



Industria y Comercio

SUPERINTENDENCIA

IE

Delegatura de Propiedad Industrial

División de Nuevas Creaciones

PET

SOLICITUD

PATENTE DE INVENCION

21. EXPEDIENTE No.

05-2611

54. TITULO

METODO PARA RETORNAR SINCRONIZACION DE ENLACE

EN UN SISTEMA SATELITAL CDMA ORTOGONAL

51. CLASIFICACION INTERNACIONAL

71. SOLICITANTE

QUALCOMM INCORPORATED

DOMICILIO

San Diego, California, Estados Unidos de América.

74. APODERADO

EMILIO FERRERO

C.C. 438,019 de Usqueñ.

22. BOGOTA, D.C.,



Industria y Comercio
SUPERINTENDENCIA

PETITORIO

SUPERINTENDENCIA I LICENCIU
Radicación : 05002611 00000000 Folios: 129
Fecha (HUB): 2005-01-14 16:52:59
Trámite : 011 PCT-PATENT 379 FASE NACI 411 PRESENTAC
Dependencia: 2020 DIVISION DE NUEVAS CREACIONES

FORMULARIO UNICO DE SOLICITUD DE PATENTE
PCT
ENTRADA EN FASE NACIONAL

1 SOLICITUD DE:			
☒ Patente de Invención.		☐ Patente de Modelo de Utilidad.	
☐ Capítulo I.		☒ Capítulo II.	
2 SOLICITANTE (71)	Nombre: QUALCOMM INCORPORATED sociedad constituida y existente bajo las leyes del Estado de Delaware, Estados Unidos de América. Dirección: 5775 Morehouse Drive, San Diego, California 92121-1714, Estados Unidos de América. Domicilio: San Diego, California, Estados Unidos de América.		IDENTIFICACIÓN C.C. ☐ NIT ☐ C.E. ☐ Otro ☐ Cual _____ Número _____
3 REPRESENTANTE O APODERADO	Nombre: EMILIO FERRERO Dirección: Carrera 4ª. No. 72-35 Teléfono: 347 36 11 Fax: 217 92 11 E-mail: clientes@camyo.com Domicilio: Bogotá, Colombia.		IDENTIFICACIÓN. C.C. ☒ NIT ☐ C.E. ☐ Otro ☐ Cual _____ Número 438.019 T.P 31.929
4 INVENTOR (ES) (72)	1. David S. MILLER 5775 Morehouse Drive, San Diego, California 92121, Estados Unidos de América. 2. Leonard N. SCHIFF 13689 Winstanley Way, San Diego, California 92130, Estados Unidos de América.		
5 PCT (86) Solicitud Internacional No. <u>PCT/US2003/020063</u> Fecha: <u>24 de junio de 2003</u> Publicación Internacional No. <u>WO 2004/002022 A1</u> Fecha: <u>31 de diciembre de 2003</u>			
6 Título (54) <u>MÉTODO PARA RETORNAR SINCRONIZACIÓN DE ENLACE</u> <u>EN UN SISTEMA SATELITAL CDMA ORTOGONAL</u>			
7 Clasificación Internacional (51) <u>H04B 7/26</u>			
8 Prioridad SI ☒ NO ☐	(33) País de Origen	(32) Fecha	(31) Número de Solicitud
	<u>US.</u> <u>US.</u>	<u>24 de junio de 2002</u> <u>24 de junio de 2002</u>	<u>60/391.437</u> <u>60/391.438</u>
9 Comprobante de pago No.: <u>05 - 107</u> Fecha: <u>3 de enero de 2005</u>			

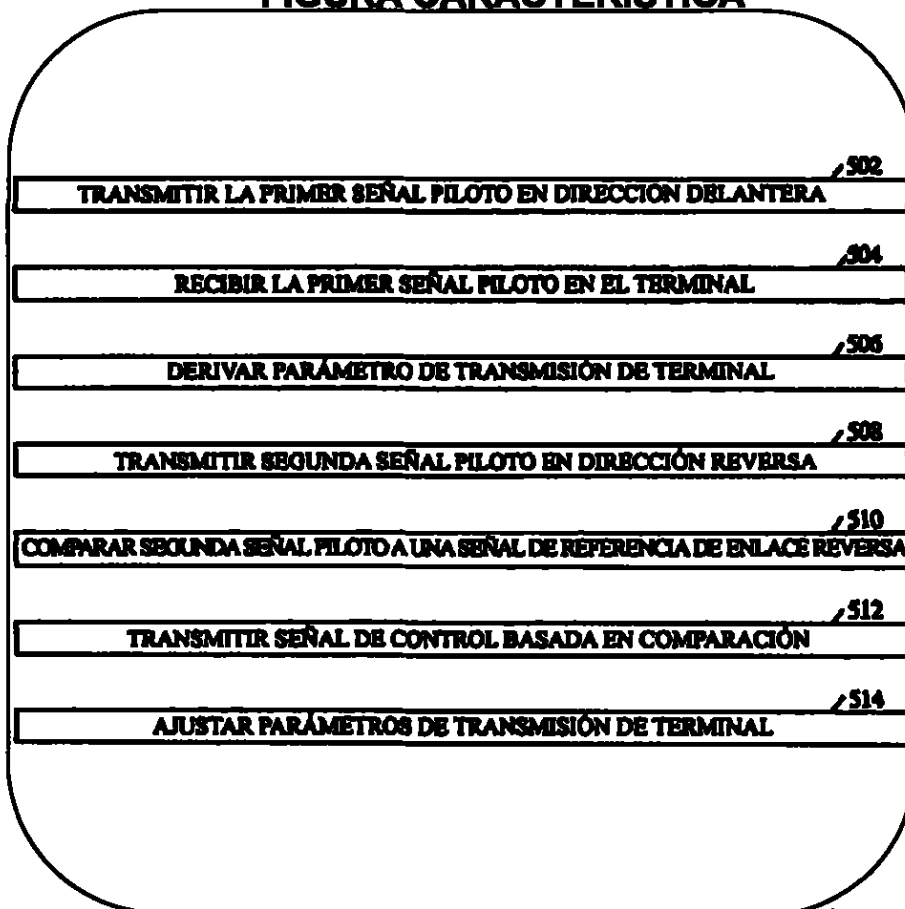
10

Anexos:

- ☒ Comprobante de pago de la tasa de presentación de la solicitud por \$ 443.000.00.
- ☐ Comprobante de pago por reivindicación de prioridad.
- ☒ Documento que acredita la existencia y representación legal cuando el solicitante sea persona jurídica.
- ☒ Poderes, si fuere el caso.
- ☐ Documento de cesión del inventor al solicitante o a su causante.
- ☐ Declaraciones.
- ☒ Copia de la solicitud internacional. (Resumen, descripción, reivindicaciones, dibujos)
- ☒ Traducción de la solicitud internacional al castellano. (Resumen, descripción, reivindicaciones, dibujos)
- ☒ Copia del examen preliminar efectuado por la IPEA.
- ☐ Traducción del examen preliminar efectuado por la IPEA.
- ☐ De ser el caso, copia del contrato de acceso.
- ☐ De ser el caso, documento que acredite la licencia o autorización de uso de conocimientos tradicionales de las comunidades indígenas.
- ☐ De ser el caso, certificado de depósito del material biológico.
- ☒ Arte final 12x12
- ☐ De ser el caso, información sobre otras solicitudes de patente o títulos obtenidos en el extranjero por el mismo titular o su causante, relacionadas parcial o totalmente con la invención de esta solicitud.
- ☒ Otros: 2 documentos citados en el Informe de Búsqueda Intl.

11

FIGURA CARACTERÍSTICA



12

Solicito la concesión de la patente,

NOMBRE: EMILIO FERREROFIRMA: *Emilio Ferrero*

C.C. 438.019 de Usaquén T.P. 31.929

State of California

SECRETARY OF STATE

APOSTILLE

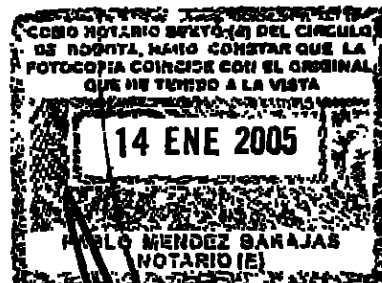
(Convention de La Haye du 5 octobre 1961)

1. Country: United States of America
This public document
2. has been signed by GREGORY J. SMITH
3. acting in the capacity of ASSESSOR/ COUNTY CLERK/RECORDER
4. bears the seal/stamp of the county of SAN DIEGO
State of California

CERTIFIED

5. At SAN DIEGO, California
6. The 20TH day of AUGUST 2004
7. by Deputy Secretary of State, State of California
8. No. 114512
9. Stamp/Seal

10. Signature



Kevin Shelley
KEVIN SHELLEY
Secretary of State

BY

Gregory J. Smith



Gregory J. Smith

COUNTY OF SAN DIEGO

ASSESSOR / RECORDER / COUNTY CLERK



ASSESSOR'S OFFICE
1600 Pacific Highway, Room 103
San Diego, CA 92101-2480
Tel. (619) 236-3771 • Fax (619) 557-4056

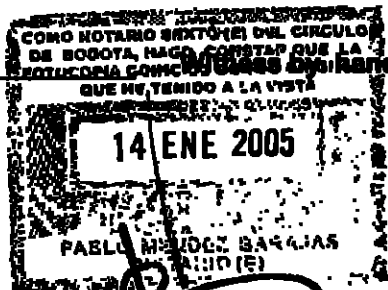
www.sdarcc.com

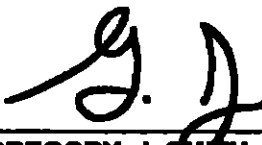
RECORDER/COUNTY CLERK'S OFFICE
1600 Pacific Highway, Room 260
P.O. Box 121750 • San Diego, CA 92112-1750
Tel. (619) 237-0502 • Fax (619) 557-4155

I, **GREGORY J SMITH**, Assessor/Recorder/County Clerk of the County of San Diego, State of California, having by law a Seal, DO HEREBY CERTIFY that:

ROMINA M CLEARY whose name is subscribed to the oath or Certificate of Proof or Acknowledgement of the annexed instrument and thereon written, was at the time of taking such oath, or Proof or Acknowledgement, a Notary Public, in and for said County, duly commissioned and sworn and duly authorized by the laws of said State to take the same and administer oaths and to take the Acknowledgements and Proofs of Deeds and other instruments in writing to be recorded in this State. I am acquainted with the handwriting of such Notary Public and believe that the signature to said oath or Certificate of Proof Acknowledgement is genuine. I further certify that under the laws of the State of California the said oath or Certificate of Proof or Acknowledgement is required to be under seal, but the impression of said seal is not required by the laws of the State of California to be filed in my office or in any other place.

DATED: August 20, 2004




GREGORY J SMITH, County Assessor/Recorder/Clerk



Branch Offices Available To Serve You

CHULA VISTA
590 Third Avenue
Chula Vista, CA 91910-5617
(619) 498-2200

EL CAJON
200 S. Magnolia Avenue
El Cajon, CA 92020-4524
(619) 401-5700

KEARNY MESA
9225 Clairemont Mesa Blvd.
San Diego, CA 92123-1211
(858) 505-6262

SAN MARCOS
334 Via Vera Cruz, Suite 150
San Marcos, CA 92078-2638
(760) 940-6868

Representación y Poder con autenticación notarial y Apostille para patentes, modelos de utilidad, diseños industriales, marcas de fábrica, nombres comerciales, enseñas, nombres de dominio, lemas comerciales, licencias.

Representation and Power-of-Attorney with notarial authentication and Apostille for patents, utility models, industrial designs, trademarks, commercial names, trade emblems, domain names, slogans, licenses.

REPRESENTACION Y PODER

REPRESENTATION AND POWER-OF-ATTORNEY

Yo (nosotros), abajo firmado (s)/I (we), the undersigned

QUALCOMM INCORPORATED

domiciliado (s) en/of 5775 Morehouse Drive

San Diego, California 92121-1714, United States of America

el presente nombramos a EMILIO FERRERO, tpa. 31929; GONZALO PERDOMO, tpa. 831; LUZ CLEMENCIA DE PAEZ, tpa. 23555 y GERMAN CAVELIER, tpa. 832, domiciliados en la Carrera 4a N° 72-35, Bogotá, Colombia, en obediencia a lo dispuesto en el párrafo 1o del Artículo 543 del Código de Comercio, el primero como principal y los demás como suplentes, en su orden, como mis (nuestros) representantes en todos los asuntos de propiedad industrial con facultad para recibir notificaciones y nombrar apoderados judiciales o extrajudiciales. El primer representante suplente reemplazará al principal en caso de ausencia o impedimento temporal o definitivo de aquél. La misma regla se aplicará cuando el segundo representante suplente haya de reemplazar al primero, o el tercero al segundo. En tales casos, el representante principal, o el primero, o segundo suplente, en su caso, o ambos, declararán su intención de no ejercer la representación mediante declaración autenticada por Notario Público en Colombia, o por Notario u otro Funcionario Público, o Cónsul de Colombia, en el extranjero; y si se tratare de impedimento, con el certificado respectivo. Si alguno de los nombrados faltare definitivamente, el siguiente tomará su lugar. Cuando cesare la ausencia o impedimento del representante principal, o de su primero o segundo suplentes, en su caso, podrán ejercer la representación, en su orden, uno u otros según el caso, asumiéndola por el solo hecho de ejercerla, cesando en ese momento el ejercicio de la representación por el primero, segundo o tercer suplente en su caso.

Además, confiero (conferimos) poder a los abogados arriba nombrados, para obtener la protección de mi (nuestra) propiedad industrial y contra la competencia desleal, a cuyo efecto autorizo (amos) a los dichos apoderados para que me (nos) representen ante cualesquiera entidades o personas, ejerzan o no jurisdicción, especialmente ante las del orden administrativo, contencioso-administrativo y judicial, así como los tribunales de arbitramento, en todo lo concerniente a los siguientes asuntos: a) Obtención de patentes de invención, modelos de utilidad y diseños industriales; el registro de marcas de fábrica, colectivas, defensivas, de servicio, lemas comerciales, nombres comerciales, enseñas, nombres de dominio, variedades vegetales y denominaciones de origen; su renovación, traspaso, cambio de nombre o domicilio, cancelación voluntaria; y el registro de licencias de uso de esos derechos; b) Las acciones de competencia desleal, protección del consumidor,

in due compliance with the terms of paragraph 1st. of article 543 of the Commercial Code, do hereby appoint EMILIO FERRERO, tpa. 31929; GONZALO PERDOMO, tpa. 831; LUZ CLEMENCIA DE PAEZ, tpa. 23555 and GERMAN CAVELIER, tpa. 832, domiciled at Carrera 4a N° 72-35, Bogotá, Colombia, the first as principal and the others as alternates, in the order of their appointment, as our representatives for all industrial property matters with faculty to receive notifications and to appoint attorneys in and out of Court. The first alternate shall replace the principal in case of his absence or of temporal or definitive impediment. The same rule will apply when the second alternate representative is to replace the first one, or when the third is to replace the first or second alternates in their turn, or both of them, second. In such cases, the principal representative, or the first or second alternates in their turn, or both of them, shall state their intention not to act as representatives through a declaration given before a Notary Public in Colombia, or before a Notary or another Public Official or a Colombian Consul abroad; and in case of impediment, the appropriate certificate shall suffice. If any of the appointees were to be definitely absent, the following alternate shall take his place. When the absence or impediment of the principal representative, or of his first or second alternates, in their turn ceases, the representation can be exercised by the principal, the first or second alternate depending on case, and the mere fact or its exercise will justify the representation by the first, second or third alternate in their turn shall end at such time. In addition, we grant a Power of Attorney in favor of the above named attorneys at law so that they may obtain the protection of my (our) industrial property and against the unfair competition, for which purpose I (we) authorize the said attorneys to represent me (us) before any authorities or persons, with or without jurisdiction, specially those administrative, administrative contentious and judicial, as well as before Arbitration Court, in all matters concerning the following: a) Obtainment of patents, utility models and industrial designs; the registration of trademarks, collective, defensive and service marks, slogans, commercial names, trade emblems, domain names, vegetal varieties and denominations of origin; its renewal, assignment, change of name or domicile, voluntary cancellation; and the registration of licenses of use of the above rights; b) Actions of unfair competition, protection to

oposiciones u observaciones, cancelación administrativa y judicial, nulidad, medidas cautelares, concesión de licencias, la tutela, la protección de secretos industriales, y en general los juicios civiles, penales, administrativos o contencioso-administrativos relacionados con estos derechos; acciones y procesos que promovamos o se nos promuevan. Y para que en todos los asuntos arriba determinados, puedan sustituir este mandato, transigir, conciliar, admitir los hechos del proceso, desistir, cancelar, recibir, renunciar, y ratificar los actos de agentes oficiosos.

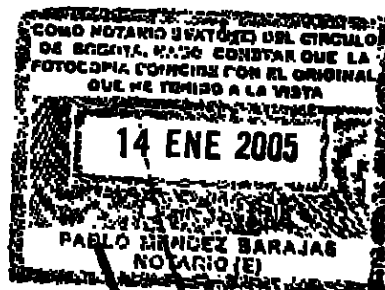
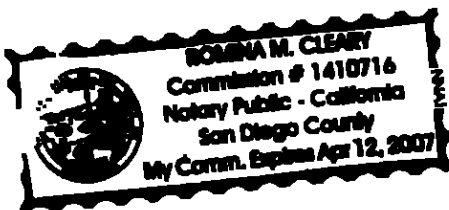
the consumer, oppositions or observations, administrative or Court cancellation, nullity, infringement, granting of licenses, the action for writ mandamus, the protection of trade secrets, and in general the civil, penal, and administrative suits relating to those rights; actions and suits instituted by me (us) or against me (us). And that in all the above matters they may substitute this Power of Attorney, compromise, conciliate, admit the facts of the case, desist, cancel, receive, resign, and ratify acts done by representatives without a power of attorney.

Dado y firmado hoy/Given and signed this 13 day of August 2004

en/in San Diego, California

por/by George A. Whitten, Vice President/Patent Counsel

Firma George A. Whitten Signature



ALIF RNIA ALL-PURPOSE A KN WLEDGMENT

State of California

County of

San Diego

ss.

On August 13th 2001

before me,

Romina Cleary, Notary Public

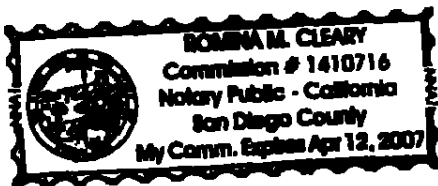
Name and Title of Officer (s.e. John Doe, Notary Public)

personally appeared

George A. Whitten

Name(s) of Signer(s)

- ☒ personally known to me
☐ proved to me on the basis of satisfactory evidence



to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies) and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

WITNESS my hand and official seal.

R Cleary
Signature of Notary Public

Place Notary Seal Above

OPTIONAL

Though the information below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent removal and reattachment of this form to another document.

Description of Attached Document

Title or Type of Document:

Colombia

Document Date:

Number of Pages:

Signer(s) Other Than Named Above:

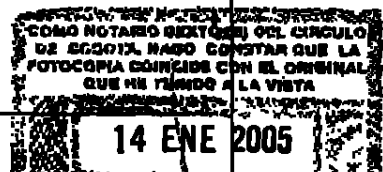
Capacity(ies) Claimed by Signer

Signer's Name:

- ☐ Individual
☐ Corporate Officer — Title(s): _____
☐ Partner — ☐ Limited ☐ General
☐ Attorney in Fact
☐ Trustee
☐ Guardian or Conservator
☐ Other: _____

Signer is Representing:

PLACE THUMBPRINT OF SIGNER
 Top of thumb here



CERTIFICADO NOTARIAL (INDIVIDUO)

A los 13 días del mes de AGOSTO
de 2004 ante mí, Notario Público o Funcionario Autorizado
de estado de California
compareció(eron) personalmente George A. Whitten

a quien(es) doy fe de conocer y me consta que es(son) la(s)
persona(s) firmante(s) del documento que precede, y quien(es)
tiene(n) capacidad legal para otorgarlo

Notario Público o Funcionario Autorizado - Notary Public or Attesting Official

CERTIFICADO NOTARIAL (SOCIEDAD)

Hoy 13 de Agosto de 2004
Compareció(eron) ante mí George A. Whitten
quien(es) conozco personalmente y que firma(n) este
documento en representación de la Sociedad/compañía
denominada QUALCOMM INCORPORATED

Certifico:

1. Que he visto los siguientes documentos:*

ARTICULOS DE CONSTITUCION, REPLANTEADOS,
ESTADO DE DELAWARE, 10 SEP, 1991

2. Que dichos documentos prueban lo siguiente:

2.1. Que QUALCOMM INCORPORATED

es una Sociedad/Compañía legalmente constituida y existente
de acuerdo con las leyes del Estado de
Delaware

2.2. Que el domicilio de dicha Sociedad/Compañía es 775 Morehouse Drive, San Diego, California 92121-1714, Estados Unidos de América

2.3. Que el objeto u objetos para los cuales se otorga el presente
poder están comprendidos dentro del objeto social de la
mencionada Sociedad/Compañía.

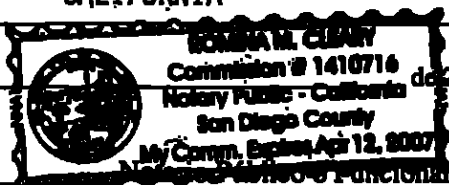
2.4. Que la(los) Sra.(Sras.) GEORGE A. WHITTEN

está(n) autorizado(s) para otorgar el presente Poder.

Ciudad SAN DIEGO

Estado CALIFORNIA

Hoy 13 de Agosto de 2004



Notario Público o Funcionario Autorizado - Notary Public or Attesting Official

NOTARIAL CERTIFICATE (INDIVIDUAL)

On this 13th day of August
2004 before me, a Notary Public or Attesting Official of
the state of California
personally appeared George A. Whitten

to me known, and known to me to be the person(s) who
executed that foregoing document, and who has(have) legal
capacity to execute it.

NOTARIAL CERTIFICATE (CORPORATION)

On this 13th day of August 2004
appeared before me George A. Whitten
who(m) I know personally and who(m) signed this document as
representative(s) of the Corporation/Company named QUALCOMM INCORPORATED

I certify:

1. That I have seen the following documents:*

Restated Certificate of Incorporation,
State of Delaware, September 10, 1991.

2. That the above documents duly prove the following:

2.1. That QUALCOMM INCORPORATED

is a Corporation/Company legally constituted and in existence
in accordance with the laws of the State of Delaware

2.2. That the domicile of said Corporation/Company is 775 Morehouse Drive, San Diego, California 92121-1714, United States of America

2.3. That the purpose or purposes for which the present Power
of Attorney is granted are comprised within the corporation
purposes set forth in the Charter of the mentioned
Corporation/Company.

2.4. That Mrs.(Messrs.) George A. Whitten
is(are) authorized to grant the present Power of Attorney.

City San Diego

State California

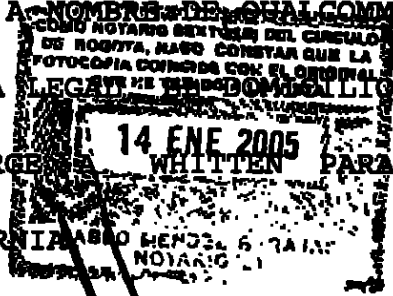
This 13th day of August 2004

Notary Public or Attesting Official

TRADUCCIÓN OFICIAL 314/2004 DE UN DOCUMENTO ESCRITO EN INGLÉS Y EN ESPAÑOL, REALIZADA POR EDUARDO CALADO NOGUERA, TRADUCTOR OFICIAL APROBADO POR RESOLUCIÓN 541 DEL 27 DE FEBRERO DE 1976 POR EL MINISTERIO DE JUSTICIA Y DEBIDAMENTE REGISTRADO ANTE EL MINISTERIO DE RELACIONES EXTERIORES DE LA REPÚBLICA DE COLOMBIA Y MEDIANTE EL CUAL QUALCOMM INCORPORATED, EMPRESA DOMICILIADA EN 5775 MOREHOUSE DRIVE, SAN DIEGO, CALIFORNIA 92121-1714, ESTADOS UNIDOS DE AMÉRICA OTORGA PODER A EMILIO FERRERO, TPA 31929, GONZALO PERDOMO, TPA 831; LUZ CLEMENCIA DE PAEZ TPA 23555 Y A GERMÁN CAVELIER, TPA 832. EXPEDIDO Y FIRMADO HOY 3 DE AGOSTO DE 2004 EN SAN DIEGO, CALIFORNIA POR GEORGE A WHITTEN, VICEPRESIDENTE, ABOGADO DE PATENTES. FIRMA ILEGIBLE

SELLO: ROMIN M. CLEARY, CARGO 1410716. NOTARIO PÚBLICO, CALIFORNIA. CONDADO DE SAN DIEGO, MI CARGO VENCE EL 12 DE ABRIL DE 2007.

CERTIFICADO NOTARIAL EN INGLÉS Y EN ESPAÑOL DE FECHA 13 DE AGOSTO DE 2004, POR EL CUAL SE CERTIFICA LA COMPARECENCIA DE GEORGE A. WHITTEN, PARA FIRMAR EL PODER ARRIBA CITADO A NOMBRE DE QUALCOMM INCORPORATED Y PARA CERTIFICAR LA EXISTENCIA DE DICHA EMPRESA Y LA CAPACIDAD DE GEORGE A. WHITTEN PARA COMPROMETER A DICHA FIRMA. SAN DIEGO, CALIFORNIA



GREGORY J SMITH

CONDADO DE SAN DIEGO

EVALUADOR/REGISTRADOR/SECRETARIO

Yo, GREGORY J. SMITH, evaluador/registrador/secretario del condado de San Diego, Estado de California, que por ley tiene sello, POR EL PRESENTE CERTIFICO QUE ROMINA M. CLEARY, cuyo nombre aparece firmado en el juramento o certificado de prueba o

reconocimiento del documento adjunto, era al momento de tomar dicho juramento, prueba o reconocimiento, un notario público, para dicho condado, debidamente nombrado, juramentado y debidamente autorizado por las leyes de dicho estado para tomar el mismo y administrar juramentos y tomar el reconocimiento y prueba de escrituras y otros instrumentos escritos que vayan a registrarse en este estado. Conozco la caligrafía de dicho notario público y opino que la firma en dicho juramento o certificado de prueba o reconocimiento es genuina. Además certifico que de acuerdo con las leyes del estado de California, dicho juramento o certificado de prueba o reconocimiento se requiere que esté bajo sello, pero que la impresión de dicho sello no se requiere de acuerdo con las leyes del estado de California que se radiquen en mi oficina o en ningún otro lugar.

FECHADO: 20 de agosto de 2004. Atestiguo mediante mi firma

GREGORY J SMITH, EVALUADOR, REGISTRADOR, SECRETARIO DEL CONDADO.

RECONOCIMIENTO MULTIPROPÓSITO DE CALIFORNIA

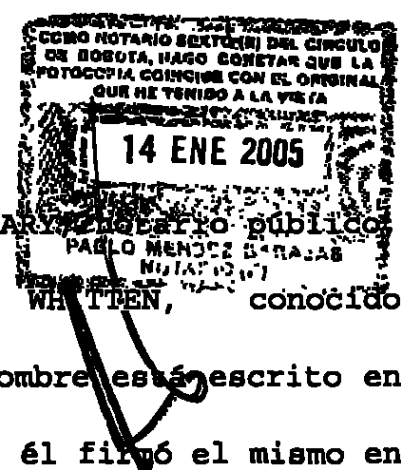
ESTADO DE CALIFORNIA, CONDADO DE SAN DIEGO

DECLARACIÓN JURAMENTADA

El 13 de agosto de 2004, ante mi, ROMINA CLEARY, notario público, compareció personalmente GEORGE A. WHITTEN, conocido personalmente por mi como la persona cuyo nombre está escrito en el documento adjunto y reconoció ante mi que él firmó el mismo en su calidad autorizada y que mediante su firma en el documento la persona o entidad a cuyo nombre actuaba, firmó el documento.

Atestiguo mediante mi firma y sello oficial

ROMINA CLEARY



Sello: ROMINA M. CLEARY, Cargo 1410716, notario público,
California. Condado de San Diego. Mi cargo vence el 12 de abril
del 2007.

Descripción del documento adjunto: COLOMBIA.

ESTADO DE CALIFORNIA

SECRETARÍA DE ESTADO

APOSTILLA:

(Convención de La Haya del 5 de octubre de 1961)

1. Estados Unidos de América

Este documento público

2. ha sido firmado por GREGORY J. SMITH

3. quien actúa en su calidad de EVALUADOR/SECRETARIO DEL
CONDADO/REGISTRADOR

4. lleva el sello del condado de SAN DIEGO, ESTADO DE
CALIFORNIA

CERTIFICADO

5. EN SAN DIEGO, CALIFORNIA

6. el 20 DE AGOSTO DE 2004

7. por el Secretario suplente del estado de 16a ENE 2005a

8. Número 114512

9. Sello:

El gran sello del estado de California

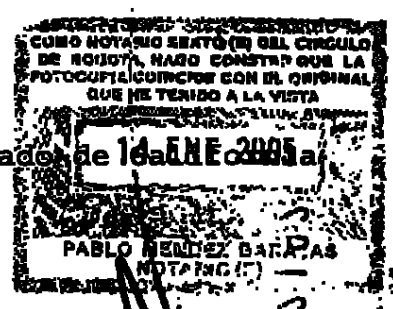
10. Firma: KEVIN SHELLEY, secretario de estado.

POR: FIRMA ILEGIBLE.

COLO-14439-841-001-5

WPCL002G ID 6270

Bogotá, 3 de diciembre de 2004.



Eduardo Calabaz
Eduardo Calabaz
"TRABAJA CON CALIDAD"
BOLSA DE TRABAJO
Bogotá, Colombia

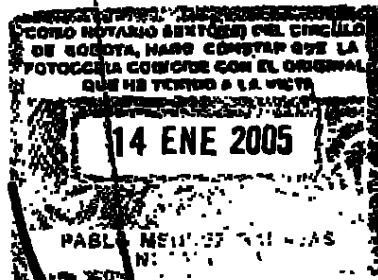
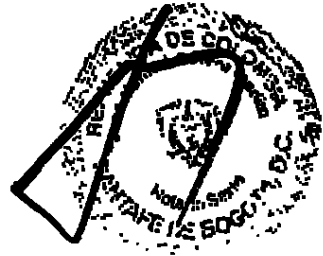
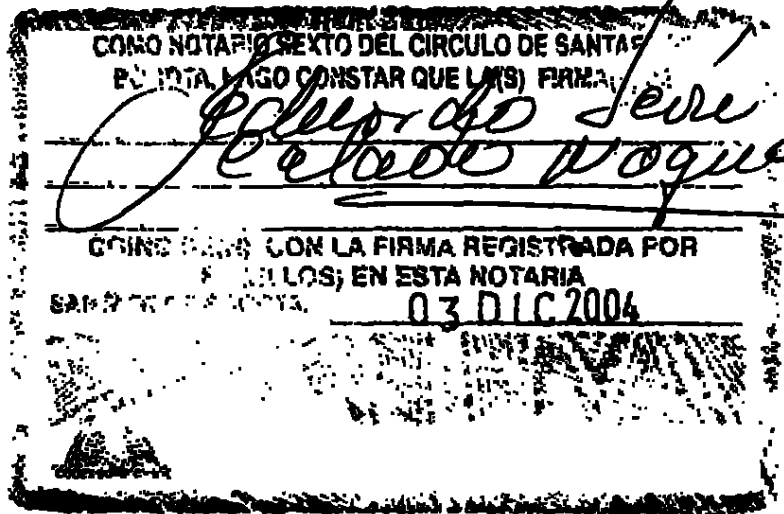
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Eduardo Cárdenas
CUYA FIRMA APARECE EN EL
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LAS FUNCIONES INDICADAS



(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
31 December 2003 (31.12.2003)

PCT

(10) International Publication Number
WO 2004/002022 A1

(51) International Patent Classification⁷: H04B 7/26, 7/216

(21) International Application Number:
PCT/US2003/020063

(22) International Filing Date: 24 June 2003 (24.06.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/391,437 24 June 2002 (24.06.2002) US
60/391,438 24 June 2002 (24.06.2002) US

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GE, GD, GR, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

(71) Applicant: QUALCOMM INCORPORATED [US/US];
5775 Morehouse Drive, San Diego, CA 92121 (US).

(72) Inventors: MILLER, David, S.; 5775 Morehouse Drive,
San Diego, CA 92121 (US). SCHIFF, Leonard, N.; 13689
Winstanley Way, San Diego, CA 92130 (US).

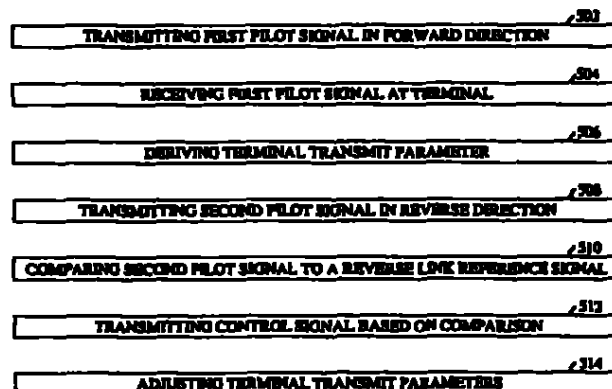
(74) Agent: OGROD, Gregory, D.; Qualcomm Incorporated,
5775 Morehouse Drive, San Diego, CA 92121 (US).

Published:

- with international search report
- before the expiration of the time limits for amending the claims and to be republished in the event of receipt of amendments

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD FOR RETURN LINK SYNCHRONISATION IN AN ORTHOGONAL CDMA SATELLITE SYSTEM



(57) Abstract: A technique for realizing code synchronism to enable the application of modulation codes needed for implementing orthogonal CDMA modulation for reverse link communications. In a satellite communications system using orthogonal CDMA in the reverse link, a ground station transmits a first pilot signal in the forward link direction, which is acquired and tracked by a terminal or remote station, and used in recovering carrier phase and modulation chip clock timing. The terminal then derives a transmission carrier frequency and chip clock timing to be used, from the recovered forward pilot carrier frequency and chip clock timing. The terminal transmits a second pilot signal in the reverse link direction which, after being received and retransmitted by a satellite, is detected at the ground station. Terminals have the ability to advance or retard the timing of their signals for transmission relative to the timing derived from the forward link pilot signal. The ground station tracks timing, and in some embodiments also tracks frequency, of the terminal pilot signal, and compares these parameters to a reverse link reference signal. Based at least in part on the results of the comparison, the ground station transmits a control signal on the forward link to each terminal, thereby commanding the terminal to advance or retard its respective transmission timing. Each terminal then adjusts its transmission timing and/or frequency in small increments to maintain a desired level of time alignment with the ground station.

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METHOD FOR RETURN LINK SYNCHRONISATION IN AN ORTHOGONAL CDMA SATELLITE SYSTEM

BACKGROUND OF THE INVENTION

Related Applications

[0001] This application claims the benefit of prior filed provisional applications 60/391,437, filed on June 24, 2002, and 60/391,438, filed on June 24, 2002.

Field of the Invention

[0002] The present invention relates generally to wireless communication systems, and more particularly to methods and apparatus for using orthogonal Code Division Multiple Access (O-CDMA) techniques in the return path of a communications system. In further aspects, the invention relates to providing code synchronization and employing O-CDMA by access terminals on return links in satellite communication systems.

Related Art

[0003] Various satellite communication systems have been developed over the years. One early system architecture uses an air interface or signal modulation technique referred to as Time Division Multiple Access (TDMA). TDMA is characterized by assignment of time slots in a communication channel to each of a plurality of user or remote terminals, and by having communication with each of the terminals take place in specifically assigned time slots. An improved system architecture uses an air interface or signal modulation technique referred to as Code Division Multiple Access (CDMA), which is characterized by the use of spread spectrum modulation techniques to provide separate user or user traffic signal channels. Such techniques are disclosed in the teachings of U.S. Patent No. 4,901,307, which issued Feb. 13, 1990 under the title "Spread Spectrum Multiple Access Communication System Using Satellite or Terrestrial Repeaters," and U.S. Patent No. 5,103,459, issued April 7, 1992, entitled "System And Method for Generating Signal Waveforms In A CDMA Cellular Telephone System," which are both assigned to the assignee of the present invention and incorporated herein by reference.

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[0004] CDMA based communication systems generally provide greater bandwidth efficiency than do TDMA based communication systems. Many CDMA based satellite communication systems typically operate in a CDMA mode over the forward link (FL) direction, that is, for signals transferred from hubs or gateways to the terminals, and in a TDMA mode over the return or reverse link (RL) direction, that is, for signals transferred from terminals to the gateway.

[0005] There are two main types or modes of CDMA communication signal processing in use, asynchronous CDMA and synchronous orthogonal CDMA. In the asynchronous mode of CDMA operation, the signals from different terminals are not synchronized and, as such, can arrive out of code phase or sync and cause interference to each other. In the synchronous mode of operation, the signals transmitted from different terminals are timed so as to arrive synchronously, and are in code phase with each other or have code synchronization, at the receiver. In the synchronous mode of CDMA, if orthogonal codes are used to distinguish different terminal transmissions, then there is generally no, or very little, cross-interference among the different signals received from terminals, due to a cross-correlation approaching zero. This technique and resulting waveforms are referred to as Orthogonal CDMA (O-CDMA). In this case, one achieves higher bandwidth efficiency due to reduced interference. 11:30

[0006] On the forward link, orthogonality among different codes is effectively maintained because all signals originate at the same location, namely at the hub or gateway providing communication service to one or more remote terminals. Where several gateways are used throughout a communication system, they are generally configured to use a common timing source, such as the phase of signals detected from GPS satellites, which employ a form of what is referred to as Universal Time. Alternatively, or in addition, gateways can be in communication with each other and/or a timing signal reference, in order to provide a synchronization mechanism. Other such mechanisms are known in the art or being contemplated.

[0007] However, for signals being transferred by terminals on the return link, there is generally no common synchronization mechanism, and signals transmitted from different terminals arrive asynchronously at the gateway(s) due to their different propagation delays or paths, even if the timing of the initial transmission is close to synchronization, which it often may not be. Therefore, while satellite communication systems can easily incorporate orthogonal CDMA for use on forward links, they cannot

make use of this technique on the reverse links. In order to improve communication, through reducing potential interference and other deleterious effects, what is needed are methods and apparatus for enabling orthogonal CDMA to be employed in the return signal paths of a satellite communication system, or over the reverse communication links.

SUMMARY OF THE INVENTION

[0008] Briefly, code synchronism or synchronization is achieved thereby enabling the use of modulation codes desired to implement orthogonal CDMA in the return direction. In a satellite communications system including a geostationary satellite, the use of orthogonal CDMA in the reverse link is advantageously enabled by embodiments of the present invention. A ground station transmits a first or forward link pilot signal in the forward link direction, and one or more terminals acquire and track the pilot signal, recovering carrier phase and timing for the modulation code (chip) clock timing used by the communication system. A terminal then derives a transmit or transmission carrier frequency to be used for signals it transmits, and code chip clock timing to be used for signal modulation, from the recovered forward pilot carrier frequency and chip clock timing. The terminal transmits a second or reverse link pilot signal in the reverse link direction which, after being received and retransmitted by the satellite, is detected at the ground station. The ground station tracks timing, and in some embodiments also tracks frequency, of the terminal originated pilot signal and compares these characteristics to those of a reverse link reference signal. Terminals, in accordance with the present invention, have the ability to advance or retard the timing of their transmitted signals relative to the timing derived from the forward link pilot signal, and they do so based, at least in part, on the results of the timing comparison with the reference. This is accomplished by having the ground station transmit a control signal on the forward link to each terminal it desires to communicate with in a beam or sub-beam, providing commands or instructions to each terminal as to a desired amount or degree by which it should advance or retard the respective transmit timing for achieving desired synchronization of the reverse link signals. Each terminal then adjusts its transmit timing and/or frequency in small increments to maintain time alignment with the ground station.

- [0009] A method of providing orthogonal CDMA communication in a return link, in accordance with the present invention includes, receiving a first pilot signal at a plurality of terminals; deriving at least one transmit timing characteristic from the received first pilot signal, wherein deriving is performed within each of the plurality of terminals; transmitting, at an assigned time a pilot signal from each of the plurality of terminals in accordance with the derived at least one transmit timing characteristic; receiving a control signal, the content of the control providing instructions to adjust the at least one transmit timing characteristic; and adjusting, responsive to the control signal, the least one transmit timing characteristic.
- [0010] A method of operating a communications system including a geosynchronous satellite disposed in a forward link and a reverse link, to provide orthogonal CDMA communication in the reverse link, in accordance with the present invention includes, transmitting a first pilot signal from a ground station in the forward link direction; receiving the first pilot signal at a terminal, and recovering carrier phase and modulation chip clock timing therein; deriving a transmit carrier frequency and chip clock timing from the recovered forward pilot carrier frequency and modulation chip clock timing; transmitting a second pilot signal from the terminal in the reverse link direction; comparing, at the ground station, the second pilot signal to a reverse link reference signal; transmitting, in the forward link direction, a control signal, the content of the control signal based at least in part on the comparison between the second pilot signal and the reverse link reference signal; and adjusting, responsive to the control signal, at least one operational parameter of the terminal.
- [0011] Such a method may further include transmitting orthogonal CDMA traffic signals from the terminal.
- [0012] In some embodiments of such a method, the at least one operational parameter of the terminal comprises transmit timing; and adjusting is performed to maintain the transmit timing of the terminal to within a predetermined fraction of a code chip period, for example within 1/8 of a chip period.
- [0013] Such a method may further include providing a reverse uplink receiver beam width of approximately 0.5°.
- [0014] In some embodiments of such a method, the control signal directs the terminal to advance its transmit timing, while in others it directs the terminal to retard its transmit

timing. The timing in embodiments may be advanced or retarded by predetermined amounts, or by an amount specified by the control signal.

[0015] An embodiment of a terminal, includes, means for receiving a first pilot signal; means for recovering carrier phase and modulation chip clock timing from the first pilot signal; means for transmitting a second pilot signal; means for receiving a control signal; means for transmitting an orthogonal CDMA traffic signal to a geostationary satellite, the orthogonal CDMA traffic signal having a first timing characteristic; and means for adjusting the first timing characteristic.

[0016] In some embodiments of such a terminal, the means for adjusting the first timing characteristic comprises circuitry for advancing a transmit timing characteristic of the orthogonal CDMA traffic signal by a predetermined amount, and in others means for retarding a transmit timing characteristic of the orthogonal CDMA traffic signal by a predetermined amount.

[0017] In some embodiments of such a terminal the means for adjusting the first timing characteristic comprises circuitry for advancing, and others for retarding, a transmit timing characteristic of the orthogonal CDMA traffic signal by an amount specified by the control signal.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The features, objects, and advantages of the present invention will become more apparent from the detailed description set forth below when taken in conjunction with the drawings in which like reference characters identify the same or similar elements throughout and wherein:

[0019] FIG. 1 illustrates one embodiment of the present invention in a satellite system.

[0020] FIG. 2 is a block diagram representation of a receiver for receiving a plurality of concurrent CDMA transmissions on the return link from a corresponding plurality of terminals.

[0021] FIG. 3 is a block diagram representation of a transmitter in a terminal adapted to send messages on the return link of an OCDMA satellite communications system.

[0022] FIG. 4 is a flowchart of an illustrative process that shows operations of a gateway.

[0023] FIG. 5 is a flowchart of an illustrative process using a terminal.

[0024] FIG. 6 illustrates one embodiment of a hardware system to implement various embodiments.

[0025] FIG. 7 illustrates one embodiment of a machine-readable medium to store executable instructions to implement various embodiments.

DETAILED DESCRIPTION

[0026] Generally, embodiments of the present invention provide improved bandwidth efficiencies, increased ability to overcome rain fade or other channel degrading phenomenon, reduced transmission power, or various combinations thereof. More particularly, by advantageous use of orthogonal CDMA in the return link of a geosynchronous satellite based communication system, embodiments of the present invention permit a plurality of access terminals, each with a unique code channel assignment, to transmit concurrently in a beam, with the same or lower aggregate power as would be used by a single access terminal using TDMA as its access method. In other embodiments, advantageous use of orthogonal CDMA in the return link allows one or more access terminals, each in a common beam and assigned a common time slot, to transmit at a higher transmission power to overcome channel degradation effects such as those due to rain fade.

[0027] In the following description, various aspects of the present invention will be described. However, it will be apparent to those skilled in the art that the present invention may be practiced with only some or all aspects of the present invention. For purposes of explanation, specific numbers, materials and configurations are set forth in order to provide a thorough understanding of the present invention. However, it will also be apparent to one skilled in the art that the present invention may be practiced without the specific details. In other instances, well-known features are omitted or simplified in order not to obscure the present invention.

[0028] Various aspects of the invention may be implemented as circuit-based solutions, including possible implementation on a single integrated circuit. As would be apparent to one skilled in the art, various functions of circuit elements may also be implemented as processing operations in a software program. Such software may be employed in, for example, a digital signal processor, micro-controller, embedded controller, or general-purpose computer. It is well known that most gateways use arrays or racks of circuit cards and assemblies to accomplish all of the signal processing tasks they undertake.

These cards may have specialized controllers and processors, or use commercially available computer processor chips and various types of memory to perform certain functions. In addition, entire computers, workstations, and other similar devices are often integrated into the system designs, and are used to operate and control certain functions in a gateway or a base station.

[0029] Many wireless devices such as telephones, PDAs, and modems, also contain sophisticated signal processing elements, resources, and capabilities to accommodate the features expected in modern device designs.

[0030] The invention can be embodied in the form of methods as well as apparatus for practicing those methods. The present invention can also be embodied in the form of program code embodied in tangible media, such as punched cards, magnetic tape, floppy disks, hard disk drives, CD-ROMs, flash memory cards, or other machine-readable storage medium, wherein, when the program code is loaded into and executed by a machine, such as a computer, the machine becomes an apparatus for practicing the invention. The present invention can also be embodied in the form of program code, for example, whether stored in a storage medium, loaded into and/or executed by a machine, or transmitted over some transmission medium or carrier, such as over electrical wiring or cabling, through fiber optics, or via electromagnetic radiation, wherein, when the program code is loaded into and executed by a machine, such as a processor, the machine becomes an apparatus for practicing the invention. When implemented on a programmable controller, signal processor, general-purpose processor and the like, the program code segments combine with the processor to provide a unique device that operates analogously to specific logic circuits.

[0031] Reference herein to "one embodiment", "an embodiment", or similar formulations, means that a particular feature, structure, operation, or characteristic described in connection with the embodiment, is included in at least one embodiment of the present invention. Thus, the appearances of such phrases or formulations herein are not necessarily all referring to the same embodiment. Furthermore, various particular features, structures, operations, or characteristics may be combined in any suitable manner in one or more embodiments.

Terminology

- [0032] A "chip", as used herein, refers to a binary state or value which is used to produce a "code." That is a series of binary values referred to as code "chips" are used to generate a particular code or code sequence. While a chip can be referring to a binary state in a spread spectrum signal or Pseudorandom (PN) code, as used herein they are generally referring to orthogonal channelizing codes or code sequences used to establish different communication channels for user terminals within beams or sub-beams. Typically, these are well known Walsh codes, used to create orthogonal communication channels in a communication system.
- [0033] The terms, base station, and gateway, are sometimes used interchangeably in the art, with gateways being perceived as specialized base stations that direct communications through satellites, while base stations use terrestrial antennas to direct communications within a surrounding geographical region. The expression ground station is sometimes used interchangeably in this field with gateway.
- [0034] Communications satellites may form beams which illuminate a "spot" or area produced by projecting satellite communications signals onto the Earth's surface. A typical satellite beam pattern for a spot comprises a number of beams arranged in a predetermined coverage pattern. Typically, each beam comprises a number of so-called sub-beams covering a common geographic area, each occupying a different frequency band. In appropriate instances, the sub-beams may be referred to as CDMA or FDM channels.
- [0035] The expressions reverse link, reverse direction, return link, and return direction, are sometimes used interchangeably in this field. Unless specified otherwise in the context of their usage herein, these expressions, and formulations similar thereto, refer to communication pathways by which signals propagate from a terminal unit to a satellite, and from the satellite to a ground station. In terrestrial communication systems, they propagate from a terminal to a base station directly.
- [0036] The expressions forward link and forward direction are sometimes used interchangeably in this field. Unless specified otherwise in the context of their usage herein, these expressions, and formulations similar thereto, refer to communication pathways by which signals propagate from a ground station to a satellite, and from the satellite to a terminal unit. In terrestrial communication systems, they propagate from a base station to a terminal directly.

[0037] The expression up-link refers to pathways by which signals propagate either from a ground station to a satellite or from a terminal to a satellite. The expressions forward up-link and forward down-link refer to pathways by which signals propagate from a ground station to a satellite and from a satellite to a terminal, respectively; while the expressions reverse up-link and reverse down-link refer to pathways by which signals propagate from a terminal to a satellite and from a satellite to a ground station, respectively.

[0038] Terminals, or user terminals, are also sometimes referred to as access terminals, subscriber units, mobile units, mobile stations, or simply "users," "mobiles," or "subscribers" in some communication systems, depending on preference. These terms are well understood in this field.

[0039] Conventional satellite-based communication systems are known which use orthogonal CDMA in the forward link direction, and which do not use orthogonal CDMA in the reverse link direction. Systems which do not use orthogonal CDMA in the reverse link may also be referred to as having an interference shared reverse channel.

Typical Wireless Communications System Environment

[0040] An exemplary wireless communication system in which various embodiments of the invention find application may include as parts of that communication system, at least one geo-stationary communication satellite and at least one ground station, which are suitable for effecting communications with one or more remote user terminals. Although the invention is described primarily in terms of wireless, satellite-based communications, the present invention may be applicable to other types of communications channel(s), including digital, electrical or optical, wireless or wire/fiber, etc.

[0041] FIG. 1 illustrates a satellite-based communications system 100 incorporating one or more satellites 110 that relay communications between a plurality or series of user terminals (112a, 112b, 112c, 112d) in a service area 114 and at least one gateway 116, there sometimes being more than one in a service area. Gateway 116 could provide, for instance, an access point between the satellite network and external networks, such as the Internet or some other external network (partially shown). The terminals communicate with the external network through the satellite 110 and the gateway 116.

- [0042] Service area 114 is covered by one or more beams, or cells, such as beam 112, which are projected onto the surface of the Earth by satellite 110. Beams illuminate a "spot" or area produced by projecting satellite communications signals onto the Earth's surface. The beams are arranged in a predetermined coverage pattern. Each beam generally uses either the full frequency spectrum available to the satellite in the case of a full frequency reuse pattern, or some division of the available frequency spectrum in the case of a partial reuse pattern. Each beam may also include a number of so-called sub-beams (also referred to as FDM signals, channels, or links) covering a common geographic area, with each sub-beam occupying a particular frequency band.
- [0043] The group of signals that go from the terminals through satellite 110, down to gateway 116 comprise the "return link." The return link includes a number of uplinks 120 from the terminals, and a downlink 124 from satellite 110 to gateway 116. The return uplinks 120 are generally all combined at satellite 110 into the return downlink 124, although this is not necessarily required. In one embodiment, code divisional multiple access (CDMA) is used in the return link to distinguish among signals from various terminals. That is, multiple terminals can simultaneously transmit in a shared frequency band using separate codes.
- [0044] For completeness, FIG. 1 also shows the group of signals that go from the gateway 116 through satellite 110, down to terminals 112 (112a, 112b, 112c, 112d) which comprise the "forward link." The forward link includes a number of downlinks 122 to the terminals, and an uplink 126 from satellite 110 to gateway 116.
- [0045] The user terminals (112a, 112b, 112c, 112d) are each wireless communication devices such as, but not limited to, a cellular telephone, a data transceiver, or a two-way pager, and each can be hand-held or vehicle-mounted as desired. It is also understood that the teachings of the invention are applicable to fixed units where remote wireless service is desired, including "indoor" as well as "open air" locations.
- [0046] CDMA spread-spectrum communications systems typically contemplate the use of coherent modulation and demodulation for forward link user terminal communications. In communication systems using this approach, a "pilot" carrier signal, also referred to as a "pilot signal," is used as a coherent phase reference for forward link signals. That is, a signal which contains no data modulation is transmitted by a ground station (i.e., a gateway or a base station) throughout a region of coverage as a reference.

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- [0047] Pilot signals are used by user terminals to obtain initial system synchronization and provide time, frequency, and phase tracking of other signals transmitted by the gateway or base station. Phase information obtained from tracking a pilot signal carrier is used as a carrier phase reference for coherent demodulation of other system signals or traffic (i.e., data) signals. This technique allows many traffic signals to share a common pilot signal as a phase reference, providing for a less costly and more efficient tracking mechanism. A single pilot signal is typically transmitted by each gateway or base station for each frequency used, referred to as a CDMA or FDM channel or sub-beam, and shared by all user terminals receiving signals from that gateway or base station on that frequency.
- [0048] In order to implement orthogonal CDMA in the return direction of a satellite based communications system, embodiments include the use of orthogonal codes as part of the signal modulation, and demodulation. These codes comprise a series of binary values referred to as code "chips", and are generally based on well known Walsh codes. The communication system employs a known code-phase relationship between signals from at least two terminals in a beam. The known code-phase relationship between signals for the various user terminals is such that the timing or phase of the respective Walsh codes are separated relative to each other by only a small fraction of a chip period or duration, and maintain carrier frequency differences that are generally within a few degrees of each other.
- [0049] Methods and apparatus in implanted in accordance with the invention provide for synchronizing the return up-link transmissions of a set of terminals in a beam of a geostationary satellite network with a precision at least adequate to allow the use of orthogonal CDMA techniques.
- [0050] In an illustrative embodiment, which includes a geo-stationary satellite as part of the communication system, a ground station transmits a first or forward link pilot signal in the forward link direction. One or more user terminals located in the forward link beam acquire and track the transmitted pilot signal. Each terminal operates so as to recover carrier phase and modulation chip clock timing from the pilot signal that originated at the ground station. The terminal then derives its transmit or transmission carrier frequency and chip clock timing from the recovered forward pilot carrier frequency and modulation chip clock timing. Such a method avoids the need for

expensive stabilized reference oscillators in the user terminals. A similar method can be employed in terrestrial cellular CDMA subscriber terminals.

[0051] In addition to timing synchronization (i.e., code phase synchronization), the frequency offset between the transmitter of the access terminal and the receiver of the gateway should also be made small enough so that the phase change of the signal over the period of one orthogonal code is negligible, as discussed below. In one method for achieving frequency synchronization between an access terminal and the gateway, the access terminal adjusts the frequency of its oscillator so as to lock to the frequency of the signal received from the gateway.

[0052] At a time appropriate for the particular access protocol in use (which is well understood in the art), each terminal in communication with the ground station transmits a second or reverse link pilot signal in the reverse link direction, that is subsequently detected at a receiver in the ground station. at a receiver in the ground station after being relayed through a satellite. The user terminals, in accordance with the invention, have the ability to advance or retard the timing of transmissions or transmitted signals relative to the timing previously derived from the forward link pilot signal.

[0053] The terminals track timing characteristics for the ground station signals (first pilot), and subsequently the ground station tracks timing characteristics for terminals. Generally, this is in the form of monitoring an operational parameter, such as the signal timing, for the code phase synchronization. However, that is just one timing characteristic of a terminal, with another timing characteristic, as seen from above, that is optionally tracked, being the frequency of the either the first or second pilot signal(s) transmitted from the ground station or each user terminal. Typically, the offset value between the tracked frequency and a reference frequency is the operational parameter used.

[0054] The terminals derive at least one transmit timing characteristic from the received first pilot signal, with the derivation being performed within each of the plurality of terminals. The terminals then transmit, at an assigned time a pilot signal from each of the plurality of terminals in accordance with the derived at least one transmit timing characteristic.

[0055] A reverse link reference signal is generated, typically by the ground station itself. The ground station compares at least the timing of the terminal originated second pilot signals to that of the reverse link reference signal. A return link reference signal,

generated at the ground station, represents the ideal timing, or nearly so, of a perfectly timed return link transmission as it should be received at the ground station. Such a reference signal can be derived from a local reference, delayed by the predicted round trip delay to and from a reference point on the earth (typically the center of the beam) through a satellite transponder, plus a suitable margin to allow for more distant terminals. Alternatively, this reference signal can be derived from the received pilot signals of one or more representative user terminals.

[0056] Based, at least in part, upon this comparison of the reference and reverse link pilot signal or signals, the ground station determines the nature of certain timing or control information which is to be transmitted to each terminal. The timing or control information represents such information or data that indicates the timing discrepancy between the reverse link pilot signals and the reference signal. This information is to be used by a user terminal to alter the timing of the transmitted signals it is providing to the ground station, generally by advancing or retarding signal timing, in order to achieve a desired timing for synchronization, relative to the reference signal.

[0057] The ground station then transmits a control, command, or reference signal on the forward link to each desired terminal, which acts to instruct the terminal to advance or retard its transmit timing, or alter its transmission frequency in some embodiments. This can be referred to as control signaling. In response to the information or commands provided by the ground station, each terminal then adjusts its transmit timing and/or frequency, typically, in small increments, in accordance with the instructions received, to maintain time alignment with the receiver(s) in the ground station. Such a process of determining and implementing the changes in a terminal's transmit timing, which are used to maintain the time alignment, may be performed for a plurality of terminals in a beam. Ensuring the desired time alignment is one aspect of the present invention which enables the use of orthogonal CDMA in the return direction.

[0058] Therefore, in the illustrative examples, a ground station transmits a forward link pilot signal. A user terminal acquires and tracks the forward link pilot signal, recovering the carrier phase and modulation chip clock timing. A user terminal derives its transmit carrier frequency and chip clock timing from the recovered forward pilot carrier frequency and chip clock timing. Such a method avoids the need for expensive stabilized reference oscillators in the user terminals. It is noted that a similar method is employed in terrestrial cellular CDMA subscriber terminals.

- [0059] It is noted that the synchronization mechanism described above is designed to synchronize the signal arrivals at the Walsh code boundary, where those signals originate with different access terminals.
- [0060] FIG. 2 is a block diagram representation of a receiver 200 for receiving a plurality of concurrent CDMA transmissions on the return link from a corresponding plurality of terminals. The receiver of FIG. 2 includes an antenna 202 coupled to a downconverter 204. The downconverter takes an RF signal and reduces the frequency. Various techniques for downconversion are known but are not described further herein. The output of the downconverter is coupled to an analog-to-digital (A/D) converter 206 which converts an analog signal to a corresponding signal in the digital domain. The output of A/D converter 206 is coupled to each of a plurality of despreaders 208a, 208b, 208n. There is no particular limit on the number of despreaders, although in some embodiments, the number of despreaders is equal to the number of code-modulated (i.e., CDMA) signals that a gateway may receive from access terminals in any particular time period or slot. A code source 210 is also coupled to each of despreaders 208a, 208b, 208n. Code source 210 provides the despreaders with the code needed to despread the incoming CDMA signals. The output terminal of each despreaders 208a, 208b, 208n is coupled respectively to an input terminal and a data demodulator 212a, 212b, 212n.
- [0061] This architecture is used here because, in accordance with the present invention, a plurality of access terminals are transmitting OCDMA signals to the gateway in parallel.
- [0062] In order to generate the desired commands or control signals discussed further below, receiver 200 uses the despreaders 208a, 208b, 208n and demodulators 212a, 212b, 212n, or one or more specialized searchers 220 which provide the despreading function 222 along with a search engine 224 for detecting the various, non-data bearing, pilot signals being received from the terminals. Information from the searcher 220 or the demodulators is received by a receiver controller or processor 230, from an input bus or line 226.
- [0063] Processor 230 uses the information to determine certain operational parameters from, or associated with, the pilot signals from user terminals, such as either timing or frequency offsets. This is generally accomplished by detecting and comparing the timing or frequency with that of a reference signal. Here, the reference signal is shown being provided by a reference source 232 which provides an input to the processor.

Reference source 232 could be configured to generate the reference at the time it is needed, such as using highly stable and accurate oscillators or timing circuits, or could store values previously generated by processor 230.

[0064] In addition, processor 230 can use various types of memory 234 to store information about what types of commands are desirable to issue depending on the results of the comparison. For example, if the comparison shows the timing is too fast or frequency is too high, the processor can simply send a command or request to retard either parameter in the terminal. If, on the other hand, the frequency is too low or the timing is too slow, the processor can send a simple command requesting the terminal to advance the value. However, the processor can also send more complicated instructions, as desired, in some systems in which it specifies the amount of the offsets to be compensated for and a request for adjustment, or a specific value by which an adjustment should be made. Such commands can be sent as separate signals or appended to other communications, such as traffic, access instructions, or command and control signals being forwarded to the terminals.

[0065] It is to be understood that typical receivers in ground stations and gateways are known to have one or more controllers for detecting certain characteristics of the signals being received, to affect timing changes for output signals, to assist with the timing and control of demodulation, code selection, and other processes within the ground station. Processor 230 can form part of such controllers or be configured as a separate processor which is dedicated to the operations of embodiments of the invention.

[0066] FIG. 3 is a block diagram representation of a transmitter 300 in a terminal adapted to send messages or data in the return link of an OCDMA satellite communications system. As sated above, in prior systems, access terminals received CDMA signals from the gateway, but used TDMA to communicate in or over a return link. The transmitter shown in FIG. 3 is adapted not only to transmit CDMA signals but also to adjust its transmit timing or code phase, as well as typically its power, as described in detail below. This transmitter includes a data modulator 302 that modulates the baseband signal and a code modulator 304 that further modulates, in accordance with the code channel assigned to this particular access terminal, the signal to be transmitted. The output of code modulator 304 is up-converted by a series of mixers 306a and 306b in this illustrative example. Any suitable means of up-conversion may be used. A final transmitter circuit 308 determines the transmit power in

accordance with control signals received from a power control unit 312. Power control unit 312 is coupled to receive control information from the power control parameter storage unit 314. The transmitter power control is a function of the transmit power instruction received by the access terminal from the gateway, and of the access terminal's own determination of channel degradation effects. The terminal estimates signal strength changes on the FL, for instance due to fading caused by rain, by measuring the signal strength on the FL. Whenever there is a change in the signal strength on the FL, the terminal estimates the corresponding signal strength change on the RL and makes an adjustment to the data rate and/or the transmission power on the RL accordingly. In one embodiment, the terminal will use a calibration table to determine the RL signal strength changes based on the FL signal variation.

[0067] In order to utilize the desired commands or control signals discussed further below, terminal 300 uses the code modulator 304 and mixers 306 along with, a code source or controller 320, frequency sources 324 and 326, and information from a receiver portion of the terminal which is provided to a terminal controller or processor 330, from an input bus or line.

[0068] Processor 330 uses command or control information received by a receiver portion, which is well known in the art, and similar to that shown for the ground station, to determine what commands or requests for adjustment have been forwarded to the terminal, and what action is appropriate to take to adjust certain operational parameters associated generation and transmission of signals from the terminals. For example, processor 330 determines if either timing or frequency offsets are being compensated for and by what amount. The commands may specify an amount of adjustment or simply that a predetermined adjustment take place to either retard or advance the parameter values. In addition, processor 330 can use various types of memory 334 to store information about what types of actions are desirable to implement depending on the adjustment information or commands being received. For example, where fixed adjustment commands are sent, processor 330 can use previously stored information to select the amount by which a parameter is changed. The memory may indicate different amounts that can change with time, or other activities within the terminal, and so forth.

[0069] If an adjustment request is based on the timing being too fast or frequency too high, the processor commands either the code source 320, on line 322 to retard the code timing, or one or more of the frequency sources 324, 326 on line 328 to retard or

decrease the frequency, respectively. If, on the other hand, the adjustment request is based on the timing being too slow, or the frequency too low, processor 330 commands either the code source 320 to advance the code timing, or one or more of the frequency sources 324, 326 to advance or increase the frequency, respectively. Alternatively, processor 330 can use one or more adjustable delay elements to adjust the code timing external of the code source, as desired.

[0070] It is to be understood that typical terminals are known to have one or more controllers for detecting certain characteristics of the signals being received or transmitted, to affect timing changes for output signals, to assist with the timing and control of modulation, code selection, and other processes within the terminal. Processor 330 can form part of such controllers or be configured as a separate processor which is dedicated to the operations of embodiments of the invention.

[0071] It is also noted that the retarding and advancement of code timing is discussed and illustrated in the patents referred to above as well as in US Patent 6,327,534B1, issued December 4, 2001, which is incorporated herein by reference, and those skilled in the art will readily understand how to implement this process in a variety of ways.

[0072] FIG. 4 is a flowchart of an illustrative process that shows operations of a gateway in accordance with an embodiment. This illustrative process includes receiving in step 402, at the gateway, a message, here a pilot signal, from a user terminal. This signal can be used for other activities or analysis such as determining the channel conditions between the gateway and the terminal in step 404, which does not form part of the invention. The terminal may use any suitable means of contacting the gateway for this initial message. The method further includes determining in step 406, at the gateway, a timing offset or timing affecting operational parameter of the received pilot signal. Determining this offset, whether something such as frequency or timing, is one aspect of establishing OCDMA in the return link. The illustrative method further includes transmitting in step 408, to the terminal, a transmit time adjustment instruction; along with typical transmit power instructions. In further aspects, the gateway may detect a frequency offset as an operational parameter for timing in a step 406, and then transmit a frequency adjustment instruction in step 408, as well. The time and frequency adjustment instructions enable the terminal to advance or retard transmission time and/or frequency in order to maintain a desired degree of code synchronism for OCDMA in the return link.

- [0073] It is noted that the synchronization mechanism described above is designed to synchronize the signal arrivals at the Walsh code boundary, where those signals originate with different access terminals.
- [0074] Referring to FIG. 5, a method of operating a communications system including a geo-synchronous satellite disposed in a forward link and a reverse link, to provide orthogonal CDMA communication in the reverse link, is illustrated. More particularly, a first pilot signal is transmitted in step 502 from a ground station in the forward link direction. That is, a signal is sent from gateway 116 to a satellite 110, which in this embodiment is in a geosynchronous orbit, and that signal is relayed to a portion of the Earth's surface. The first pilot signal is received in step 504 at a user terminal (112), and the terminal recovers carrier phase and modulation chip clock timing from the first pilot signal.
- [0075] The terminal then derives a transmit carrier frequency and chip clock timing in step 506 from the recovered forward pilot carrier frequency and modulation chip clock timing. The terminal then transmits a second pilot signal in the reverse link direction in step 508 to the geosynchronous satellite (110) and the satellite relays the second pilot signal to the ground station (116). The second pilot signal is compared in step 510 at the ground station to a reverse link reference signal. The ground station then transmits in step 512, in the forward link direction (i.e., up to the satellite, and then from the satellite down to the terminal), a control signal, where the content of the control signal is based at least in part on the comparison between the second pilot signal and the reverse link reference signal. In response to the control signal, at least one operational parameter related to transmissions from the terminal, is adjusted in step 514 within the terminal. Typically, such adjustments relate to advancing or retarding the timing of the terminal's transmitted signals relative to the timing derived from the forward link pilot signal.
- [0076] The timing can be advanced or retarded using several pre-selected approaches or techniques to determine the amount or magnitude by which an adjustment is made. In one embodiment, during system design a predetermined amount of adjustment or change in timing or frequency is selected and used as the basis for responding to control signals. Such values can be based on known empirical data as to how quickly or effectively a terminal adjusts parameters, and how large a change is generally required to achieve a given result. It can also be based on design characteristics of the terminal.

In addition, there may be delay factors in executing the instructions which might lead one to want to make smaller changes within the terminal to avoid overshooting a desired value. There is no desire to make very large changes which result in further changes being requested in an opposite direction, and so forth. It is desirable to quickly but efficiently move toward a solution without incurring any substantial overshoots in the results which take more time to correct. In addition, the overall changes required may be rather small as a general rule depending on the known communication system characteristics, size of beams, terminal characteristics (frequency stability, timing), and so forth. It may also be more effective or desirable to have the terminal chose a predetermined amount so as to shorten the type of control signal information or commands that would be transmitted from the ground station.

[0077] However, in some configurations, it may be more desirable to have the ground station instruct the terminal with a more precise amount of adjustment desired to potentially reach a desired end result quicker, or if only one quick small change is needed, for example. In addition, it is often desirable to perform as much of the computational and information storage activities or functions within a ground station instead of a terminal which is more power and volume constrained for having storage or memory elements or more complicated controllers. Those skilled in the art will readily understand the characteristics of a given communication system that allow them to address this choice.

[0078] There is no desire to make very large changes which result in further changes in an opposite direction being needed, and so forth. It is desirable to quickly but efficiently move toward a solution without incurring large overshoots in the results. In addition, the overall changes required may be rather small as a general rule depending on the known communication system characteristics, size of beams, terminal characteristics (frequency stability, timing), and so forth. In addition, it may be more effective to have the terminal chose a predetermined amount to shorten the type of control signal information or commands that would be needed.

[0079] However, in some configurations, it may be more desirable to have the ground station instruct the terminal with a more precise amount of adjustment desired to potentially reach a desired end result quicker, or if only one quick small change is needed, for example. Those skilled in the art will readily understand the characteristics of a given communication system that allow them to address this choice.

[0080] The velocity of a typical geo-stationary satellite relative to a fixed earth terminal position has been estimated at between 0.3 m/s and 3 m/s, depending on the specific design and control parameters for various (known) geo-stationary satellites. At 3 m/s, the Doppler effect is about 10^{-8} , with frequency Doppler being about 300 Hz and Code Doppler, that is, the delay rate, being about 10 ns/s. If the satellite return up link receiver beam width is about 0.5° , then the worst case difference in time rate between a terminal at the center of the beam and any other terminal served by the same beam is on the order of 10 ns/s times $\sin(0.25^\circ) = 0.044$ ns/s.

[0081] For an exemplary code chip rate of around 3 Mcps, the period or time interval for one chip equals 333 ns, and a representative fractional period such as a 1/8 chip rate represents a period of approximately 42 ns. In this situation, the worst case drift in residual delay between two terminals in the same beam is 1/8 chip in $42/0.044=954$ seconds, or about 16 minutes. However, other fractional periods can be used as a target value or could occur in a communication system depending on the specific known configurations of beams, locations of terminals, and communication link characteristics.

[0082] In view of the preceding, it can be seen that with just one correction every few minutes, the transmit timing of a terminal can be controlled to within one 1/8th of a chip period, which is sufficient to support orthogonal CDMA modes of transmission.

[0083] Between this transmit timing adjustment process and maintaining a very tight uplink beam width (e.g., 0.5 degrees or less) code synchronism is achieved, thereby enabling the use of the modulation codes needed for orthogonal CDMA in the return direction.

[0084] This is desirable as discussed earlier because a greater bandwidth efficiency may be obtained with the use of orthogonal CDMA as compared to TDMA. With respect to an OCDMA return link, L users are each assigned a unique orthogonal Walsh code. Each user sends one data modulation symbol during each Walsh code period or time interval. In other words, each access terminal repeats a data modulation symbol L times over the period of its assigned Walsh code resulting in a processing gain of L . Let $(E_b/N_0)_{\text{TDMA}}$ denote the energy per bit measured in a TDMA based system for a given coding and modulation scheme. Then, if each access terminal in the OCDMA system, , transmits at its maximum available power, the E_b/N_0 received on the OCDMA channel for one access terminal on the return link, denoted by $(E_b/N_0)_{\text{OCDMA}}$, is given by:

$$(E_b/N_t)_{\text{OCDMA}} = L(E_b/N_t)_{\text{TDMA}}$$

[0085] In other words, for the same transmit power at the access terminal, the achievable E_b/N_t is L times greater on the OCDMA channel than on the TDMA channel due to the processing gain of OCDMA. Therefore, one may use a higher order modulation in the case of OCDMA and achieve higher bandwidth efficiency than in the TDMA approach. Note that in OCDMA each access terminal effectively has $1/L$ th of the bandwidth that one access terminal in the TDMA system has. That is, the data rate on one OCDMA channel is, for the same modulation/coding choice, L times lower than on the TDMA channel. However, it can be seen that since, for the same transmit power a higher order modulation/coding scheme may be used for an OCDMA access terminal, the bandwidth efficiency of OCDMA is greater.

[0086] Various embodiments of the present invention require computational resources to carryout the above-described functionality. FIG. 6 illustrates one embodiment of a hardware system intended to represent a broad category of computer systems such as personal computers, workstations, and/or embedded systems. In the illustrated embodiment, the hardware system includes processor 610 coupled to high speed bus 605, which is coupled to input/output (I/O) bus 615 through bus bridge 630. Temporary memory 620 is coupled to bus 605. Permanent memory 640 is coupled to bus 615. I/O device(s) 650 is also coupled to bus 615. I/O device(s) 650 may include a display device, a keyboard, one or more external network interfaces, etc.

[0087] Certain embodiments may include additional components, may not require all of the above components, or may combine one or more components. For instance, temporary memory 620 may be on-chip with processor 610. Alternatively, permanent memory 640 may be eliminated and temporary memory 620 may be replaced with an electrically erasable programmable read only memory (EEPROM), wherein software routines are executed in place from the EEPROM. Some implementations may employ a single bus, to which all of the components are coupled, or one or more additional buses and bus bridges to which various additional components can be coupled. Those skilled in the art will be familiar with a variety of alternative internal networks including, for instance, an internal network based on a high speed system bus with a memory controller hub and an I/O controller hub. Additional components may include

additional processors, a CD ROM drive, additional memories, and other peripheral components known in the art.

[0088] In one embodiment, the present invention, as described above, is implemented using one or more hardware systems such as the hardware system of FIG. 6. Where more than one computer is used, the systems can be coupled to communicate over an external network, such as a local area network (LAN), an internet protocol (IP) network, etc. In one embodiment, the present invention is implemented as software routines executed by one or more execution units within the computer(s). For a given computer, the software routines can be stored on a storage device, such as permanent memory 640.

[0089] Alternately, as shown in FIG. 7, the software routines can be machine executable instructions 710 stored using any machine readable storage medium 720, such as a diskette, CD-ROM, magnetic tape, digital video or versatile disk (DVD), laser disk, ROM, Flash memory, etc. The series of instructions need not be stored locally, and could be received from a remote storage device, such as a server on a network, a CD ROM device, a floppy disk, etc., through, for instance, I/O device(s) 650 of FIG. 6.

[0090] From whatever source, the instructions may be copied from the storage device into temporary memory 620 and then accessed and executed by processor 610. In one implementation, these software routines are written in the C programming language. It is to be appreciated, however, that these routines may be implemented in any of a wide variety of programming languages.

[0091] In alternative embodiments, discrete hardware or firmware may be used. For example, one or more application specific integrated circuits (ASICs) could be programmed with one or more of the above described functions of the present invention. In another example, one or more functions of the present invention could be implemented in one or more ASICs on additional circuit boards and the circuit boards could be inserted into the computer(s) described above. In another example, field programmable gate arrays (FPGAs) or static programmable gate arrays (SPGA) could be used to implement one or more functions of the present invention. In yet another example, a combination of hardware and software could be used to implement one or more functions of the present invention.

Conclusion

[0092] Methods and apparatus in accordance with embodiments of the invention utilize orthogonal CDMA in the return link of satellite communication systems to advantageously provide greater transmit power margins to compensate for channel degradation effects, such as rain fade.

[0093] It is to be understood that the present invention is not limited to the embodiments described above, but encompasses any and all embodiments within the scope of the subjoined Claims.

[0094] What we claim as our invention is:

CLAIMS

1. A method of providing orthogonal CDMA communication in a return link, comprising:

receiving a first pilot signal at a plurality of terminals;

deriving at least one transmit timing characteristic from the received first pilot signal, wherein deriving is performed within each of the plurality of terminals;

transmitting, at an assigned time, a pilot signal from each of the plurality of terminals in accordance with the derived at least one transmit timing characteristic;

receiving a control signal, the content of the control signal providing instructions to adjust the at least one transmit timing characteristic; and

adjusting, responsive to the control signal, the at least one transmit timing characteristic.

2. The method of Claim 1, further comprising providing a reverse uplink receiver beam width of approximately 0.5°.

3. A method of operating a communications system having a forward link and a reverse link, to provide orthogonal CDMA communication in the reverse link, comprising:

transmitting a first pilot signal from a ground station in the forward link direction;

receiving the first pilot signal at a terminal, and recovering carrier phase and modulation chip clock timing therein;

transmitting a second pilot signal from the terminal in the reverse link direction;

comparing, at the ground station, the second pilot signal to a reverse link reference signal;

transmitting, in the forward link direction, a control signal, the content of the control signal based at least in part on the comparison between the second pilot signal and the reverse link reference signal; and

adjusting, responsive to the control signal, at least one operational parameter of the terminal.

4. The method of Claim 3, further comprising transferring signals through a geosynchronous satellite disposed in said forward link and reverse link.

5. The method of Claim 3, further comprising transmitting orthogonal CDMA traffic signals from the terminal.

6. The method of Claim 3, wherein the at least one operational parameter of the terminal comprises transmit timing; and adjusting is performed to maintain the transmit timing of the terminal to within a pre-selected fractional part of a chip period.

7. The method of Claim 6, wherein the pre-selected fractional part is one-eighth of a chip period, or less.

8. The method of Claim 6, further comprising providing a reverse uplink receiver beam width of approximately 0.5° .

9. The method Claim 3, wherein the control signal directs the terminal to advance its transmit timing.

10. The method of Claim 9, wherein the transmit timing is advanced by a predetermined amount.

11. The method of Claim 9, wherein responsive to the control signal, the terminal transmit timing is adjusted by an amount specified by the control signal.

12. The method of Claim 3, wherein the control signal directs the terminal to retard its transmit timing.

13. The method of Claim 12, wherein the transmit timing is retarded by a predetermined amount.

14. The method of Claim 12, wherein responsive to the control signal, the terminal transmit timing is adjusted by an amount specified by the control signal.

15. The method Claim 3, wherein the control signal directs the terminal to adjust its transmission frequency.

16. A terminal, comprising:
means for receiving a first pilot signal;
means for recovering carrier phase and modulation chip clock timing from the first pilot signal;
means for transmitting a second pilot signal from the terminal;
means for receiving a control signal;
means for transmitting an orthogonal CDMA traffic signal, the orthogonal CDMA traffic signal having a first timing characteristic; and
means for adjusting the first timing characteristic in response to said control signal.

17. The terminal of Claim 16, wherein the means for transmitting an orthogonal CDMA traffic signal comprises a geostationary satellite.

18. The terminal of Claim 16, wherein the at least one operational parameter of the terminal comprises transmit timing; and said means for adjusting maintains the transmit timing of the terminal to within a pre-selected fractional part of a chip period.

19. The terminal of Claim 18, wherein the pre-selected fractional part is one-eighth of a chip period, or less.

20. The terminal of Claim 16, further comprising means for providing a reverse uplink receiver beam width of approximately 0.5°.

21. The terminal of Claim 16, wherein the means for adjusting the first timing characteristic comprises circuitry for advancing a transmit timing characteristic of the orthogonal CDMA traffic signal.

22. The terminal of Claim 16, wherein the means for adjusting the first timing directs the terminal to advance its transmit timing.

23. The terminal of Claim 22; wherein the transmit timing is advanced by a predetermined amount.

24. The terminal of Claim 22, wherein the means for adjusting the first timing characteristic comprises circuitry for advancing a transmit timing characteristic of the orthogonal CDMA traffic signal by an amount specified by the control signal.

25. The terminal of Claim 16 wherein the means for adjusting the first timing characteristic comprises circuitry for retarding a transmit timing characteristic of the orthogonal CDMA traffic signal.

26. The terminal of Claim 25 wherein the means for adjusting the first timing characteristic comprises circuitry for retarding a transmit timing characteristic of the orthogonal CDMA traffic signal by a predetermined amount.

27. The terminal of Claim 25, wherein the means for adjusting the first timing characteristic comprises circuitry for retarding a transmit timing characteristic of the orthogonal CDMA traffic signal by an amount specified by the control signal

28. The terminal of Claim 25 wherein the circuitry for retarding a transmit timing characteristic of the orthogonal CDMA traffic signal comprises a clock output connected to a code modulator, and a control input connected to a signal receiver .

29. A ground station operating in a communications system having a forward link and a reverse link, to provide orthogonal CDMA communication in the reverse link, comprising:

means for transmitting a first pilot signal in the forward link direction;

means for receiving a second pilot signal from at least one terminal in the reverse link direction, and for recovering carrier phase and modulation chip clock timing therein;

means for comparing the second pilot signal to a reverse link reference signal;
and

means for transmitting, in the forward link direction, a control signal to control at least one operational parameter of the terminal, the content being based at least in part on the comparison between the second pilot signal and the reverse link reference signal.

30. A terminal device, comprising:

a processor;

a memory of stored CDMA signal transmit timing characteristic control information coupled to the processor; and

a machine accessible medium, coupled to the processor, having instructions encoded therein, the instructions, when executed by the processor, cause the terminal device to:

receive a first pilot signal;

recover carrier phase and modulation chip clock timing from the first pilot signal;

transmit a second pilot signal;

receive a control signal;

transmit an orthogonal CDMA traffic signal having a first timing characteristic;

and

adjusting the first timing characteristic in response to said control signal.

31. The terminal device of Claim 30, wherein the instructions, when executed by the processor further cause the terminal device to provide a reverse uplink receiver beam width of approximately 0.5°.

32. The terminal device of Claim 30, wherein the instructions, when executed by the processor further cause the terminal device to advance a transmit timing characteristic of the orthogonal CDMA traffic signal.

33. The terminal device of Claim 30, wherein the instructions, when executed by the processor further cause the terminal device to retard a transmit timing characteristic of the orthogonal CDMA traffic signal.

34. The terminal device of Claim 30, wherein memory is part of the terminal device.

35. The terminal device of Claim 30, wherein the instructions, when executed by the processor further cause the terminal device to adjust a transmit frequency of the orthogonal CDMA traffic signal by an amount specified by the control signal.

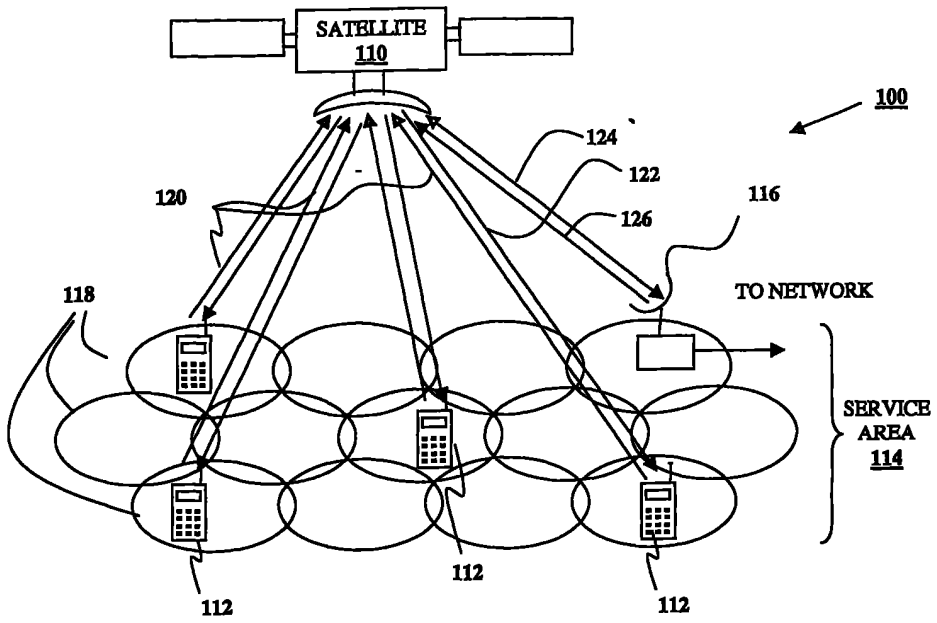


FIG. 1

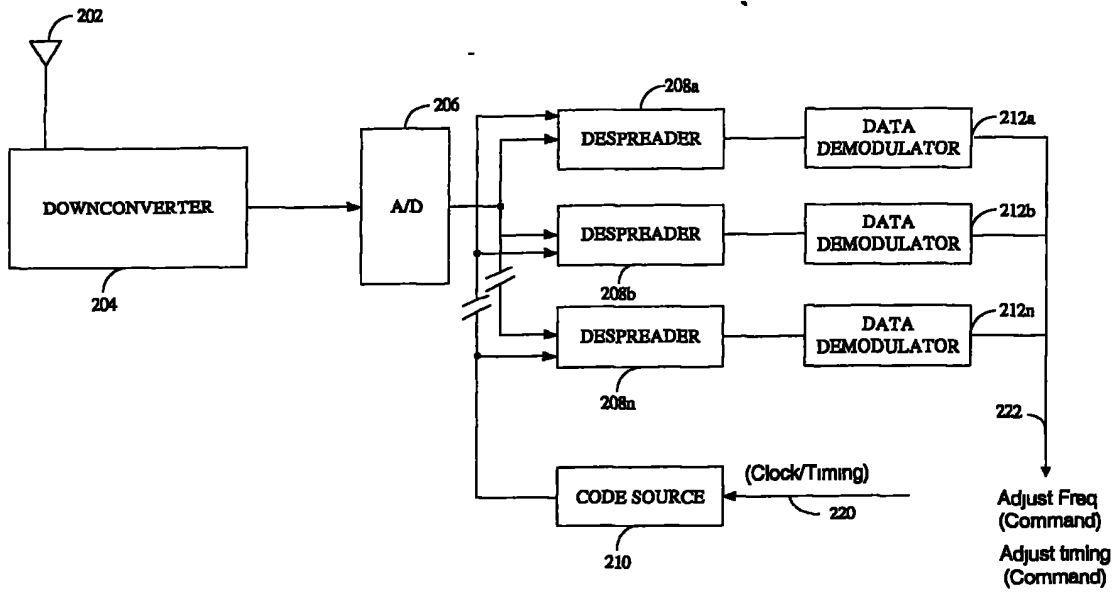


FIG. 2

28

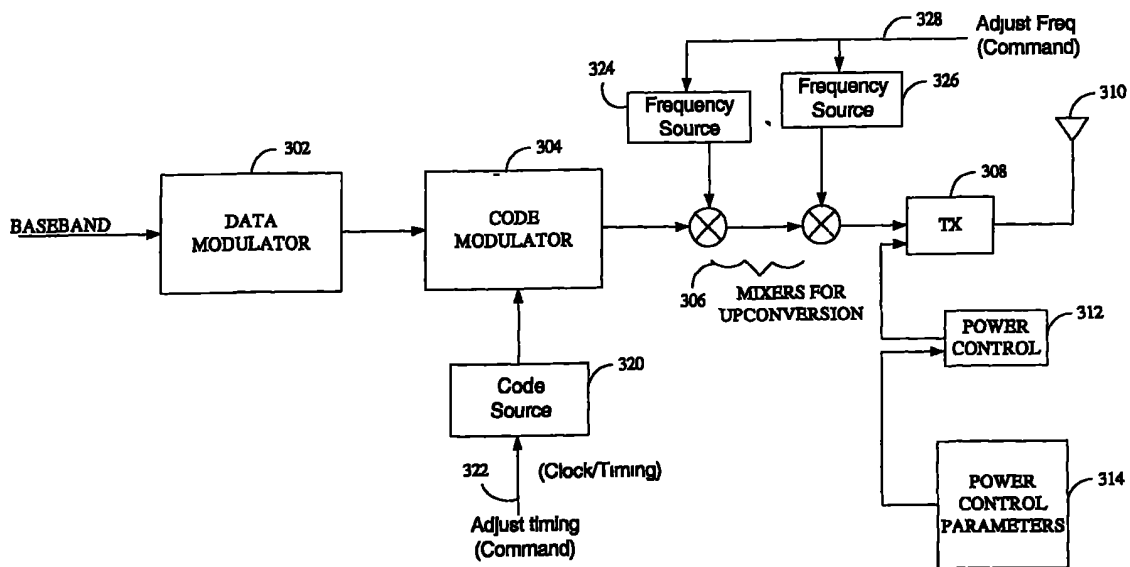


FIG. 3

30

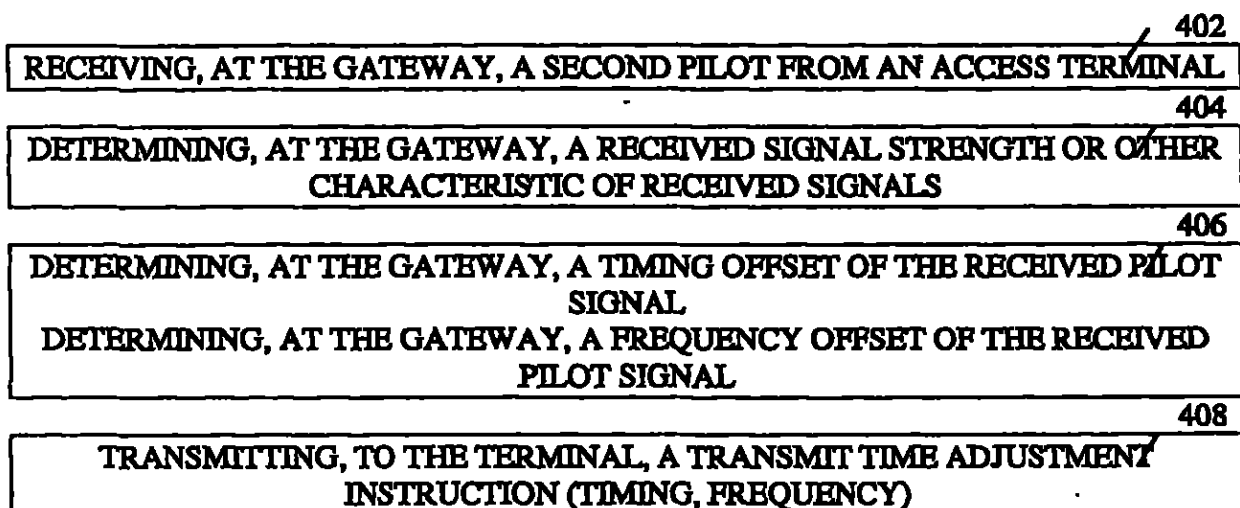


FIG. 4

5/6

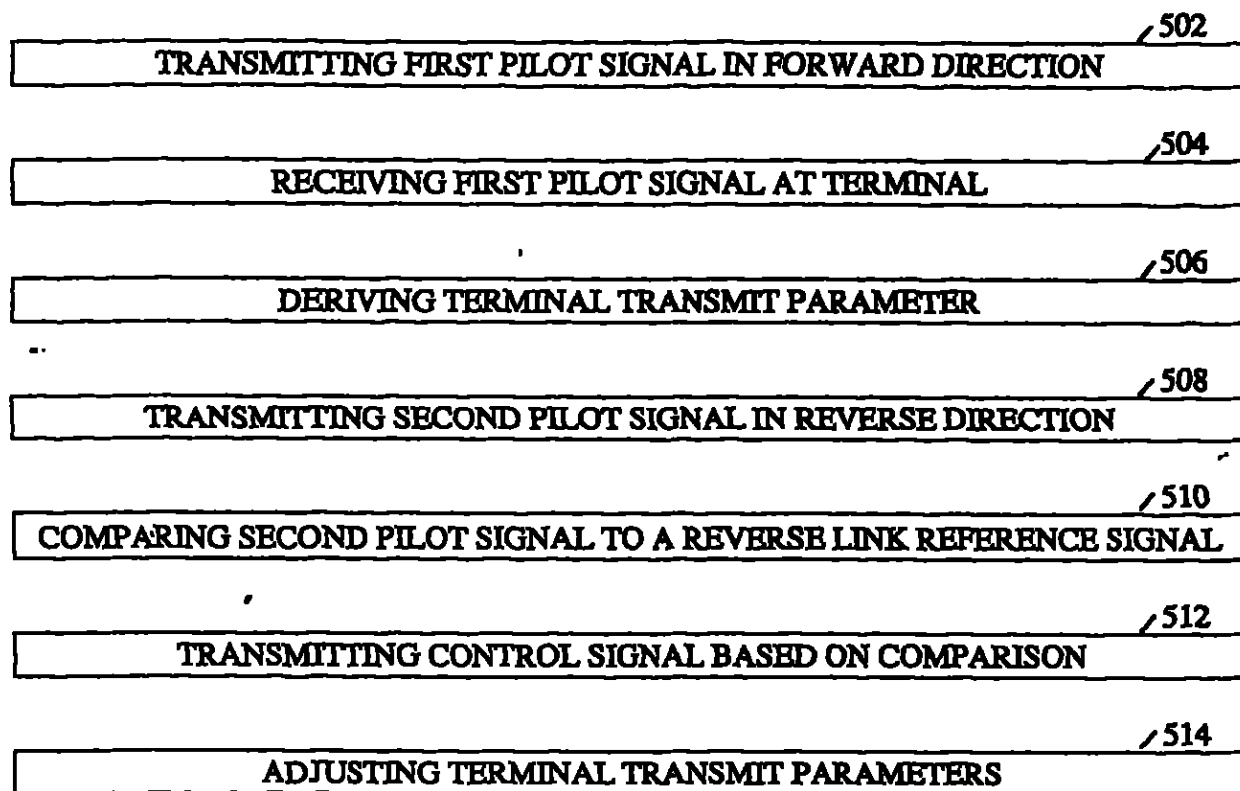


FIG. 5

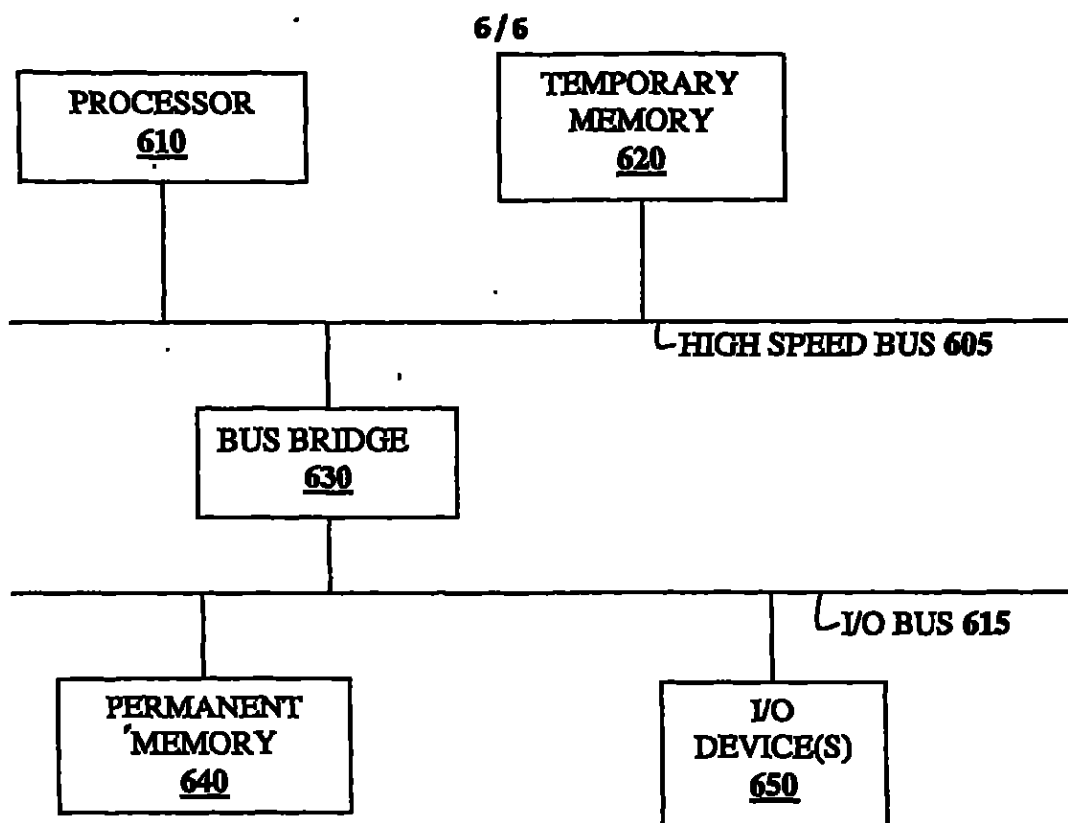


FIG. 6

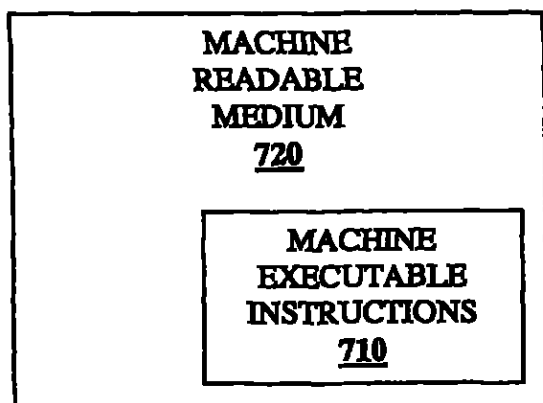


FIG. 7

P. INT COOPERATION TREATY

34

From the INTERNATIONAL SEARCHING AUTHORITY

PCT

NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL SEARCH REPORT
OR THE DECLARATION

(PCT Rule 44.1)

To:
QUALCOMM INCORPORATED
Attn. Ograd, Gregory D.
5775 Morehouse Drive
San Diego, CA 92121
UNITED STATES OF AMERICA

Date of mailing
(day/month/year) 05/11/2003

Applicant's or agent's file reference
020579U1W0

FOR FURTHER ACTION See paragraphs 1 and 4 below

International application No.
PCT/US 03/ 20063

International filing date
(day/month/year) 24/06/2003

Applicant

QUALCOMM INCORPORATED

1. ☒ The applicant is hereby notified that the International Search Report has been established and is transmitted herewith.

Filing of amendments and statement under Article 18:

The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

When? The time limit for filing such amendments is normally 2 months from the date of transmittal of the International Search Report; however, for more details, see the notes on the accompanying sheet.

Where? Directly to the International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Facsimile No.: (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no International Search Report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. ☐ With regard to the protest against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. Further action(s): The applicant is reminded of the following:

Shortly after 18 months from the priority date, the International application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the International application, or of the priority claim, must reach the International Bureau as provided in Rules 90bis.1 and 90bis.3, respectively, before the completion of the technical preparations for International publication.

Within 19 months from the priority date, a demand for International preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within 20 months from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the International Searching Authority



European Patent Office, P.B. 5818 Patentlaan 2
NL-2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Sascha Oppenberg

These Notes are intended to give the basic instructions concerning the filing of amendments under article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the PCT Applicant's Guide, a publication of WIPO.

In these Notes, "Article", "Rule", and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions respectively.

INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only.

What parts of the international application may be amended?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41.

When?

Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

Where not to file the amendments?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 48.2).

Where a demand for international preliminary examination has been/is filed, see below.

How?

Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Administrative Instructions, Section 205(b)).

The amendments must be made in the language in which the international application is to be published.

What documents must/may accompany the amendments?

Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.

The letter must indicate the differences between the claims as filed and the claims as amended. It must, in particular, indicate, in connection with each claim appearing in the international application (it being understood that identical indications concerning several claims may be grouped), whether

- (i) the claim is unchanged;
- (ii) the claim is cancelled;
- (iii) the claim is new;
- (iv) the claim replaces one or more claims as filed;
- (v) the claim is the result of the division of a claim as filed.

The following examples illustrate the manner in which amendments must be explained in the accompanying letter:

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:
"Claims 1 to 29, 31, 32, 34, 35, 37 to 48 replaced by amended claims bearing the same numbers; claims 30, 33 and 36 unchanged; new claims 49 to 51 added."
2. [Where originally there were 15 claims and after amendment of all claims there are 11]:
"Claims 1 to 15 replaced by amended claims 1 to 11."
3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]:
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."
4. [Where various kinds of amendments are made]:
"Claims 1-10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

"Statement under article 19(1)" (Rule 48.4)

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

It must be in the language in which the international application is to be published.

It must be brief, not exceeding 500 words if in English or if translated into English.

It should not be confused with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It may not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim.

Consequence if a demand for international preliminary examination has already been filed

If, at the time of filing any amendments under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the same time of filing the amendments with the International Bureau, also file a copy of such amendments with the International Preliminary Examining Authority (see Rule 62.2(a), first sentence).

Consequence with regard to translation of the international application for entry into the national phase

The applicant's attention is drawn to the fact that, where upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see Volume II of the PCT Applicant's Guide.

PCT

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INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 020579U1W0	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/US 03/ 20063	International filing date (day/month/year) 24/06/2003	(Earliest) Priority Date (day/month/year) 24/06/2002
Applicant QUALCOMM INCORPORATED		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 4 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

- a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

2. ☐ Certain claims were found unsearchable (See Box I).

3. ☐ Unity of invention is lacking (see Box II).

4. With regard to the title,

☐ the text is approved as submitted by the applicant.

☒ the text has been established by this Authority to read as follows:

METHOD FOR RETURN LINK SYNCHRONISATION IN AN ORTHOGONAL CDMA SATELLITE SYSTEM

5. With regard to the abstract,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

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☐ None of the figures.

INTERNATIONAL SEARCH REPORT

Int. Application No
PCT/US 03/20063

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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04B7/26 H04B7/216

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 209 938 A (SAMSUNG ELECTRONICS CO LTD) 29 May 2002 (2002-05-29) paragraph '0029! - paragraph '0036!	1,3, 9-14,16, 21-35
X	US 2002/009129 A1 (CHOI HO-KYU ET AL) 24 January 2002 (2002-01-24) paragraph '0034! - paragraph '0041!	1,3,5-7, 16,18, 19,29,30
X	3GPP TR 25 937: "Low chip rate TDD Iub/Iur protocol aspects" ETSI TR 125 937 V4.0.0, XX, XX, March 2001 (2001-03), pages 1-3, XP002190433 page 23, paragraph 8.1.1.2	1
A	— -/-	2-35

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"A" document member of the same patent family

Date of the actual completion of the international search

29 October 2003

Date of mailing of the international search report

05/11/2003

Name and mailing address of the ISA

European Patent Office, P.B. 5518 Patentkan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3018

Authorized officer

Larcinese, A

INTERNATIONAL SEARCH REPORT

Int'l Application No

PC1/US 03/20063

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GERAKOULIS D ET AL: "NETWORK ACCESS AND SYNCHRONIZATION PROCEDURES FOR A CDMA SATELLITE COMMUNICATION SYSTEM" MILCOM 1999. IEEE MILITARY COMMUNICATIONS CONFERENCE PROCEEDINGS. ATLANTIC CITY, NJ, OCT. 31 - NOV. 3, 1999, IEEE MILITARY COMMUNICATIONS CONFERENCE, NEW YORK, NY: IEEE, US, vol. VOL 1 OF 2 CONF. 18, 31 October 1999 (1999-10-31), pages 413-417, XP000921960 ISBN: 0-7803-5539-3 page 413, left-hand column, line 1 -page 414, right-hand column, line 15	1-35

INTERNATIONAL SEARCH REPORT

Inform. on patent family members

Int. Application No

PCT/US 03/20063

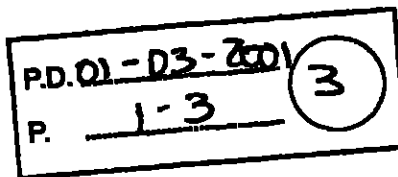
40

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 1209938	A	29-05-2002	AU 758861 B2	03-04-2003
			AU 2314502 A	27-05-2002
			CA 2397323 A1	23-05-2002
			CN 1404668 T	19-03-2003
			EP 1209938 A1	29-05-2002
			WO 0241540 A1	23-05-2002
			KR 2002038562 A	23-05-2002
			US 2002131379 A1	19-09-2002
US 2002009129	A1	24-01-2002	AU 765333 B2	18-09-2003
			AU 6638901 A	08-01-2002
			CN 1383623 T	04-12-2002
			EP 1201041 A1	02-05-2002
			WO 0201742 A1	03-01-2002
			KR 2002000720 A	05-01-2002
			US 2002006170 A1	17-01-2002

ETSI TR 125 937 V4.0.0 (2001-03)

Technical Report

XP-002190433



**Universal Mobile Telecommunications System (UMTS);
Low chip rate TDD lub/lur protocol aspects
(3GPP TR 25.937 version 4.0.0 Release 4)**



8 lub/lur aspects of Uplink synchronisation

8.1 Introduction

This aspect includes the following items:

- Special Layer1-Synchronisation Shift (SS) symbols;
- Number of used SS symbols can take 3 values;
- SS-symbols are transmitted once per subframe.

In principle, this feature replaces the "Timing advance" function which is performed by higher layer interaction in 3.84 Mcps TDD.

8.1.1 The establishment of uplink synchronization

8.1.1.1 Preparation of uplink synchronization by downlink synchronization

When a UE is powered on, it first needs to establish the downlink synchronisation with the cell as describe in [3] about cell search procedure. Only after the UE can establish and maintain the downlink synchronisation, it can start the uplink synchronisation procedure.

8.1.1.2 Establishment uplink synchronization

Although the UE can receive the downlink synchronization signal from the Node B, the distance to Node B is still uncertain which would lead unsynchronised uplink transmission. Therefore, the first transmission in uplink direction is performed in a special Channel UpPCH to reduce interference in traffic time-slots.

The timing used for the SYNC1 burst are set e.g. according to the received power level of DwPCH and/or P-CCPCH.

At the detection of the SYNC1 sequence in the searching window, the Node B will evaluate the received power levels and timing, and reply by sending the adjustment information to UE to modify its timing and power level for next transmission and for establishment of the uplink synchronisation procedure. Within the next 4 sub-frames, the Node B will send the adjustment information to the UE (in a single subframe message in the FPACH) The uplink synchronisation procedure, normally used for a random access to the system, can also be used for the re-establishment of the uplink synchronisation when uplink is out of synchronisation.

8.1.2 Maintenance of uplink synchronisation

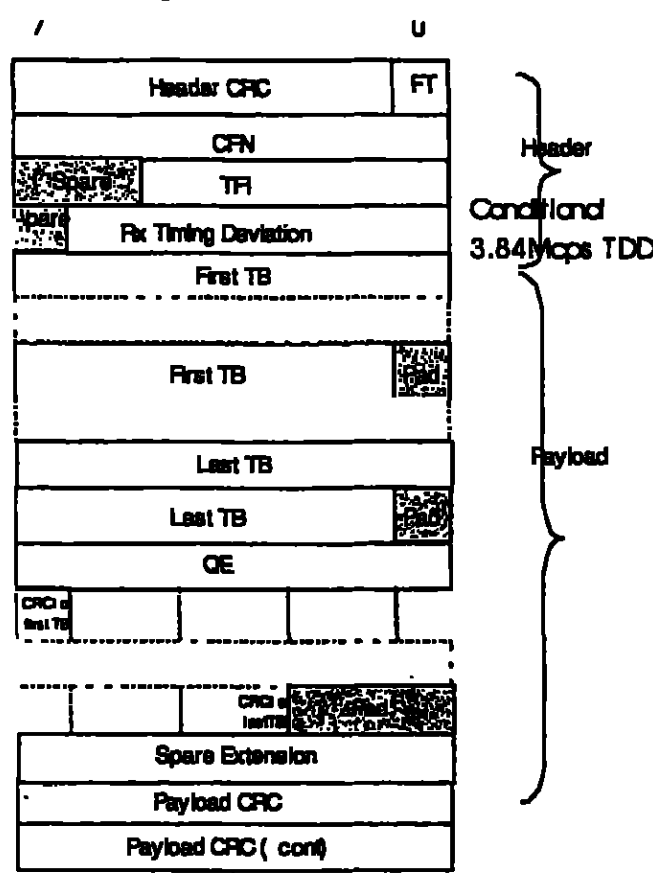
For the maintenance of the uplink synchronization, the midamble field of each uplink burst can be used.

In each uplink time slot the midamble in each UE is different. The Node B can estimate the power level and timing shift by measuring the midamble field of each UE in the same time slot. Then, in the next available downlink time slot, the Node B will signal the Synchronisation Shift (SS) and the Power Control (PC) commands to enable the UE to properly adjust respectively its Tx timing and Tx power level.

These procedures guarantee the reliability of the uplink synchronisation. The uplink synchronization can be checked once per TDD sub-frame. The step size in uplink synchronization is configurable and re-configurable and can be adapted from 1/8 chip to 1 chip duration. The following updates for UL synchronization are possible: 1 step up; 1 step down; no update.

[Explanation difference:]

For high chip rate option, uplink synchronisation is mentioned in 4.3 of TS25.224. But the implementation method is a little different with the low chip rate option. For low chip rate option, the establishment of the UL synchronization is done by using the UpPCH and the FPACH.



8.5.6 Impact on other WG3 Specifications and TRs

It is expected that the lub/lur aspects of uplink synchronisation have an impact also on the Specifications [9] and [12] because it may influence the physical channel handling procedures. In this TR (25.937), these aspects are covered implicitly in chapter 6 where the physical channel types are addressed.

8.6 Open issues

None.

9 lub/lur aspects of Measurements

9.1 Introduction

This aspect includes the following bullets:

- Ranges and accuracy have to be adapted for the low chip rate option.

In principle, this issue relates to:

- measurements to be performed by Node B and to be reported to DRNC/SRNC, and
- measurements performed by UE, reported to SRNC or CRNC, and used by SRNC, DRNC or Node B.

Due to the different power control and uplink synchronisation concept, different measurements are expected.

XP-000921960

Network Access and Synchronization Procedures
for a CDMA Satellite Communication System

B0241150

Diakoumis Gerakoulis

Evaggelos Geraniotis, Hsuan-Jung Su

p413-417-(S) AT&T Laboratories
Florham Park, NJ 07932

University of Maryland
College Park, MD 20742

PD 31-10-1999

Abstract

This paper provides the network access and synchronization procedures of an orthogonal CDMA geostationary satellite system for fixed service communications. These procedures include, initial synchronization, access channel acquisition and fine synchronization control. We also describe the system architecture and provide the performance evaluation. The main objective is to provide network wide synchronization of all uplink orthogonal CDMA transmissions. This is achieved in steps; first by providing coarse synchronization using the uplink random access channel and then fine sync using innovative tracking control mechanisms. The uplink access channel receiver utilize a parallel/serial search method for rapid code acquisition, while the code tracking of the uplink orthogonal CDMA traffic channel is based on a delay feedback early-late gate in which the sync control resides in the receiver. The proposed system is designed to minimize the onboard complexity and satisfy the performance requirements. As shown in the performance section, the requirement that all uplink transmissions are synchronized to a reference time within 10% of the chip length can be achieved. In addition, the system analysis determines the design parameters values which optimize performance.

1 Introduction

Future geostationary satellite systems are expected to offer direct two-way communications between end satellite users having ultra small aperture terminals. Such services require high system capacity, low bit error rates and low signal-to-noise ratio which can be achieved with a Satellite Switched CDMA (SS/CDMA), proposed in [1]. The SS/CDMA uses orthogonal CDMA in both uplink and downlink. The orthogonal CDMA can reject the interference between the user Traffic channels and thus maximize the system capacity. However, the use of orthogonal CDMA in the uplink, requires a network wide synchronization of all satellite transmissions (global synchronization). The accuracy of the synchronization at steady-state and the speed at which synchronization is acquired depends on the propagation environment i.e., the channel condition, the mobility of the end user, the propagation delay, etc. There are several examples in which synchronous CDMA

(orthogonal or quasi-orthogonal) attempted for use in the uplink or inbound channel. One such example is presented in reference [2] in which synchronous CDMA is proposed for mobile satellite applications. Other examples, presented in reference [3] and [4], recommend Orthogonal CDMA for the inbound and outbound links in terrestrial wireless applications. In reference [3] also shown (by simulation) that the required synchronization jitter from a reference time should not exceed 10% of the chip length for orthogonal CDMA operation. This requirement can be achieved easily if the CDMA system has relatively narrow band [4]. On the other hand a wideband orthogonal CDMA requires substantial effort in acquiring and maintaining synchronization, especially in mobile environment. The above referenced systems however, only assume that a synchronization subsystem is in place without presenting one. In this paper we provide the procedures and the system design which can achieve synchronization in a geostationary satellite orthogonal CDMA for fixed service communications.

As described in [1], the multibeam satellite common interface provides Signaling control and user Traffic channels within each satellite beam. The control channels are used for the acquisition of the user Traffic channel. The downlink control channels are, the Pilot, Sync and Paging broadcast channels and are defined by PN-code and orthogonal codes. In the uplink there is an asynchronous Access channel which has an assigned beam PN-code. The Access channel operation is based on a spread-spectrum random access (SSRA) protocol described in the next section. The Traffic channels are defined by the user orthogonal code and the beam orthogonal and/or PN codes.

The system evaluation is focused on the performance of the Access channel code acquisition and the performance of the tracking control loop. The synchronization procedures and the system design are presented in the next section. In section 3 we provide the system performance evaluation.

2 System Description

The satellite common interface provides control channels (Access in the uplink and Pilot, Sync and Paging in the downlink) and Traffic channels. The Traffic channels are based on orthogonal CDMA and provide direct links between the end subscriber units (SUs) without onboard

decoding. The control channel provide the communication links between the satellite and the SU's and are used for both signaling and synchronization purposes. Control channels have an assigned frequency band different from the bands assigned to Traffic channels. The spreading bandwidth of all bands is the same.

In describing the synchronization procedures of the system we first identify the PN and orthogonal codes of each channel that we use in the process. These codes are: The PN code $g_p(t)$ defining the downlink pilot signal which has rate R_c and is transmitted continuously in the frequency band of the downlink control channels, ($g_p(t)$ is transmitted with given phase offset Δ , corresponding to satellite beam i). The uplink Access channel in beam i is identified by the PN code $a_i(t)$, has a chip rate R_c and operates in an assigned frequency band. Traffic channels are defined by the user orthogonal codes W_k ($k = 1, 2, \dots$), the beam PN-codes $g_i(t)$ ($i = 1, 2, \dots$) and the beam orthogonal codes W_i ($i = 1, 2, 3, 4$). The codes W_i having chip rate $R_c = 4R_{c1}$, provide orthogonal isolation between four adjacent beams. Beam PN-code g_i and user orthogonal code W_k have rate R_{c1} . All uplink Traffic Channels codes are required to arrive synchronously at the satellite despanders in order to maintain the orthogonality between users within the beam as well as between beams. That is, the starting time of all orthogonal codes should be aligned upon arriving at the satellite despreaders.

2.1 The Synchronization Procedure

The process that provides network wide synchronization consist of a number of steps described below:

1. **Initial Synchronization:** Upon Power-On the SU acquires synchronization to the Pilot PN sequence using the serial search acquisition circuit in the Sync and Paging receiver unit (S&PRU). The S&PRU in the SU will then acquires the corresponding Sync channel in the beam. Based on the system information supplied by the Sync channel the SU will receive the orthogonal code W_i of the Paging channel (in the downlink) and the PN code a_i of the corresponding Access channel (in the uplink). The SU then acquires and monitors the Paging channel.

2. **Access Channel Acquisition:** The SU will then make an access attempt in the Access channel. The first message transmitted by the SU_{ki} (SU k in beam i) and received successfully at the ACRU will be used to establish the time delay (phase offset) $\Delta\tau_{ki}$ from the reference arrival time (τ_0). i.e., $\Delta\tau_{ki} = \tau_{ki} - \tau_0$. This message may arrive at the satellite despreaders at any possible phase offset of the sequence $a_i(t)$. An array of K parallel Access Channel Detection Circuits (ACDC) are then used to cover all phase offsets of the code a_i (as described in section 3) in order to acquire and despread the code. $\Delta\tau_{ki}$ may provide a resolution of T_c (one chip length), $T_c/2$, $T_c/4$ (T_c/ℓ is called chip cell, $\ell = 1, 2, \text{ or } 4$); That is, $\Delta\tau_{ki} = x_{ki}T_c/\ell$. The value of $\Delta\tau_{ki}$ will then be sent back to the SU via a Paging channel.

3. **Traffic Channel Acquisition:** The SU will use the value

of $\Delta\tau_{ki}$ to establish Coarse Synchronization to the satellite Reference Arrival Time. This is done by advancing (or delaying) x_{ki} chip cells the starting point of the code from its original position at the successful message transmission. Then, the SU aligns each orthogonal and PN code of the uplink Traffic channel to the code a_i and begins transmission. (The traffic channel orthogonal and PN codes W_k , W_i , g_i in the uplink, and W_i , W_j , g_j in the downlink, are supplied to the SU by the onboard control unit.)

4. **Fine Sync Control:** After the SU begin transmitting on the Traffic channel a feedback Tracking Loop will provide fine alignment of the uplink codes with the reference arrival time at the satellite despanders. This feedback loop extends between the satellite to the SU and is described in detail in section 2.2.

5. **Sync Retention Control:** After steady state has been reached, another Sync control circuit will be used to retain the fine Sync attained in the previous step. This circuit consist of the downlink (Traffic channel) Tracking circuit and uplink SYNC control described in section 2.2.

2.2 The System Design

In step 2 of the procedure, the Access channel provides coarse synchronization for the orthogonal uplink Traffic channel. This is an additional function of the Access channel which comes at no extra cost. Its main function is to provide access for call set-up signaling messages. The Access channel operates as an asynchronous random access channel. Its transmissions obey the *Spread Spectrum Random Access (SSRA)* protocol. According to SSRA, there is one PN code $a_i(t)$ for all users in beam i . Each user may begin transmitting a message at any time instant (unslotted channel). Each message consists of a preamble (containing no data) and the message information data field. The transmitted preamble signal will arrive at the receiver at any phase offset of the PN-code. Signals arriving at the receiver more than one chips apart will be distinguished and received. Messages that have (uncorrected) errors due to interference or noise will be retransmitted randomly after the time out interval, while messages that are successfully received will be acknowledged. The Access Channel Receiver Unit (ACRU) consists of a non-coherent detector, an array of parallel Access Channel Detection Circuits (ACDC) and a pool of parallel data decoders. The array of parallel ACDCs, shown in Figure 1, provide a combination of parallel with serial acquisition circuits. Each ACDC searches for synchronization of the message by correlating over a window of w chips, during the message preamble. The serial search method utilize a typical double dwell algorithm. Given L chips the length of PN code a_i , and K the number of ACDCs the window size will then be, $w = L/K$, ($1 \leq w \leq L$). For example if $L=1204$ chips and $K=16$, then $w=84$ chips. The correlation process takes place during the message preamble. The actual number of parallel ACDCs K is determined by the required length of the preamble interval. In the serial search (double dwell)

method, the length of the dwell time γ_1 and γ_2 as well as the thresholds (Θ_1 and Θ_2), are determined so that the requirements for the false alarm and detection probabilities are met. Also, the Access channel is assumed to operate at low traffic load in order to offer high probability of successful message transmission with the first attempt. (See performance analysis in section 3.1).

The mechanism used in step 4 for fine sync control, is shown in Figure 2. It consists of the on-board SYNC Tracking circuit the downlink feedback path, the SU SYNC control circuit and uplink Traffic channel timing jitter control. The On-board tracking consist of an Early-Late gate that provides the timing jitter Z_Δ . The timing jitter value Z_Δ will be inserted in a message and sent to the SU via the Paging channel. The SU SYNC Control circuit will then take Z_Δ as input to make the timing adjustment on the uplink Traffic channel. The Early or Late despreading circuits may rely on the highest chip rate beam code W_1 , i.e., $W_1(t \pm \Delta T_c)$ (The other codes g_i and W_k have chip length $T_{c2} = 4T_c$). Hence, the design of the proposed tracking loop differs from the typical one since the timing adjustment takes place at the transmitter(SU), not the receiver. This is necessary in order to align the transmitted orthogonal code to the reference time (at the satellite) at which all other transmissions have been aligned with. This tracking loop however introduces delays both in the feedback (downlink) as well as in the forward (uplink) path. This delay is equal to the satellite round trip propagation delays which is of about 250 ms. The delay also varies slowly because the satellite has a drift motion of about 2.5 meters/sec. The performance evaluation of this tracking loop have been provided in section 3.2.

The last step of the process is required in order to maintain the fine sync achieved in the previous step without making use of the the on-board sync tracking circuit. The onboard tracking circuit will become available (after a steady state is reached) for reuse in another call and thus reduce the on-board hardware. The sync retention control circuitry consists of the downlink Traffic channel tracking circuit and the SYNC control circuit. The feedback signal Z_Δ of the tracking circuit of the downlink Traffic channel will also feed the input of the SU Sync control circuit. Hence, any change in the satellite propagation delay with respect to the established timing, by $\Delta\tau_p$ (resulting from satellite drift motion) will be indicated at the downlink Traffic channel tracking circuit. The $\Delta\tau_p$ timing jitter will then be used (by the SU Sync control circuit) to compensate the uplink transmission by advancing or delaying by $\Delta\tau_p$ using the SYNC control circuit.

3 Performance Evaluation

3.1 The Access Channel Performance

Considering the long round trip satellite propagation delay, the main performance requirement of the Access channel is to provide high probability of success with the first transmission attempt. The probability of a successful mes-

sage transmission depends (a) on the probability of PN code acquisition during the message preamble, (b) on the probability of message collision and (c) on the probability of no bit errors in the message after channel decoding (called Retention probability).

(a) The performance analysis (presented in [5]), determines the design parameters for a serial/parallel acquisition circuit which maximizes the probability of acquiring successfully (P_{acq}) within the preamble interval. These parameters are the minimum preamble interval and the optimum window size ω for a given code length of L chips and known interference noise conditions. The probability P_{acq} refer as the acquisition confidence, is given by

$$P_{acq} = Pr[T_{acq} \leq T_h] = \int_0^{T_h} f_{T_{acq}}(\tau) d\tau = F_{T_{acq}}(T_h) \quad (1)$$

Where, T_{acq} is the acquisition time for the window size of ω chips and T_h is the minimum allowed length of the message preamble which satisfies the acquisition confidence. The probability distribution $f_{T_{acq}}$ or the cumulative distribution $F_{T_{acq}}$ functions of the acquisition time are derived in [5].

(b) Collision of two or more packets will occur if they are overlapping and have the same PN code phase offset when they arrive at the despreader. This is based on the assumption that the channel is unslotted (continuous time) and a single PN code has been used for all users in the channel. Also we assume that all packets arrive at the despreader with approximately equal power. The probability that i packets collide given k_0 packets are overlapping at any time instant, is given by

$$P_{coll}(i|k_0) = \binom{k_0}{i} (1/L)^i (1 - 1/L)^{k_0-i} \text{ for } 2 \leq i \leq k_0 \quad (2)$$

Where, $1/L$ is the probability that i packets have exactly the same phase offset of the PN code. The number of all possible phase offsets is assumed to be L , equal to the length of the code (in number of chips). (If the phase offset is less than a chip we assume that collision takes place) The probability that k_0 packets overlap is given by

$$P(k_0) = \frac{(2t_p G)^{k_0}}{k_0!} e^{-2t_p G} \quad (3)$$

In the above expression t_p is the packet length and G in the total offered traffic load which includes both the newly arrived and retransmitted packets. (Two or more packets will overlap if they arrive in the interval $2t_p$) The probability of collision then will be

$$P_{coll} = \sum_{k_0=2}^{\infty} \sum_{i=2}^{k_0} P_{coll}(i|k_0) P(k_0) \quad (4)$$

(c) The probability of packet retention P_{ret} , is the probability of having no errors in the packet's information field after FEC. That is, if the packet length is n bits then

$P_{ret} = (1 - P_e)^n$, where P_e is the bit error probability. The probability of successful packet transmission then is given by

$$P_{succ} = P_{acq}(1 - P_{coll})P_{ret} \quad (5)$$

In the above equation however we assumed that there is always a receiver available to decode the data in the packet. If there are ℓ parallel data receivers available (as shown in Figure 3) then the probability of not finding an available one is $P_{un}(\ell) = \sum_{k_o \geq \ell} P(k_o)$; Where $P(k_o)$ is the probability of having k_o packets overlapping at the reception at a given load G (given in (3)).

Then $P'_{succ} = P_{succ}[1 - P_{un}(\ell)]$.

3.1.1 Performance Results

In order to determine the values of T_h corresponding to the required acquisition confidence (as in (1)), we first derived the cdf of the acquisition time $F_{T_{acq}}$, (see [5]).

In Table 1 we presented the serial/parallel acquisition circuit performance results for code lengths $L = 512$ and for $K = 32, 16$ parallel circuits. The false alarm probabilities used are $P_{F1} = 0.01$, $P_{F2} = 0.1$ and the corresponding penalty γ_p is equal to the PN code period L . The mean acquisition time $E[T_{acq}]$ varies from 0.3 to 1.4 ms depending on the values of the (E_c/I_0) (chip energy to interference ratio), L and K . The dwell accumulation values γ_1 and γ_2 are optimized for each case. The required preamble length T_h is provided in each case in number of code lengths ($\times L$) and in msec assuming the chip rate is $R_c = 9.8304$ Mc/s. The T_h values given in the tables represent the minimum preamble length required to achieve acquisition confidence 95%. As shown, the minimum required preamble length T_h varies from 0.73 to 3.65 ms for $L = 1024$ depending on the channel conditions (E_c/I_0) and the number of parallel ACDCs (K). The packet delays introduced by these preamble lengths are then feasible and acceptable even with delay sensitive traffic.

Assuming acquisition confidence $P_{acq} = 0.95$ and bit error rate 10^{-8} (after FEC), we have also evaluated and plotted the probability of successful packet transmission P_{succ} versus the offered load (packets/sec) for packet lengths of $n = 256$ and $n = 512$ encoded bits (or 128 and 256 information bits assuming FEC rate 1/2) the with $\ell = 1, 2, 3$ parallel data receivers (channel decoders). The period of the encoder is 512. The plot is shown in Figure 9. As shown, the P_{succ} is near 0.95 for a wide range of packet load (up to 10 packets/sec), when the packet length is 256 symbols and with 2 or more channel decoders.

3.2 Tracking Control Loop Performance

In this section we examine the tracking loop stability and the steady state error. The tracking loop performance is based on the analysis given in references [6] and [7]. The mean and the variance of the discriminator output has been derived for a discrete time model of the loop. The tracking

loop has been approximated by a linear model. The steady state timing error (derived in [7]) is given by

$$\tau_s = \lim_{z \rightarrow 1} (1 - z^{-1}) \frac{\tau(z)}{T_c} = \frac{c}{A\alpha F(z)} \quad (6)$$

Where $F(z)$ is the loop filter, and c is the normalized doppler shift. The variance of the timing error $\sigma_s^2 = \text{Var}(\tau/T_c)$ is given by (see [7]):

$$\sigma_s^2 = \frac{(V_0 + n_0)}{2\pi} \int_{-\pi}^{\pi} \left| \frac{\alpha F(e^{j\omega}) e^{j\omega(-d-1)}}{1 - e^{-j\omega} + A\alpha F(e^{j\omega}) e^{j\omega(-d-1)}} \right|^2 d\omega. \quad (7)$$

The value of $A\alpha$ is usually very small, and as we can see from the above expression the steady state variance increases as α increases. This implies that given a loop filter, there is an optimal value of α . We note however that the interference variance V_0 is itself a function of the steady state error. A simple form of loop filter is taken for evaluation.

$$F(z) = \frac{1}{1 + \beta z^{-1}} \quad (8)$$

Computer search shows that β can only be in the range of $(-1, 1)$ so the system is stable. We then define a cost function as $\tau_s + 2\sigma_s$, which means we have more than 95% confidence that the timing error will be smaller than $\tau_s + 2\sigma_s$. With the timing error requirement being $T_c/10$, the optimal values of α and β for which the convergence time is the shortest have then been determined. The complete analysis of the tracking loop is given in [5].

4 Conclusion

In this paper we have presented and evaluated the network synchronization for an orthogonal CDMA satellite system. The objective of providing synchronization of all uplink orthogonal code Traffic channels, as shown, can be achieved with a procedure which involves the uplink random access channel for coarse code acquisition and the use of an innovative feedback tracking control loop for fine synchronization. The Access channel code acquisition scheme is based on a parallel/serial design which is optimized in terms of minimizing the acquisition time and maximizing the acquisition confidence for a given signal-to-noise ratio. Performance analysis indicates that packets may be transmitted successfully over the Access channel with probability near 0.95 when the traffic load is up to 10 packets/sec and for a given set of system parameters. Performance analysis of the tracking loop has also been performed in order to determine the stability and the optimum loop design. Due to long round trip satellite propagation delay the loop response has a steady state error which can be corrected by a scaling adjustment. Thus, the requirement of synchronizing each orthogonal code to the reference time within 10% of the chip length can be achieved.

References

- [1] D. Gerakoulis, E. Geraniotis, R. Miller and S. Ghassemzadeh. "A Satellite Switched CDMA (SS/CDMA) System Architecture for Fixed Service Communications". *IEEE Communications Magazine*, July 1999.
- [2] R. De Gaudenzi, F. Giannetti and M. Luise. "Advances in Satellite CDMA Transmission for Mobile and Personal Communications" *Proceedings of the IEEE* Vol. 84, No. 1, January 1996, pp 18-39.
- [3] D.T. Magill, F.D. Natali and G.P. Edwards. "Spread-Spectrum Technology for Commercial Applications" *Proceedings of the IEEE* Vol. 82, No. 4, April 1994; pp 572-584.
- [4] J.K. Omura and P.T. Yang "Spread-Spectrum S-CDMA for Personal Communication Services" MIL-COM'92 pp. 113.1-5
- [5] D. Gerakoulis, E. Geraniotis, H-J Su "Network Synchronization of an Orthogonal CDMA Satellite Communication System". Submitted to the *Journal on Selected Areas in Communications*.
- [6] A. J. Viterbi. "CDMA : Principles of Spread Spectrum Communications" Addison-Wesley, Massachusetts, 1995.
- [7] H-J Su, P. Li, E. Geraniotis and D. Gerakoulis. "Code Tracking Loop Performance for an Orthogonal CDMA Uplink SATCOM System". Conference proceedings, IEEE ISCC'98, Athens, Greece.

K	E_c/I_0 (dB)	E/T_{acq} (ms)	$T_h (\times L)$	T_h (ms)
32	-10	0.3695	7.0937	0.1611
32	-12	0.2537	11.2253	0.5847
32	-14	0.4015	17.7618	0.9251
16	-10	0.3044	14.0784	0.7333
16	-12	0.4811	22.2688	1.1599
16	-14	0.7609	35.1989	1.8334

Table 1: Acquisition performance for $L = 512$.

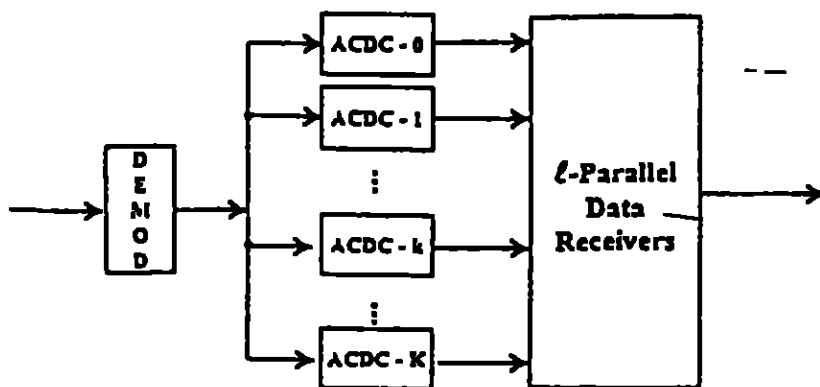


Figure 1. Array of parallel Access Channel Detection Circuits (ACDC).

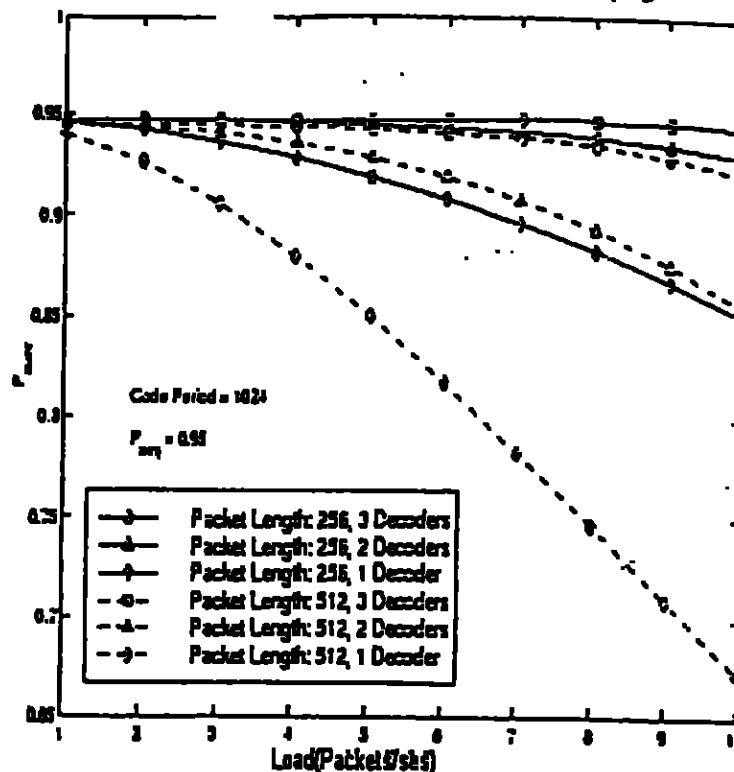


Figure 3. The Probability of Successful Packet Transmission

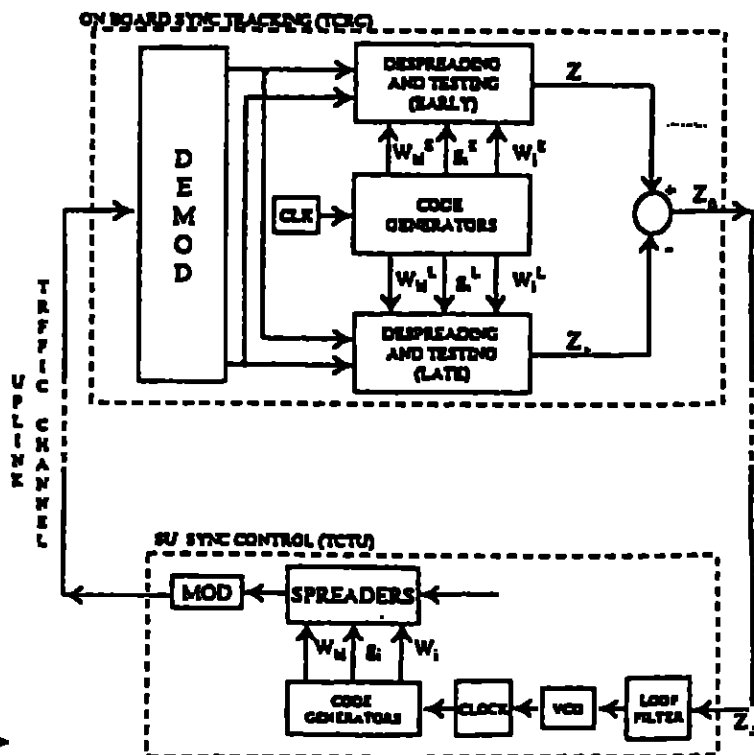


Figure 2. The SYNC and Tracking Feedback Control Loop

From the INTERNATIONAL BUREAU

PCT

NOTICE INFORMING THE APPLICANT OF THE
COMMUNICATION OF THE INTERNATIONAL
APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

To:

OGROD, Gregory, D.
Qualcomm Incorporated
5775 Morehouse Drive
San Diego, CA 92121
ETATS-UNIS D'AMERIQUE

Date of mailing (day/month/year) 31 December 2003 (31.12.2003)		
Applicant's or agent's file reference 020579H		
IMPORTANT NOTICE		
International application No. PCT/US2003/020063	International filing date (day/month/year) 24 June 2003 (24.06.2003)	Priority date (day/month/year) 24 June 2002 (24.06.2002)
Applicant QUALCOMM INCORPORATED		

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this notice:

AU, AZ, BY, CH, CN, CO, DE, DZ, EP, HU, JP, KG, KP, KR, MD, MK, MZ, RU, TM

In accordance with Rule 47.1(c), third sentence, those Offices will accept the present notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:

AE, AG, AL, AM, AP, AT, BA, BB, BG, BR, BZ, CA, CR, CU, CZ, DK, DM, EA, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, ID, IL, IN, IS, KE, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MG, MN, MW, MX, NI, NO, NZ, OA, OM, PG, PH, PL, PT, RO, SC, SD, SE, SG, SK, SL, SY, TJ, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW

The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this notice is a copy of the international application as published by the International Bureau on 31 December 2003 (31.12.2003) under No. WO 2004/002022

4. **TIME LIMITS** for filing a demand for international preliminary examination and for entry into the national phase

The applicable time limit for entering the national phase will, subject to what is said in the following paragraph, be 30 MONTHS from the priority date, not only in respect of any elected Office if a demand for international preliminary examination is filed before the expiration of 19 months from the priority date, but also in respect of any designated Office, in the absence of filing of such demand, where Article 22(1) as modified with effect from 1 April 2002 applies in respect of that designated Office. For further details, see *PCT Gazette* No. 44/2001 of 1 November 2001, pages 19926, 19932 and 19934, as well as the *PCT Newsletter*, October and November 2001 and February 2002 issues.

In practice, time limits other than the 30-month time limit will continue to apply, for various periods of time, in respect of certain designated or elected Offices. For regular updates on the applicable time limits (20, 21, 30 or 31 months, or other time limit), Office by Office, refer to the *PCT Gazette*, the *PCT Newsletter* and the *PCT Applicant's Guide*, Volume II, National Chapters, all available from WIPO's Internet site, at <http://www.wipo.int/pct/en/index.html>.

For filing a demand for international preliminary examination, see the *PCT Applicant's Guide*, Volume I/A, Chapter IX. Only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination (at present, all PCT Contracting States are bound by Chapter II).

It is the applicant's sole responsibility to monitor all these time limits.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Gijsbertus Beijer - Carlos Roy
Facsimile No.(41-22) 740.14.35	Telephone No.(41-22) 338.91.11

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/US 03/20063

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 H04B7/26 H04B7/216

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 209 938 A (SAMSUNG ELECTRONICS CO LTD) 29 May 2002 (2002-05-29) paragraph '0029! - paragraph '0036!	1,3, 9-14,16, 21-35
X	US 2002/009129 A1 (CHOI HO-KYU ET AL) 24 January 2002 (2002-01-24) paragraph '0034! - paragraph '0041!	1,3,5-7, 16,18, 19,29,30
X	3GPP TR 25 937: "Low chip rate TDD Iub/Iur protocol aspects" ETSI TR 125 937 V4.0.0, XX, XX, March 2001 (2001-03), pages 1-3, XP002190433 page 23, paragraph 8.1.1.2	1
A	— -/-	2-35

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubt on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (see specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, each combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

29 October 2003

Date of mailing of the international search report

05/11/2003

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Palmstein 2
 NL - 2280 HV Rijswijk
 Tel. (+31-70) 340-2040, Tx. 31 051 epo nl,
 Fax (+31-70) 340-2018

Authorized officer

Larcinese, A.

INTERNATI NAL SEARCH REP RT

International Application No

PCT/US 03/20063

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GERAKOULIS D. ET AL: "NETWORK ACCESS AND SYNCHRONIZATION PROCEDURES FOR A CDMA SATELLITE COMMUNICATION SYSTEM" MILCOM 1999. IEEE MILITARY COMMUNICATIONS CONFERENCE PROCEEDINGS. ATLANTIC CITY, NJ, OCT. 31 - NOV. 3, 1999, IEEE MILITARY COMMUNICATIONS CONFERENCE, NEW YORK, NY: IEEE, US, vol. VOL 1 OF 2 CONF. 18, 31 October 1999 (1999-10-31), pages 413-417, XP000921960 ISBN: 0-7803-5539-3 page 413, left-hand column, line 1 -page 414, right-hand column, line 15	1-35

Form PCT/ISA/210 (continuation of second sheet) (July 2002)

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US 03/20063

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 1209938	A	29-05-2002	AU 758861 B2	03-04-2003
			AU 2314502 A	27-05-2002
			CA 2397323 A1	23-05-2002
			CN 1404668 T	19-03-2003
			EP 1209938 A1	29-05-2002
			WO 0241540 A1	23-05-2002
			KR 2002038562 A	23-05-2002
			US 2002131379 A1	19-09-2002
US 2002009129	A1	24-01-2002	AU 765333 B2	18-09-2003
			AU 6638901 A	08-01-2002
			CN 1383623 T	04-12-2002
			EP 1201041 A1	02-05-2002
			WO 0201742 A1	03-01-2002
			KR 2002000720 A	05-01-2002
			US 2002006170 A1	17-01-2002

PATENT COOPERATION TREATY

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From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:
PHILIP R. WADSWORTH
QUALCOMM INCORPORATED
5775 MOREHOUSE DRIVE
SAN DIEGO, CALIFORNIA 92121

PCT

NOTIFICATION OF TRANSMITTAL OF INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Rule 71.1)

Date of Mailing
(day/month/year) **02 NOV 2004**

Applicant's or agent's file reference

020579U1WO

IMPORTANT NOTIFICATION

International application No.

PCT/US03/20063

International filing date (day/month/year)

24 June 2003 (24.06.2003)

Priority date (day/month/year)

24 June 2002 (24.06.2002)

Applicant

QUALCOMM INCORPORATED

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.
4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/US

Mail Stop PCT, Attn: IPEA/US
Commissioner for Patents
P.O. Box 1490
Alexandria, Virginia 22313-1490

Facsimile No. (703) 305-3230

Authorized officer

Alpus H. Hsu

Telephone No. (571) 272-2000

Rugenia Zogor

Form PCT/IPEA/416 (July 1992)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 020579UIWO	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPBA/416)	
International application No. PCT/US03/20063	International filing date (day/month/year) 24 June 2003 (24.06.2003)	Priority date (day/month/year) 24 June 2002 (24.06.2002)
International Patent Classification (IPC) or national classification and IPC IPC(7): H04B 7/26; H04Q 7/38 and US Cl.: 370/203, 320, 335, 342, 350, 491; 375/145, 149; 455/13.2, 430		
Applicant QUALCOMM INCORPORATED		
1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36. 2. This REPORT consists of a total of <u>3</u> sheets, including this cover sheet. ☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT). These annexes consist of a total of <u> </u> sheets. 3. This report contains indications relating to the following items: I ☒ Basis of the report II ☐ Priority III ☐ Non-establishment of report with regard to novelty, inventive step and industrial applicability IV ☐ Lack of unity of invention V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement VI ☐ Certain documents cited VII ☐ Certain defects in the international application VIII ☐ Certain observations on the international application		
Date of submission of the demand 22 January 2004 (22.01.2004)	Date of completion of this report 25 September 2004 (25.09.2004)	
Name and mailing address of the IPEA/US Mail Stop PCT, Attn: IPBA/US Commissioner for Patents P.O. Box 1430 Alexandria, Virginia 22313-1430 Facsimile No. (703) 305-3230	Authorized officer Alpin H. Hsu Telephone No. (571)272-2600	

Form PCT/IPBA/409 (cover sheet)(July 1998)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/US03/20063

I. Basis of the report

1. With regard to the elements of the international application:*

- ☒ the international application as originally filed.
- ☒ the description:
pages 1-23 as originally filed
pages NONE, filed with the demand
pages NONE, filed with the letter of _____.
- ☒ the claims:
pages 24-29 as originally filed
pages NONE, as amended (together with any statement) under Article 19
pages NONE, filed with the demand
pages NONE, filed with the letter of _____.
- ☒ the drawings:
pages 1-6 as originally filed
pages NONE, filed with the demand
pages NONE, filed with the letter of _____.
- ☐ the sequence listing part of the description:
pages NONE as originally filed
pages NONE, filed with the demand
pages NONE, filed with the letter of _____.

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language _____ which is:

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in printed form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages NONE
- ☐ the claims, Nos. NONE
- ☐ the drawings, sheets/fig NONE

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(e)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/US03/20063**V. Reasoned statement under Rule 66.2(a)(II) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement****1. STATEMENT**

Novelty (N)	Claims 2-35	YES
	Claims 1	NO
Inventive Step (IS)	Claims 3-35	YES
	Claims 1-2	NO
Industrial Applicability (IA)	Claims 1-35	YES
	Claims NONE	NO

2. CITATIONS AND EXPLANATIONS

Claim 1 lacks novelty under PCT Article 33(2) as being anticipated by LEE et al. in EP Patent Application No. 1 209 938 A1 or ASANUMA in U.S. Patent No. 5,983,113.

LEE et al. teaches all technical features of a method of providing CDMA communication in a return link by: receiving a first pilot signal at a plurality of terminals, deriving at least one transmit timing characteristic from the received first pilot signal, transmitting a second pilot signal at an assigned time in accordance with the derived transmit timing characteristic, receiving a control signal providing instructions to adjust the transmit timing characteristic, and adjusting the transmit timing characteristic responsive to the control signal (see abstract, page 4, line 15 to page 5, line 7, page 5, line 42 to page 6, line 36, page 9, line 32 to page 10, line 24) as in claim 1. Similarly, ASANUMA also teaches all technical features of a method of providing CDMA communication in a reverse link by: receiving a first pilot signal at a plurality of terminals, deriving at least one transmit timing characteristic from the received first pilot signal, transmitting a second pilot signal at an assigned time in accordance with the derived transmit timing characteristic, receiving a control signal providing instructions to adjust the transmit timing characteristic, and adjusting the transmit timing characteristic responsive to the control signal (see col. 2, line 13 to col. 3, line 55, col. 6, line 6 to col. 10, line 6) as in claim 1.

Claim 2 lacks an inventive step under PCT Article 33(3) as being obvious over LEE et al. in EP Patent Application No. 1 209 938 A1 or ASANUMA in U.S. Patent No. 5,983,113. Each of LEE et al. and ASANUMA references fails to disclose a specific reverse uplink receiver beam width of approximately 0.5 degree, which would have been obvious and within the level of ordinary skill artisan to implement in either system of LEE et al. or ASANUMA since it is well known and common practice for engineer to set the reverse uplink receiver beam width at any degree to satisfy the system design specification requirement.

Claims 3-35 meet the criteria set out in PCT Article 33(2)-(4), because the prior art does not teach or fairly suggest a method and apparatus of operating a communication system having a forward link and a reverse link to provide orthogonal CDMA communication in the reverse link by: receiving a first pilot, recovering carrier phase and modulation chip clock timing from the received first pilot signal, transmitting a second pilot, receiving a control signal, transmitting an orthogonal CDMA traffic signal having a first timing characteristic, and adjusting the first timing characteristic in response to the control signal.

NEW CITATIONS

US 5,983,113 A (ASANUMA) 09 November 1999, see col. 2, line 14 to col. 3, line 55, col. 6, line 6 to col. 10, line 6.

PATENT COOPERATION TREATY

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PCT

From the INTERNATIONAL BUREAU

INFORMATION CONCERNING ELECTED
OFFICES NOTIFIED OF THEIR ELECTION

(PCT Rule 61.3)

To:

OGROD, Gregory, D.
Qualcomm Incorporated
5775 Morehouse Drive
San Diego, CA 92121
United States of America

Date of mailing (day/month/year)
24 March 2004 (24.03.2004)

Applicant's or agent's file reference
020579U1WO

IMPORTANT INFORMATION

International application No.
PCT/US2003/020063

International filing date (day/month/year)
24 June 2003 (24.06.2003)

Priority date (day/month/year)
24 June 2002 (24.06.2002)

Applicant
QUALCOMM INCORPORATED

1. The applicant is hereby informed that the International Bureau has, according to Article 31(7), notified each of the following Offices of its election:

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3. The applicant is reminded that he must enter the "national phase" before the expiration of 30 months from the priority date before each of the Offices listed above. This must be done by paying the national fee(s) and furnishing, if prescribed, a translation of the international application (Article 39(1)(a)), as well as, where applicable, by furnishing a translation of any annexes of the international preliminary examination report (Article 38(3)(b) and Rule 74.1).

Some offices have fixed time limits expiring later than the above-mentioned time limit. For detailed information about the applicable time limits and the acts to be performed upon entry into the national phase before a particular Office, see Volume II of the PCT Applicant's Guide.

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The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Authorized officer:

Jean-Luc MARTIN

Facsimile No. (41-22) 338.87.40

Telephone No. (41-22) 338 9887

MÉTODO PARA RETORNAR SINCRONIZACIÓN DE ENLACE EN UN
SISTEMA SATELITAL CDMA ORTOGONAL

ANTECEDENTES DE LA INVENCION

Solicitudes Relacionadas

Esta solicitud reivindica el beneficio de solicitudes provisionales presentadas anteriormente 60/391437, presentada en Junio 24, 2002, y 60/391,438, presentada en junio 24, 2002.

Campo de la Invención

La presente invención se relaciona de manera general con sistemas de comunicación inalámbrica, y más particularmente con métodos y aparatos para utilizar técnicas de acceso múltiple mediante división por código ortogonal (O-CDMA) en la vía de regreso de un sistema de comunicaciones. En aspectos adicionales, la invención se relaciona con suministrar sincronización de código y emplear (O-CDMA) mediante terminales de acceso en los enlaces de retorno del sistema de comunicación satelital.

Técnica Relacionada

Se han desarrollado varios sistemas de comunicación satelital durante los años. Una arquitectura de un sistema anterior utiliza una interfaz aérea o técnica de modulación de señal denominada como acceso múltiple por división de tiempo (TDMA). El TDMA se caracteriza por asimilar franjas de tiempo en un canal de comunicación a cada una de una pluralidad de usuarios o terminales remotos, y al tener comunicación con cada una de las terminales que tienen lugar en asimilar específicamente las franjas de tiempo. Una arquitectura de sistema mejorada utiliza una interfaz aérea o una técnica de modulación de señal denominada como acceso múltiple mediante división por código (CDMA), que se caracteriza por el uso de técnicas de modulación de expansión del espectro para suministrar usuario separado o canales de señal de tráfico de usuario. Tales técnicas son descritas en las enseñanzas de la patente U.S. No. 4,901,307, que fue concedida en febrero 13, 1990, bajo el título "*Spread Spectrum Multiple Access Communication System Using Satellite or Terrestrial Repeaters*", y la patente U.S. No. 5,103,459, otorgada en abril 7, 1992, titulada "*System and Method for Generating Signal Waveforms In a*

CDMA Cellular Telephone System", ambas cedidas al cesionario de la presente invención e incorporadas aquí como referencia.

Los sistemas de comunicación basados en CDMA generalmente suministran mayor eficiencia de ancho de banda que los sistemas de comunicación basados en TDMA. Muchos sistemas de comunicación satelitales basados en CDMA típicamente operan en un modo CDMA sobre la dirección de enlace delantero (FR), esto es, para señales transferidas desde concentradores o puertas de enlace a los terminales, y en un modo TDMA sobre la dirección del enlace de reversa (RL) esto es, para señales transferidas desde terminales a puertas de enlace.

Existen dos tipos o modos principales de procesamiento de señal en comunicación CDMA en uso, el CDMA asincrónico y el CDMA ortogonal sincrónico. En el modo asincrónico de operación del CDMA, las señales de diferentes terminales no están sincronizadas y, por lo tanto, pueden llegar fuera de fase de código o zinc y pueden causar interferencia una con la otra. En el modo de operación sincrónico, las señales transmitidas de los diferentes terminales son temporizadas con el fin de llegar

sincrónicamente, y están en fase de código la una con la otra o tiene sincronización de código, en receptor. En el modo sincrónico del CDMA, si los códigos ortogonales son utilizados para distinguir diferentes transmisiones de terminal, entonces no existe de manera general, o muy poca, interferencia cruzada entre las diferentes señales recibidas de los terminales, debido a la correlación cruzada que se aproxima a cero. Esta técnica y formas de onda resultante son denominadas como CDMA ortogonal (O-CDMA). En este caso uno logra mayor eficiencia de ancho de banda debido a la interferencia reducida.

En el enlace delantero, la ortogonalidad entre diferentes códigos es mantenida efectivamente en razón a que todas las señales se originan en el mismo sitio, a saber en el concentrador o puerta de enlace que suministra el servicio de comunicación a uno o más terminales remotos. Donde varias puertas de enlace son utilizadas en todo un sistema de comunicación, ellas son generalmente configuradas para utilizar una fuente de tiempo común, tal como la fase de las señales detectadas de los satélites GPS, que emplean una forma de lo que se denomina como Tiempo Universal. Alternativamente, o en adición, las puertas de enlace pueden estar en

comunicación una con la otra y/o una referencia de señal temporizada, con el fin de suministrar un mecanismo de sincronización. Otros de Tales mecanismos son conocidos en la técnica o son contemplados.

Sin embargo, para que las señales sean transferidas a los terminales en el enlace de retorno, no existe generalmente un mecanismo de sincronización común y las señales transmitidas desde los diferentes terminales llegan asincrónicamente a la (las) puertas de enlace debido a su diferentes retrasos o sendas de propagación, aun si el tiempo de la transmisión inicial está cercano a la sincronización, que a menudo puede no estar. Por lo tanto, aunque los sistemas de comunicación satelital pueden fácilmente incorporar CDMA ortogonal para uso en enlaces directos, ellos pueden no hacer uso de esta técnica en los enlaces inversos. Con el fin de mejorar la comunicación, al reducir la interferencia potencial y otros efectos deletéreos, lo que se requiere son métodos y aparatos para posibilitar que el CDMA ortogonal sea empleado en las sendas de señal de retorno de un sistema de comunicación satelital, o sobre los enlaces de comunicación inversos.

RESUMEN DE LA INVENCION

En resumen, el sincronismo de código o la sincronización se logra posibilitando el uso de códigos de modulación deseados para implementar el CDMA ortogonal en la dirección de retorno. En un sistema de comunicación satelital que incluye un satélite geoestacionario, el uso del CDMA ortogonal en el enlace inverso se posibilita ventajosamente mediante las modalidades de la presente invención. Una estación terrena transmite una señal piloto de enlace primero o directo en la dirección de enlace delantero, y uno o más terminales adquieren y siguen la señal piloto, recuperando fase de portador y temporizando el tiempo del reloj del código de modulación (chip) utilizado por el sistema de comunicación. Un terminal entonces deriva una frecuencia portadora de transmisión para ser utilizada para las señales que esta transmite, y la temporización del reloj con chip de código para ser utilizada para la modulación de señal, de la frecuencia portadora piloto directa recuperada y la temporización del reloj de chip. El terminal transmite una señal piloto de enlaces segunda o inversa en la dirección de enlace inversa la cual, después de ser recibida y

remitida por el satélite, está dirigida a la estación terrena. La estación hace seguimiento, y en algunas modalidades también hace seguimiento de la frecuencia, de la señal piloto originada terminal y compara esas características con aquellas de una señal de referencia de enlace inverso. Los terminales, de acuerdo con la presente invención, tiene la capacidad de avanzar o retardar el tiempo de su señales transmitidas con relación al tiempo derivado de la señal piloto de enlace delantero, y ellas lo hacen así basadas, al menos en parte en los resultados de la comparación de tiempo con la referencia. Esto se logra al tener la transmisión de la estación terrena una señal de control sobre el enlace delantero a cada terminal con el que este desee comunicarse con un haz, o sub-haz, suministrando comandos o instrucciones a cada terminal en una cantidad o grado deseado por medio del cual este debe avanzar o retardar el respectivo tiempo de transmisión para lograr la sincronización deseada de las señales de enlace inverso. Cada terminal ajusta entonces su tiempo y/o frecuencia de transmisión en pequeños incrementos para mantener la alineación de tiempo con la estación terrena.

Un método para suministrar comunicación CDMA ortogonal en un enlace de retorno, de acuerdo con la presente invención incluye, recibir una primer señal piloto en una pluralidad de terminales; derivando al menos una característica de tiempo de transmisión de la señal piloto primera recibida, en donde la derivación se desarrolla dentro de cada uno de una pluralidad de terminales; transmitir, en un tiempo asignado una señal piloto desde cada una de la pluralidad de terminales de acuerdo con la al menos una característica de temporización de transmisión derivada; recibir una señal de control, el contenido de las instrucciones que suministran control para ajustar al menos una característica de temporización de transmisión; y ajustar, en respuesta a la señal de control, al menos una característica de temporización de transmisión.

Un método para operar un sistema de comunicaciones que incluye un satélite geosincrónico dispuesto en un enlace delantero y un enlace inverso, para suministrar comunicación CDMA ortogonal en el enlace inverso, de acuerdo con la presente invención incluye, transmitir una primer señal piloto desde una estación terrena en la dirección de enlace delantero; recibir la primera señal

piloto en un terminal y recibir la fase portadora y la temporización del reloj del chip de modulación allí; derivando una frecuencia portadora de transmisión y una temporización de reloj de chip desde la frecuencia portadora piloto directa recuperada y la temporización del reloj de chip de modulación; transmitir una segunda señal piloto desde el terminal en la dirección de enlace inverso; comparar en la estación terrena, la segunda señal piloto a una señal de referencia de enlace inverso; transmitir, en la dirección de enlace delantero, una señal de control el contenido de la señal de control basado al menos en parte en la comparación entre la segunda señal piloto y la señal de referencia de enlace inversa; y ajustar, en respuesta a la señal de control, al menos un parámetro operacional del terminal.

Tal método puede además incluir señales de tráfico CDMA ortogonales del terminal.

En alguna modalidad de tal método, en al menos un parámetro operacional del terminal comprende temporización de transmisión; y el ajuste se desarrolla para mantener la temporización de transmisión del terminal dentro de una fracción predeterminada de un

periodo de chip de código, por ejemplo en $1/8$ de un periodo de chip.

El método puede incluir adicionalmente suministrar un enlace ascendente y un ancho de haz de receptor de enlace ascendente inverso de aproximadamente $0,5^\circ$.

En algunas modalidades de tal método, la señal de control se dirige al terminal para avanzar su temporización de transmisión, aunque otras esta se dirige al terminal para retardar su temporización de transmisión. La temporización en unas modalidades puede ser avanzada o retardada por cantidades predeterminadas o por una cantidad específica por la señal de control.

Una modalidad de un terminal, incluye, medios para recibir una primer señal piloto; medios para recuperar fase de portadora y temporización de reloj de chip de modulación desde la primer señal piloto; medios para transmitir una segunda señal piloto; medios para recibir una señal de control; medios para transmitir una señal de tráfico CDMA ortogonal a un satélite geoestacionario, la señal de tráfico CDMA ortogonal tiene una primer

característica de temporización; y medios para ajustar la primer característica de temporización.

En algunas modalidades de cada terminal, los medios para ajustar la primer característica de temporización comprenden circuitos para avanzar una característica de temporización de transmisión de la señal de tráfico de CDMA ortogonal mediante una cantidad predeterminada, y en los otros medios para retardar una característica de temporización de transmisión de la señal de tráfico CDMA ortogonal mediante una cantidad predeterminada.

En algunas modalidades de tal terminal los medios para ajustar la primera característica de temporización comprenden circuitos para avanzar y otros para retardar, una característica de temporización de transmisión de la señal de tráfico CDMA ortogonal mediante una cantidad especificada por la señal de control.

BREVE DESCRIPCIÓN DE LAS DIBUJOS

Las características, objetos, y ventajas de la presente invención serán más evidentes de la descripción detallada establecida adelante cuando se toma en conjunto con los

dibujos en los cuales los caracteres de preferencia similares identifican los mismos o similares elementos en todas partes y en donde:

La figura 1 ilustra una modalidad de la presente invención en un sistema satelital.

La figura 2 es una representación y un diagrama de bloques de un receptor para recibir una pluralidad de transmisiones del CDMA concurrentes en el enlace de retorno desde una pluralidad correspondiente de terminales.

La figura 3 es una representación de un diagrama de bloques de un transmisor en un terminal adaptado para enviar mensajes sobre un enlace de retorno de un sistema de comunicaciones satelital o CDMA.

La figura 4 es un diagrama de flujo de un proceso ilustrativo que muestra las operaciones de una puerta de enlace.

La figura 5 es un diagrama de flujo de un proceso ilustrativo utilizando un terminal.

La figura 6 ilustra una modalidad de un sistema de equipo para implementar varias modalidades.

La figura 7 ilustra una modalidad de un medio leíble por máquina para almacenar instrucciones ejecutables para implementar varias modalidades.

DESCRIPCIÓN DETALLADA

De manera general, las modalidades de la presente invención suministran eficiencia de ancho de banda mejorada, capacidad creciente para solucionar el desvanecimiento por lluvia u otros fenómenos de degradación de canal, poder de transmisión reducido, o varias combinaciones de estos. Más particularmente, durante el uso ventajoso del CDMA ortogonal en el enlace de retorno de un sistema de comunicaciones basado en satélite geosincrónico, las modalidades de la presente invención permiten una pluralidad de terminales de acceso, cada una con una asignación de canal de código único, para transmitir concurrentemente en un haz con la misma o menor potencia agregada como se utilizaría mediante un terminal de acceso simple utilizando TDMA

como su método de acceso. En otras modalidades, el uso ventajoso del CDMA ortogonal en el enlace de retorno permite uno o más terminales de acceso, cada uno en haz común y asignado una franja de tiempo común, para transmitir a una potencia de transmisión mayor para solucionar los efectos de degradación del canal tal como aquellos debidos al desvanecimiento por lluvia.

En la siguiente descripción, varios aspectos de la presente invención se describirán. Sin embargo, se da evidente para aquellos expertos en la técnica que la presente invención puede ser practicada con solamente algunos o todos los aspectos de la presente invención. Para propósito de explicación, los números específicos, materiales y configuraciones están establecidos con el fin de suministrar un entendimiento completo de la presente invención. Sin embargo, también será evidente para aquellos expertos en la técnica que la presente invención se puede practicar sin los detalles específicos. En otros casos, las características bien conocidas son omitidas o simplificadas con el fin de no oscurecer la presente invención.

Varios aspectos de la invención se pueden implementar como soluciones basadas en circuitos, incluyendo posible implementación sobre un circuito integrado simple. Como sería evidente para un experto en la técnica, varias funciones de los elementos del circuito se pueden implementar como operaciones de procesamiento en un programa de software. Tal software se puede implementar en, por ejemplo, un procesador de señal digital, microcontrolador, controlador embebido, o computador de propósito general. Es bien conocido que la mayoría de las puertas de enlace usan disposiciones, bastidores de tarjeta de circuito y montajes para lograr todas las tareas de procesamiento de señal que ellas emprenda.

Estas tarjetas pueden tener controladores y procesadores especializados, o utilizar chips de procesadores de computador comercialmente disponibles y varios tipos de memoria para desarrollar ciertas funciones, además, los computadores completos, estaciones de trabajo y otros dispositivos similares son a menudo integrados en los diseños del sistema, y son utilizados para operar y controlar ciertas funciones en una puerta de enlace o una estación base.

Muchos dispositivos inalámbricos tales como teléfonos, PDAs, y módems, también contiene elementos de procesamiento de señal sofisticados, recursos, y capacidades para acomodar las características esperadas en diseños de dispositivo moderno.

La invención puede tener modalidades en la forma de métodos así como también aparatos para practicar aquellos métodos. La presente invención puede también tener modalidad en la forma de código de programa con modalidad menos tangibles, tales como, tarjetas perforadas, cintas magnéticas, floppy disks, unidades de disco duro, CD-ROMs, tarjetas de memoria "flash", u otros medios de almacenamiento leíbles por máquina, en donde, cuando el código de programa es cargado y ejecutado por una máquina, tal como una computadora, la máquina se vuelve un aparato para practicar la invención. La presente invención también puede tener una modalidad en la forma de un código de programa, por ejemplo, si se almacena en un medio de almacenamiento, cargado y/o ejecutado por una máquina o transmitido sobre algunos medios o portadores de transmisión, tales como sobre alambres o cableado eléctrico, a través de fibras ópticas, o por vía de radiación electromagnética, en donde, cuando el código de

programa es cargado en y ejecutado por una máquina, tal como un procesador, la máquina se vuelve un aparato par a practicar la invención. Cuando se implemente sobre un controlador programable, el procesador de señal, el procesado de propósitos generales y similares, los segmentos de código de programa se combinan con el procesador para suministrar el dispositivo único que opera análogamente a circuitos lógicos específicos.

La referencia aquí "una modalidad", "modalidad", o formulaciones similares, significan que una característica, estructura, operación, o carácter particular descrito en relación con la modalidad, está incluido en al menos una modalidad de la presente invención. Así, las apariencias de tales fases o formulaciones no son necesariamente todas de referencia a la misma modalidad. Adicionalmente, varias características, estructuras, operaciones, o caracteres particulares se pueden combinar de cualquier manera adecuada en una o más modalidades.

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Terminología

Un "chip" como se utiliza aquí, se refiere a un estado o valor binario que se utiliza para producir un "código". Esto es una serie de valores binarios denominados como "chips" código son utilizados para generar un código particular o una secuencia de código. Aunque un chip se puede referir a un estado binario en una señal de amplio espectro o un código Seudoaleatorio (PN), como se utiliza aquí ellos generalmente se refieren a códigos de canalización ortogonal o secuencias de código utilizadas para establecer diferentes canales de comunicación para los terminales de usuario dentro de haces o sub-haces. Típicamente, estos son códigos Walsh bien conocidos, utilizados para crear canales de comunicación ortogonal en un sistema de comunicación.

Los términos, estación base, y puerta de enlace, son algunas veces utilizados intercambiabilmente en la técnica, siendo las puertas de enlace presididas como estaciones base especializadas que dirigen comunicaciones a través de satélites, aunque las estaciones base utilizan antenas terrestres para dirigir comunicaciones dentro una región geográfica circundante. La expresión

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estación terrena es algunas veces utilizada intercambiabilmente en este campo con puerta de enlace.

Los satélites de comunicación pueden formar haces que iluminan una "mancha" o área producida por las señales de comunicación satelital proyectantes sobre la superficie de la tierra. Un patrón de haz satelital típico para una mancha comprende un número de haces disgustos en un patrón de cubrimiento predeterminado. Típicamente, cada haz comprende un número de así llamados sub-haces que cubren un área geográfica común, cada una ocupando una banda de frecuencia diferente. En casos apropiados, los sub-haces se pueden denominar como canales CDMA o FDM.

La expresión enlace inverso, dirección inversa, enlace de retorno, y dirección de retorno, son utilizadas algunas veces intercambiabilmente en este campo. Al menos que se especifique otra cosa en el contexto de su uso aquí, estas expresiones, y formulaciones similares a estas, se refieren a sendas de comunicación por medio de las cuales las señales se propagan desde una unidad terminal a un satélite, y desde un satélite a una estación terrena. En sistemas de comunicación terrestre, ellas se propagan desde un terminal a una estación base directamente.

Las expresiones enlace delantero y dirección directa son algunas veces utilizadas intercambiabilmente en este campo. Al menos que se especifique otra cosa en el contexto de su utilización aquí, estas expresiones, y formulaciones similares a esta, se refieren a sendas de comunicación por medio de los cuales las señales se propagan desde una estación terrena a un satélite, y desde un satélite a una unidad terminal. En los sistemas de comunicación terrestres, ellos repropagan desde una estación base a un terminal directamente.

La expresión enlace ascendente se refiere a sendas por medio de las cuales las señales se propagan desde una estación terrestre a un satélite o desde terminal a un satélite. Las expresiones enlace ascendente directo y enlace descendente directo se refieren a sendas por medio de las cuales las señales se propagan desde una estación terrestre a un satélite y desde un satélite a un terminal, respectivamente; aunque la expresión enlace ascendente inverso y enlace descendente inverso se refieren a sendas por medio de las cuales las señales se propagan desde un terminal a un satélite y desde un satélite a una estación terrestre, respectivamente.

Los terminales, o terminales de usuario, también son algunas veces denominados como señales de acceso, unidades de subscritor, unidades móviles, estaciones móviles, o simplemente "usuarios", "móviles", o "subscriptores" en algunos sistemas de comunicación, dependiendo de la preferencia. Estos términos son bien entendidos en este campo.

Los sistemas de comunicación basados en satélites convencionales son conocidos los cuales utilizan CDMA ortogonal en la dirección de enlace delantero, y que no utilizan CDMA ortogonal en la dirección de enlace inverso. Los sistemas que no utilizan CDMA ortogonal en el enlace inverso también se pueden referir como teniendo un canal inverso compartido de interferencia.

Ambientes del Sistema de Comunicaciones Inalámbrico

Típico

Un sistema de comunicaciones inalámbrico de ejemplo en el cual varias modalidades de la invención encuentran aplicación pueden incluir como partes de este sistema de comunicación, al menos un satélite de comunicación

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geoestacionaria al menos una estación terrestre, que son adecuados para efectuar comunicaciones con uno o más terminales de usuario remoto. Aunque la invención se describe primariamente en términos de comunicaciones basadas en satélites, inalámbricas, la presente invención puede ser aplicable a otros tipos de canal o canales de comunicación, incluyendo digital, eléctrica, u óptica, inalámbrica o alámbrica/fibra, etcétera.

La figura 1 ilustra un sistema de comunicaciones basado en satélite 100 que incorpora uno o más satélites 110 que relevan comunicaciones entre una pluralidad o serie de terminales de usuario (112a, 112b, 112c, 112d) en un área de servicio 114 y al menos una puerta de enlace 116, siendo algunas veces más de un área de servicio. La puerta de enlace 116 podía suministrar, por ejemplo, un punto de acceso entre una red satelital o redes externas, tales como, la Internet y en algunas otras redes externas (parcialmente mostradas). Los terminales se comunican con la red externa a través del satélite 110 y la puerta de enlace 116.

El área de servicio 114 está cubierta por una o más haces, o sendas, tales como, el haz 112, que son

proyectados sobre la superficie de la tierra por el satélite 110. Los haces iluminan una "mancha" o área producida por las señales de comunicaciones del satélite proyectante sobre la superficie de la tierra. Los haces están dispuestos en un patrón de cubrimiento predeterminado. Cada haz generalmente utiliza el espectro de frecuencia completo disponible en el satélite en el caso de patrón de reutilización de frecuencia completa, o alguna división del espectro de frecuencia disponible en el caso de un patrón de reutilización parcial. Cada haz también puede incluir un número de los así llamados sub-haces (también denominados como señales FDM, canales, o enlaces) que cubren un área geográfica común con cada sub-haz ocupando una banda de frecuencia particular.

El grupo de señales que van desde los terminales a través del satélite 110, descendiendo a la puerta de enlace 116 comprende el "enlace de retorno". El enlace de retorno incluye un número de enlaces ascendentes 120 desde los terminales, y un enlace descendiente 124 desde el satélite 110 a la puerta de enlace 116. los enlaces ascendentes de retorno 120 son generalmente todos combinados en el satélite 110 en un enlace descendiente de retorno 124, aunque esto no se requiere

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necesariamente. En una modalidad, el acceso múltiple por división de código (CDMA) se utiliza en el enlace de retorno para distinguir entre señales desde varias terminales. Esto es, los terminales múltiples pueden simultáneamente transmitir una banda de frecuencia compartida utilizando códigos separados.

Para completar, la figura 1 también muestra el grupo de señales que van desde la puerta de enlace 116 a través del satélite 110, descendiendo a los terminales 112 (112a, 112b, 112c, 112d) que comprende "enlace delantero". El enlace delantero incluye un número de enlaces descendientes a los terminales, y un enlace ascendente 126 desde el satélite 110 a la puerta de enlace 116.

Los terminales de usuario (112a, 112b, 112c, 112d) son cada uno dispositivos de comunicación inalámbrico tales como, pero no limitados a, teléfono celular, un transceptor de datos, o un buscapersonas de doble vía, y cada uno puede ser manejado con la mano o montado en un vehículo según se desee. También se tiene que las enseñanzas de la invención son aplicables a unidades fijas donde el servicio inalámbrico remoto es deseado,

incluyendo "interiormente" o así como también sitios "exteriores".

La expansión de espectro de los sistemas de comunicación CDMA contemplan típicamente el uso de modulación coherente y desmodulación para comunicación de terminal de usuario de enlace delantero. En sistemas de comunicación que usan este enfoque, una señal portadora "piloto", también referida como una "señal piloto", es usado como una fase de referencia coherente para las señales de enlace delantero. Esto es, una señal que no contiene datos de modulación que son transmitidos por una estación terrestre (por ejemplo, una puerta de enlace o una estación base) a todo lo largo de una región cubierta como referencia.

Las señales del piloto son utilizadas por los terminales de usuario para obtener sincronización de sistema inicial y suministrar seguimiento de tiempo, frecuencia, y fase de las señales transmitidas por la puerta de enlace o la estación base. La información de fase obtenida del seguimiento de un portador de señal de piloto se utiliza como una referencia de fase de portador para la desmodulación coherente de otras señales del sistema o de

señales de tráfico (es decir datos). Esta técnica permite que muchas señales de tráfico compartan una señal piloto común como una referencia de fase, proporcionando menor costo y un mecanismo de seguimiento más eficiente. Una señal piloto simple es típicamente transmitida por cada puerta de enlace o estación base para cada frecuencia utilizada, denominada como un canal CDMA o FDM o su-haz y compartida por todos los terminales de usuario que reciben señales provenientes de la puerta de enlace o la estación base en esta frecuencia.

Con el fin de implementar el CDMA ortogonal en la dirección de retorno de un sistema de comunicación basado en satélite, las modalidades incluyen el uso de códigos ortogonales como parte de la desmodulación de señal, y la desmodulación. Estos códigos comprenden una serie de valores binarios denominados "chips" de código y están generalmente basados en códigos Walsh bien conocidos. El sistema de comunicación emplea una relación de código no fase conocida entre señales de al menos dos terminales en un haz. La relación de código-fase conocida entre señales para varios terminales de usuario es tal que el tiempo o la fase de los respectivos códigos Walsh son separados con relación uno del otro por solo una pequeña fracción

de un periodo de duración de chip, y mantiene diferencia de frecuencia de portador que están generalmente dentro de pocos grados una de la otra.

Métodos y aparatos en implantado de acuerdo con la invención suministran o proporcionan la sincronización de las transmisiones de enlace ascendente de retorno de un conjunto de terminales en un haz de una red de satélites geoestacionarios con una precisión al menos adecuada para permitir el uso de técnicas CDMA ortogonal.

En una modalidad ilustrativa, que incluye un satélite geoestacionario como parte del sistema de comunicación, una estación terrena trasmite una señal piloto de enlace primera o directa en la dirección de enlace delantero. Uno o más terminales localizados en el haz de enlace delantero adquieren y hacen seguimiento a la señal de piloto transmitida. Cada terminal opera con el fin de recuperar la fase de portador y el tiempo del reloj de chip de modulación proveniente de la señal piloto que se origina en la estación terrestre. La terminal entonces deriva su frecuencia de portador de transmisión y la temporización de reloj con chip de una frecuencia de portador piloto directo y una temporización de reloj de

chip de modulación. Tal método evita la necesidad de osciladores de referencia estabilizados costosos en los terminales de usuario. Un método similar se puede emplear en los terminales de subscritor CDMA celulares terrestres.

Además de la sincronización del tiempo (es decir la sincronización de fase de código), el desfase de frecuencia entre el transmisor y el terminal de acceso y el receptor de la puerta de enlace deben ser suficientemente pequeños de tal forma que el cambio de fase de la señal sobre el periodo de un código ortogonal sea despreciable, como se discute adelante. En un método para lograr sincronización de frecuencia entre un terminal de acceso y una puerta de enlace, el terminal de acceso ajusta la frecuencia de su oscilador con el fin de asegurarse a la frecuencia de la señal recibida de la puerta de enlace.)

El momento adecuado para el protocolo de acceso en uso (que es bien entendido en la técnica), cada terminal en comunicación con la estación terrena transmite una señal piloto de enlace segunda o inversa en la dirección de enlace inverso, que es subsecuentemente detectada en un

receptor en la estación terrena. En el receptor en la estación terrena después de ser retransmitida a través de un satélite. Las terminales de usuario, de acuerdo con la invención, tienen la capacidad de avanzar o retardar el tiempo de las transmisiones o las señales transmitidas con relación al tiempo previamente derivado de la señal piloto de enlace delantero.

Las terminales hacen seguimiento de las características de tiempo para las señales de la estación terrena (primer piloto), y subsecuentemente la estación terrena hace seguimiento de las características de tiempo para las terminales. De manera general, este es en la forma de monitorear un parámetro operacional, tal como la temporización de señal, para cada sincronización de fase de código. Sin embargo, esa es solo una característica de tiempo de una terminal, con otra característica de tiempo, como se vio anteriormente, que es opcionalmente seguida, siendo la frecuencia de cualquiera la primer o la segunda señales piloto transmitidas desde la estación terrena o cada terminal de usuario. Típicamente, el valor de desfase de la frecuencia seguida y una frecuencia de referencia es el parámetro operacional utilizado.

Las terminales derivan al menos una característica de tiempo de transmisión de la primer señal piloto recibida, con la derivación siendo desarrollada en cada una de una pluralidad de terminales. Las terminales entonces trasmiten, en un tiempo asignado una señal piloto de cada una de la pluralidad de terminales de acuerdo con la derivada al menos una característica de tiempo de transmisión.

Una señal de referencia de enlace inverso es generada, típicamente por la estación terrena misma. La estación terrena compara al menos el tiempo de la terminal originada en las segundas señales piloto a aquella de la señal de referencia de enlace inverso. Una señal de referencia de enlace de retorno, generada en la estación terrena, representa el tiempo ideal, o cercano a este de una transmisión de enlace de retorno perfectamente temporizada como se debe recibir en la estación terrena. Tal señal de referencia se puede derivar de una referencia local, retrasada por el viaje de ida y vuelta predicho a y desde un punto de referencia en la tierra (típicamente el centro del haz) a través de un transpondedor satelital, mas un margen adecuado para permisividad a las terminales más distantes.

Alternativamente, esta señal de referencia se puede derivar de las señales piloto recibida de una o más terminales de usuario representativas.

Basados, al menos en parte, en esta comparación de la señal o señales piloto de enlace de referencia e inversa, la estación terrena determina la naturaleza de cierta información de tiempo o control que va a ser transmitida a cada terminal. La información de tiempo o control representa tal información o datos que indican la discrepancia de tiempo entre las señales piloto de enlace inversa y la señal de referencia. Esta información va a ser utilizada por una terminal de usuario para alterar la temporización de las señales transmitidas que se suministran a la estación terrena, generalmente al avanzar o retardar el tiempo de la señal, con el fin de lograr un tiempo deseado de sincronización, con relación a la señal de referencia.

La estación terrena entonces permite una señal de control, comando, o referencia sobre el enlace delantero a cada uno de los terminales deseados, que actúan para instruir la terminal para avanzar o retardar su tiempo de transmisión, o alterar su frecuencia transmisión en

algunas modalidades. Esto se puede denominar como una señal de control. En respuesta a la información o a los comandos suministrados por la estación terrena, cada terminal ajusta entonces su tiempo de transmisión y/o frecuencia, típicamente, en incrementos pequeños, de acuerdo con las instrucciones recibidas, para mantener la alineación de tiempo con el o los receptores en la estación terrena. Tal proceso de determinar e implementar los cambios en un tiempo de transmisión de la terminal, que son utilizados para mantener la alineación de tiempo, se puede desarrollar por una pluralidad de terminales en un haz. Asegurar la alineación de tiempo deseada es un aspecto de la presente invención que posibilita el uso del CDMA ortogonal en la dirección de retorno.

Por lo tanto, en los ejemplos ilustrativos, una estación terrena trasmite una señal piloto de enlace delantero. Una terminal de usuario adquiere y hace seguimiento a las señal piloto de enlace delantero, recuperando la fase de portador y modulando el tiempo de reloj del chip. Una terminal de usuario deriva su frecuencia de portador de transmisión y el tiempo del reloj del chip desde la frecuencia de portador de piloto directa recuperada y el tiempo del reloj del chip. Tal método evita la necesidad

de osciladores de referencia estabilizados costosos en los terminales de usuario. Se nota que un método similar se emplea en los terminales de subscritor CDMA celulares terrestres.

Se nota que el mecanismo de sincronización descrito anteriormente se diseña para sincronizar los arribos de la señal en el límite del código Walsh, donde aquellas señales se originan con diferentes señales de acceso.

La figura 2 es una representación de un diagrama de bloques de un receptor 200 para recibir una pluralidad de transmisiones CDMA concurrentes sobre el enlace de retorno de una pluralidad correspondiente de terminales. El receptor de la figura 2 incluye una antena 202 acoplada a un convertidor reductor 204. El convertidor reductor toma una señal RF y reduce la frecuencia. Varias técnicas para conversión reducción son conocidas pero no son descritas aquí. La salida del convertidor reductor se acopla a un convertidor análogo digital (A/D) 206 que convierte una señal análoga a una señal correspondiente en el dominio digital. La salida del convertidor A/D 206 se acopla a cada una de una pluralidad de desensanchadores del espectro 208a, 208b, 208n. No existe

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límite particular al número de desensanchadores del espectro, aunque en algunas modalidades el número de desensanchadores del espectro es igual al número de señales moduladas de código (es decir CDMA) que una puerta de enlace puede recibir de los terminales de acceso en cualquier periodo o franja de tiempo particular. Una fuente código 210 también está acoplada a cada uno de los desensanchadores del espectro 208a, 208b, 208n. La fuente código 210 suministra los desensanchadores del espectro con el código necesario para desensanchar el espectro de las señales CDMA entrantes. La terminal de salida de cada desensanchador del espectro 208a, 208b, 208n se acopla respectivamente con una terminal de entrada y un desmodulador de datos 212a, 212b, 212n.

Esta arquitectura se utiliza aquí porque de acuerdo con la presente invención una pluralidad de terminales de acceso están transmitiendo señales OCDMA a la puerta de enlace en paralelo.

Con el fin de generar los comandos deseados o las señales de control discutidas posteriormente, el receptor 200 utiliza los desensanchadores del espectro 208a, 208b,

208n y los desmoduladores 212a, 212b, 212n o uno o más buscadores especializados 220 que suministren la función de desensanchamiento del espectro 222 junto con un motor de búsqueda 224 para detectar las varias señales piloto que no llevan datos que son recibidas de los terminales. La información proveniente del buscador 220 o los desmoduladores se reciben por un controlador o procesador receptor 230, de un bus o línea de entrada 226.

El procesador 230 utiliza la información para determinar ciertos parámetros operacionales de, o asociados con, las señales piloto de los terminales de usuario, tal como los desfases de tiempo o frecuencia. Esto generalmente se logra al detectar y comparar el tiempo o frecuencia con aquella de una señal de referencia. Aquí, la señal de referencia se muestra siendo suministrada por una fuente de referencia 232 que suministra una entrada al procesador. La fuente de referencia 232 podría ser configurada para generar la referencia en el momento en que se necesite, tal como utilizando osciladores altamente estables y precisos o circuitos de tiempo, o podría almacenar valores previamente generados por el procesador 230.

Además, el procesador 230 puede utilizar varios tipos de memoria 234 para almacenar la información acerca de que tipos de comandos son deseables para emitir dependiendo de los resultados de la comparación. Por ejemplo, si la comparación muestra que el tiempo es demasiado rápido o la frecuencia demasiado alta, el procesador puede simplemente enviar un comando o solicitud para retardar el parámetro en la terminal. Si, de otra parte, la frecuencia es demasiado baja o la temporización es demasiado lenta el procesador puede enviar un comando simple que le solicite a la terminal avanzar en valor. Sin embargo, el procesador también puede enviar instrucciones más complicadas, según se desee, en algunos sistemas en los cuales este especifique la cantidad de los desfases a ser compensados y una solicitud de ajuste, o un valor específico por medio del cual se deba hacer un ajuste. Tales comandos pueden ser enviados como señales separadas o apéndices a otras comunicaciones, tales como las señales de tráfico, instrucciones de acceso, o comando y control siendo enviadas a los terminales.

Se debe entender que los receptores típicos en las estaciones terrenas y las puertas de enlace son conocidos por tener uno o más controladores para detectar ciertas

características de las señales que son recibidas, para afectar los cambios de temporización para las señales de salida, ayudar con la temporización y control de la desmodulación, selección de código, y otros procesos dentro de la estación terrena. El procesador 230 puede formar parte de tales controladores o ser configurado como un procesador separado que está dedicado a las operaciones de las modalidades de la invención.

La figura 3 es una representación de un diagrama de bloques de un transmisor 300 en un terminal adaptado para enviar mensajes o datos en el enlace de retorno de un sistema de comunicaciones por satélite OCDMA. Como se estableció anteriormente, en los sistemas anteriores, los terminales de acceso recibían señales CDMA provenientes de la puerta de enlace pero utilizaban TDMA para comunicarse en o sobre un enlace de retorno. El transmisor mostrado en la figura 3 está adaptado no solamente a transmitir señales CDMA sino también a ajustar su tiempo de transmisión o fase de código, así como también típicamente su potencia, como se describe en detalle adelante. El transmisor incluye un modulador de datos 302 que modula la señal de la banda base y un modulador de código 304 que modula adicionalmente, de acuerdo con el

canal de código asignado a este terminal de acceso particular, la señal a ser transmitida. La salida del modulador de código 304 es convertida de manera ascendente por una serie de mezcladores 306a y 306b en el ejemplo de ilustración. Cualquier medio adecuado de conversión ascendente se puede utilizar. Un circuito transmisor final 308 determina transmitir potencia de acuerdo con las señales de control recibidas de una unidad de control de potencia 312. La unidad de control 312 está acoplada para recibir información de control proveniente de la unidad de almacenamiento de parámetro de control de potencia 314. El control de potencia de transmisor es una función de la instrucción de potencia de transmisión recibida por el terminal de acceso de la puerta de enlace y de la determinación propia de los terminales de acceso de los efectos de degradación del canal. El terminal estima los cambios de fortaleza de la señal sobre el FL, por ejemplo debido a desvanecimiento causado por lluvia, al medir la fortaleza de la señal sobre el FL. Siempre y cuando en fortaleza de la señal en el FL, la terminal estima el cambio de la fortaleza de la señal correspondiente sobre el RL, a hace el ajuste a la proporción de datos y/o la potencia de transmisión sobre el RL de la manera procedente. En una modalidad, el

terminal utilizará una tabla de calibración para determinar los cambios de fortaleza de la señal RL con base en la variación de la señal FL.

Con el fin de utilizar los comandos deseados y las señales de control discutidas adicionalmente adelante, el terminal 300 utiliza un modulador de código 304 y mezcladores 306 junto con, una fuente de código o un controlador 320, fuentes de frecuencia 324 y 326, e información de una porción receptora del terminal que es suministrado a un controlador o procesador de terminal 330, desde un bus o línea de ingreso.

El procesador 330 utiliza información de comando de control recibida por una porción receptora, que es bien conocida en la técnica, y similar a aquella mostrada en la estación terrena, para determinar que comandos o solicitudes de ajuste han sido enviadas a la terminal, y que acción es apropiada tomar para ajustar ciertos parámetros operacionales asociados con la generación de transmisión de señales desde las terminales. Por ejemplo, el procesador 330 determina si los desfases de tiempo o frecuencia están siendo compensados y en que cantidad. Los comandos pueden especificar una cantidad de ajuste o

simplemente que un ajuste predeterminado tenga lugar para retardar o avanzar los valores del parámetro. Adicionalmente, el procesador 330 puede utilizar varios tipos de memoria 334 para almacenar la información alrededor de que tipos de acciones son deseables para implementar dependiendo de la información de ajuste o los comandos que son recibidos. Por ejemplo, donde los comandos de ajuste fijos son enviados, el procesador 330 puede utilizar información previamente almacenada para seleccionar la cantidad por medio de la cual el parámetro es cambiado. La memoria puede indicar diferentes cantidades que pueden cambiar con el tiempo, u otras actividades dentro de la terminal, y así sucesivamente.

Si una solicitud de ajuste está basada en un tiempo que es demasiado rápido o una frecuencia demasiado alta, el procesador comanda la fuente del código 320, en línea 322 para retardar el tiempo de código, o una o mas de las fuentes de frecuencia 324, 326 en línea 328 para retardar o disminuir la frecuencia respectivamente. Si, de otra parte, la solicitud de ajuste está basada en un tiempo que es demasiado lento a una frecuencia demasiado baja el procesador 330 da instrucciones a la fuente de código 320 para avanzar el tiempo de código, o una mas fuentes de

frecuencia 324, 326 para avanzar o incrementar la frecuencia, respectivamente. Alternativamente, el procesador 330 puede utilizar uno o más elementos de retraso para ajustar el tiempo de código externo a la fuente de código, según se desee.

Debe entenderse que las terminales típicas son conocidas por tener uno o mas controladores para detectar ciertas características de las señales que son recibidas o transmitidas, para afectar los cambios de tiempo para las señales de salida, ayudar con el tiempo y el control de la modulación, la selección de código, y otros procesos dentro del terminal. El procesador 330 puede formar parte de tales controladores o ser configurado como un procesador separado que está dedicado a las operaciones de las modalidades de la invención.

También se nota que el retardo o avance del tiempo del código se discute o lustra en las patentes referidas anteriormente así como también en la patente US 6,327,534B1, otorgada en diciembre 4, 2001, que se incorpora aquí como referencia, y aquellos expertos en la técnica fácilmente entenderán como implementar este proceso en una variedad de formas.

La figura 4 es un diagrama de flujo de un proceso ilustrativo que muestra las operaciones de una puerta de enlace de acuerdo con la modalidad. Este proceso ilustrativo incluye recibir en la etapa 402 una puerta de enlace, un mensaje, aquí una señal piloto, proveniente de una terminal de usuario. Esta señal se puede utilizar para otras actividades o análisis tales como determinar las condiciones del canal entre la puerta de enlace y la terminal en la etapa 404, que no forman parte de la invención. La terminal puede utilizar cualquier medio adecuado para poner en contacto a la puerta de enlace para este mensaje inicial. El método incluye adicionalmente determinar en la etapa 406, en la puerta de enlace, un desfase de tiempo o un parámetro operacional que afecte en tiempo de la señal piloto recibida. Determinar este desfase, sea algo tal como la frecuencia o el tiempo, es un aspecto de establecer el OCDMA en el enlace de retorno. El método ilustrativo además incluye transmitir en la etapa 408, a la terminal, una instrucción de ajuste de tiempo de transmisión; junto con una instrucción de potencia de transmisión típica. Es aspectos adicionales, la puerta de enlace puede detectar un desfase de frecuencia en un parámetro operacional para

temporizar en una etapa 406, y luego transmitir una instrucción de ajuste de frecuencia en la etapa 408, también. El tiempo y la frecuencia de las instrucciones de ajuste le posibilitan a la terminal a avanzar o retardar el tiempo de transmisión y/o la frecuencia con el fin de mantener el grado deseado de sincronismo de código para el OCDMA en el enlace de retorno.

Se nota que el mecanismo de sincronización descrito anteriormente se diseña para sincronizar los arribos de señal en el límite de código Walsh, donde aquellas señales se originan con diferentes terminales de acceso.

En relación ahora a la figura 5, un método de operar un sistema de comunicaciones que incluye un satélite geosincrónico dispuesto en un enlace delantero y en un enlace inverso, para proporcionar comunicación CDMA ortogonal en el enlace inverso, se ilustra. Más particularmente, una primera señal piloto se transmite en la etapa 502 desde una estación terrena en la dirección del enlace delantero. Esto es, una señal se envía desde la puerta de enlace 116 al satélite 110, que en esta modalidad es una órbita geosincrónica, y esa señal es retransmitida a una porción de la superficie de la

tierra. La primera señal piloto recibida en la etapa 504 en una terminal de usuario (112), y el terminal recupera la fase de portador y el tiempo de reloj del chip de modulación desde la primer señal piloto.

La terminal entonces deriva una frecuencia de portador de transmisión y un tiempo de reloj de chip en la etapa 506 desde una frecuencia de portador piloto directa recuperada y un tiempo de reloj de chip de modulación. El terminal transmite entonces una segunda señal piloto en la dirección de enlace inverso en la etapa 508 al satélite geosincrónico (110) y el satélite retransmite la segunda señal piloto a la estación terrena (116). La segunda señal piloto se compara en la etapa 510 en la estación terrena a una señal de referencia de enlace inverso. La estación terrena transmite entonces en la etapa 512, en la dirección de enlace delantero (es decir, arriba hacia el satélite, y luego y entonces desde el satélite hacia abajo la terminal), una señal de control, donde el contenido de la señal de control está basado al menos en parte en la comparación entre la segunda señal piloto y la señal de referencia inverso. En respuesta a la señal de control al menos un parámetro operacional relacionado con las transmisiones de la terminal, se

ajusta en la etapa 514 dentro de la terminal. Típicamente, tal ajuste se relaciona con avanzar o retardar el tiempo de las señales transmitidas en la terminal con relación al tiempo derivado de la señal piloto de enlace delantero.

El tiempo puede avanzar o retardarse utilizando varias aproximaciones o técnicas preseleccionadas para determinar la cantidad de magnitud por medio del cual se hace un ajuste. En una modalidad, durante el diseño del sistema una cantidad predeterminada de ajuste o cambio en el tiempo o frecuencia se seleccionan y utilizan como base para responder a las señales de control. Tales valores pueden basar en datos empíricos conocidos tal como que tan rápido o efectivamente una terminal ajusta los parámetros, y de que tan grande es un cambio generalmente requerido para lograr un resultado dado. Este también se puede basar en características de diseño del terminal. Además, estos pueden ser factores de retraso para ejecutar las instrucciones que podían conducirlo a uno a querer hacer cambios más pequeños dentro de la terminal para evitar sobre impulsar un valor deseado. No existe deseo de hacer cambios muy grandes que den como resultado cambios adicionales que son

solicitados en una dirección opuesta, y así sucesivamente. Es deseable mover rápida pero eficientemente hacia una solución sin incurrir o ninguno sobre impulsos substanciales en los resultados que tomen mas tiempo de corregirse. Además, los cambios totales requeridos pueden ser mas pequeños como regla general dependiendo de las características del sistema de comunicación conocido, el tamaño de los haces, las características del terminal (la estabilidad de la frecuencia, el tiempo), y así sucesivamente. También puede ser más efectivo o deseable tener escogida una cantidad predeterminada con el fin de acortar el tiempo de información de señal de control o los comandos que serían transmitidos desde la estación terrena.

Sin embargo, en algunas configuraciones, puede ser más deseable tener la estación terrena con instrucción al terminal con una cantidad mas precisa de ajuste deseado para alcanzar potencialmente un resultado final deseado mas rápido, o si solamente un cambio pequeño rápido es necesario, por ejemplo. Además, es a menudo deseable desarrollar tanto de las actividades de almacenamiento computacional y de información o funciones dentro de la estación terrena en lugar de una terminal que sea más

constreñida en potencia y volumen para tener elementos de almacenamiento o memoria o controladores más complicados. Aquellos expertos en la técnica entenderán fácilmente las características de un sistema de comunicación dado que les permita dirigirse a esta escogencia.

No existe deseo de hacer cambios muy grandes que den como resultado cambios adicionales en la dirección opuesta a la que se necesita, y así sucesivamente. Es deseable moverse rápida pero eficientemente hacia una solución sin incurrir sobre impulsos grandes en los resultados. Además, los cambios totales requeridos pueden ser mas pequeños como regla general dependiendo de las características del sistema de comunicación conocido, tamaño de haces, características del terminal (estabilidad de frecuencia, tiempo), y así sucesivamente. Además, puede ser más efectivo tener en el terminal escogido una cantidad predeterminada para acortar el tiempo de información de señal de control o los comandos que serían necesarios.

Sin embargo, en algunas configuraciones, puede ser más deseable tener la estación terrena instruyendo al terminal con una cantidad mas precisa del ajuste deseado

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para alcanzar potencialmente un resultado final deseado más rápido, o si solamente se requiere un cambio más pequeño, por ejemplo. Aquellos expertos en la técnica entenderán fácilmente las características de un sistema de comunicaciones dado que les permita dirigirse a esta escogencia.

La velocidad del satélite geoestacionario típico con relación a la posición del terminal terrestre fijo ha sido estimado entre 0,3 m/s y 3 m/s, dependiendo de los parámetros de diseño de control específicos para varios satélites geoestacionarios (conocidos). A los 3 m/s, el efecto Doppler es aproximadamente 10^{-8} , siendo la frecuencia Doppler aproximadamente de 300 Hz y el Código Doppler, estos es la proporción de retraso, siendo aproximadamente 10 ns/s. si el ancho del haz del receptor de enlace ascendente de retorno satelital es aproximadamente $0,5^\circ$ entonces la peor diferencia del caso en proporción de tiempo entre un terminal en el centro del haz y cualquier otro terminal servido por el mismo haz es del orden de 10 ns/s veces $\text{seno}(0,25^\circ) = 0,044$ ns/s.

Para una proporción de chip de código de ejemplo de alrededor de 3 Mcps, el periodo o intervalo de tiempo para un chip igual a 333 ns, y un periodo de fracción representativo tal como $1/8$ de proporción de chip representa un periodo de aproximadamente 42 ns. En esta situación, el peor caso llevado en retraso residual entre dos terminales en el mismo haz es $1/8$ de chip en $42/0,44=954$ segundos, o aproximadamente 16 minutos. Sin embargo, otros periodos de fracción se pueden utilizar como un valor objetivo o podían ocurrir en un sistema de comunicación dependiendo de las configuraciones de haces conocidos específicos, localizaciones de terminales, y características de enlace de comunicación.

En vista de lo precedente, se puede ver que con solo una corrección cada pocos minutos, el tiempo de transmisión de una terminal puede ser controlada dentro de $1/8$ de un periodo de chip, que es suficiente para soportar los modos CDMA ortogonales de transmisión.

Entre este proceso de ajuste de tiempo de transmisión y mantener un ancho de haz de enlace ascendente muy estrecho (por ejemplo, 0,5 grados o menos) se logra sincronismo de código, posibilitando de esta manera el

uso de los códigos de modulación necesarios para el CDMA ortogonal en la dirección de retorno.

Esto es deseable como se discutió anteriormente porque un mayor eficiencia de ancho de banda se puede obtener con el uso del CDMA ortogonal comparado con el TDMA. Con respecto al enlace de retorno OCDMA, los usuarios L se les asigna a cada uno un código Walsh ortogonal único. Cada usuario envía un símbolo de modulación de datos durante cada periodo de código Walsh o intervalo de tiempo. En otras palabras, cada terminal de acceso repite un símbolo de modulación de datos L veces durante el periodo de su código Walsh que da como resultado una ganancia de procesamiento de L . Denotemos $(E_b/N_t)_{TDMA}$ como la energía por bit medidas en un sistema basado en TDMA para un código dado y un esquema de modulación. Entonces, si cada terminal de acceso en el sistema OCDMA transmite a su máxima potencia disponible, el E_b/N_t recibido sobre el canal OCDMA para una terminal de acceso en el enlace de retorno, denotada por $(E_b/N_t)_{OCDMA}$, es dado por:

$$(E_b/N_t)_{OCDMA} = L (E_b/N_t)_{TDMA}$$

En otras palabras, para la misma potencia de transmisión en el terminal de acceso, el E_b/N_t lograble es L veces mayor en el canal OCDMA que en el canal TDMA debido a la ganancia de procesamiento del OCDMA. Por lo tanto, uno puede utilizar un mayor orden de modulación en el caso del OCDMA y lograr mayor eficiencia de ancho de banda que en la aproximación TDMA. Nótese que en el OCDMA cada terminal de acceso efectivamente tiene un L avo del ancho de banda que un terminal de acceso tiene en el sistema TDMA. Esto es, la proporción de datos en un canal OCDMA es, para la misma escogencia de modulación/codificación, L veces inferior que en el canal TDMA. Sin embargo, puede verse que desde que, para la misma potencia de transmisión o mayor esquema de modulación/codificación de orden superior se puede utilizar un terminal de acceso OCDMA, la eficiencia del ancho de banda del OCDMA es mayor.

Varias modalidades de la presente invención requieren fuentes computacionales para llevar a cabo la funcionalidad descrita anteriormente. La figura 6 ilustra una modalidad de un sistema de equipo pretendida para representar una categoría amplia de sistemas de computador tal como los computadores personales, las

estaciones de trabajo, y/o los sistemas embebidos. En la modalidad ilustrada, el sistema de equipo incluye el procesador 610 acoplado a un bus de alta velocidad 605, que está acoplado a un bus de entrada/salida (I/O) 615 a través de un puente de bus 630. La memoria temporal 620 está acoplada al bus 605. La memoria permanente 640 está acoplada al bus 615. El o los dispositivos I/O 650 están también acoplados al bus 615. El o los dispositivos I/O 650 pueden incluir un dispositivo de pantalla, un teclado, una o más interfases de red externa, etcétera.

Ciertas modalidades pueden incluir componentes adicionales, pueden no requerir todos los componentes anteriores, o pueden combinar uno o más componentes. Por ejemplo, la memoria temporal 620 puede estar en el chip con el procesador 610. Alternativamente, la memoria permanente 640 se puede eliminar y la memoria temporal 620 se puede remplazar con una memoria de solo lectura programable eléctricamente borrable (EEPROM), en donde las rutinas del software son ejecutados en lugar del EEPROM. Algunas implementaciones pueden emplear un bus simple, al cual todos los componentes están acoplados, o uno o más buses adicionales y puentes de bus a los cuales puedan estar acoplados componentes adicionales. Aquellos expertos en la técnica estarán familiarizados con una

variedad de redes internas alternativas que incluyen, por ejemplo, una red interna basada en un sistema de alta velocidad con un concentrador de controlador de memoria y un concentrador de controlador I/O. los componentes adicionales pueden incluir procesadores adicionales, una unidad CD ROM, memorias adicionales, y otros componentes periféricos conocidos en la técnica.

En una modalidad, la presente invención, como se describió anteriormente, está implementada utilizando uno o más sistemas de equipo tales como los sistemas de equipo de la figura 6. donde mas de un componente es utilizado, los sistemas se pueden acoplar para comunicarse sobre una red externa, tal como una red de área local (LAN), una red de protocolo de Internet (IP), etcétera. En una modalidad, la presente invención se implementa como rutinas de software ejecutadas por una o más unidades de ejecución dentro del o los computadores. Para un computador dado, las rutinas del software se pueden almacenar en un dispositivo de almacenamiento, tal como la memoria permanente 640.

Alternativamente, como se muestra en la figura 7, las rutinas de software pueden ser instrucciones ejecutables

por máquina 710 almacenadas utilizando cualquier medio de razonamiento leible por máquinas 720, tal como un disquete, un CD ROM, una cinta magnética, un disco de video digital o versátil (DVD), un disco láser, un ROM, una memoria Flash, etc. Las series de instrucciones no necesitan ser almacenadas localmente, y se pueden recibir de un dispositivo de almacenamiento remoto, tal como un servidor sobre una red, un dispositivo CD ROM, un floppy disk, etc., a través, por ejemplo, de un o unos dispositivos I/O 650 de la figura 6.

De cualquier fuente, las instrucciones pueden ser copiadas del dispositivo de almacenamiento en memorias temporales 620 y luego accedidas y ejecutadas por el procesador 610. En una implementación, estas rutinas de software son escritas en un lenguaje de programación C. también se apreciara, sin embargo, que estas rutinas se pueden implementar en cualquiera de una amplia variedad de lenguajes de programación.

En modalidades alternativas, se pueden utilizar equipos o "firmware" discretos. Por ejemplo, uno o más circuitos integrados específicos de aplicación (ASICs) podrían ser programados con una o mas de las funciones anteriormente

descritas de la presente invención. En otro ejemplo, una o mas funciones de la presente invención se podrían implementar en uno o mas ASICs en tarjetas de circuito adicionales y las tarjetas de circuito podrían ser insertadas en o los computadores descritos anteriormente. En otro ejemplo, las disposiciones de puerta programable de campo (FPGAs) o arreglos de puerta programable estática (SPGA) podrían ser utilizados para implementar una o más funciones de la presente invención. En aun otro ejemplo, una combinación de equipo y software se podía utilizar para implementar una o más funciones de la presente invención.

Conclusión

Los métodos y aparatos de acuerdo con las modalidades de la invención utilizan CDMA ortogonal en enlaces de retorno de los sistemas de comunicación satelital para suministrar ventajosamente mayores márgenes de potencia de transmisión para compensar los efectos de degradación del canal, tal como el desvanecimiento por lluvia.

Se debe entender que la presente invención no esta limitada a las modalidades descritas anteriormente, sino

que comprende cualquiera y todas las modalidades dentro del alcance de las reivindicaciones subunidas.

Lo que nosotros reivindicamos como nuestra invención es:

REIVINDICACIONES

1. Un método para suministrar comunicación CDMA ortogonal en un enlace de retorno, que comprende:

Recibir una primera señal piloto en una pluralidad de terminales;

Derivar al menos una característica de tiempo de transmisión de la primer señal piloto recibida, en donde derivar se desarrolla dentro de cada uno de la pluralidad de terminales;

Transmitir, en un tiempo asignado, una señal piloto desde cada una de una pluralidad de terminales de acuerdo con la al menos una característica de tiempo de transmisión derivada;

Recibir una señal de control, el contenido de la señal de control que suministra instrucciones para ajustar la al menos una característica de tiempo de transmisión; y

Ajustar, en respuesta a la señal de control, la al menos una característica de tiempo de transmisión.



2. El método de la reivindicación 1, que comprende además suministrar un ancho de haz de receptor de enlace ascendente inverso de aproximadamente $0,5^\circ$.
3. Un método para operar un sistema de comunicaciones que tiene un enlace delantero y un enlace inverso, para suministrar comunicación CDMA ortogonal en el enlace inverso, que comprende:

Transmitir una primer señal piloto desde una estación terrena en la dirección del enlace delantero;

Recibir la primera señal piloto en un terminal, y recuperar la fase de portador y el tiempo del reloj del chip de modulación allí;

Transmitir una segunda señal piloto desde el terminal en la dirección de enlace inverso;

Comparar, en la estación terrestre, la segunda señal piloto a una señal de referencia de enlace inverso;

Transmitir, en la dirección de enlace delantero, una señal de control, el contenido de la señal

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de control basado al menos en parte en la comparación entre la segunda señal piloto y la señal de referencia de enlace inverso; y
Ajustar, en respuesta a la señal de control, al menos un parámetro operacional del terminal.

4. El método de la reivindicación 3, que comprende además transferir las señales a través de un satélite geosincrónico dispuesto en dicho enlace delantero y enlace inverso.
5. El método de la reivindicación 3, que comprende además transmitir señales de tráfico CDMA ortogonal desde la terminal.
6. El método de la reivindicación 3, en donde el al menos un parámetro operacional del terminal comprende transmitir tiempo; y el ajuste se desarrolla para mantener el tiempo de transmisión del terminal dentro de una parte de fracción preseleccionada de un periodo de chip.

7. El método de la reivindicación 6, en donde la parte fraccional preseleccionada es un octavo del periodo de chip, o menos.
8. El método de la reivindicación 6, que comprende además suministrar un ancho de haz de receptor de enlace ascendente inverso de aproximadamente $0,5^\circ$.
9. El método de la reivindicación 3, en donde la señal de control se dirige a la terminal para avanzar su tiempo de transmisión.
10. El método de la reivindicación 9, en donde el tiempo de transmisión se avanza una cantidad predeterminada.
11. El método de la reivindicación 9, en donde en respuesta a la señal de control, el tiempo de transmisión del terminal se ajusta por medio de una cantidad específica por la señal de control.



12.El método de la reivindicación 3, en donde la señal de control se dirige a la terminal para retardar su tiempo de transmisión.

13.El método de la reivindicación 12, en donde el tiempo de transmisión se retarda una cantidad predeterminada.

14.El método de la reivindicación 12, en donde en respuesta a la señal de control, el tiempo de transmisión del terminal se ajusta una cantidad especificada por la señal de control.

15.El método de la reivindicación 3, en donde la señal de control se dirige a la terminal para ajustar su frecuencia de transmisión.

16.Una terminal, que comprende:

Medios para recibir una primer señal piloto;

Medios para recibir fase de portador y tiempo de reloj del chip de modulación de la primer señal piloto;

Medios para transmitir una segunda señal pilotos desde el terminal;

Medios para recibir una señal de control;

Medios para transmitir una señal de tráfico CDMA ortogonal, la señal de tráfico CDMA ortogonal tiene una primer característica de tiempo, y

Medios para ajustar la primer característica de tiempo en respuesta a dicha señal de control.

17. La terminal de la reivindicación 16, en donde los medios para transmitir una señal de tráfico CDMA ortogonal comprende un satélite geoestacionario.

18. La terminal de la reivindicación 16, en donde en al menos un parámetro operacional del terminal comprende tiempo de transmisión; y dichos medios para ajustar mantienen el tiempo de transmisión de la terminal dentro de una parte de fracción preseleccionada del periodo del chip.

19. La terminal de la reivindicación 18, en donde la parte de fracción preseleccionada es un octavo del periodo de chip, o menos.

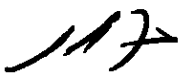
20. El terminal de la reivindicación 16, que comprende además medios para suministrar un ancho de haz de receptor de enlace ascendente inverso de aproximadamente $0,5^{\circ}$.

21. El terminal de la reivindicación 16, en donde los medios para ajustar la primera característica de tiempo comprende circuitos para avanzar una característica de tiempo de transmisión de la señal de tráfico CDMA ortogonal-

22. La terminal de la reivindicación 16, en donde los medios para ajustar dirigen la terminal para avanzar su tiempo de transmisión.

23. El terminal de la reivindicación 22, en donde el tiempo de transmisión se avanza una cantidad predeterminada.

24. La terminal de la reivindicación 22, en donde los medios para ajustar la primera característica de tiempo comprenden circuitos para avanzar una característica de tiempo de transmisión de la



señal de tráfico CDMA ortogonal por medio de una cantidad especificada por la señal de control.

25. La terminal de la reivindicación 16, en donde los medios para ajustar la primer característica de tiempo comprenden circuitos para retardar una característica de tiempo de transmisión de la señal de tráfico CDMA ortogonal por medio de una cantidad especificada por la señal de control.

26. La terminal de la reivindicación 25, en donde los medios para ajustar la primer característica de tiempo comprenden circuitos para retardar una característica de tiempo de transmisión de la señal de tráfico CDMA ortogonal una cantidad predeterminada.

27. La terminal de la reivindicación 25, en donde los medios para ajustar la primer característica de tiempo comprenden circuitos para retardar una característica de tiempo de transmisión de la señal de tráfico CDMA ortogonal una cantidad especificada por la señal de control.

28. La terminal de la reivindicación 25, en donde el circuito para retardar las características de tiempo de transmisión de la señal de tráfico CDMA ortogonal comprenden una salida de reloj conectada a un modulador de código, y una entrada de control conectada a un receptor de señal.

29. Una estación terrena que opera en un sistema de comunicaciones que tiene un enlace delantero y un enlace inverso, para suministrar comunicación CDMA ortogonal entre enlace inverso, que comprende:

Medios para transmitir una primer señal piloto en la dirección de enlace delantero;

Medios para recibir una segunda señal piloto de la al menos una terminal en la dirección de enlace inverso, y para recuperar fase de portador y tiempo de reloj del chip de modulación allí;

Medios para recibir una señal de control;

Medios para comparar la segunda señal piloto a una señal de referencia de enlace inverso;

Medios para transmitir, en la dirección de enlace delantero, una señal de control para monitorear al menos un parámetro operacional del terminal, el contenido estando basado al menos en parte en la comparación entre la segunda señal piloto y la señal de referencia de enlace inverso.

30. Un dispositivo de terminal que comprende:

Un procesador;

Una memoria de información CDMA de control de características de tiempo de transmisión de señal acopladas al procesador; y

Un medio accesible a máquina, acoplado al procesador, que tiene instrucciones codificadas aquí, las instrucciones, cuando se ejecutan por el procesador, originan que el dispositivo de terminal:

Reciba una primer señal piloto;

Recupere fase de portador y tiempo de reloj de chip de modulación desde la primer señal piloto;

Transmitir una segunda señal piloto;

Recibir una señal de control;

Transmitir una señal de tráfico CDMA ortogonal
que tenga una primer característica de tiempo;
y

Ajustar la primer característica de tiempo de
respuesta a dicha señal de control.

31. El dispositivo terminal de la reivindicación 30,
en donde las instrucciones, cuando se ejecutan
por el procesador adicionalmente originan que el
dispositivo terminal suministre un receptor de
enlace ascendente y un ancho de haz receptor de
enlace ascendente inverso de aproximadamente
0,5°.

32. El dispositivo terminal de la reivindicación 30,
en donde la instrucción, cuando se ejecuta por el
procesador origina adicionalmente que el
dispositivo terminal avance una característica de
tiempo de transmisión de la señal de tráfico CDMA
ortogonal.

33. El dispositivo terminal de la reivindicación 30,
en donde las instrucciones, cuando se ejecutan

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por el procesador originan adicionalmente que el dispositivo terminal retarde una característica de tiempo de transmisión de la señal de tráfico CDMA ortogonal.

34. El dispositivo terminal de la reivindicación 30, en donde la memoria es parte del dispositivo terminal.

35. El dispositivo terminal de la reivindicación 30, en donde las instrucciones, cuando se ejecutan por el procesador originan adicionalmente que el dispositivo terminal se ajuste a una frecuencia de transmisión del tráfico CDMA ortogonal en una cantidad específica por la señal de control.

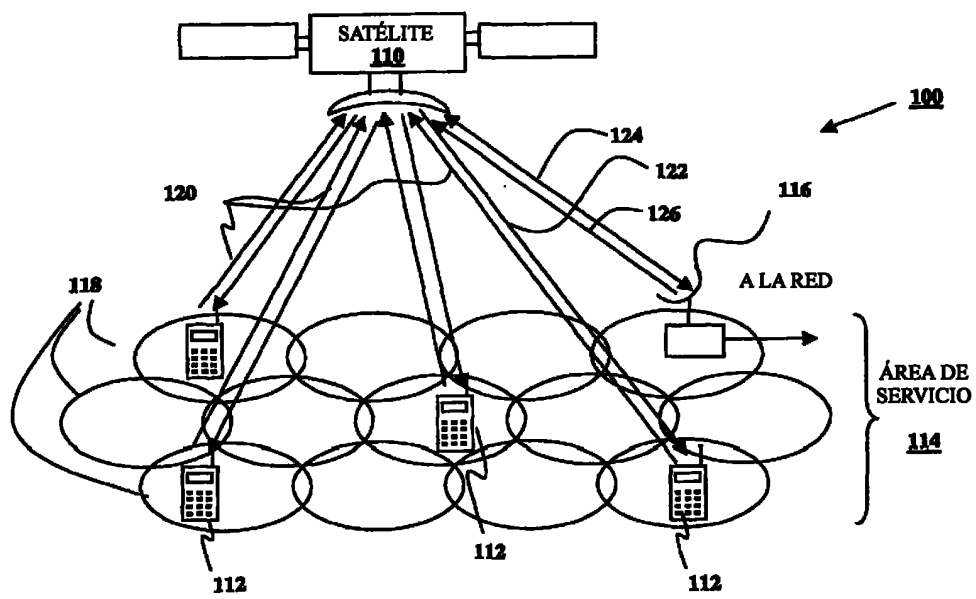


FIG. 1

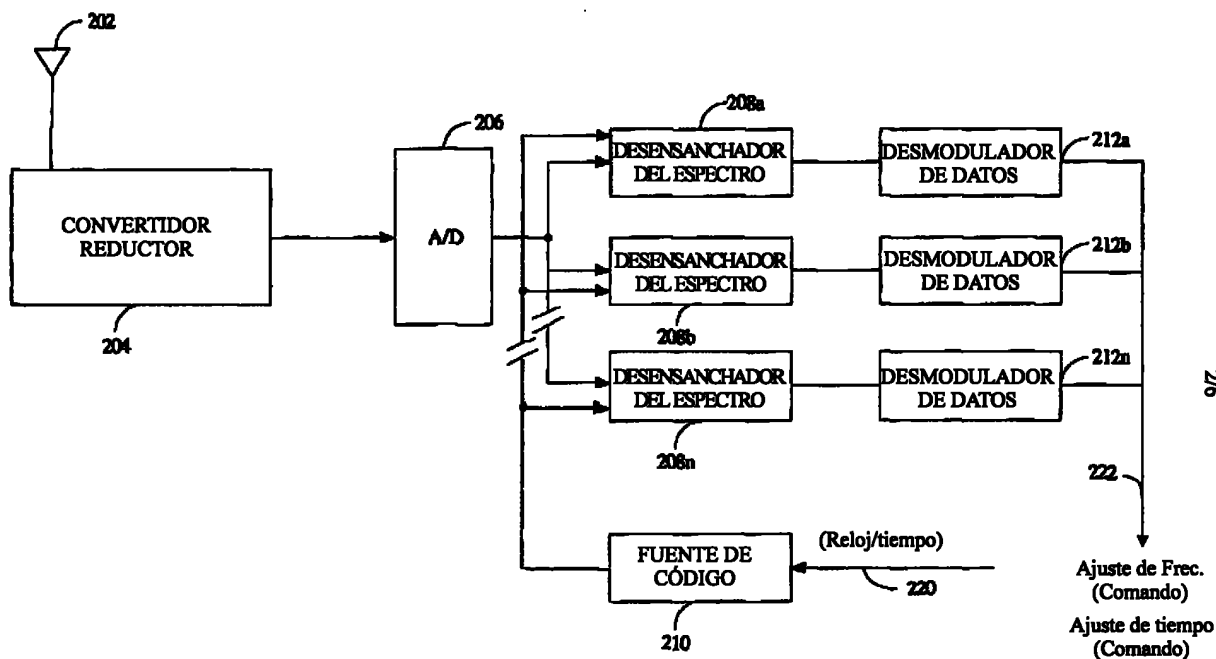


FIG. 2

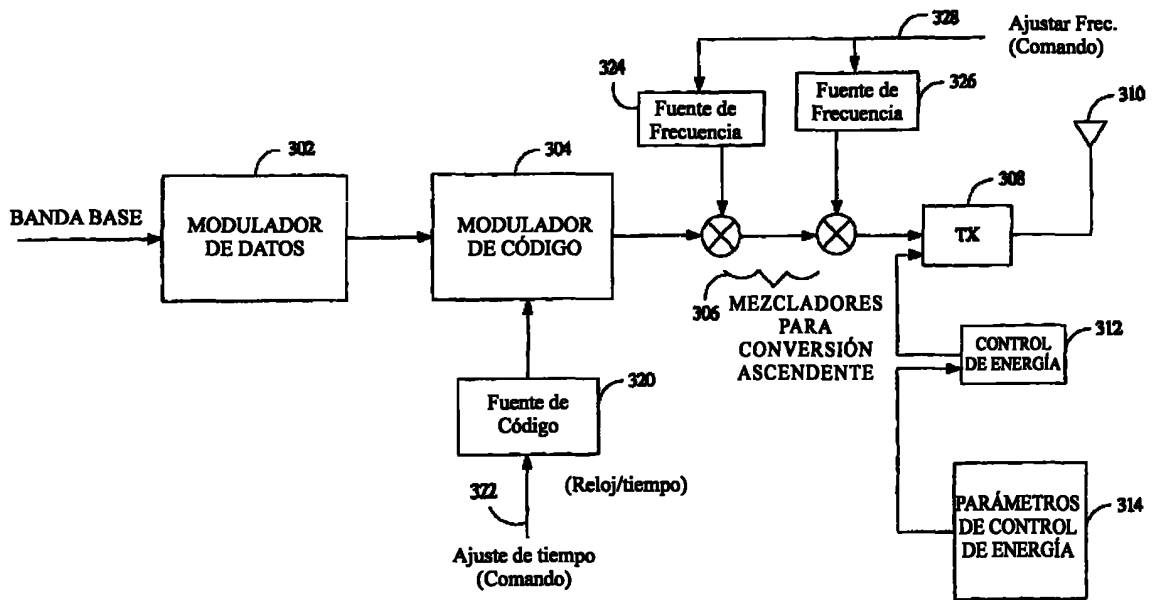


FIG. 3

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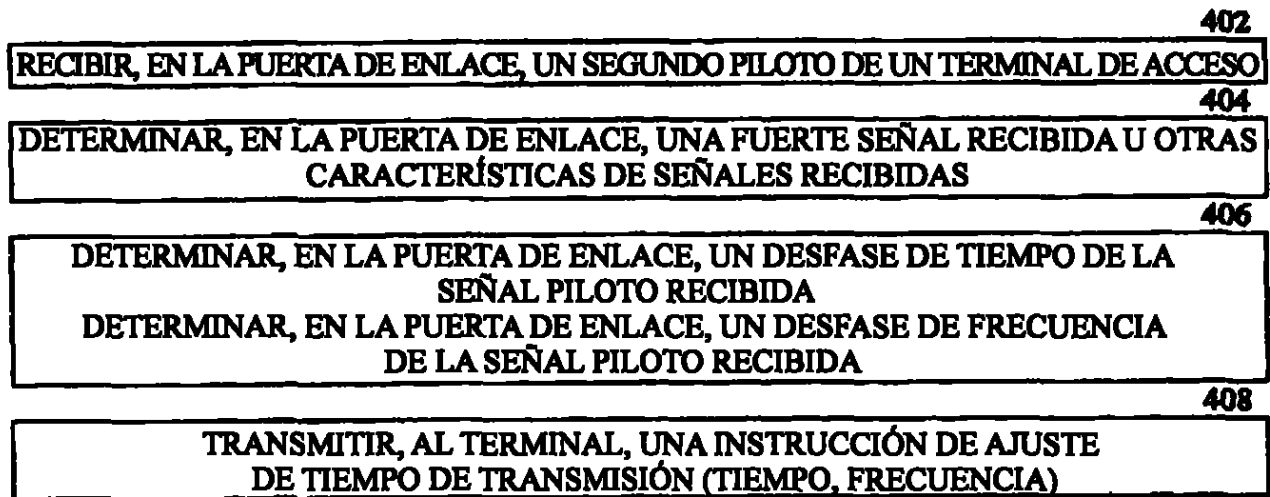


FIG. 4



FIG. 5

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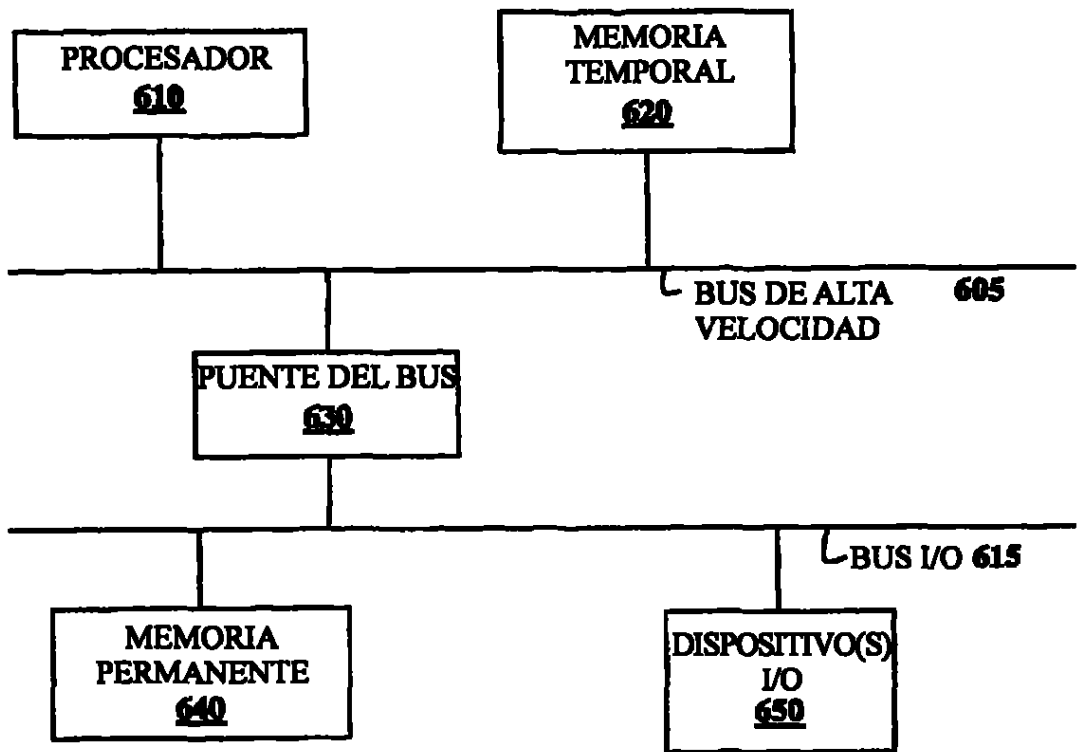


FIG. 6

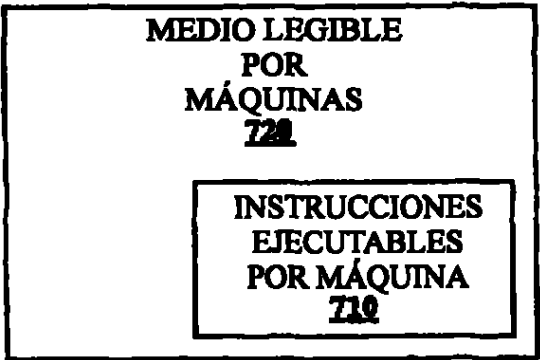


FIG. 7



FORMATO DE DIGITALIZACION
RELACION DE ANEXOS



Royal
Technologies S.A.
Calle 101 No. 101, P.O. Box 101

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Expediente No		No de Folio
Item	No de unidades	
1	CD	
2	DVD	
3	REVISTA	
4	LIBRO	
5	PERIODICO	
6	DISQUETES	
7	SOBRE DE MANILA	
8	SOBRE BLANCO TAMAÑO CARTA	
9	SOBRE BLANCO TAMAÑO OFICIO	
10	OTROS:	

Observaciones: Acta Final

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SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO

MIT : 800174089-2

SUPERINDUSTRIA Y COMERCIO

Radicacion : 05002611 00000000 Folios: 129
Fecha (AMD): 2005-01-14 16:32:59
Tramite : 011 PCT-PATENT 379 FASE NACI 411 PRESENTAC
Dependencia: 2020 DIVISION DE NUEVAS CREACIONES

RECIBO OFICIAL DE CAJA : 05 - 107
FECHA : ENERO 3 DE 2005

***** CONSIGNACION *****

DEPOSITANTE	TIPO PAGO	BANCO	CUENTA	No. PAGO	FECHA PGO	Vr. PAGO
CAVELIER ABOGADOS	CONSIGNACION	BANCO POPULAR	050-00110-6	32758703	03/01/2005	43,625,400.00

***** CONCEPTO *****

CANT.	RENTISTICO	CONCEPTO	TOTAL CONCEPTO
1	50003-01-01	SOLICITUDES	
		1 TRAMITES DE SOL. DE PATENTE DE IN	443,000.
		TOTAL :	443,000.

SOM: CUATROCIENTOS CUARENTA Y TRES MIL PESOS

RESPONSABLE : _____

RECIBO DE CAJA APLICADO AL EXPEDIENTE No. _____

Colo 14439-841-003-1

SUPERINDUSTRIA Y COMERCIO
Radicación : ES002611 00000000 Folios 129
Fecha (MM): 2005-01-14 16:52:59
Trámite : 011 PCT-PATENT 379 FASE INCI 411 PRESENTAC
Dependencia 2000 DIVISION DE NUEVAS CREACIONES

REQUISITOS NECESARIOS PARA PRESENTACION Y AGILIZACION DEL

	COMPLETA	INCOMPLETA
PATENTE DE INVENCION	()	()
Indicacion de que se solicita la concesion de una patente	()	()
Datos de Identificacion del solicitante o de la persona que presenta la solicitud	()	()
Descripcion de la invencion	()	()
Dibujos de ser estos pertinentes	()	()
Comprobante de Pago de las tasas establecidas	()	()
COMPLETA	()	INCOMPLETA ()
DISEÑO INDUSTRIAL ()		
- Indicacion de que se solicita el registro de Diseño Industrial	()	()
- Datos de identificación del solicitante o de la persona que presenta la solicitud	()	()
- Representación gráfica o fotográfica del Diseño Industrial completa del Material que incorpora el diseño.	()	()
- Comprobante de pago de las tasas establecidas	()	()
COMPLETA ()		INCOMPLETA ()
ESQUEMA DE TRAZADO ()		
- Indicacion de que solicita el registro de un Esquema de Trazado	()	()
- Datos de identificación del solicitante o de la persona que presenta la solicitud	()	()
- Representación gráfica del esquema de trazado	()	()
- Comprobante de pago de las tasas establecidas	()	()
COMPLETA ()		INCOMPLETA ()

Firma Responsable

Fecha

Extra de Publicación
Folios 131 al 133

134
131



Industria y Comercio
SUPERINTENDENCIA

2020
Bogotá, D.C.,

Doctor:
EMILIO FERRERO
Apoderado
QUALCOMM INCORPORATED

Oficio N°
001 12161

ASUNTO:	Radicación N°	05-2611
	Solicitud internacional	PCT/US2003/020063
	Fecha inicio fase nacional	24/01/2005
	Trámite	011
	Evento	379
	Actuación	430
	Folios	001

Como resultado del examen de forma, realizado con fundamento en el artículo 38 de la Decisión 486 de la Comisión de la Comunidad Andina, artículo 27 del Tratado de Cooperación en Materia de Patentes (PCT), regla 51 bis del Reglamento y Circular Única de la Superintendencia de Industria y Comercio, se le comunica que:

- La solicitud no contiene la copia del documento en que consta la cesión del derecho a la patente del inventor al solicitante o a su causante. (Art. 26-k) Decisión 486).

En cumplimiento de lo dispuesto por el artículo 39 de la Decisión 486, se le requiere para que dentro del término de dos meses siguientes a la fecha de notificación del presente oficio, complete los requisitos anteriormente enunciados. En caso de no dar cumplimiento al presente requerimiento, la solicitud se considerará abandonada y perderá su prelación.

Notifíquese el presente oficio conforme a lo dispuesto en el numeral 5.2, literal e), del capítulo quinto del título primero de la Circular Única N° 10 de 2001.

ALIX CARMENZA CESPEDES DE VERGEL
Jefe de la División de Nuevas Creaciones.

El anterior requerimiento fue notificado por fijación en lista de fecha, 18 FEB. 2005.

202030

Carrera 13 No. 27-00 Piso 5 y 10
Commutador: 334 12 21-2-3-4
Fax: 281 31 25 e-mail: info@sic.gov.co
Santa Fe de Bogotá D.C. - Colombia

18-02-05