하는 방법

그림 4는 주파수 영역 확산 부호를 SR 채널 구성을 위해 할당하고, RS와 SR 정보 전송 심볼들에 따라 서로 다른 길이를 갖는 시간 영역 확산 부호 할당을 적용한 coherent SR 전송 구조를 보이고 있다. 그림에서와 같이 coherent SR 전송을 위해 dedicated RS를 구성한 경우에는 SR 전송 심볼들에서 적용한 시간 영역 직교

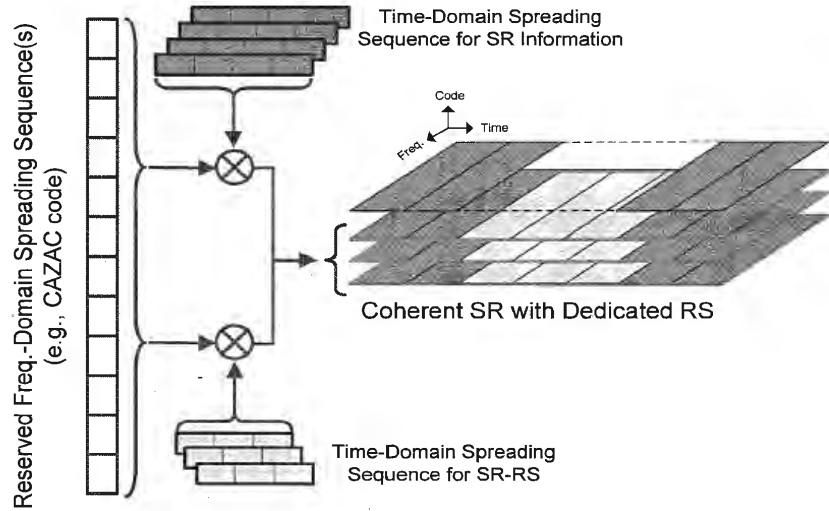


그림 4. 주파수영역 확산 부호를 할당하여 dedicated RS를 갖는 coherent SR 채널 구성의 예

확산 부호의 수가 RS 전용 직교확산 부호에 비해 많더라도, coherent SR 신호복조 (제어신호 없이 SR 전송만이 이루어 지는 경우)를 위해 지원 가능한 SR 채널 수는 dedicated RS 또는 SR information 구간에서의 시간영역 직교 확산 부호 수의 최소값에 의해 결정된다. 이와 같이 ACK/NACK 채널 구성에서 활용되는 시간-주파수영역 확산부호를 활용하여 SR 제어채널 구성을 수행하는 경우, 주파수 영역 확산 부호의 할당에 따라 UE multiplexing capability가 달라 지게 된다. LTE에서의 ACK/NACK 채널 구조에서 주파수 영역에서 하나의 ZC root sequence에 대해 circular shift를 통해 6개의 직교 확산 부호 생성이 가능한 경우, 하나의 할당된 circular shift에 대해 지원 가능한 SR 채널은 3-RS에서의 직교 확산부호에 따라 3개의 SR 채널 생성이 가능하고, 이로 인해 3개의 ACK/NACK 채널이 줄어들게 된다. <표 1>은 dedicated SR 채널 구성을 위해 할당된 circular shift의 수에 따라 증감되는 SR 및 ACK/NACK 채널의 수를 보이고 있다.

<표 1> 주파수영역 확산 부호 할당에 따른 dedicated SR 및 ACK/NACK 채널 수의 변화

The Number of Reserved Freq.-Domain Spreading Codes	The Number of Coherent SR Channels with Dedicated RS	The Number of ACK/NACK Channels
0	0	18
1	3	15
2	6	12
⋮	⋮	⋮
6	18	0

그림 4에서와 같이 구성된 SR 채널을 특정 단말에 할당하는 경우 그 단말이 ACK/NACK과 같은 제어 신호 전송이 동시에 발생하지 않는 경우에는 할당된 부호를 통해 2D 확산을 통해 SR 정보와 이를 위한 RS 신호를 전송하게 되고, 이를 수신한 기지국에서는 coherent/non-coherent 복조를 통해 SR 신호를 획득하게 된다. 한편, SR 신호 전송시에 ACK/NACK 신호전송이 동시에 요구되는 경우에는 그림 4에서와 같이 구성된 SR 채널에 대해 SR information이 전송되는 구간에 ACK/NACK 신호를 변조하여 전송함으로써, 수신단에서는 dedicated SR 확산부호에 대해 non-coherent 복조 (e.g., demodulation of on-off keying)를 통해 SR 신호 검출을 수행하고, ACK/NACK 신호에 대해서 SR 전용 RS을 통한 채널추정 결과를 활용하여 coherent ACK/NACK 복조를 수행하게 된다.

(2) ACK/NACK 채널에 할당된 시간영역 확산부호(time covering) 중 하나 또는 그 이상의 직교부호를 dedicated SR을 위해 할당하는 방법

그림 5는 RS와 SR 정보 전송 심볼들에 따라 서로 다른 길이를 갖는 시간 영역 확산 부호를 할당하여 coherent SR 채널 설계방안을 보이고 있다. 그림에서와 같이 ACK/NACK 채널 구성에서 활용되는 시간-주파수 영역 확산부호를 활용하여 SR 제어채널 구성을 수행하는 경우, 시간 영역 확산 부호의 할당에 따라 UE multiplexing capability가 달라 지게 되고, 할당된 하나의 시간 영역 확산 부호에 대해 주파수영역에서 지원가능한 직교 부호 수만큼의 SR 채널 생성이 가능하다. LTE ACK/NACK 채널 구조를 고려하면, 주파수 영역에

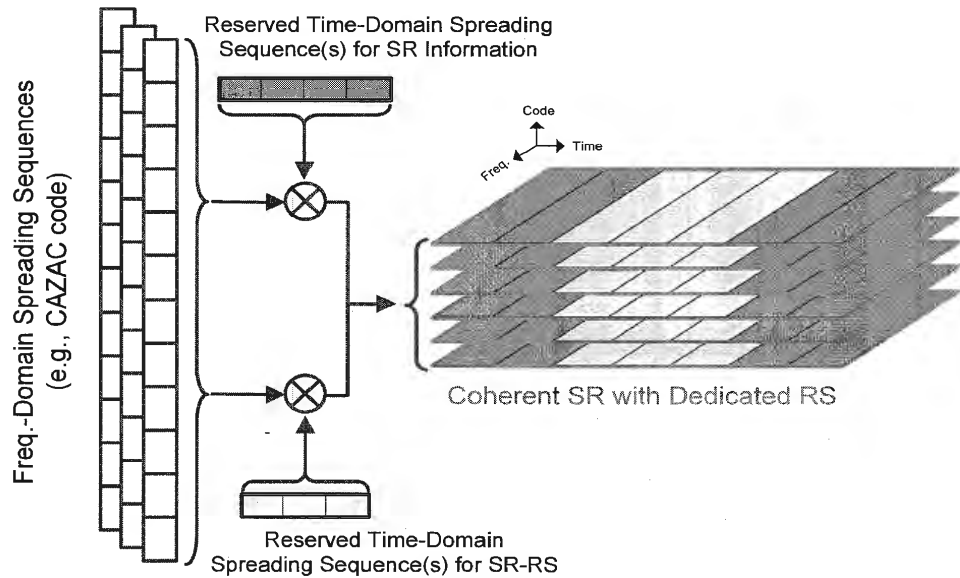


그림 5. 시간영역 확산 부호를 할당하여 dedicated RS를 갖는 coherent SR 채널 구성의 예

서 하나의 ZC root sequence에 대해 circular shift를 통해 6개의 직교 확산 부호 생성이 가능하고, SR 정보가 실리는 OFDM 심볼에 대해 길이 4의 직교 부호를, RS로 활용되는 구간에서 길이 3의 직교부호를 각각 할당하여 SR 채널 구성을 하는 경우, 예약된 시간영역 확산부호에 따라 최대 6개의 SR 채널 생성이 가능하다. 이로 인해 6개의 ACK/NACK 채널 감소를 갖게 된다. <표 2>는 dedicated SR 채널 구성을 위해 할당된 시간영역 확산 부호 (RS의 경우 길이 3의 최대 3개의 직교부호를 갖게 되므로, SR을 위해 할당가능한 시간영역 확산부호의 수를 3으로 제한하였다.)의 수에 따라 증감되는 SR 및 ACK/NACK 채널의 수를 보이고 있다.

<표 2> 시간영역 확산 부호 할당에 따른 dedicated SR 및 ACK/NACK 채널 수의 변화

The Number of Reserved Time-Domain Spreading Codes	The Number of Coherent SR Channels with Dedicated RS	The Number of ACK/NACK Channels
0	0	18
1	6	12
2	12	6
3	18	0

그림 5에서와 같이 구성된 SR 채널을 특정 단말에 할당하는 경우 그 단말이 ACK/NACK과 같은 제어 신호 전송이 동시에 발생하지 않는 경우에는 할당된 부호를 통해 2D 확산을 통해 SR 정보와 이를 위한 RS 신호를 전송하게 되고, 이를 수신한 기지국에서는 coherent/non-coherent 복조를 통해 SR 신호를 획득하게 된다. 한편, SR 신호 전송시에 ACK/NACK 신호전송이 동시에 요구되는 경우에는 그림 5에서와 같이 구성된 SR 채널에 대해 SR information이 전송되는 구간에 ACK/NACK 신호를 변조하여 전송함으로써, 수신단에서는 dedicated SR 확산부호에 대해 non-coherent 복조 (e.g., demodulation of on-off keying)를 통해 SR 신호 검출을 수행하고, ACK/NACK 신호에 대해서 SR 전용 RS를 통한 채널추정 결과를 활용하여 coherent ACK/NACK 복조를 수행하게 된다.

(3) ACK/NACK 채널에 할당된 시간-주파수 2D 확산부호 중 하나 또는 그 이상의 직교부호를 dedicated SR을 위해 할당하는 방법

그림 6은 RS와 SR 정보 전송 심볼들에 따라 서로 다른 길이를 갖는 시간 영역 확산 부호의 할당과 함께 주파수 영역에서의 확산부호를 임의로 할당하여 2D 확산부호를 SR 채널 구성을 위해 예약한 경우를 보이고 있다. 그림에서와 같이 ACK/NACK 채널 구성에서 활용되는 시간 및 주파수영역 확산부호를 활용하여 SR 제어채널 구성을 수행하는 경우, 할당된 확산 부호는 coherent SR 채널 구성과 일대일로 매핑되며, 이와 함께 ACK/NACK UE multiplexing capability가 달라 지게 된다. LTE ACK/NACK 채널 구조를 고려하면, 주파수 영역에서 하나의 ZC root sequence에 대해 circular shift를 통해 6개의 직교 확산 부호 생성이 가능하고, SR 정보가 실리는 OFDM 심볼에 대해 길이 4의 직교 부호를, RS로 활용되는 구간에서 길이 3의 직교부호를 사용하는 경우 2D 직교확산 부호는 총 18개 생성되고 (RS에서의 길이 3의 확산부호로 직교부호의 cardinality에 제

약을 주게 됨), 이 중 특정 2D 확산부호를 활용하여 하나의 coherent SR 채널 구성이 가능하다.

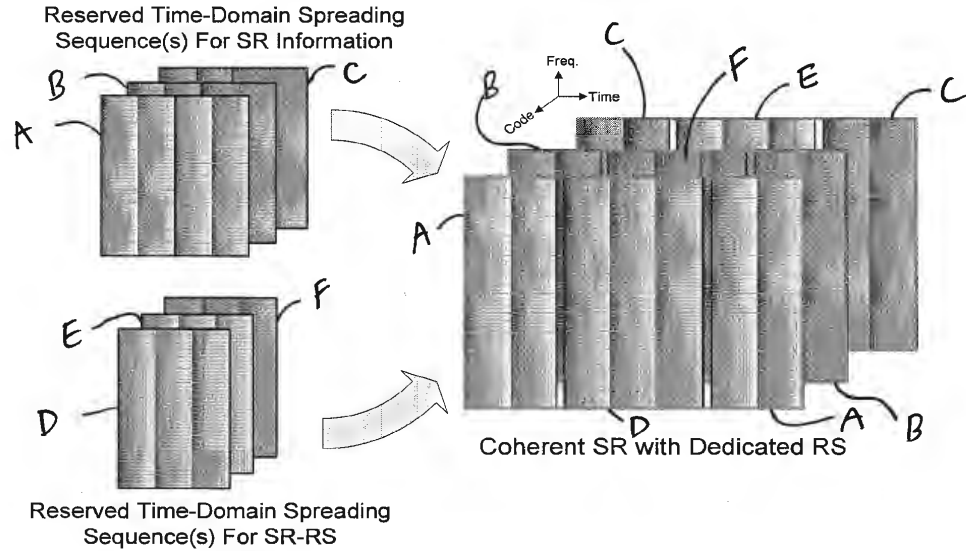


그림 6. 시간-주파수 영역 확산 부호를 할당하여 dedicated RS를 갖는 coherent SR 채널 구성의 예

<표 3>은 dedicated SR 채널 구성을 위해 할당된 시간-주파수 영역 확산 부호의 수에 따라 증감되는 SR 및 ACK/NACK 채널의 수를 보이고 있다.

<표 2> 시간영역 확산 부호 할당에 따른 dedicated SR 및 ACK/NACK 채널 수의 변화

The Number of Reserved Time-Domain Spreading Codes	The Number of Coherent SR Channels with Dedicated RS	The Number of ACK/NACK Channels
0	0	18
1	1	17
⋮	⋮	⋮
18	18	0

그림 5에서와 같이 구성된 SR 채널을 특정 단말에 할당하는 경우 그 단말이 ACK/NACK과 같은 제어 신호 전송이 동시에 발생하지 않는 경우에는 할당된 부호를 통해 2D 확산을 통해 SR 정보와 이를 위한 RS 신호를 전송하게 되고, 이를 수신한 기지국에서는 coherent/non-coherent 복조를 통해 SR 신호를 획득하게 된다. 한편, SR 신호 전송시에 ACK/NACK 신호전송이 동시에 요구되는 경우에는 그림 5에서와 같이 구성된 SR 채널에 대해 SR information이 전송되는 구간에 ACK/NACK 신호를 변조하여 전송함으로써, 수신단에서는 dedicated

SR 확산부호에 대해 non-coherent 복조 (e.g., demodulation of on-off keying)를 통해 SR 신호 검출을 수행하고, ACK/NACK 신호에 대해서 SR 전용 RS를 통한 채널추정 결과를 활용하여 coherent ACK/NACK 복조를 수행하게 된다.

이상에서 언급한 coherent SR 채널 구성을 통하여 SR 신호 전송 방식은 그림 7에서와 같이 3가지 시나리오로 정리할 수 있다. 먼저, 확산부호를 통해 구성된 SR 채널을 통해 SR 신호만을 전송 (그림 7의 (3)의 경우) 할 때는 coherent SR 채널의 특성상 추가적인 SR 관련 정보를 함께 전송가능하다. 일반적으로 SR information이 1bit으로 정의된다고 가정하면, coherent SR을 통해 QPSK 변조 방식 등을 통해 2-bit 전송이 이루어지는 경우 그림에서와 같이 SR (1bit) 정보를 coherent 방식으로 검출하는 경우 추가 정보라 전송가능한 information은 1 bit이 된다. 반면, SR 정보를 non-coherent(on-off keying) 방식으로 검출하는 경우 추가 정보는 QPSK 변조로 모두 전송가능하므로 이 경우에는 최대 2bit의 추가 정보 전송이 가능하다. 그림 7의 (2)의 경우와 같이 SR 전송시 ACK/NACK 신호 전송이 요구되는 경우 기할당된 SR 채널을 통해 SR과 ACK/NACK의 동시 전송이 가능하다. 이 때에는 SR 정보는 non-coherent 방식으로 검출하고, ACK/NACK 정보에 대해서는 기존 ACK/NACK 채널의 복조 방식과 동일한 coherent 복조를 통해 정보를 획득하게 된다. 이 경우에도 ACK/NACK 정보 전송량이 1bit과 같이 coherent SR의 전송용량에 비해 적은 경우에는 SR 정보 전송 역시 coherent 방식으로 변복조 가능하다. 마지막으로 그림 7에서 (1)의 경우와 같이 ACK/NACK 만을 전송하는 경우에는 기할당된 ACK/NACK 채널을 통해 ACK/NACK 정보를 coherent 변복조를 수행하게 된다.

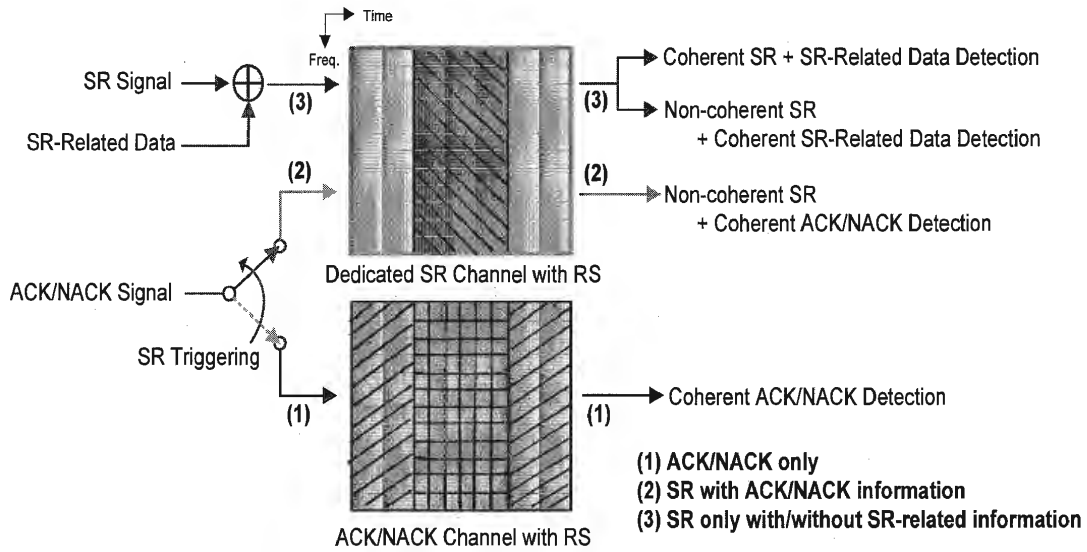


그림 7. Dedicated RS를 갖는 coherent SR 채널을 통한 SR 신호 송수신 방식

C. Non-coherent SR Structure without Dedicated RS

Dedicated SR 채널 구성 방식으로 앞절에서 언급한 coherent SR 구조의 경우 dedicated RS와 함께 구성되어 실제 multiplexing capability를 감소시키는 대신 추가적인 정보 전송에 유용하게 활용될 수 있다. 이와 달리 non-coherent SR 구조로서 dedicated RS를 갖지 않는 SR 채널 구조의 경우 coherent SR에 비해 SR 채널 용량을 증대시키는 반면 추가적인 SR 관련 정보 전송에 어려운 점을 갖고 있다. 구체적인 non-coherent SR 채널 구성방식에 대해 앞 절에서와 같이 세가지 부호화할 방식에 따라 채널 생성 방식을 살펴 보자.

(1) ACK/NACK 채널에 할당된 임의의 frequency-domain spreading code (e.g. ZC root sequence)에 대해 하나 또는 그 이상의 특정 부호 (e.g. circular shift)를 dedicated SR을 위해 할당하는 방법

그림 8은 주파수 영역 확산 부호를 SR 채널 구성을 위해 할당하고, non-coherent SR 복조를 기반으로 dedicated RS를 사용하지 않는 SR 채널 구성의 예를 보이고 있다. 그림 4의 coherent SR 전송방식과 달리 예약된 주파수 영역의 확산 부호에 대해 SR 정보가 전송되는 시간영역 구간에서의 직교확산부호의 수에 의해 RS 영역에서의 직교부호 수에 관계없이 생성 가능한 SR 채널의 수가 결정된다. LTE의 ACK/NACK 구조에서 살펴보면, 하나의 ZC circular shift에 대해 시간영역에서 길이 4의 직교 확산부호를 생성하게 되면, 하나의 circular shift로 총 4개의 SR 채널 생성이 가능하다. 이 때 감소되는 ACK/NACK 채널의 수는 coherent 복조를 가정하고 있으므로 RS의 직교확산 부호의 수와 데이터 영역에서 남은 2D 직교확산 부호의 수에 따라 달라지게 된다. 또한, 기본적으로 SR 채널 생성을 위한 주파수 또는 시간 영역 확산 부호를 예약하지 않더라도, 데이터 영역과 RS영역의 2D 직교 확산부호의 수가 상이하여 그림 3의 ACK/NACK 구조에서는 데이터 영역에서 6개의 2D 확산부호를 활용함으로써 6개의 non-coherent SR 채널 생성이 가능하다. <표 4>는 dedicated SR 채널 구성을 위해 할당된 circular shift의 수에 따라 증감되는 SR 및 ACK/NACK 채널의 수를 보이고 있다.

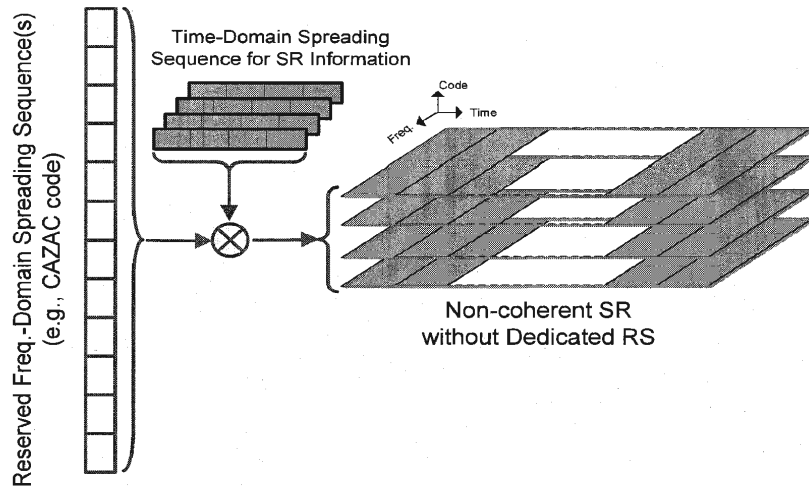


그림 8. 주파수영역 확산 부호를 할당하여 non-coherent SR 채널 구성의 예

<표 4> 주파수영역 확산 부호 할당에 따른 dedicated SR 및 ACK/NACK 채널 수의 변화

The Number of Reserved Freq.-Domain Spreading Codes	The Number of Non-coherent SR Channels without Dedicated RS	The Number of ACK/NACK Channels
0	6	18
1	6	18
2	8	16
3	12	12
⋮	⋮	⋮
6	24	0

그림 8에서와 같이 구성된 SR 채널을 특정 단말에 할당하는 경우 그 단말이 ACK/NACK과 같은 제어 신호 전송이 동시에 발생하지 않는 경우에는 할당된 부호를 통해 2D 확산을 통해 SR 정보와 이를 위한 RS 신호를 전송하게 되고, 이를 수신한 기지국에서는 non-coherent 복조를 통해 SR 신호를 획득하게 된다. 한편, SR 신호 전송시에 ACK/NACK 신호전송이 동시에 요구되는 경우에는 그림 8에서와 같이 구성된 SR 채널에 대해 SR information이 전송되는 구간에 ACK/NACK 신호를 변조하여 전송하고, ACK/NACK에서 정의된 RS 영역을 동시에 전송함으로써, 수신단에서는 dedicated SR 확산부호에 대해 non-coherent 복조 (e.g., demodulation of on-off keying)를 통해 SR 신호 검출을 수행하고, ACK/NACK 신호에 대해서 ACK/NACK 전용 RS을 통한 채널추정 결과를 활용하여 coherent ACK/NACK 복조를 수행하게 된다. 다시 말해서, non-coherent SR 복조와 coherent ACK/NACK 복조가 가능하게 된다.

(2) ACK/NACK 채널에 할당된 시간영역 확산부호(time covering) 중 하나 또는 그 이상의 직교부호를 dedicated SR을 위해 할당하는 방법

그림 9는 시간 영역 확산 부호를 SR 채널 구성을 위해 할당하고, non-coherent SR 복조를 기반으로 dedicated RS를 사용하지 않는 SR 채널 구성의 예를 보이고 있다. LTE의 ACK/NACK 구조에서 살펴보면, 시간 영역에서 길이 4의 직교 확산부호를 SR 채널 생성에 할당하게 되면, 하나의 ZC root sequence에 대해 총 6개의 직교부호 생성이 가능하므로 6개의 SR 채널 생성이 가능하다. 이 때 감소되는 ACK/NACK 채널의 수는 데이터 심볼에서의 시간영역 확산 부호의 cardinality가 RS 심볼들에서의 확산 부호 수에 비해 하나 많으므로 하나의 시간영역 확산부호 할당으로 인한 ACK/NACK 채널 손실은 발생하지 않는다. 하지만, 2개이상의 시간영역 확산 부호를 할당하는 경우에는 할당된 확산부호마다 6개의 ACK/NACK 채널 감소가 발생하게 된다. <표 5>는 dedicated SR 채널 구성을 위해 할당된 길이 4의 시간영역 확산부호의 수에 따라 증감되는 SR 및 ACK/NACK 채널의 수를 보이고 있다.

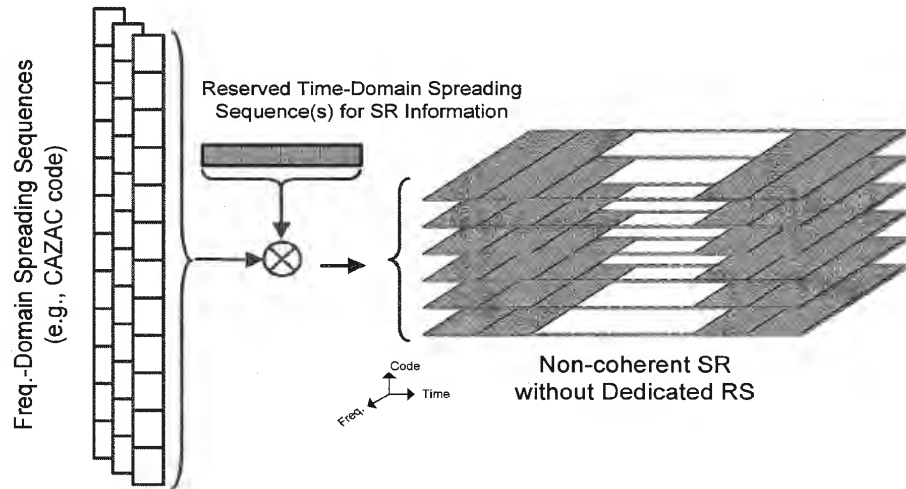


그림 9. 시간영역 확산 부호를 할당하여 non-coherent SR 채널 구성의 예

<표 4> 주파수영역 확산 부호 할당에 따른 dedicated SR 및 ACK/NACK 채널 수의 변화

The Number of Reserved Freq.-Domain Spreading Codes	The Number of Non-coherent SR Channels without Dedicated RS	The Number of ACK/NACK Channels
0	6	18
1	6	18
2	12	12
3	18	6
4	24	0

그림 9에서와 같이 구성된 SR 채널을 특정 단말에 할당하는 경우 그 단말이 ACK/NACK과 같은 제어 신호 전송이 동시에 발생하지 않는 경우에는 할당된 부호를 통해 2D 확산을 통해 SR 정보와 이를 위한 RS 신호를 전송하게 되고, 이를 수신한 기지국에서는 non-coherent 복조를 통해 SR 신호를 획득하게 된다. 한편, SR 신호 전송시에 ACK/NACK 신호전송이 동시에 요구되는 경우에는 그림 8에서와 같이 구성된 SR 채널에 대해 SR information이 전송되는 구간에 ACK/NACK 신호를 변조하여 전송하고, ACK/NACK에서 정의된 RS 영역을 동시에 전송함으로써, 수신단에서는 dedicated SR 확산부호에 대해 non-coherent 복조 (e.g., demodulation of on-off keying)를 통해 SR 신호 검출을 수행하고, ACK/NACK 신호에 대해서 ACK/NACK 전용 RS을 통한 채널추정 결과를 활용하여 coherent ACK/NACK 복조를 수행하게 된다. 다시 말해서, non-coherent SR 복조와 coherent ACK/NACK 복조가 가능하게 된다.

(3) ACK/NACK 채널에 할당된 시간-주파수 2D 확산부호 중 하나 또는 그 이상의 직교부호를 dedicated SR을 위해 할당하는 방법

그림 10은 시간-주파수 영역 2D 확산 부호를 SR 채널 구성을 위해 할당하고, non-coherent SR 복조를 기반으로 dedicated RS를 사용하지 않는 SR 채널 구성의 예를 보이고 있다. 그림에서와 같이 ACK/NACK 채널 구성에서 활용되는 시간 및 주파수영역 확산부호를 활용하여 SR 제어채널 구성을 수행하는 경우, 할당된 확산 부호는non-coherent SR 채널 구성과 일대일로 매핑되며, 이와 함께 ACK/NACK UE multiplexing capability가 달라 지게 된다. LTE ACK/NACK 채널 구조를 고려하면, 주파수 영역에서 하나의 ZC root sequence에 대해 circular shift를 통해 6개의 직교 확산 부호 생성이 가능하고, SR 정보가 실리는 OFDM 심볼에 대해 길이 4의 직교 부호를 활용하여 총 24개의 2D 직교확산 부호가 생성되고, 이 중 특정 2D 확산부호를 활용하여 하나의 coherent SR 채널 구성이 가능하다. RS영역에서의 2D 직교 확산 부호의 cardinality가 18이므로, dedicated SR에 할당된 2D 직교확산 부호가 6개 이하인 경우에는 ACK/NACK 채널수에 변화를 주지 않게 된다. <표 6>은 dedicated SR 채널 구성을 위해 할당된 2D 시간-주파수 영역 확산부호의 수에 따라 증감되는 SR 및 ACK/NACK 채널의 수를 보이고 있다.

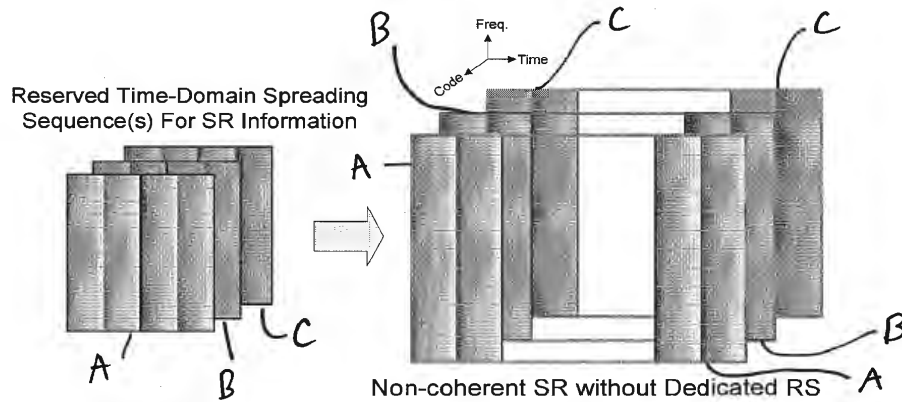


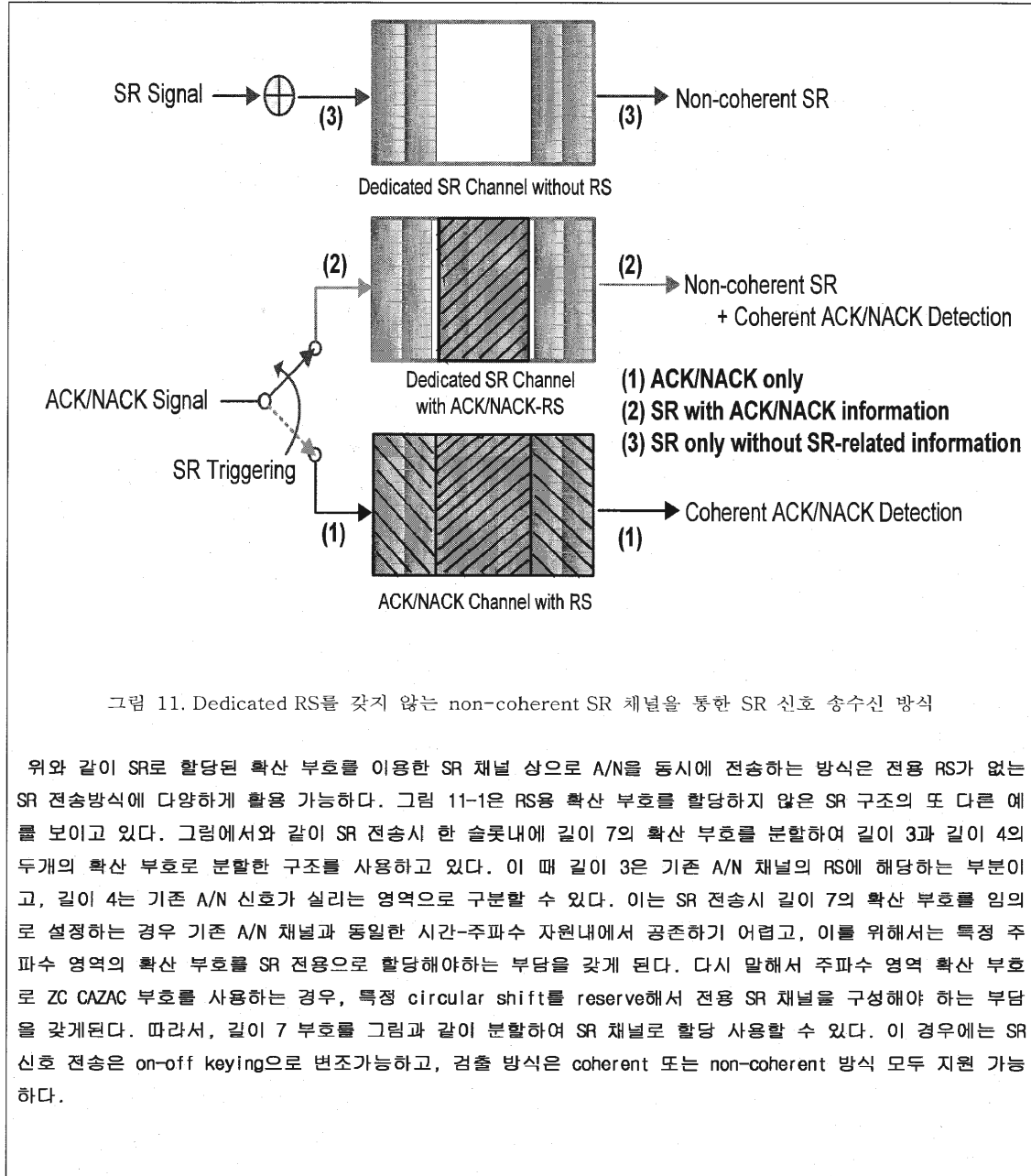
그림 10. 시간-주파수 영역 확산 부호를 할당하여 non-coherent SR 채널 구성의 예

<표 5> 시간-주파수영역 확산 부호 할당에 따른 dedicated SR 및 ACK/NACK 채널 수의 변화

The Number of Reserved Freq.-Domain Spreading Codes	The Number of Non-coherent SR Channels without Dedicated RS	The Number of ACK/NACK Channels
0~6	6	18
7	7	17
8	8	16
⋮	⋮	⋮
24	24	0

그림 10에서와 같이 구성된 SR 채널을 특정 단말에 할당하는 경우 그 단말이 ACK/NACK과 같은 제어 신호 전송이 동시에 발생하지 않는 경우에는 할당된 부호를 통해 2D 확산을 통해 SR 정보와 이를 위한 RS 신호를 전송하게 되고, 이를 수신한 기지국에서는 non-coherent 복조를 통해 SR 신호를 획득하게 된다. 한편, SR 신호 전송시에 ACK/NACK 신호전송이 동시에 요구되는 경우에는 그림 8에서와 같이 구성된 SR 채널에 대해 SR information이 전송되는 구간에 ACK/NACK 신호를 변조하여 전송하고, ACK/NACK에서 정의된 RS 영역을 동시에 전송함으로써, 수신단에서는 dedicated SR 확산부호에 대해 non-coherent 복조 (e.g., demodulation of on-off keying)를 통해 SR 신호 검출을 수행하고, ACK/NACK 신호에 대해서 ACK/NACK 전용 RS를 통한 채널추정 결과를 활용하여 coherent ACK/NACK 복조를 수행하게 된다. 다시 말해서, non-coherent SR 복조와 coherent ACK/NACK 복조가 가능하게 된다.

이상에서 언급한 non-coherent SR 채널 구성을 통하여 SR 신호 전송 방식은 그림 11에서와 같이 3가지 시나리오로 정리할 수 있다. 먼저, 확산부호를 통해 구성된 SR 채널을 통해 SR 신호만을 전송 (그림 11의 (3)의 경우)한다. 이 때에 ACK/NACK의 RS 영역에 해당하는 부분에 대해서도 1D 또는 2D 확산부호를 할당하여 SR 전송만을 위한 dedicated 채널 구성이 가능하다. SR 신호를 non-coherent SR 채널을 통해 전송하는 경우 non-coherent 특성상 부가적인 SR 관련 정보 전송이 어렵게 된다. 일반적으로 SR information이 1bit으로 정의되고, 추가 정보 전송이 요구되지 않는 상황에서 ACK/NAK 등 제어채널과의 공존을 허용하기 위해서는 제안한 non-coherent 방식이 multiplexing capability 증가 측면에서 유리한 장점을 갖게 된다. 그림 7의 (2)의 경우와 같이 SR 전송시 ACK/NACK 신호 전송이 요구되는 경우 기할당된 SR 채널을 통해 ACK/NACK 신호를 전송하고, 여기 요구되는 RS는 기존 ACK/NACK에 할당된 RS를 활용하게 된다. 이 때에는 SR 정보는 non-coherent 방식으로 검출하고, ACK/NACK 정보에 대해서는 기존 ACK/NACK 채널의 복조 방식과 동일한 coherent 복조를 통해 정보를 획득하게 된다. 이 경우에도 ACK/NACK 정보 전송량이 1bit과 같이 coherent SR의 전송용량에 비해 적은 경우에는 SR 정보 전송 역시 coherent 방식으로 변복조 가능하다. 마지막으로 그림 11의 (3)의 경우와 같이 ACK/NACK 만을 전송하는 경우에는 기할당된 ACK/NACK 채널을 통해 ACK/NACK 정보를 coherent 변복조를 수행하게 된다.



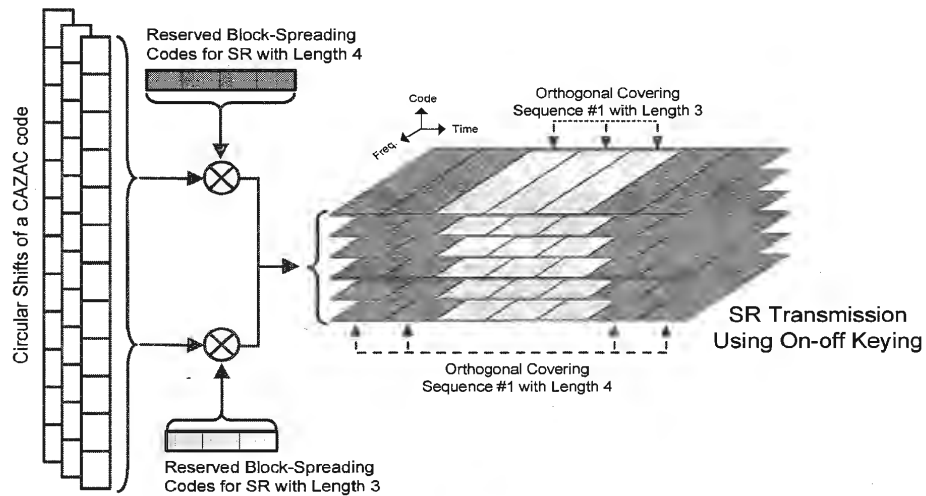


그림 11-1 분할된 길이 7 확산 부호를 이용한 RS가 없는 SR 전송 구조

이와 같은 SR 구조의 경우에도 그림 11에서와 같이 SR과 A/N을 동시에 전송해야 하는 경우, 그림 11-2와 같이 동일한 방식으로 전송 가능하다. 이 때, 길이 3의 SR 부호가 추가 할당되어 있으므로 coherent A/N 검출을 위한 RS 부분을 기존 SR에 할당된 부호를 그대로 사용하여 전송 가능하다.

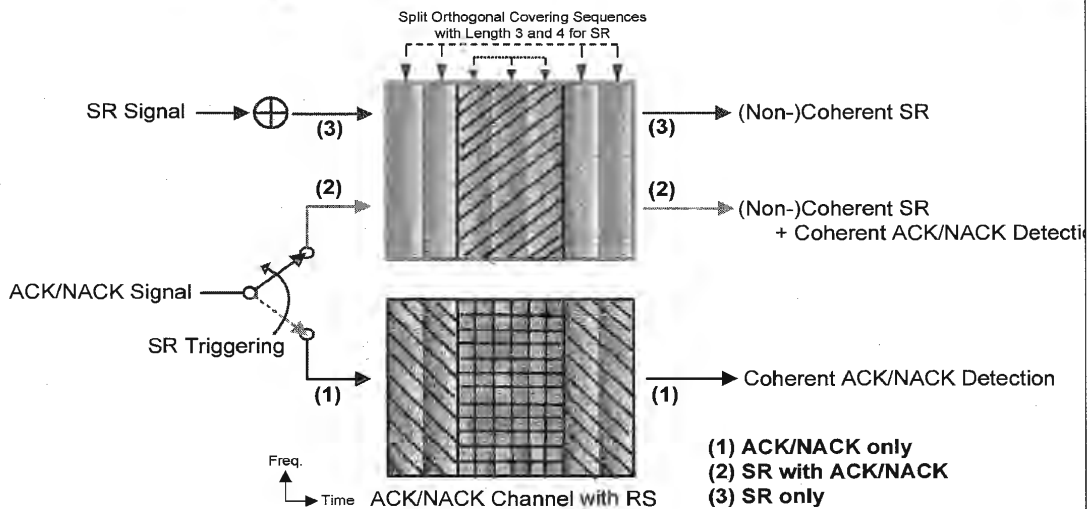


그림 11-2 길이 3과 4로 분할된 길이 7 확산 부호를 사용하는 SR 구조에서 A/N 송수신 방법

D. SR Transmission Method in a Slot-based Hopping ACK/NACK Channel Structure

앞 절에서 설명한 coherent 또는 non-coherent SR 전송 구조의 경우 ACK/NACK 채널과의 공존을 고려하고, 이를 반영하여 SR only 전송 시와 동일한 하나의 채널 구성 방식을 제안하고 있다. 한편, dedicated SR 채널 구조를 coherent ACK/NACK 구조와의 공존을 고려하지 않고, dedicated time-/frequency-resource 상에 전송하는 것으로 가정하는 경우, SR 채널의 capability 가 동일 자원에서의 효율성 증대와 함께 중요한 부분을 차지하게 된다. 다시 말해서 1 RB, 1 subframe 에서 2D spreading을 통해 최대 42개(non-coherent 방식, 부가 정보 전송이 없는 경우)의 SR 채널 생성이 가능하게 된다. 따라서, 기존 ACK/NACK 채널과 SR 채널이 공존하지 않는 경우를 가정한다면, SR 정보를 ACK/NACK 채널을 통해 전송하기 위해서는 부가적인 1 bit 정보를 기존 ACK/NACK 채널에 전송가능한 방법의 도출이 요구된다. 이에 본 발명에서는 기존 slot 단위의 ACK/NACK 구조를 유지하면서 부가적인 1bit 정보 전송을 위한 방안을 제안한다. 그림 2에서와 같이 LTE의 제어채널 구성은 데이터 전송이 없는 경우 양 끝단에 정의된 제어 자원 영역을 통해 전송하고 이 때 slot 단위의 hopping을 통한 frequency diversity 이득을 제공하고 있다. 본 발명에서는 ACK/NACK 채널의 경우 slot 단위로 동일한 ACK/NACK 정보가 전송되므로, 두 slot에 실리는 ACK/NACK 정보의 위상 또는 부호를 변화시켜 추가적인 SR 1bit 정보 전송 방식을 제안한다. 그림 12에서와 같이 SR 전송이 요구되는 경우 ACK/NACK 전송 정보량이 1bit일 때는 추가 1bit의 SR 정보는 QPSK ACK/NACK 변조를 통해 전송 가능하다. 하지만, 2bit ACK/NACK 전송의 경우 SR 전송이 요구되는 상황에서는 매 slot에 ACK/NACK 정보에, 미리 결정된 위상변화량 또는 직교 부호를 곱하거나 differential modulation/encoding 방식으로 전송함으로써 수신단에서는 slot 단위의 ACK/NACK 복조 후에 SR 신호의 복원이 가능하다. 물론, 이 경우에도 non-coherent 방식의 SR 검출 방식을 먼저 적용할 수 있다. 이와 같은 구조에서의 SR 변복조 전송 방식에 대해서 그림 13에서 보이고 있다.

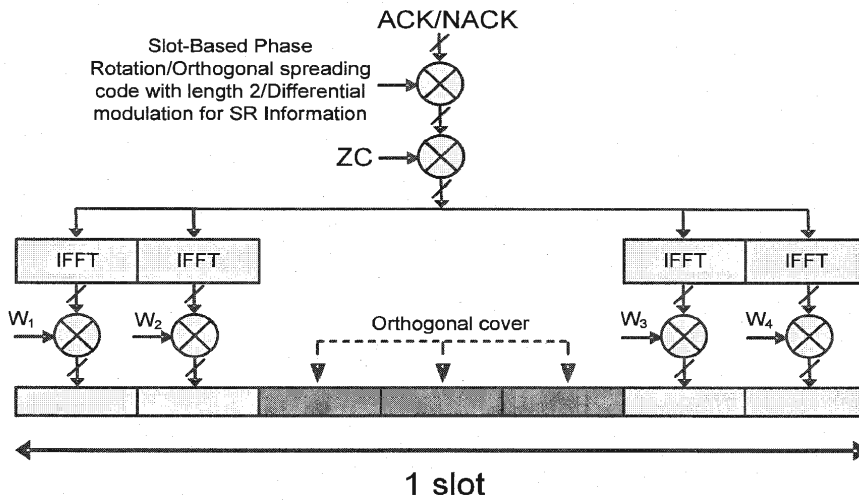
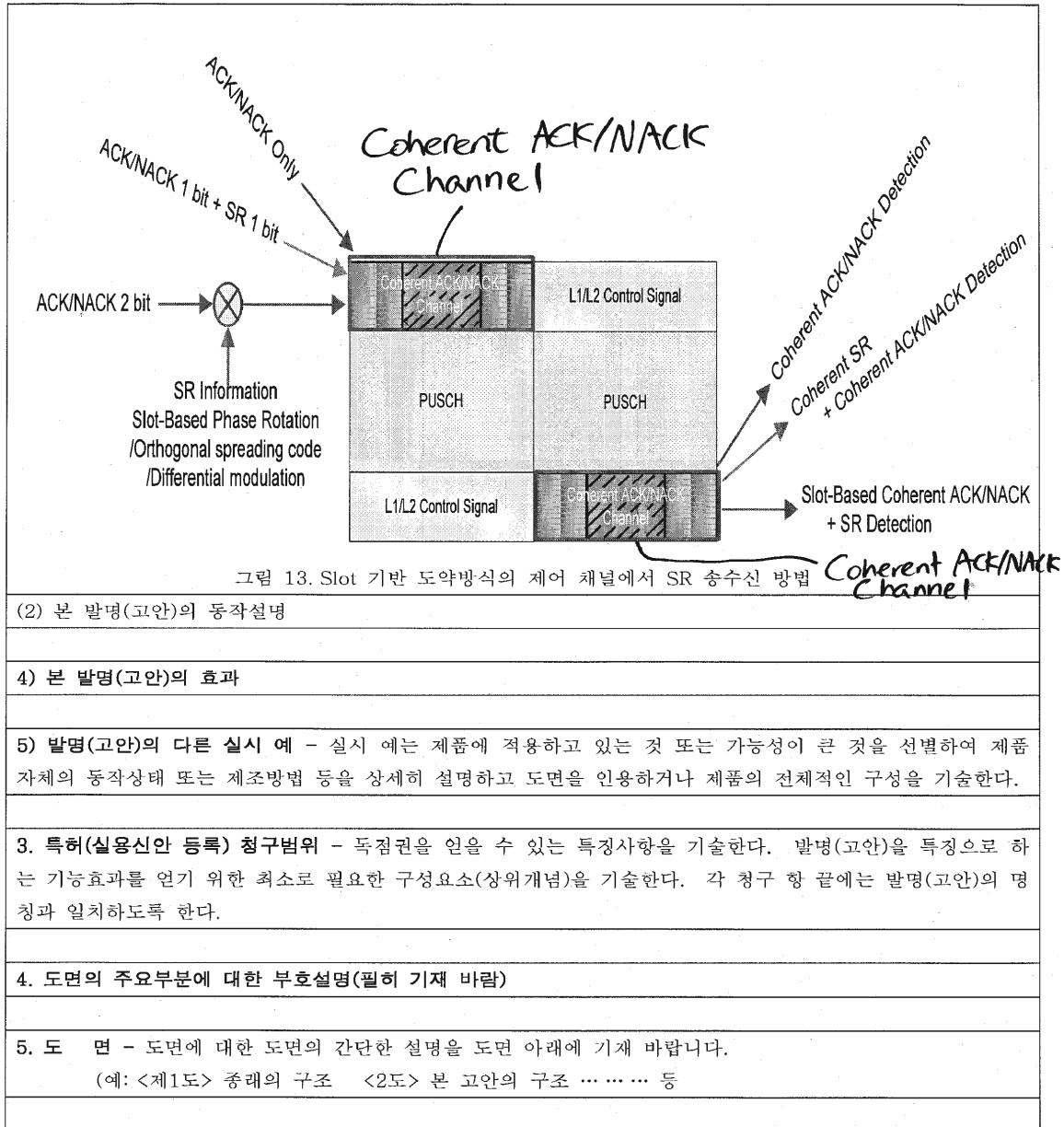


그림 12. 기존 ACK/NACK slot 구조에 영향을 주지않는 SR 신호 전송 방식



Electronic Patent Application Fee Transmittal				
Application Number:				
Filing Date:				
Title of Invention:		TRANSMISSION METHODS FOR SCHEDULING REQUEST THROUGH TIME/FREQUENCY SPREADING CONTROL CHANNELS		
First Named Inventor/Applicant Name:		Jin Sam KWAK		
Filer:		Andrew S. Park/Soojin KIM		
Attorney Docket Number:		UT07-0084-USP0		
Filed as Large Entity				
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Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Provisional application filing	1005	1	210	210
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Miscellaneous:				
Total in USD (\$)				210



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60/979,860	10/14/2007	Jin Sam KWAK	UT07-0084-USPO

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IMPROPER PROVISIONAL LETTER



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KORPAT, PC
GANGNAM P.O 1655
SEOUL, 135-616
KOREA, REPUBLIC OF

Date Mailed: 10/26/2007

Letter re Non-English Language Application Papers in a Provisional Application

The above-identified provisional application was filed in a language other than English. An English-language translation of a non-English provisional application and a statement that the translation is accurate must be filed in the provisional application. See 37 CFR 1.78(a)(5)(iv). Applicants are strongly encouraged to file the English-language translation of the provisional application and the statement that the translation is accurate in the provisional application before a nonprovisional application claiming the benefit of the provisional application is filed, or, alternatively, when making a claim for the benefit of the provisional application in a nonprovisional application. If, however, an English translation and a statement that the translation is accurate have not been filed in the above-identified provisional application when a nonprovisional application is filed claiming the benefit of the filing date of the provisional application, the Office should mail a Notice requiring an English translation and the statement to be filed in the provisional application and a confirmation to be filed in the nonprovisional application.

In the event that the Office schedules a nonprovisional application that claims the benefit of a provisional application filed in a language other than English for publication without issuing a Notice requiring the applicant to file an English translation of the non-English provisional application, the applicant should file the English translation of the non-English provisional application and a statement that the translation is accurate as soon as possible in the provisional application.

/ltan/

Office of Initial Patent Examination (571) 272-4000 or 1-800-PTO-9199

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EFS ID:	4843698
Application Number:	60979860
International Application Number:	
Confirmation Number:	8080
Title of Invention:	TRANSMISSION METHODS FOR SCHEDULING REQUEST THROUGH TIME/ FREQUENCY SPREADING CONTROL CHANNELS
First Named Inventor/Applicant Name:	Jin Sam KWAK
Customer Number:	67487
Filer:	Andrew S. Park/Soojin KIM
Filer Authorized By:	Andrew S. Park
Attorney Docket Number:	UT07-0084-USP0
Receipt Date:	24-FEB-2009
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Application Type:	Provisional

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Authorization to access Appl. by Trilateral Office	SB39_UT07-084.pdf	137182 <small>48b91cea88bb29d2ecff759cb8223242e9a0c445</small>	no	1

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Information:

Total Files Size (in bytes):	137182
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PTO/SB/39 (01-09)

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COMPLETE IF KNOWN

Application Number	60/979,860
Filing Date	10-14-2007
First Named Inventor	Jin Sam KWAK
Attorney Docket Number	UT07-0084-USPO
Title (Required)	TRANSMISSION METHODS FOR SCHEDU

The undersigned hereby grants the USPTO authority to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), and any other intellectual property offices in which a foreign application claiming priority to the above-identified application is filed access to the above-identified patent application. See 37 CFR 1.14(c) and (h).

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/Andrew S. PARK/

02-19-2009

Signature

Date

Andrew S. PARK

82-2-2193-0001

Printed or Typed Name

Telephone Number

TRANSMISSION METHODS FOR SCHEDULING REQUEST THROU

47841

Title

Registration Number, if applicable

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
60/979,860	10/14/2007		210	UT07-0084-USPO		

67487
KORPAT, PC
GANGNAM P.O 1655
SEOUL, 135-616
KOREA, REPUBLIC OF

CONFIRMATION NO. 8080
REPLACEMENT FILING RECEIPT



0000000034721318

Date Mailed: 02/26/2009

Receipt is acknowledged of this provisional patent application. It will not be examined for patentability and will become abandoned not later than twelve months after its filing date. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Applicant(s)

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Power of Attorney: The patent practitioners associated with Customer Number 67487

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If Required, Foreign Filing License Granted: 02/25/2009

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 60/979,860**

Projected Publication Date: None, application is not eligible for pre-grant publication

Non-Publication Request: No

Early Publication Request: No

Title

TRANSMISSION METHODS FOR SCHEDULING REQUEST THROUGH TIME/FREQUENCY
SPREADING CONTROL CHANNELS

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Electronic Acknowledgement Receipt	
EFS ID:	7831499
Application Number:	60979860
International Application Number:	
Confirmation Number:	8080
Title of Invention:	TRANSMISSION METHODS FOR SCHEDULING REQUEST THROUGH TIME/ FREQUENCY SPREADING CONTROL CHANNELS
First Named Inventor/Applicant Name:	Jin Sam KWAK
Customer Number:	67487
Filer:	Andrew S. Park/Soyoun MOON
Filer Authorized By:	Andrew S. Park
Attorney Docket Number:	UT07-0084-USP0
Receipt Date:	17-JUN-2010
Filing Date:	14-OCT-2007
Time Stamp:	03:18:47
Application Type:	Provisional

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		UT07084_T.pdf	4058652 1e306ef1eb32047f55c644d3a2640926aee8d686	yes	26

	Multipart Description/PDF files in .zip description		
	Document Description	Start	End
	Miscellaneous Incoming Letter	1	2
	Specification	3	26

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New International Application Filed with the USPTO as a Receiving Office
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Docket No.: UT07-0084-USPO
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Jin Sam KWAK, et al.

Application No.: 60/979,860

Confirmation No.: 8080

Filed: October 14, 2007

Art Unit:

For: TRANSMISSION METHODS FOR SCHEDULING
REQUEST THROUGH TIME/FREQUENCY
SPREADING CONTROL CHANNELS

Examiner:

**REPLY TO LETTER RE NON-ENGLISH LANGUAGE
APPLICATION PAPERS IN A PROVISIONAL APPLICATION**

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Examiner:

In response to the Letter re Non-English Language Application Papers in a Provisional Application forwarded with the Official Filing Receipt dated October 26, 2007, for the above-identified Provisional application, and in accordance with 37 C.F.R. 1.78(a)(5), enclosed are:

1. An English Translation of the Specification; and
2. A statement of Verification dated June 17, 2010.

Respectfully submitted,

Dated: June 17, 2010
Customer No. 67487

By: / Andrew S. PARK/
Andrew S. PARK
Registration No.: 47,841
KBK & Associates

VERIFICATION

I, Hyunjung KIM(Name of translator), residing at 10F., Songam Bldg., #642-10, Yeoksam-dong, Gangnam-gu, Seoul, Republic of Korea state that the attached document is a true and complete translation to the best of my knowledge of the Korean and English languages and that the writings contained in the following pages are a correct English translation of the specification of United States Provisional Application No. 60/979,860 filed on October 15, 2007.

Date: June 17. 2010

Signature of translator: KIM. Hyunjung

**PROVISIONAL APPLICATION FOR UNITED STATES PATENT
IN THE NAMES OF**

Jin Sam KWAK, Yeong Hyeon KWON, Seung Hee HAN, Min Seok
NOH, Hyun Woo LEE, Dong Cheol KIM, Ki Ho NAM, Sung Gu CHO,
Hong Won PARK and Jae Hoon CHUNG

for

**TRANSMISSION METHODS FOR SCHEDULING REQUEST
THROUGH TIME/FREQUENCY SPREADING CONTROL CHANNELS**

prepared by:

KBK & Associates

Customer Number: 67487

Attorney Docket Number: UT07-0084-USP0

Total Number of pages: 24 (including cover)

Specification	
1. Title of the invention(device) –	
Transmission Methods for Scheduling Request Through Time- or Frequency Spreading Control Channels	
2. Detailed description of the invention (device)	
1) Object of the invention (device)	
<p>The present invention proposes methods for transmitting additional information by taking the existing structure of a control channel into account if a scheduling request (SR) is made through time or frequency spreading channels for a control signal. Particularly, the present invention proposes a transmission method which can support both the control signal and the SR in the same time-frequency resource without changing the existing structure of a spreading control channel. To this end, there are proposed an SR channel creating method using a spreading code, and an additional SR channel creating method without using a spreading code for an allocated control signal. Specifically, there are proposed a code allocation method for distinguishing a control signal and an SR signal, a channel configuration method for transmitting SR information through an allocated code, a coherent/non-coherent demodulation method, and separately a method for enabling transmission of additional SR information through frequency hopping while maintaining the code allocation method for configuring the control channel.</p>	
2) Description of related art – Problems of the latest published technology related to the present invention (device) are as follows. If there are literatures, patent publication or the like publication as an example of the related art, they have to be attached and described with reference to accompanying drawings. (the above well-known data is important to describe claims of the invention (device))	
(1) Configuration of related art	
<p>In the case of a broadband communication system, there have been proposed trans-receiving techniques and utilization plans more effective in time, spatial and frequency domains in order to maximize efficiency in limited wireless resources. Particularly, a multi-carrier based orthogonal frequency divisional multiplexing (OFDM) is in the limelight for increasing the efficiency of wireless resources the frequency domain since it is advantageous in that spectral efficiency is maximized through selective scheduling or the like in the frequency domain on the basis of different channel characteristics of a sub-carrier in addition to reduced complexity of a receiver under a frequency selective fading environment generated in the broadband channel. Multiple antenna technologies have been applied to maximize the efficiency in the spatial domains, and utilized as a technology suitable for high-speed multimedia data transmission through generation of a plurality of time and frequency domains in the spatial domain. To efficiently use resources in the time domain, there have also been applied an HARQ technique or the like suitable for packet-data transmission as well as scheduling that utilizes channel coding and channel selective characteristics among plural users.</p> <p>As above, downlink/uplink control signal transmission with regard to the time, spatial and frequency</p>	

domains is prerequisite in order to achieve various trans-receiving techniques for high-speed packet transmission in the broadband time-space. To this end, previously-allocated control channels have been utilized to transmit the control signals. Specifically, a transmission structure for an uplink control signal in long term evolution (LTE) will be described as an exemplary embodiment. An ACK/NACK transmission structure will be examined with a small amount of data signal transmission in the LTE. It is important for the transmission to concentrate power on one spot instead of increasing a bandwidth of a signal transmitted by user equipment, and a peak-to-average power ratio (PAPR) of a transmission signal has to be also decreased. For this, the LTE basically uses single carrier-frequency division multiplexing (SC-FDM) in the uplink signal transmission. The SC-FDM is a transmission method of making variation of a signal small, which have a larger coverage effect when using a power amplifier. A basic structure of the SC-FDM is shown in FIG. 1. The most significant feature of the SC-FDM, which a transmission signal is first spread through discrete Fourier transform (DFT) and then mapped as being concentrated on a frequency band at a part where the transmission signal is generated, is that the generated signal has an effect like a single carrier. Thus, the generated signal has a small PAPR.

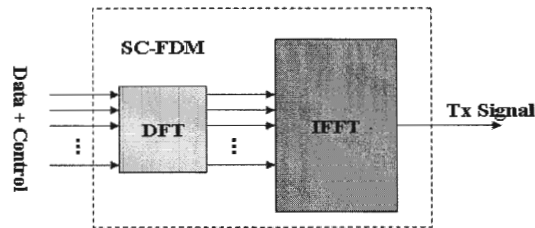


FIG. 1. SC-FDM structure

With this SC-FDM structure, there are points to be considered when transmitting a control signal. First, when the control signal is transmitted, different methods are taken according to whether there is data or no data. If there is no data to be transmitted along with the control signal, some of a system band is distinguished and allocated by FDM and the user equipment for transmitting only the control signal transmits the control signal by demodulating the control signal to this allocated region in the form of SC-FDM (refer to FIG. 2). In this allocated region, the method of transmitting the control signal may employ FDM or code division multiplexing (CDM) between the user equipments.

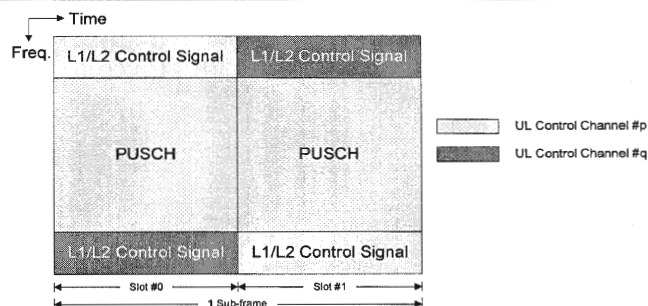


FIG. 2. Transmission of the control signal when there is no data

When the control signal is transmitted within a previously allocated band as shown in FIG. 2, it has been considered that the spreads in the time domain as well as the frequency domain are all used to maximize UE capability for transmitting a small amount of data. Further, FIG. 3 shows a control channel structure for transmitting coherent ACK/NACK transmission. In the drawing, the transmission structure of one slot is shown, and a frequency diversity gain is obtained as one signal is repetitively transmitted through slot-based frequency hopping in one sub-frame as shown in FIG. 2.

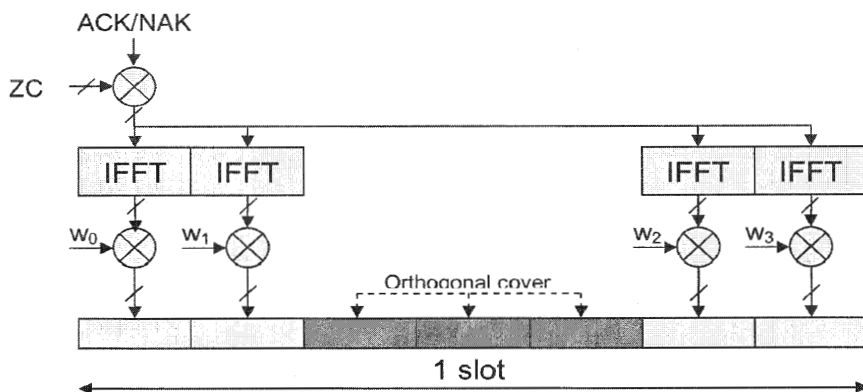


FIG. 3. Transmission structure of uplink control signal for coherent ACK/NACK in LTE

The control channel region previously allocated for transmitting the above time-frequency spreading ACK/NACK signal has to be taken into account when the user equipment (UE) transmits a scheduling request for transmitting the uplink data. It is possible to configure a dedicated SR channel by allocating certain time/frequency/code resources. At this time, if an arbitrary UE has to transmit both the SR signal

and the control signal in a certain transmission section, it is difficult to maintain the feature of the SC-FDMA when transmitting them through a plurality of channels different in a frequency domain, and thus single information may have to be transmitted through a single channel selected between an SR channel and a control channel. However, since it is difficult to clearly distinguish priority for selecting a certain signal between the control signal and the SR signal, particularly, the ACK/NACK control signal necessary for maximizing the efficiency of the limited wireless resource by performing retransmission effective in the downlink based on a small amount of the control signal directly affects the downlink performance, the downlink performance is deteriorated and the resource efficiency is lowered if the ACK/NACK transmission is dropped even through the high priority SR transmission is required. Accordingly, there is need of proposing an effective SR transmission method using the existing control channel under the condition that a certain UE is required to transmit the SR signal and the control signal.

(2) Description of how device of related art operates

(3) Problems of related art

3) Description of the invention (device) – Overall descriptions about achievement with regard to the object of the invention (device).

(1) Configuration of the invention (device)

The present invention proposes an effective SR channel configuration for SR transmission in a control channel configured with time-frequency domain spreads. As a detailed approaching method, there is proposed a method of transmitting an SR signal in a 2D spreading channel structure considering time and frequency spreading like an LTE ACK/NACK channel. To this end, a channel structure for transmitting the SR signal is designed considering the following required conditions.

(1) It is needed to design a channel compatible with the existing ACK/NACK channel structure as shown in FIG. 3.

(2) It has to be possible to support the same channel structure when transmitting only an SR signal.

(3) UE capability and transmission capacity in the existing ACK/NACK channel have to be maintained when transmitting only the ACK/NACK.

(4) UE multiplexing capability have to be maximized when both the SR signal and the control signal are transmitted.

(5) The same SR channel has to be configured regardless of whether the ACK/NACK signal and the SR signal are transmitted simultaneously or not.

(6) The ACK/NACK channel and the SR channel have to be flexibly configured in the allocated time-frequency resources.

(7) The flexibility of code allocation has to be enhanced when a dedicated SR channel is configured through the code allocation.

(8) It has to be possible to transmit the control signal and the SR signal in the minimum frequency resource allocation supportable in a narrow band.

(9) The performance of detecting the ACK/NACK signal has not to be deteriorated after detecting an SR signal.

(10) One method for detecting the SR signal has to be applied regardless of whether there is an ACK/NACK signal.

(11) The structure has to coexist with the existing control signal (ACK/NACK or CQI) transmission method without any restriction to the existing control signal transmission method.

There is proposed a method of configuring an SR channel and an ACK/NACK channel through the code allocation is proposed in order to consider the SR channel configuration plan by taking the foregoing requirements into account, and a specific SR channel structure based on a coherent or non-coherent SR detecting method using the same. Also, there is proposed an SR transmission method through frequency hopping using the existing ACK/NACK structure. The SR channel structure proposed in the present invention can be extended as a general SR channel configuration method irrespective of presence of an arbitrary control signal as long as it is not limited to only the transmission simultaneous with a certain control signal such as the ACK/NACK signal.

A. SR Channel Generation by Allocating the Spreading Codes for Control Channels

In the case of the existing channel for transmitting the ACK/NACK control signal as shown in FIG. 3, the control channel is configured by 2D spreading using ZC codes in the frequency domain and orthogonal codes having a length of 4 (for short CP) for the ACK/NACK data or orthogonal codes having a length of 3 for RS in the time domain. Specifically, if 6 orthogonal codes can be generated by a circular shift with regard to a ZC root sequence having a length of 12 in the frequency domain of 1RB, the ACK/NACK UE capability supportable in 1 slot is 18, in which the multiplexing capacity is determined by the length of RS for coherent demodulation. At this time, the 2D spreading codes in the ACK/NACK are effectively reserved for the SR transmission and allocated for the SR, so that a SR dedicated channel can be configured. Thus, the SR signal transmission using the dedicated SR channel need not try to detect a dedicated SR code for detecting an SR signal every time when the ACK/NACK signal is detected and tries to detect the SR signal only when both the SR signal and the ACK/NACK signal are simultaneously transmitted, since it is possible to obtain the SR signal through non-coherent signal detection using a dedicated SR allocation code regardless of whether the ACK/NACK

signal is detected or not and a base station knows the simultaneous transmissions.

The code allocation methods for configuring the ACK/NACK channel and the dedicated SR channel are as follows.

- (1) A method of allocating one or more certain codes (e.g., circular shift) for the dedicated SR with regard to an arbitrary frequency-domain spreading code (e.g. ZC root sequence) allocated to the ACK/NACK channel frequency-domain spreading code
- (2) A method of allocating one or more orthogonal codes for the dedicated SR among the time-domain spreading codes (time covering) allocated to the ACK/NACK channel
- (3) A method of allocating one or more orthogonal codes for the dedicated SR among time-frequency 2D spreading codes allocated to the ACK/NACK channel

The above three code allocating methods can be applied to a control channel structure employing a code hopping method by extending to allocation of a spreading hopping pattern defined per one or more symbols. As to the specific SR channel configuration method based on the foregoing code allocation method, the following transmission method can be proposed by dividing into the coherent SR structure and the non-coherent SR structure according to the presence of the dedicated RS.

B. Coherent SR Structure with Dedicated RS

The coherent SR structure having the dedicated RS can configure the channels different according to the spreading code allocation method as described above. The SR channel configuration method proposed in this embodiment is applicable in an arbitrary control channel structure using a spreading code, and detailed exemplary embodiments will be described considering the ACK/NACK channel configuration method as shown in FIG. 3.

- (1) A method of allocating one or more certain codes (e.g., circular shift) for the dedicated SR with regard to an arbitrary frequency-domain spreading code (e.g. ZC root sequence) allocated to the ACK/NACK channel frequency-domain spreading code

FIG. 4 shows the coherent SR transmission structure in which the frequency domain spreading code is allocated for the SR channel configuration, and the time domain spreading code allocation different in length is applied according to the RS and SR information transmission symbols. As shown therein, if the dedicated RS is configured for the coherent SR transmission, even though the number of time-domain orthogonal spreading codes used in the SR transmission symbols is larger than that of the RS dedicated orthogonal spreading codes, the number of SR channels supportable for the coherent SR signal demodulation (only the SR transmission without the control signal) is determined by the minimum number of time-domain orthogonal spreading codes in a dedicated RS or SR information section. Thus, when the SR control channel is configured with the time-frequency domain spreading code used in

the ACK/NACK channel configuration, UE multiplexing capability is varied depending on allocation of the frequency domain spreading code. In the ACK/NACK channel structure of the LTE, if it is possible to generate 6 orthogonal spreading codes through a circular shift with regard to one ZC root sequence in the frequency domain, three SR channels supportable to one allocated circular shift can be generated depending on the orthogonal spreading codes in 3-RS, and thus three ACK/NACK channels are decreased. <Table 1> shows the number of SR and ACK/NACK channels increased/decreased in accordance with the number of circular shifts allocated for configuring the dedicated SR channel.

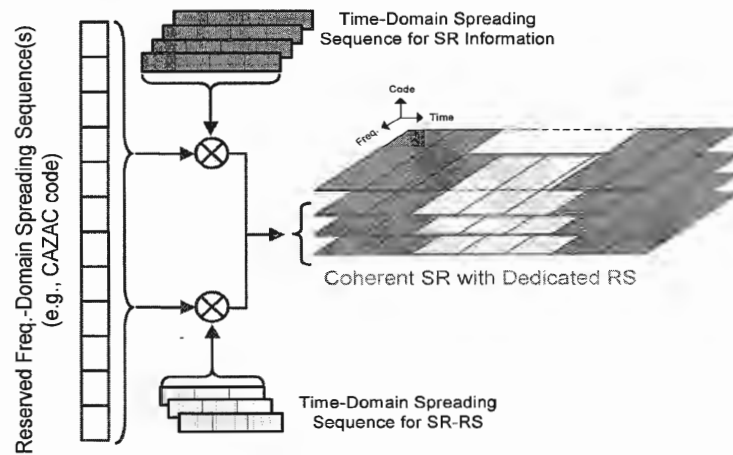


FIG. 4. Example of the coherent SR channel configuration having the dedicated RS by allocating the frequency-domain spreading code.

<Table 1> Change in the number of dedicated SR and ACK/NACK channels according to the allocation of the frequency-domain spreading codes

The Number of Reserved Freq.-Domain Spreading Codes	The Number of Coherent SR Channels with Dedicated RS	The Number of ACK/NACK Channels
0	0	18
1	3	15
2	6	12
⋮	⋮	⋮
6	18	0

In the case that the SR channel configured as shown in FIG. 4 is allocated to a certain UE, the UE transmits the SR information and the RS signal therefor through 2D spreading based on the allocated codes if the transmission of the control signal such as the ACK/NACK is not simultaneously performed, and the base station that receives them obtains the SR signal through the coherent/non-coherent demodulation. Meanwhile, if the transmission of the ACK/NACK signal is required at the same time when the SR signal is transmitted, the ACK/NACK signal in a section where the SR information is transmitted is modulated and transmitted with respect to the SR channel configured as shown in FIG. 4, so that the receiver detects the SR signal through the non-coherent demodulation (e.g., demodulation of on-off keying) with respect to the dedicated SR spreading code, and performs the coherent ACK/NACK demodulation through a channel estimation result based on the SR dedicated RS with respect to the ACK/NACK signal.

(2) A method of allocating one or more orthogonal codes for the dedicated SR among the time-domain spreading codes (time covering) allocated to the ACK/NACK channel

FIG. 5 shows a coherent SR channel designing plan by allocating the time-domain spreading codes different in length from each other according to the RS and SR information transmission symbols. As shown therein, in the case that the SR control channel is configured with the time-frequency domain spreading codes used in the ACK/NACK channel configuration, the UE multiplexing capability is varied depending on the allocation of the time-domain spreading codes, and the SR channel can be generated as many as the number of orthogonal codes supportable in the frequency-domain with regard to one allocated time-domain spreading code.

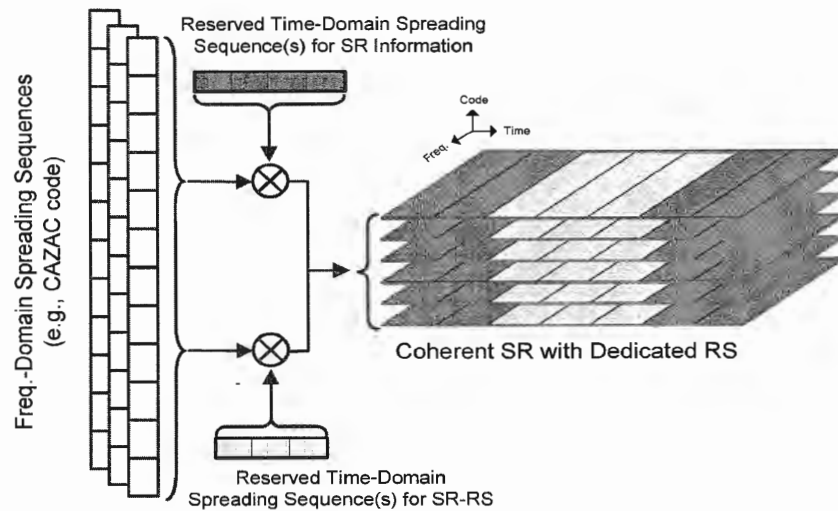


FIG. 5. Example of the coherent SR channel configuration having the dedicated RS by allocating the time-domain spreading code.

In consideration of the LTE ACK/NACK channel structure, 6 orthogonal spreading codes can be generated by the circular shift with regard to one ZC root sequence in the frequency domain, and if the SR channel is configured by respectively allocating the orthogonal codes having a length of 4 to OFDM symbols for carrying SR information and the orthogonal codes having a length of 3 to a section used as RS, it is possible to generate the maximum six SR channels according to reserved time-domain spreading codes. Thus, six ACK/NACK channels are reduced. <Table 2> shows the number of SR and ACK/NACK channels increased and decreased depending on the number of time-domain spreading codes (the number of time-domain spreading codes applicable for the SR was limited to 3 since the maximum 3 orthogonal codes having a length of 3 are given in the case of RS) allocated for configuring the dedicated SR channel.

<Table 2> Change in the number of dedicated SR and ACK/NACK channels according to allocation of time-domain spreading codes

The Number of Reserved Time-Domain Spreading Codes	The Number of Coherent SR Channels with Dedicated RS	The Number of ACK/NACK Channels
0	0	18
1	6	12

2	12	6
3	18	0

In the case where the SR channels configured as shown in FIG. 5 are allocated to a certain UE, the UE transmits the SR information and the RS signal therefor through the 2D spreading based on the allocated codes if the transmission of the control signal such as ACK/NACK is not simultaneously performed, and the base station that receives them obtains the SR signal through the coherent/non-coherent demodulation. Meanwhile, if the transmission of the ACK/NACK signal is required at the same time when the SR signal is transmitted, the ACK/NACK signal in a section where the SR information is transmitted is modulated and transmitted with respect to the SR channel configured as shown in FIG. 5, so that the receiver detects the SR signal through the non-coherent demodulation (e.g., demodulation of on-off keying) with respect to the dedicated SR spreading code, and performs the coherent ACK/NACK demodulation through a channel estimation result based on the SR dedicated RS with respect to the ACK/NACK signal.

(3) A method of allocating one or more orthogonal codes for the dedicated SR among time-frequency 2D spreading codes allocated to the ACK/NACK channel

FIG. 6 shows that the 2D spreading codes are reserved for configuring the SR channel by arbitrarily allocating the spreading codes in the frequency domain in addition to allocating time-domain spreading codes different in length from one another according to the RS and SR information transmission symbols. As shown therein, if the SR control channel is configured by the time and frequency domain spreading codes used in the ACK/NACK channel configuration, the allocated spreading codes are one-to-one mapped to the coherent SR channel configuration, and thus the ACK/NACK UE multiplexing capability is varied. In consideration of the LTE ACK/NACK channel structure, 6 orthogonal spreading codes can be generated by the circular shift with regard to one ZC root sequence in the frequency domain, and if the orthogonal codes having a length of 4 are used to OFDM symbols for carrying SR information and the orthogonal codes having a length of 3 are used to a section used as RS, total eighteen 2D orthogonal spreading codes are generated (the spreading codes having a length of 3 in the RS restricts cardinality of the orthogonal codes), and a certain 2D spreading code among them may be used to configure one coherent SR channel.

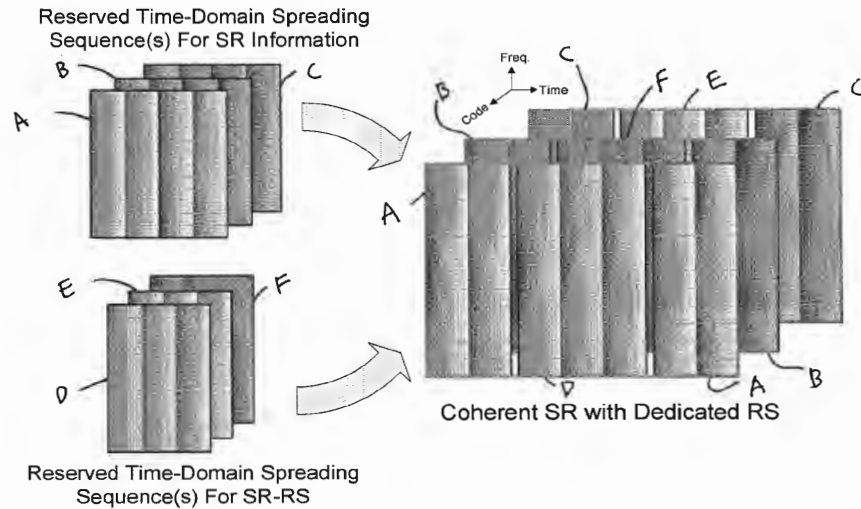


FIG. 6. Example of the coherent SR channel configuration having the dedicated RS by allocating the time-frequency domain spreading codes

<Table 3> shows the number of SR and ACK/NACK channels increased and decreased depending on the number of time-frequency domain spreading codes allocated for configuring the dedicated SR channel.

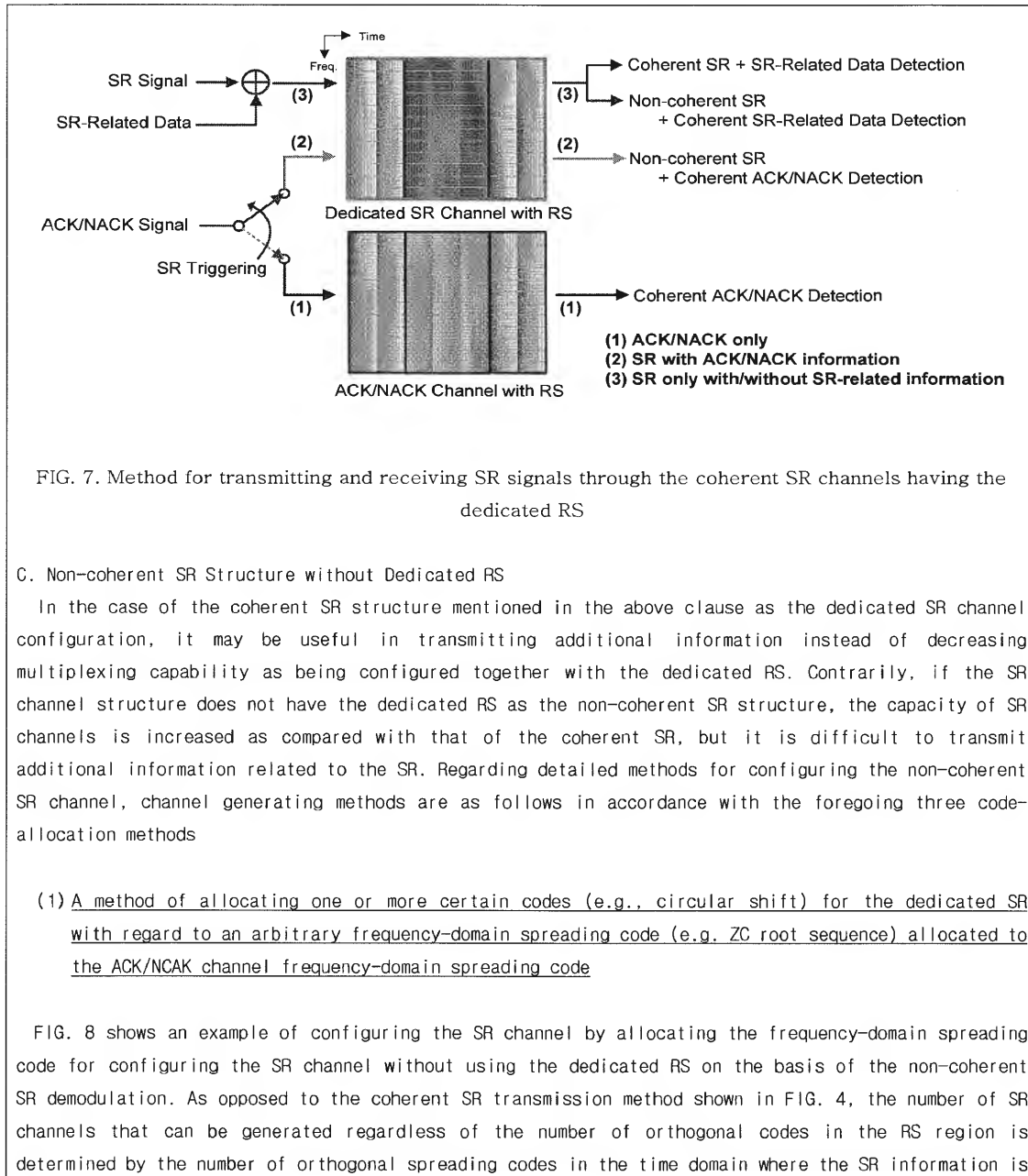
<Table 2> Change in the number of dedicated SR and ACK/NACK channels according to the allocation of time-domain spreading codes

The Number of Reserved Time-Domain Spreading Codes	The Number of Coherent SR Channels with Dedicated RS	The Number of ACK/NACK Channels
0	0	18
1	1	17
⋮	⋮	⋮
18	18	0

In the case where the SR channels configured as shown in FIG. 5 are allocated to a certain UE, the UE transmits the SR information and the RS signal therefor through the 2D spreading based on the allocated codes if the transmission of the control signal such as ACK/NACK is not simultaneously performed, and the base station that receives them obtains the SR signal through the coherent/non-coherent demodulation. Meanwhile, if the transmission of the ACK/NACK signal is required at the same

time when the SR signal is transmitted, the ACK/NACK signal in a section where the SR information is transmitted is modulated and transmitted with respect to the SR channel configured as shown in FIG. 5, so that the receiver detects the SR signal through the non-coherent demodulation (e.g., demodulation of on-off keying) with respect to the dedicated SR spreading code, and performs the coherent ACK/NACK demodulation through a channel estimation result based on the SR dedicated RS with respect to the ACK/NACK signal.

Through the coherent SR channel configuration mentioned above, the SR signal transmission method is classified into three scenarios as shown in FIG. 7. First, if only the SR signal is transmitted through the SR channel configured through the spreading code (refer to (3) of FIG. 7), the feature of the coherent SR channel allows additional information related to the SR to be transmitted together. Assume that the SR information is generally defined with 1bit. If 2-bit transmission is achieved by QPSK modulation or the like through the coherent SR, and the SR (1bit) information is detected by a coherent method as shown in the drawing, the information to be transmittable is 1bit since it is additional information. On the other hand, if the SR information is detected by a non-coherent (on-off keying) method, additional information can be all transmitted by QPSK modulation and thus additional information transmission of the maximum 2bit is possible. If the transmission of the ACK/NACK signal is required at the SR transmission like (2) of FIG. 7, both the SR and ACK/NACK can be transmitted through the previously allocated SR channel. At this time, the SR information is detected by the non-coherent method, and the ACK/NACK information is obtained by the same coherent demodulation as the existing demodulation method of the ACK/NACK channel. In even this case, if a transmission amount of ACK/NACK information is less like 1bit than that of the coherent SR, the SR information can be also modulated/demodulated by the coherent method. Lastly, if only the ACK/NACK is transmitted like (1) of FIG. 7, the ACK/NACK information undergoes the coherent modulation/demodulation through the previously allocated ACK/NACK channels.



transmitted with the spreading codes in the reserved frequency domain. Referring to the ACK/NACK structure of the LTE, total four SR channels can be generated with one circular shift when an orthogonal spreading code having a length of 4 is generated in the time-domain with regard to one ZC circular shift. At this time, the reduced number of ACK/NACK channels is varied depending on the number of RS orthogonal spreading codes and the number of 2D orthogonal spreading codes remained in the data region since the coherent demodulation is supposed. Also basically, even though the frequency or time domain spreading code is not reserved for generating the SR channel, the data region and the RS region are different in the number of 2D orthogonal spreading codes, and thus the data region uses six 2D spreading codes in the ACK/NACK structure of FIG. 3, thereby generating six non-coherent SR channels. <Table 4> shows the number of SR and ACK/NACK channels increased and decreased depending on the number of circular shifts allocated for configuring the dedicated SR channel.

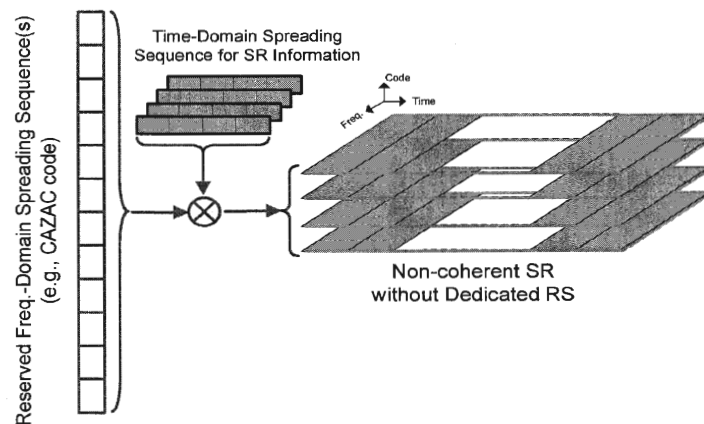


FIG. 8. Example of configuring the non-coherent SR channel by allocating the frequency-domain spreading codes

<Table 4> Change in the number of dedicated SR and ACK/NACK channels according to the allocation of frequency-domain spreading codes

The Number of Reserved Freq.-Domain Spreading Codes	The Number of Non-coherent SR Channels without Dedicated RS	The Number of ACK/NACK Channels
0	6	18
1	6	18

2	8	16
3	12	12
⋮	⋮	⋮
6	24	0

In the case where the SR channels configured as shown in FIG. 8 are allocated to a certain UE, the UE transmits the SR information and the RS signal therefor through the 2D spreading based on the allocated codes if the transmission of the control signal such as ACK/NACK is not simultaneously performed, and the base station that receives them obtains the SR signal through the coherent/non-coherent demodulation. Meanwhile, if the transmission of the ACK/NACK signal is required at the same time when the SR signal is transmitted, the ACK/NACK signal in a section where the SR information is transmitted is modulated and transmitted with respect to the SR channel configured as shown in FIG. 8, so that the receiver detects the SR signal through the non-coherent demodulation (e.g., demodulation of on-off keying) with respect to the dedicated SR spreading code, and performs the coherent ACK/NACK demodulation through a channel estimation result based on the ACK/NACK dedicated RS with respect to the ACK/NACK signal. In other words, the non-coherent SR demodulation and the coherent ACK/NACK modulation are possible.

(2) A method of allocating one or more orthogonal codes for the dedicated SR among the time-domain spreading codes (time covering) allocated to the ACK/NACK channel

FIG. 9 shows an example of configuring the SR channel by allocating the time-domain spreading code for configuring the SR channel without using the dedicated RS on the basis of the non-coherent SR demodulation. Referring to the ACK/NACK structure of the LTE, if the orthogonal spreading codes having a length of 4 is allocated for generating the SR channels in the time domain, six SR channels can be generated since total six orthogonal spreading codes can be generated with regard to one ZC root sequence. At this time, the reduced number of ACK/NACK channels does not cause loss of the ACK/NACK channels due to the allocation of one time-domain spreading code since the cardinality of the time-domain spreading codes in the data symbols is more by one than the number of spreading codes in the RS symbols. However, if two or more time-domain spreading codes are allocated, six ACK/NACK channels are reduced per allocated spreading code. <Table 5> shows the number of SR and ACK/NACK channels increased and decreased according to the number of time-domain spreading codes having a length of 4 allocated for configuring the dedicated SR channel.

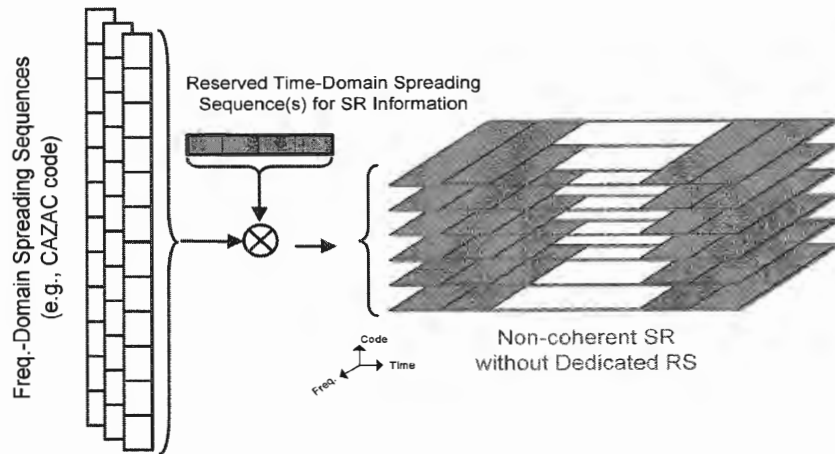


FIG. 9. Example of configuring a non-coherent SR channel by allocating the time-domain spreading codes

<Table 4> Change in the number of dedicated SR and ACK/NACK channels according to the allocation of frequency-domain spreading codes

The Number of Reserved Freq.-Domain Spreading Codes	The Number of Non-coherent SR Channels without Dedicated RS	The Number of ACK/NACK Channels
0	6	18
1	6	18
2	12	12
3	18	6
4	24	0

In the case where the SR channels configured as shown in FIG. 9 are allocated to a certain UE, the UE transmits the SR information and the RS signal therefor through the 2D spreading based on the allocated codes if the transmission of the control signal such as ACK/NACK is not simultaneously performed, and the base station that receives them obtains the SR signal through the coherent/non-coherent demodulation. Meanwhile, if the transmission of the ACK/NACK signal is required at the same time when the SR signal is transmitted, the ACK/NACK signal in a section where the SR information is transmitted is modulated and transmitted with respect to the SR channel configured as shown in FIG. 8, so that the receiver detects the SR signal through the non-coherent demodulation (e.g.,

demodulation of on-off keying) with respect to the dedicated SR spreading code, and performs the coherent ACK/NACK demodulation through a channel estimation result based on the ACK/NACK dedicated RS with respect to the ACK/NACK signal. In other words, the non-coherent SR demodulation and the coherent ACK/NACK modulation are possible.

(3) A method of allocating one or more orthogonal codes for the dedicated SR among time-frequency 2D spreading codes allocated to the ACK/NACK channel

FIG. 10 shows an example of configuring the SR channel by allocating the time-frequency domain 2D spreading code for configuring the SR channel without using the dedicated RS on the basis of the non-coherent SR demodulation. As shown therein, if the SR control channel is configured with the time and frequency domain spreading codes used in configuring the ACK/NACK channel, the allocated spreading codes are one-to-one mapped to the non-coherent SR channel configuration, and thus the ACK/NACK UE multiplexing capability is varied. In consideration of the LTE ACK/NACK channel structure, 6 orthogonal spreading codes can be generated by the circular shift with regard to one ZC root sequence in the frequency domain, total 24 2D orthogonal spreading codes are generated using the orthogonal codes having a length of 4 with regard to the OFDM symbols for carrying SR information, and a certain 2D spreading code among them may be used to configure one coherent SR channel. Because the cardinality of the 2D orthogonal spreading codes in the RS region is 18, there is no change in the number of ACK/NACK channels if the 2D orthogonal spreading codes allocated to the dedicated SR is 6 or less. <Table 6> shows the number of SR and ACK/NACK channels increased and decreased according to the number of 2D time-frequency domain spreading codes allocated for configuring the dedicated SR channel.

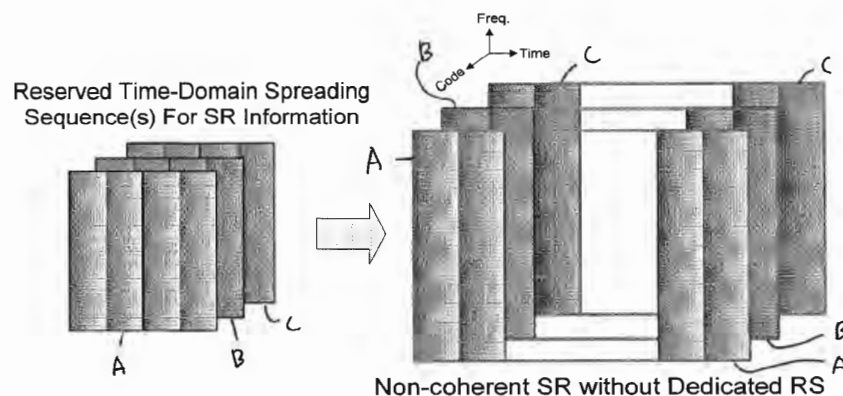


FIG. 10. Example of configuring the non-coherent SR channel by allocating time-frequency domain

spreading codes

<Table 5> Change in the number of dedicated SR and ACK/NACK channels according to the allocation of the time-frequency domain spreading codes

The Number of Reserved Freq.-Domain Spreading Codes	The Number of Non-coherent SR Channels without Dedicated RS	The Number of ACK/NACK Channels
0~6	6	18
7	7	17
8	8	16
⋮	⋮	⋮
24	24	0

In the case where the SR channels configured as shown in FIG. 10 are allocated to a certain UE, the UE transmits the SR information and the RS signal therefor through the 2D spreading based on the allocated codes if the transmission of the control signal such as ACK/NACK is not simultaneously performed, and the base station that receives them obtains the SR signal through the non-coherent demodulation. Meanwhile, if the transmission of the ACK/NACK signal is required at the same time when the SR signal is transmitted, the ACK/NACK signal in a section where the SR information is transmitted is modulated and transmitted with respect to the SR channel configured as shown in FIG. 8 and the RS region defined in the ACK/NACK is simultaneously transmitted, so that the receiver detects the SR signal through the non-coherent demodulation (e.g., demodulation of on-off keying) with respect to the dedicated SR spreading code, and performs the coherent ACK/NACK demodulation through a channel estimation result based on the ACK/NACK dedicated RS with respect to the ACK/NACK signal. In other words, the non-coherent SR demodulation and the coherent ACK/NACK demodulation are possible.

Through the non-coherent SR channel configuration mentioned above, the SR signal transmission method is classified into three scenarios as shown in FIG. 11. First, only the SR signal is transmitted through the SR channel configured through the spreading code (refer to (3) of FIG. 11). At this time, it may be possible to configure the dedicated channel for the SR transmission by allocating 1D or 2D spreading codes to even a portion corresponding to the RS region of the ACK/NACK. In the case of transmitting the SR signal through the non-coherent SR channel, it is difficult to transmit additional SR information due to the non-coherent feature. Under the condition that the SR information is generally defined with 1bit and additional information transmission is not required, the proposed non-coherent method is advantageous in light of increasing the multiplexing capability in order to allow coexistence with the ACK/NACK or the like control channels. If the transmission of the ACK/NACK signal is required at the SR transmission like (2) of FIG. 7, the ACK/NACK signal can be

transmitted through the previously allocated SR channel, in which the RS allocated to the existing ACK/NACK is used as the RS required here. At this time, the SR information is detected by the non-coherent method, and the ACK/NACK information is obtained by the same coherent demodulation as the existing demodulation method for the ACK/NACK channel. In even this case, if a transmission amount of ACK/NACK information is less like 1bit than that of the coherent SR, the SR information can be also modulated/demodulated by the coherent method. Lastly, if only the ACK/NACK is transmitted like (3) of FIG. 11, the ACK/NACK information undergoes the coherent modulation/demodulation through the previously allocated ACK/NACK channels.

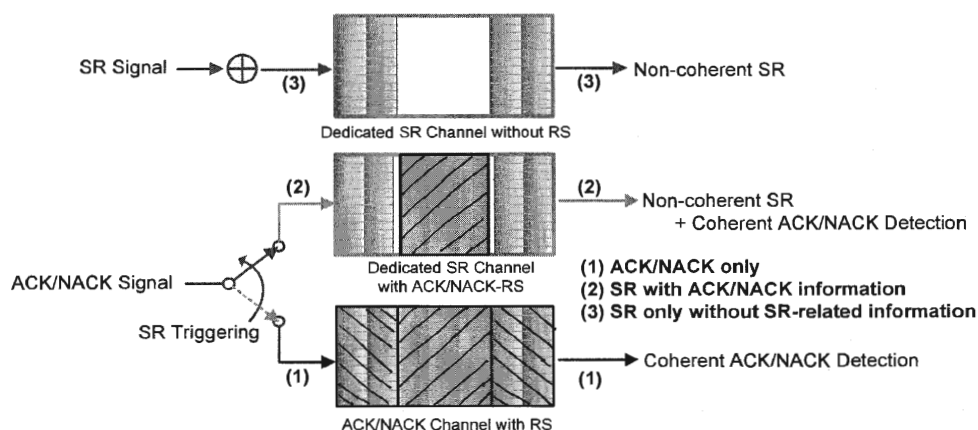


FIG. 11. Method of transmitting and receiving the SR signal through the non-coherent SR channel without the dedicated RS

As described above, the method of transmitting A/N on the SR channel at the same time using the spreading codes allocated as the SR may be variously applicable to the SR transmission method without the dedicated RS. FIG. 11-1 shows another example of the SR structure in which the spreading codes are not allocated for the RS. As shown therein, the spreading code having a length of 7 is divided into two spreading codes respectively having a length of 3 and a length of 4 within one slot at the SR transmission. At this time, the length of 3 corresponds to the RS of the existing A/N channel, and the length of 4 corresponds to a region for carrying the existing A/N signal. If the spreading code having a length of 7 is arbitrarily set at the SR transmission, it is difficult to coexist with the existing A/N channel within one time-frequency resource, and therefore a spreading code of a certain frequency domain has to be allocated for the dedicated SR. Accordingly, the code having the length of 7 is divided as shown in the drawing, and allocated for the SR channel. In this case, the SR signal transmission can be modulated by on-off keying, and the detection method supports both the coherent

and non-coherent methods.

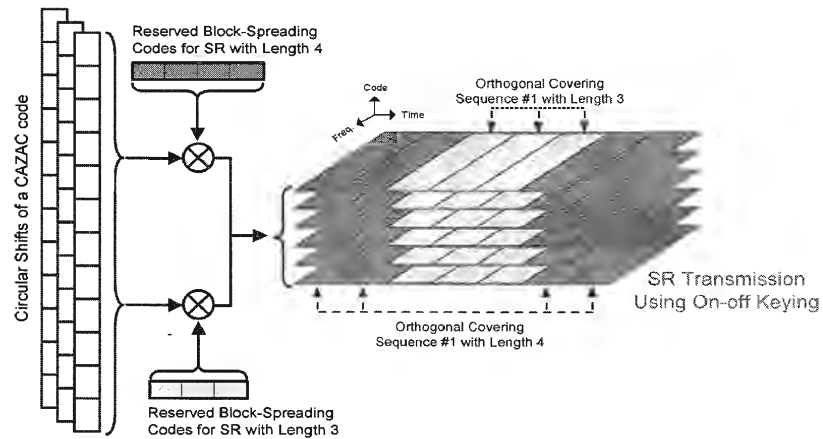


FIG. 11-1 SR transmission structure without RS using the divided spreading codes corresponding to the length of 7

If both the SR and the A/N have to be transmitted as shown in FIG. 11 in even this SR structure, the same transmission method can be used as shown in FIG. 11-2. At this time, since the SR code having a length of 3 is additionally allocated, the RS portion for detecting the coherent A/N can be transmitted using the code allocated to the existing SR as it is.

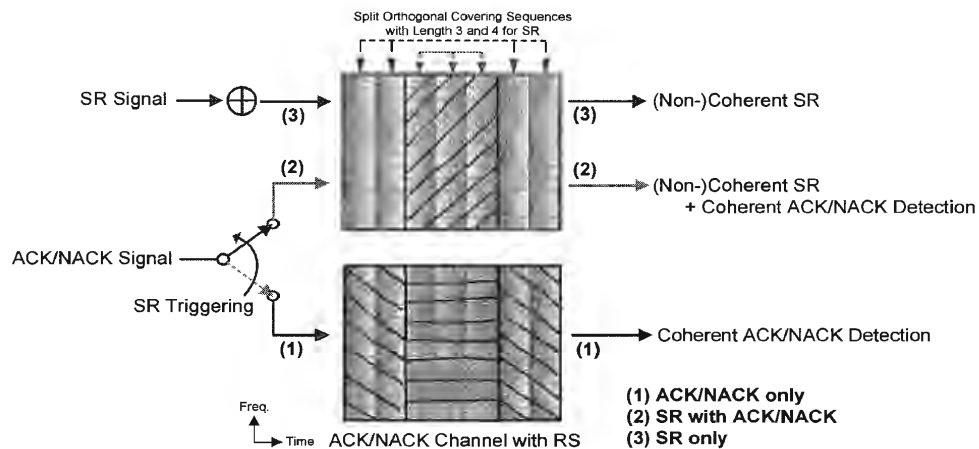


FIG. 11-2 Method of transmitting and receiving A/N in the SR structure using the spreading code having a length of 7 divided into lengths of 3 and 4

D. SR Transmission Method in a Slot-based Hopping ACK/NACK Channel Structure

In the coherent or non-coherent SR transmission structure described in the foregoing clause, the same one channel configuration as that for transmitting only the SR is proposed by considering and reflecting the coexistence with the ACK/NACK channel. On the other hand, if the coexistence between the dedicated SR channel structure and the coherent ACK/NACK structure is not considered and transmission is performed on the dedicated time-/frequency-resource, the capability of the SR channel is important together with efficiency increase in one resource. In other words, The maximum 42 SR channels (non-coherent method, and no addition information transmission) can be generated through 2D spreading in 1RB, 1 subframe. Therefore, if the SR channel does not coexist with the existing ACK/NACK channel, it is required a method capable of transmitting additional 1bit information to the existing ACK/NACK channel so as to transmit the SR information through the ACK/NACK channel. Accordingly, the present invention proposes a plan for transmitting the additional 1bit information while maintaining the ACK/NACK structure of the existing slot unit. As shown in FIG. 2, the control channel configuration of the LTE performs transmission through a control resource region defined in opposite terminals when there is no data transmission and at this time provides a frequency diversity gain through hopping of a slot unit. The present invention proposes a method of altering the phase or code of the ACK/NACK information carried on two slots to transmit the additional SR information of 1bit since the same ACK/NACK information with regard to each slot is transmitted in the case of the ACK/NACK channel. If the SR transmission is required as shown in FIG. 12 and the amount of ACK/NACK to be transmitted is 1bit, the additional SR information of 1bit can be transmitted through QPSK ACK/NACK modulation. However, in the case of 2bit ACK/NACK transmission, if the SR transmission is required, the ACK/NACK information of every slot is multiplied with a previously determined phase variation or an orthogonal code, or transmitted in a differential modulation/encoding fashion, so that the receiver can restore the SR signal after the ACK/NACK demodulation of the slot unit. Of course, the non-coherent SR detection method can be first applied in this case. With this structure, the SR demodulating/modulating transmission is shown in FIG. 13.

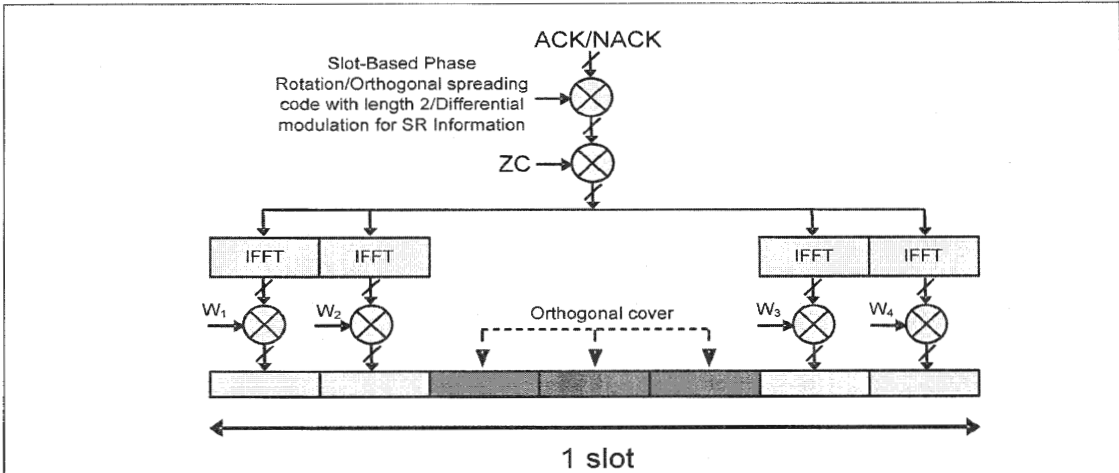


FIG. 12. Method of transmitting the SR signal without affecting the existing ACK/NACK slot structure

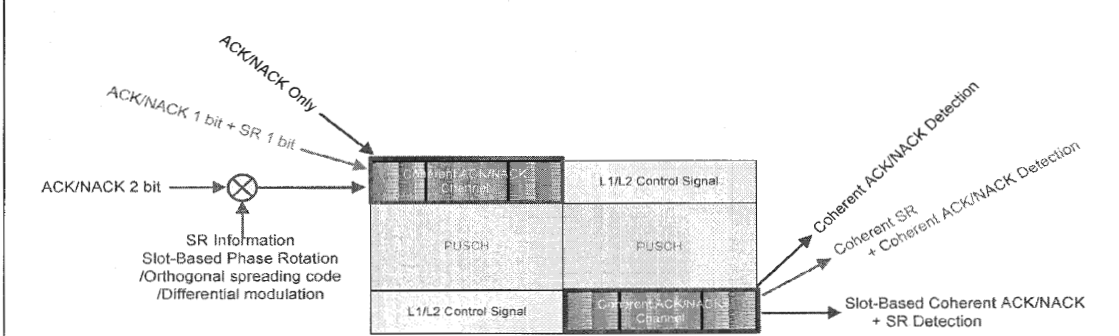


FIG. 13. Method of transmitting and receiving the SR in the control channel of the slot based hopping fashion

(2) Description of operation in the invention (device)
4) Effect of the invention (device)
5) Another exemplary embodiment of the invention (device) – Embodiments explain operations, manufacturing methods or the like of a product itself in more detail while sorting something being applied to the product or having high possibility, or quote the drawings or disclose the whole configuration of the

product.
3. Claims of Patent (Utility Model registration) – Features are disclosed to hold exclusive rights. The minimum necessary elements (super ordinate concept) for obtaining effective functions of the invention (device) are described. Every claim has to be terminated with the same as the title of the invention (device).
4. Explanation of major parts in drawings (need to be mentioned)
5. Drawings – Please briefly write descriptions of the drawings below the drawings. (ex: <FIG. 1> Structure of related art <FIG. 2> Structure of the present device, and so on