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Application Number: 14510766 Document Date: 10/09/2014

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- Drawing

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Form Revision Date: August 26, 2013

PATENT
Attorney Docket No.: HAVA-00402

HAVERSTOCK & OWENS LLP
162 North Wolfe Road
Sunnyvale, CA 94086
(408) 530-9700
Customer No.: 28960

MAIL STOP PATENT APPLICATION
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Anticipated Classification of this Application:
Class: _____ Subclass: _____
Prior Application: 13/240,776
Examiner: Allahyar Kasraian
Art Unit: 2642

TRANSMITTAL OF FILING UNDER 37 C.F.R. § 1.53(b)

Sir:

This is a request for filing a Continuation application under 37 C.F.R. § 1.53(b), of pending prior application Serial No. 13/240,776 filed on September 22, 2011 of *Vasudevan Ganesan* for **MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLING**

CERTIFICATE OF ELECTRONIC TRANSMISSION

I hereby certify that this New Application and the documents referred to are attached are being electronically transmitted to the **United States Patent and Trademark office, Alexandria, Virginia** via EFS-Web on October 9, 2014

Jonathan O. Owens
(Name of Person E-Filing)

/Jonathan O. Owens/
Signature

1. Copy of Prior Application as Filed Which is Attached

I hereby verify that the attached papers are a true copy of what is shown in my records to be the above identified prior application, including the oath or declaration originally filed. The copy of the papers of prior application as filed which are attached are as follows: 21 page(s) of specification; 8 page(s) of claims; 1 page(s) of abstract; and 2 page(s) of drawings. The original of declaration, combined with power of attorney1 page(s), and the original Assignment 2 page(s), as filed September 22, 2011 in U.S. Patent Application Serial No. 13/240,776.

2. Amendments

X Cancel in this application original claims 19-37 of the prior application before calculating the filing fee.

X A preliminary amendment is enclosed, including changes to the specification, claims, and remarks.

3. Fee Calculation (37 C.F.R. § 1.16)

FEE CALCULATION				
			Basic Fee	280.00
			Search Fee	600.00
			Examination fee	720.00
			Total	$1,600.00
Application Siz Fee	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $270.00 ($135 for small entity) for each additional 50 sheets or fraction thereof.		Fee = $270.00	
Claims	Number Filed	Number Extra	Rate	0.00
Total Claims	19 - 20 =	0	$80.00	0.00
Independent Claims	3 - 3 =	0	$420.00	0.00
Multiple Dependent claim(s), if any			$780.00	
			Filing Fee Calculation	$1,600.00

4. X Applicant is entitled to small entity status 50% reduction

TOTAL FEES $800.00

5. Drawings

2 Sheets of drawings are enclosed.

X Formal.

6. Relate Back-35 U.S.C. § 120

X The specification has been amended by inserting before the first line the sentence:

– This Patent Application is a continuation application of co-pending U.S. Patent Application No. 13/240,776, filed on September 22, 2011, and entitled "MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLER," which is a divisional application of co-pending U.S. Patent Application No. 11/330,675, filed on January 11, 2006, and entitled "MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLER," which claims priority of U.S. provisional application, serial number 60/643,829, filed January 14, 2005, and entitled "TELEPHONE COMMUNICATIONS PROCESSING CONTROLLER," by the same inventors and is a continuation-in-part of U.S. Patent Application, serial number 11/031,498, filed January 6, 2005, and entitled "TELEPHONE WITH AUTOMATIC SWITCHING BETWEEN CELLULAR AND VOIP NETWORKS", all of which are ~~is~~ hereby incorporated by reference. U.S. Patent Application, serial no. 11/031,498 claims priority of U.S. provisional application, serial number 60/534,466, filed January 6, 2004, and entitled "RADIOTELEPHONE WITH AUTOMATIC SWITCHING BETWEEN CELLULAR AND WI-FI NETWORKS USING WI-FI SIGNAL STRENGTH VALUES," the content of which is also incorporated herein by reference in its entirety. –

7. Inventorship Statement

(a) With respect to the prior co-pending U.S. application from which this application claims benefit under 35 U.S.C. § 120 the inventor(s) in this application is (are):

X the same.

(b) The inventorship for all the claims in this application is:

X the same.

8. Fee Payment Being Made At This Time

X By e-Filer via RAM

9. Method of Payment of Fees

X E-Filer via RAM charge Credit Card the amount of $ 800.00

10. Authorization To Charge Additional Fees

X The Commissioner is hereby authorized to charge any fees or credit any overpayment during the pendency of this application to Account No. 08-1275.

11. Power of Attorney

X The power of attorney in the prior application is to: Jonathan O. Owens HAVERSTOCK & OWENS LLP, 162 North Wolfe Road, Sunnyvale, CA 94086.

a. X The power appears in the original papers as filed on September 22, 2011. A copy is attached.

b. X Address all future communications to: HAVERSTOCK & OWENS LLP
ATTN: Jonathan O. Owens
162 North Wolfe Road
Sunnyvale CA, 94086

IPR2025-00447 Page 00003

12. Maintenance of Codependency of Prior Application

X This application is a continuation of co-pending Serial No. 13/240,776 filed on September 22, 2011.

13. X Incorporation by Reference
The entire disclosure of the prior application(s), from which a copy of the oath of declaration is supplied under Box 1, is considered to be part of the disclosure of the accompanying application and is hereby incorporated by reference.

I hereby declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Dated: October 9, 2014

By: /Jonathan O. Owens/
Name: Jonathan O. Owens
Registration No.: 37,902

PTO/AIA/14 (12-13)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	HAVA-00402
	Application Number	
Title of Invention	MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLER	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2

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

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Vasudevan		Ganesan	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Cupertino	State/Province	CA	Country of Residence i	US

Mailing Address of Inventor:

Address 1	19500 Pruneridge Ave., #6208		
Address 2			
City	Cupertino	State/Province	CA
Postal Code	95014	Country i	US

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	28960		
Email Address	jowens@holp.com	Add Email	Remove Email

Application Information:

Title of the Invention	MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLER		
Attorney Docket Number	HAVA-00402	Small Entity Status Claimed	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	2	Suggested Figure for Publication (if any)	

Filing By Reference :

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	HAVA-00402
	Application Number	
Title of Invention	MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLER	

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	28960		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the application number blank.

Prior Application Status			Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	Continuation of	13240776	2011-09-22
Prior Application Status			Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
13240776	Division of	11330675	2006-01-06
Prior Application Status			Remove

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	HAVA-00402
	Application Number	
Title of Invention	MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLER	

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
11330675	Claims benefit of provisional	60643829	2005-01-14
Prior Application Status			Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
11330675	Continuation in part of	11031498	2005-01-06
Prior Application Status			Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
11031498	Claims benefit of provisional	60534466	2004-01-06

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(d). When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX) [i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(h)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country [i]	Filing Date (YYYY-MM-DD)	Access Code [i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. Add

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

PTO/AIA/14 (12-13)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	HAVA-00402
	Application Number	
Title of Invention	MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLER	

Authorization to Permit Access:

☐ Authorization to Permit Access to the Instant Application by the Participating Offices

If checked, the undersigned hereby grants the USPTO authority to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the instant patent application is filed access to the instant patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the instant patent application is filed to have access to the instant patent application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the instant patent application with respect to: 1) the instant patent application-as-filed; 2) any foreign application to which the instant patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the instant patent application; and 3) any U.S. application-as-filed from which benefit is sought in the instant patent application.

In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date of filing this Authorization.

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1 Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

◉ Assignee	○ Legal Representative under 35 U.S.C. 117	○ Joint Inventor
○ Person to whom the inventor is obligated to assign.	○ Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor :	
If the Applicant is an Organization check here. ☒	
Organization Name	Vasu Networks Corporation

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	HAVA-00402
	Application Number	
Title of Invention	MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLER	

Mailing Address Information:			
Address 1	19500 Pruneridge Ave., #6208		
Address 2			
City	Cupertino	**State/Province**	CA
Country i	US	Postal Code	95014
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not subsitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication . An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

Remove

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. Add

PTO/AIA/14 (12-13)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	HAVA-00402
	Application Number	
Title of Invention	MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLER	

Signature:

Remove

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications					
Signature	/Jonathan O. Owens/			Date (YYYY-MM-DD)	2014-10-09
First Name	Jonathan	Last Name	Owens	Registration Number	37902
Additional Signature may be generated within this form by selecting the Add button. Add					

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

Privacy Act Statement

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

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

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PATENT
Attorney Docket No.: HAVA-00402

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	)	Group Art Unit:
	)	
Vasudevan Ganesan	)	Examiner:
	)	
Application No.: Not yet available	)	
	)	
Filed: Herewith	)	**PRELIMINARY AMENDMENT**
	)	
For: **MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLER**	)	162 North Wolfe Road Sunnyvale, California 94086 (408) 530-9700
	)	
	)	Customer No. 28960

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

AMENDMENTS

Prior to an examination on the merits please amend the subject application as follows:

Amendments to the Drawings begin on page 2 of this paper.

Amendments to the Specification begin on page 3 of this paper.

Amendments to the Claims are reflected in the listing of claims which begins on page 5 of this paper.

Remarks/Arguments begin on page 10 of this paper.

Amendments to the Drawings:

The attached sheet of drawings includes changes to Figure 1. An annotated sheet showing the changes to Figure 1 is included and a replacement sheet are included. Figure 1 has been modified so that component 82 states CIWF to correctly reflect pages 11and 16-20 of the Current Specification. No new matter has been added.

Amendments to the Specification:

Please amend the following paragraph at Page 1, lines 5-17 as follows:

This Patent Application is a continuation application of co-pending U.S. Patent Application No. 13/240,776, filed on September 22, 2011, and entitled "MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLER," which is a divisional application of co-pending U.S. Patent Application No. 11/330,675, filed on January 11, 2006, and entitled "MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLER," which ~~This application~~ claims priority of U.S. provisional application, serial number 60/643,829, filed January 14, 2005, and entitled "TELEPHONE COMMUNICATIONS PROCESSING CONTROLLER," by the same inventors~~. This application incorporates U.S. provisional application, serial number 60/643,829, filed January 14, 2005, and entitled "TELEPHONE COMMUNICATIONS PROCESSING CONTROLLER," in its entirety by reference. This application~~ and is ~~also~~ a continuation-in-part of U.S. Patent Application, serial number 11/031,498, filed January 6, 2005, and entitled "TELEPHONE WITH AUTOMATIC SWITCHING BETWEEN CELLULAR AND VOIP NETWORKS", all of which are ~~is~~ hereby incorporated by reference. U.S. Patent Application, serial no. 11/031,498 claims priority of U.S. provisional application, serial number 60/534,466, filed January 6, 2004, and entitled "RADIOTELEPHONE WITH AUTOMATIC SWITCHING BETWEEN CELLULAR AND WI-FI NETWORKS USING WI-FI SIGNAL STRENGTH VALUES," the content of which is also incorporated herein by reference in its entirety.

Please amend the following paragraph beginning on page 10, line 10 as follows:

Figure 2 illustrates a simplified high-level block diagram of one embodiment of the mobile communication device 90. The mobile communication device 90 includes a WiFi portion and a cellular portion. The cellular part uses either GSM or CDMA, and access to a communications network is provided through the nearest base station 10. The WiFi portion uses the VOIP client to originate and terminate communications over the WiFi network. The mobile communication device 90 is adapted to automatically switch communications between cellular and VOIP networks. The mobile communication device 90 includes a cellular communication module 93 coupled to a cellular antenna 91, a WiFi communication module 94 coupled to a WiFi antenna 92, an audio/video amplifier 95, a network switch unit 96, a timer unit 97, a WiFi signal

level strength monitor 98, a microphone 100, a speaker 99, and a display monitor 101. The mobile communication device 90 is adapted to establish and maintain communication via either the cellular communication module 93 coupled to a cellular base station 10 (Figure 1), and/or via the WiFi communication module 94 coupled to a WiFi access point 40 (Figure 1). The cellular communication module 93 further includes a transceiver 102 adapted to transmit signals to and receive signals from a cellular network. The WiFi communication module 94 further includes a transceiver 103 adapted to transmit signals to and receive signals from an IP network. Depending on the level of the detected WiFi signal emitted from a WiFi access point, a call initially established via cellular communication module ~~83~~ 93 can be switched to be handled by the WiFi communication module 94, or a call initially established via the WiFi communication module 94 can be switched to be handled by the cellular communication module 93.

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (currently amended) A method of providing communications for a mobile communication device that roams between multiple ~~different types of~~ wireless networks, the method comprising:
   - ~~a.~~ establishing a first communication link between the mobile communication device and an end destination device, wherein the first communication link ~~includes~~ comprises a first wireless communication link between the mobile communication device and a first ~~type of~~ wireless network;
   - ~~b.~~ monitoring a signal strength of the first wireless communication link;
   - ~~c.~~ when the signal strength drops below a ~~predetermined~~ threshold, notifying an interface server and establishing a second communication link between the ~~an~~ interface server and the end destination device without disrupting the first communication link;
   - ~~d.~~ notifying the mobile communication device to terminate transmission over the first communication link; and
   - ~~e.~~ re-directing the second communication link from the interface server to the mobile communication device, thereby establishing a second wireless communication link between the mobile communication device and ~~the~~ a second ~~type of~~ wireless network

2. (currently amended) The method of claim 1 wherein the first ~~type of~~ wireless communication link comprises a WiFi communication link, and the first ~~type of~~ wireless network ~~includes~~ comprises a WiFi network access point.

3. (currently amended) The method of claim 2 wherein the second ~~type of~~ wireless network ~~includes~~ comprises a wireless cellular network.

4. (original) The method of claim 1 wherein establishing the first communication link includes routing through a VOIP network.

5. (original) The method of claim 1 wherein establishing the first communication link includes routing through a cellular network.

6. (original) The method of claim 1 wherein establishing the second communication link includes routing through a VOIP network.

7. (original) The method of claim 1 wherein establishing the second communication link includes routing through a cellular network.

8. (currently amended) The method of claim 1 further comprising providing a connectivity status by the mobile communication device to the interface server while the mobile communication device is within a first coverage area of the first ~~type of~~ wireless network.

9. (currently amended) The method of claim 8 further comprising providing a routing association to a mobile switching center within the second ~~type of~~ wireless network, wherein the routing association associates the mobile communication device to the interface server.

10. (currently amended) The method of claim 9 further comprising routing a termination communication intended for the mobile communication device from the mobile switching center to the interface server according to the routing association when the connectivity status is active, and routing the termination communication from the interface server to the mobile communication device over the first ~~type of~~ wireless network.

11. (original) The method of claim 10 further comprising when the connectivity status is not provided to the interface server, the router association is removed from the mobile switching center.

12. (currently amended) The method of claim 1 further comprising registering the mobile communication device with a mobile switching center within the second ~~type of~~ wireless network when the signal strength drops below the ~~predetermined~~ threshold.

13. (original) The method of claim 12 further comprising setting up the second communication link with the end destination device and forwarding the second communication link to the interface server.

14. (currently amended) A method of providing communications for a mobile communication device that roams between multiple ~~WiFi~~ IEEE 802.11 standard based coverage areas, the method comprising:

~~a.~~ associating the mobile communication device with a nomadic server, wherein the nomadic server is coupled to one or more ~~WiFi~~ IEEE 802.11 standard based access points;

~~b.~~ establishing a first ~~WiFi~~ IEEE 802.11 standard based communication link between the mobile communication device and a first ~~WiFi~~ IEEE 802.11 standard based access point;

~~c. registering the mobile communication device with the nomadic server including providing an IP address of the first WiFi access point to the nomadic server;~~

~~d.~~ configuring a communication path to the mobile communication device via the nomadic server ~~according to the IP address of the first WiFi access point~~ and the first ~~WiFi~~ IEEE 802.11 standard based communication link;

~~e.~~ detecting movement of the mobile communication device into a coverage area of a second ~~WiFi~~ IEEE 802.11 standard based access point;

~~f. registering the mobile communication device with the nomadic server including an IP address of the second WiFi access point;~~

~~g.~~ establishing a second ~~WiFi~~ IEEE 802.11 standard based communication link between the mobile communication device and the second ~~WiFi~~ IEEE 802.11 standard based access point; and

~~h.~~ re-configuring the communication path ~~according to the IP address of the second WiFi access point~~ via the nomadic server and the second ~~WiFi~~ IEEE 802.11 standard based communication link;

wherein the mobile communication device attempts to notify the nomadic server if the first communication link falls below a threshold.

15. (original) The method of claim 14 further comprising associating the mobile communication device to the nomadic server at the mobile switching center.

16. (original) The method of claim 14 further comprising providing a routing association to a mobile switching center within a cellular network, wherein the routing association associates the mobile communication device to the interface server.

17. (original) The method of claim 16 further comprising routing a termination communication intended for the mobile communication device from the mobile switching center to the interface server according to the routing association, and routing the termination communication from the interface server to the mobile communication device over the communication path.

18. (currently amended) The method of claim 14 wherein registering the mobile communication device with the nomadic server provides a connectivity status of the mobile communication device while the mobile communication device is within a specific coverage area of a specific ~~WiFi~~ IEEE 802.11 standard based access point.

Claims 19-37 (canceled)

38. (currently amended) A method of providing communications between mobile communication devices, the method comprising:

~~a.~~ routing a communication over a first communication link between a first mobile communication device and a first cellular base station, wherein the communication is directed from the first mobile communication device to a second communication device;

~~b.~~ routing the communication over a second communication link between the first cellular base station and a first controller device;

~~c.~~ routing the communication over a third communication link between the first controller device and a second controller device, wherein the third communication link comprises an Internet Protocol network;

~~d.~~ routing the communication over a fourth communication link between the second controller device and a second cellular base station; and

~~e.~~ routing the communication over a fifth communication link between the second cellular base station and the second communication device;

wherein the first mobile communication device notifies an interface server if the first communication link falls below a threshold.

REMARKS

The applicants respectfully request further examination and reconsideration in view of the above preliminary amendment. By this preliminary amendment, the Specification and Drawings have been amended to correct typographical errors. Specifically, replacement and annotated sheets for Figure 1 have been attached hereto wherein Figure 1 has been modified so that component 82 states CIWF to correctly reflect pages 11 and 16-20 of the Specification. Further by this preliminary amendment, Claims 1-3, 8-10, 12, 14, 18 and 38 have been amended and Claims 19-37 have been canceled. Accordingly, after the above preliminary amendment, Claims 1-18 and 38 are now pending.

Applicants respectfully submit that the claims, as amended, are now in a condition for allowance, and allowance at an early date would be appreciated. Should the Examiner have any questions or comments, they are encouraged to call the undersigned at (408) 530-9700 to discuss the same so that any outstanding issues can be expeditiously resolved.

Respectfully submitted,
HAVERSTOCK & OWENS LLP

Dated: October 9, 2014

By: /Jonathan O. Owens/
Jonathan O. Owens
Reg. No.: 37,902
Attorneys for Applicant

Annotated Sheet

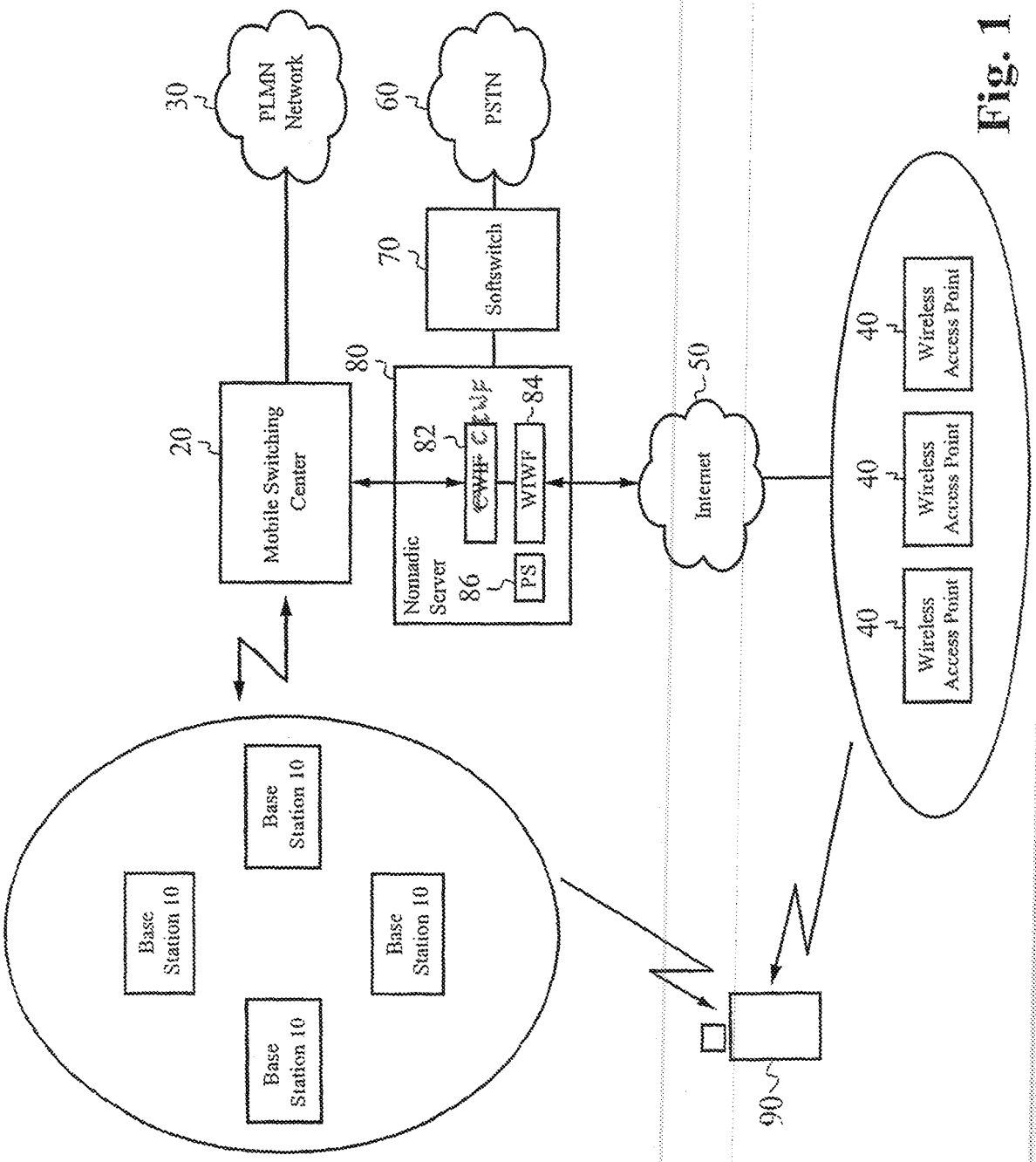


Fig. 1

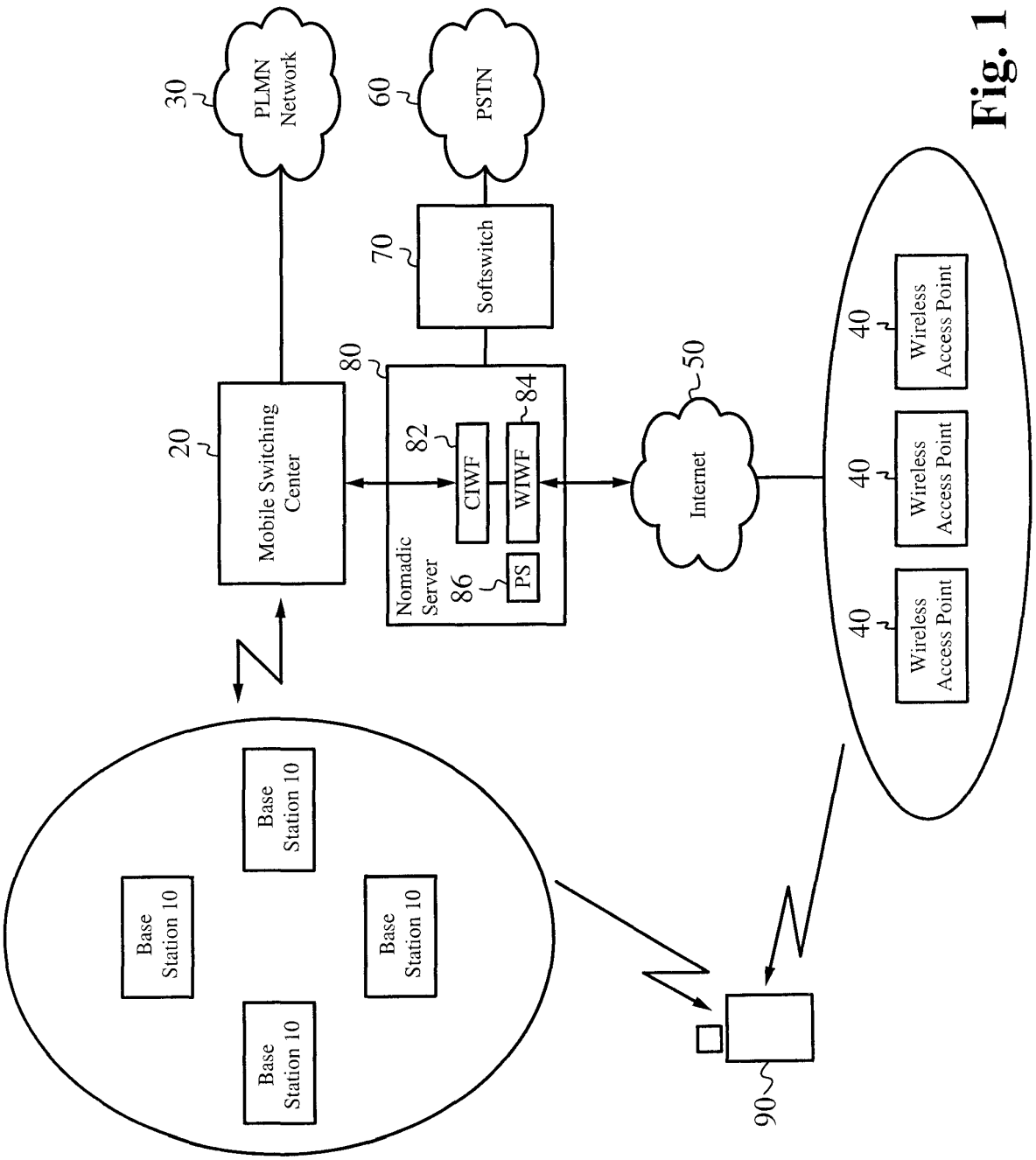

30
PLMN Network
60
PSTN
70
Softswitch
80
20
Mobile Switching Center
82
CIWF
84
WIWF
Nomadic Server
86
PS
50
Internet
40
Wireless Access Point
40
Wireless Access Point
40
Wireless Access Point
Base Station 10
Base Station 10
Base Station 10
Base Station 10
90

Fig. 1

PATENT
Attorney Docket No. HAVA-00400

MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLER

Related Applications

This application claims priority of U.S. provisional application, serial number 60/643,829, filed January 14, 2005, and entitled "TELEPHONE COMMUNICATIONS PROCESSING CONTROLLER ," by the same inventors. This application incorporates U.S. provisional application, serial number 60/643,829, filed January 14, 2005, and entitled "TELEPHONE COMMUNICATIONS PROCESSING CONTROLLER," in its entirety by reference. This application is also a continuation-in-part of U.S. Patent Application, serial number 11/031,498, filed January 6, 2005, and entitled "TELEPHONE WITH AUTOMATIC SWITCHING BETWEEN CELLULAR AND VOIP NETWORKS", which is hereby incorporated by reference. U.S. Patent Application, serial no. 11/031,498 claims priority of U.S. provisional application, serial number 60/534,466, filed January 6, 2004, and entitled "RADIOTELEPHONE WITH AUTOMATIC SWITCHING BETWEEN CELLULAR AND WI-FI NETWORKS USING WI-FI SIGNAL STRENGTH VALUES," the content of which is incorporated herein by reference in its entirety.

Field of the Invention

The present invention relates to the field of network communication processing. In particular, the present invention relates to seamlessly switching communications among Voice over Internet (VOIP), public cellular, and public circuit switched networks.

Background of the Invention

Current telephone communications occur over wireless cellular networks, such as GSM, CDMA, and CDMA2000, Voice Over Internet (VOIP), or circuit switched network, such as PSTN. Current state of the art of most telephones used with such networks is that each

telephone is restricted for use with only one specific network. For example, a cellular phone works in a cellular network; a VOIP phone works in VOIP network, and a landline phone works in a circuit switched network. Such limitations imply that an in-progress telephone communication cannot be seamlessly switched among cellular, VOIP, and circuit switched networks without losing the connection.

Such wireless networks use regulated portions of the radio spectrum and are shared by many users. The infrastructure costs of wireless networks are relatively high due to the size and complexity of the network equipment. There is a wide variance in the performance of different wireless networks. For example, a conventional wireless cellular network covers a relatively large geographical area, but provides a relatively low bandwidth. Other wireless networks, such as CDMA2000-EV-DO/DV networks, offer higher bandwidth and enhanced data services, such as web browsing. However, these networks also pack many users into a relatively small portion of the regulated spectrum. Other types of wireless networks are adapted to improve spectral efficiency with increased speed and smaller coverage areas. For example, an IEEE 802.11x (or WiFi) network may transmit at speeds up to 11 Mbps using a Direct Sequence Spread Spectrum (DSSS) mode or at speeds up to 54 Mbps using an Orthogonal Frequency Division Multiplexing (OFDM) mode.

A network wireless access point conforming to a WiFi (e.g., IEEE 802.11b) network may cover an area of a few hundred feet in diameter. Each such network access point is connected to a larger network (e.g., Internet). One such example is WiFi VOIP (Wireless Fidelity Voice over Internet Protocol), through which a communication device user can place a wireless telephone call over the Internet, using the technology specified in IEEE 802.xx at the network access point. VOIP is a method for taking analog audio signals and converting them into digital data that can be transmitted over the Internet. Conventional VOIP telephone communications are enabled by VOIP network carriers, which utilize VOIP networks (e.g. the Internet), to place VOIP based telephone calls. VOIP enabled and compatible networks include VOIP switching for proper routing and billing of VOIP based telephone calls.

In order to cover larger geographical areas, a relatively large number of IEEE 802.11x, for example, network access points and relatively large wire-line back haul networks are required. In part, due to the relatively small geographical coverage area of each network access point, the resulting IEEE 802.11x based network may thus be prohibitively expensive to set up. Further, the small coverage areas may lead to many "dead zones" in which mobile communication device users are unable to place telephone calls using the VOIP network.

Conventional VOIP phones, which function in a WiFi coverage area (hotspot) corresponding to a WiFi access point, offers relatively inexpensive telephone communications. However, the WiFi availability is limited due to the small geographical area supported by each WiFi access point.

Conventional cellular phones, which function in a cell coverage area within the cellular network, are relatively expensive for telephone communications and have limited multimedia capabilities. Cellular networks and availability to the network covers a much wider, extensive geographical area.

Conventional landline phones, which function in a circuit switched network such as most residences, do not offer extensive telephone communication features, for example video. Such landline phones also do not offer the mobility provided by mobile communications devices such as the VOIP phones or the cellular phones.

Summary of the Invention

The present invention is directed to an interface server, referred to as a nomadic server, and a related system that provides seamless roaming of a mobile communication device between different types of wireless networks, such as WiFi and cellular networks for voice, data and video communication. Use of the nomadic server enables a combination of WiFi and cellular networks for providing access to the mobile communication device and makes use of the VOIP networks for switching the calls wherever possible.

The nomadic server is a telephone communication processing and switching server that will "hold" the present, in-progress telephone communications without dropping, while roaming between WiFi access points and cellular networks, without losing the present, in-progress communication. For example, a telephone communication can be seamlessly switched between VOIP and cellular telephone networks using the nomadic server. Nomadic server resources interface with the VOIP and cellular network switches to provide the hand-off between networks. This approach enables switching of telephone communications over a VOIP network wherever possible either through WiFi or through cellular networks.

In one aspect of the present invention, a method provides communications for a mobile communication device that roams between multiple different types of wireless networks. The method comprises establishing a first communication link between the mobile communication device and an end destination device, wherein the first communication link includes a first wireless communication link between the mobile communication device and a first type of wireless network, monitoring a signal strength of the first wireless communication link, when the signal strength drops below a predetermined threshold, establishing a second communication link between an interface server and the end destination device, notifying the mobile communication device to terminate transmission over the first communication link, and re-directing the second communication link from the interface server to the mobile communication device, thereby establishing a second wireless communication link between the mobile communication device and the second type of wireless network. The first type of wireless communication link can comprise a WiFi communication link, and the first type of wireless network can include a WiFi network access point. The second type of wireless network can include a wireless cellular network. Establishing the first communication link can include routing through a VOIP network. Establishing the first communication link can include routing through a cellular network. Establishing the second communication link can include routing through a VOIP network. Establishing the second communication link can include routing through a cellular network.

The method can also include providing a connectivity status by the mobile communication device to the interface server while the mobile communication device is within a first coverage area of the first type of wireless network. The method can also include providing a routing association to a mobile switching center within the second type of wireless network, wherein the routing association associates the mobile communication device to the interface server. The method can also include routing a termination communication intended for the mobile communication device from the mobile switching center to the interface server according to the routing association when the connectivity status is active, and routing the termination communication from the interface server to the mobile communication device over the first type of wireless network. The method can also include when the connectivity status is not provided to the interface server, the router association is removed from the mobile switching center. The method can also include registering the mobile communication device with a mobile switching center within the second type of wireless network when the signal strength drops below the predetermined threshold. The method can also include setting up the second communication link with the end destination device and forwarding the second communication link to the interface server.

In another aspect of the present invention, a method provides communications for a mobile communication device that roams between multiple WiFi coverage areas. The method includes associating the mobile communication device with a nomadic server, wherein the nomadic server is coupled to one or more WiFi access points, establishing a first WiFi communication link between the mobile communication device and a first WiFi access point, registering the mobile communication device with the nomadic server including providing an IP address of the first WiFi access point to the nomadic server, configuring a communication path to the mobile communication device via the nomadic server according to the IP address of the first WiFi access point and the first WiFi communication link, detecting movement of the mobile communication device into a coverage area of a second WiFi access point, registering the mobile communication device with the nomadic server including an IP address of the second WiFi

access point, establishing a second WiFi communication link between the mobile communication device and the second WiFi access point, and re-configuring the communication path according to the IP address of the second WiFi access point and the second WiFi communication link. The method can also include associating the mobile communication device to the nomadic server at the mobile switching center. The method can also include providing a routing association to a mobile switching center within a cellular network, wherein the routing association associates the mobile communication device to the interface server. The method can also include routing a termination communication intended for the mobile communication device from the mobile switching center to the interface server according to the routing association, and routing the termination communication from the interface server to the mobile communication device over the communication path. Registering the mobile communication device with the nomadic server can provide a connectivity status of the mobile communication device while the mobile communication device is within a specific coverage area of a specific WiFi access point.

In yet another aspect of the present invention, a system provides communications for a mobile communication device that roams between multiple different types of wireless networks. The system includes a plurality of different types of wireless networks, the mobile communication device configured to access the plurality of wireless networks, and an interface server coupled to the plurality of wireless networks, wherein the interface server maintains a seamless communication link between the mobile communication device and an end destination device as the mobile communication device roams from a first wireless coverage area associated within a first type of wireless network to a second wireless coverage area associated with a second type of wireless network, the interface server is configured to establish a second communication link over the second type of wireless network while a first communication link between the mobile communication device and the end destination device over the first type of wireless network is active, wherein the second communication link is initially set up to be forwarded to the interface server and subsequently the second communication link is routed to the mobile communication device as the first communication link is terminated. The first

communication link can include a first wireless communication link between the mobile communication device and the first type of wireless network. The first wireless coverage area can be a WiFi coverage area, and the first wireless communication link can be a WiFi communication link between the mobile communication device and a WiFi access point. The first communication link can include a routing path through a VOIP network. The first communication link can include a routing path through a cellular network. The second communication link can include a second wireless communication link between the mobile communication device and the second type of wireless network. The second wireless coverage area can be a cellular coverage area and the second wireless communication link can be a wireless cellular communication link between the mobile communication device and a cellular base station. The second communication link can include a routing path through a VOIP network. The second communication link can include a routing path through a cellular network. The second type of wireless network can include a wireless cellular network.

In still yet another aspect of the present invention, an interface server maintains a seamless communication link between a mobile communication device and an end destination device as the mobile communication device roams from a first wireless coverage area associated within a first type of wireless network to a second wireless coverage area associated with a second type of wireless network, the interface server is configured to establish a second communication link over the second type of wireless network while a first communication link between the mobile communication device and the end destination device over the first type of wireless network is active, wherein the second communication link is initially set up to be forwarded to the interface server and subsequently the second communication link is routed to the mobile communication device as the first communication link is terminated. The interface server can also include a first inter-network function block to maintain current configuration and status information associated with the first communication link. The first wireless coverage area can be a WiFi coverage area, and the first communication link can be a WiFi communication link between the mobile communication device and a WiFi access point. The interface server can

also include a second inter-network function block to maintain current configuration and status information associated with the second communication link. The interface server can also include a provisioning server to provide the mobile communication device with configuration information.

Brief Description of the Several Views of the Drawings

Figure 1 illustrates an exemplary system of interconnected networks in which a nomadic server is coupled to a cellular network, a wireless IP network, and a public switched telephone network.

Figure 2 illustrates a simplified high-level block diagram of one embodiment of the mobile communication device.

The present invention is described relative to the several views of the drawings. Where appropriate and only where identical elements are disclosed and shown in more than one drawing, the same reference numeral will be used to represent such identical elements.

Detailed Description of the Invention

Embodiments of a nomadic server enable telephone communications that can be initiated using VOIP while within a VOIP access point, such as a WiFi hotspot, and enable telephone communications that can be initiated using a cellular network while within a cellular area and outside of a VOIP access point. When a caller roams outside the range of a VOIP access point, the nomadic server functions to "hold" the current telephone communication while switching occurs from the VOIP access point to the cellular network. Similarly, when a caller roams into the range of a VOIP access point while engaged in a telephone communication on the cellular network, the nomadic server functions to "hold" the current telephone communication while switching occurs from the cellular network to the VOIP access point. The nomadic server remains engaged, or active, in the telephone communication while switching from one network

to another. After switching is completed, the nomadic server disengages from the telephone communication.

Figure 1 illustrates an exemplary system of interconnected networks in which a nomadic server 80 is coupled to a cellular network, a wireless IP network, and a public switched telephone network (PSTN) 60. The cellular network shown in Figure 1 includes a mobile switching center 20 coupled to a public land mobile network 30, and a plurality of base stations 10 coupled to the mobile switching center 20. For clarity, the cellular network shown in Figure 1 is a simplified cellular network architecture. For example, the cellular network in Figure 1 includes only a single mobile switching center, however it is understood that the cellular network includes multiple mobile switching centers. Further, it will be apparent to those skilled in the art, that the functionality of the mobile switching center could alternatively be incorporated into either the base station or any other cellular network infrastructure, or into the nomadic server. Accordingly, as used herein, the term mobile switching center refers to the mobile switching center or any appropriate device within the cellular network equipment infrastructure which performs the functionality of a mobile switching center. Figure 1 shows four base stations 10 coupled to the mobile switching center 20. Alternatively, more or less than four base stations can be coupled to each mobile switching center.

The wireless IP network shown in Figure 1 includes a plurality of wireless IP access points 40 coupled to the Internet 50. Examples of a wireless IP access point include, but are not limited to, a wireless or wired broadband termination element, a wireless or wired modem, a wireless or wired router, and a WiFi access point.

In this example, the nomadic server 80 is coupled to the PSTN 60 through the softswitch 70. The softswitch 70 provides an interface for the nomadic server 80 to legacy networks, such as the PSTN.

A mobile communication device 90 is preferably a dual mode telephone that provides VoIP client functionality over a WiFi network and GSM/CDMA mobile telephony functionality over a cellular network. The mobile communication device 90 can also be configured to

automatically switch an existing communication from a cellular network to a wireless IP network, or to switch an existing communication from an IP network to a cellular network. Such a mobile communication device is described in co-pending and co-owned U.S. Patent Application Serial No.11/031,498, filed January 6, 2005, and entitled "TELEPHONE WITH AUTOMATIC SWITCHING BETWEEN CELLULAR AND VOIP NETWORKS", which is hereby incorporated by reference. Alternative types of mobile communication devices include, but are not limited to, laptop computers, music players/recorders, PDAs, telephones, or any conventional mobile communication device capable of receiving broadband content over a wireless connection.

Figure 2 illustrates a simplified high-level block diagram of one embodiment of the mobile communication device 90. The mobile communication device 90 includes a WiFi portion and a cellular portion. The cellular part uses either GSM or CDMA, and access to a communications network is provided through the nearest base station 10. The WiFi portion uses the VOIP client to originate and terminate communications over the WiFi network. The mobile communication device 90 is adapted to automatically switch communications between cellular and VOIP networks. The mobile communication device 90 includes a cellular communication module 93 coupled to a cellular antenna 91, a WiFi communication module 94 coupled to a WiFi antenna 92, an audio/video amplifier 95, a network switch unit 96, a timer unit 97, a WiFi signal level strength monitor 98, a microphone 100, a speaker 99, and a display monitor 101. The mobile communication device 90 is adapted to establish and maintain communication via either the cellular communication module 93 coupled to a cellular base station 10 (Figure 1), and/or via the WiFi communication module 94 coupled to a WiFi access point 40 (Figure 1). The cellular communication module 93 further includes a transceiver 102 adapted to transmit signals to and receive signals from a cellular network. The WiFi communication module 94 further includes a transceiver 103 adapted to transmit signals to and receive signals from an IP network. Depending on the level of the detected WiFi signal emitted from a WiFi access point, a call initially established via cellular communication module 83 can be switched to be handled by the

WiFi communication module 94, or a call initially established via the WiFi communication module 94 can be switched to be handled by the cellular communication module 93.

Referring back to Figure 1, the nomadic server 80 enables a seamless handoff from one wireless access point to another as the mobile telephone device 90 roams from one WiFi coverage area to another WiFi coverage area, or roams outside a WiFi coverage area but still within a cellular network coverage area. The nomadic server 80 includes a cellular inter-working function (CIWF) block 82, a WiFi inter-working function (WIWF) block 84, and a provisioning server 86. The nomadic server 80 and the mobile switching center 20 are either "tightly" coupled or "loosely" coupled. When tightly coupled, the nomadic server 80 and the mobile switching center 20 are coupled together by a local area network (LAN), or a wide area network (WAN) or any other appropriate interface, using either a proprietary or non-proprietary interface of the mobile switching center 20. In this manner, the nomadic server 80 is able to communicate to the mobile switching center 20 through this interface. When loosely coupled, the nomadic server 80 and the mobile switching center 20 are coupled using an Integrated Services Digital Network (ISDNC) trunk, or by using a softswitch or any other appropriate interface. In this context, a softswitch is defined variously as a media gateway controller, call agent or gate keeper, used to control connections at the junction point between circuit and packet networks.

The nomadic server 80 is coupled to one or more mobile switching centers 20 for communicating signaling and media traffic. A point of interconnection (PoI), is formed between each mobile switching center 20 and the nomadic server 80. Within any given network, one or more nomadic servers 80 can be implemented. Each mobile communication device 90 is associated with a home nomadic server, in this case the nomadic server 80. Each nomadic server can be the home nomadic server for one or more mobile communication devices. Preferably, a mobile switching center is interfaced to only one nomadic server such that a home mobile switching center is interfaced to the home nomadic server. In this manner, the mobile communication device is associated with a home mobile switching center. Alternatively, multiple mobile switching centers are coupled to any given nomadic server.

When the mobile communication device 90 originates a call within a WiFi coverage area, a WiFi communication link is established with the nomadic server 80. The call can be completed by the nomadic server 80 over the cellular network or the VOIP network. If the call is completed over the cellular network, then the call is routed through any mobile switching center coupled to the nomadic server 80. If the call is completed over the VOIP network, then the call is routed through a softswitch 70 of a service provider, using the Session Initiation Protocol (SIP) or any other appropriate protocols, such as H323. In other words, if the mobile communication device 90 is located within a WiFi coverage area, then the first leg of the call is routed over a WiFi communication link and the remaining portion of the call can be routed over either the cellular network, the VOIP network, or the PSTN.

In operation, a first call is established by the mobile communication device 90 by first determining if it is in a WiFi coverage area. Such a determination is preferably made by measuring a signal strength or other criteria of the nearest WiFi access point 40, and if the signal strength or other criteria is above a predetermined threshold, then a WiFi communication link is established. If WiFi access is not available, then the mobile communication device 90 establishes a cellular communication link with the nearest base station 10. When the mobile communication device 90 first establishes a WiFi communication link, the mobile communication device 90 establishes a communication link with the provisioning server 86 over the WiFi communication link. The WiFi communication link includes the WiFi access point 40, and the Internet 50. The provisioning server 86 provides the mobile communication device 90 with configuration information including an identification of its home nomadic server, which in this case is the nomadic server 80. The mobile communication device 90 preferably uses XML over SSL for communicating with the provisioning server 86 over the Internet 50.

The mobile communication device 90 also registers with the nomadic server 80. In some embodiments, a SIP REGISTER method or any other appropriate protocol, such as H323, with authentication is used between the mobile communication device 90 and the nomadic server 80. The nomadic server 80 also maintains configuration information of the mobile switching center

20. The nomadic server 80 updates the mobile switching center 20 with a current location of the mobile communication device 90. The current location refers to the WiFi access point associated with the WiFi coverage area in which the mobile communication device 90 is currently located. The nomadic server 80 updates the mobile switching center 20 with the location of the mobile communication device 90 at a specified periodicity. In this manner, the mobile switching center 20 maintains a current location of the mobile communication device 90. Using this location information, calls received over the cellular network for the mobile communication device 90 are directed from the mobile switching center 20 over the WiFi communication link via the nomadic server 80.

As long as the mobile communication device 90 maintains a WiFi communication link with the wireless access point 40, irrespective of the cellular network coverage, the mobile communication device 90 registers with its home nomadic server, the nomadic server 80 in this case. The nomadic server 80 in turn updates the current location of the mobile communication device 90 in the mobile switching center 20. When a signal strength or other criteria of the WiFi communication link weakens below a predetermined threshold, the mobile communication device 90 notifies the nomadic server 80. In response, the nomadic server 80 stops sending location updates to the mobile switching center 20. Additionally, the mobile communication device 90 stops sending SIP registrations to the nomadic server 80, and the mobile communication device 90 initiates registration with the nearest mobile switching center. In this manner, subsequent calls originating from or terminating at the mobile communication device 90 are handled by the mobile switching center. The nearest mobile switching center can be the home mobile switching center of the mobile communication device 90 or another mobile switching center, referred to as a visitor mobile switching center, within the cellular network.

While the first call is still established over the WiFi communication link, the mobile communication device 90 sets up a second call to the same end destination as the first call currently setup over the WiFi communication link, thereby establishing a cellular communication link. If the cellular communication link is established via the home mobile switching center,

then the second call is routed to the nomadic server 80 via the PoI between the home mobile switching center and the nomadic server 80. In response, the nomadic server 80 determines if the first call over the WiFi communication link is still in progress. If so, access is switched from the WiFi communication link to the cellular communication link.

If, however, the cellular communication link is established over a visitor mobile switching center, then the visitor mobile switching center forwards the second call to a visitor nomadic server coupled to the visitor mobile switching center. The visitor nomadic server can not determine the status of the first call over the WiFi communication link, so the visitor nomadic server switches the second call to the end destination. Concurrently, the home nomadic server, which previously received the notification from the mobile communication device 90 about losing the WiFi communication link, waits for a connection request from the home mobile switching center for the second call to be established. However, the home nomadic server will not receive such a connection request since the second call is being processed by the visitor nomadic server. As such, the home nomadic server drops the first call on the WiFi communication link, and the second call is maintained by the mobile communication device 90 over the cellular communication link.

Once a cellular communication link is established between the mobile communication device 90 and the nearest mobile switching center, the mobile communication device 90 does not attempt to establish another WiFi communication link upon re-entering a WiFi coverage area. The mobile communication device 90 attempts access to a WiFi communication link when the mobile communication device 90 is back in an idle state.

As the mobile communication device roams from a first coverage area to a second coverage area, the transition steps vary depending on the type of the second coverage area and on the original call setup configuration. Roaming from the first coverage area to the second coverage area can generally be accomplished according to one of five different scenarios, each scenario including associated transition steps.

A first scenario includes the mobile communication device roaming from a first WiFi coverage area to a second WiFi coverage area. The first WiFi coverage area is associated with a first WiFi access point, and the second WiFi coverage area is associated with a second WiFi access point. Each WiFi access point includes an IP address. When the mobile communication device is within the first WiFi coverage area, the mobile communication device registers with its home nomadic server over the first WiFi access point. The home nomadic server updates the location of the mobile communication device with the home mobile switching center of the mobile communication device. For incoming calls directed to the mobile communication device, the home mobile switching center routes the calls to the home nomadic server based on the most recent location information.

When the mobile communication device roams into the second WiFi coverage area, the mobile communication device detects the transition. The mobile communication device acquires the IP address from the second WiFi access point and sends the IP address change to the provisioning server of the home nomadic server. The mobile communication device also sends a SIP register message with the new IP address to the home nomadic server. In response, the home nomadic server redirects any incoming calls to the IP address of the second WiFi access point. The location of the mobile communication device maintained by the home mobile switching center is still valid.

A second scenario includes the mobile communication device 90 initiating a call within a first WiFi coverage area, setting up the call over a VOIP network, and roaming from the first WiFi coverage area to a cellular coverage area supported by the home mobile switching center of the mobile communication device 90. In this scenario, the mobile communication device 90 roams from the first WiFi coverage area to a non-WiFi coverage area. When a first call is initiated and setup, a WiFi communication link is established between the mobile communication device and a first wireless access point associated with the first WiFi coverage area. When the mobile communication device is within the first WiFi coverage area, the mobile communication device registers with its home nomadic server via the first WiFi access point.

The first call is routed from the first wireless access point through a VOIP network, such as the Internet.

The mobile communication device monitors a signal strength or other criteria of the WiFi communication link. When the signal strength or other criteria drops below a predetermined threshold, the mobile communication device registers with the nearest mobile switching center, which in this second scenario is the home mobile switching center of the mobile communication device. The mobile communication device also sends a call setup request to the home mobile switching center for a second call with the same end destination as the first call. The second call is setup by the home mobile switching center, and the second call is routed to the CIWF block within the home nomadic server. The CIWF block determines from the WIWF block if the first call is in progress. If the first call is in progress, then the CIWF block sends an affirmative answer message to the home mobile switching center. The home mobile switching center in turn sends the affirmative answer message to the mobile communication device.

In response to receiving the affirmative answer message, the mobile communication device stops media streaming over the WiFi communication link and powers down the WiFi part. The CIWF block then changes the registration of the mobile communication device in the WIWF block with an IP address of the CIWF block. The CIWF block sends a re-invite message to the WIWF block signifying a media switchover to the IP address of the CIWF block from the IP address of the first wireless access point. Media streaming associated with the first call is then redirected to the CIWF block, where the media is then switched over to the home mobile switching center. Media associated with the first call is now associated with the second call, where the media is now streamed from the VOIP network to the WIWF block to the CIWF block to the home mobile switching center to the mobile communication device. The transition according to the second scenario is now complete. If the second call is subsequently disconnected by the mobile communication device, then the corresponding call breakdown process is supervised by the CIWF block. If the second call is subsequently disconnected by the

end destination device, then the corresponding call breakdown process is supervised by both the WIWF block and the CIWF block.

A third scenario includes the mobile communication device initiating a call within a first WiFi coverage area, setting up a back end of the call over a cellular network, and roaming from the first WiFi coverage area to a cellular coverage area supported by the home mobile switching center of the mobile communication device. In this scenario, the mobile communication device roams from the first WiFi coverage area to a non-WiFi coverage area. When a first call is initiated and setup, a WiFi communication link is established between the mobile communication device and a first wireless access point associated with the first WiFi coverage area. When the mobile communication device is within the first WiFi coverage area, the mobile communication device registers with its home nomadic server via the first WiFi access point. The first call is routed from the wireless access point 40 through a cellular network, such as the mobile switching center and either the PLMN or the PSTN.

The mobile communication device monitors a signal strength or other criteria of the WiFi communication link. When the signal strength or other criteria drops below a predetermined threshold, the mobile communication device registers with the nearest mobile switching center, which in this third scenario is the home mobile switching center of the mobile communication device. The mobile communication device also sends a call setup request to the home mobile switching center for a second call with the same end destination as the first call. The second call is setup by the home mobile switching center, and the second call is routed to the CIWF block within the home nomadic server. The CIWF block determines from the WIWF block if the first call is in progress. If the first call is in progress, then the CIWF block sends an affirmative answer message to the home mobile switching center. The home mobile switching center in turn sends the affirmative answer message to the mobile communication device.

In response to receiving the affirmative answer message, the mobile communication device stops media streaming over the WiFi communication link and powers down its WiFi part. The CIWF block then changes the registration of the mobile communication device in the WIWF

block with an IP address of the CIWF block. The CIWF block sends a re-invite message to the WIWF block signifying a media switchover to the IP address of the CIWF block from the IP address of the first wireless access point. Media streaming associated with the first call is then redirected to the CIWF block, where the media is then switched over to the home mobile switching center. The media stream associated with the first call is now associated with the second call, where the media stream is now directed from the cellular network to the CIWF block to the home mobile switching center to the mobile communication device. The transition according to the third scenario is now complete. If the second call is subsequently disconnected by the mobile communication device, then the corresponding call breakdown process is supervised by the CIWF block and the home mobile switching center. If the second call is subsequently disconnected by the end destination device, then the corresponding call breakdown process is supervised by the CIWF block.

A fourth scenario includes the mobile communication device initiating a call within a first WiFi coverage area that resides outside a cellular coverage area supported by the home mobile switching center of the mobile communication device, setting up a back end of the call over a VOIP network, and roaming from the first WiFi coverage area to a cellular coverage area supported by a visitor mobile switching center. In this scenario, the mobile communication device roams from the first WiFi coverage area to a non-WiFi coverage area. When a first call is initiated and setup, a WiFi communication link is established between the mobile communication device and a first wireless access point associated with the first WiFi coverage area. When the mobile communication device is within the first WiFi coverage area, the mobile communication device registers with its home nomadic server via the first WiFi access point. In this manner, the WIWF block in the home nomadic server monitors the location of the mobile communication device . The first call is routed from the mobile communication device to the first wireless access point via the WiFi communication link to the WIWF block of the visitor nomadic server associated with the visitor mobile switching center to the VOIP network

The mobile communication device monitors a signal strength or other criteria of the WiFi communication link. When the signal strength or other criteria drops below a predetermined threshold, the mobile communication device registers with the nearest mobile switching center, which in this fourth scenario is the visitor mobile switching center. The mobile communication device notifies the WIWF block in its home nomadic server that the signal strength or other criteria is below the predetermined threshold. The mobile communication device also sends a call setup request to the visitor mobile switching center for a second call with the same end destination as the first call. The visitor mobile switching center forwards the call setup request to the CIWF block within the visitor nomadic server. Within the visitor nomadic server, the CIWF block determines from the WIWF block if the first call is in progress. Since the mobile communication device has been registering itself with its home nomadic server, and not with the visitor nomadic server, the WIWF block within the visitor nomadic server does not have a record of the first call being in progress. In response, the visitor nomadic server sets up the second call over the cellular network. Concurrently, the home nomadic server tears down the first call over the VOIP network.

A fifth scenario includes the mobile communication device initiating a call within a first WiFi coverage area that resides outside a cellular coverage area supported by the home mobile switching center of the mobile communication device, setting up a back end of the call over a cellular network, and roaming from the first WiFi coverage area to a cellular coverage area supported by a visitor mobile switching center. In this scenario, the mobile communication device roams from the first WiFi coverage area to a non-WiFi coverage area. When a first call is initiated and setup, a WiFi communication link is established between the mobile communication device and a first wireless access point associated with the first WiFi access point. The first call is routed from the mobile communication device to the first wireless access point via the WiFi communication link to the CIWF block of the visitor nomadic server to the visitor mobile switching center to the cellular network.

The mobile communication device monitors a signal strength or other criteria of the WiFi communication link. When the signal strength or other criteria drops below a predetermined threshold, the mobile communication device registers with the nearest mobile switching center, which in this fifth scenario is the visitor mobile switching center. When the mobile communication device is within the first WiFi coverage area, the mobile communication device registers with its home nomadic server via the first WiFi access point. In this manner, the WIWF block in the home nomadic server monitors the location of the mobile communication device. The mobile communication device notifies the WIWF block in its home nomadic server that the signal strength or other criteria is below the predetermined threshold. The mobile communication device also sends a call setup request to the visitor mobile switching center for a second call with the same end destination as the first call. The visitor mobile switching center forwards the call setup request to the CIWF block within the visitor nomadic server. Within the visitor nomadic server, the CIWF block determines from the WIWF block if the first call is in progress. Since the mobile communication device has been registering itself with its home nomadic server, and not with the visitor nomadic server, the WIWF block within the visitor nomadic server does not have a record of the first call being in progress. In response, the visitor nomadic server sets up the second call over the cellular network. Concurrently, the home nomadic server tears down the first call over the cellular network and the first WiFi communication link.

It is understood that the five scenarios described above are not exhaustive or inclusive of all scenarios in which the mobile communication device can roam from a first coverage area to a second coverage area with the support of the nomadic server. It is understood that other scenarios are also contemplated.

In some embodiments, the nomadic server 80 also communicates to other nomadic services over the Internet to route and complete calls using VOIP. This server-to-server communication can be used for all calls, even for cellular to cellular calls. In such a situation, the cellular telephone communication is transmitted from the initiating cellular telephone to the

appropriate base station. From this base station, the communication is routed to the appropriate nomadic server 80, which in some embodiments is the nomadic server 80 that is the closest to the receiving base station 10. This initiating nomadic server 80 then transmits the communication over the Internet, to the nomadic server 80 that is closest to the appropriate base station 10 corresponding to the location of the receiver's cellular telephone. This receiving nomadic server 80 then transmits the communication to this receiving base station 10, which transmits the communication to the receiver's cellular telephone. In this manner, the only portions of the transmission that are communicated over the cellular telephone network, are the initial leg, from the initiating cellular telephone to the appropriate base station, and the final leg, from the appropriate base station to the receiver's cellular telephone. The remaining, intermediate, portions of the transmission are communicated between the appropriate nomadic servers over the Internet, which allows the call to be completed more efficiently than if the call was transmitted completely over the cellular network in the traditional manner. As will be apparent to those skilled in the art, communications are directed in both directions in this manner in order to complete the call between the initiator and the receiver, with the initial and final portions of the transmission routed over the cellular network and the remaining intermediate portions of the transmission routed between nomadic servers 80, over the Internet 50.

The present invention has been described in terms of specific embodiments incorporating details to facilitate the understanding of the principles of construction and operation of the invention. As such, references herein to specific embodiments and details thereof are not intended to limit the scope of the claims appended hereto. It will be apparent to those skilled in the art that modifications can be made to the embodiments chosen for illustration without departing from the spirit and scope of the invention.

Claims

We claim:

1. A method of providing communications for a mobile communication device that roams between multiple different types of wireless networks, the method comprising:
   a. establishing a first communication link between the mobile communication device and an end destination device, wherein the first communication link includes a first wireless communication link between the mobile communication device and a first type of wireless network;
   b. monitoring a signal strength of the first wireless communication link;
   c. when the signal strength drops below a predetermined threshold, establishing a second communication link between an interface server and the end destination device;
   d. notifying the mobile communication device to terminate transmission over the first communication link; and
   e. re-directing the second communication link from the interface server to the mobile communication device, thereby establishing a second wireless communication link between the mobile communication device and the second type of wireless network

2. The method of claim 1 wherein the first type of wireless communication link comprises a WiFi communication link, and the first type of wireless network includes a WiFi network access point.

3. The method of claim 2 wherein the second type of wireless network includes a wireless cellular network.

4. The method of claim 1 wherein establishing the first communication link includes routing through a VOIP network.

5. The method of claim 1 wherein establishing the first communication link includes routing through a cellular network.

6. The method of claim 1 wherein establishing the second communication link includes routing through a VOIP network.

7. The method of claim 1 wherein establishing the second communication link includes routing through a cellular network.

8. The method of claim 1 further comprising providing a connectivity status by the mobile communication device to the interface server while the mobile communication device is within a first coverage area of the first type of wireless network.

9. The method of claim 8 further comprising providing a routing association to a mobile switching center within the second type of wireless network, wherein the routing association associates the mobile communication device to the interface server.

10. The method of claim 9 further comprising routing a termination communication intended for the mobile communication device from the mobile switching center to the interface server according to the routing association when the connectivity status is active, and routing the termination communication from the interface server to the mobile communication device over the first type of wireless network.

11. The method of claim 10 further comprising when the connectivity status is not provided to the interface server, the router association is removed from the mobile switching center.

12. The method of claim 1 further comprising registering the mobile communication device with a mobile switching center within the second type of wireless network when the signal strength drops below the predetermined threshold.

13. The method of claim 12 further comprising setting up the second communication link with the end destination device and forwarding the second communication link to the interface server.

14. A method of providing communications for a mobile communication device that roams between multiple WiFi coverage areas, the method comprising:

a. associating the mobile communication device with a nomadic server, wherein the nomadic server is coupled to one or more WiFi access points;

b. establishing a first WiFi communication link between the mobile communication device and a first WiFi access point;

c. registering the mobile communication device with the nomadic server including providing an IP address of the first WiFi access point to the nomadic server;

d. configuring a communication path to the mobile communication device via the nomadic server according to the IP address of the first WiFi access point and the first WiFi communication link;

e. detecting movement of the mobile communication device into a coverage area of a second WiFi access point;

f. registering the mobile communication device with the nomadic server including an IP address of the second WiFi access point;

g. establishing a second WiFi communication link between the mobile communication device and the second WiFi access point; and

h. re-configuring the communication path according to the IP address of the second WiFi access point and the second WiFi communication link.

15. The method of claim 14 further comprising associating the mobile communication device to the nomadic server at the mobile switching center.

16. The method of claim 14 further comprising providing a routing association to a mobile switching center within a cellular network, wherein the routing association associates the mobile communication device to the interface server.

17. The method of claim 16 further comprising routing a termination communication intended for the mobile communication device from the mobile switching center to the interface server according to the routing association, and routing the termination communication from the interface server to the mobile communication device over the communication path.

18. The method of claim 14 wherein registering the mobile communication device with the nomadic server provides a connectivity status of the mobile communication device while the mobile communication device is within a specific coverage area of a specific WiFi access point.

19. A system to provide communications for a mobile communication device that roams between multiple different types of wireless networks, the system comprising:

a. a plurality of different types of wireless networks;

b. the mobile communication device configured to access the plurality of wireless networks; and

c. an interface server coupled to the plurality of wireless networks, wherein the interface server maintains a seamless communication link between the mobile communication device and an end destination device as the mobile communication device roams from a first wireless coverage area associated within a first type of wireless network to a second wireless coverage area associated with a second type of wireless network, the interface server is configured to establish a second communication link over the second type of wireless network while a first communication link between the mobile communication device and the end destination device over the first type of wireless network is active, wherein the second communication link is initially set up to be forwarded to the interface server and subsequently the second communication link is routed to the mobile communication device as the first communication link is terminated.

20. The system of claim 19 wherein the first communication link includes a first wireless communication link between the mobile communication device and the first type of wireless network.

21. The system of claim 20 wherein the first wireless coverage area comprises a WiFi coverage area, and the first wireless communication link comprises a WiFi communication link between the mobile communication device and a WiFi access point.

22. The system of claim 20 wherein the first communication link includes a routing path through a VOIP network.

23. The system of claim 20 wherein the first communication link includes a routing path through a cellular network.

24. The system of claim 19 wherein the second communication link includes a second wireless communication link between the mobile communication device and the second type of wireless network.

25. The system of claim 24 wherein the second wireless coverage area comprises a cellular coverage area and the second wireless communication link comprises a wireless cellular communication link between the mobile communication device and a cellular base station.

26. The system of claim 24 wherein the second communication link includes a routing path through a VOIP network.

27. The system of claim 24 wherein the second communication link includes a routing path through a cellular network.

28. The system of claim 19 wherein the second type of wireless network includes a wireless cellular network.

29. An interface server to maintain a seamless communication link between a mobile communication device and an end destination device as the mobile communication device roams from a first wireless coverage area associated within a first type of wireless network to a second wireless coverage area associated with a second type of wireless network, the interface server is configured to establish a second communication link over the second type of wireless network while a first communication link between the mobile

communication device and the end destination device over the first type of wireless network is active, wherein the second communication link is initially set up to be forwarded to the interface server and subsequently the second communication link is routed to the mobile communication device as the first communication link is terminated.

30. The interface server of claim 29 further comprising a first inter-network function block to maintain current configuration and status information associated with the first communication link.

31. The interface server of claim 30 wherein the first wireless coverage area comprises a WiFi coverage area, and the first communication link comprises a WiFi communication link between the mobile communication device and a WiFi access point.

32. The interface server of claim 30 further comprising a second inter-network function block to maintain current configuration and status information associated with the second communication link.

33. The interface server of claim 32 further comprising a provisioning server to provide the mobile communication device with configuration information.

34. The interface server of claim 29 wherein the interface server communicates to the mobile communication device through a mobile switching center.

35. The interface server of claim 34 wherein the interface server is tightly coupled to the mobile switching center through a network.

36. The interface server of claim 34 wherein the interface server is loosely coupled to the mobile switching center through a one of an trunk interface or a softswich.

37. The interface server of claim 34 wherein the interface server communicates to the mobile switching center through an interface protocol established by the mobile switching center.

38. A method of providing communications between mobile communication devices, the method comprising:

a. routing a communication over a first communication link between a first mobile communication device and a first cellular base station, wherein the communication is directed from the first mobile communication device to a second communication device;

b. routing the communication over a second communication link between the first cellular base station and a first controller device;

c. routing the communication over a third communication link between the first controller device and a second controller device, wherein the third communication link comprises a Internet Protocol network;

d. routing the communication over a fourth communication link between the second controller device and a second cellular base station; and

e. routing the communication over a fifth communication link between the second cellular base station and the second communication device.

Abstract of the Disclosure

A nomadic server and a related system provides seamless roaming for a mobile communication device between different types of wireless networks, such as WiFi and cellular networks for voice, data and video communication. Use of the nomadic server enables a combination of WiFi and cellular networks for providing access to the cellular phones and make use of the VOIP networks for switching the calls wherever possible. The nomadic server is a telephone communication processing and switching server that will "hold" the present, in-progress telephone communications without dropping, while roaming without losing the present, in-progress communication. For example, a telephone communication can be seamlessly switching between VOIP and cellular telephone networks using the nomadic server. Nomadic server resources interface with the VOIP and cellular network switches to provide the hand-off between networks. This approach enables switching of telephone communications over a VOIP network wherever possible either through WiFi or through cellular networks.

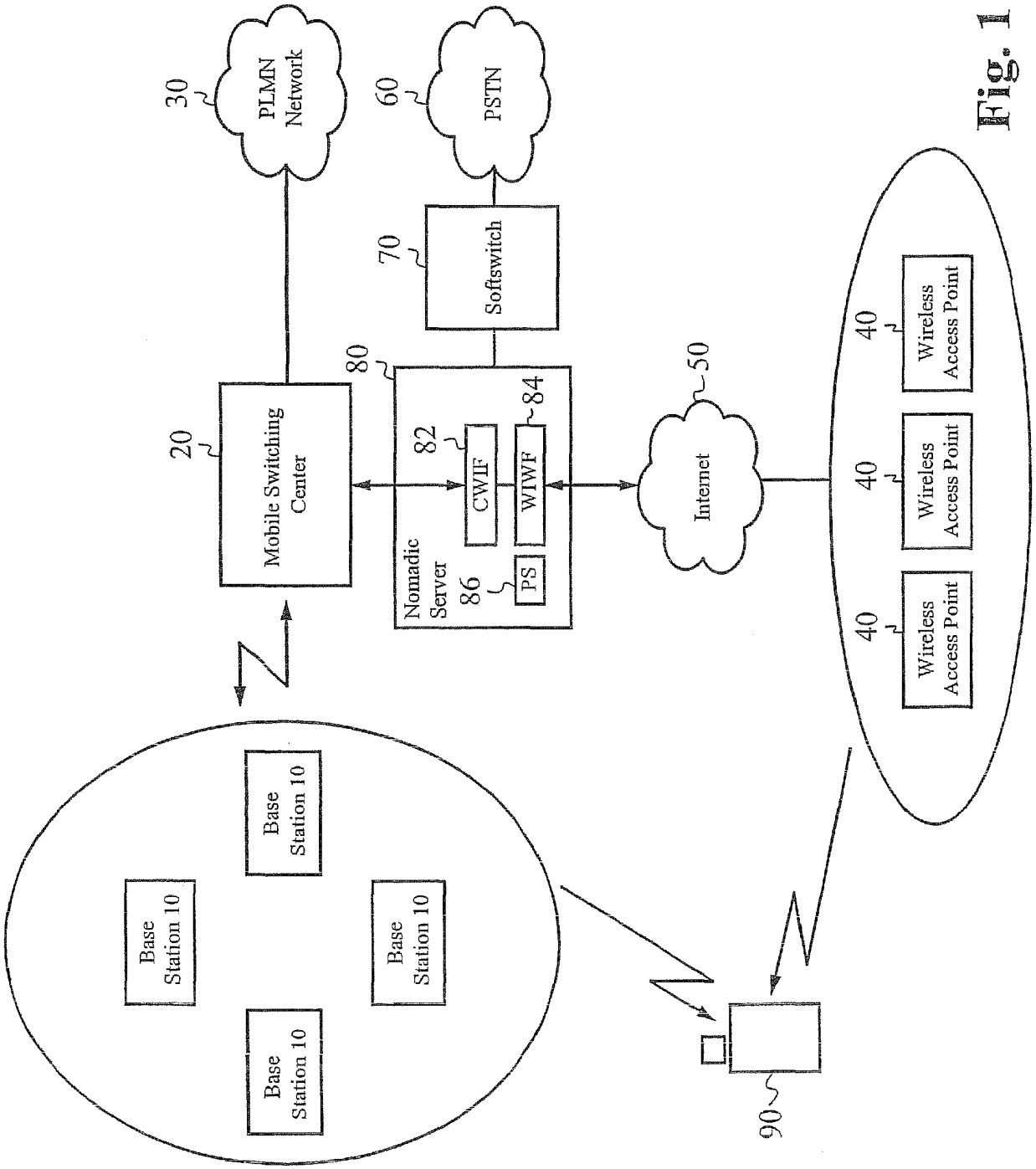

30
PLMN Network
60
PSTN
70
Softswitch
80
20
Mobile Switching Center
82
CWIF
84
WIWF
Nomadic Server
86
PS
50
Internet
40
Wireless Access Point
40
Wireless Access Point
40
Wireless Access Point
Base Station 10
Base Station 10
Base Station 10
Base Station 10
90

Fig. 1

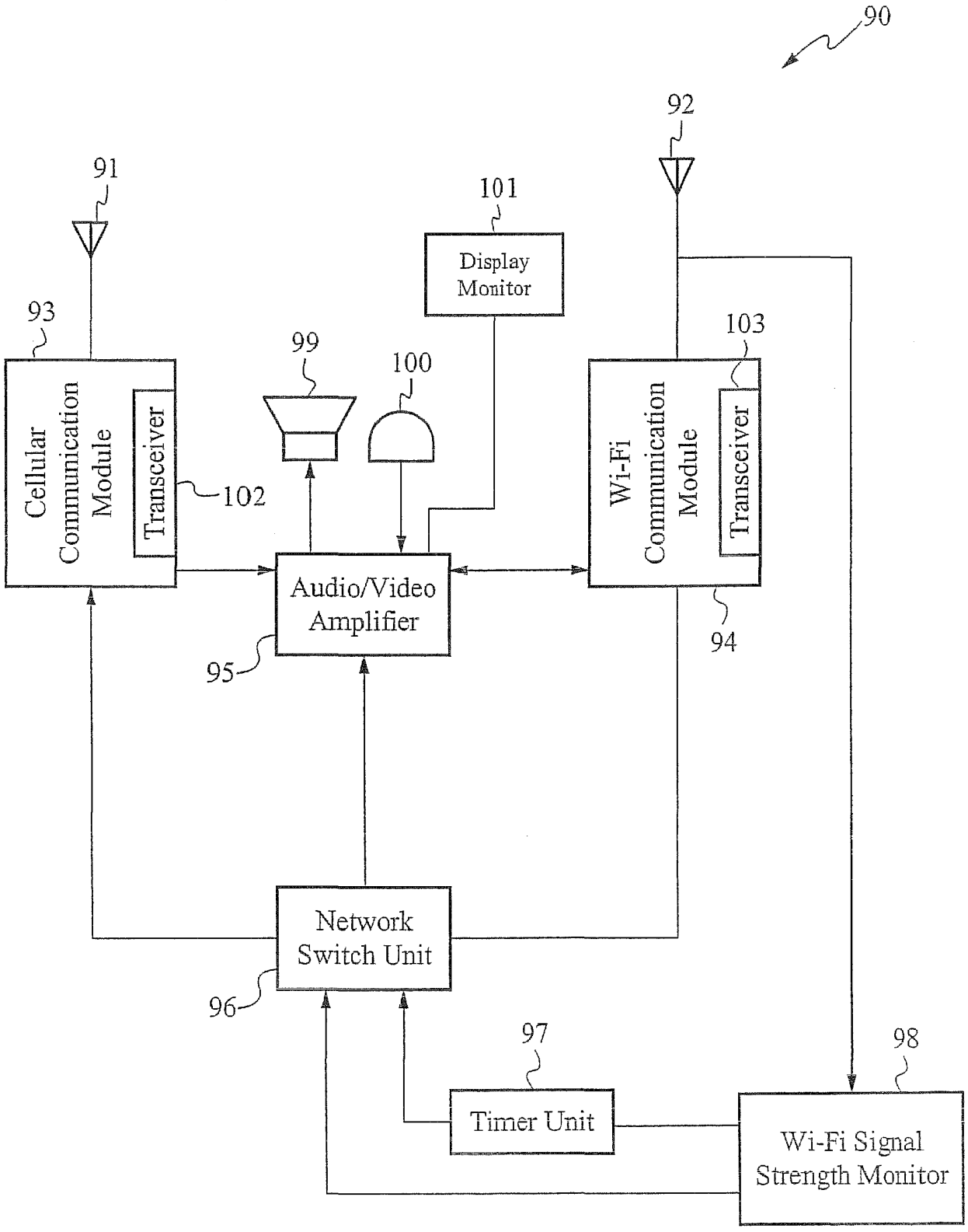

90
91
92
93
101
Display Monitor
99
100
103
Cellular Communication Module
Transceiver
102
Wi-Fi Communication Module
Transceiver
Audio/Video Amplifier
94
95
Network Switch Unit
96
97
98
Timer Unit
Wi-Fi Signal Strength Monitor

Fig. 2

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY

As a below-named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated next to my name. I believe I am an original, first and sole inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled: **MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLER**. The specification of which is attached hereto. I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claim	
			Yes	No
Number	Country	Day/Month/Year Filed		

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

11/031,498	January 6, 2005	Pending
Application Serial No.	Filing Date	Status: Patented, Pending, Abandoned

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

60/643,829	January 14, 2005
Application Serial No.	Filing Date

I hereby appoint the following as my attorneys with full power of substitution to prosecute this application and transact all business in the Patent and Trademark Office in connection therewith:

Thomas B. Haverstock	32,571	Jonathan O. Owens	37,902

Please direct all correspondence regarding this application to the following:

Jonathan O. Owens
HAVERSTOCK & OWENS LLP
162 North Wolfe Road
Sunnyvale, California 94086
Customer Number 28960

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of First Sole Inventor: Vasudevan Ganesan

Inventor's Signature: _____ Date: Jan. 11, 06

Residence: 19500 Pruneridge Ave #6208, Cupertino, CA 95014
Citizenship: Canadian
Post Office Address: 19500 Pruneridge Ave #6208, Cupertino, CA 95014

ASSIGNMENT

WHEREAS, I, Vasudevan Ganesan, hereinafter referred to as "ASSIGNOR", have invented certain new and useful improvements as described and set forth in the below-identified application for United States Letters Patent:

Title of Invention: **MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLER**

Date of execution of application: _____ Filing Date: Serial No.:

WHEREAS, Hava Corporation, a corporation of the State of California, 19500 Pruneridge Ave., #6208, Cupertino, California 95014 hereinafter referred to as "ASSIGNEE", is desirous of acquiring the entire right, title and interest in said invention and application and in any Letters Patent which may be granted on the same;

NOW THEREFORE, TO ALL WHOM IT MAY CONCERN: Be it known that, for good and valuable consideration, receipt of which is hereby acknowledged, Assignor have sold, assigned and transferred, and by these presents do sell, assign and transfer unto said Assignee, and Assignee's successors and assigns, all right, title and interest in and to said invention, said application for United States Letters Patent, and any Letters Patent which may hereafter be granted on the same in the United States and all countries throughout the world including any divisions, renewals, continuations in whole or in part, substitutions, conversions, reissues, prolongations or extensions thereof, said interest to be held and enjoyed by said Assignee as fully and exclusively as it would have been held and enjoyed by said Assignors had this assignment and transfer not been made, to the full end and term of any Letters Patent.

Assignor further agree that they will, without charge to said Assignee, but at Assignee's expense, cooperate with Assignee in the prosecution of said application and/or applications, execute, verify, acknowledge and deliver all such further papers, including applications for Letters Patent and for the reissue thereof, and instruments of assignment and transfer thereof, and will perform such other acts as Assignee lawfully may request, to obtain or maintain Letters Patent for said invention and improvement in any and all countries, and to vest title thereto in said Assignee, or Assignee"s successors and assigns.

IN TESTIMONY WHEREOF, Assignor have hereunto signed their names to this assignment on the dates indicated below.

Vasudevan Ganesan — JAN. 11, 06
Date

STATE OF California
COUNTY OF Santa Clara
On Jan. 11, 2006 before me, Danielle Rae Dalton,
personally appeared Vasudevan Ganesan,
☐ personally known to me - **OR** ☒ proved to me on the basis of satisfactory evidence to be the person(s) whose names 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.

SEAL

Signature of Notary Public

DANIELLE RAE DALTON
Commission # 1615380
Notary Public — California
Santa Clara County
My Comm. Expires Oct 22, 2009

ASSIGNMENT

WHEREAS, Hava Corporation, a corporation of the State of California, hereinafter referred to as "ASSIGNOR", has acquired title by previous assignment to the below-identified application for United States Letters Patent:

Title of Invention: **MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLER**

Date of Execution: _____ Filing Date: January 11, 2006 Serial No.: 11/330,675

WHEREAS, Vasu Networks Corporation, a corporation of the State of California,19500 Pruneridge Ave., #6208, Cupertino, CA 95014, hereinafter referred to as "ASSIGNEE", is desirous of acquiring the entire right, title and interest in said invention and application and in any Letters Patent which may be granted on the same;

NOW THEREFORE, TO ALL WHOM IT MAY CONCERN: Be it known that, for good and valuable consideration, receipt of which is hereby acknowledged, Assignor has sold, assigned and transferred, and by these presents does sell, assign and transfer unto said Assignees, and Assignee successors and assigns, all right, title and interest in and to said invention, said application for United States Letters Patent, and any Letters Patent which may hereafter be granted on the same in the United States and all countries throughout the world including any divisions, renewals, continuations in whole or in part, substitutions, conversions, reissues, prolongations or extensions thereof, said interest to be held and enjoyed by said Assignees as fully and exclusively as it would have been held and enjoyed by said Assignor had this assignment and transfer not been made, to the full end and term of any Letters Patent.

Assignor further agrees that it will, without charge to said Assignee, but at Assignee's expense, cooperate with Assignee in the prosecution of said application and/or applications, execute, verify, acknowledge and deliver all such further papers, including applications for Letters Patent and for the reissue thereof, and instruments of assignment and transfer thereof, and will perform such other acts as Assignee lawfully may request, to obtain or maintain Letters Patent for said invention and improvement in any and all countries, and to vest title thereto in said Assignee, or Assignee's successors and assigns.

IN TESTIMONY WHEREOF, Assignor has hereunto signed their name to this assignment on the date indicated below.

Hava Corporation

_____ oct. 06, 2010

Vasu Ganesan Date
President/CEO

STATE OF California

COUNTY OF Santa Clara

On October 6, 2010 Before me, Paulette Fernandez, a notary public, personally appeared Vasu Ganesan, who 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.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

SEAL

_____
Signature of Notary Public

PAULETTE L. FERNANDEZ
Commission # 1870555
Notary Public - California
Santa Clara County
My Comm. Expires Dec 2, 2013

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLER
First Named Inventor/Applicant Name:	Vasudevan Ganesan
Filer:	Jonathan O Owens
Attorney Docket Number:	HAVA-00402
Filed as Small Entity	

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Utility filing Fee (Electronic filing)	4011	1	70	70
Utility Search Fee	2111	1	300	300
Utility Examination Fee	2311	1	360	360
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**730**

Electronic Acknowledgement Receipt	
EFS ID:	20377598
Application Number:	14510766
International Application Number:	
Confirmation Number:	2888
Title of Invention:	MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLER
First Named Inventor/Applicant Name:	Vasudevan Ganesan
Customer Number:	28960
Filer:	Jonathan O Owens
Filer Authorized By:	
Attorney Docket Number:	HAVA-00402
Receipt Date:	09-OCT-2014
Filing Date:	
Time Stamp:	16:31:40
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$730
RAM confirmation Number	2921
Deposit Account	081275
Authorized User	OWENS, JONATHAN O.
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees) Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)	

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal of New Application	Transmittal_10_9_2014.pdf	14775 15e236b5284729198bd662e5c0b9234f56a59425	no	3
Warnings:					
Information:					
2	Application Data Sheet	DataSheet_10_9_2014.pdf	1561381 f36a1c684ddf934f84d8c83877add999c63e87fa	no	7
Warnings:					
Information:					
3		Preliminary_Amendment_10_9_2014.pdf	47851 3dde513db22f592df83b5954b8367e9ebbcafe06	yes	10

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Preliminary Amendment	1	9
	Applicant Arguments/Remarks Made in an Amendment	10	10

Warnings:					
Information:					
4	Drawings-other than black and white line drawings	Annotated_Sheet_10_9_2014.pdf	1413745 506cdf1c75a0b4f696ec370258589ab3ff488a22	no	1
Warnings:					
Information:					
5	Drawings-only black and white line drawings	Replacement_Sheet_10_9_2014.pdf	48914 7b3f04f45641b4874f2aa57562f253962951db94	no	1
Warnings:					
Information:					
6		Specification_10_9_2014.pdf	2722133 3e74f5f5b0973c23093a1e3045b3d3b43149f010	yes	30

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**

	Specification		1		21
	Claims		22		29
	Abstract		30		30
Warnings:					
Information:					
7	Drawings-only black and white line drawings	Figures_10_9_2014.pdf	102578 3693bcc97ce29f6abb5b079a122b59246b3fa3f3	no	2
Warnings:					
Information:					
8	Oath or Declaration filed	Declaration_10_9_2014.pdf	125167 570e6702a849c987f2c23fcc5dc77015258fd4f9	no	1
Warnings:					
Information:					
9	Assignee showing of ownership per 37 CFR 3.73.	Assignment_A_10_9_2014.pdf	120019 c0125663f4deeeff913929609bc7a188ea01bb5c	no	1
Warnings:					
Information:					
10	Assignee showing of ownership per 37 CFR 3.73.	Assignment_B_10_9_2014.pdf	91617 2df6a8868917210ed350001660c030f28720cbd4	no	1
Warnings:					
Information:					
11	Fee Worksheet (SB06)	fee-info.pdf	33016 b9ad4de4500a0100b2296b9fd505ed19d4ea1b05	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	6281196		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
14/510,766	10/09/2014	2414	730	HAVA-00402	19	3

CONFIRMATION NO. 2888

28960
HAVERSTOCK & OWENS LLP
162 N WOLFE ROAD
SUNNYVALE, CA 94086

FILING RECEIPT

OC00000071368162

Date Mailed: 10/16/2014

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

Vasudevan Ganesan, Cupertino, CA;

Applicant(s)

Vasu Networks Corporation, Cupertino, CA

Power of Attorney: None

Domestic Priority data as claimed by applicant

This application is a CON of 13/240,776 09/22/2011
which is a DIV of 11/330,675 01/11/2006 PAT 8078164 *
which claims benefit of 60/643,829 01/14/2005
and is a CIP of 11/031,498 01/06/2005 PAT 7991399
which claims benefit of 60/534,466 01/06/2004
(*)Data provided by applicant is not consistent with PTO records.

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

If Required, Foreign Filing License Granted: 10/15/2014
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 14/510,766**
Projected Publication Date: To Be Determined - pending completion of Corrected Papers
Non-Publication Request: No
Early Publication Request: No

** SMALL ENTITY **

Title

MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLER

Preliminary Class

370

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

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Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 14/510,766

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	70		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	300		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	360		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	19 minus 20 =	*	x 40 =	0.00	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 minus 3 =	*	x 210 =	0.00			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			0.00			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0.00			
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	730		TOTAL	

APPLICATION AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)		RATE($)	ADDITIONAL FEE($)
Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/510,766	10/09/2014	Vasudevan Ganesan	HAVA-00402

CONFIRMATION NO. 2888

28960
HAVERSTOCK & OWENS LLP
162 N WOLFE ROAD
SUNNYVALE, CA 94086

FORMALITIES LETTER

OC000000071368163

Date Mailed: 10/16/2014

NOTICE TO FILE CORRECTED APPLICATION PAPERS

Filing Date Granted

An application number and filing date have been accorded to this application. The application is informal since it does not comply with the regulations for the reason(s) indicated below. Applicant is given TWO MONTHS from the date of this Notice within which to correct the informalities indicated below. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

The required item(s) identified below must be timely submitted to avoid abandonment:

- A substitute specification excluding claims in compliance with 37 CFR 1.52, 1.121(b)(3), and 1.125 is required. The substitute specification must be submitted with markings and be accompanied by a clean version (without markings) as set forth in 37 CFR 1.125(c) and a statement that the substitute specification contains no new matter (see 37 CFR 1.125(b)). Since a preliminary amendment was present on the filing date of the application and such amendment is part of the original disclosure of the application, the substitute specification must include all of the desired changes made in the preliminary amendment. See 37 CFR 1.115 and 1.215.

Applicant is cautioned that correction of the above items may cause the specification and drawings page count to exceed 100 pages. If the specification and drawings exceed 100 pages, applicant will need to submit the required application size fee.

Items Required To Avoid Processing Delays:

Applicant is notified that the above-identified application contains the deficiencies noted below. No period for reply is set forth in this notice for correction of these deficiencies. However, if a deficiency relates to the inventor's oath or declaration, the applicant must file an oath or declaration in compliance with 37 CFR 1.63, or a substitute statement in compliance with 37 CFR 1.64, executed by or with respect to each actual inventor no later than the expiration of the time period set in the "Notice of Allowability" to avoid abandonment. See 37 CFR 1.53(f).

A new inventor's oath or declaration that identifies this application (e.g., by Application Number and filing date) is required. The inventor's oath or declaration does not comply with 37 CFR 1.63 in that it:

- does not state that the above-identified application was made or authorized to be made by the person executing the oath or declaration.

  Vasudevan Ganesan

Replies must be received in the USPTO within the set time period or must include a proper Certificate of Mailing or Transmission under 37 CFR 1.8 with a mailing or transmission date within the set time period. For more information and a suggested format, see Form PTO/SB/92 and MPEP 512.

Replies should be mailed to:

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Registered users of EFS-Web may alternatively submit their reply to this notice via EFS-Web, including a copy of this Notice and selecting the document description "Applicant response to Pre-Exam Formalities Notice". https://sportal.uspto.gov/authenticate/AuthenticateUserLocalEPF.html

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/nhassani/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	14510766
	Filing Date	2014-10-09
	First Named Inventor	Ganesan, Vasudevan
	Art Unit	
	Examiner Name	Not Yet Assigned
	Attorney Docket Number	HAVA-00402

U.S.PATENTS						Remove
Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6009328		1999-12-28	Muszynski	
	2	6175737	B1	2001-01-16	Kao	
	3	6195543	B1	2001-02-27	Granberg	
	4	6473413	B1	2002-10-29	Chiou et al.	
	5	6515983	B1	2003-02-04	Utas	
	6	6553022	B2	2003-04-22	Hartmaier	
	7	6754833	B1	2004-06-22	Black et al.	
	8	6584087	B1	2003-06-24	Czaja et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14510766
	Filing Date	2014-10-09
	First Named Inventor	Ganesan, Vasudevan
	Art Unit	
	Examiner Name	Not Yet Assigned
	Attorney Docket Number	HAVA-00402

	9	6795700	B2	2004-09-21	Karaoguz et al.	
	10	6862444	B2	2005-03-01	Karaoguz et al.	
	11	6996107	B2	2006-02-07	Janoska	
	12	7127232	B2	2006-10-24	O'Neil et al.	
	13	7142847	B2	2006-11-28	Umeda et al.	
	14	7254119	B2	2007-08-07	Jiang et al.	
	15	7382763	B2	2008-06-03	Ludwig et al.	
	16	7398088	B2	2008-07-07	Belkin et al.	
	17	7483984	B1	2009-01-27	Jonker et al.	
	18	7512796	B2	2009-03-31	Haverninen et al.	
	19	8041360	B2	2011-10-18	Ibe et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14510766
	Filing Date	2014-10-09
	First Named Inventor	Ganesan, Vasudevan
	Art Unit	
	Examiner Name	Not Yet Assigned
	Attorney Docket Number	HAVA-00402

	20	6754833	B1	2004-06-22	Black et al.	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20010049790	A1	2001-12-06	Faccin et al.	
	2	20020078174	A1	2002-06-20	Sim et al.	
	3	20020085516	A1	2002-07-04	Bridgelall	
	4	20020114305	A1	2002-08-22	Oyama et al.	
	5	20020147008	A1	2002-10-10	Kallio	
	6	20020150228	A1	2002-10-17	Umeda et al.	
	7	20030083079	A1	2003-05-01	Clark et al.	
	8	20030086366	A1	2003-05-08	Branlund et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14510766
	Filing Date	2014-10-09
	First Named Inventor	Ganesan, Vasudevan
	Art Unit	
	Examiner Name	Not Yet Assigned
	Attorney Docket Number	HAVA-00402

	9	20030087629		2003-05-08	Juitt et al.	
	10	20030112766	A1	2003-06-19	Riedel et al.	
	11	20030157899	A1	2003-08-21	Trossen et al.	
	12	20030177196	A1	2003-09-18	Bhasin et al.	
	13	20030185172	A1	2003-10-02	Rue	
	14	20030217007	A1	2003-11-20	Fukushima et al.	
	15	20030217091	A1	2003-11-20	Echigo et al.	
	16	20030224792	A1	2003-12-04	Verma et al.	
	17	20030232615	A1	2003-12-18	Kim et al.	
	18	20040005878	A1	2004-01-08	Olin et al.	
	19	20040030791	A1	2004-02-12	Dorenbosch et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14510766
	Filing Date	2014-10-09
	First Named Inventor	Ganesan, Vasudevan
	Art Unit	
	Examiner Name	Not Yet Assigned
	Attorney Docket Number	HAVA-00402

	20	20040085959	A1	2004-05-06	Ohkawa	
	21	20040087307	A1	2004-05-06	Ibe et al.	
	22	20040105424	A1	2004-06-03	Skoczkowski	
	23	20040114559	A1	2004-06-17	Wang	
	24	20040127208	A1	2004-07-01	Nair et al.	
	25	20040132427	A1	2004-07-08	Lee et al.	
	26	20040137902	A1	2004-07-15	Chaskar et al.	
	27	20040174880	A1	2004-09-09	White et al.	
	28	20040203666	A1	2004-10-14	Foster et al.	
	29	20040203788	A1	2004-10-14	Fors et al.	
	30	20040203802	A1	2004-10-14	McCormick et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14510766
	Filing Date	2014-10-09
	First Named Inventor	Ganesan, Vasudevan
	Art Unit	
	Examiner Name	Not Yet Assigned
	Attorney Docket Number	HAVA-00402

	31	20040204097	A1	2004-10-14	Scheinert et al.	
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CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

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☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

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SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Jonathan O. Owens/	Date (YYYY-MM-DD)	2014-11-04
Name/Print	Jonathan O. Owens	Registration Number	37902

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(19) Bundesrepublik Deutschland
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(71) Name und Wohnsitz des Inhabers:
InterDigital Technology Corporation, Wilmington, Del., US

(74) Name und Wohnsitz des Vertreters:
FROHWITTER Patent- und Rechtsanwälte, 81679 München

Die folgenden Angaben sind den vom Anmelder eingereichten Unterlagen entnommen

(54) Bezeichnung: **Vorrichtung für die Übergabe zwischen einem universellen drahtlosen lokalen Netzwerk (WLAN) und einem universellen mobilen Telekommunikationssystem (UMTS)**

(57) Hauptanspruch: In Kombination, ein Teilnehmergerät (UE), das in der Lage ist, eine automatische Übergabe des UE von einem ersten System an ein zweites System durchzuführen, wobei dieses erste System eines von einem universellen mobilen Telekommunikationssystem (UMTS) und einem drahtlosen lokalen Netzwerk (WLAN) ist, und das zweite System das andere von einem UMTS und WLAN ist, umfassend:

dieses erste System, umfassend:

Mittel zum Senden einer Liste von zweiten Systemen, die für die Kommunikation verfügbar sind;

dieses UE, umfassend:

Mittel zum Empfangen und Speichern einer Liste dieser zweiten Systeme, die innerhalb einer Zelle verfügbar sind, in der sich das UE befindet;

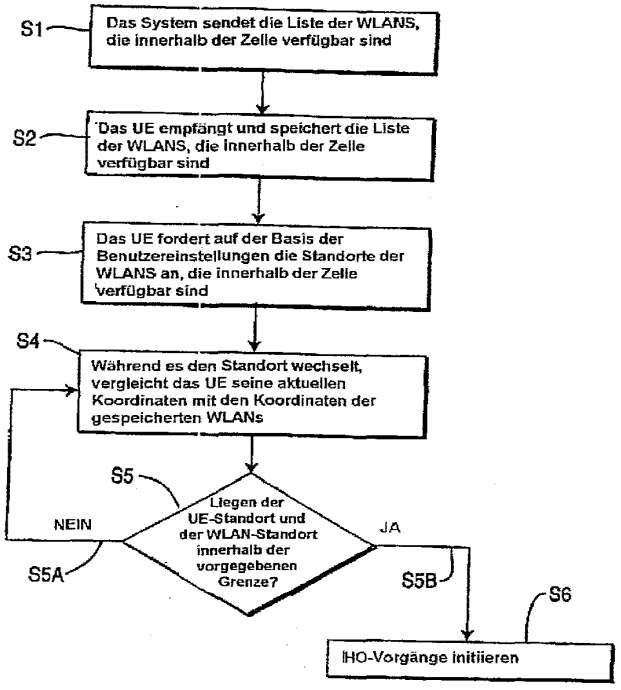
Mittel zum Anfordern verfügbarer bevorzugter zweiter Systeme;

Mittel zum Anfordern der Standorte der zweiten Systeme, die in dieser Zelle verfügbar sind und auf die Initialisierungsmittel ansprechen;

Mittel zum Bereitstellen der Koordinaten des UE;

Mittel zum Vergleichen der Koordinaten des UE mit den im UE gespeicherten Koordinaten der zweiten Systeme; und

Mittel zum Initiieren eines Übergabevorgangs, wenn der Vergleichsvorgang ergibt, daß das zweite System innerhalb einer vorgegebenen Grenze liegt.



Beschreibung

[0002] BESCHREIBUNG DES STAND DER TECHNIK

[0001] Die vorliegende Erfindung betrifft WLAN- und UMTS-Systeme. Insbesondere betrifft diese Erfindung Vorrichtungen und Techniken für die automatische Übergabe zwischen WLAN- und UMTS-Systemen.

[0002] Die Auslösung eines Übergabevorgangs zwischen einem UMTS-System und einem WLAN-System kann durch einen manuellen Übergabevorgang erfolgen, der vom Benutzer eingeleitet wird, wobei dem Benutzer das Vorhandensein eines WLAN-Versorgungsbereichs am aktuellen geographischen Ort bekannt ist er seinen WLAN-Anschluß „einschaltet".

[0003] Es ist jedoch sehr wünschenswert, einen automatischen Übergabevorgang bereitzustellen.

ZUSAMMENFASSUNG DER ERFINDUNG

[0004] Die vorliegende Erfindung ist dadurch gekennzeichnet, daß sie eine automatische Übergabevorrichtung bereitstellt, die entweder UE-initiiert oder systeminitiiert sein kann.

[0005] Bezüglich der UE-initiierten Vorrichtung erkennt das UE das Vorhandensein einer WLAN-Footprint und initiiert den Übergabevorgang (HO-Vorgang) auf der Basis einer Benutzereinstellung. Alternativ dazu kann das UE die Orte der WLAN-Versorgungsbereiche verfolgen und den HO-Vorgang innerhalb eines bestimmten Bereichs vom WLAN initiieren.

[0006] Die systeminitiierte Vorrichtung führt folgendes durch:

[0007] Leistungsmessungen, die vom UE durch das System angefordert werden, die einen Satz aller WLAN-Frequenzen enthalten. Das System- initiiert die HO-Vorgänge auf der Basis einer Gruppe von Kriterien, zu denen die Mobilität des UE und die gewünschten Anwendungen gehören, wenn das UE sich innerhalb des WLAN-Versorgungsbereichs befindet.

[0008] In einer anderen Ausführungsform verfolgt das System den UE-Standort und initiiert die HO-Vorgänge auf der Basis einer Gruppe von Kriterien, zu denen die Mobilität des UE und die angeforderten Anwendungen gehören, wenn das UE sich innerhalb des WLAN-Versorgungsbereichs be findet .

KURZE BESCHREIBUNG DER ZEICHNUNGEN

[0009] Die vorliegende Erfindung wird durch die ausführliche Beschreibung und die Zeichnungen verständlich, wobei gleiche Elemente durch gleiche Bezugszeichen bezeichnet werden, und wobei:

[0010] **Fig.** 1 ein Flußdiagramm ist, das eine US-initiierte Übergabe von einem UMTS an ein WLAN zeigt.

[0011] **Fig.** 2 ein Flußdiagramm ist, das eine US-initiierte Übergabe von einem UMTS an ein WLAN zeigt, die standortbasierend ist.

[0012] **Fig.** 3 ein Flußdiagramm ist, das eine US-initiierte Übergabe von einem UMTS an ein WLAN zeigt, die leistungsbasierend ist.

[0013] **Fig.** 4 ein Flußdiagramm ist, das eine US-initiierte Übergabe von einem UMTS an ein WLAN zeigt, die leistungsbasierend ist, wobei kein Senden stattfindet.

[0014] **Fig.** 5 ein Flußdiagramm ist, das eine US-initiierte Übergabe von einem WLAN an ein UMTS zeigt, die eine WLAN-Sendetechnik verwendet.

[0015] **Fig.** 6 ein Flußdiagramm ist, das eine US-initiierte Übergabe von einem WLAN an ein UMTS zeigt, wobei kein Senden stattfindet.

[0016] **Fig.** 7 ein Flußdiagramm ist, das eine UMTS-systeminitiierte Übergabe eines UE von einem UMTS an ein WLAN zeigt, die leistungsbasierend ist

AUSFÜHRLICHE BESCHREIBUNG DER BEVORZUGTEN AUSFÜHRUNGSFORM(EN)

[0017] Eine UE-initiierte Übergabe von einem UMTS **12** an ein WLAN **14** wird im Flußdiagramm von **Fig.** 1 dargestellt, wobei das System (UMTS) in Schritt S1 eine Liste der WLANs sendet, die in der Zelle verfügbar sind, in der sich das UE **10** befindet. In Schritt S2 empfängt und speichert das UE **10** eine Liste aller WLANs, die in dieser Zelle verfügbar sind. In Schritt S3 fordert das UE **10** die Standorte der WLANs an, die in dieser Zelle verfügbar sind, wobei diese Anforderung auf Benutzereinstellungen basiert. In Schritt S4 vergleicht das UE **10**, während es seinen Standort wechselt, seine aktuellen Koordinaten mit den Koordinaten der gespeicherten WLANs. In Schritt S5 wird bestimmt, ob der Standort. des UE **10** und der Standort des WLAN **14** innerhalb einer vorgegebenen Grenze liegen. Wenn nicht, springt das Programm in Schritt S5A zu Schritt S4 zurück. Falls die Standorte des UE **10** und des WLAN **14** innerhalb der vorgegebenen Grenze liegen, springt das Programm in Schritt S5B zu Schritt S6, wonach der Übergabevorgang (HO-Vorgang) initiiert wird.

[0018] **Fig.** 2 zeigt eine detailliertere UE-initiierte Übergabetechnik, die standortbasierend ist, wobei die Schritte des Vorgangs zwischen UE **10**, UMTS **12** und WLAN **14** stattfinden.

[0019] In Schritt S1 hört UE **10** den Sendesteuerkanal (BCCH) ab. In Schritt S2 sendet UMTS **12** eine Liste der verfügbaren WLANs. In Schritt S3 empfängt und speichert UE **10** die WLAN–Liste, UE **10** initiiert die Erfassung der Standorte der bevorzugten WLANs auf der Basis der voreingestellten Benutzereinstellungen und fordert in Schritt S4 an, daß UMTS **12** die Standorte der bevorzugten WLANs sendet. In Schritt S5 ruft UMTS **12** die Standortinformation ab und versorgt UE **10** in Schritt S6 mit einer Liste der WLANs und ihrer zugehörigen Standorte.

IPR2025-00447 Page 00083

[0020] In Schritt S7 überwacht UE **10** die Standortinformation und initiiert eine Übergabe (HO), wenn UE **10** sich im WLAN-Versorgungsbereich befindet, wobei UE **10** in Schritt 58 den WNAN-Dienst zum WLAN **14** initiiert.

[0021] WLAN **14** authentifiziert in Schritt S9 das UE **10** durch einen Informationsaustausch mit UMTS **12** in Schritt S10 und gewährt in Schritt S11 der UE **10** je nach Interworking-Fall den Zugang und kann je nach Interworking-Fall eine neue Internetprotokoll (IP)-Adresse bereitstellen.

[0022] In Schritt S12 initiiert UE **10** durch UMTS **12** die Übergabe an das WLAN, wobei in Schritt S13 durch eine Kommunikationsverbindung zwischen UMTS **12** und WLAN **14** das Routing von Daten durchgeführt wird.

[0023] In Schritt S14 gibt UMTS **12** eine Meldung an UE **10** aus, daß der Übergabevorgang abgeschlossen ist, und in Schritt S15 werden die Dienste auf dem WLAN-System **14** zwischen UE **10** und WLAN **14** fortgesetzt.

[0024] **Fig.** 3 zeigt eine andere Technik für eine UEinitiierte Übergabe von einem UMTS **12** an ein WLAN **14**, wobei UE **10'** eine Kommunikationsfähigkeit von **10a'** mit dem UMTS **12** und von **10b'** mit dem WLAN **14** aufweist.

[0025] In Schritt S1 hört UE **10'** den Sendekanal (BCCH) ab, in Schritt S2 sendet UMTS **12** eine Liste der verfügbaren WLANs in den Kanal.

[0026] In Schritt S3 empfängt UE **10'** die WLAN-Frequenzliste und speichert diese. In Schritt S4 initialisiert UE **10'** die Funkeinheit **10b'** und sendet in Schritt S5 die WLAN-Frequenzliste an **10b'**. In Schritt S6 überwacht der WLAN-Empfänger **10b'** die WLAN-Kanäle, schaltet in Schritt S7 einen WLAN-Kanal auf und initiiert in Schritt S8 den WLAN-Dienst mit WLAN **14**.

[0027] In Schritt S9 authentifiziert WLAN **14** das UE **10'** durch einen Informationsaustausch mit UMTS **12** in Schritt S10. In Schritt S11 gewährt WLAN **14** den Zugang zum WLAN-Dienst und kann je nach Interworking-Fall eine neue IP-Adresse zuweisen. In Schritt S12 wird die Übergabe zwischen **10b'** und **10a'** initiiert, und **10a'** initiiert in Schritt S13 die Übergabe an WLAN **14** durch das UMTS **12**, das in Schritt S14 das Routing von Daten zum WLAN **14** durchführt.

[0028] In Schritt S15 meldet UMTS **12** der Einheit **10a'**, daß der Übergabevorgang abgeschlossen ist, in Schritt S16 meldet **10b'**, daß der H0-Vorgang abgeschlossen ist, wonach in Schritt S17 die Dienste des WLAN-Systems zwischen UE **10'** und dem WLAN **14** wieder aufgenommen werden.

[0029] **Fig.** 4 zeigt eine UE-initiierte Übergabetechnik von UMTS **12** zum WLAN **14**, wobei das in **Fig.** 4 gezeigte UE **10'** ähnlich aufgebaut ist wie das in **Fig.** 3 gezeigte UE **10'**. In dieser Ausführungsform ist die Übergabe leistungsbasierend, und es findet kein Senden statt.

[0030] In Schritt S1 wird das vermittelte Datenpaket (PS) von der Einheit **10a'** angehängt, und in Schritt S2 wird die Leistung von **10b'** eingeschaltet. Die Einheit **10a'** initialisiert in Schritt S3 die Funkeinheit von **10b'**, worauf der Empfänger von **10b'** in Schritt S4 die WLAN-Kanäle überwacht, in Schritt S5 einen WLAN-Kanal aufschaltet und in Schritt S6 den WLAN-Dienst mit WLAN **14** initialisiert.

[0031] WLAN **14** authentifiziert UE **10'** in Schritt S7, durch einen Authentifizierungsvorgang mit UMTS **12** in Schritt S8, und gewährt in Schritt S9 Zugang zum WLAN-Dienst und kann je nach Interworking-Fall eine neue IP-Adresse zuweisen.

[0032] In Schritt S10 initiiert Einheit **10b'** die Übergabe (HO) mit Einheit **10a'**, die in Schritt S11 durch UMTS **12** die Übergabe zu WLAN **14** initiiert, die in Schritt S12 zwischen UMTS **12** und WLAN **14** geroutet wird, und in Schritt S13 meldet UMTS **12** der Einheit **10a'**, daß der Übergabevorgang abgeschlossen ist. In Schritt S14 meldet Einheit **10a'** der Einheit **10b'**, daß die Übergabe abgeschlossen ist, wonach in Schritt S15 die Dienste auf dem WLAN-Systems zwischen UE **10'** und WLAN **14** wieder aufgenommen werden.

[0033] **Fig.** 5 zeigt eine andere UE-initiierte Übergabetechnik, die eine WLAN-Sendung verwendet. UE **10'** entspricht UE **10'** in **Fig.** 3 und 4.

[0034] In Schritt 1 hört das UE durch Einheit **10b'** die Sendung ab, wobei in Schritt S2 die Liste der verfügbaren UMTSs durch WLAN **14** gesendet wird. In Schritt S3 empfängt und speichert UE **10'** durch Einheit **10b'** die UMTS-Frequenzliste und initiiert in Schritt S4 die Übergabe (HO), die vom Benutzer oder auf der Basis der Signalqualität initiiert wurde, wenn die HO eingeleitet wurde, wählt der Benutzer eine vorgegebene Einstellung. Wenn die Signalqualität als Kriterium verwendet wird, wird eine Messung der Signalqualität durchgeführt und die HO wird initiiert, wenn die Signalqualität einen bestimmten Schwellwert erreicht.

[0035] Nach Initiierung der Übergabe bewirkt **10b'** in Schritt S5 die Funkinitialisierung der Einheit **10a'**. In Schritt S6 startet die Einheit **10a'** die UMTS-Dienst-Initialisierung, der angehängte Datenpakete (PS), Packetdatenprotokoll (PDP)-Kontext und so weiter umfaßt. In Schritt S7 schließt UMTS **12** die Initialisierung ab, indem es der Einheit **10a'** meldet, daß die Initialisierung erfolgreich war. In Schritt S8 initiiert UE **10'** durch Einheit **10b'** die Übergabe an das UMTS (Dienstkontinuität). In Schritt S9 wird das Routing von Daten zwischen dem WLAN **14** und UMTS **12** durchgeführt, worauf in Schritt S10 WLAN **14** der Einheit **10b'** meldet, daß die Übergabe abgeschlossen ist (und erfolgreich war). In Schritt S11 meldet Einheit **10b'** meldet der Einheit **10a'**, daß die Übergabe abgeschlossen ist, und schaltet den WLAN-Empfänger in Schritt S12 aus, wonach in Schritt S13 die Dienste auf dem WLAN-System zwischen UMTS **12** und der Einheit **10a'** wieder aufgenommen werden.

[0036] **Fig.** 6 zeigt eine UE-initiierte Übergabe von

IPR2025-00447 Page 00084

einem WLAN **14** an ein UMTS **12**. In dieser Ausführungsform initiiert UE **10'** in Schritt S1 durch die Einheit **10b'** eine Übergabe entweder durch den Benutzer oder automatisch, abhängig von der Signalqualität, wobei diese Vorgänge im wesentlichen denen entsprechen, die in Verbindung mit Schritt S4 in der Ausführungsform von **Fig.** 5 beschrieben wurden.

[0037] Einheit **10b'** bewirkt in Schritt S2 die Funkinitialisierung von **10a'**, die in Schritt S3 das UMTS-System **12** aufschaltet, und führt den UMTS-Dienst und die Initialisierung aus, wobei dieser Schritt im wesentlichen dem Schritt S6 in der Ausführungsform von **Fig.** 5 entspricht. Danach werden die Schritte S5 bis S11 von **Fig.** 6 durchgeführt, die im wesentlichen den Schritten S7 bis S14 in **Fig.** 5 entsprechen, wobei der Unterschied zwischen den Ausführungsformen von **Fig.** 5 und **Fig.** 6 darin liegt, daß in der Ausführungsform von **Fig.** 6 keine WLAN-Sendung statt findet .

[0038] **Fig.** 7 zeigt eine UMTS-systeminitiierte Übergabe von einem UMTS **12** zum WLAN **14**, wobei die Übergabetechnik leistungsbasierend ist.

[0039] In Schritt S1 hört UE **10'** durch Einheit **10a'** den Sendekanal (BCCH) ab, wobei UMTS **12** in Schritt S2 eine Liste der verfügbaren WLANS sendet. In Schritt S3 empfängt und speichert UE **10'** durch Einheit **10a'** die WLAN-Frequenzliste, initialisiert in Schritt S4 die Funkeinheit **10b'** und versorgt die Einheit **10b'** in Schritt S5 mit der Frequenzliste. Der WLAN-Empfänger bei Einheit **10b'** überwacht in Schritt S6 die WLAN-Kanäle, sendet in Schritt S7 einen Meßbericht an Einheit **10a'**, wobei dieser Bericht in Schritt S8 von Einheit **10a'** an UMTS **12** weitergeleitet wird.

[0040] UMTS **12** wählt in Schritt S9 ein spezifisches Ziel-WLAN und initiiert den Übergabevorgang, wobei es in Schritt S10 das Ziel-WLAN-System des Übergabevorgangs an Einheit **10a'** sendet.

[0041] UE **10'** meldet durch Einheit **10a'** der Einheit **10b'** das Ziel-WLAN-System, und in Schritt S12 schaltet der WLAN-Empfänger der Einheit **10b'** den WLAN-Kanal des Ziel-WLAN-Systems auf und kommuniziert mit WLAN **14**, um in Schritt S13 den WLAN-Dienst zu initiieren.

[0042] Das WLAN **14** authentifiziert UE **10'** in Schritt S14 durch Kommunikation mit dem UMTS **12**, und gewährt in Schritt S15 den Zugang, indem es mit Einheit **10b'** kommuniziert, die in Schritt S16 der Einheit **10a'** meldet, daß die Übergabe abgeschlossen ist. Die Einheit **10a'** meldet dem UMTS **12** in Schritt S17, daß die Übergabe an WLAN **14** abgeschlossen ist, wonach UMTS **12** in Schritt S18 das Routing von Daten zum WLAN **14** durchführt. In Schritt S19 meldet UMTS **12** der Einheit **10a'**, daß der Übergabevorgang abgeschlossen ist, wonach Einheit **10a'** in Schritt S20 der Einheit **10b'** meldet, daß der Vorgang abgeschlossen ist, wonach in Schritt S21 der Dienst auf dem WLAN-System zwischen UE **10'** und 14 aufgenommen wird.

Schutzansprüche

1. In Kombination, ein Teilnehmergerät (UE), das in der Lage ist, eine automatische Übergabe des UE von einem ersten System an ein zweites System durchzuführen, wobei dieses erste System eines von einem universellen mobilen Telekommunikationssystem (UMTS) und einem drahtlosen lokalen Netzwerk (WLAN) ist, und das zweite System das andere von einem UMTS und WLAN ist, umfassend:
dieses erste System, umfassend:
Mittel zum Senden einer Liste von zweiten Systemen, die für die Kommunikation verfügbar sind;
dieses UE, umfassend:
Mittel zum Empfangen und Speichern einer Liste dieser zweiten Systeme, die innerhalb einer Zelle verfügbar sind, in der sich das UE befindet;
Mittel zum Anfordern verfügbarer bevorzugter zweiter Systeme;
Mittel zum Anfordern der Standorte der zweiten Systeme, die in dieser Zelle verfügbar sind und auf die Initialisierungsmittel ansprechen;
Mittel zum Bereitstellen der Koordinaten des UE;
Mittel zum Vergleichen der Koordinaten des UE mit den im UE gespeicherten Koordinaten der zweiten Systeme; und Mittel zum Initiieren eines Übergabevorgangs, wenn der Vergleichsvorgang ergibt, daß das zweite System innerhalb einer vorgegebenen Grenze liegt.

2. In Kombination, ein Teilnehmergerät (UE), das in der Lage ist, eine Übergabe des UE von einem ersten System an ein zweites System durchzuführen, wobei dieses erste System eines von einem universellen mobilen Telekommunikationssystem (UMTS) und einem drahtlosen lokalen Netzwerk (WLAN) ist, und das zweite System das andere von einem UMTS und WLAN ist, umfassend:
dieses erste System, umfassend:
Mittel zum Senden einer Liste von zweiten Systemen, die verfügbar sind;
dieses UE, umfassend:
Mittel zum Kommunizieren mit dem ersten und zweiten System;
Mittel zum Empfangen und Speichern dieser Liste;
Mittel zum Überwachen der Kanäle der verfügbaren zweiten Systeme und zum Aufschalten eines Kanals, um auf diesem einen Kanal einen Dienst mit dem zweiten System zu initiieren;
dieses zweite System, umfassend:
Mittel zum Authentifizieren des UE und zum Gewähren des Zugangs;
wobei das UE außerdem umfaßt:
Mittel zum Initiieren der Übergabe an das zweite System durch Kommunikation mit einem ersten System;
dieses erste System, umfassend:
Mittel zum Routing von Daten durch das zweite System, und zum Melden an das UE, wenn der Übergabevorgang abgeschlossen ist; und

IPR2025-00447 Page 00085

wobei das UE außerdem umfaßt:
Mittel, um die Dienste mit dem zweiten System fortzusetzen, nach dem Empfang einer Meldung vom ersten System, daß der Übergabevorgang abgeschlossen ist.

3. Kombination nach Anspruch 2, wobei das Überwachungsmittel des UE umfaßt:
Mittel zum Vergleichen des Signals in diesem einen Kanal mit einem Schwellwert; und
Mittel zum Aufschalten dieses einen Kanals, wenn das Signal mindestens diesem Schwellwert entspricht.

4. In Kombination, ein bimodales Teilnehmergerät (UE), das in der Lage ist, mit einem drahtlosen lokalen Netzwerk (WLAN) zu kommunizieren, wenn es in einem WLAN-Modus ist, und mit einem universellen mobilen Telekommunikationssystem (UMTS), wenn es in einem UMTS-Modus ist, um die Übergabe des UE von einem WLAN an ein UMTS durchzuführen, umfassend:
dieses WLAN, umfassend:
Mittel zum Senden einer Liste der verfügbaren UMTS;
dieses UE, umfassend:
Mittel zum Betreiben im WLAN-Modus;
Mittel zum Empfangen und Speichern der UMTS-Liste, wenn es im WLAN-Modus ist;
Mittel zum Initiieren der Übergabe und zum Bewirken der Funkinitialisierung des UMTS-Modus;
Mittel zum Betreiben des UMTS im UMTS-Modus und Mittel zur Bereitstellen der UMTS-Dienst-Initialisierung an das UMTS, wenn es im UMTS-Modus ist;
dieses UMTS, umfassend:
Mittel zum Abschließen der Initialisierung;
wobei das UE außerdem umfaßt:
Mittel zum Initiieren einer Übergabe an das UMTS mit dem WLAN, wenn es im WLAN-Modus ist;
dieses WLRN, umfassend:
Mittel zum Routing von Daten zum UMTS;
Mittel zum Melden an das UE, daß die Übergabe abgeschlossen ist; und
wobei das UE außerdem umfaßt:
Mittel zum Beenden des WLAN-Modus und zum Fortsetzen der Dienste mit dem UMTS im UMTS-Modus.

5. In Kombination, ein bimodales Teilnehmergerät (UE), das in der Lage ist, mit einem drahtlosen lokalen Netzwerk (WLAN) zu kommunizieren, wenn es in einem WLAN-Modus ist, und mit einem universellen mobilen Telekommunikationssystem (UMTS), wenn es in einem UMTS-Modus ist, um die Übergabe des UE von einem WLAN an ein UMTS durchzuführen, umfassend:
dieses UE, umfassend:
Mittel zum Betreiben im WLAN-Modus;
Mittel zum Überwachen der WLAN-Kanäle, wenn es in einem WLAN-Modus ist;
Mittel zum Aufschalten eines WLAN-Kanals und Initiieren einer Übergabe und zum Bewirken der Funkinitialisierung des UMTS-Modus;
Mittel zum Betreiben des UE und des UMTS-Modus;
Mittel zum Bereitstellen der UMTS-Dienst-Initialisierung an das UMTS, wenn das UE im UMTS-Modus ist;
dieses UMTS, umfassend:
Mittel zum Abschließen der Initialisierung;
wobei das UE außerdem umfaßt:
Mittel zum Initiieren einer Übergabe an das UMTS mit dem WLAN, wenn es im WLAN-Modus ist;
dieses WLAN, umfassend:
Mittel zum Routing von Daten zu UMTS;
Mittel zum Melden an das UE, daß die Übergabe abgeschlossen ist; und
wobei das UE Mittel aufweist, um den WLAN-Modus zu beenden und Dienste von UMTS im UMTS-Modus zu erhalten.

6. Kombination nach Anspruch 5, wobei das UE-Mittel zum Aufschalten des WLAN-Kanals umfaßt:
Mittel zum Vergleichen des Signals in diesem einen Kanal mit einem Schwellwert; und
Mittel zum Aufschalten dieses einen Kanals, wenn das Signal mindestens diesem Schwellwert entspricht.

7. In Kombination, ein bimodales Teilnehmergerät (UE), das in der Lage ist, in einem drahtlosen lokalen Netzwerk (WLAN)-Modus und in einem universellen mobilen Telekommunikationssystem (UMTS)-Modus betrieben zu werden, und das in der Lage ist, eine Übergabe von einem UMTS an ein WLAN durchzuführen, umfassend:
dieses UMTS, umfassend:
Mittel zum Senden einer Liste von verfügbaren WLANs;
dieses UE, umfassend:
Mittel zum Betreiben im UMTS-Modus;
Mittel zum Empfangen und Speichern einer Liste von WLANs, wenn es UMTS-Modus ist;
Mittel zum Initialisieren von Funkvorgängen, wenn es im WLAN-Modus ist;
Mittel zum Bereitstellen, wenn es im UMTS-Modus ist, um im WLAN-Modus eine Liste der WLAN-Frequenzen bereitzustellen;
Mittel zum Überwachen der WLAN-Kanäle, wenn es im WLAN-Modus ist; und
Mittel zum Bereitstellen eines Meßberichts an das UMTS, wenn es im UMTS-Modus ist;
wobei das UMTS außerdem umfaßt:
Mittel zum Wählen eines Ziel-WLAN und zum Initiieren eines Übergabevorgangs;
Mittel zum Bereitstellen an das UE, im UMTS-Modus, eines Ziel-WLAN-Systems;
wobei das UE außerdem umfaßt:
Mittel zum Auslösen des WLAN-Modus, um den Kanal des Ziel-WLAN aufzuschalten und den

WLAN-Dienst zu initiieren, wenn es im UMTS-Modus ist;
wobei dieses UMTS und dieses WLAN Schnittstellenmittel aufweisen, um die Authentifizierung für den WLAN-Dienst zu ermöglichen, und das WLAN Mittel aufweist, um dem UE im WLAN-Modus den Zugang zu gewähren.
wobei das UE außerdem umfaßt:
Mittel, um dem UMTS-Modus zu melden, daß die Übergabe abgeschlossen ist, wenn das UE im WLAN-Modus ist; und
Mittel, um den Abschluß der Übergabe zu bestätigen, wenn es im UMTS-Modus ist; und
Mittel, um Dienste auf dem WLAN-System fortzusetzen, wenn es im WLAN-Modus ist.

8. In Kombination, ein Teilnehmergerät (UE), das in der Lage ist, eine Übergabe von einem ersten System an ein zweites System durchzuführen, wobei dieses erste System eines von einem UMTS und einem WLAN ist und das zweite System das andere von einem UMTS und einem WLAN ist, umfassend:
dieses erste System, umfassend:
Mittel zum Kommunizieren mit dem WLAN und dem UMTS;
das Senden einer Liste der Kanäle des zweiten Systems, die verfügbar sind;
dieses UE, umfassend:
Mittel zum Kommunizieren mit dem ersten System;
Mittel zum Empfangen und Speichern der Liste;
Mittel zum Überwachen der Kanäle des zweiten Systems und Aufschalten eines Kanals, wenn eine Signalqualität dieses einen Kanals einen bestimmten Schwellwert erreicht;
das zweite System, umfassend:
Mittel zum Authentifizieren des UE und Gewähren des Zugangs;
wobei dieses UE außerdem umfaßt:
Mittel zum Initiieren der Übergabe an das zweite System durch Kommunikation mit dem ersten System; das erste System, umfassend:
Mittel zum Routing von Daten durch das zweite System, und um dem UE zu melden, wenn der Übergabevorgang abgeschlossen ist; und
wobei dieses UE außerdem umfaßt:
Mittel, um die Dienste mit dem zweiten System fortzusetzen, nachdem vom ersten System die Meldung empfangen wurde, daß der Übergabevorgang abgeschlossen ist.

Es folgen 7 Blatt Zeichnungen

IPR2025-00447 Page 00087

Anhängende Zeichnungen

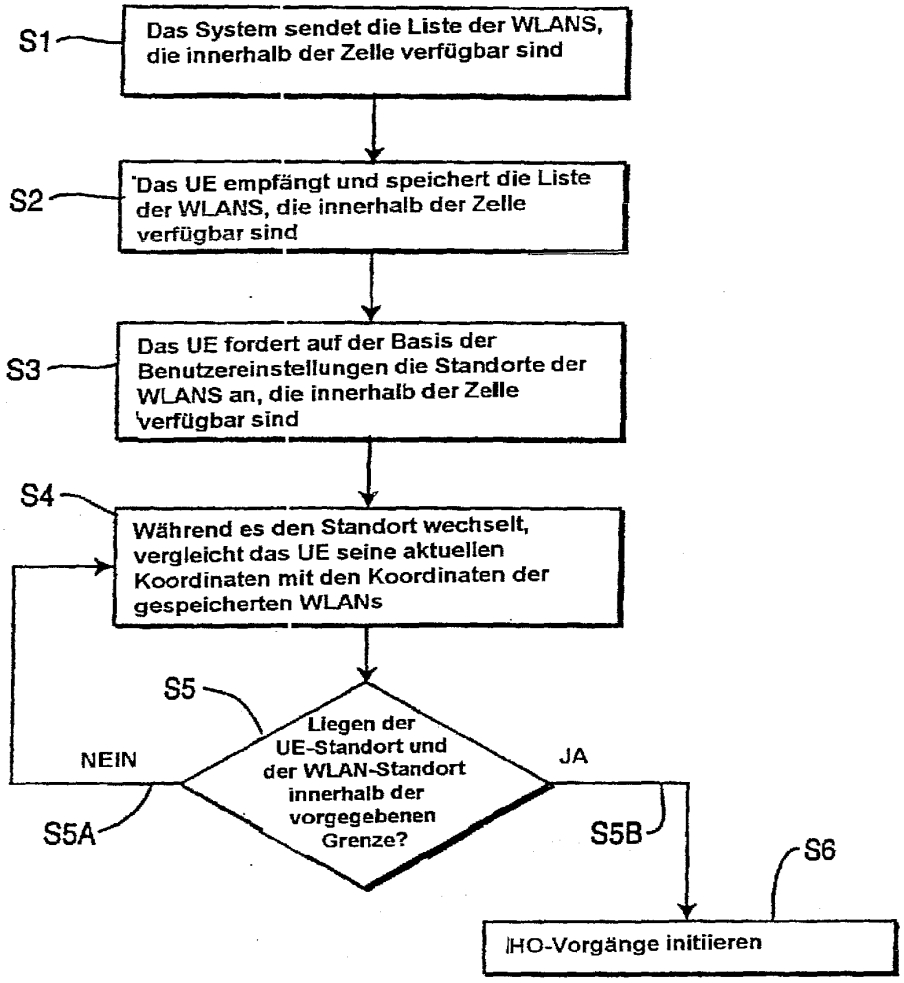


FIG. 1

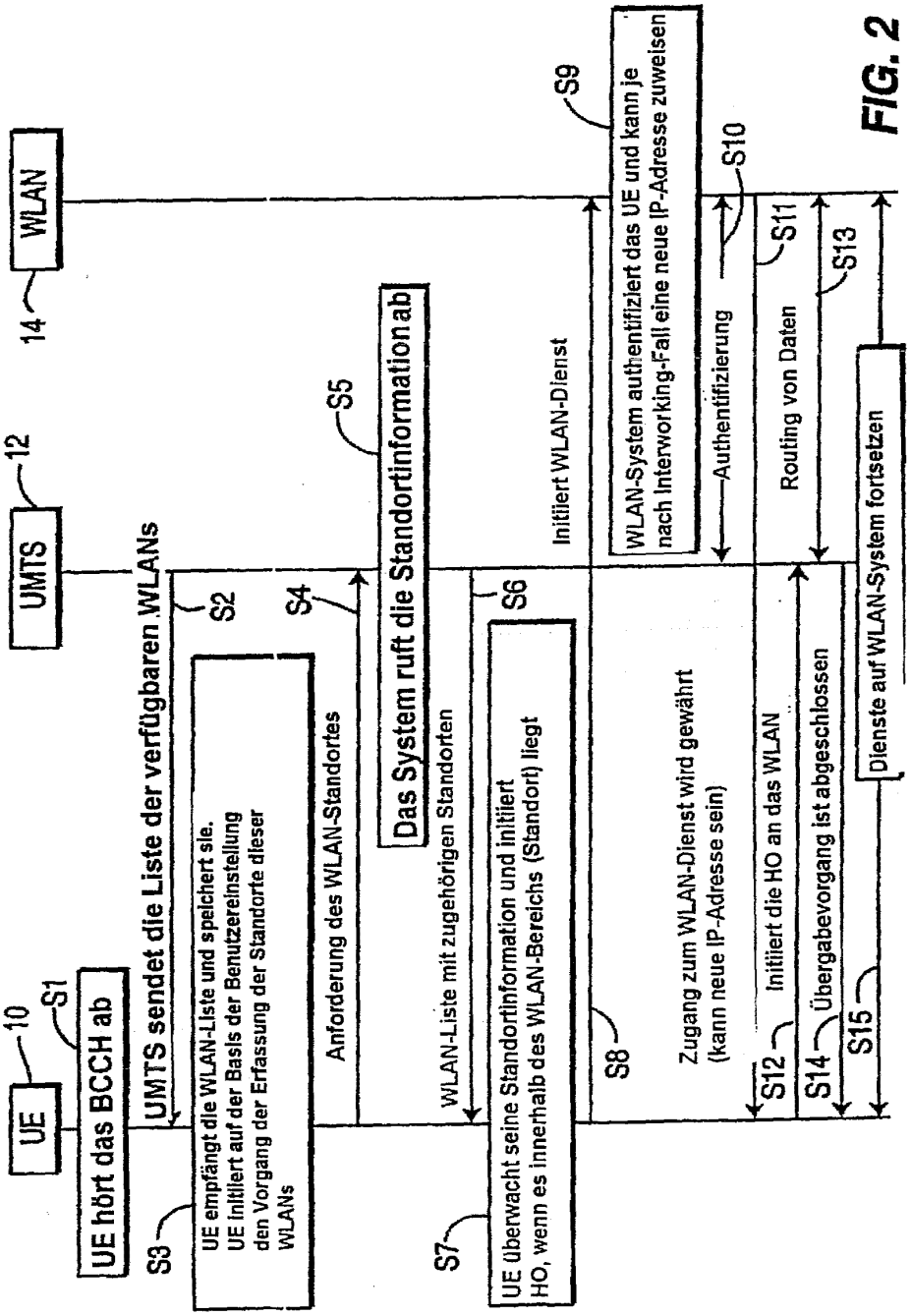

UE
10
WLAN
14
UMTS
12
S1
UE hört das BCCH ab
UMTS sendet die Liste der verfügbaren WLANs
S2
S3
UE empfängt die WLAN-Liste und speichert sie.
UE initiiert auf der Basis der Benutzereinstellung
den Vorgang der Erfassung der Standorte dieser
WLANs
S4
Anforderung des WLAN-Standortes
S5
Das System ruft die Standortinformation ab
WLAN-Liste mit zugehörigen Standorten
S6
S7
UE überwacht seine Standortinformation und initiiert
HO, wenn es innerhalb des WLAN-Bereichs (Standort) liegt
Initiiert WLAN-Dienst
S9
WLAN-System authentifiziert das UE und kann je
nach Interworking-Fall eine neue IP-Adresse zuweisen
S10
Authentifizierung
S8
Zugang zum WLAN-Dienst wird gewährt
(kann neue IP-Adresse sein)
S11
Routing von Daten
S12
Initiiert die HO an das WLAN
S13
S14
Übergabevorgang ist abgeschlossen
S15
Dienste auf WLAN-System fortsetzen

FIG. 2

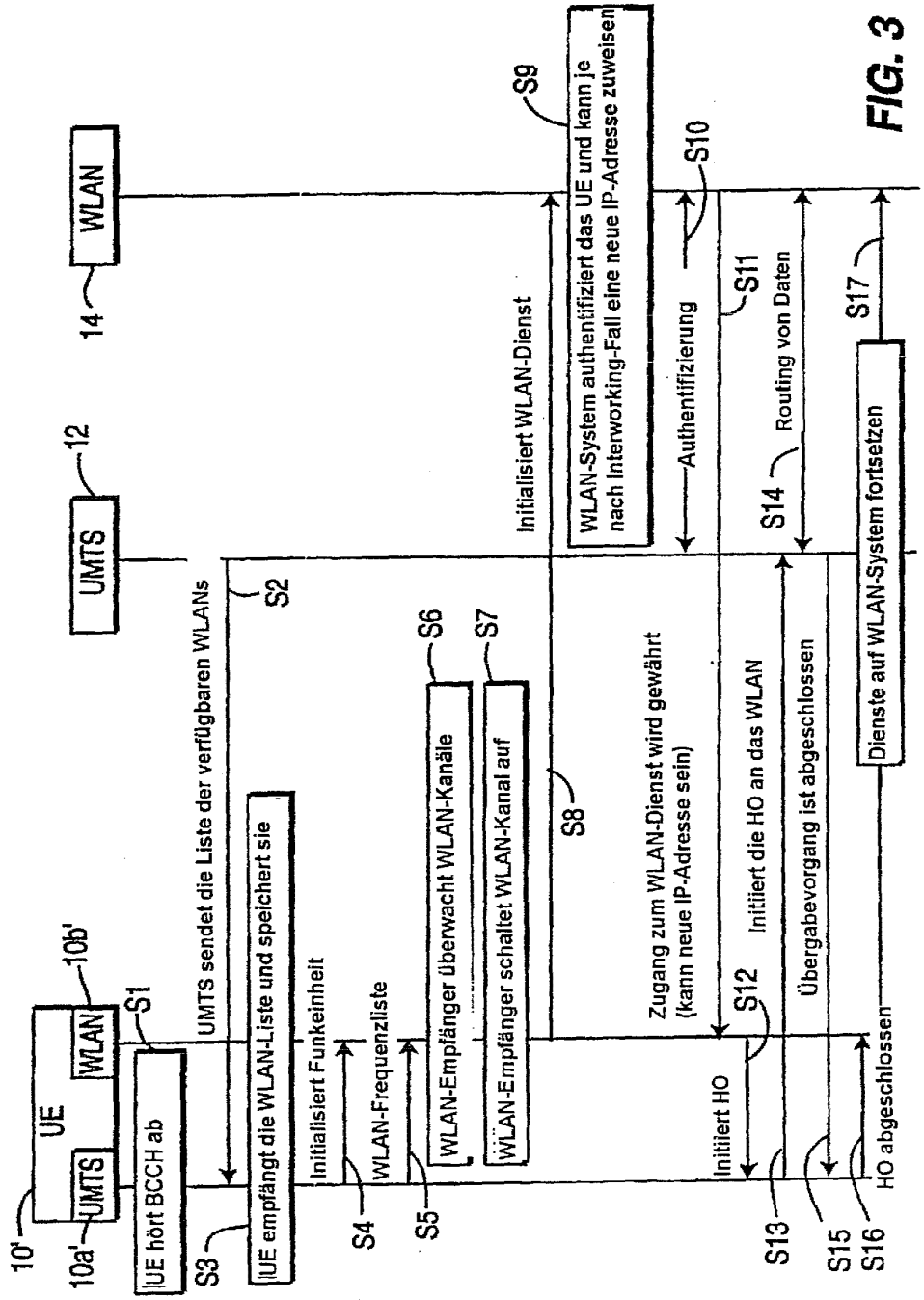

10'
UE
UMTS
WLAN
10a'
10b'
S1
IUE hört BCCH ab
S3
UMTS sendet die Liste der verfügbaren WLANs
IUE empfängt die WLAN-Liste und speichert sie
S2
Initialisiert Funkeinheit
S4
WLAN-Frequenzliste
S5
WLAN-Empfänger überwacht WLAN-Kanäle
S6
WLAN-Empfänger schaltet WLAN-Kanal auf
S7
S8
Zugang zum WLAN-Dienst wird gewährt
(kann neue IP-Adresse sein)
Initiiert HO
S12
S13
Initiiert die HO an das WLAN
Übergabevorgang ist abgeschlossen
S15
HO abgeschlossen
S16
Dienste auf WLAN-System fortsetzen
S17
12
UMTS
14
WLAN
Initialisiert WLAN-Dienst
S9
WLAN-System authentifiziert das UE und kann je nach Interworking-Fall eine neue IP-Adresse zuweisen
S10
Authentifizierung
S11
S14
Routing von Daten

FIG. 3

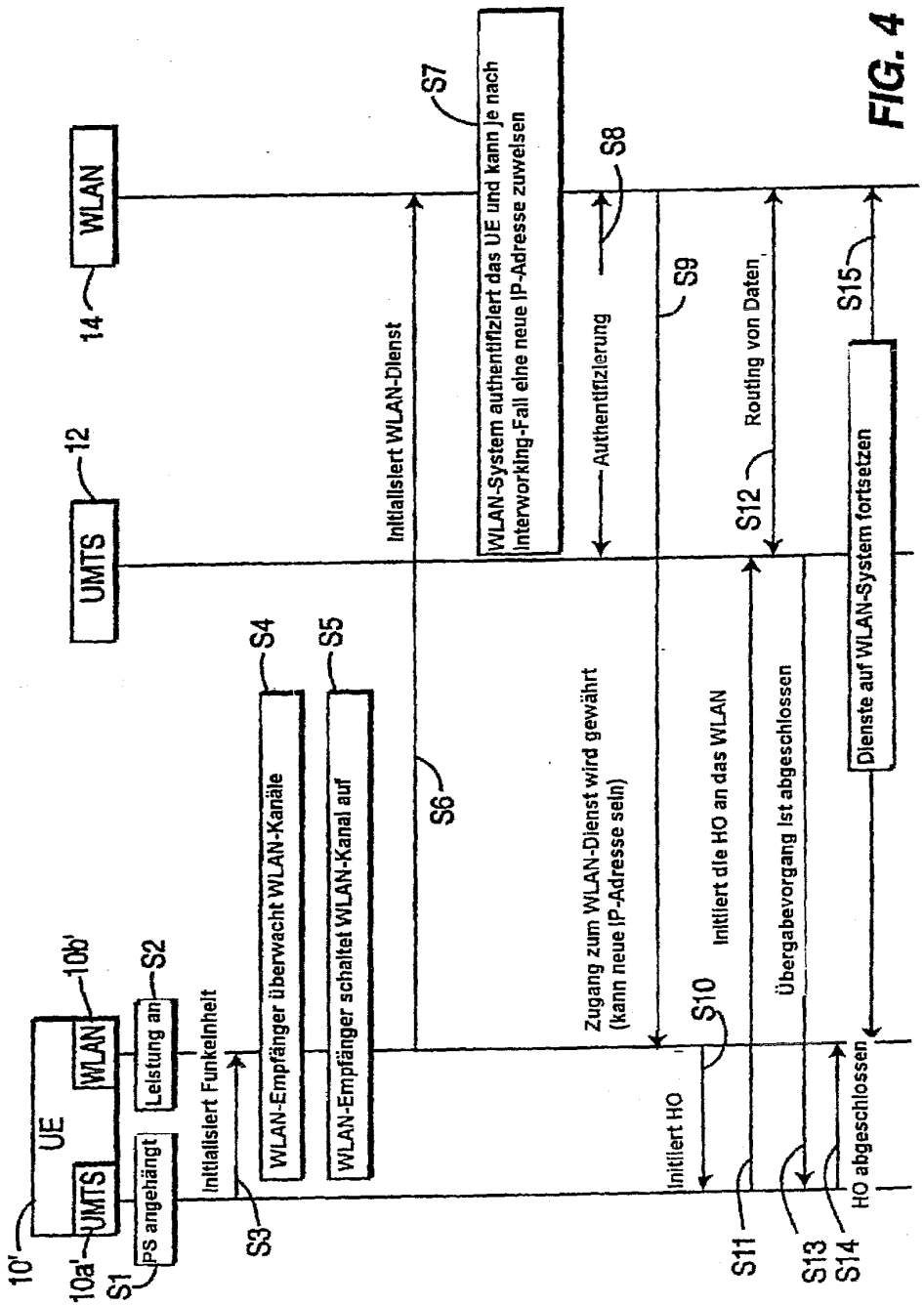

10'
UE
UMTS
WLAN
10a'
10b'
S1
PS angehängt
S2
Leistung an
Initialisiert Funkkelnheit
S3
WLAN-Empfänger überwacht WLAN-Kanäle
S4
WLAN-Empfänger schaltet WLAN-Kanal auf
S5
S6
Initialisiert WLAN-Dienst
UMTS
12
WLAN
14
S7
WLAN-System authentifiziert das UE und kann je nach Interworking-Fall eine neue IP-Adresse zuweisen
S8
Authentifizierung
S9
Routing von Daten
S12
S15
Zugang zum WLAN-Dienst wird gewährt (kann neue IP-Adresse sein)
S10
Initiiert die HO an das WLAN
Initiiert HO
Übergabevorgang ist abgeschlossen
Dienste auf WLAN-System fortsetzen
HO abgeschlossen
S11
S13
S14

FIG. 4

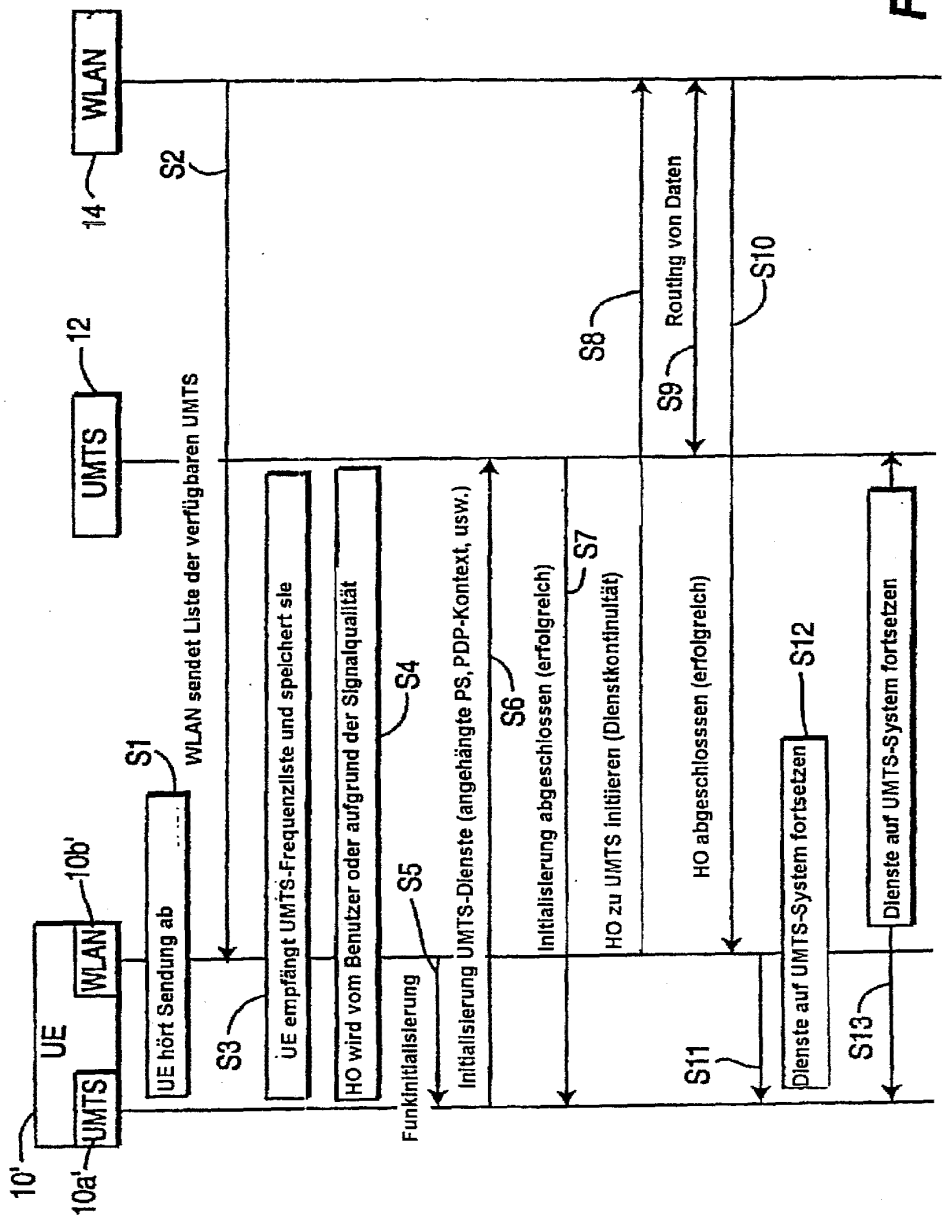

10'
UE
10a'
UMTS
WLAN
10b'
S1
UE hört Sendung ab
WLAN sendet Liste der verfügbaren UMTS
S2
S3
UE empfängt UMTS-Frequenzliste und speichert sie
HO wird vom Benutzer oder aufgrund der Signalqualität
S4
S5
Funkinitialisierung
Initialisierung UMTS-Dienste (angehängte PS, PDP-Kontext, usw.)
S6
Initialisierung abgeschlossen (erfolgreich)
S7
HO zu UMTS initiieren (Dienstkontinuität)
S8
S9
Routing von Daten
S10
HO abgeschlossen (erfolgreich)
S11
Dienste auf UMTS-System fortsetzen
S12
Dienste auf UMTS-System fortsetzen
S13
UMTS
12
WLAN
14

FIG. 5

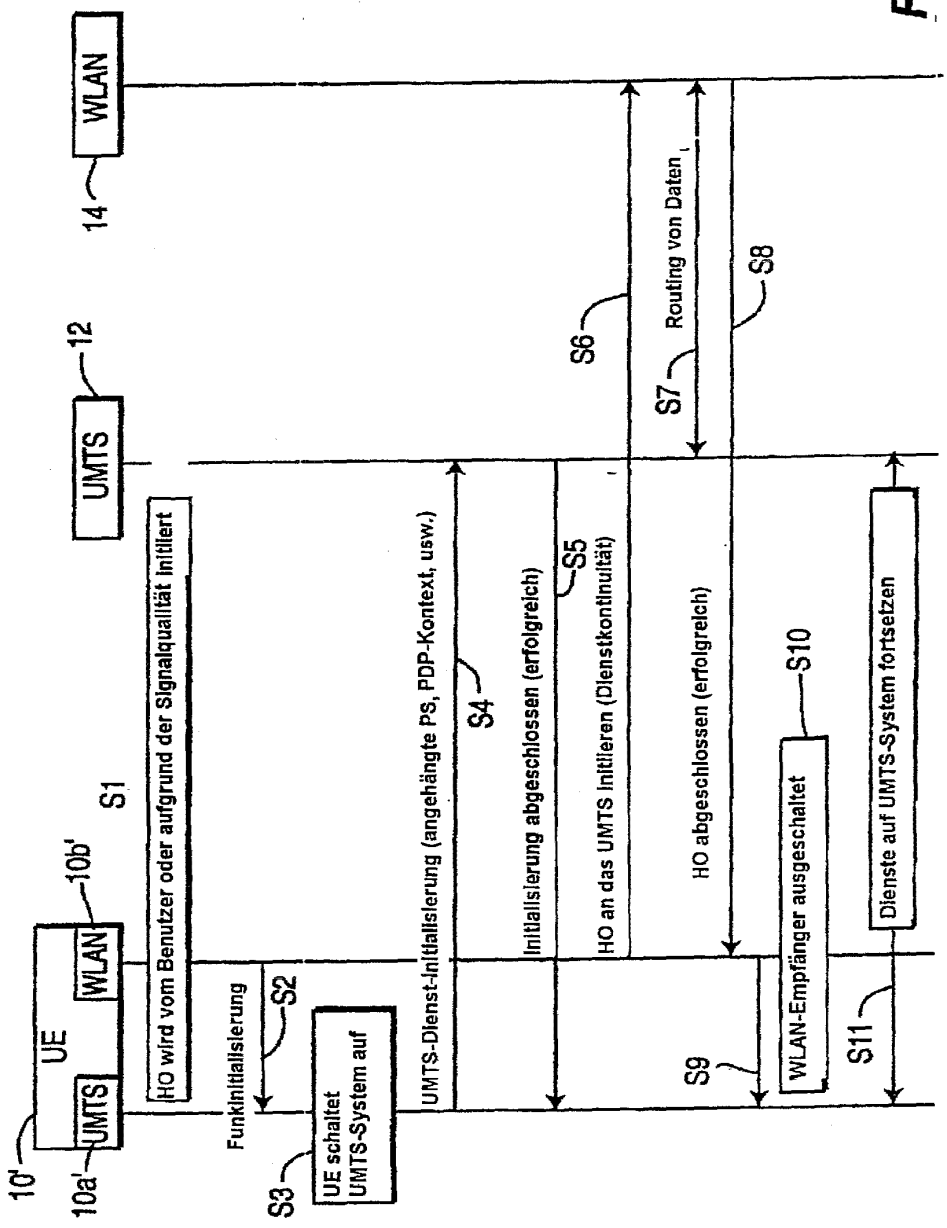

10'
UE
10a'
UMTS
10b'
WLAN
14
WLAN
12
UMTS
S1
HO wird vom Benutzer oder aufgrund der Signalqualität initiiert
S2
Funkinitialisierung
S3
UE schaltet UMTS-System auf
S4
UMTS-Dienst-Initialisierung (angehängte PS, PDP-Kontext, usw.)
Initialisierung abgeschlossen (erfolgreich)
S5
HO an das UMTS Initiieren (Dienstkontinuität)
S6
S7
Routing von Daten
S8
HO abgeschlossen (erfolgreich)
S9
S10
WLAN-Empfänger ausgeschaltet
S11
Dienste auf UMTS-System fortsetzen

FIG. 6

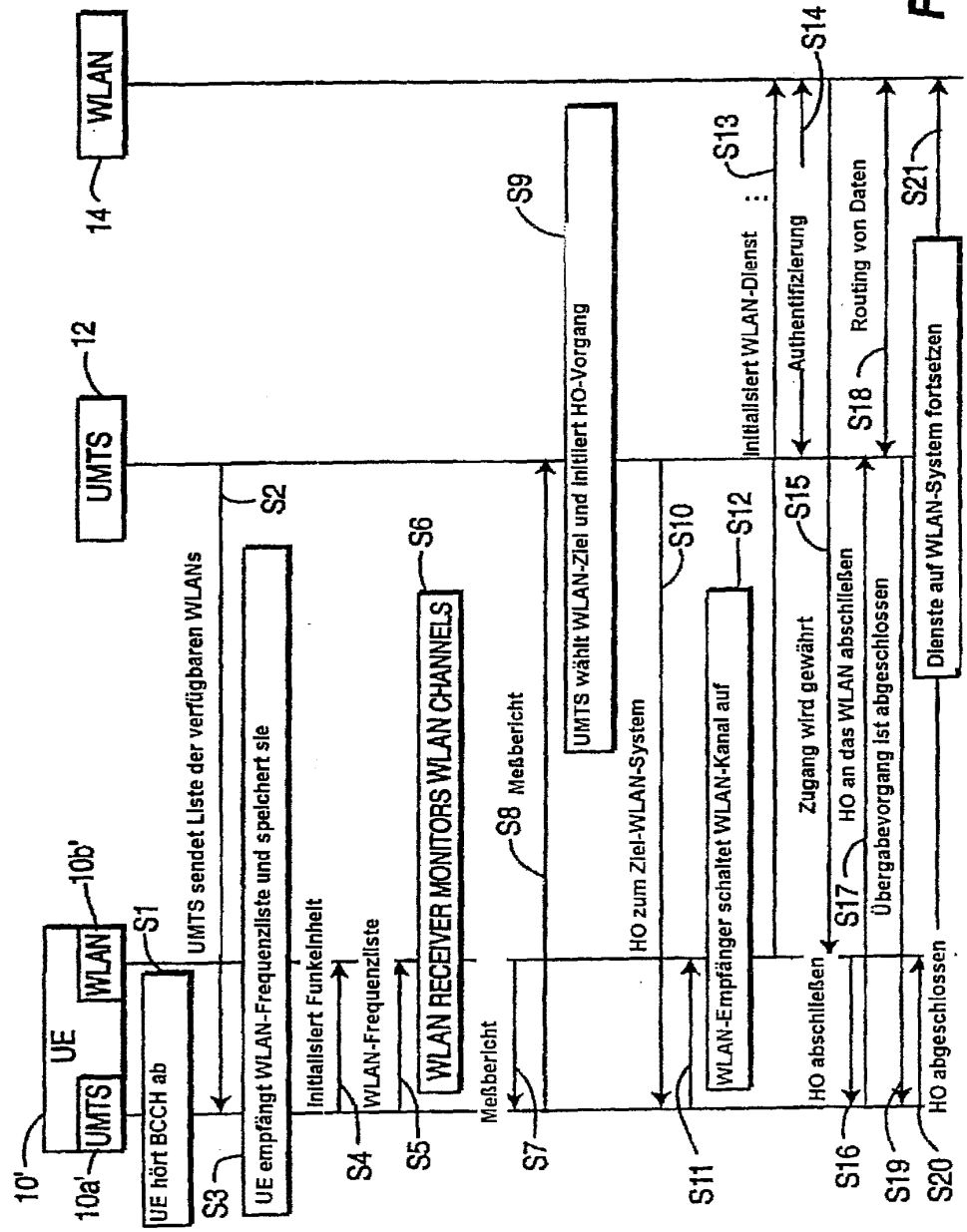

10'
UE
UMTS
WLAN
10a'
10b'
S1
UE hört BCCH ab
S3
UMTS sendet Liste der verfügbaren WLANs
UE empfängt WLAN-Frequenzliste und speichert sie
S2
UMTS
12
WLAN
14
Initiallslert Funkeinheit
S4
WLAN-Frequenzliste
S5
WLAN RECEIVER MONITORS WLAN CHANNELS
S6
Meßbericht
S7
S8 Meßbericht
S9
UMTS wählt WLAN-Ziel und initiiert HO-Vorgang
HO zum Ziel-WLAN-System
S10
S11
WLAN-Empfänger schaltet WLAN-Kanal auf
S12
Initiallslert WLAN-Dienst
S13
Authentifizierung
S14
Zugang wird gewährt
S15
HO abschließen
S16
HO an das WLAN abschließen
S17
Routing von Daten
S18
Übergabevorgang ist abgeschlossen
S19
HO abgeschlossen
S20
Dienste auf WLAN-System fortsetzen
S21

FIG. 7

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(54) Integrated wireless telecommunication and local area network system

(57) The invention includes a network system and method and apparatus for integrating wireless LAN and mobile telecommunications system. A network proxy and a terminal proxy are provided to allow a terminal (10) to connect to a network (1) and use any one of a number of connection interfaces. The proxies allow for switching between interfaces, and hide the switching from the higher layers of the communications protocol. Switching is managed in the link layer.

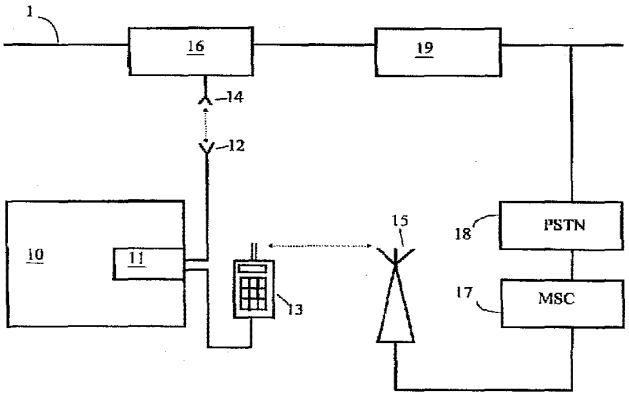


Figure 1

EP 0 936 777 A1

Description

[0001] This invention relates to a method and apparatus for integrating wireless LAN and mobile telecommunications and, in particular for an integrated Wireless LAN and telecommunication data card. The invention also relates to a network system, including at least one terminal and means for connecting to said network system.

[0002] The user of a portable computer or small mobile data terminal may be connected to a Local Area Network (LAN) by a number of different systems. The LAN may provide for wireless connection, using a Wireless LAN cord and an aerial. Alternative, access via a telephone dial-up service, using for example a telecommunication data card and a mobile telephone, or an integrated card, may be provided to the user when outside the range of the wireless LAN. These systems provide the user with a degree of flexibility, but require the user to log-on to the LAN each time the mode of access (or intertace) is altered.

[0003] There is a need for network access systems which are flexible, and yet require the minimum of hardware, since this increases the weight and the cost.

[0004] According to a first aspect of the invention there is provided a network system including: a terminal; and means for connecting the terminal to the network via at least two interfaces characterised in that means for switching the network connection between one interface and another are provided and further characterised in that a network proxy and a terminal proxy, adapted to redirect data packets in the link layer, are provided to support seamless switching between one interface and the other.

[0005] The invention thus provides simple, efficient and light weight method and apparatus for connecting to a network. The invention enables the user to stay connected to the network whilst roaming inside a building and whilst away from the building. The invention switches seemless between the two connections and enables a single card to be utilised to perform both functions. Using a single card has additional benefits in terms of power requirements and battery life.

[0006] The invention provides a mechanism that switches between communication interfaces without affecting the higher layer communications protocols, either in the mobile terminal or in the network. To the upper protocol layers, the invention provides a single network interface, regardless of the particular mode of connection.

[0007] The network proxy and the terminal proxy are functional blocks within the network architecture which support for seamless switching. The proxies may be tailored to each particular network and terminal combination.

[0008] Embodiments of the invention are described below, and with reference to the following figures, in which:

Figure 1 shows in outline a network configuration.

[0009] The information related to the capabilities of the network, are stored in a network proxy. The information relating to the capabilities of a terminal, 10, is stored in a terminal proxy. The terminal may connect to the network using conventional wireless LAN connection, using the combined data and Wireless LAN card 11, antennae 12 and 14 and the wireless LAN access point 16. Once connected, the terminal may communicate with other devices on the network via an ethernet backbone 1. Alternatively, the terminal may connect to the network using a telephone dial up service, via the data card 11 and cellular mobile telephone. The dialup service allows the terminal to log-on to the network, using the cellular mobile and public switched telephone services, 15, 17 and 18 via a dial up server 19.

[0010] To the upper protocol layers of the terminal, the combined card 11 appears as a single LAN interface, regardless of whether the terminal is currently connected via the wireless LAN or cellular data network. This means that none of the higher layer protocols need to modify their behaviour, or be aware of the mobile terminals movement. In the following examples, an ethernet network system running TCP/IP is used as an example.

[0011] The switching mechanism is responsible for hiding the movement of the mobile terminal from the higher protocol layers. When the mobile terminal is communicating via the wireless LAN interface, the application transmits packets (including address resolution requests) as normal.

[0012] The switching mechanism communicates with the wireless LAN interface and cellular data interface to determine the current signal strength of the two interfaces. The decision to switch can be made based upon a number of factors. One possibility is that when the wireless LAN signal strength drops below a given threshold the switching function activates the cellular data interface and then de-activates the wireless LAN interface. Switching decisions can also be made on the basis of: measured error rates; bandwidth; or cost.

[0013] When the switching mechanism decides to perform a switch two scenarios are possible: (1) switching from the wireless LAN interface to the cellular data interface or (2) switching from the cellular data interface to the wireless LAN interface. The functions performed by the switching function in both cases are described below:

1) Moving from the wireless LAN to the cellular data network

[0014] Initially the switching function activates the cellular data interface, registers with the cellular data network, and creates a dial-up connection to the configured address of the dial-up server. During the dial-up process the dial-up server will inform the mobile terminal of

IPR2025-00447 Page 00097

the IP address it should use for this interface. The switching function must then send a mobile IP message to the network phone indicating the mobile terminals currently active IP address. The network proxy will then send a gratuitous ARP message over its IP subnetwork saying that traffic destined for the mobile terminal's home address should be sent to the home agent. The network proxy will thus receive data destined for the mobile terminal, this is then encapsulated in an IP header containing the dial-up interface IP address and transmitted to the mobile terminal via the dial-up server. When the integrated card receives the IP packet it must strip off the outer header and pass the packet up to the upper protocol layers. This means the upper protocol layers will always send and receive traffic with the wireless LAN IP address. When the wireless LAN interface is activated again, the card must transmit a gratuitous ARP to the network containing the wireless LAN IP and MAC addresses.

[0015] At this point, the wireless LAN interface on the card should be deactivated. Traffic arriving from the upper layers of the mobile terminal protocol stack will now be forwarded via the cellular data interface. The higher layer protocols will still assume that the mobile terminal is attached to a LAN, and hence will generate ARP requests for terminals residing on the same subnet as the wireless LAN. Via the dial-up connection from the cellular data interface, MAC addresses are not required since this is a point-to-point connection to the dial-up server. However the higher protocol layers expect a response. The following alternative approaches can be followed to provide the higher layers with a response so that they will continue to forward data traffic to the card for transmission.

* The switching function captures the ARP request and generates an ARP response with a dummy MAC address which it forward to the higher layer protocols. This will enable the upper protocol layers to forward the queued traffic in a timely manner. The ARP request can then be discarded.
* An alternative is to still forward the fake ARP response to the higher layers but to queue the ARP request so that when the switching function activates the wireless LAN interface again, all of the queued ARP requests can be transmitted. The responses would then be forwarded to the upper layer protocols to overwrite the ARP cache containing the fake MAC address.
* An alternative is to send the fake ARP response to the higher layer protocols, but to also forward the ARP requests to the dial-up server. The dial-up server should then forward it over the local subnet to obtain a response. When the dial-up server receives a response it should forward it to the mobile terminal. In this case the integrated card should forward the ARP response to the higher protocol layers to update the ARP translation information. This approach has the advantage that when the mobile terminal moves back to the wireless LAN it will already contain the correct ARP information.

[0016] Traffic from the mobile terminal will travel to the rest of the network via the cellular data interface. Traffic destined for the mobile terminal will be received by the dial-up server and forwarded to the mobile terminal.

2) Moving from the cellular data network to the wireless LAN

[0017] When the switching function makes the decision to move to the wireless LAN interface, this interface should be re-activated. When the wireless LAN interface is active the mobile terminal must send a gratuitous ARP message indicating its current IP address and MAC address. It must also send a message to the home agent indicating that it is now connected via the wireless LAN interface and what its current IP and MAC address is. The network proxy should then broadcast a gratuitous ARP stating the current mobile terminal's IP address and MAC address. The switching function should then trigger the necessary local ARP recovery function chosen from the alternatives above. At this point the cellular data interface should be de-activated. Traffic from the mobile terminal will then flow via the wireless access point to the rest of the subnet. Traffic arriving from other hosts will be forwarded to the mobile terminal by the wireless LAN access point.

[0018] The wireless LAN access point and dial-up server may be integrated into a single device which also implements the network proxy. In this case, all traffic to and from other hosts will always be routed via the same device, regardless of whether the integrated card wireless LAN or cellular data interface is active. This means that when the active interface changes gratuitous ARPs no longer need to be transmitted over the network. In this case when the switching function decides to change the active interface it sends a message to the integrated wireless forwarding device indicating the new active interface. This integrated forwarding device is then responsible for forwarding the traffic via this new interface. This has the benefit that the rest of the network is unaware of which interface on the integrated card is currently active. It also means that traffic follows an optimal route to the mobile terminal rather than having to be forwarded through multiple network devices. It also reduces the complexity of the switching function since mobile IP does not need to be implemented within the card.

[0019] The following proxies use the highest preferred network that has an acceptable signal strength. If a more preferred network becomes available again, the proxy swaps back to it. If the network currently in use becomes unacceptable and there are no higher preferred networks available the proxy drops to the next lower preferred network if that is available.

IPR2025-00447 Page 00098

Terminal proxy

[0020]

when connected to the wireless LAN
while the wireless lan signal strength is greater than an acceptable level
continuously gather the wireless lan signal strength and apply a smoothing function to remove transient signal strength fluctuations
continuously gather the dial-up network signal strength and apply a smoothing function to remove transient signal strength fluctuations
forward any data received from the terminal's higher layers over the wireless lan interface
forward data received from the wireless lan interface to the higher layers of the terminal
when the wireless lan signal strength is below an acceptable level
send a handover signal to the network proxy indicating that the terminal is moving from a wireless lan to a dial-up connection
create a dial-up connection to the network proxy
when the dial-up connection is created deactivate the wireless lan interface when connected to the dial-up interface
while the wireless lan signal strength is below an acceptable level and the dial-up signal strength is above an acceptable network (NB if these are the only two available networks a signal strength above zero may be acceptable)
continuously gather the wireless lan signal strength and applying a smoothing function to remove transient signal strength fluctuations
continuously gather the dial-up network signal strength and apply a smoothing function to remove transient signal strength fluctuations
forward any data received from the terminal's higher layers over the dial-up interface including address resolution requests
forward data received from the dial-up interface to the higher layers of the terminal including address resolution responses
when the wireless lan signal strength is above an acceptable level
send a handover signal to the network proxy indicating that the terminal is moving from a dial-up connection to a wireless LAN connection
activate the wireless LAN interface
tear-down the dial-up connection to the network proxy
when both the wireless LAN and dial-up signal strengths are below an acceptable level
inform the higher layers that no networks are currently available
inform the network proxy no networks are currently available
tear down the dial-up connection

Network proxy (for wireless LAN bridge, dial-up server and mobility support)

[0021]

if the proxy receives data for terminal x

if terminal x is accessible via the wireless LAN
forward data over the wireless LAN interface to the terminal
otherwise if terminal x is accessible via the dial-up interface
forward data over the dial-up interface to the terminal
otherwise if the terminal is not accessible by any network
inform the sender of the packet that the terminal is not accessible
if the proxy receives data from terminal x
forward the data to the destination
if the proxy receives a handover request from terminal x
if the terminal is moving to a dial-up connection
add the terminal to the list of current dial-up terminals
when the dial-up connection is active and the terminal was previously connected to a wireless LAN interface
remove the terminal from the list of current wireless LAN terminals
if the terminal is moving to a wireless LAN connection
add the terminal to the list of current wireless LAN terminals remove the terminal from the list of current dial-up terminals

Claims

1. A network system including: a terminal; and means for connecting the terminal to the network via at least two interfaces characterised in that means for switching the network connection between one interface and another are provided and further characterised in that a network proxy and a terminal proxy, adapted to redirect data packets in the link layer, are provided to support seamless switching between one interface and the other.

2. A network system as claimed in claim 1 characterised in that the terminal has one link layer address which is used by the terminal regardless of the connecting interface.

3. A network system as claimed in claim 1 characterised in that the network proxy hides the switching from other devices connected to the network.

4. A network system as claimed in claim 1 character-

IPR2025-00447 Page 00099

ised in that the terminal proxy hides the switching from higher layers in the terminal.

IPR2025-00447 Page 00100

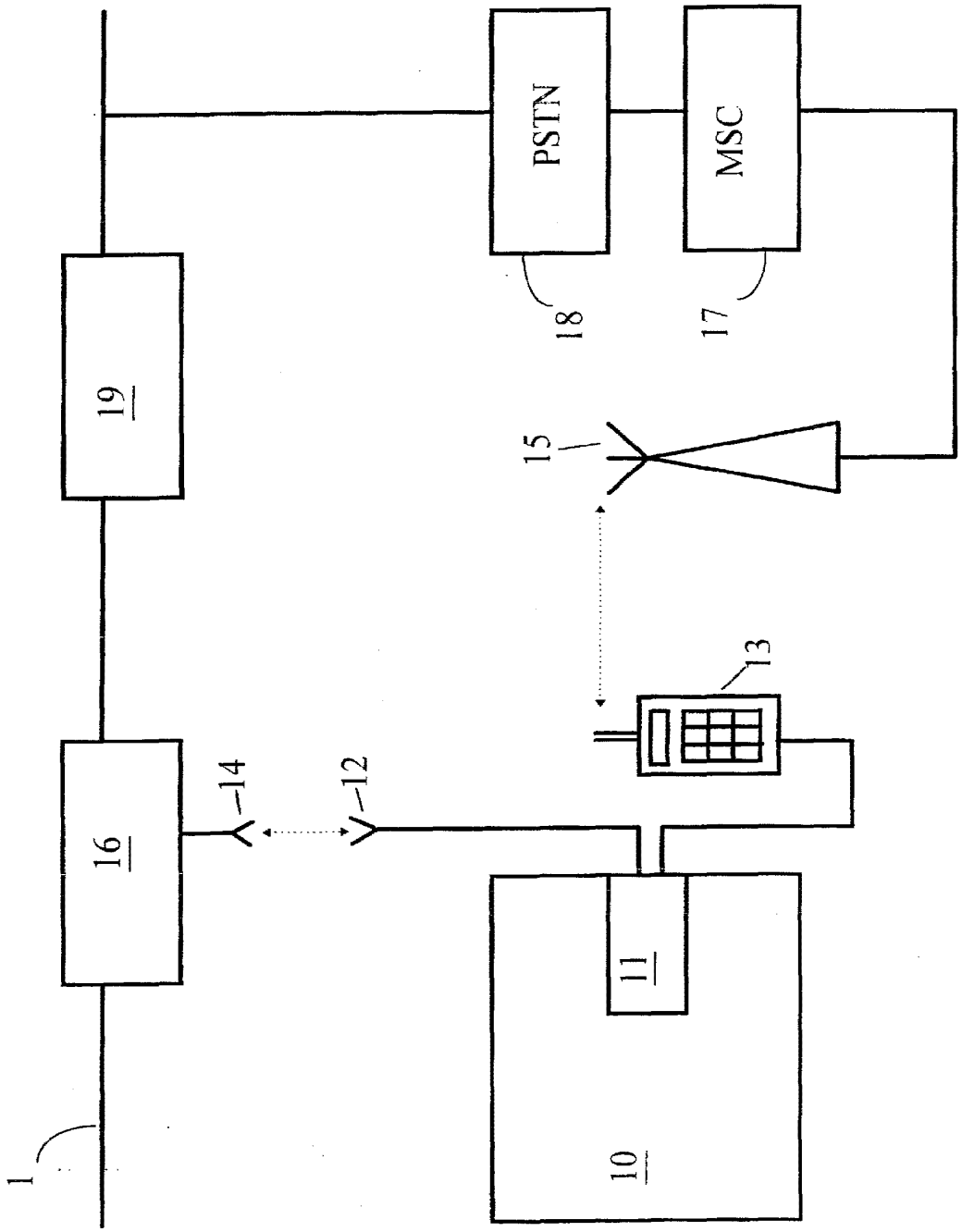


Figure 1

IPR2025-00447 Page 00101

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 30 1053

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 4 692 918 A (ELLIOTT ROGER A ET AL) 8 September 1987 * abstract * * column 1, line 1 - column 13, line 26 * * figures 1,2 *	1-4	H04L12/28 H04Q7/22 H04L29/06
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TECHNICAL FIELDS SEARCHED (Int.Cl.6)
H04L
H04Q

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	16 June 1998	Lievens, K

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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IPR2025-00447 Page 00102

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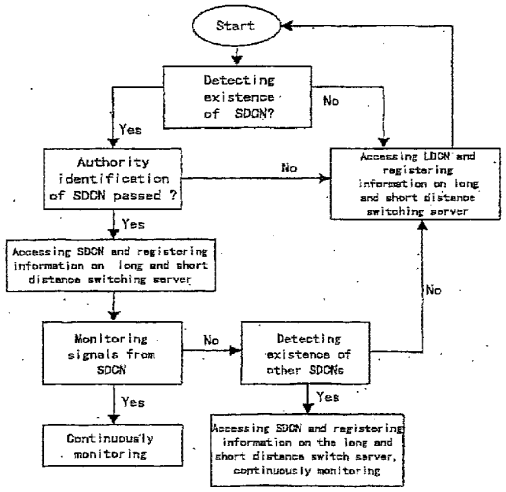
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(54) A COMBINED LONG AND SHORT DISTANCE WIRELESS COMMUNICATION SYSTEM AND ITS METHOD

(57) This invention provides a combined long and short distance wireless communication system and method thereof. A dual distance terminal provides subscribers with the long and short distance wireless communication service and guarantees that the service isn't interrupted when switching between different networks occurs. A remote distance base station provides the dual distance terminal with remote distance wireless access. A short distance AP provides the dual distance terminal with short distance wireless access. A dual distance network server connects the remote distance base station and the short distance AP to switch between networks and make the dual distance terminal access the network to which is switched. The present invention enables the dual distance terminal within the coverage of the long and short distance wireless system to communicate with the long distance networks and automatically switch to short distance wireless local area networks (WLAN) when the dual distance terminal enters the short distance WLAN so that seamless switch is achieved. The subscribers having different priority levels access different short distance WLANs with different levels after authority identification.

Fig. 2



EP 1 471 665 A1

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Description

BACKGROUND OF THE INVENTION

FIELD OF INVENTION

[0001] This invention relates to a wireless communication system and its method, more specially, to a wireless communication system which combines long and short distance wireless communication techniques and achieves seamless switch of links. This invention belongs to the field of communication techniques.

BACKGROUND OF PRIOR ART

[0002] In current mechanisms of communication systems, GSM/GPRS and the future 3G (third generation) are all long distance communication (LDC). The major characteristics for long distance communication include the coverage of large area, installation with low cost, and operation with high cost and low transmission rate, etc. The long distance communication can be referred as to a concept of "ocean". Recent 802.11 and BT, for example, belong to the short distance communication (SDC). The major characteristics of short distance communication include the use in office areas and certain business areas, the coverage of limited areas, installation with high cost, operation with low cost and high transmission rates, etc. The short distance communication can also be referred as to a concept of "island". The networks of the short distance communication are separated from each other, and have been significantly limited to a certain area respectively.

[0003] In GSM900/1800 networks, and the interacting networks of GSM/GPRS and the third generation mobile communication, all of them embody the concept of long distance, i.e. the concept of "ocean". The operation modes employed are multiple access modes such as TDMA, CDMA. However, in long and short distance communication networks, short distance communication generally employs operation modes such as CSMA/CA which are suitably used for short distance transmission. Meanwhile, in long distance communication networks (LDCN), although the transmission powers thereof are always very large, the transmission powers are limited due to the limitation of Local Area Networks (LAN) such as WLAN networks, so that the characteristics of "island" is present. Furthermore, with respect to long distance communication networks, short distance communication networks (SDCN) have the advantages of wide bands, fast transmission rates, low cost etc.

[0004] There exists a need to combine long distance communication networks and short distance communication networks to complement the advantages for each other. Thus, a terminal can receive the services from long and short distance communication networks according to different requests. For example, the terminal may obtain a voice service with long distance communication networks whereas obtain a data service with short distance communication networks. That is, in long and short distance communication networks, the characteristics of that short distance communication is present in long distance communication network coverage.

SUMMARY OF THE INVENTION

[0005] An object of the present invention is therefore to provide a wireless communication system and method which can combine long and short distance communication techniques.

[0006] Another object of the present invention is to provide a wireless communication dual distance terminal which can combine long and short distance communication techniques.

[0007] Yet another object of the present invention is to provide a wireless communication dual distance network server which can combine long and short distance communication techniques.

[0008] The present invention may achieve seamless switch such as automatic switching, capacity evaluation and security issues and the likes when a user enters an area covered by both long and short distance wireless communication while guarantee the long distance wireless communication so that the user may use short distance wireless communication and access whole networks through the short distance wireless access point (AP). Thus, the two types of network resources can be more effectively used.

[0009] To achieve above objects of the prevent invention, according to one aspect of the present invention, a combined long and short distance wireless communication system comprises: a dual distance terminal for providing subscribers with long and short distance communication services, at least one remote distance base station for providing remote distance wireless access for the dual distance terminal, at least one short distance access point (AP) for providing short distance wireless access for the dual distance terminal, and a dual distance network server for connecting the remote distance base station through the short distance AP to execute network switching for the dual distance terminal and enabling the dual distance terminal to access the network to which it is switched.

[0010] According to another aspect of the present invention, a wireless communication method using combined long and short distance wireless communication systems, comprising steps of scanning a dual distance terminal to determine whether it is located in a service area covered by a short distance access point upon powering on; entering a short distance communication network through the short distance access point if the dual distance terminal is located within the service area covered by the short distance access point, and informing a dual distance home server of the position of the dual distance terminal; searching for a base station for

IPR2025-00447 Page 00105

a long distance communication service if the dual distance terminal is not located in the area covered by any one of the short distance access points, entering a long distance communication network through a long distance access network, and informing the dual distance home server of the position of the dual distance terminal.

[0011] According to yet another aspect of the present invention, a dual distance network server used for a combined long and short distance wireless communication system, comprising:

a data service function entity for detecting whether a long and short distance data transmission occurs, if it occurs, then providing a connection service for said data transmission;

a memory function entity for storing data that may be missed at the time of memory switching, and sending the stored data to a terminal via said data service function entity after said terminal switching is completed, in order to implement seamless switch for the terminal between a long distance communication network and a short distance communication network;

a dual distance home server for registering the dual distance character parameters of the dominated dual distance terminals, obtaining terminal switch information via said data service function entity when dual distance switch occurs, updating the terminal data; and informing said data service function entity of terminal-related dual distance information when a query regarding the terminal exists;

an external network interface unit for connecting dual distance network and an interface of external networks.

[0012] For the dual distance terminal of the invention, it has to adapt configuration of both the long distance and short distance communication networks so that the dual distance terminal may move in both networks, the dual distance terminal comprises:

a short distance communication function entity having a short distance radio frequency function module for functioning as physical layer, part of MAC layer or link layer and operating in a short distance communication network to obtain data information;

a long distance communication function entity having a long distance radio frequency function module for functioning as physical layer and part of link layer;

a network switch condition judging function entity for performing network switching for the dual distance terminal based on the corresponding dual distance switch condition judging and instructing the short distance communication function entity or the long distance communication function entity to send a beacon signal to the dual distance network server;

a common function entity for implementing display and input and output functions of the terminal.

[0013] The combination of long and short distance wireless communication according to the invention brings a lot of convenience, and changes the status of separation of the architectures of long distance and short distance radically. The present invention has the advantages as follows:

at any time, a real-time transmission may be achieved by the long distance wireless communication;

when a mobile terminal is allowed to enter the short distance wireless LAN, it can automatically switching to the short distance communication mechanism with priority, and the transmitting traffic stream of the subscriber would not be interrupted so that seamless switch can be achieved;

when the mobile terminal move out the short distance wireless LAN, it can automatically switch to the long distance communication network, and the transmitting traffic stream for the subscriber would not be interrupted so that seamless switch can be achieved;

when the other subscriber terminal in the system according to the invention is calling and querying any one of the terminal allowed to be accessed, the system according to the invention may guarantee the subscriber could be accessed either in the short distance communication LAN or in the short distance communication network.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] Above and/or other objects and advantages of the present invention will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompany drawings of which:

Figure 1 is a schematic diagram showing the structure of according to an embodiment of the present invention.

Figure 2 is a flow chart showing the operation according to the embodiment of the invention.

Figure 3 is a schematic diagram showing the structure of the dual distance communication network

IPR2025-00447 Page 00106

server function module of the invention.

Figure 4 is a flow chart when the dual distance communication network server performs switching.

Figure 5 is a schematic diagram showing the structure of the dual distance terminal according to the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0015] The present invention constructs a wireless communication system as a structure of "ocean + island". According to the wireless communication system of the present invention, remote distance base stations cover all the effective areas; short distance access points (AP) cover areas such as offices, residents, and business areas which subscriber density is relatively high. A long and short distance communication server connects the short distance APs with the remote distance base stations. A plurality of dual distance terminals may freely move within the all areas covered by the short distance APs and the remote distance base stations.

The operation principle of the present invention

[0016] When a dual distance terminal is powered on, first, it detects whether it is located in the service area covered by a certain short distance AP. If it is yes, then the dual distance terminal accesses the network through the short distance AP, and informs a dual distance home server of the position thereof. If the dual distance terminal is not within the area covered by any one of the short distance APs, then it searches for a base station for a long distance communication service, accesses network through the remote distance base station, and informs the dual distance home server of position thereof.

[0017] When a dual distance terminal located in the long distance communication network enters any one of the service areas covered by the short distance APs, the dual distance terminal will detect the short distance AP. If the short distance signal thereof is above a predetermined threshold, the dual distance terminal will automatically switch to short distance communication frequency band, and begin to access the network via the short distance AP. The data transmission carried out by the long distance communication network is then carried out by the short distance communication network to achieve seamless switch. Further, the terminal informs its home server of the area which it locates now. The server is in charge of the query and communication to the terminal from other terminals in the network.

[0018] When a dual distance terminal located in the short distance communication networks moves out of the service area covered by the short distance communication networks and enters the long distance network, the terminal detects the short distance AP signal. If the short distance signal thereof is below a predetermined threshold, the dual distance terminal automatically switches to the long distance network. The data transmission carried out by the short distance is then carried out by the long distance network to achieve seamless switch. Then, the terminal informs its home server that it has already located in the area covered by the long distance network. After that, the server is in charge of the query and communication to the terminal from other terminals in the network.

[0019] When a dual distance terminal located in the long distance networks requests to enter any one of the service areas of the short distance APs, if the AP in the area in which the terminal locate rejects the access of dual distance terminal due to security or other issues, the dual distance terminal then still keeps the long distance communication.

[0020] When a dual distance terminal moves from one short distance cell to another short distance cell, the dual distance terminal identify the area, into which the dual distance terminal will enter, covered by the short distance AP. Then the dual distance terminal transmits information of the corresponding cell to the dual distance communication network server so as to achieve the switching between the short distance cells. After that, the dual distance terminal informs the home server among the dual distance network communication servers that it has already been enter into the area covered by another short distance communication network. The home server is then in charge of the queries and communications to the dual distance terminal from the other terminals in the networks.

[0021] The invention will be described by using a combined dual distance wireless communication system which is formed by combining a long distance GSM/GPRS with a short distance WLAN by way of example. The network architecture of the wireless communication system according to the invention comprises GSM/GPRS base stations, a long distance access related network function entity, wireless LAN APs, a short distance access related network function entity, a dual distance communication network server for linking the long distance GSM/GPRS networks and the short distance wireless LANs, dual distance terminals compatible with long distance communication network and short distance communication network. Figure 1 shows the basic network structure of the invention. However, it should be noted that the present invention is not limited to the example shown as Figure 1, it may include a combined architecture formed by combining a long distance 3G communication with a short distance WLAN or a combined architecture of other long distance and short distance communication modes.

[0022] Now referring to Figures 1 and 2, the operation of a dual distance communication network formed by combining GSM/GPRS with WLAN according to an em-

IPR2025-00447 Page 00107

bodiment of the invention will be described in more detail.

1. In the dual distance network, after the dual terminal powered on.

[0023] For the system described in the invention, the dual terminal automatically searches for the network environment currently located after it is powered on by the subscriber. If the dual distance terminal detects that a wireless local area network WLAN network exists and does not require authority identification at present, the dual distance terminal then accesses the WLAN network directly. On the contrary, if the result of the detection indicates that current WLAN network requires authority identification, the dual distance terminal then performs access authority identification via WLAN. If the authority identification is successful, the dual distance terminal accesses current WLAN network. Otherwise, the dual distance terminal will continue the detection and enter into the long distance GPRS communication network.

[0024] After the dual distance terminal enters into the WLAN network, the dual distance terminal may perform data transmission by accessing the dual distance communication server via the short distance WLAN network.

2. Switching between networks

2.1 Switching from the short distance WLAN communication networks to the long distance GPRS communication networks

[0025] When the dual distance terminal moves out of the short distance WLAN network and enter into the GPRS network, the dual distance terminal may make judgment by using a predetermined switching condition. If a predetermined threshold for switching (which may refer to a non-usable threshold of a short distance communication network signal or may refer to a non-optimal threshold of a short distance communication network signal) is satisfied, the dual distance terminal terminates data transmitted through the WLAN radio frequency function entity (not shown) with the predetermined switching condition, and activates the long distance communication function entity and uses it to implement the possible sequent data transmission. If the service level of this dual distance terminal requires a seamless switching, then the dual distance terminal terminates the data being transmitted by the WLAN radio frequency function entity. At the same time, it sends beacon signal for switching between the short distance communication network and the long distance communication network to the short distance AP, from which the communication is switched, by the short distance communication function entity in the terminal. The beacon signal is transmitted to the dual distance communication network server by the short distance AP. After receiving the corresponding beacon signal, the dual distance network server informs the long distance communication function entity to be accessed by the dual distance terminal of the receipt, and determines the service queue position which the dual distance terminal is arranged in the long distance network function entity (provided in the dual distance network server, not shown) based on its service level.

[0026] Meanwhile, the dual distance communication network server stores the data packets which may be missed in the switching process to protect the data packets, the stored data packets are forwarded to the dual distance terminal after the switching is completed, thereby preventing data for the dual distance terminal from lost during the switching.

2.2 Switching from the long distance GPRS networks to the short distance WLAN networks

[0027] When the dual distance terminal moves out of the long distance GPRS network and enters into the short distance WLAN network, the dual distance terminal may make judgment by using switching condition. If the predetermined threshold for switching is satisfied, the dual distance terminal terminates the data transmitted through the long distance communication function entity with the predetermined switching condition, and activates the short distance communication function entity and uses it to implement the possible sequent data transmissions.

[0028] When terminating the data being transmitted by the long distance communication function entity, the dual distance terminal further sends one beacon signal of long and short distance switching to the GPRS service function entity, from which switch is performed, by the base station and the corresponding GPRS network function entity in the dual distance terminal. The beacon signal is transmitted to the dual distance network server by the GPRS function entity. After receiving the corresponding beacon signal, the dual distance network server informs the short distance communication function entity of the receipt, and determines the priority of the dual distance terminal in the short distance communication network function entity based on its service level.

[0029] Meanwhile, the dual distance communication network server stores the data packets which may be missed in the switching process to protect the data packets, the stored data packets are forwarded to the dual distance terminal after the switching is completed, thereby preventing data for the dual distance terminal from lost during the switching.

2.3 Switching from one short distance communication network to another short distance communication network

[0030] When the dual distance terminal moves from one short distance cell to another short distance cell, the

IPR2025-00447 Page 00108

dual distance terminal identifies the short distance AP to which it will enter, and sends the cell information to the dual distance network server, thereby implementing the switching between the short distance cells. The dual distance terminal then informs the home server among the dual distance network servers that it has already entered in the area covered by another short distance communication network, and the home server is in charge of the query and communication to it from the other terminals in the network.

2.4 Automatic switching

[0031] The subscriber may define the priority level of the switching in advance if necessary so that the dual distance terminal may perform automatic switching. The priority level is set according to charging fee, transmission rates, quality stability and the likes, for example. The dual distance terminal automatically identifies the switching according to the priority level. Further, when the subscriber is located within the areas covered by short distance AP, it may not select the use of short distance AP, but may directly select the use of long distance communication.

3. Scanning and detecting

[0032] With respect to the long and short distance communication network architecture, the most important problems are as follows:

(1) the dual distance terminal keeps the long distance and the short distance radio frequency entity in operating state all the time, and detects the possible long distance or short distance communication network environment in real-time, continuously feeds the detected results back to the dual distance terminal switching management mechanism, the detected results are reported to the dual distance network server through the existing network periodically or as desired;

(2) the dual distance terminal keeps the radio frequency function entity in the network in which it locates in operating state all the time, and activates the corresponding radio frequency function entities for the other networks periodically or non-periodically to detect the candidate networks;

(3) The dual distance terminal may keeps the radio frequency function entity in the network in which it locates in operating state all the time, and does not scan and detect the other networks. In this case, the dual distance terminal detects the other networks only when the existing network is not available;

[0033] The detection for candidate networks with non-periodically activating the corresponding radio frequency function entity may be carried out by means of some specific algorithms, such as a viable-step detection method which the time interval of finally finding the occurrence of other networks is used as a function.

4. Switching conditions

[0034] The switching conditions can be selected according to different situations for the network user, hereafter is the two examples of the switching conditions. It should be noted that the present invention did not limit the two switching conditions as described below, other conditions can also be used in the present invention.

(1) The network switching is performed based on priority level. That is, as long as the dual distance terminal finds the occurrence of the network with higher priority level, then it switches to the network with higher priority level, no matter whether the network which is used currently is available or not. The subscribers can define the priority levels of various wireless networks as desired, for example, transmission rate, usage fee and the likes.

(2) The dual distance terminal switches to other networks only when the currently used wireless network signals may not be received. This switching condition means that the switch is performed only when the wireless network in which the dual distance terminal currently locates is not available. In contrary, the switch is not performed if the network in which the dual distance locates is available, even though there is a network with a higher priority level.

[0035] Figure 3 is a schematic diagram showing the dual distance network server. The dual distance network server comprises a data service function entity, a memory function entity, a dual distance home server, and an external network interface. The data service function entity detects whether a long or short distance data transmission occurs. The data transmission includes data transmission between the dual distance terminal located in a long distance communication network and the dual distance terminal located in a short distance communication network, and the data transmission between the dual distance terminal located in a long or a short distance communication network and external networks. The data transmission between the dual distance terminals located in a long (or short) distance communication network can be carried out by the long (or short) distance network function entity (provided in the dual distance network server, not shown). When a long and a short distance data transmission occurs, a connection service is provided to the data transmission.

[0036] A beacon signal of the dual distance terminal forwarded by the long (short) distance network function entity is detected to determine whether the dual distance

IPR2025-00447 Page 00109

terminal performs a switching between the long and short distance communication networks. If so, then a new terminal information (for example, a network name to which the terminal is switched) is informed to a dual distance home register.

[0037] The memory function entity stores the data which is possibly missed at the time of switching. Further, the memory function entity forwards the stored data to the terminal via the data service function entity after the switching is completed so that the terminal can achieve a seamless switching between the long distance communication network and the short distance communication network.

[0038] The dual distance home server records the dual distance characteristic parameters of the managed dual distance terminals, such as the situations of the located network, priority level parameters of the terminals and the likes. The terminal switching information can be obtained via the data service function entity when a switching occurs between the long distance communication network and the short distance communication network. The terminal data is updated. The terminal-related dual distance information is informed to the data service function entity when a query regarding the terminal occurs.

[0039] The external network interface connects the long distance communication network and short distance communication network to the external network. The external network interface comprises a wireless interface, an interface for wire network, and an interface for other wireless networks.

[0040] Figure 4 is a flow chart showing the operation process when the dual network server performs switching. When the dual distance terminal moves from one network to another network, the dual distance network server cooperates with the dual distance terminal for performing switch. The process of the switching is as follows:

first step: detecting the dual distance beacon signal of the dual distance terminal by the long (or short) distance network function entity, checking whether a switching occurs, if it is not, then the detection is repeated; if it is yes, the flow turns to next step;

second step: updating the subscriber information registered in the dual distance home register;

third step: determining whether or not data transmission occurs, if it is not, the flow returns to the first step;

fourth step: determining whether or not there exist a need for seamless switching, if it is not, the flow returns to the fist step;

fifth step: buffering the transmitted data, and forwarding the buffered data to the dual distance terminal after the switch is completed.

[0041] Figure 5 is a schematic diagram showing the functional structure of the dual distance terminals according to an embodiment of the invention. The dual distance terminal according to the present invention can operate within the long distance communication network and the short distance communication network during it moves in both networks. Therefore, it is necessary for the dual distance terminals of the invention to have a structure adaptive to the features of both networks. The dual distance terminal comprises at least a short distance communication function entity, a long distance communication function entity, a dual network switch condition judging function entity, and a common function entity.

[0042] The short distance communication function entity includes a short distance radio frequency function module and may achieve the functions of the physical layer and a part of a MAC layer or link layer. The short distance communication function entity operates in the short distance communication network and obtains data information.

[0043] The long distance communication function entity includes a long distance radio frequency function module and may achieve the functions the physical layer and a part of link layer.

[0044] The network switch condition judging function entity performs network switching for the dual distance terminal based on the corresponding dual distance switch condition judging and instructs the short distance communication function entity or the long distance communication function entity to send a beacon signal to the dual distance network server;

[0045] The common function entity includes basic functions such as display, input and output contained in conventional terminals;

[0046] The dual distance terminal controls the operating modes of the radio frequency function module in the long (short) communication function entity by using the dual network switch condition judging function entity. The operating modes of the radio frequency function modules comprise (1) the long radio frequency function module and short radio frequency function module operate simultaneously; (2) performs the viable-step operating mode according to circumstances; and (3) only when one network does not exist, the radio frequency function entity corresponding to the other network is activated so as to search for the other network.

[0047] In the present invention, alternatively, the dual distance terminal may also comprise a data management and buffering function entity which manages and buffers the corresponding data during the switching.

[0048] Unlike the conventional terminals, the dual distance terminal of the invention has both the long distance and the short distance communication function entity. Therefore, it can detect or automatically search the possible short distance communication networks

IPR2025-00447 Page 00110

such as WLAN and the long distance communication networks such as GSM/GPRS or 3G simultaneously. Further, it can also perform the short distance or long distance data transmission services (including voice which is a specific data service) by means of the short distance and the long distance function entities. Another difference from the conventional terminals is in that the dual distance terminal of the invention also comprises a network switch condition judging function entity. The network switch condition judging function entity performs network switching for the dual distance terminal based on the corresponding dual distance switch condition judging and instructs the short distance communication function entity or the long distance communication function entity to send a beacon signal to the dual distance network server. Further, it may optionally comprise a data management and buffering function entity which manages and buffers the corresponding data during the switching. Thus, the data transmission requested by the common function entity does not be interrupted due to the switching.

[0049] Although the present invention has been described by way of exemplary embodiments, it should be understood that many changes and substitutions may further be made by those skilled in the art without departing from the scope of the present invention which is defined by the appended claims.

Claims

1. A combined long and short distance wireless communication system comprising:

   a dual distance terminal for providing subscribers with long and short distance communication services;

   at least one remote distance base station for providing remote distance wireless access for said dual distance terminal;

   at least one short distance access point (AP) for providing short distance wireless access for said dual distance terminal; and

   a dual distance network server for connecting said at least one remote distance base station through said at least one short distance AP to execute network switching for said dual distance terminal and enabling said dual distance terminal to access the network to which it is switched.

2. The wireless communication system according to claim 1, wherein said at least one remote distance base station comprises a plurality of long distance communication network devices associated with said remote distance base stations.

3. The wireless communication system according to claim 1, wherein said short distance access point comprises a plurality of short distance communication network devices associated with said short distance access points.

4. A dual distance server used for a combined long and short distance wireless communication system as claimed in claim 1, comprising:

   a data service function entity for detecting whether or not the occurrence of a long and short distance data transmission is, if it is, then providing a connection service for said data transmission;

   a memory function entity for storing data that may be missed at the time of switching, and sending the stored data to a terminal via said data service function entity after said terminal switching is completed, in order to implement seamless switch for the terminal between a long distance communication network and a short distance communication network;

   a dual distance home server for registering the dual distance character parameters of the dominated dual distance terminals, obtaining terminal switch information via said data service function entity when dual distance switch occurs, updating the terminal data; and informing said data service function entity of terminal-related dual distance information when a query regarding the terminal exists;

   an external network interface unit for connecting dual distance network and an interface of an external network.

5. The dual distance server according to claim 4, wherein said external network interface comprises a wireless interface, an interface for wire network, and an interface for other wireless networks.

6. A dual distance terminal used for a combined long and short distance wireless communication system as claimed in claim 1, comprising:

   a short distance communication function entity having a short distance radio frequency function module for functioning as physical layer, part of MAC layer or link layer and operating in a short distance communication network to obtain data information;

   a long distance communication function entity

IPR2025-00447 Page 00111

having a long distance radio frequency function module for functioning as physical layer and part of link layer;

a network switch condition judging function entity for performing network switching for the dual distance terminal based on the corresponding dual distance switch condition and instructing the short distance communication function entity or the long distance communication function entity to send a beacon signal to the dual distance network server;

a common function entity for implementing display and input and output functions of the terminal.

7. The dual distance terminal according to claim 6, wherein said dual distance terminal further comprise a data management and buffering function entity for storing data which is missed during the switch and forwarding the stored data to the common function entity which is a higher level of the terminal after the switch is completed.

8. A wireless communication method using combined long and short distance wireless communication systems, comprising steps:

detecting a dual distance terminal to determine whether it is located in a service area covered by a short distance access point upon powering on;

entering a short distance communication network through the short distance access point if the dual distance terminal is located within the service area covered by the short distance access point, and informing a dual distance home server of the position of the dual distance terminal;

searching for a base station for a long distance communication service if the dual distance terminal is not located in the area covered by any one of the short distance access points, entering a long distance communication network through a long distance access network, and informing the dual distance home server of the position of the dual distance terminal.

9. The wireless communication method according to claim 8, further comprising the steps of if the dual distance terminal detects that a wireless local area network (WLAN) exists and does not require authority identification at present, the dual distance terminal then accesses the WLAN network directly; if the result of the detection indicates that current WLAN network requires authority identification, the dual distance terminal then performs access authority identification via WLAN network; and if the authority identification is successful, the dual distance terminal accesses current WLAN network; the dual distance terminal continues the detection and enters into the long distance GPRS communication network if the authority identification is unsuccessful.

10. The wireless communication method according to claim 9, further comprising the step of the dual distance terminal performs data transmission by accessing the dual distance server via the short distance WLAN network after the dual distance terminal enters into the WLAN network.

11. The wireless communication method according to claim 9 or 10, further comprising the steps of switching from the short distance communication network to the long distance communication network immediately before the dual distance terminal moves out of the short distance WLAN network and enters into the GPRS network; the dual distance terminal makes judgment by using switching conditions, if a predetermined threshold for the switching is satisfied, the dual distance terminal terminates data transmission through a short distance radio frequency function entity with the switching conditions, and activates a long distance communication function entity and uses it to implement the possible sequent data transmission.

12. The wireless communication method according to claim 11, wherein the threshold for the switching condition is a non-usable threshold of a short distance communication network signal or a non-optimal threshold of a short distance communication network signal.

13. The wireless communication method according to claim 11, wherein during the process of switching from the short distance communication network to the long distance communication network, if the dual distance terminal requests seamless switching based on its service level, the dual distance terminal terminates data transmission through the short distance radio frequency function entity and sends a beacon signal for switching between the short distance communication network and the long distance communication network to the short distance AP from which is switched through the short distance communication function entity in the terminal while it terminates the data being transmitted by the WLAN radio frequency function entity, the beacon signal is then transmitted to the dual distance network server by the short distance AP; after receiving the corresponding beacon signal, the dual distance

IPR2025-00447 Page 00112

network server informs the long distance communication function entity to be accessed by the dual distance terminal of the receipt, and determines the service queue position which the dual distance terminal is arranged in the long distance network function entity based on its service level.

14. The wireless communication method according to claim 13, wherein the dual distance communication network server stores the data packets which may be missed in the switching process to protect the data packets, the stored data packets are forwarded to the dual distance terminal after the switching is completed, preventing data for the dual distance terminal from lost during the switching.

15. The wireless communication method according to claim 8, further comprising the steps of switching from the long distance communication network to the short distance communication network immediately before the dual distance terminal moves out of the long distance communication network and enters into the short distance WLAN network; the dual distance terminal makes judgment by using switching conditions, if a predetermined threshold of the switching is satisfied, the dual distance terminal terminates data transmission through a long distance radio frequency function entity with the switching conditions, and activates a short distance communication function entity and uses it to implement the possible sequent data transmission.

16. The wireless communication method according to claim 15, wherein if the dual distance terminal requests seamless switching from the long distance communication network to the short distance communication network based on its service level, when terminating the data being transmitted by the long distance communication function entity, the dual distance terminal further sends one beacon signal of long and short distance switching to the long distance service function entity from which is switched through the base station and the long distance network function entity in the dual distance terminal, the beacon signal is transmitted to the dual distance network server by the long distance network function entity, and after receiving the corresponding beacon signal, the dual distance network server informs the short distance communication function entity of the receipt, and determines the priority of the dual distance terminal in the short distance communication network function entity based on its service level.

17. The wireless communication method according to claim 16, further comprises the dual distance communication network server stores the data packets which may be missed in the switching process to protect the data packets, the stored data packets are forwarded to the dual distance terminal after the switching is completed, thereby preventing data for the dual distance terminal from lost during the switching.

18. The wireless communication method according to claim 9 or 10, wherein when the dual distance terminal moves from one short distance cell to another short distance cell, the dual distance terminal identifies the short distance AP to which it enters, and sends the cell information to the dual distance network server, thereby implementing the switching between the short distance cells.

19. The wireless communication method according to claim 18, further comprises the step of when one dual distance terminal moves from one short distance cell to another short distance cell, the dual distance terminal informs the home server among the dual distance network servers that it has already entered in the area covered by said another short distance communication network, and the home server is in charge of the query and communication to it from the other terminals in the network.

20. The wireless communication method according to claim 8, wherein said dual distance terminal detects the long and short distance communication networks in the manner of scanning with one of the following three ways:

(1) the dual distance terminal keeps the long distance and the short distance radio frequency entity in operating state all the time, and detects the possible long distance or short distance communication network environment in real-time, continuously feeds the detected results back to the dual distance terminal switching management mechanism, the detected results are reported to the dual distance network server through the existing network periodically or as desired;

(2) the dual distance terminal keeps the radio frequency function entity corresponding to the network in which it locates in operating state all the time, and activates the radio frequency function entities for the other networks periodically or non-periodically to detect the candidate networks;

(3) the dual distance terminal keeps the radio frequency function entity in the network in which it locates in operating state all the time, and does not scan and detect the other networks until the existing network is not available.

IPR2025-00447 Page 00113

21. The wireless communication method according to claim 20, wherein the detection for candidate networks with non-periodically activating the corresponding radio frequency function entity is carried out by using a viable-step detection method which the time interval of finally finding the occurrence of other networks is used as a function.

22. The wireless communication method according to claim 11, wherein said switching conditions comprising two types of as follows:

(1) the dual distance terminal switches to the network with higher priority level as long as the network with higher priority level is detected;
(2) The dual distance terminal switches to other networks only when the currently used wireless network signals can not be received.

23. The wireless communication method according to claim 15, wherein said switching conditions comprising two types of as follows:

(1) the dual distance terminal switches to the network with higher priority level as long as the network with higher priority level is detected;

(2) The dual distance terminal switches to other networks only when the currently used wireless network signals can not be received.

24. The wireless communication method according to claim 18, wherein said switching conditions comprising two types of as follows:

(1) the dual distance terminal switches to the network with higher priority level as long as the network with higher priority level is detected;

(2) the dual distance terminal switches to other networks only when the currently used wireless network signals can not be received.

25. The wireless communication method according to any one of claims 22-24, wherein the switching condition which the dual distance terminal switches to other networks only when the currently used wireless network signals can not be received means that only when the wireless network in which the dual distance terminal is located is not available, the dual distance terminal performs switch, and if the network which the dual distance terminal currently located is available, the switch is not performed even though there are networks with a higher priority levels.

26. The wireless communication method according to claim 8, wherein when the dual distance terminal moves from one network to another network, the dual distance server cooperates with the dual distance terminal to perform the switch.

27. The wireless communication method according to claim 26, wherein the process of the dual distance server cooperating with the dual distance terminal to perform the switch comprises:

first step: detecting the dual distance beacon signal of the dual distance terminal by the long (or short) distance network function entity, checking whether a switching occurs, if it is not, then the detection is repeated; if it is yes, the flow turns to next step;

second step: updating the subscriber information registered in the dual distance home register;

third step: determining whether or not data transmission occurs, if it is not, the flow returns to the first step;

fourth step: determining whether or not there exists a need for seamless switching, if it is not, the flow returns to the fist step;

fifth step: buffering the transmitted data, and forwarding the buffered data to the dual distance terminal after the switch is completed.

28. The wireless communication method according to claim 15, wherein when the dual distance terminal located in the long distance network requests to enter any one of the service areas covered by the short distance APs, if the AP within the area rejects the access of the dual distance terminal due to security or other issues, then the dual distance terminal still operates the long distance communication.

29. The wireless communication method according to claim 8, wherein the subscriber may define the priority levels of the switching in advance as desired so that the dual distance terminal performs automatic switching.

IPR2025-00447 Page 00114

Fig. 1

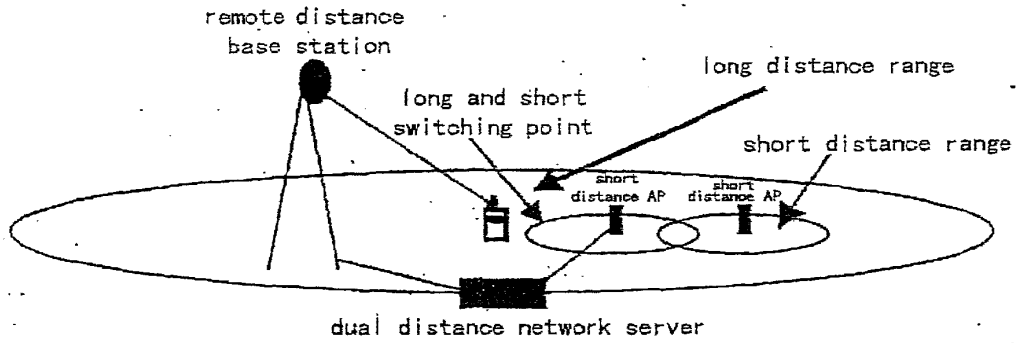
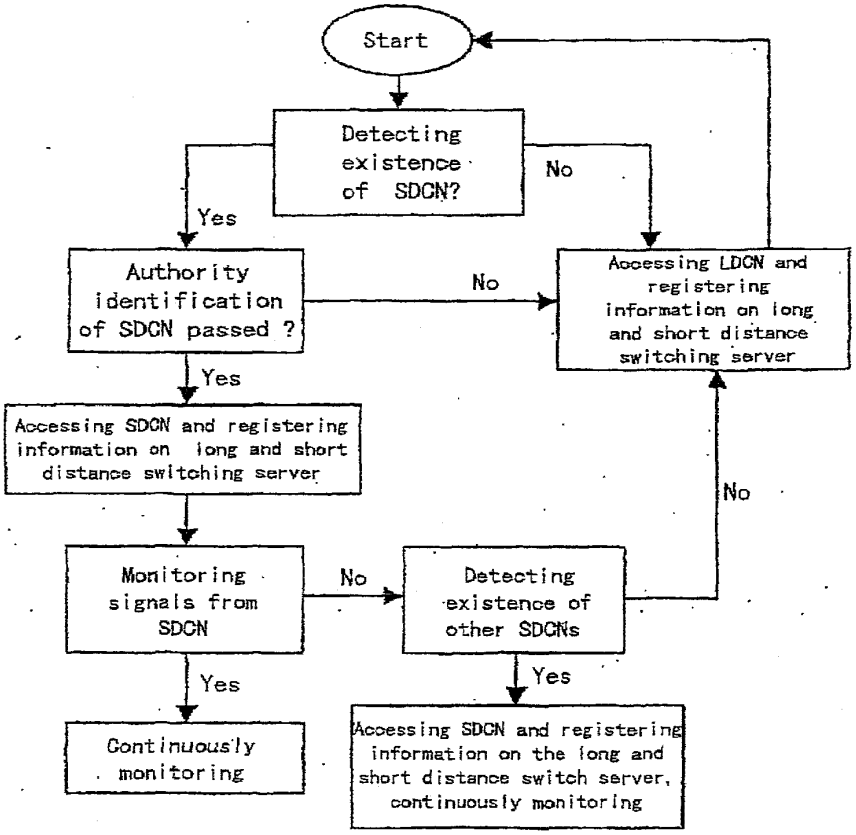


Fig. 2



IPR2025-00447 Page 00115

Fig. 3

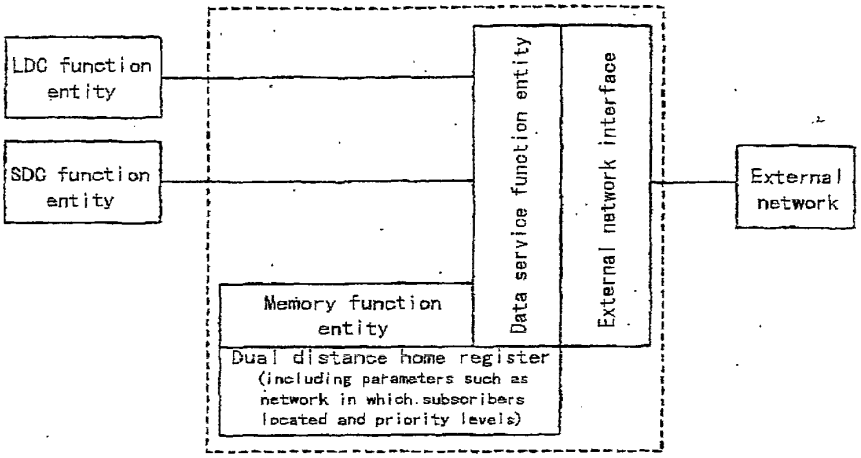
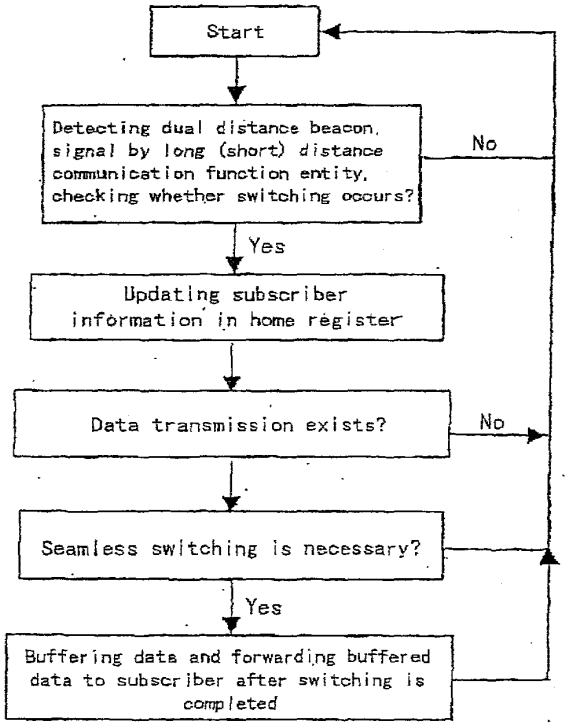
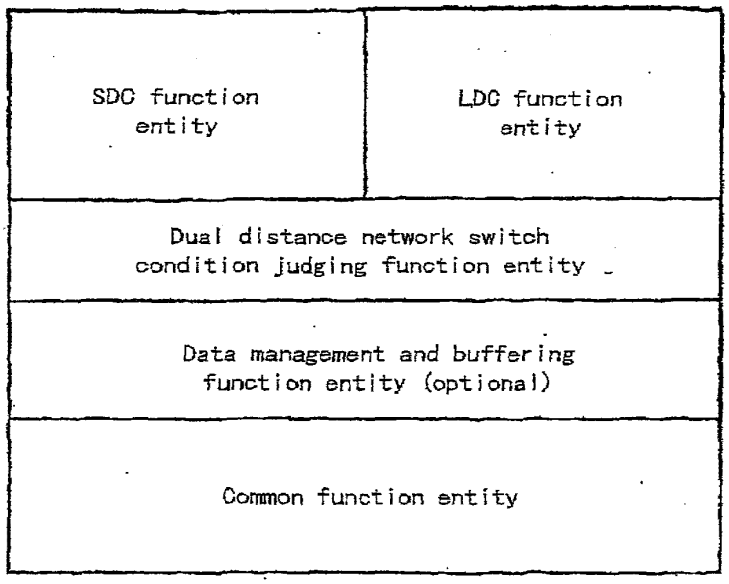


Fig. 4



IPR2025-00447 Page 00116

Fig. 5



IPR2025-00447 Page 00117

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN02/00914

A. CLASSIFICATION OF SUBJECT MATTER

IPC[7]: H04B 7/26 H04Q 7/32

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 7/26 H04Q 7/32

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 practicable, search terms used)

WPI、EPODOC、PAJ、CNPAT

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A		4、5、14、17
Y	WO 94/00946 A1 (MOTOROLA INC.) 6 Jan. 1994 (06.01.94) See the whole document	1-3、6-13、15、16、20-26、28、29
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☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21. Feb 2003 (21. 02. 2003)	20 MAR 2003 (20.03.03)
Name and mailing address of the ISA/CN 6 Xitucheng Rd., Jimen Bridge, Haidian District, 100088 Beijing, China Facsimile No. 86-10-62019451	Authorized officer GUO QUN Telephone No. 86-10-62093785

IPR2025-00447 Page 00118

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Search request No.
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IPR2025-00447 Page 00119

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H04Q 7/38

(52) UK CL (Edition N)
H4L LDSH L1H10

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(54) Method for determining handover in a multicellular environment

(57) A method for determining whether a handoff is required for a mobile station in a communications system having both macro- and microcells includes the steps of measuring a received signal parameter in the serving cell and from a plurality of neighbouring cells, comparing the values measured for each of the neighbouring cells, with a variable threshold value, and measuring either the time for which the threshold value is exceeded or the number of times the threshold value is exceeded in a given period for use as a handoff criterion.

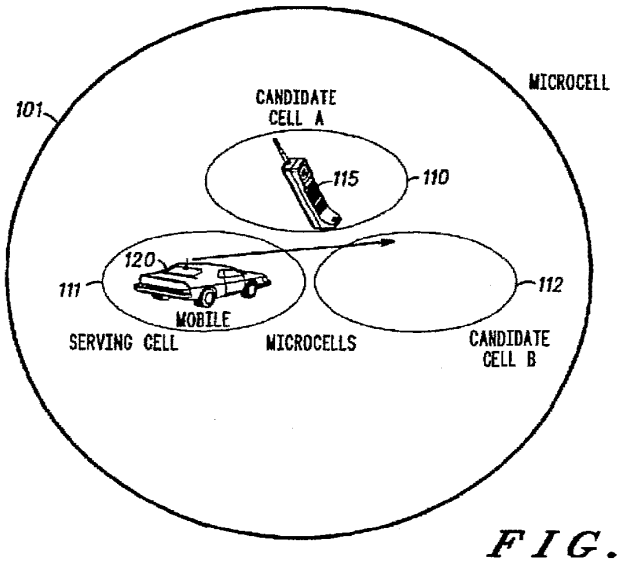


FIG.1

GB 2 287 858 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

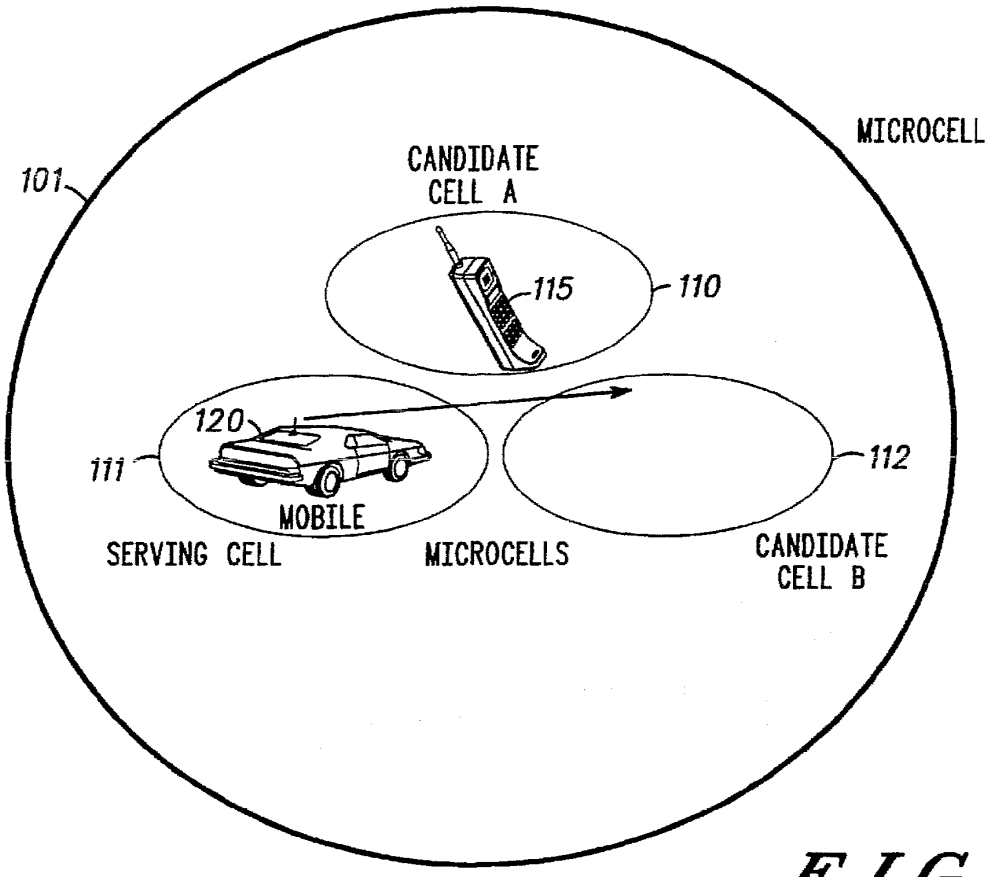

MICROCELL
101
CANDIDATE
CELL A
115
110
120
111
112
MOBILE
SERVING CELL
MICROCELLS
CANDIDATE
CELL B

FIG.1

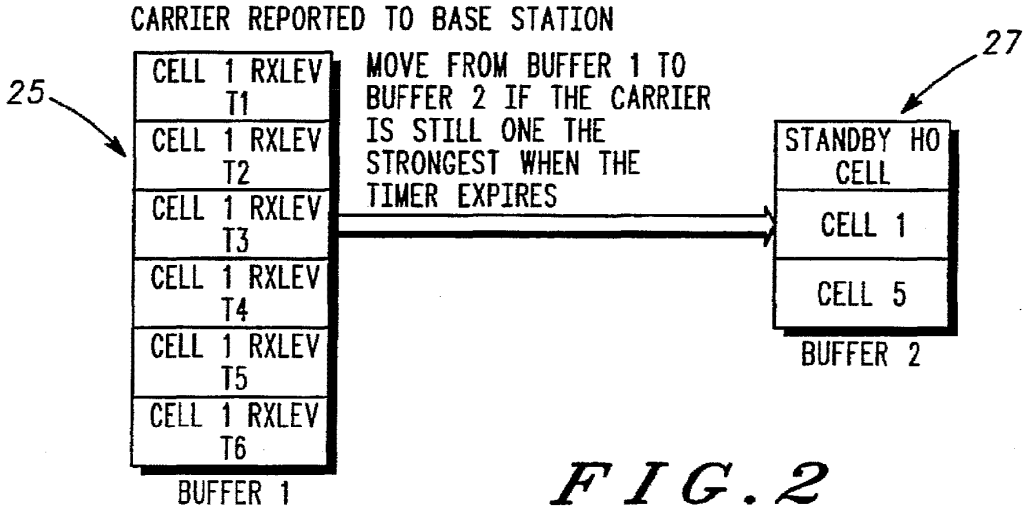

CARRIER REPORTED TO BASE STATION
25
27
CELL 1 RXLEV T1
CELL 1 RXLEV T2
CELL 1 RXLEV T3
CELL 1 RXLEV T4
CELL 1 RXLEV T5
CELL 1 RXLEV T6
BUFFER 1
MOVE FROM BUFFER 1 TO BUFFER 2 IF THE CARRIER IS STILL ONE THE STRONGEST WHEN THE TIMER EXPIRES
STANDBY HO CELL
CELL 1
CELL 5
BUFFER 2

FIG.2

FIG. 3

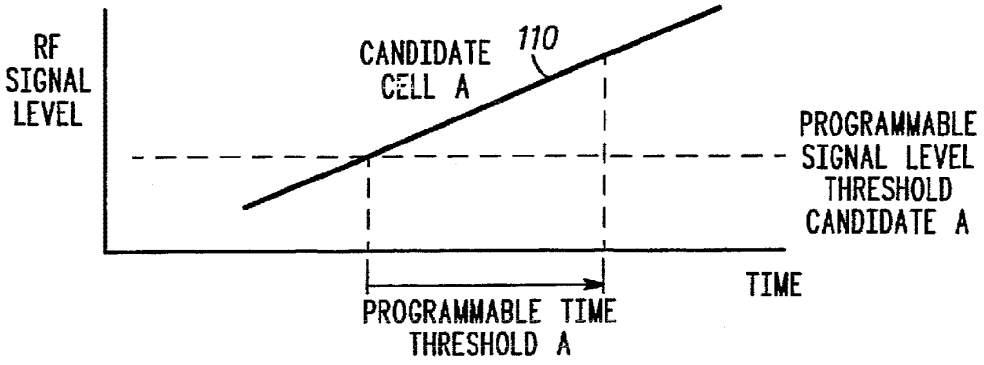


FIG. 4

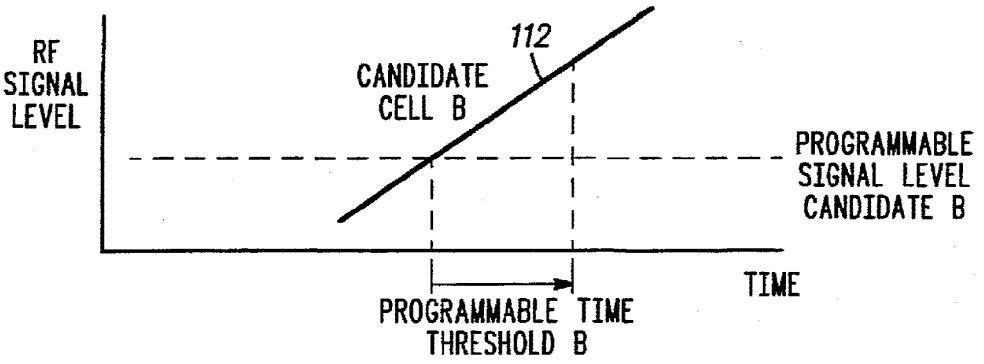
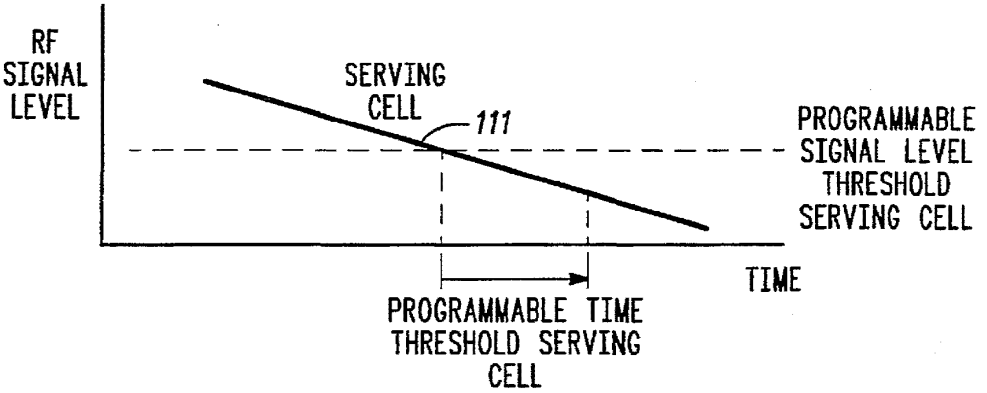


FIG. 5



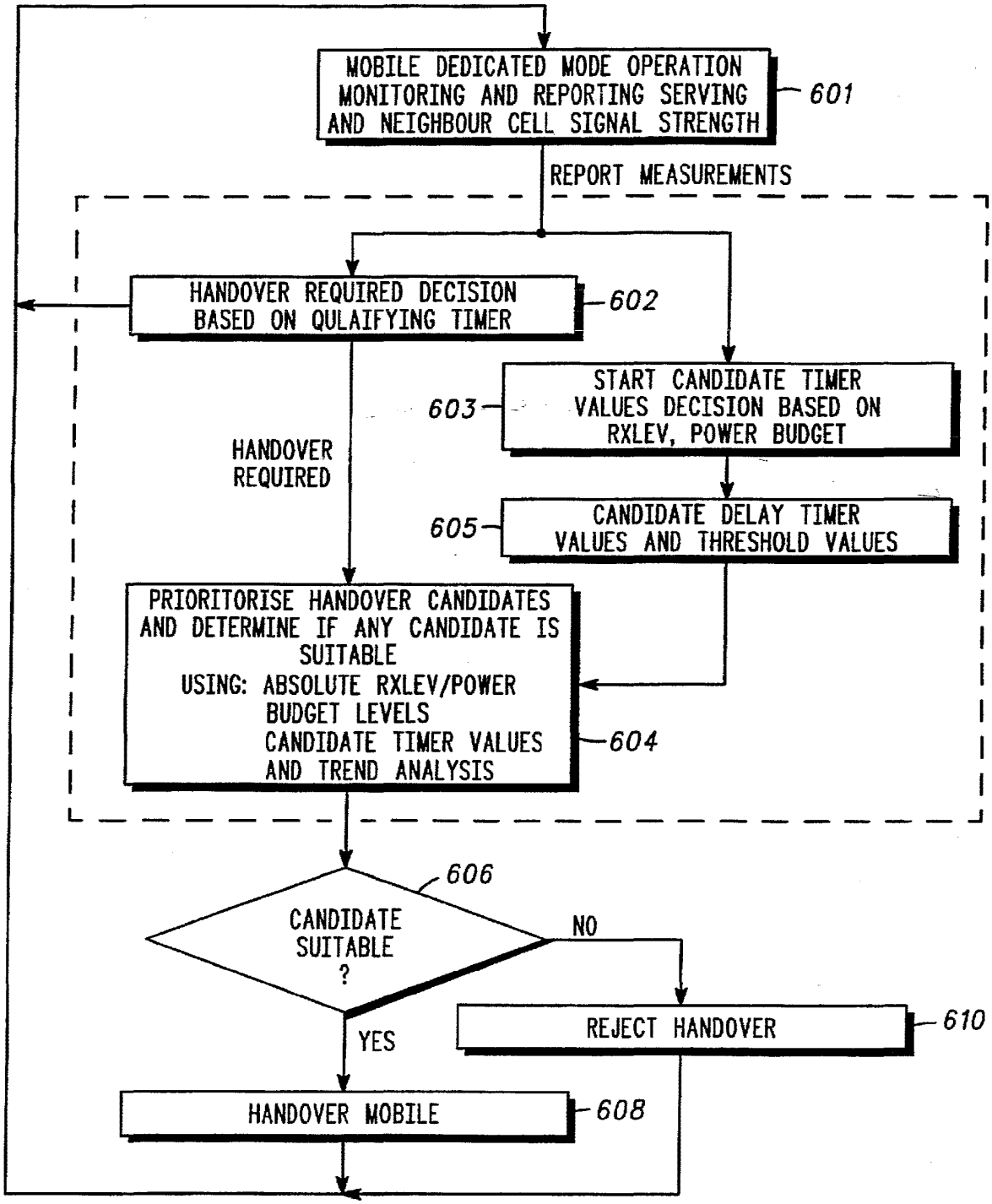

MOBILE DEDICATED MODE OPERATION MONITORING AND REPORTING SERVING AND NEIGHBOUR CELL SIGNAL STRENGTH
601
REPORT MEASUREMENTS
HANDOVER REQUIRED DECISION BASED ON QULAIFYING TIMER
602
START CANDIDATE TIMER VALUES DECISION BASED ON RXLEV, POWER BUDGET
603
HANDOVER REQUIRED
CANDIDATE DELAY TIMER VALUES AND THRESHOLD VALUES
605
PRIORITORISE HANDOVER CANDIDATES AND DETERMINE IF ANY CANDIDATE IS SUITABLE
USING: ABSOLUTE RXLEV/POWER BUDGET LEVELS
CANDIDATE TIMER VALUES
AND TREND ANALYSIS
604
606
CANDIDATE SUITABLE ?
NO
YES
REJECT HANDOVER
610
HANDOVER MOBILE
608

FIG.6

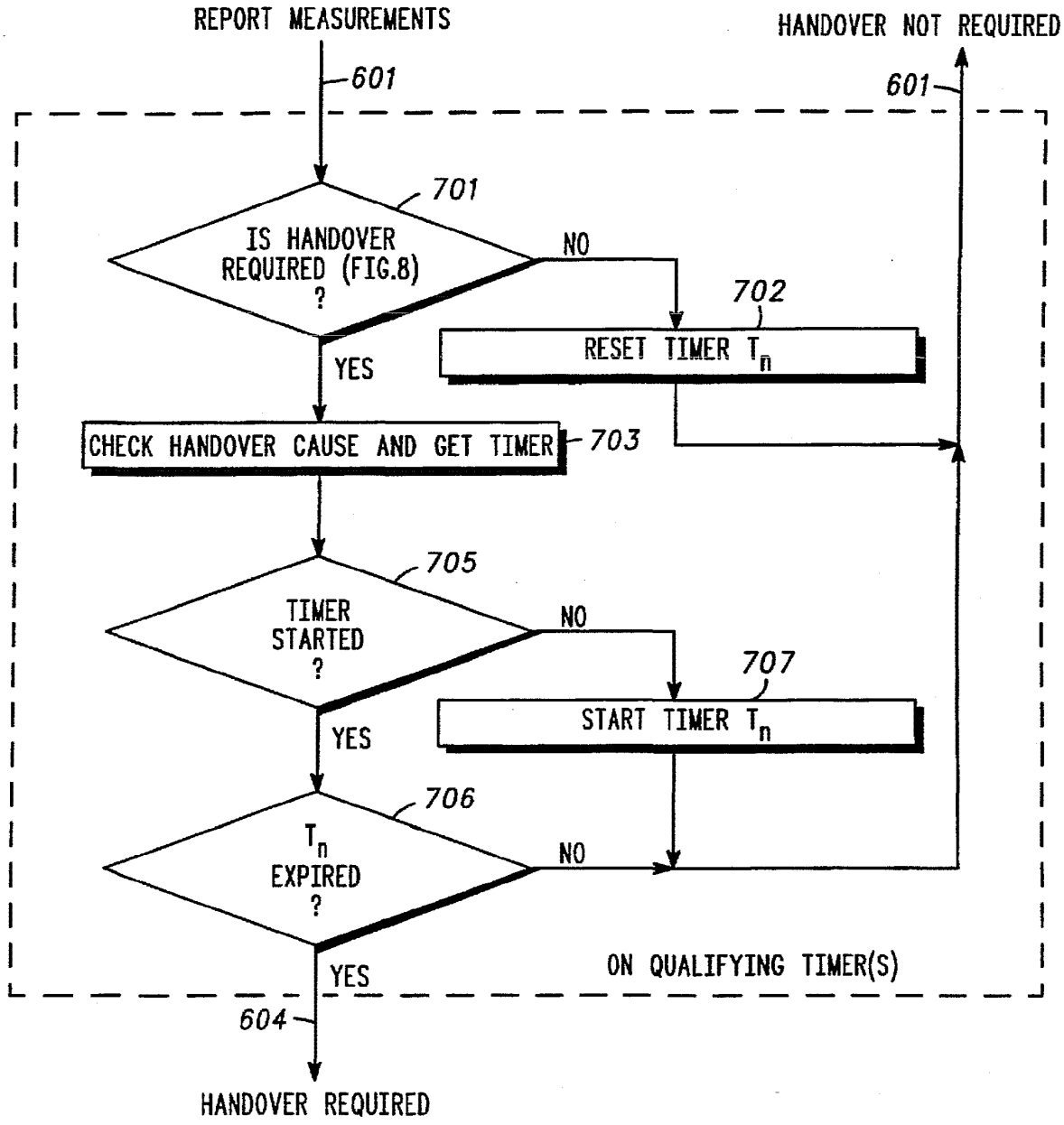
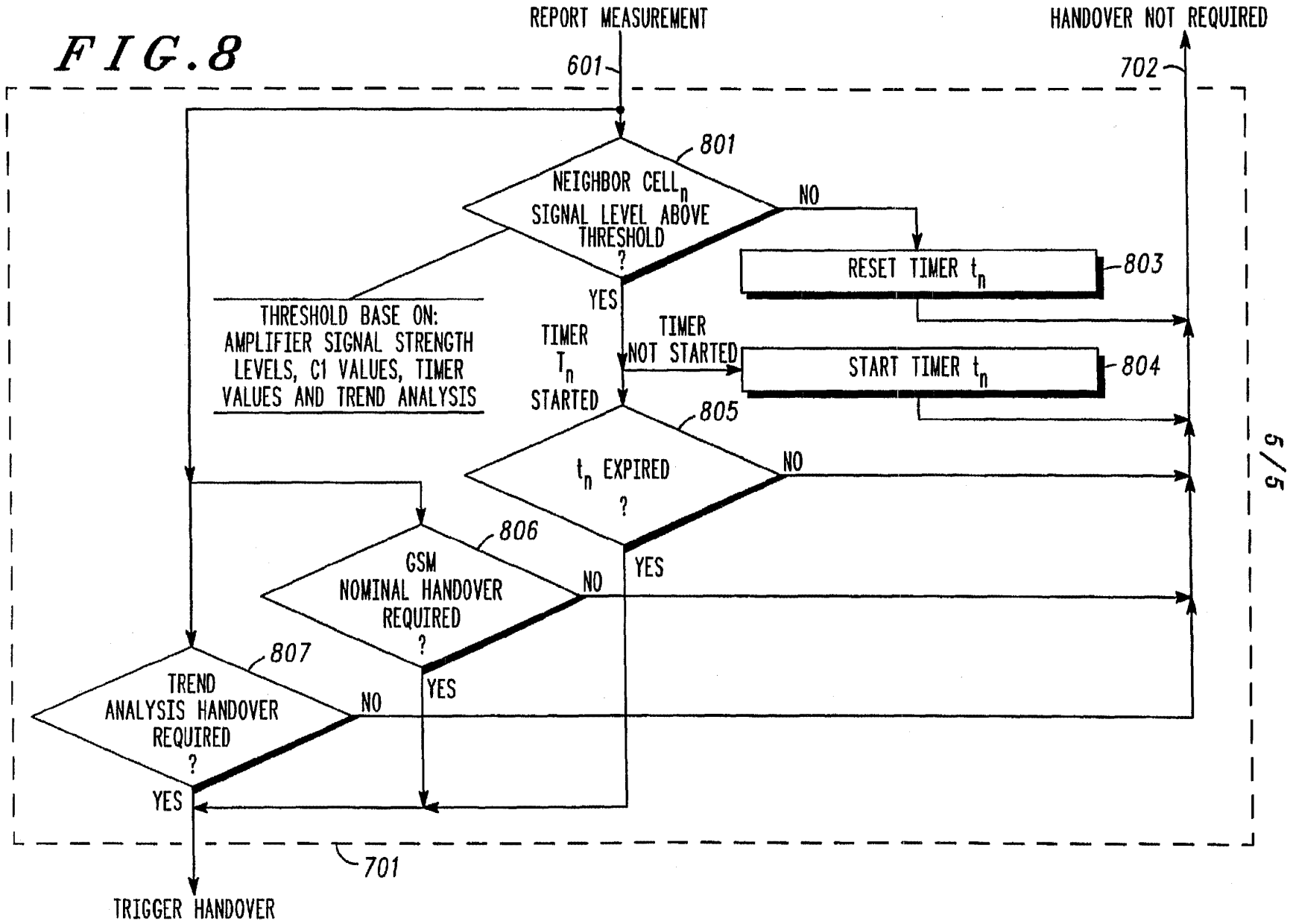

REPORT MEASUREMENTS
601
701
IS HANDOVER REQUIRED (FIG.8) ?
NO
YES
702
RESET TIMER T_n
CHECK HANDOVER CAUSE AND GET TIMER
703
705
TIMER STARTED ?
NO
YES
707
START TIMER T_n
706
T_n EXPIRED ?
NO
YES
ON QUALIFYING TIMER(S)
604
HANDOVER REQUIRED
HANDOVER NOT REQUIRED
601

FIG. 7

FIG.8



5/5

IPR2025-00447 Page 00125

METHOD FOR DETERMINING HANDOVER IN A MULTICELLULAR ENVIRONMENT

Field of the Invention

This invention relates in general to a method of determining handovers in a multicellular environment, and more particularly to determining handover in a multicellular environment based on a parameter of an incoming signal from at least one of the neighbouring cells or serving cell.

Background to the Invention

In a cellular environment, at any one time, there is usually one serving cell defined as the cell with the base station that a mobile unit is receiving service from so that the mobile unit may receive and transmit communication and a number of surrounding cells that are referred to as neighbouring cells. The serving cell may also be referred to as the cell that the mobile unit is camped on to.

In a multicellular environment, there may be cells of different sizes where a number of cells of the same size are located within one larger cell (umbrella cell or macrocell). The smaller cells within the umbrella cell may be called microcells. Microcells are created in a dense population of users to allow a greater capacity of users on the cellular system. The microcells facilitate the reuse of frequencies over a smaller distance. Thus, a mobile unit may be located within a microcell as well as an umbrella cell.

Typically, rural areas that do not have a large number of users or do not require a large capacity only need to be divided into larger cells. As the areas grow or the cells get closer to densely populated areas, the larger cells do not have the capacity to facilitate the increased number of users. There are not enough frequencies allocated. So microcells are created within the larger cells and the larger cells become umbrella cells. This allows frequency reuse among the microcells. Such microcellular techniques improve spectral efficiency and increase the capacity of the cellular network.

Microcells have disadvantages. One disadvantage is that in microcellular areas the number of handovers increases and the time available to make handover decisions decreases. For example, having too

many smaller size microcells in an area where there is a fast moving mobile, the fast moving mobile travels through a number of microcells in a short amount of time causing a number of handovers to be processed. Increasing the number of handovers in a short amount of time decreases the call reliability and increases the number of breaks in communication, thus, reducing the quality of communication and in extreme cases, loses calls.

Thus, a fast and reliable method of determining when to handover in a multicellular environment needs to be established. One such method has been proposed in co-pending UK Patent Application No. 9324428.3 entitled "Method for Determining Handover in a Multicellular Environment" filed on November 27, 1993 by Motorola. A related co-pending application that the present application claims priority from is UK Patent Application No. 9405539.9 entitled "Method for Determining Handover Candidate in a Multicellular Environment" filed on March 24, 1994 by Motorola.

Digital cellular communications systems, such as the GSM (Global System for Mobile Communications), integrate a large number of cells in a microcellular environment. It is required in GSM that a mobile station report a received signal level strength of its six strongest neighbouring cells. Current handover techniques choose a handover candidate from one of the strongest neighbouring cells. In a microcellular environment where the signal strengths are varying rapidly, a cell may produce a strong signal level strength in one measurement report and then a weak signal level strength in a next measurement report. Thus, making a handover decision based solely on a first report of signal strengths may result in selecting a base site that would not be a reliable serving cell for the mobile station.

Furthermore, in Phase One GSM there is no scheme to support an overlay macrocellular network and an underlay microcellular network in terms of handovers between the macrocells and the microcells.

Presently, a mobile station monitors the signal strength of a number of neighbour cells and reports this information on a regular basis to the serving base station. The cells that the mobile station monitors is determined by the Basestation Allocation (BA) list sent to it by the base station.

In Phase One GSM systems and Phase Two GSM systems the process of determining the need for a handover and the selection of the best

candidate is separate. In such systems there are two methods that are used to determine that a handover is required:

1) The average signal level falls/link quality/time delay ... below programmable thresholds;

2) The signal strength of neighbour cells exceeds that of the serving cell by a programmable threshold.

The second part of the process is to determine the best handover candidate. It must be separately decided which the best candidate is from those available based on signal strength readings from the serving cell and a number of candidate base stations.

For multicellular environments, it is desirable to make reliable handover decisions based on a number of criteria involving received signal parameters.

Summary of the Invention

According to the present invention, there is provided a method for determining a handover in a multicellular communication system including the steps of measuring received signal parameters received from a serving cell and a plurality of neighbouring cells, comparing received signal parameters with a variable threshold value for each of the plurality of neighbour cells, measuring time received signal parameters are above threshold value for each of the plurality of neighbour cells, and determining handover based on the measured time.

In an alternative embodiment the method includes measuring for a period of time a number of times the received signal parameters are above threshold value for each of the plurality of neighbour cells and determining handover based on the number of times.

In a further embodiment the method includes measuring for a period of time a number of times the received signal parameters are above threshold value for each of the plurality of neighbour cells and determining handover based on the measured number of times.

Brief Description of the Drawing

FIG. 1 illustrates a multicellular environment.

FIG. 2 illustrates a buffer arrangement for an embodiment of the present invention.

FIGS. 3-5 illustrates signal strength variations when a mobile is moving as indicated in FIG. 1.

FIG. 6-8 illustrate flow charts for embodiments of the present invention.

Detailed Description of the Preferred Embodiment

Referring to FIG. 1, a multicellular (or microcellular) environment is shown comprising of at least one macrocell (or umbrella cell) 101 and a plurality of microcells 110, 111, 112. Each cell includes a base station typically located in the geographic area covered by the cell. The base stations are not shown in FIG. 1. A base station 115 typically determines the size and capacity of the cell 110. A communication system may include different sized cells as well as a mobile station 120 which may be receiving service from either a base station of the macrocell 101 or a base station of one of the microcells 111. Receiving service from a particular base station in terms of being able to receive and transmit calls is also referred to as being camped on that particular base station. When a mobile station enters the multicellular environment a decision should be made to determine whether to remain being served by the current cell type or handover to a new cell type. The decision may be dependent upon the speed of the mobile unit.

Two cases may be defined when a mobile station is in a multicellular environment or coverage area. The mobile unit may be moving at a high speed or at a slower speed.

When a fast moving mobile station is in a microcellular environment it is desirable that the mobile station remain on the macrocell 101 to alleviate the number of handovers that would be required in a short amount of time.

On the other hand, when a slow moving mobile station is in a microcellular environment it is desirable that the slow moving mobile station is handed over to a microcell 111. This ensures that the macrocell does not become congested and the maximum traffic is handled by the microcell.

Thus, according to one embodiment of the present invention when the mobile station 120 enters a microcellular environment the received signal parameters received from the serving cell and a plurality of neighbouring cells are measured at the mobile station 120 and sent to the serving cell base

station. The received signal parameters are compared with a respective variable threshold value for each of the plurality of neighbour cells. Then a duration of time is measured time corresponding to how long the received signal parameters are above the respective threshold value for each of the plurality of neighbour cells. Thus, a reliable handover or handover candidate may be determined based on the measured time.

An alternative embodiment of the present invention includes measuring for a period of time a number of times the received signal parameters are above threshold value for each of the plurality of neighbour cells or a percentage of time that the received signal parameters are above the threshold value and determining handover or handover candidate based on the measured number of times or percentage.

Similarly, a further embodiment includes calculating an average of time or an average of the received signal parameter exceeding the respective threshold value.

The method of the present invention may also include taking into account the actual or absolute received signal parameter as well as any history available.

The received signal parameter may be a received signal level, a power level control signal or a timing advance signal.

The method of the present invention may be used for determining a requirement to handover or determining an ordering of a priority of handover candidates or both.

The method of the present invention proposes that a timer be started when the mobile station sees that the received signal parameter, such as the signal strength, of a neighbouring cell is above a programmable level or a variable threshold value. The neighbouring cell may be the serving cell or a candidate cell.

The variable or programmable threshold value is used to start a timer and may be different for each cell. Likewise, a different timer may be associated with each cell. Both the threshold value and the time may be predetermined or adaptively defined.

In a preferred embodiment of the present invention, the timer keeps running while the measured received signal strength level is above the respective cell's threshold value.

The following is examples of criteria in GSM which may be used to determine if a particular cell received signal level is above a threshold value.

A cell has been continuously being reported in the mobile measurement reports (e.g.. SACCH multiframes) and exceeding some programmable threshold over the time Tn. Under this condition the neighbouring cell has the highest probability to be a good handover candidate but it may not take into account fast changes in RXLEV due to fading, shadowing etc.

The cell has been reported at least n out of m times in the mobile measurement report and exceeding some programmable threshold over the time Tn. This method takes into account any fast changes in RXLEV in the neighbouring cell reporting and therefore has a high probability of identifying a good handover candidate. The values of n and m may be optimised for each cell.

The average RXLEV of the cell exceeds a threshold over the time Tn. This method averages out all the peaks and troughs of RXLEV but may not give a very accurate indication of a handover candidate because values are changing so rapidly.

The signal strength threshold could be set such that candidate cells are monitored well before the candidate cell is higher than the serving cell. This would allow microcells to be monitored in advance of time when a handover is required, and make a more informed macrocell/microcell handover decision.

The timer value indicates the length of time that a cell has been a good candidate. The longer this time then the more likely that it is to be a good candidate cell. Microcells will only appear as good cells if sufficient time is spent in the cell (a mobile user is travelling slowly or the cell is a macro cell). RF planning could be used to encourage mobiles onto microcells.

In addition to having a threshold set at which a serving cell indicates that a handover is required due to very poor serving cell signal levels the present invention provides that predetermined (or variable) levels of neighbour cells could be used to indicate that a handover is requested.

Thus, a handover candidate may be determined by the present invention. One possible implementation is that for a cell not to be considered as a handover candidate unless it has been one of the strong cells (RXLEV exceeds given programmable signal level threshold) for a give time Tn. A timer Tn is associated with each cell. It can be different for each of the cells and is defined by the user in the database. The signal level threshold could be different for each cell.

FIG. 2 shows one way in which the timer T_n may be used in determining a handover candidate. In FIG. 2 the mobile station reports the strongest neighbour carriers in terms of received signal levels to the base station. The system controller of the base station puts them in a first buffer 25 and starts a timer T_n. If at the expiry of the timer T_n the cell is still one of the six strongest carriers than it is moved to a second buffer 27 as one of the handover candidates.

Using this method the handover candidate list should always contain at least one cell which is the Standby Handover Cell. Standby Handover Cell is defined as a cell which is cell barred for normal call origination, but is available for any emergency handovers. It may be one of the macrocells (or certain timeslots in a given macrocell). This will ensure that in the cases where a handover is required but there are no suitable microcells available, then the call can be handed over without it being dropped.

RXQUAL and any other criterion currently used in the handover algorithm may also need to be satisfied if the cell is to be considered as handover candidate.

The ordering of the priority of the candidate cells could be determined by the following parameters: values of C1 for each cell, the absolute signal strength of the candidate cells and the serving cells, the value of the timers for each of the candidate cells. The decision could be made on the current values of each parameter or multi-parameter trends could also be used.

Alternatively, the timer does not need to bar the cell being considered as a candidate cell for a period of time. The timer could be used a weighting factor in the ordering of the candidate handover cells. The weighting factor could be any function of time (for example squared law, linear, or exponential).

The decision that a handover is required can be considered as a separate process to that of deciding the best handover candidate cells. An

embodiment of the present invention which may be used to determine handover may include any combination of the following: determining that the signal strength of the serving cell is below a programmable threshold, a timer tn expires, and an algorithm to indicate when a handover is required. The handover decision is determined by the value of the timers and the absolute signal levels levels of either the serving cell or the candidate cells.

FIGS. 3-5 show the signal strength variations when the mobile is moving along the direction indicated by the arrow in FIG. 1. FIG. 3 shows that a received signal level increases for cell A 110 as the mobile 120 travels in the direction as indicated. The received signal level for cell A 110 steadily increases for a time shown on the horizontal axis as a respective programmable time threshold A.

FIG. 4 shows that a received signal level for cell B is above its respective threshold value (level) and steadily increases for its respective programmable time threshold B. The rate of the received signal level of cell B is increasing faster than the rate of the received signal level of A. Thus, cell B may have a higher absolute value for a received signal level while the programmable time for cell A is longer.

FIG. 5 shows the received signal level for the serving cell 111 decreasing as the mobile station moves as indicated. The received signal level of the serving cell drops below its respective threshold level and steadily decreases for its respective programmable time.

FIG. 6 illustrates a flow chart for an embodiment of the present invention. Particularly, in dedicated mode operation a mobile station is monitoring and reporting serving and neighbouring cell signal strengths and link quality as in step 601. The mobile station reports the measurements to the base station and whether a handover is required is determined based on a qualifying timer algorithm as in step 602 and further defined in FIG. 7. A qualifying timer algorithm includes such as are known in GSM and trend analysis as well as that described in accordance with the present invention in FIG. 7.

If a handover is required as determined by a qualifying timer algorithm in step 602, then it is determined as in step 604 which candidates if any are suitable.

Another method is continuously monitoring the measurement reports from each neighbour cell as in step 603.

The ordering or prioritising of handover candidates as in step 604 may be done simultaneously and independently of determining whether a handover is required. Thus, a list of candidates may be constantly generated and updated so that when it is determined that a handover is required handover candidates may be readily available and ordered so the best handover candidate may be handed over to quickly.

Alternatively, the timers used to reorder the priority of handover candidates may be triggered by the handover request from step 602.

Specifically, absolute received signal levels or power budget levels from neighbouring cells may be used in determining whether any cell is a suitable handover candidate. Furthermore, candidate timer values may be used independently for each cell for measuring respective received parameters. Trend analysis may also be used to determine suitable handover candidates and prioritise handover candidates. Particular checks may include minimum RXLEV threshold exceeded availability, Power Budget better than current serving cell and handover margin hysteresis exceeded.

If a suitable handover candidate is determined in step 606 than the mobile station is handed over to the suitable candidate as in step 608. If no suitable candidate is available as determined by step 606 then no handover is performed as in step 610. In both situations the mobile returns to monitoring and reporting as in step 601.

Based on the reported measurements received in step 603, candidate timers are started to determine possible handover candidates as well as possibly prioritisation of candidates. The decision to start the candidate timers may be based on received signal levels and power budget signals.

The timer values and respective threshold values are transferred as in step 605 to the method of determining the handover candidates and prioritisation of candidates in step 604. Therefore, the ordering or prioritisation of handover candidates maybe implemented as an independent process initiated when the need to handover is required.

FIG. 7 shows a flow chart that provides a handover required decision based on a timer method according to the present invention. The method is to ascertain, if any, of the many possible handover causes generated by step 701 has been continuously valid for a programmable handover cause dependent delay and thus should generate a Handover Required command.

A Handover Required command shall indicate the cause that led its generation. In the case when several handover cause dependent timers are expired when a Handover Required command is generated, all causes shall be listed. Additionally, the Handover Required command may include all causes which are valid at the time of generation indicating whether or not the associated timers have expired.

Some causes may have zero timer values, for example, if such a cause might indicate that communication could be lost.

An alternative embodiment of the method could include a mechanism to enable timers to be dynamically varied. For example, if some cause or combination of causes, might indicate that a particular kind of handover would be beneficial even if the timer associated with that cause had not expired.

If a handover is required as in step 701 and as further described in FIG. 8 then the handover cause and respective timer is checked as in step 703. If the timer has been already started as determined in step 705 then it is determined whether the timer has been expired as in step 706. If the timer has expired then a handover is required.

If no handover is required as in step 701 then the respective timer is reset and no handover is required.

If the respective timer has not been started as in step 705 then the timer is started as in step 707 and no handover is required.

The timers of FIG. 7 are handover delay timers.

FIG. 8 further describes a method that triggers a handover situation according to an embodiment of the present invention. From the reported measurements it is determined whether the neighbouring cells signal levels are above a threshold value as in step 801. The threshold value may be variable or predetermined and may vary from cell to cell. The threshold values may also be based on absolute signal strength levels, C1 values, timer values and trend analysis.

If it is determined in step 801 that a neighbour cell signal level is above its respective threshold and its respective timer has been started then it is determined whether the timer has expired as in step 805. If yes, then a handover is triggered, if not, no handover is required. The respective timers may be respective neighbour cell signal level timers.

If it is determined in step 801 that no neighbour cell received signal levels are above their respective threshold then the respective timer is reset as in step 803. If a received signal level is above its respective threshold and its respective timer has not been started then the timer is started as in step 804.

Other two independent determinations of whether a handover is required may be made by GSM nominal handover required method as determined in step 806 and trend analysis handover methods as in step 807. The trend analysis method includes signal strength trends and step change methods.

Although the methods of the present invention have been described as being implemented at the base station of the serving cell, the method could actually be implemented in a mobile station provided that the required intelligence is built into the mobile station. The methods could also be implemented at the base station of a neighbouring cell provided the proper information was passed to the base station of the neighbouring cell. As cellular systems expand, methods such as the one of the present invention may be implemented elsewhere in the infrastructure of the system.

In conclusion, the present invention uses programmable and absolute thresholds, elapsed timers and historic information to determine the handover candidates and the target handover cells. Thus, a method is provided for a multicellular communication system, that minimises the number of handovers required and makes efficient handovers decisions. The present invention significantly reduces the number of handovers required and the cellular environment is efficiently utilised. By efficiently utilising the cellular environment, capacity of the cellular communication system may be increased.

Claims

1. A method for determining a handover in a multicellular communication system including a serving cell and a plurality of neighbouring cells where the serving cell and the neighbouring cells comprise of at least one macrocell cell and a plurality of microcells, each cell having a respective base station, the method for determining a handover comprising the steps of:

measuring received signal parameters received from the serving cell and a plurality of neighbouring cells;

comparing received signal parameters with a variable threshold value for each of the plurality of neighbour cells;

measuring time received signal parameters are above threshold value for each of the plurality of neighbour cells; and

determining handover based on the measured time.

2. A method for determining a handover in a multicellular communication system including a serving cell and a plurality of neighbouring cells where the serving cell and the neighbouring cells comprise of at least one macrocell cell and a plurality of microcells, each cell having a respective base station, the method for determining a handover comprising the steps of:

measuring received signal parameters received from the serving cell and a plurality of neighbouring cells;

comparing received signal parameters with a variable threshold value for each of the plurality of neighbour cells;

measuring for a period of time a number of times the received signal parameters are above threshold value for each of the plurality of neighbour cells; and

determining handover based on the measured number of times.

3. The method of any preceding claim wherein the parameter is a received signal level.

4. The method of claims 1 or 2 wherein the parameter is a power level control signal.

5. The method of claims 1 or 2 wherein the parameter is a timing advance signal.

6. The method of any preceding claim wherein the step of determining handover includes determining whether the signal parameters received are continuously over the respective threshold value.

7. The method of any preceding claim wherein the step of determining handover further includes determining handover based on the respective measured received signal parameters.

8. The method of any preceding claim further comprising the step of calculating an average of the received signal parameters.

9. The method of any of the preceding claims for determining a requirement to handover, an ordering of a priority of handover candidates or both.

10. A method for determining a handover of a mobile unit in a cellular communication system substantially as herein described with reference to FIGS. 6-8 of the drawing.

Patents Act 1977 **Examiner's report to the Comptroller under Section 17** **(The Search report)** -14-	Application number GB 9416186.6
Relevant Technical Fields (i) UK Cl (Ed.M) H4L (LDSD, LDSF, LDSX); H4K (KY4D14H) (ii) Int Cl (Ed.5) H04Q 7/04	Search Examiner MR N HALL Date of completion of Search 7 NOVEMBER 1994
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ONLINE : WPI	Documents considered relevant following a search in respect of Claims :- 1-10

Categories of documents

X:	Document indicating lack of novelty or of inventive step.	**P:**	Document published on or after the declared priority date but before the filing date of the present application.
Y:	Document indicating lack of inventive step if combined with one or more other documents of the same category.	**E:**	Patent document published on or after, but with priority date earlier than, the filing date of the present application.
A:	Document indicating technological background and/or state of the art.	**&:**	Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
Y	GB 2204215 A	(MITSUBISHI) see abstract Claim 3	1, 2 at least
Y	WO 92/12602 A1	(BRITISH TELECOM) see whole document	1,2 at least

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

D4

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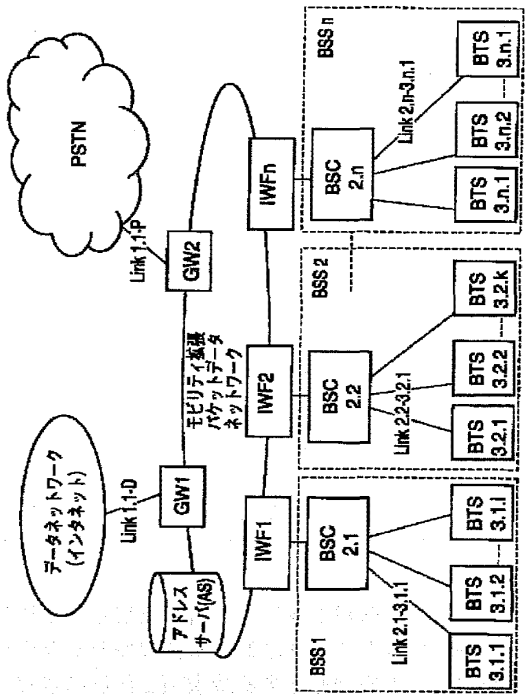
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最終頁に続く

(54)【発明の名称】　無線ネットワークシステム

(57)【要約】
【課題】　既存のエアインターフェースおよび加入者装置との互換性を維持しつつ、高速かつ低コストの無線ネットワークシステムを提供する。
【解決手段】　無線ネットワークシステムは少なくとも１つの基地局サブシステム（ＢＳＳ）とモビリティ拡張パケットデータネットワークとからなり、ＢＳＳとモビリティ拡張パケットデータネットワークとは、インターワーキング機能（ＩＷＦ）を用いて通信する。ＩＷＦは、ＢＳＳとモビリティ拡張パケットデータネットワークとにそれぞれ固有のアダプテーション制御面およびユーザ面プロトコルを実行する。さらにモビリティ拡張パケットデータネットワークには外部ネットワークへの少なくとも１つのブリッジが設けられている。



【特許請求の範囲】

【請求項１】　モビリティ拡張パケットデータネットワークと、
前記モビリティ拡張パケットデータネットワークと通信を行う少なくとも１つの基地局サブシステム（以下、ＢＳＳという。）と、を設け、
前記ＢＳＳは基地局コントローラ（以下、ＢＳＣという。）を有し、
前記モビリティ拡張パケットデータネットワークは外部ネットワークへの少なくとも１つのブリッジを有する、ことを特徴とする無線ネットワークシステム。

【請求項２】　前記モビリティ拡張パケットデータネットワークは、インターワーキング機能（以下、ＩＷＦという。）を用いて前記ＢＳＣを通して前記少なくとも１つのＢＳＳと接続しており、前記ＩＷＦはコンピュータで実現されることを特徴とする請求項１記載の無線ネットワークシステム。

【請求項３】　前記モビリティ拡張パケットデータネットワークにアタッチされたアドレスサーバを更に有することを特徴とする請求項１記載の無線ネットワークシステム。

【請求項４】　移動局からの、あるいは移動局へのデータおよび音声トラフィックをトランスポート可能であることを特徴とする請求項１記載の無線ネットワークシステム。

【請求項５】　前記ブリッジはゲートウエイを用いて構成され、前記ゲートウエイは前記モビリティ拡張パケットデータネットワークと前記外部ネットワークとの間のプロトコルマッピングを実行することを特徴とする請求項１あるいは２記載の無線ネットワークシステム。

【請求項６】　前記ＩＷＦは前記ＢＳＣに統合されていることを特徴とする請求項２記載の無線ネットワークシステム。

【請求項７】　前記ＩＷＦは、ＢＳＳ制御、呼制御、移動管理、無線リソース管理、ユーザ面アダプテーション、およびプロキシシグナリングからなる機能エンティティを含むことを特徴とする請求項２記載の無線ネットワークシステム。

【請求項８】　前記アドレスサーバは、モバイルＩＤ、前記モビリティ拡張パケットデータネットワーク内でのルーティングのためのルーティング情報、加入者プロファイル、および認証情報を含み、問い合わせに応じて検索可能である、ことを特徴とする請求項３記載の無線ネットワークシステム。

【請求項９】　前記ＩＷＦによって、分散形式で呼処理が実行されることを特徴とする請求項２記載の無線ネットワークシステム。

【請求項１０】　前記ＩＷＦは、前記モビリティ拡張パケットデータネットワークに対するプロキシシグナリングを実行することを特徴とする請求項２記載の無線ネットワークシステム。

【請求項１１】　モバイル加入者ＩＳＤＮ番号（以下、ＭＳＩＳＤＮという。）を用いてプロキシ・シグナリング・インスタンスを選択することを特徴とする請求項３記載の無線ネットワークシステム。

【請求項１２】　前記モビリティ拡張パケットデータネットワークはＡＴＭ（非同期転送モード）に基づいていることを特徴とする請求項３記載の無線ネットワークシステム。

【請求項１３】　エアインタフェースはＧＳＭ（Global System for Mobilecommunication）に基づいていることを特徴とする請求項３記載の無線ネットワークシステム。

【請求項１４】　前記ゲートウエイは前記ＩＷＦ内に同居していることを特徴とする請求項５記載の無線ネットワークシステム。

【請求項１５】　前記ゲートウエイは前記モビリティ拡張パケットデータネットワーク内の任意のポイントにアタッチされていることを特徴とする請求項５記載の無線ネットワークシステム。

【請求項１６】　前記アドレスサーバは、国際モバイル加入者識別子（ＩＭＳＩ）を保持することを特徴とする請求項１１記載の無線ネットワークシステム。

【請求項１７】　前記アドレスサーバは、移動局ＩＳＤＮ番号を保持することを特徴とする請求項１１記載の無線ネットワークシステム。

【請求項１８】　前記アドレスサーバは、パケットデータネットワークルーティング情報を保持することを特徴とする請求項１１記載の無線ネットワークシステム。

【請求項１９】　ＭＳＩＳＤＮは、呼設定メッセージにおけるサブアドレス情報要素（ＩＥ）として運ばれることを特徴とする請求項１３記載の無線ネットワークシステム。

【請求項２０】　ＡＴＭアダプテーションレイヤ１が音声トラフィックベアラのために使用されることを特徴とする請求項１３記載の無線ネットワークシステム。

【請求項２１】　ＡＴＭアダプテーションレイヤ２が音声トラフィックベアラのために使用されることを特徴とする請求項１３記載の無線ネットワークシステム。

【請求項２２】　移動局で発信および着信されるトラフィックを伴うネットワークシステムにおいて、
単一のネットワークインフラストラクチャによって、データおよび音声の両方のトラフィックが処理可能であることを特徴とするネットワークシステム。

【請求項２３】　異なるインタフェース技術が使用されることを特徴とする請求項２２記載のネットワークシステム。

【請求項２４】　インターワーキング機能（以下、ＩＷＦという。）を通してモビリティ拡張パケットデータネットワークに接続された少なくとも１つの基地局サブシ

ステム（以下、ＢＳＳという。）とアドレスサーバとを有するセルラネットワーキングシステムにおける移動局（以下、ＭＳという。）の位置を更新する方法において、
ａ）前記ＭＳに関する情報を得るために、前記アドレスサーバの位置更新手順を起動し、
ｂ）前記情報を用いて前記ＭＳの認証を行い、
ｃ）前記ＭＳが認証された場合には当該ＭＳをアクティブとしてマークし、
ｄ）前記モビリティ拡張パケットデータネットワーク内で前記ＩＷＦのアドレスをルーティングアドレスとして登録する、
ことを特徴とする方法。
【請求項２５】　インターワーキング機能（以下、ＩＷＦという。）を通してモビリティ拡張パケットデータネットワークに接続された少なくとも１つの基地局サブシステム（以下、ＢＳＳという。）とアドレスサーバとを有するセルラネットワーキングシステムにおける移動局（以下、ＭＳという。）で呼を終端する方法において、
ａ）前記ＭＳのルーティング情報を呼設定メッセージの部分として伝達し、
ｂ）前記ルーティング情報を用いて前記ＭＳに関連するプロキシシグナリングインスタンスを識別、選択し、
ｃ）サービス認証、ページング、呼設定、およびベアラコネクション確立を含む必要なアクションを前記ＩＷＦによって起動し、
ｄ）前記呼が受理された場合には発呼者へ確認応答を返し、受理されなかった場合にはエラーメッセージを返す、
ことを特徴とする方法。
【請求項２６】　インターワーキング機能（以下、ＩＷＦという。）を通してモビリティ拡張パケットデータネットワークに接続された少なくとも１つの基地局サブシステム（以下、ＢＳＳという。）とアドレスサーバとを有するセルラネットワーキングシステムにおける移動局（以下、ＭＳという。）で呼を発信する方法において、
ａ）宛先情報を載せた呼設定要求を前記ＩＷＦで受信し、
ｂ）前記呼設定要求が前記モビリティ拡張パケットデータネットワークへ向けられているか、その外部に向けられているかを判定し、
ｃ）前記呼設定要求が外部に向けられている場合には、当該呼をゲートウエイ機能へ送信し、
ｄ）当該呼に対する１以上のコネクションを確立する、
ことを特徴とする方法。
【請求項２７】　２つのインターワーキング機能（以下、ＩＷＦという。）を通してモビリティ拡張パケットデータネットワークに接続された少なくとも２つの基地局サブシステム（以下、ＢＳＳという。）とアドレスサーバとを有するセルラネットワーキングシステムにおいて、前記２つのＩＷＦの間で移動局（以下、ＭＳという。）のシグナリングおよびベアラコネクションのハンドオーバを実行する方法において、
ａ）あるＢＳＳがハンドオーバを要求し、
ｂ）当該ＢＳＳに関係する前記ＩＷＦが、前記ハンドオーバ要求において与えられた無線セル識別子に基づいてターゲットＩＷＦを決定し、
ｃ）シグナリングおよびベアラコネクションのハンドオーバを促進するためにネットワークサイドおよびＢＳＳサイドにおいて必要な手順を起動し、
ｄ）前記ターゲットＩＷＦと通信し、
ｅ）コネクションが再ルーティングされうるように前記コネクションおよびＭＳのデータを前記ターゲットＩＷＦへ提供し、
ｆ）前記アドレスサーバを前記ターゲットＩＷＦのアドレスによって更新する、
ことを特徴とする方法。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は移動通信システムのためのインターワーキング機能(Interworking function)を提供する方法に係り、特に従来のセルラ基地局システム（セルラＢＳＳ）をモビリティ拡張（エンハンスド）パケットデータネットワークにアタッチするための技術に関する。
【０００２】
【従来の技術】先ず、便宜のために本明細書で使用される略語とその意味を列挙しておく。
【０００３】ＡＰＩ：Application Programming Interface（アプリケーション・プログラミング・インタフェース）
ＡＴＭ：Asynchronous Transfer Mode（非同期転送モード）
ＢＳＣ：Basestation Controller（基地局コントローラ）
ＢＳＳ：Basestation Subsystem（基地局サブシステム）
ＢＳＳＭＡＰ：Basestation Subsystem Mobile Application Part（基地局サブシステム移動アプリケーション部）
ＢＴＳ：Basestation Transceiver System（基地局送受信器システム）
ＣＣＢ：Call Control Block（呼制御ブロック）
ＣＩＣ：Circuit Identity Code（回線識別コード）
ＤＴＡＰ：Direct Transfer Application Part（直接転送アプリケーション部）
ＥＩＲ：Equipment Identification Register（装置識別レジスタ）
ＧＳＭ：Global System for Mobile communication
ＧＳＭＰ：General Switch management protocol（汎用

スイッチ管理プロトコル）
ＨＡ：Home Address（ホームアドレス）
ＩＭＳＩ：International Mobile Subscriber ID（国際モバイル加入者識別子）
ＩＷＦ：Interworking Function（インターワーキング機能）
ＭＡＴＭ：Mobility enhanced ATM（モビリティ拡張ＡＴＭ）
ＭＭ：Mobility Management（移動管理）
ＭＳＣ：Mobile Switching Center（モバイル交換局）
ＭＳＩＳＤＮ：Mobile Subscriber ISDN（モバイル加入者ＩＳＤＮ）
ＭＴＰ：Message Transfer Protocol 2（メッセージ転送プロトコル２）
ＭＵＮＩ：Mobility enhanced User Network Interface（モビリティ拡張ユーザ・ネットワーク・インタフェース）
ＲＲ：Radio Resource management（無線リソース管理）
ＳＳ７：Signalling System 7（Ｎｏ．７信号方式）
ＳＳＭ：System Startup Module（システム・スタートアップ・モジュール）
ＳＣＣＰ：Service Connection Control Part（サービスコネクション制御部）
ＴＭＳＩ：Temporary Mobile Subscriber ID（テンポラリ・モバイル加入者識別子）
ＵＮＩ：User Network Interface（ユーザ・ネットワーク・インタフェース）。

【０００４】ＧＳＭ、ＩＳ－９５およびＩＳ－１３６に準拠した第２世代セルラ無線ネットワークは、１組の機能エンティティからなる同じあるいは類似の階層的アーキテクチャを有する。ＧＳＭの詳細は、M. Mouly M.-B. Pautet: "The GSM System for Mobile Communications" Cell & Sys 1992, ISBN: 2-9507190-0 に記載されている。ＩＳ－９５の詳細は、Electronic Industries Association/Telecommunications Industry Association, Mobile station-base station compatibilitystandard for dual-mode wideband spread spectrum cellular system, TIA/EIA/IS-95-A. May, 1995 に記載されている。ＩＳ－１３６の詳細は、ElectronicIndustries Association/Telecommunications Industry Association, TDMA Cellular PCS (ANSI/TIA/EIA-136-99) TIA/EIA 136 に記載されている。

【０００５】セルラ無線ネットワークの主要なコンポーネントは、モバイル交換局（ＭＳＣ）、基地局コントローラ（ＢＳＣ）、及び基地局送受信器システム（ＢＴＳ）である。なお、本明細書では、基地局サブシステム（ＢＳＳ）が基地局コントローラ（ＢＳＣ）及び基地局送受信器システム（ＢＴＳ）の組み合わせに対応する。

【０００６】コンポーネントは、モバイル交換局（ＭＳＣ）によって実行されている集中制御機能に対応して配置される。モバイル交換局（ＭＳＣ）は階層構造の最上位レベルを構成する。さらに、モバイル交換局（ＭＳＣ）は全ての移動端末に対するシグナリングエンドポイントとして機能する。加えて、移動機が起点及び／又は終点となる音声ベアラコネクションは、そのシグナリングコネクションに従う。このようなコネクションは、全階層を通過してモバイル交換局（ＭＳＣ）に達する。同様に、１つの基地局送受信器システム（ＢＴＳ）あるいは基地局コントローラ（ＢＳＣ）に関連する２つの移動機間のコネクションでさえモバイル交換局（ＭＳＣ）を通過する。さらに、モバイル交換局（ＭＳＣ）は公衆電話交換網（ＰＳＴＮ）のような他のネットワークに対するゲートウエイを構成する。

【０００７】モバイル交換局（ＭＳＣ）より低いレベルにおいて、基地局コントローラ（ＢＳＣ）は与えられた無線位置登録エリアを制御する。このような無線位置登録エリアは複数の無線セルからなる。基地局コントローラ（ＢＳＣ）は無線位置登録エリアに対してコーディネーション機能及び無線制御機能を実行する。

【０００８】階層の最下位レベルは、基地局送受信器システム（ＢＴＳ）により提供される無線セルである。基地局送受信器システム（ＢＴＳ）はシンプルであり、無線周波数（ＲＦ）送信器及び受信器を含む。

【０００９】機能性及びそれに関連するコストは、最上位レベルであるモバイル交換局（ＭＳＣ）において最も高い。典型的な展開としては、１個あるいは１０個未満のモバイル交換局（ＭＳＣ）を全国的あるいは地域的なセルラネットワークにおいて配置する。デバイスの数は階層レベルが低いほど多くなる。たとえば、１つのモバイル交換局（ＭＳＣ）には複数の基地局コントローラ（ＢＳＣ）が接続され、１つの基地局コントローラ（ＢＳＣ）によって複数の基地局送受信器システム（ＢＴＳ）が制御される。

【００１０】セルラネットワークアーキテクチャは以前から存在する回線交換電話網（ＰＳＴＮ）から発展してきた。すなわち、そのネットワークの中心的なコンポーネントとして働くモバイル交換局（ＭＳＣ）は局交換機に由来し、モディファイされた電話交換機をもとにして考案された。セルラネットワークのインフラストラクチャは、階層内の種々のコンポーネントを相互接続する既存の有線トランスポートアーキテクチャを用いて構築される。ＰＤＨ（Plesiochronous Digital hierarchy：非同期デジタルハイアラーキ）およびＳＤＨ（Synchronous Digital Hierarchy：同期デジタルハイアラーキ）フレーミング及びマルチプレクシングを用いた専用線は、階層内の種々のデバイス間に設定され、コネクション及びモビリティ制御を適時に行う上で必要な特性を保証する。しかしながら、専用線インフラストラクチャは、セルラネットワークの運用を行う上で高価なコンポーネン

トである。

【００１１】このようなセルラネットワークを通してデータサービスを提供するためには、第２のパケットデータネットワークを回線交換ネットワークと並行して配置する必要がある。ＧＰＲＳ(General Packet Radio Service)ネットワークはこの第２データネットワークの代表例である。ＧＰＲＳについて更に詳しい情報は、European Telecommunications Standards Institute (ETSI): General Packet RadioService (GPRS) Service Description; Stage 2 GSM 03.60 V5.3.0 1998-03を参照のこと。

【００１２】しかしながら、２つの別々のネットワークの設定、運用、及び維持管理は、更なる投資及び運用コストをネットワーク運用者に課すこととなる。

【００１３】また、パケットデータネットワーク（ＡＴＭ、ＩＰ、フレームリレー、Ｘ．２５）およびセルラシステムを介して提供されるべきデータサービスが発展するに伴って、データおよび音声の統一トランスポートのためにパケットデータネットワークインフラストラクチャを使用することから得られるであろう利点は、未だ実現していない。しかしながら、このアプローチは基地局コントローラ（ＢＳＣ）及び基地局送受信器システム（ＢＴＳ）とデータネットワークとのインターワーキングを必要とする。このようなインターワーキングは、物理的なデバイス間のインターワーキングや制御面及びユーザ面プロトコル間のインターワーキングを伴うこととなる。更に、パケットデータネットワークは、適時コネクション設定手順なしに即時データ転送を提供するから、帯域幅を必要に応じて使用することができ、多重化によりかなりの利得を得ることができる。

【００１４】さらに、モバイルデバイスコネクション制御のためのシグナリングエンドポイントは、たとえばインターワーキング機能と一緒になったならば分散化されるであろうが、今現在はそうなっていない。このように、従来のシステムでは、コネクションルーティングは最適化されていない。たとえば、１つのモバイルデバイスから他の移動局（ＭＳ）への接続は常に中央局（ＭＳＣ）にルーティングされ、それによってリソースが不必要に浪費される。同じことは、今のところ複数のノードにわたって分散されていない他のネットワークへのゲートウエイ機能についてもあてはまる。その結果、全ネットワークにかかるトータルな負荷およびトータルな設備容量は高くなり、それらを低減することが必要である。

【００１５】従来のセルラネットワークのサービスエリアは、オーバラップしているあるいはしていない複数の無線セルからなる。各無線セルは基地局送受信器システム（ＢＴＳ）によって制御される。基地局送受信器システム（ＢＴＳ）は無線システムを含み、典型的にはアンテナサイトと共に設置されている。セルラ移動局（ＭＳ）は、そのＭＳが現在在圏している地理的なエリアをカバーする基地局送受信器システム（ＢＴＳ）との間に無線リンクを確立する。

【００１６】小さな送信電力で広いエリアをカバーし、周波数スペクトラムを再利用するために、多くの（全国的なネットワークでは１０００個代までの）無線セルがそれぞれ別個の基地局送受信器システム（ＢＴＳ）によって制御されセルラネットワークを形成する。したがって、基地局送受信器システム（ＢＴＳ）をシンプルで安価にすることが有利である。機能は、送信及び受信といった基本的な無線機能に減縮する。それ以上の処理及び制御機能は基地局コントローラ（ＢＳＣ）で実行する。基地局コントローラ（ＢＳＣ）は多数の（１０００個代までの）基地局送受信器システム（ＢＴＳ）を管理する。基地局サブシステム（ＢＳＳ）は、１つの基地局コントローラ（ＢＳＣ）と、それに接続された複数の基地局送受信器システム（ＢＴＳ）とを含む。複数の基地局コントローラ（ＢＳＣ）はモバイル交換局（ＭＳＣ）と接続する。モバイル交換局（ＭＳＣ）は、モバイルデバイスのためのコネクション制御、他のネットワーク（ＰＳＴＮ、データネットワーク）へのゲートウエイ、全てのリソース管理、および、関連するデータベースと協同した加入者管理及びモビリティ制御、を含む複数の機能を有する。このデータベースは、ホームロケーションレジスタおよびビジタロケーションレジスタである。１つのモバイル交換局（ＭＳＣ）は、通常、十万人の加入者を扱うことができる。大きなネットワークでは、複数のモバイル交換局（ＭＳＣ）が配置されている。図１は従来のセルラネットワークのアーキテクチャを例示する。

【００１７】図１に示すように、モバイル交換局ＭＳＣ（１．１）は、複数の基地局コントローラＢＳＣ（２．１～２．ｎ）にそれぞれリンク１－２．１～１－２．ｎを介して接続されている。複数の基地局コントローラＢＳＣ（２．１～２．ｎ）は、それぞれ１組の基地局送受信器システムＢＴＳ（３．１．１～３．１．ｉ）、（３．２．１～３．２．ｋ）、・・・（３．ｎ．１～３．ｎ．１）にそれぞれリンク（２．１－３．１．１～２．１－３．１．ｉ）、（２．２－３．２．１～２．２－３．２．ｋ）、・・・（２．ｎ－３．ｎ．１～２．ｎ－３．ｎ．１）を介して接続されている。基地局サブシステムＢＳＳ１は基地局コントローラＢＳＣ２．１と基地局コントローラＢＴＳ（３．１．１～３．１．ｉ）とからなり、基地局サブシステムＢＳＳ２は基地局コントローラＢＳＣ２．２と基地局コントローラＢＴＳ（３．２．１～３．２．ｋ）とからなり、基地局サブシステムＢＳＳｎは基地局コントローラＢＳＣ２．ｎと基地局コントローラＢＴＳ（３．ｎ．１～３．ｎ．１）とからなる。さらに、モバイル交換局ＭＳＣ（１．１）は、専用リンク１．１－１．２、１．１－Ｐ、および１．１－Ｄを通して、それぞれ、他のモバイル交換局ＭＳＣ（１．２）、公衆電話網（ＰＳＴＮ）およびデータネットワー

クへのコネクションを有する。複数の基地局送受信器システムＢＴＳと複数の基地局コントローラＢＳＣとを相互接続するリンク（２．１－３．１．１～２．ｎ－３．ｎ．１）および複数の基地局コントローラＢＳＣと１つのモバイル交換局ＭＳＣとを相互接続するリンク（１－２．１～１－２．ｎ）はそれぞれ専用リンクであり、それらは静的に設定されている。実際、これら専用リンクは固定された専用ラインあるいはマイクロ波リンクからなる。

【００１８】

【発明が解決しようとする課題】パケットベースのデータネットワークインフラおよび基地局サブシステム（ＢＳＳ）を相互接続するために分散コネクション制御を採用する利点は数多くあり、とりわけ無線セルラネットワークの設定および運用における効率およびコストの点で利点が多い。

【００１９】既存のセルラ基地局サブシステム（ＢＳＳ）をモビリティ拡張パケットデータネットワークへアタッチするためのメカニズムについては、この発明の詳細な説明の欄に記載されている。このシステムの基本は、無線セルラＢＳＳのパケットデータネットワークとのインターワーキングを可能にするインターワーキング機能（ＩＷＦ）である。次の文献に記載されているように、パケットデータネットワークがモビリティ、すなわち登録、登録抹消、認証、およびハンドオーバ、をサポートすると仮定する。

・C. Perkins: "Mobile IP Design Principles and Practices", Addison Wesley 1997, ISBN 0-201-63469-4
および
・B. Rajagopalan, D. Reininger: "Wireless ATM: QoS and Mobility Management" in Mobile Communications Handbook second edition, CRC Press IEEE Press 1999, ISBN 0-8493-8597-0。

【００２０】インターワーキング機能（ＩＷＦ）は、一般に、パケットデータネットワークおよび基地局サブシステムＢＳＳとのインタフェースを有するコンピューティングデバイスで実現される。ＩＷＦの制御部は、パケットデータネットワークに結合される任意のコンピューティングデバイス上で別個に実現することができる。ＩＷＦは、セルラサイド（ＢＳＳ）で使用されるユーザ面プロトコルおよび制御面プロトコルをモビリティ拡張パケットデータネットワーク固有のプロトコルに変換する。識別番号、加入者プロファイルおよび課金情報などの加入者データを有するアドレスサーバは、さらに、加入者が現在関与しているＩＷＦを決定するための呼ルーティング情報も有する。この技術によって、既存のエアインターフェースおよび加入者装置との互換性を維持しつつ、高速かつインターネット指向のモバイルネットワークが実現可能となる。

【００２１】本発明の詳細な説明によって、従来の基地局サブシステムＢＳＳをパケットデータネットワークに相互接続するためのソリューションが教示される。モバイル交換局ＭＳＣの機能性は、複数のネットワークエレメント、好ましくは従来のＢＳＳをパケットデータネットワークに相互接続するインターワーキングノードに分散させる。これらのネットワークエレメントは、全てのトラフィックが行き来し唯一の障害点を表すモバイル交換局ＭＳＣに比べてスループットおよび信頼性に関する要求が低いことから、安価な既製のハードウエアを用いて実現することができる。

【００２２】パケットデータネットワークはモビリティをサポートすべきである。本発明のソリューションはＡＴＭに関して証明されるが、ＩＰのような他のデータネットワーク技術にも容易に拡張することができる。

【００２３】より高速のデータトラフィックが割合として高い第３世代のデジタルシステムは第２世代のシステムから発展するであろうから、特に、異種のエアインターフェースが配置されて狭い地理的サービスエリアに高いバンド幅を示すホットスポットを設定する場合には、将来のセルラネットワークに対しても、パケットデータネットワークインフラストラクチャを使用する利点がある。

【００２４】

【課題を解決するための手段】上記目的を達成するために、本発明による無線ネットワークシステムは、モビリティ拡張パケットデータネットワークと、前記モビリティ拡張パケットデータネットワークと通信を行う少なくとも１つの基地局サブシステム（以下、ＢＳＳという。）と、を設け、前記ＢＳＳは基地局コントローラ（以下、ＢＳＣという。）を有し、前記モビリティ拡張パケットデータネットワークは外部ネットワークへの少なくとも１つのブリッジを有する、ことを特徴とする。

【００２５】好ましくは、前記モビリティ拡張パケットデータネットワークは、インターワーキング機能（以下、ＩＷＦという。）を用いて前記ＢＳＣを通して前記少なくとも１つのＢＳＳと接続しており、前記ＩＷＦはコンピュータで実現される。

【００２６】好ましくは、無線ネットワークシステムは、モビリティ拡張パケットデータネットワークにアタッチされたアドレスサーバを更に有する。

【００２７】好ましくは、移動局からの、あるいは移動局へのデータおよび音声トラフィックをトランスポート可能である。

【００２８】更に好ましくは、前記ブリッジはゲートウエイを用いて構成され、前記ゲートウエイは前記モビリティ拡張パケットデータネットワークと前記外部ネットワークとの間のプロトコルマッピングを実行する。

【００２９】更に好ましくは、前記ＩＷＦは前記ＢＳＣに統合されている。また、前記ＩＷＦは、ＢＳＳ制御、呼制御、移動管理、無線リソース管理、ユーザ面アダプ

テーション、およびプロキシシグナリングからなる機能エンティティを含むことが望ましい。

【００３０】更に好ましくは、前記アドレスサーバは、モバイルＩＤ、前記モビリティ拡張パケットデータネットワーク内でのルーティングのためのルーティング情報、加入者プロファイル、および認証情報を含み、問い合わせに応じて検索可能である。

【００３１】更に好ましくは、前記ＩＷＦによって、分散形式で呼処理が実行される。また、前記ＩＷＦは、前記モビリティ拡張パケットデータネットワークに対するプロキシシグナリングを実行することが望ましい。

【００３２】更に好ましくは、モバイル加入者ＩＳＤＮ番号（以下、ＭＳＩＳＤＮという。）を用いてプロキシ・シグナリング・インスタンスを選択する。

【００３３】更に好ましくは、前記モビリティ拡張パケットデータネットワークはＡＴＭ（非同期転送モード）に基づいている。

【００３４】更に好ましくは、エアインタフェースはＧＳＭ（Global System for Mobile communication）に基づいている。

【００３５】更に好ましくは、前記ゲートウエイは前記ＩＷＦ内に同居している。また、前記ゲートウエイは、望ましくは、前記モビリティ拡張パケットデータネットワーク内の任意のポイントにアタッチされている。

【００３６】前記アドレスサーバは、望ましくは、国際モバイル加入者識別子（ＩＭＳＩ）、移動局ＩＳＤＮ番号、あるいはパケットデータネットワークルーティング情報を保持する。

【００３７】ＭＳＩＳＤＮは、呼設定メッセージにおけるサブアドレス情報要素（ＩＥ）として運ばれることが望ましい。

【００３８】音声トラフィックベアラのために、ＡＴＭアダプテーションレイヤ１あるいはＡＴＭアダプテーションレイヤ２が使用されることが望ましい。

【００３９】本発明の別の観点によれば、移動局で発信および着信されるトラフィックを伴うネットワークシステムは、単一のネットワークインフラストラクチャによって、データおよび音声の両方のトラフィックが処理可能であることを特徴とする。望ましくは、異なるインタフェース技術が使用される。

【００４０】本発明の別の観点によれば、インターワーキング機能（以下、ＩＷＦという。）を通してモビリティ拡張パケットデータネットワークに接続された少なくとも１つの基地局サブシステム（以下、ＢＳＳという。）とアドレスサーバとを有するセルラネットワーキングシステムにおける移動局（以下、ＭＳという。）の位置を更新する方法において、ａ）前記ＭＳに関する情報を得るために、前記アドレスサーバの位置更新手順を起動し、ｂ）前記情報を用いて前記ＭＳの認証を行い、ｃ）前記ＭＳが認証された場合には当該ＭＳをアクティブとしてマークし、ｄ）前記モビリティ拡張パケットデータネットワーク内で前記ＩＷＦのアドレスをルーティングアドレスとして登録する、ことを特徴とする。

【００４１】本発明のさらに別の観点によれば、インターワーキング機能（以下、ＩＷＦという。）を通してモビリティ拡張パケットデータネットワークに接続された少なくとも１つの基地局サブシステム（以下、ＢＳＳという。）とアドレスサーバとを有するセルラネットワーキングシステムにおける移動局（以下、ＭＳという。）で呼を終端する方法において、ａ）前記ＭＳのルーティング情報を呼設定メッセージの部分として伝達し、ｂ）前記ルーティング情報を用いて前記ＭＳに関連するプロキシシグナリングインスタンスを識別、選択し、ｃ）サービス認証、ページング、呼設定、およびベアラコネクション確立を含む必要なアクションを前記ＩＷＦによって起動し、ｄ）前記呼が受理された場合には発呼者へ確認応答を返し、受理されなかった場合にはエラーメッセージを返す、ことを特徴とする。

【００４２】本発明のさらに別の観点によれば、インターワーキング機能（以下、ＩＷＦという。）を通してモビリティ拡張パケットデータネットワークに接続された少なくとも１つの基地局サブシステム（以下、ＢＳＳという。）とアドレスサーバとを有するセルラネットワーキングシステムにおける移動局（以下、ＭＳという。）で呼を発信する方法において、ａ）宛先情報を載せた呼設定要求を前記ＩＷＦで受信し、ｂ）前記呼設定要求が前記モビリティ拡張パケットデータネットワークへ向けられているか、その外部に向けられているかを判定し、ｃ）前記呼設定要求が外部に向けられている場合には、当該呼をゲートウエイ機能へ送信し、ｄ）当該呼に対する１以上のコネクションを確立する、ことを特徴とする。

【００４３】本発明のさらに別の観点によれば、２つのインターワーキング機能（以下、ＩＷＦという。）を通してモビリティ拡張パケットデータネットワークに接続された少なくとも２つの基地局サブシステム（以下、ＢＳＳという。）とアドレスサーバとを有するセルラネットワーキングシステムにおいて、前記２つのＩＷＦの間で移動局（以下、ＭＳという。）のシグナリングおよびベアラコネクションのハンドオーバを実行する方法において、ａ）あるＢＳＳがハンドオーバを要求し、ｂ）当該ＢＳＳに関係する前記ＩＷＦが、前記ハンドオーバ要求において与えられた無線セル識別子に基づいてターゲットＩＷＦを決定し、ｃ）シグナリングおよびベアラコネクションのハンドオーバを促進するためにネットワークサイドおよびＢＳＳサイドにおいて必要な手順を起動し、ｄ）前記ターゲットＩＷＦと通信し、ｅ）コネクションが再ルーティングされうるように前記コネクションおよびＭＳのデータを前記ターゲットＩＷＦへ提供し、ｆ）前記アドレスサーバを前記ターゲットＩＷＦのアド

レスによって更新する、ことを特徴とする。

【００４４】

【発明の実施の形態】図２は、本発明の一実施形態による基地局サブシステムＢＳＳをパケットデータネットワークに相互接続するセルラネットワークのネットワークアーキテクチャを示す。本実施形態によれば、複数の基地局コントローラＢＳＣ（２．１～２．ｎ）は、インターワーキング機能ＩＷＦ１～ＩＷＦｎをそれぞれ介してパケットデータネットワークに接続されている。これらＩＷＦ１～ＩＷＦｎは、それぞれパケットデータネットワークとの相互接続を提供する対応する基地局コントローラＢＳＣと同居、すなわち同じ場所に位置すること(co-located)が望ましい。ＩＷＦは対応するＢＳＣ内に統合されてもよい。

【００４５】パケットデータネットワークにアタッチされるのが望ましいアドレスサーバＡＳは、アドレス、ユーザプロファイル、ルーティング情報、課金データなどのデータを格納する。アドレスサーバは分散システムとして実現されてもよい。アドレスサーバは、ＩＷＦと同じ場所に設けられるか、あるいはＩＷＦと統合されてもよい。

【００４６】公衆電話交換網ＰＳＴＮのような外部ネットワークへのブリッジは、ゲートウエイＧＷ１、ＧＷ２によって構成される。ゲートウエイＧＷ１、ＧＷ２は、パケットデータネットワークで使用されるプロトコルと外部ネットワーク（たとえばＰＳＴＮ）で使用されるプロトコルとの間のプロトコルマッピングを実行する。ＰＳＴＮの代わりに、あるいはＰＳＴＮに加えて、任意の他のデータネットワークを使用してもよい。ゲートウエイはパケットデータネットワークの任意のポイントにアタッチすることができる。ゲートウエイは、ＩＷＦと同じ場所に、あるいはＩＷＦと統合して設けられてもよい。

【００４７】以下のセクションにおいて、本実施形態の構成要素を列挙して説明する。

【００４８】Ａ．ＩＷＦ（インターワーキング機能）

ＩＷＦは、基地局サブシステムＢＳＳを制御し、移動局ＭＳのためのシグナリングエンドポイントとして機能し、パケットデータネットワークのためのプロキシシグナリングを実行するための機能エンティティを含む。ＩＷＦは呼制御、移動管理、リソース管理、およびセルラサイドで使用されるプロトコルとパケットデータネットワークで使用されるプロトコルとの間のユーザ面アダプテーションを実行する。

【００４９】図３はＩＷＦの主要な機能エンティティおよびそれらのインターフェースＩ１～Ｉ１０を示す。ＩＷＦの主要な機能を次に説明する。

【００５０】１．移動局のためのシグナリングエンドポイント

コネクション制御（設定、解放）のためのシグナリングプロトコルは移動局とＩＷＦとの間で実行される。ＧＳＭの場合、シグナリングプロトコルはＳＳ７プロトコルに基づいている。ＳＳ７プロトコルの詳細については、European Telecommunications Standards Institute (ETSI): Mobile Radio Interface Layer 3Specification GSM 04.08 Phase 2, April 1997 を参照のこと。

【００５１】２．ＢＳＳ制御

ＢＳＳ制御はＢＳＳを制御するためのプロトコルとロジックからなる。ＧＳＭの場合、プロトコルはＳＳ７プロトコルに基づいている。このＳＳ７プロトコルの詳細については、European Telecommunications Standards Institute (ETSI): signaling Transport Mechanism Specification for the BSS/MSC InterfaceETSI GSM 08.06 Phase 2, July 1995 を参照のこと。

【００５２】３．呼制御（ＣＣ）

呼制御（ＣＣ）は、移動局ＭＳとネットワークとの間のアクティブなコネクションのための呼状態マシンおよび関連するロジックを含む。呼制御は、また、移動局ＭＳのためのシグナリングエンドポイントとプロキシ・シグナリング・エンティティとの間のブリッジングレイヤを構成する。ＧＳＭの場合、呼制御は、European Telecommunications Standards Institute (ETSI): Mobile Radio Interface Layer 3 Specification GSM 04.08 Phase 2, April 1997 で規定された手順を実行する。

【００５３】４．移動管理（ＭＭ）

移動管理は、モバイルの位置情報、すなわち、モバイルがＢＳＣで制御される位置エリアに入るあるいは出るといった情報を処理するためのロジックを含む。それにより、ＢＳＳおよびパケットデータネットワークサイドへの手順が引き起こされる。ＧＳＭの場合、移動管理（ＭＭ）は、European TelecommunicationsStandards Institute (ETSI): Mobile Radio Interface Layer 3 SpecificationGSM 04.08 Phase 2, April 1997 で規定された手順を実行する。

【００５４】５．無線リソース管理（ＲＲＭ）

無線リソース管理ＲＲＭは、リソース管理およびハンドオフ制御を実行する。ＲＲＭは、ＩＷＦに現在関連している移動局ＭＳごとにデータレコードを保持する。ＧＳＭの場合、このモジュールは、ＧＳＭ ＲＩＬ３ ＲＲプロトコルのネットワークサイドを実行する。これらのプロトコルの詳細は、European Telecommunications Standards Institute (ETSI): Mobile Services Switching Center-Basestation system (MCS-BSS) interface layer 3 Specification ETSI SM 08.08 Phase 2, September 1996 を参照のこと。

【００５５】６．ユーザ面アダプテーション

このエンティティは、パケットデータネットワークおよびＢＳＳサイド間のメディアストリーム（たとえば音声）のアダプテーションを実行する。これには、データの圧縮／伸長およびトランスコードが含まれうる。

【００５６】７．プロキシ・シグナリング
プロキシ・シグナリングは、パケットデータネットワーク内の通信のために使用される呼関連の、およびモビリティ関連のシグナリング・プロトコルを終端する。関連する移動局ＭＳごとに、それぞれ１つの論理的なインスタンスが生成される。各論理的インスタンスは、モビリティ拡張パケットデータネットワークに元々属するモバイルノードをエミュレートする。このプロキシ・シグナリングは、MMおよびＣＣモジュールと相互に接続する。各インスタンスは、コネクション設定時にパラメータとして伝達される端末識別子を介してアドレス指定される。
【００５７】Ｂ．アドレスサーバ（ＡＳ）
アドレスサーバは、基地局サブシステムＢＳＳで使用される識別およびルーティングのためのアドレスをパケットデータネットワークで使用されるアドレスおよび識別情報にマッピングする。さらに、アドレスサーバは、サービスプロファイル、認証情報、課金情報などを有する加入者レコードを含むことができる。
【００５８】ＧＳＭセルラ標準の場合、アドレスサーバは、ＩＭＳＩ（国際モバイル加入者識別子）、ＭＳＩＳＤＮ（モバイル加入者ＩＳＤＮ番号）、パケットデータネットワークルーティング情報、たとえばパケットデータネットワークにおける関連するホームアドレスだけでなく移動局の現在位置でのＩＷＦのＩＰアドレスなど、を含む。また、ＧＳＭで定義されるテンポラリモバイル加入者識別子（ＴＭＳＩ）を含んでもよい。
【００５９】さらに、課金および加入者情報と共に認証情報が３つ一組としてアドレスサーバに保持されうる。
【００６０】アドレスサーバはデータベースであり、複数のコンピュータにまたがって分散可能である。分散データベース内では、特別なメカニズムによりデータの統合が保証されるべきである。アドレスサーバはパケットベースのデータネットワークにアタッチされる。
【００６１】Ｃ．ゲートウエイ機能
ゲートウエイ機能は、他のネットワークへのブリッジとして使用される。ゲートウエイ機能は、モビリティ拡張パケットデータネットワークとターゲットネットワークあるいは次の中継ネットワークとの間で使用されるユーザ面および制御面プロトコルをマッピングすることにある。ゲートウエイ機能は、宛先のネットワークに相互接続された単一のあるいは複数のコンピューティングデバイスで実現されうる。ゲートウエイ機能をＩＷＦ内に同居させれば、それによって全体的なネットワーク負荷を軽減できる。
【００６２】Ｄ．装置識別レジスタ（ＥＩＲ）
装置識別レジスタはモバイルデバイスの識別番号を格納する。その情報は、特定の移動局あるいは移動局の特定グループをブラックリストに載せるために使用される。ＥＩＲはパケットデータネットワークの任意のパートにアタッチすることができる。関連があれば、ＥＩＲはその装置がブラックリストに載っているかどうか尋ねられる。ＥＩＲの機能は、M. Mouly M.-B. Pautet: "The GSM Systemfor Mobile Communications" Cell & Sys 1992, ISBN: 2-9507190-0 に記載されたものと同様である。なお、図２には、ＥＩＲは示されていない。
【００６３】Ｅ．手順
次に、本実施形態の動作のためのいくつかの手順を説明する。
【００６４】１．位置更新
図４は、位置更新シナリオの一実施例を示している。図４に示すように、移動局ＭＳの位置登録あるいは在圏エリアの変更があると、ＩＷＦはアドレスサーバの位置更新手順を起動してその特定移動局ＭＳのための格納情報を取得する。引数として渡される加入者識別子（ＩＭＳＩ又は／およびＴＭＳＩ）は、アドレスサーバデータベースにおいてキーとして働く。ＩＷＦはその情報を用いて当該移動局ＭＳの認証を開始してもよい。認証されたならば、その移動局はモビリティ拡張パケットデータネットワークにおいてアクティブとしてマークされる。当該移動局ＭＳが関係するＩＷＦアドレスは、モビリティ拡張パケットデータネットワーク内でルーティングアドレスとして登録される。モビリティ拡張パケットデータネットワーク内でのルーティングアドレスを設定するためのメカニズムは、C. Perkins: "Mobile IP Design Principles and Practices", Addison Wesley1997, ISBN 0-201-63469-4 および B. Rajagopalan, D. Reininger: "Wireless ATM: QoS and Mobility Management" in Mobile Communications Handbook second edition, CRC Press IEEE Press 1999, ISBN 0-8493-8597-0 に記載されたものと同様である。
【００６５】２．コネクション設定
コネクション設定においては、少なくとも２つのシナリオが区別されうる。すなわち、呼がモバイル側から発信されたものであるか（モバイル発信）、モバイル側で終端されたものであるか（モバイル着信）の２つの場合である。
【００６６】（１）モバイル着信
本実施形態では、呼がパケットデータネットワーク内で移動局ＭＳが現在関係しているＩＷＦへ正しくルーティングされている、すなわち移動端末の識別が適切なルーティング情報に変換されているものと仮定する。このような変換を実行する方法のいくつかは、C. Perkins: "Mobile IP Design Principles and Practices", Addison Wesley 1997, ISBN 0-201-63469-4 および B. Rajagopalan, D. Reininger: "Wireless ATM: QoS and Mobility Management" in Mobile Communications Handbook second edition, CRC Press IEEE Press 1999, ISBN 0-8493-8597-0 に記載されたメカニズムに基づくことができる。

【００６７】図５は、モバイル終端コネクション設定の一実施例のためのイベントシーケンスを示す図である。図５に示すように、ＧＳＭにおける移動局ＭＳのＭＳＩＳＤＮ番号のようなセルラシステムで使用されるルーティング情報は呼設定メッセージの部分として運ばれる。このＭＳＩＳＤＮ番号を用いて、その移動局ＭＳに関係するプロキシシグナリングインスタンスを特定し選択する。もしシグナリングを有するＡＴＭがパケットデータネットワークのために使用されるならば、セルラルーティング情報（たとえば、ＭＳＩＳＤＮ番号）は、ＳＥＴＵＰメッセージのサブアドレス情報要素（ＩＥ）において運ばれうる。ＩＷＦは、サービス認証、ページング、シグナリングセットアップ、およびベアラコネクション等のような必要なアクションを実行させる。その呼が受け付けられると、接続確認がパケットデータネットワークを通して発呼者へ返される。その呼が拒否されるか、あるいは、その他の何らかの理由でその呼が完了することができないならば、エラーメッセージが発呼者へ送信される。呼が解放されると、ベアラコネクションはクリアされ、前もって予約されたリソースは解放される。アドレスサーバに格納された加入者情報は、たとえばコネクション設定および／又は解放に依存した課金のために更新されうる。

【００６８】（２）モバイル発信

図６は、モバイル発信の一実施例のためのイベントシーケンスを示す図である。本実施例を説明するために、移動局ＭＳへのシグナリングコネクションが設定されているものとする。宛先（着呼者）情報を運ぶコネクション設定要求はＩＷＦによって受信される。この宛先情報を用いて、ＩＷＦは単独で（あるいはアドレスサーバと協力して）その呼がモバイルネットワークドメイン内の宛先であるか、あるいは外部ユーザへの宛先であるかを決定する。その呼が外部ユーザへ向けられたものであれば、その呼は対応するゲートウエイへ方向付けされる。その呼が受け付けられると、ベアラコネクションが確立される。呼が解放されると、ベアラコネクションはクリアされ、前もって予約されたリソースは解放される。アドレスサーバに格納された加入者情報は、たとえばコネクション設定および／又は解放に依存した課金のために更新されうる。ＵＮＩ（ユーザーネットワーク・インタフェース）シグナリングを有するＡＴＭがパケットデータネットワークのために使用されるならば、セルラルーティング情報（たとえば、ＭＳＩＳＤＮ番号）は、ＳＥＴＵＰメッセージのサブアドレス情報要素（ＩＥ）において運ばれうる。

【００６９】（３）モバイルからモバイルへの呼

この呼は上記（１）および（２）の組み合わせである。ＩＷＦに同時に関係する端末から発呼され終端される場合には、その呼はＩＷＦによってローカルに処理される。

【００７０】３．ハンドオーバ

本実施形態の説明のために、ハンドオーバが異なる基地局コントローラＢＳＣ間で発生する、すなわちネットワークの何らかの介在を必要とするものと仮定する。

【００７１】図７はハンドオーバ中のイベントシーケンスを示す図である。図７において、ハンドオーバは基地局サブシステム（ＢＳＳ）によって要求される。ハンドオーバ要求は、そのハンドオーバがターゲットとしうる無線セルのリストを含む。ＩＷＦは、ハンドオーバ要求で与えられる無線セル識別子およびトラフィック負荷などの他の基準に基づいてターゲットＩＷＦを決定する。移動局ＭＳがまだ関係しているＩＷＦは、ネットワークサイドおよびＢＳＳサイドで必要な手順を始動させてハンドオーバを支援する。このＩＷＦは、ハンドオーバ手順のためにターゲットＩＷＦと直接通信する。

【００７２】全ての必要なコネクションおよび移動局データは、コネクションが再ルーティングされ得るようにターゲットＩＷＦへ提供される。最後に、アドレスサーバ（ＡＳ）はターゲットＩＷＦのアドレスで更新される。モバイル拡張パケットデータネットワークにより提供されるこの手順を用いて、そのネットワーク内でのコネクションの再ルーティングが実行される。関連するハンドオーバ情報は、パケットデータネットワークを介して２つの（隣接する）ＩＷＦの間で直接渡される。その結果として、ネットワークハンドオーバは全体的なリソースの観点から高速かつ効率的となる。

【００７３】Ｆ．実施例

１．ネットワーク

代表的なＭＡＴＭ－ＧＳＭネットワークは、モバイルＡＴＭネットワークを介して相互接続された複数のモバイルＡＴＭ－ＧＳＭ基地局からなる。モバイルＡＴＭ－ネットワークインフラストラクチャは、公衆網インフラストラクチャの一部であり、モバイルサービスおよび固定サービスを供給する複数のオペレータ間で共有される。コネクションは動的に確立され、それによって既存のコネクションに対するサービス品質（ＱｏＳ）を保証しつつ、リソースの効率的な使用を可能にする。

【００７４】また、モバイルＡＴＭネットワークは従来のＡＴＭネットワークに重ねることができ、それによって仮想プライベートネットワーク（ＶＰＮ）を生成することができる。複数のゲートウエイによって、モバイルＡＴＭネットワークをＰＳＴＮやインターネットなどの他のネットワークに相互接続させることができる。アドレスサーバは識別子およびアドレスのマッピングだけでなく加入者情報も格納する。一般的には、あるサービスプロバイダがそのアドレスサーバを運用し、それによって複数のサービスプロバイダが単一のネットワークオペレータのインフラストラクチャを用いてサービスを提供する事が可能となる。

【００７５】図８には、２つのＧＳＭ－基地局サブシス

テム（ＢＳＳ）およびゲートウエイをＰＳＴＮネットワークに相互接続するモバイルＡＴＭネットワークの機能的アーキテクチャおよび関連インタフェースが示される。

【００７６】基地局、ゲートウエイ、およびアドレスサーバは、標準化されたＭ－ＵＮＩ、Ｍ－ＮＮＩ、およびＵＮＩを介してモバイルＡＴＭネットワークにそれぞれアタッチされる。（Ｍ－）ＡＴＭシグナリングはこれら標準化された機能エンティティにおいて終端される。内部インターフェースは、シグナリングスタックおよびそれぞれのインターワーキング機能（ＢＳ－ＩＷＦ、ゲートウエイＩＷＦ）およびアドレスサーバの間で特定される。標準化されたＧＳＭ　Ａ－インターフェースは、ＧＳＭ基地局サブシステム（ＧＳＭ　ＢＳＳ）および基地局アダプタ（ＢＳＡ）の間の論理的インターフェースとして働く。基地局アダプタは、インターワーキング機能、プロトコルスタック、および必要なハードウエアおよびドライバを主催する物理的エンティティである。呼設定およびルーティング手順がＡＴＭシグナリングにもっぱら依存しているのに対し、ＡＴＭ－ＧＳＭ－ＢＳＡｓ間、およびＡＴＭ－ＧＳＭ－ＢＳＡｓ／ＡＴＭ－ＧＳＭ－ゲートウエイおよびアドレスサーバ間の通信はＡＴＭ（クラシカルＩＰ、ＬＡＮエミュレーション）上のＴＣＰ／ＩＰコネクションに依存している。

【００７７】ＡＴＭ－ＧＳＭ基地局アダプタ（ＢＳＡ）およびアドレスサーバ（ＡＳ）については、次のセクションで説明する。記載を簡単にするために、本実施形態は単一のアドレスサーバおよび２つのＡＴＭ－ＧＳＭ基地局サブシステム（ＢＳＳ）からなり、それらは２つのＡＴＭ－ＧＳＭ　ＢＳＡを介してモバイルＡＴＭネットワークに接続されているものと仮定する。更に、単一のアドレスサーバはアドレス変換および識別子マッピングを提供する。

【００７８】２．ＡＴＭ－ＧＳＭ　ＢＳＡ

ＡＴＭ－ＧＳＭ基地局アダプタ（ＢＳＡ）は、ユーザ面プロトコルおよび制御面プロトコル（それらはＧＳＭのために標準化されている）からモバイルＡＴＭへの変換およびその逆の変換を行う。

【００７９】ユーザ面において、ＧＳＭでは、複数の６４ｋｂｐｓ音声チャネルを１つの２ＭｂｐｓＥ１フレームに多重化するＴＤＭＡ方式が定義されている。ＡＴＭへの変換のために、同一コネクションに属する複数の音声サンプルは１つのＡＴＭセル内に格納され運ばれる。そのＶＣＩはコネクションを特定する。反対方向の変換、すなわちＡＴＭからＴＤＭＡ（Ｅ１）への変換では、ＡＴＭセルの内容は、複数の後続するＥ１フレームの与えられたスロットで送信される。Ｅ１のタイミング条件のために、ＡＴＭアダプテーションレイヤ１（ＡＡＬ１）を用いて音声コネクションをトランスポートする。

【００８０】制御面では、ＳＳ７シグナリングからモバイルＡＴＭシグナリングへの変換およびその逆の変換が行われる。さらに、基地局アダプタ（ＢＳＡ）はモバイル交換局（ＭＳＣ）機能を実行し、基地局サブシステム（ＢＳＳ）を制御する。ＡＴＭ－ＧＳＭ　ＢＳＡは標準化されたＳＳ７ＧＳＭシグナリング（ＭＴＰ－２，ＭＴＰ－３，ＳＣＣＰ）を終端し、それを用いてＢＳＳの動作を制御し、関連するＧＳＭモバイル端末のためのコネクション制御を行う。ＡＴＭサイドにおいて、ＡＴＭ－ＧＳＭ　ＢＳＡは、ＭＡＴＭ－ＵＮＩシグナリングのためのシグナリングエンドポイントを形成するプロキシシグナリングエンティティを含む。単一のシグナリング・インスタンスは、基地局アダプタ（ＢＳＡ）の電源が投入されると生成される。ＢＳＡは、そのネットワークで登録される単一のＡＴＭアドレスを有する。このＡＴＭアドレスは、当該ＢＳＡに現在登録されているモバイルへのルーティングアドレスとして働く。新しい端末インスタンス（プロキシシグナリングインスタンス）は対応するＧＳＭ端末ごとに生成される。ＡＴＭコネクション設定メッセージの部分であるＡＴＭサブアドレス情報要素は特定の端末インスタンスを参照する。サブアドレス情報要素は、ＡＴＭ（ＵＮＩ，ＮＮＩ）シグナリングパスを通してエンド・ツウ・エンドに透過的に運ばれる。

【００８１】基地局アダプタ（ＢＳＡ）は、ＴＣＰ／ＩＰコネクション上で隣接するＢＳＡと通信を行う。これらＴＣＰ／ＩＰコネクションは基地局間のハンドオフのために使用される。ＢＳＡはアドレスサーバへのＴＣＰ／ＩＰコネクションを維持する。アドレスサーバは位置更新およびコネクション制御について尋ねられる。

【００８２】基地局ＩＷＦ（ＢＳ－ＩＷＦ）は、基地局間の、および、ＭＡＴＭ（モビリティ拡張ＡＴＭ）ネットワークでのハンドオフをトリガする。フォワードハンドオフメカニズムはＭＡＴＭネットワーク内でサポートされている。すなわち、無線ハンドオーバに従って、新しいネットワークコネクションが確立される。

【００８３】各ＡＴＭ－ＧＳＭ加入者（端末）には、ＭＡＴＭネットワーク内でロケーションサーバが割り当てられる。ロケーションサーバは、登録された端末のＡＴＭ位置情報データを維持する。この情報を用いて、ＭＡＴＭネットワーク内での呼ルーティングが行われる。ロケーションサーバは位置更新が発生すると更新される。端末は、ロケーションサーバとして同一のネットワークプレフィックスを有するＡＴＭアドレス（ホームＡＴＭアドレス）を所有する。ＧＳＭ加入者がＡＴＭネットワーク内でローミングするためのＧＳＭ固有データは、加入者ホームＰＬＭＮからゲートウエイを通して取り出される。

【００８４】基地局ＩＷＦ（ＢＳ－ＩＷＦ）は、ＢＳＡに現在登録されている各モバイルのＬＡＩ、ＩＭＳＩ（国際モバイル加入者識別子）およびＭＳＩＳＤＮ（モ

バイル加入者ＩＳＤＮ番号）などのモバイル関連データを保持する。このデータを用いて、ＧＳＭにおいて定義されている呼設定手順に従ってモバイルを呼び出す。この設定手順についての詳細は、European Telecommunications Standards Institute (ETSI): Mobile Radio Interface Layer 3 Specification GSM 04.08 Phase2, April 1997 を参照のこと。

【００８５】３．アドレスサーバ

アドレスサーバは、全てのＧＳＭ加入者のＩＭＳＩ（国際モバイル加入者識別子）、ＭＳＩＳＤＮ（モバイル加入者ＩＳＤＮ番号）、ホームＡＴＭアドレス、およびロケーションサーバアドレスを検索可能なデータベースを保持する。データベースのテンポラリエントリはＧＳＭ加入者をローミングするために生成される。アドレスサーバはＴＣＰ／ＩＰコネクションを通してそのクライアントと通信する。クライアントはＡＴＭ－ＧＳＭ ＢＳＡおよびゲートウエイである。ＴＣＰ／ＩＰトランスポートの下位レイヤは指定されないので、ＡＴＭ（クラシカルＩＰ：ＣＬＩＰ、ＬＡＮエミュレーション：ＬＡＮＥ）あるいはその他のレイヤ２プロトコルが利用可能である（イーサネット（登録商標）、Ｘ．２５）。

【００８６】以下、図９を参照しながら詳細に説明する。図９は、参照モデルの好ましい実施形態を示す。

【００８７】４．ＧＳＭ基地局サブシステム（ＢＳＳ）

図９において、ＧＳＭ ＢＳＳは、基地局コントローラ（ＢＳＣ）および基地局送受信器（ＢＴＳ）からなる規格に沿ったＧＳＭ装置である。ＧＳＭ装置は、基地局アダプタＢＳＡへの標準化されたＡ－インタフェースを提供する。Ａ－インタフェースは、European Telecommunications Standards Institute (ETSI) GSM 08.xx series (BS to MSC) specifications に定義されている。ＧＳＭ ＢＳＳは、Ａ－インタフェース上で６４ｋｂｐｓ音声チャネルを提供するためのＴＲＡＵ（トランクレートアダプテーション：trunk rate adaptation）機能を含む。

【００８８】５．Ｅ１－ＡＴＭ変換ユニット

Ｅ１－ＡＴＭコンバータはＥ１トランクを終端し、Ｅ１スロット（音声チャネル）からＡＡＬ１－ＡＴＭセルへの変換およびその逆の変換を行う。さらに、このコンバータは、スイッチドＭＡＴＭコネクション（ＳＶＣ）のためのＶＣＩ変換（スイッチング）、シグナリングチャネルおよび音声チャネルの１つの物理的ライン（ファイバ）への多重化を実行する。加えて、ＢＳＳおよびモバイルＧＳＭ端末との通信のためのＳＳ７スタック（ＭＴＰ２，ＭＴＰ３，ＳＣＣＰ）が実行される。ＳＳ７シグナリングはＥ１トランク（たとえばスロット１５）から取り除かれ、ＭＴＰ－２プロトコルレイヤへ渡される。

【００８９】６．基地局インターワーキング機能

基地局サブシステムの制御、呼制御、リソース管理、およびＡＴＭシグナリングのためのソフトウエアモジュールはインターワーキング機能（ＢＳ－ＩＷＦ）で実行される。さらに、ＢＳ－ＩＷＦはＡＴＭスイッチを制御する。ＩＷＦは、ＡＴＭネットワークインタフェースカード（ＮＩＣ）を装備した既製のパーソナルコンピュータ（ＰＣ）に実現可能である。ＮＩＣを通して、ＢＳ－ＩＷＦはシグナリングおよび制御のためにＡＴＭスイッチと接続する。隣接するＢＳＡとの相互接続およびアドレスサーバとの接続は、下位レイヤのインプリメンテーションとは独立したＴＣＰ／ＩＰを通して実現される。一般的には、ＬＡＮエミュレーション（ＬＡＮＥ）あるいはクラシカルＩＰ（ＣＬＩＰ）を用いて既存のＡＴＭネットワークを介してＴＣＰ／ＩＰが実行されるであろう。

【００９０】７．アドレスサーバ

アドレスサーバは、ＧＳＭ／ＡＴＭアドレス変換を行うためのデータベースを含む。アドレスサーバには、周知のＩＰアドレスおよびＴＣＰポート番号を通してＢＳ－ＩＷＦによって到達可能である。

【００９１】Ｇ．ＡＴＭ－ＧＳＭ基地局アダプタ

１．コンポーネント概観

基地局アダプタ（ＢＳＡ）は、３つの主要コンポーネント：ハードウエアおよびドライバ；プロトコルスタック；およびＢＳ－ＩＷＦソフトウエアからなる。

【００９２】２．プロトコルスタック

図１０はプロトコルスタックを例示する。ＢＳＳシグナリングに必要なＳＳ７スタック（ＭＴＰ２，ＭＴＰ３，ＳＣＣＰ）はＡＰＩ（アプリケーション・プログラミング・インタフェース）機能セットを通してアクセス可能である。ＳＳ７分散機能は、ＳＳ７スタックによって提供されるＳＣＣＰ ＡＰＩをＢＳ－ＩＷＦへ拡張する。

【００９３】モバイルＡＴＭ端末をエミュレートするＭ－ＵＮＩスタックは、新たに定義されたＡＰＩを通してＩＷＦソフトウエアに利用可能である。ＩＷＦソフトウエアは呼制御および位置管理機能を実行する。

【００９４】３．ＩＷＦソフトウエア

図１１は、ＢＳ－ＩＷＦソフトウエアアーキテクチャを示す。ＩＷＦソフトウエアコンポーネントは更に以下に示すモジュールにブレークダウンされる。

・システムスタートアップモジュール
・ＭＴＰ２、ＭＴＰ３およびＳＣＣＰからなるＳＳ７プロトコルスタック
・ＢＳＳ制御
・データベースサーバ
・無線リソース管理
・移動管理
・呼制御
・アドレスクライアント
・ＩＷＦ－ＩＷＦインタフェース
・ＧＳＭＰクライアント
・ＭＡＴＭ－プロキシ。

【００９５】これらモジュールの各々は機能エンティティを構成し、特別な機能性を実現する。データベースサーバを除いて、これらモジュールは共に１つのタスクを構成する。データベースサーバが構成するタスクは別のタスクとして実現される。これらモジュールは定義されたインタフェースを通して互いに通信する。これらモジュールの詳細を次のセクションで説明する。

【００９６】Ｈ．ＩＷＦソフトウエアモジュールの詳細図１１に示すＢＳ－ＩＷＦソフトウエアアーキテクチャの全てのモジュールについて説明する。

【００９７】１．システムスタートアップモジュール（ＳＳＭ）

このエンティティはシステムの起動およびＩＷＦの構成を引き受ける。このエンティティは、呼制御ＣＣ、移動管理ＭＭ、無線リソース管理ＲＲおよびＢＳＳ制御モジュールのような他のモジュールを起動する。システムスタートアップモジュールは、ＩＷＦにおける種々のパラメータをプログラミングするための外部インタフェースを提供する。

【００９８】２．ＳＳ７プロトコルスタック

ＳＳ７プロトコルスタックが提供する機能は次の通りである。

【００９９】（１）無線リソースモジュールからの要求によって、ＢＳＳとのＳＣＣＰコネクションを確立し、維持し、分解する。

【０１００】（２）ＢＳＳから受信した全てのモバイル関連メッセージを、それらを受信したコネクションを識別するコネクション識別子と共に、無線リソースモジュールへ渡す。

【０１０１】３．ＢＳＳ制御

ＢＳＳ制御モジュールが提供する機能は次の通りである。

【０１０２】（１）ＢＳＳ制御は、ＧＳＭサービス制御のためにＢＳＳからＭＳＣへのインタフェース上で使用されるレイヤ３手順を実行する責任を有する。

【０１０３】（２）スタートアップ時、リセット手順を始動することでＢＳＳを再スタートさせる。

【０１０４】（３）回線識別コード（ＣＩＣｓ）によって識別される全ての回線をスタートアップ後のアイドル状態に初期化する。

【０１０５】（４）ＢＳＳからリセット（ＲＥＳＥＴ）を受信すると、そのＢＳＳに関連する全ての呼をクリアし、当該ＢＳＳへの全ての回線をアイドル状態として扱う。

【０１０６】（５）ＢＳＳ制御は、ＢＳＳによって起動された回線ブロッキング／アンブロッキング手順を管理する。

【０１０７】（６）ＳＳ７スタックを通したＳＣＣＰコネクションレスサービスを用いてＢＳＳと通信する。

【０１０８】（７）さらに、ＢＳＳ制御は次のインタフェースを提供する。

・データベースにおける回線関連情報を更新するためのデータベースサーバと接続する。

・ＢＳＳインタフェース管理に関連するＢＳＳＭＡＰメッセージを転送するためにＳＳ７スタックと接続する。

・ＢＳＳ－ＭＳＣインタフェースの状態を知らせるための無線リソース管理レイヤと接続する。

【０１０９】（８）ＢＳＳ制御によって送信され受信されるメッセージは、全インタフェースに関係し特定のモバイルに関係しない。

【０１１０】４．データベースサーバ

データベースサーバが提供する機能は次の通りである。

【０１１１】（１）データベースサーバは、ＩＷＦにおけるデータベースへのアクセスを提供する。

【０１１２】（２）システムスタートアップ時にＳＳＭにより使用されるシステムコンフィグレーションデータを保持する。

【０１１３】（３）ハンドオフで使用されるＩＷＦアドレスマッピングのためのセルＩＤを保持する。

【０１１４】（４）Ｅ１およびＡＴＭインタフェースパラメータもデータベースに保持される。

【０１１５】（５）データベースは、モバイルのテンポラリ位置情報を保持する。継続中の呼に関係する情報もデータベースに格納される。

【０１１６】（６）データベースサーバはリソース検索および割り当て機能を実現する。

【０１１７】（７）データベースサーバは次のインタフェースを提供する。

・テーブル生成

・そのテーブルにおけるデータの読み出し／書き込み

・そのテーブルのエントリ更新

・テーブル削除。

【０１１８】５．無線リソース管理（ＲＲ）

無線リソース管理モジュールが提供する機能は次の通りである。

【０１１９】（１）無線リソース管理モジュールは、識別情報、認証、および位置更新のようなモビリティ関連の特徴、すなわちネットワークサイドのＧＳＭ　ＲＩＬ３ＲＲプロトコルを実現する。ＧＳＭ　ＲＩＬ３プロトコルは、European Telecommunications Standards Institute (ETSI): Mobile Radio Interface Layer 3 Specification GSM 04.08 Phase 2, April 1997 に規定されている。

【０１２０】（２）無線リソース管理（ＲＲ）は次のインタフェースを提供する。

・無線リソース管理コネクションの確立、分解、および維持のための移動管理モジュールへのインタフェースを提供する。

・移動管理（ＭＭ）モジュールからのＤＴＡＰ（直接転送アプリケーション部）メッセージを受け付け、それら

をＳＳ７スタックとのインタフェースを通してＢＳＳへ中継する。
・ＲＲは、ＳＣＣＰコネクションの確立および分解を開始するためのＳＳ７スタックと接続する。Ａ－インタフェースメッセージは、このインタフェースを通してＢＳＳへ中継される。
・ハンドオーバ手順を実行するためにＩＷＦ－ＩＷＦインタフェースを使用する。
・ＲＲは、データベースにおけるコネクション情報を更新するためのデータベースサーバと接続する。この情報はハンドオーバを実行するために必要である。
【０１２１】（３）ＲＲは、ＳＳ７スタックから受信したＢＳＳＭＡＰ管理メッセージをＢＳＳ制御モジュールへルーティングする。さらに、Ａ－インタフェースで異常条件を示すトリガをＢＳＳ制御から受け付けると、ＭＭおよびＣＣモジュールが適切なアクションを取るように通知する。
【０１２２】（４）ＩＷＦでの加入者登録に関して、ＲＲはデータベースサーバからモバイルタグを取得する。このタグは、ＩＷＦに格納された加入者情報をインデックスするために使用される。モバイルタグは、メッセージあるいは要求を特定のモバイルに関係づけるためのモジュール間通信で使用される。
【０１２３】（５）ＲＲは、ＢＳ－ＩＷＦでのモバイル登録のためにモバイルデータブロックを生成する。続いて、このモバイルデータブロックがＭＭにより位置情報で更新される。
【０１２４】（６）発信側ＩＷＦ上で、ＲＲは、ハンドオフに必要なメッセージをＢＳＣから受信した後、ハンドオフ手順を開始する。そして、発呼側ＩＷＦは、隣接ＩＷＦのＲＲと協同して呼のハンドオフを実行する。
【０１２５】（７）終端側ＩＷＦ上で、ＲＲは、別のＩＷＦからハンドオフ呼を収容するためのリソースについてＢＳＳに問い合わせる。そのリソースが存在すれば、ＲＲはＭＡＴＭプロキシへ向けてＭＡＴＭハンドオフ手順を実行する。
【０１２６】６．移動管理（ＭＭ）
モビリティ管理モジュールが提供する機能は次の通りである。
【０１２７】（１）ＭＭモジュールは、ネットワークサイドのＧＳＭ　ＲＩＬ３　ＭＭプロトコルを実行する。
【０１２８】（２）ＩＷＦにおいて、ＭＭは次のモジュールと接続する。
・呼間連メッセージおよびこのためのリソース予約に関する呼制御
・ＭＭおよびＣＣメッセージを受信および送信し、ＲＲコネクションの核散るおよび終了手順を開始するためのＲＲ
・アドレスサーバからアドレス変換情報を売るアドレスクライアント
・ＩＷＦリソースおよびモバイル関連データに関するデータベースサーバ
・ＭＵＮＩ　ＡＰＩを起動するＭＡＴＭプロキシ。
【０１２９】（３）ＭＭは、ＢＳ－ＩＷＦで登録されたモバイルのために、ＭＡＴＭネットワークに向けて位置更新手順を開始する役割を担っている。ネットワークとの初期モバイル登録もＭＭレイヤの役割である。
【０１３０】（４）ＭＭは、データベースでのモバイルデータブロックにおいてモバイルの位置情報を更新する。この位置情報は、位置更新あるいはＩＭＳＩデタッチにおいて得ることができる。
【０１３１】（５）期限切れの位置情報はデータベースにおいて定期的に無効にされる。
【０１３２】（６）無線リソース管理モジュールから受信される呼制御メッセージは、ＭＭによってＣＣへ転送される。呼制御メッセージは、また、ＣＣから受信したＤＴＡＰメッセージを載せて透過的にＲＲへ戻す。
【０１３３】７．呼制御（ＣＣ）
呼制御（ＣＣ）モジュールが提供する機能は次の通りである。
【０１３４】（１）ＣＣは、ＧＳＭ　ＣＭレイヤを実現し、ＧＳＭとＭＡＴＭとの間の呼インターワーキングを実行する。
【０１３５】（２）ＣＣは、呼状態（Call State）およびＧＳＭ　ＲＩＬ３　ＣＣタイマを保持する。
【０１３６】（３）ＣＣは、ＧＳＭ　ＲＩＬ３　ＣＣメッセージで使用されるトランザクション識別子（ＴＩＤｓ）を割り当てて保持する。
【０１３７】（４）ＣＣは、次のインタフェースを提供する。
・ＣＣは、モバイルへ向けた呼関連ＤＴＡＰメッセージに関してＭＭと接続する。
・ＣＣは、呼制御ブロック（ＣＣＢ）の生成に関してデータベースサーバに接続する。ＣＣＢは、呼が継続中に呼関連情報を格納するために使用される。この情報はＲＲモジュールによってハンドオフのために使用される。
・ネットワークへ向けての呼制御メッセージに関して、ＣＣは適切なＭＵＮＩＡＰＩを起動する。
・モバイル側からの発呼に関して、ＣＣは、アドレスクライアントを通してアドレスサーバで被呼ＭＳＩＳＤＮ番号を変換させる。
・ＣＣはＧＳＭＰを通してＡＴＭスイッチを制御し、呼確立／解放の間に、音声ベアラコネクションを生成／解放することに関して責任を持つ。
【０１３８】（５）ＣＣは、また、ハンドオフ手順のためにＲＲと協同する。
【０１３９】８．アドレスクライアント
アドレスクライアントが実現する機能は次の通りである。
【０１４０】（１）アドレスクライアントは、アドレス

サーバからのＩＭＳＩ、ＭＳＩＳＤＮ、およびＨＡ（ホームアドレス）間のアドレス変換を得ることによって，ＢＳ－ＩＷＦにおけるアドレスマッピングサービスを実行する。また、アドレスクライアントは、ＭＡＴＭネットワーク内のサービングするロケーションサーバのＡＴＭアドレスを提供する。

【０１４１】（２）ＩＷＦスタートアップの間、アドレスクライアントはアドレスサーバとのＴＣＰコネクションを確立し、リクエストの送信および応答の受信のために維持される。

【０１４２】（３）アドレスクライアントは、ＩＷＦコンポーネントからの要求を受け付け、それらをアドレスサーバへ転送する。要求された情報を含むアドレスサーバからの応答は要求したモジュールへ戻される。

【０１４３】（４）アドレスクライアントは次のコンポーネントと接続する。

・ＭＳＩＳＤＮ番号のホームアドレスＨＡへの変換を提供する呼制御

・ＩＭＳＩからＨＡへの変換を提供する移動管理

・必要な変換のためのアドレスサーバ。

【０１４４】９．ＩＷＦ－ＩＷＦインタフェース

ＩＷＦ－ＩＷＦインタフェースが提供する機能は次の通りである。

【０１４５】（１）このモジュールは、隣接するＢＳ－ＩＷＦとのＴＣＰコネクション確立を開始し、それらを維持する役割を担っている。これらのコネクションは他のＩＷＦへの呼のハンドオーバのために使用される。サーバおよびクライアントサイドは、ＩＰアドレスの辞書式順序付けによって決定される。すなわち、辞書式順序でより高いＩＰアドレスを有するＩＷＦがサーバとなり、より低いＩＰアドレスを有するＩＷＦがクライアントになる。たとえば、ＩＰアドレス 139.85.243.15を有するＩＷＦ１とＩＰアドレス 139.85.243.17 を有するＩＷＦ２とが互いに接続しようとしている場合、ＩＷＦ１がクライアントとなり、ＩＷＦ２がサーバとなる。

【０１４６】（２）ＩＷＦ－ＩＷＦインタフェースは次のコンポーネントと接続する。

・ハンドオフ関連トランザクションのための無線リソース管理。

【０１４７】１０．ＧＳＭＰクライアント

このモジュールは、コネクションの追加／削除のようなスイッチング機能を単に実現するだけである。

【０１４８】１１．ＭＡＴＭプロキシサーバ

ＭＡＴＭネットワークのためのＭＡＴＭプロキシシグナリングは、コネクションごとのハンドオフ、位置更新、および複数のホームアドレス登録をサポートする。

【０１４９】１２．位置更新（登録なしの非ローミングシナリオ）

図１２は、移動局ＭＳが事前にＢＳ－ＩＷＦに登録されている場合のＩＷＦでの位置更新手順を示す。図中の矢印に付された参照番号１～１８は、それぞれ次に説明するステップを示す。

【０１５０】（ステップ１）ＳＳ７スタックは、基地局サブシステムＢＳＳからＳＣＣＰＮ－ＣＯＮＮＥＣＴ（コンプリートレイヤ３メッセージ）インジケーションを受け取る。

【０１５１】（ステップ２）ＳＣＣＰコネクションＩＤを伴うＣＯメッセージ（コンプリートレイヤ３メッセージ（位置更新要求(LOCATION UPDATE REQUEST)））を受信すると、ＳＳ７スタックはそれを無線リソース管理ＲＲへ送信する。

【０１５２】（ステップ３）ＲＲは、位置更新要求を移動管理ＭＭへ送信する。

【０１５３】（ステップ４）ＭＭは、ＩＭＳＩ変換要求(TRANSLATE IMSI REQUEST)をアドレスクライアントへ送信する。

【０１５４】（ステップ５）アドレスクライアントは、ＴＣＰ／ＩＰを通してＩＭＳＩ変換要求をアドレスサーバへ送信する。

【０１５５】（ステップ６）アドレスクライアントは、アドレスサーバからＴＣＰ／ＩＰを通してＩＭＳＩ変換応答を受信する。

【０１５６】（ステップ７）アドレスクライアントはＩＭＳＩ変換応答(TRANSLATE IMSI RESPONSE)をＭＭへ送信する。

【０１５７】（ステップ８）ＭＭはＡＴＭ位置更新要求(ATM LOCATION UPDATE REQUEST)をＭ－ＵＮＩへ送信する。

【０１５８】（ステップ９）Ｍ－ＵＮＩは、ＡＴＭ位置更新要求に対するＡＴＭ位置更新応答(ATM LOCATION UPDATE RESPONSE)をＭＭへ返す。

【０１５９】（ステップ１０）ＭＭは位置更新応答メッセージをＲＲへ送信する。

【０１６０】（ステップ１１）ＲＲは、ＣＯメッセージをＳＳ７スタックへ送信する。

【０１６１】（ステップ１２）ＳＳ７スタックはＮ－ＤＡＴＡをＢＳＳへ送信する。

【０１６２】（ステップ１３）ＭＭは、ＲＲ解放要求(RR RELEASE REQUEST)をＲＲへ送信する。

【０１６３】（ステップ１４）ＲＲは、ＳＣＣＰコネクションＩＤを含むＣＯメッセージ（クリア命令）をＳＳ７スタックへ送信する。

【０１６４】（ステップ１５）ＳＳ７スタックは、Ｎ－ＤＡＴＡ（クリア命令）要求をＢＳＳへ送信する。

【０１６５】（ステップ１６）ＢＳＳは、Ｎ－ＤＡＴＡ（クリア完了）インジケーションをＳＳ７スタックへ送信する。

【０１６６】（ステップ１７）ＲＲは、ＳＣＣＰコネクションＩＤを含むＣＯメッセージ（クリア完了）を受信する。

【０１６７】（ステップ１８）ＲＲは、ＳＣＣＰコネクションＩＤを有するＳＣＣＰコネクションを解放する。

【０１６８】１３．位置更新（登録ありの非ローミングシナリオ）

図１３は、移動局ＭＳがＢＳ－ＩＷＦによってサーブされている位置登録エリアにはじめて入る場合のＢＳ－ＩＷＦでの位置更新手順を示す。図中の矢印に付された参照番号１～２６は、それぞれ次に説明するステップを示す。

【０１６９】（ステップ1）ＳＳ７スタックは、基地局サブシステムＢＳＳからＳＣＣＰＮ－ＣＯＮＮＥＣＴ（コンプリートレイヤ３メッセージ）インジケーションを受け取る。

【０１７０】（ステップ2）ＳＣＣＰコネクションＩＤを伴うＣＯメッセージ（コンプリートレイヤ３メッセージ（位置更新要求(LOCATION UPDATE REQUEST)））を受信すると、ＳＳ７スタックはそれを無線リソース管理ＲＲへ送信する。

【０１７１】（ステップ3）ＲＲは、位置更新要求を移動管理ＭＭへ送信する。

【０１７２】（ステップ4）ＭＭは、ＩＭＳＩ変換要求(TRANSLATE IMSI REQUEST)をアドレスクライアントへ送信する。

【０１７３】（ステップ5）アドレスクライアントは、ＴＣＰ／ＩＰを通してＩＭＳＩ変換要求をアドレスサーバへ送信する。

【０１７４】（ステップ6）アドレスクライアントは、アドレスサーバからＴＣＰ／ＩＰを通してＩＭＳＩ変換応答を受信する。

【０１７５】（ステップ7）アドレスクライアントは、ここでは、新たなモバイル(NEW MOBILE)であることに起因するＩＭＳＩ変換失敗(TRANSLATE IMSI FAILURE)をＭＭへ送信する。

【０１７６】（ステップ8）ＭＭは、ＩＭＳＩおよびＮＰ（ネットワークプレフィックス：Network Prefix）をアドレスクライアントへ送信する。

【０１７７】（ステップ9）アドレスクライアントは、ＴＣＰ／ＩＰを通してＩＭＳＩ変換要求をアドレスサーバへ送信する。

【０１７８】（ステップ１０）アドレスクライアントは、アドレスサーバからＴＣＰ／ＩＰを通して新モバイル要求の応答を受信する。

【０１７９】（ステップ１１）アドレスクライアントは、新しいホームアドレス（ＨＡ）を有する新モバイル応答(NEW MOBILE RESPONSE)をＭＭへ送信する。

【０１８０】（ステップ１２）ＭＭは、LOCMSERVERアドレス要求をＭ－ＵＮＩへ送信する。

【０１８１】（ステップ１３）Ｍ－ＵＮＩは、LocMServerアドレスとホームアドレス（ＨＡ）を含むLOCMSERVERアドレス応答をＭＭへ返す。

【０１８２】（ステップ１４）ＭＭは更新LOCMSERVERアドレスをアドレスクライアントへ送信する。

【０１８３】（ステップ１５）アドレスクライアントは、ＴＣＰ／ＩＰを通してその要求をアドレスサーバへ転送する。

【０１８４】（ステップ１６）ＭＭは、ＡＴＭ位置更新要求をＭ－ＵＮＩへ送信する。

【０１８５】（ステップ１７）Ｍ－ＵＮＩは、ＡＴＭ位置更新応答をＭＭへ返す。

【０１８６】（ステップ１８）ＭＭは位置更新応答メッセージをＲＲへ送信する。

【０１８７】（ステップ１９）ＲＲは、ＣＯメッセージをＳＳ７スタックへ送信する。

【０１８８】（ステップ２０）ＳＳ７スタックはＮ－ＤＡＴＡをＢＳＳへ送信する。

【０１８９】（ステップ２１）ＭＭは、ＲＲ解放要求(RR RELEASE REQUEST)をＲＲへ送信する。

【０１９０】（ステップ２２）ＲＲは、ＳＣＣＰコネクションＩＤを含むＣＯメッセージ（クリア命令）をＳＳ７スタックへ送信する。

【０１９１】（ステップ２３）ＳＳ７スタックは、Ｎ－ＤＡＴＡ（クリア命令）要求をＢＳＳへ送信する。

【０１９２】（ステップ２４）ＢＳＳは、Ｎ－ＤＡＴＡ（クリア完了）インジケーションをＳＳ７スタックへ送信する。

【０１９３】（ステップ２５）ＲＲは、ＳＣＣＰコネクションＩＤを含むＣＯメッセージ（クリア完了）を受信する。

【０１９４】（ステップ２６）ＲＲは、ＳＣＣＰコネクションＩＤを有するＳＣＣＰコネクションを解放する。

【０１９５】１４．呼設定（モバイル発信の場合）

図１４は、モバイル発信による呼確立手順を示す。図中の矢印に付された参照番号１～３１は、それぞれ次に説明するステップを示す。

【０１９６】（ステップ1）ＳＳ７スタックは、基地局サブシステムＢＳＳからＳＣＣＰＮ－ＣＯＮＮＥＣＴ（コンプリートレイヤ３メッセージ）インジケーションを受け取る。

【０１９７】（ステップ2）ＳＣＣＰコネクションＩＤを有するＣＯメッセージ（コンプリートレイヤ３メッセージ（ＣＭサービス要求(CM SERVICE REQUEST)））を受信すると、ＳＳ７スタックはそれを無線リソース管理ＲＲへ送信する。

【０１９８】（ステップ3）ＲＲは、ローカルデータベースをチェックし、モバイルタグ(MOBILE TAG)を検索する。

【０１９９】（ステップ4）ＲＲは、ＲＲ　ＥＳＴ　ＩＮＤをＣＭサービス要求をメッセージとしてＭＭへ送信する。

【０２００】（ステップ5）ＭＭはモバイルおよびその

位置情報の有効性を検証する。

【０２０１】（ステップ６）ＭＭは、ＣＭサービス承認(CM SERVICE ACCEPT)のＲＲデータ要求をＲＲへ送信する。

【０２０２】（ステップ７）ＲＲは、ＳＣＣＰコネクションＩＤを有するＣＯメッセージ（ＣＭサービス承認）をＳＳ７スタックへ送信する。

【０２０３】（ステップ８）ＳＳ７スタックは、ＳＣＣＰ　Ｎ－ＤＡＴＡ（ＣＭサービス承認）要求をＢＳＳへ送信する。

【０２０４】（ステップ９）ＢＳＳは、ＳＣＣＰ　Ｎ－ＤＡＴＡ（セットアップ(SETUP)メッセージ）インジケーションをＳＳ７スタックへ送信する。

【０２０５】（ステップ１０）ＲＲは、ＳＳ７スタックからＳＣＣＰコネクションＩＤを有するＣＯメッセージ（セットアップ）を受信する。

【０２０６】（ステップ１１）ＲＲはそのメッセージをＭＭへ送信する。

【０２０７】（ステップ１２）ＲＩＬ３　ＣＣメッセージ（セットアップ）は、モバイルタグとともに、ＭＭを通してＣＣへ転送される。

【０２０８】（ステップ１３）ＣＣは呼制御ブロック（ＣＣＢ）を生成する。

【０２０９】（ステップ１４）ＣＣは、当該モバイルに対する呼設定処理中(CALL PROCEEDING)をＭＭへ送信する。

【０２１０】（ステップ１５）ＭＭはＲＲデータ要求をＲＲへ送信する。

【０２１１】（ステップ１６）ＲＲは、そのデータをＳＣＣＰコネクションＩＤと共にＳＳ７スタックのＳＣＣＰへ転送する。

【０２１２】（ステップ１７）ＣＣは、ＭＳＩＳＤＮ変換要求(TR#MSISDN)をアドレスクライアントへ送信する。

【０２１３】（ステップ１８）アドレスクライアントはＭＳＩＳＤＮ変換応答(TR#MSISDN#RESP)をＣＣへ返す。

【０２１４】（ステップ１９）ＣＣは、モバイルタグを有するチャネルを割り当て、ＭＭＣＣ　ＳＹＮＣ　ＲＥＱを割り当て情報とともにＭＭへ送信する。

【０２１５】（ステップ２０）ＲＲは、ＳＣＣＰコネクションＩＤを有するＣＯメッセージ（割り当て要求(ASSIGNMENT REQUEST)）をＳＳ７スタックへ送信し、ＢＳＳＭＡＰタイマＴ１０をスタートさせる。

【０２１６】（ステップ２１）ＳＳ７スタックはＳＣＣＰ　Ｎ－ＤＡＴＡ（割り当て要求）要求をＢＳＳへ送信する。

【０２１７】（ステップ２２）ＢＳＳは、ＳＣＣＰ　Ｎ－ＤＡＴＡ（割り当て完了(ASSIGNMENT COMPLETE)）インジケーションをＳＳ７スタックへ送信する。

【０２１８】（ステップ２３）ＲＲは、ＳＣＣＰコネクションＩＤを含むＣＯメッセージ（割り当て完了(ASSIGNMENT COMPLETE)）を受信し、タイマＴ１０を停止する。

【０２１９】（ステップ２４）ＭＭは、割り当て確認(Assign Confirm)をＣＣへ送信する。

【０２２０】（ステップ２５）ＣＣは、オープンＳＶＣコネクション要求(OPEN SVC CONNECTION REQ)をＭＡＴＭサイドへ送信する。

【０２２１】（ステップ２６）ＭＡＴＭは、オープンＳＶＣコネクション確認(OPEN SVC CONNECTION CNF)をＣＣへ送信する。

【０２２２】（ステップ２７）ＣＣは、ＧＳＭＰクライアントを介してＧＳＭＰコネクションをプログラムする。

【０２２３】（ステップ２８）ＣＣは、モバイルへの接続（CONNECT）メッセージを含むデータ要求（ＭＭＣＣ　ＤＡＴＡ　ＲＥＱ）をＭＭへ送信する。

【０２２４】（ステップ２９）ＭＭはそのデータ要求をＲＲへ転送する。

【０２２５】（ステップ３０）ＲＲは、ＳＣＣＰコネクションＩＤを含むＳＣＣＰ＿ＤＡＴＡをＳＳ７スタックへ送信する。

【０２２６】（ステップ３１）モバイルは接続確認応答(CONNEC ACK)で応答する。

【０２２７】１５．呼設定（モバイル着信の場合）

図１５は、モバイル着信による呼確立手順を示す。図中の矢印に付された参照番号１～３２は、それぞれ次に説明するステップを示す。

【０２２８】（ステップ１）ＳＶＣ確立のインジケーションがＡＴＭ須部アドレスフィールドの被呼ＭＳＩＳＤＮ番号とともにＣＣで受信される。

【０２２９】（ステップ２）ＣＣは、ＧＳＭ　ＴＩＤをそのトランザクションに割り当て、データベースに値を格納し、Ｅ１およびＡＴＭリソースを予約する。

【０２３０】（ステップ３）コネクション設定要求がＭＭへ送信される。

【０２３１】（ステップ４）ＭＭは、ＲＲ　ＥＳＴ　ＲＥＱをＲＲへ送信する。

【０２３２】（ステップ５）ＲＲはＣＬメッセージ（ページング）をＳＳ７スタックへ送信する。

【０２３３】（ステップ６）ＳＳ７スタックはＳＣＣＰ　Ｎ－ＵＮＩＴＤＡＴＡ（ページング）要求をＢＳＳへ送信する。

【０２３４】（ステップ７）ＳＳ７スタックは、ＳＣＣＰ　Ｎ－ＣＯＮＮＥＣＴ（コンプリートレイヤ３メッセージ）インジケーションを受信する。

【０２３５】（ステップ８）ＲＲは、ＳＳ７スタックからＳＣＣＰコネクションＩＤを有するＣＯメッセージ（コンプリートレイヤ３メッセージ（ページング応答(PAGINGRESPONSE)））を受信する。

【０２３６】（ステップ9）ＣＣは、モバイルタグを有するセットアップメッセージをMMへ送信し、ＲＩＬ３ＣＣタイマＴ３０３をスタートさせる。

【０２３７】（ステップ１０）ＲＲは、ＳＳ７スタックへＳＣＣＰコネクションＩＤを有するＣＯメッセージ（セットアップ）を送信する。

【０２３８】（ステップ１１）ＳＳ７スタックは、ＢＳＳへＳＣＣＰ　Ｎ－ＤＡＴＡ（セットアップ）要求を送信する。

【０２３９】（ステップ１２）ＳＳ７スタックは、ＢＳＳからＳＣＣＰ　Ｎ－ＤＡＴＡ（呼確認(CALL CONFIRM)）インジケーションを受信する。

【０２４０】（ステップ１３）ＲＲは、ＳＣＣＰコネクションＩＤを有するＣＯメッセージ（呼確認(CALL CONFIRM)）を受信する。

【０２４１】（ステップ１４、１４ａ）ＲＲ、MMは、モバイルタグを有する呼確認をＣＣへ転送し、ＣＣはタイマＴ３０３を停止する。

【０２４２】（ステップ１５、１５ａ）ＣＣはモバイルタグのついたチャネルを割り当てる。

【０２４３】（ステップ１６）ＲＲは、ＳＣＣＰコネクションＩＤを有するＣＯメッセージ（割り当て要求）を送信し、ＢＳＳＭＡＰタイマＴ１０をスタートさせる。

【０２４４】（ステップ１７）ＳＳ７スタックは、ＢＳＳへＳＣＣＰ　Ｎ－ＤＡＴＡ（割り当て要求）要求を送信する。

【０２４５】（ステップ１８）ＢＳＳは、ＳＣＣＰ　Ｎ－ＤＡＴＡ（割り当て完了）インジケーションをＳＳ７スタックへ送信する。

【０２４６】（ステップ１９）ＲＲは、ＳＣＣＰコネクションＩＤを含むＣＯメッセージ（割り当て完了(ASSIGNMENT COMPLETE)）を受信する。

【０２４７】（ステップ２０、２０ａ）ＲＲは、モバイルタグのついた割り当て確認(Assign Confirm)をMMを介してＣＣへ送信する。

【０２４８】（ステップ２１）ＳＳ７スタックはＳＣＣＰ　Ｎ－ＤＡＴＡ（アラート(ALERTING)）インジケーションをＢＳＳから受信する。

【０２４９】（ステップ２２）ＲＲは、ＳＣＣＰコネクションＩＤを含むＣＯメッセージ（アラート）をＳＳ７スタックから受信する。

【０２５０】（ステップ２３、２３ａ）ＲＲ、MMはモバイルタグのついたアラートメッセージをＣＣへ転送する。

【０２５１】（ステップ２４）ＳＳ７スタックは、ＳＣＣＰ　Ｎ－ＤＡＴＡ（接続(CONNECT)）インジケーションを受信する。

【０２５２】（ステップ２５）ＲＲは、ＳＣＣＰコネクションＩＤを含むＣＯメッセージ（接続(CONNECT)）を受信する。

【０２５３】（ステップ２６、２６ａ）ＲＲ、MMはモバイルタグのついたＣＯＮＮＥＣＴメッセージをＣＣへ転送する。

【０２５４】（ステップ２７）ＣＣは、呼制御ブロックを生成する。

【０２５５】（ステップ２８）ＣＣは、ＧＳＭＰクライアントを通してコネクションをプログラムする。

【０２５６】（ステップ２９）ＣＣは、MMCC#DATA#REQにモバイルタグのついた接続確認応答（CONNECT ACK）をMMへ送信する。

【０２５７】（ステップ３０）ＲＲ、MMはＳＣＣＰコネクションＩＤのついた接続確認応答メッセージをＳＳ７スタックへ転送する。

【０２５８】（ステップ３１）ＳＳ７スタックは、ＳＣＣＰ　Ｎ－ＤＡＴＡ（接続確認応答）要求をＢＳＳへ送信する。

【０２５９】（ステップ３２）ＣＣは、接続応答をＭＵＮＩインタフェースへ送信する。

【０２６０】１６．ハンドオフ（旧ＢＳ－ＩＷＦ）

図１６は、元々呼を制御している旧ＢＳ－ＩＷＦでのハンドオフ手順をを示す。図中の矢印に付された参照番号１～１７は、それぞれ次に説明するステップを示す。

【０２６１】（ステップ1）ＢＳＳはＳＣＣＰ　Ｎ－ＤＡＴＡ（ハンドオーバ要請(HANDOVER REQUIRED)）インジケーションをＳＳ７スタックへ送信する。

【０２６２】（ステップ2）ＲＲは、ＳＣＣＰコネクションＩＤのついたＨＯメッセージ（ハンドオーバ要請）を受信する。このメッセージは、呼がハンドオフされうるセルＩＤのリストを含む。

【０２６３】（ステップ3）ＲＲは、データベースを参照することでセルＩＤをＩＷＦアドレスに変換する。ＲＲはリストからセルＩＤを選択し、それを対応するＩＷＦのアドレスに変換する。

【０２６４】（ステップ4）ＲＲは、ハンドオーバ要求メッセージをハンドオフの宛先ＩＷＦへ送信する。

【０２６５】（ステップ5）ハンドオーバ応答メッセージはＲＲに送信されてくる。この段階で失敗メッセージを受信するかあるいは時間切れになると、ＲＲはセルＩＤリストから別のセルＩＤを選択し、ステップ2からやり直す。

【０２６６】（ステップ6）ＲＲは、ＳＣＣＰコネクションＩＤのついたＣＯメッセージ（ハンドオーバコマンド(HANDOVER COMMAND)）を送信し、ＧＳＭタイマＴ１０３をスタートさせる。

【０２６７】（ステップ7）ＳＳ７スタックはＳＣＣＰ　Ｎ－ＤＡＴＡ（ハンドオーバコマンド）要求をＢＳＳへ送信する。

【０２６８】（ステップ8）ＲＲは、新ＩＷＦサイドのハンドオーバ完了後、ハンドオーバ完了メッセージを受信する。

【０２６９】（ステップ９）ＲＲはハンドオーバインジケーションメッセージをMMへ送信する。
【０２７０】（ステップ１０）MMは、ハンドオーバインジケーションをＣＣへ転送する。
【０２７１】（ステップ１１）呼制御ブロックは、ＣＣによってデータベースでクリアされる。
【０２７２】（ステップ１２、１２ａ）ＲＲはクリア命令をＳＳ７スタックを送信し、ＳＳ７スタックはＮ－ＤＡＴＡ（クリア命令）要求をＢＳＳへ送信する。
【０２７３】（ステップ１３）ＳＳ７スタックはＮ－ＤＡＴＡ（クリア完了）インジケーションをＢＳＳから受信する。
【０２７４】（ステップ１４）ＲＲはＳＣＣＰコネクションＩＤを有するＣＯメッセージ（クリア完了）を受信する。
【０２７５】（ステップ１５）ＣＣはＧＳＭＰクライアントを介してコネクションをクリアする。
【０２７６】（ステップ１６）ＣＣはリソーステーブルを更新する。
【０２７７】（ステップ１７）ＳＣＣＰコネクションＩＤのついたＳＣＣＰコネクションを解放する。
【０２７８】１７．ハンドオフ（新ＢＳ－ＩＷＦ）
図１７は、新ＢＳ－ＩＷＦでのハンドオフ手順をを示す。図中の矢印に付された参照番号１～２１は、それぞれ次に説明するステップを示す。
【０２７９】（ステップ１）ＲＲは、旧ＩＷＦから、ＢＳＳへのハンドオーバ要求を伴うデータをそのＩＷＦとのＴＣＰコネクションを通して受信する。
【０２８０】（ステップ２）ＲＲは、そのトランザクションに関するモバイルタグを得る。
【０２８１】（ステップ３）ＲＲはＥ１およびＡＴＭリソースを割り当てる。
【０２８２】（ステップ４）ＲＲは、ＣＯメッセージ（ハンドオーバ要求）をＳＳ７スタックへ送信する。ＳＣＣＰコネクションが存在しないので、このメッセージにＳＣＣＰコネクションＩＤは含まれない。ＳＳ７スタックは、このメッセージを送信しコネクションＩＤをＲＲへ戻すためにＳＣＣＰコネクションを確立するであろう。
【０２８３】（ステップ５）ＳＳ７スタックはＳＣＣＰ　Ｎ－ＣＯＮＮＥＣＴ（ハンドオーバ要求）要求をＢＳＳへ送信する。
【０２８４】（ステップ６）ＳＳ７スタックは、ＳＣＣＰ　Ｎ－ＣＯＮＮＥＣＴ確認（ハンドオーバ要求の確認応答）をＢＳＳから受信する。
【０２８５】（ステップ７）ＲＲは、ＳＣＣＰコネクションＩＤを有するＣＯメッセージ（ハンドオーバ要求の確認応答）をＳＳ７スタックから受信する。
【０２８６】（ステップ８）ＲＲは、モバイルタグのついたハンドオフ準備(Prepare Handoff)をMMへ送信する。
【０２８７】（ステップ９）MMはハンドオフ準備メッセージをＣＣへ転送する。
【０２８８】（ステップ１０）転送ハンドオーバメッセージはＣＣによってＭＡＴＭへ送信される。
【０２８９】（ステップ１１）転送ハンドオーバ確認メッセージはＣＣによってＭＡＴＭから受信される。
【０２９０】（ステップ１２、１２ａ）ＣＣは、準備ハンドオーバメッセージをMMへ送信し、更にMMはそれをＲＲへ転送する。
【０２９１】（ステップ１３）ＲＲは、ハンドオーバ応答メッセージをハンドオフ始動ＩＷＦへＴＣＰコネクションを通して送信し、ＲＩＬ３　ＲＲタイマＴ２０４をスタートさせる。
【０２９２】（ステップ１４）ＣＣはＧＳＭＰクライアントを介してコネクションをプログラムする。
【０２９３】（ステップ１５）ＳＳ７スタックはＳＣＣＰ　Ｎ－ＤＡＴＡ（ハンドオーバ検出(HANDOVER DETECT)）インジケーションを受信する。
【０２９４】（ステップ１６）ＲＲは、ＳＣＣＰコネクションＩＤを有するＣＯメッセージ（ハンドオーバ検出）をＳＳ７スタックから受信する。
【０２９５】（ステップ１７）ＳＳ７スタックは、ＳＣＣＰ　Ｎ－ＤＡＴＡ（ハンドオーバ完了）インジケーションを受信する。
【０２９６】（ステップ１８）ＲＲは、ＳＣＣＰコネクションＩＤを有するＣＯメッセージ（ハンドオーバ完了）をＳＳ７スタックから受信し、タイマＴ２０４を停止する。
【０２９７】（ステップ１９）モバイルタグによりハンドオフが実行されことがMMを介してＣＣへ通知される。
【０２９８】（ステップ２０）ＣＣはハンドオーバ完了メッセージを生成してＭＡＴＭサイドへ送信する。
【０２９９】（ステップ２１）ＲＲはハンドオーバ完了を旧ＩＷＦへ送信する。
【０３００】１８．呼解放（モバイル側からの）
図１８は、ＢＳ－ＩＷＦでのモバイル始動の呼解放手順をを示す。図中の矢印に付された参照番号１～２１は、それぞれ次に説明するステップを示す。
【０３０１】（ステップ１）ＳＣＣＰ　Ｎ－ＤＡＴＡ（切断(DISCONNECT)）インジケーションがＳＳ７スタックにより受信される。
【０３０２】（ステップ２、２ａ）ＲＲは、ＳＣＣＰコネクションＩＤを有するＣＯメッセージ（切断）を受信し、それをMMへ転送する。
【０３０３】（ステップ３）MMは、モバイルタグのついたＲＩＬ３　ＣＣメッセージ（切断）をＣＣへ送信する。
【０３０４】（ステップ４）ＣＣは、解放コネクション

要求をＭＡＴＭへ送信する。

【０３０５】（ステップ５）ＭＡＴＭは、呼がＭＡＴＭで解放された後、コネクション解放の確認を送信する。

【０３０６】（ステップ６）ＣＣは、モバイルタグのついたＲＩＬ３　ＣＣメッセージ（解放(RELEASE)）をＭＭへ送信し、ＧＳＭタイマＴ３０８をスタートさせる。

【０３０７】（ステップ７）ＭＭは解放メッセージをＲＲへ送信する。

【０３０８】（ステップ８）ＲＲは、ＳＣＣＰコネクションＩＤを有するＣＯメッセージ（解放）をＳＳ７スタックへ送信する。

【０３０９】（ステップ９）ＳＳ７スタックは、ＢＳＳへ向けて、ＳＣＣＰ　Ｎ－ＤＡＴＡ（解放）要求を送信する。

【０３１０】（ステップ１０）ＳＳ７スタックは、ＢＳＳから、ＳＣＣＰ　Ｎ－ＤＡＴＡ（解放完了）インジケーションを受信する。

【０３１１】（ステップ１１、１１ａ）ＲＲは、ＳＳ７スタックから、モバイルタグのついたＣＯメッセージ（解放完了）を受信し、それをＭＭへ転送する。

【０３１２】（ステップ１２）ＭＭは、そのメッセージをＣＣへ転送し、ＣＣはタイマＴ３０８を停止する。

【０３１３】（ステップ１３）ＣＣはＧＳＭ　ＴＩＤを解放する。

【０３１４】（ステップ１４）ＲＲは、ＳＣＣＰコネクションＩＤを有するＣＯメッセージ（クリア命令）をＳＳ７スタックへ送信する。

【０３１５】（ステップ１５）ＳＳ７スタックは、Ｎ－ＤＡＴＡ（クリア命令）要求をＢＳＳへ送信する。

【０３１６】（ステップ１６）ＢＳＳからのＮ－ＤＡＴＡ（クリア完了）インジケーションは、ＳＳ７スタックによって受信される。

【０３１７】（ステップ１７）ＲＲは、ＳＣＣＰコネクションＩＤを有するＣＯメッセージ（クリア完了）をＳＳ７スタックから受信する。

【０３１８】（ステップ１８）ＣＣはコネクションをクリアし、リソースを解放する。

【０３１９】（ステップ１９）ＣＣは、リソーステーブルを更新する。

【０３２０】（ステップ２０）ＳＣＣＰコネクションＩＤを有するＳＣＣＰコネクションが解放される。

【０３２１】（ステップ２１）ＣＣＢを削除する。

【０３２２】１９．呼解放（ネットワーク側からの）

図１９は、ＢＳ－ＩＷＦでのネットワーク始動の呼解放手順をを示す。図中の矢印に付された参照番号１～１８は、それぞれ次に説明するステップを示す。

【０３２３】（ステップ１）ＭＡＴＭは解放コネクションインジケーションをＣＣへ送信する。

【０３２４】（ステップ２）ＣＣは解放コネクション応答をＭＡＴＭへ送信する。

【０３２５】（ステップ３）ＣＣは、モバイルタグのついたＲＩＬ３　ＣＣメッセージ（切断）をＭＭへ送信し、タイマＴ３０５をスタートさせる。

【０３２６】（ステップ４、４ａ）ＭＭは、そのメッセージをＲＲへ転送し、ＲＲはそれをＳＣＣＰコネクションＩＤを有するＳＳ７スタックのＳＣＣＰへ転送する。

【０３２７】（ステップ５）ＳＳ７スタックは、ＳＣＣＰ　Ｎ－ＤＡＴＡ（切断）要求をＢＳＳへ送信する。

【０３２８】（ステップ６）ＳＳ７スタックは、ＳＣＣＰ　Ｎ－ＤＡＴＡ（解放）インジケーションをＳＳ７ＳＣＣＰから受信する。

【０３２９】（ステップ７、７ａ）ＲＲは、ＳＣＣＰコネクションＩＤを有するＣＯメッセージ（解放）をＳＳ７スタックから受信し、それをＭＭへ転送する。

【０３３０】（ステップ８）ＭＭは、モバイルタグのついたＲＩＬ３　ＣＣメッセージ（解放）をＣＣへ転送する。ＣＣはタイマＴ３０５を停止する。

【０３３１】（ステップ９）ＣＣはコネクション削除(Delete Connection)をＧＳＭＰクライアントへ送信する。

【０３３２】（ステップ１０，１０ａ）ＣＣは、ＲＩＬ３　ＣＣメッセージ（解放完了）をＭＭへ送信し、ＭＭはそれをモバイルタグとともにＲＲへ転送する。

【０３３３】（ステップ１１）ＲＲは、ＳＣＣＰコネクションＩＤを有するＣＯメッセージ（解放完了）をＳＳ７スタックへ送信する。

【０３３４】（ステップ１２）ＳＳ７スタックは、ＳＣＣＰ　Ｎ－ＤＡＴＡ（解放完了）要求をＳＳ７ＳＣＣＰへ送信する。

【０３３５】（ステップ１３）ＲＲは、ＳＣＣＰコネクションＩＤを有するＣＯメッセージ（クリア命令）をＳＳ７スタックへ送信する。

【０３３６】（ステップ１４）ＳＳ７スタックは、ＳＣＣＰ　Ｎ－ＤＡＴＡ（クリア命令）要求をＳＳ７ＳＣＣＰへ送信する。

【０３３７】（ステップ１５）ＳＳ７スタックは、ＳＣＣＰ　Ｎ－ＤＡＴＡ（クリア完了）インジケーションをＳＳ７ＳＣＣＰへ送信する。

【０３３８】（ステップ１６）ＲＲは、ＳＣＣＰコネクションＩＤを有するＣＯメッセージ（クリア完了）を受信する。

【０３３９】（ステップ１７）ＣＣはＧＳＭリソースを解放し、リソーステーブルを更新する。

【０３４０】（ステップ１８）ＲＲは、RR#SCCP#DISCをＳＳ７スタックを送信することにより、ＳＣＣＰコネクションＩＤを有するＳＣＣＰコネクションを解放する。

【０３４１】Ｉ．アドレスサーバアーキテクチャ

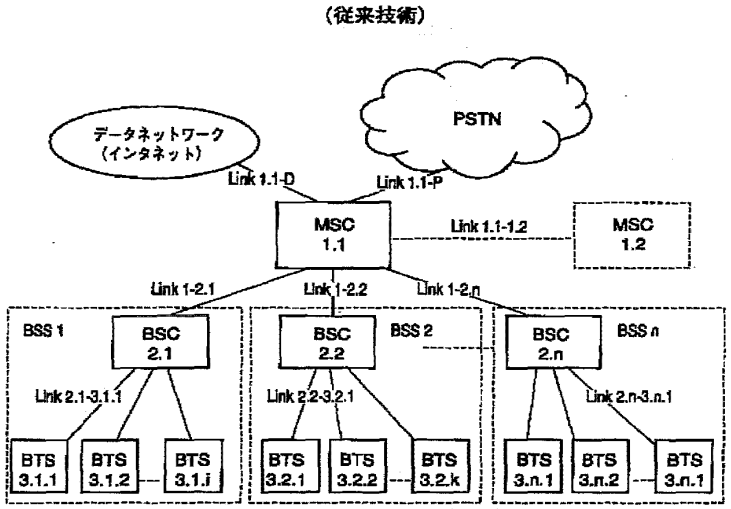
１．コンポーネント概観

図２０はアドレスサーバの主要コンポーネントを示す。アドレスサーバのモジュールについて簡単に説明する。

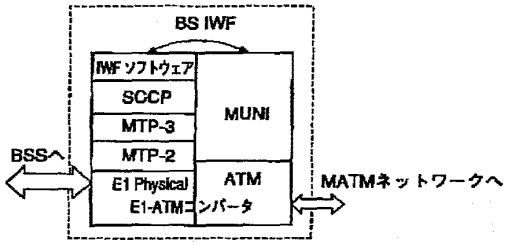
【０３４２】２．アドサーバ（AddServer：加算サーバ）
アドサーバは次の機能を実行する。
（１）アドサーバは、アドサーバのサービスにアクセスするクライアントによって使用されるアドレス変換プロトコルを実現する。
（２）アドサーバは、クライアントＩＷＦからのサービス要求を受け付け、適切なサービスシーケンスをデータベースサーバに対して構築することにより、要求されたサービスを提供する。アドサーバにより提供されるサービスには、次のものが含まれる。
・ＩＭＳＩのＨＡおよびLocMServerアドレスへの変換
・ＭＳＩＳＤＮのＨＡへの変換
・ネットワークプレフィックス（ＮＰ）に基づいた新しいＨＡの割り当て
・ある与えられたＩＭＳＩに対するLocMServerアドレスの更新
・ＥＳＩのローミングモバイル関係（コンテクスト）生成および割り当て
（３）ローミングモバイル関係削除
（４）アドサーバはオペレーションの失敗の原因を返す。
【０３４３】３．ＴＣＰアダプタ
ＴＣＰアダプタは次のサービスを提供する。
（１）ＴＣＰアダプタは、ＴＣＰ／ＩＰソケットを用いてＢＳ－ＩＷＦからのコネクション要求を受け付け、それらコネクションを確立して保持する。
（２）必要に応じて、これらコネクションの終了を開始することができる。
（３）ＩＷＦからの要求をアドサーバへ転送する。
（４）アドサーバの応答を対応するＩＷＦへ転送する。
【０３４４】ＴＣＰアダプタは２つのソケット、すなわちＩＮＥＴドメインソケットおよびＵＮＩＸ（登録商標）ドメインソケット、をモニタする。ＴＣＰアダプタは、ＵＮＩＸドメインソケット上でアドサーバと通信する。また、ＩＮＥＴドメインソケット上でＩＷＦＢＳＡからの接続要求を受け付ける。全てのＩＷＦ　ＢＳＡは、それらのアドレスマッピング要求をＩＮＥＴソケットに書き込む。要求参照番号によって、各要求はユニークに識別される。ＴＣＰアダプタは、これら要求をアドサーバへ転送する。アドサーバから応答を受信すると、ＴＣＰアダプタはそれをＩＷＦへそれぞれ転送する。ＴＣＰアダプタは、共存するサーバとして機能する。ＴＣＰアダプタは、それに接続している各ＩＷＦに対して別個のハンドらを生成する。
【０３４５】４．データベースサーバ
データベースサーバは次のサービスを提供する。
（１）データベースサーバはデータ検索サービスをアドレスサーバへ提供する。アドレス変換およびデータ変換はこれらサービスを用いて実行される。更に、アドレスサーバはネットワーク情報にアクセスする。
（２）モバイルをローミングするための一時的関係（テンポラリコンテクスト）を生成するためのデータ挿入サービスを提供する。
（３）期限を過ぎたモバイル関係を削除するためのデータ削除サービスを提供する。
【０３４６】データベースはＳＱＬデータベースを含む。ＳＱＬデータベースシステムはデータベースサーバデモンからなる。データベースにアクセスしようとするクライアントは、ＴＣＰ／ＩＰソケットを通してデータベースサーバに接続し、ＳＱＬ言語クエリの形式で要求を送信する。データベースサーバはこれらクエリを処理し、その結果をそのソケットに書き込んで返す。このクライアントーサーバ方式はデータベースに対するリモートアクセス機構を提供する。
【０３４７】本発明の他の実施例および変形例は、ここで記載され教示された事項に基づけば、当業者にとって容易となるであろう。ここでは、本発明の特定の実施形態のみを記載したが、種々の実施例および変形例が本発明の範囲を逸脱することなくなされるであろうことは明らかである。
【０３４８】
【発明の効果】以上詳細に説明したように、本発明によれば、少なくとも１つの基地局サブシステムとモビリティ拡張パケットデータネットワークとが通信可能に接続されており、さらにモビリティ拡張パケットデータネットワークには外部ネットワークへの少なくとも１つのブリッジが設けられている。このように、パケットベースのデータネットワークインフラと少なくとも１つのＢＳＳとを相互接続するために分散コネクション制御を採用することで、ネットワークの設定および運用における効率およびコストの点で有利である。
【０３４９】既存のセルラ基地局サブシステム（ＢＳＳ）をモビリティ拡張パケットデータネットワークへアタッチするためのメカニズムは、無線セルラＢＳＳのパケットデータネットワークとのインターワーキングを可能にするインターワーキング機能（ＩＷＦ）である。これにより、既存のエアインターフェースおよび加入者装置との互換性を維持しつつ、高速かつインターネット指向のモバイルネットワークが実現可能となる。
【０３５０】また、従来のＢＳＳをパケットデータネットワークに相互接続するインターワーキング機能は、モバイル交換局のような高いスループットおよび信頼性が要求されないことから、安価な既製のハードウエアを用いて実現することができる。
【図面の簡単な説明】
【図１】従来のセルラシステムのアーキテクチャを示す概略的構成図である。
【図２】本発明を実施するための無線ネットワークを示す概略的構成図である。

【図３】本発明による主要な機能性エンティティおよびインターフェースを有するインターワーキング機能の一実施形態を示す図である。
【図４】位置更新シナリオの一例を示すシーケンス図である。
【図５】移動局側での着呼シナリオの一例を示すシーケンス図である。
【図６】移動局側からの発呼シナリオの一例を示すシーケンス図である。
【図７】ハンドオーバ手順の一例を示すシーケンス図である。
【図８】本発明による望ましい一実施例のための機能的アーキテクチャおよびインターフェースを示すシステム構成図である。
【図９】本実施例のための参照モデルを示す図である。
【図１０】基地局アダプタ（ＢＳＡ）におけるプロトコルスタックの一実施例をしめす図である。
【図１１】基地局インターワーキング機能（ＢＳＩＷＦ）ソフトウエアアーキテクチャの一実施例を示す図である。
【図１２】位置登録なしのＢＳＩＷＦ非ローミング位置更新の一実施例を示す図である。
【図１３】位置登録ありのＢＳＩＷＦ非ローミング位置＊更新の一実施例を示す図である。
【図１４】モバイル発ＢＳＩＷＦ呼の一例を示す図である。
【図１５】モバイル着ＢＳＩＷＦ呼の一例を示す図である。
【図１６】旧ＢＳＩＷＦでのＢＳＩＷＦハンドオーバ手順の一例を示す図である。
【図１７】新ＢＳＩＷＦでのＢＳＩＷＦハンドオーバ手順の一例を示す図である。
【図１８】モバイル側からのＢＳＩＷＦ呼解放の一例を示す図である。
【図１９】ネットワーク側からのＢＳＩＷＦ呼解放の一例を示す図である。
【図２０】アドレスサーバソフトウエアアーキテクチャの一実施例を示す図である。
【符号の説明】
ＢＳＳ　基地局サブシステム
ＢＳＣ　基地局コントローラ
ＢＴＳ　基地局送受信器システム
ＩＷＦ　インターワーキング機能
ＡＳ　アドレスサーバ
ＧＷ　ゲートウエイ

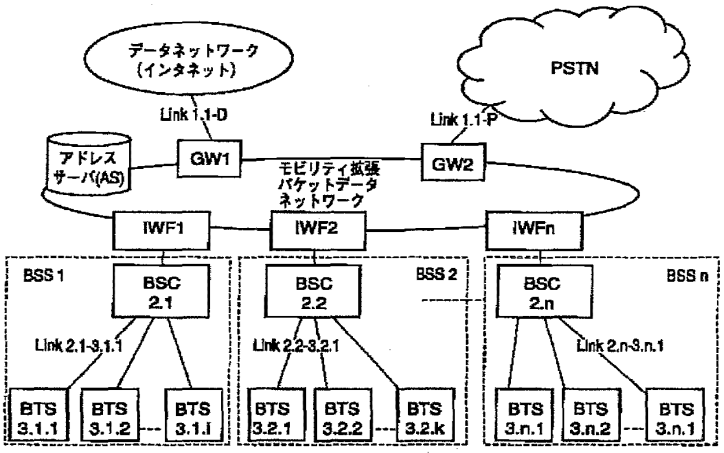
【図１】



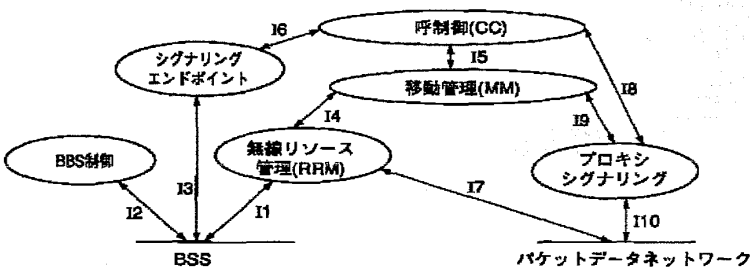
【図１０】



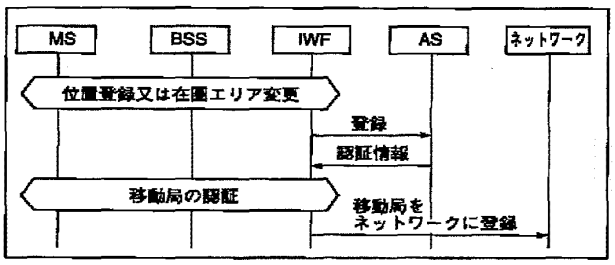
【図２】


データネットワーク
(インタネット)
PSTN
Link 1.1-D
Link 1.1-P
アドレス
サーバ(AS)
GW1
GW2
モビリティ拡張
パケットデータ
ネットワーク
IWF1
IWF2
IWFn
BSS 1
BSS 2
BSS n
BSC
2.1
BSC
2.2
BSC
2.n
Link 2.1-3.1.1
Link 2.2-3.2.1
Link 2.n-3.n.1
BTS
3.1.1
BTS
3.1.2
BTS
3.1.i
BTS
3.2.1
BTS
3.2.2
BTS
3.2.k
BTS
3.n.1
BTS
3.n.2
BTS
3.n.1

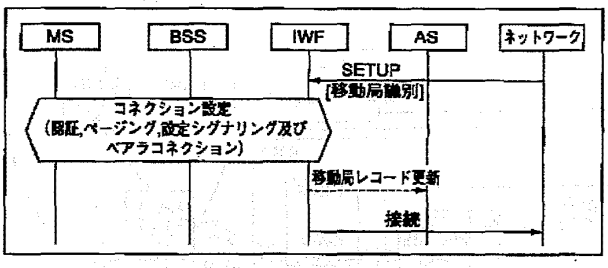
【図３】


I6
呼制御(CC)
シグナリング
エンドポイント
I5
移動管理(MM)
I8
I4
I9
BBS制御
無線リソース
管理(RRM)
プロキシ
シグナリング
I3
I7
I2
I1
I10
BSS
パケットデータネットワーク

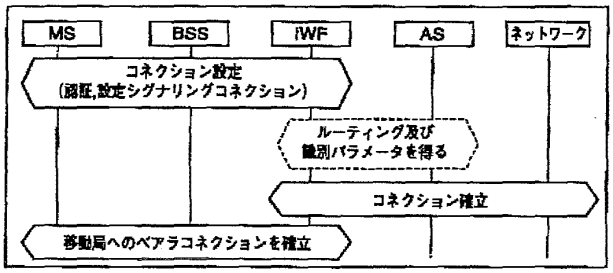
【図４】


MS
BSS
IWF
AS
ネットワーク
位置登録又は在圏エリア変更
登録
認証情報
移動局の認証
移動局を
ネットワークに登録

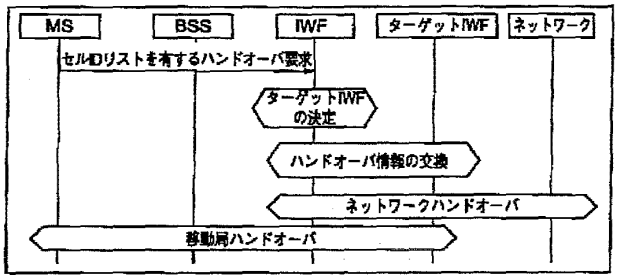
【図５】


MS
BSS
IWF
AS
ネットワーク
SETUP
[移動局識別]
コネクション設定
(認証,ページング,設定シグナリング及び
ベアラコネクション)
移動局レコード更新
接続

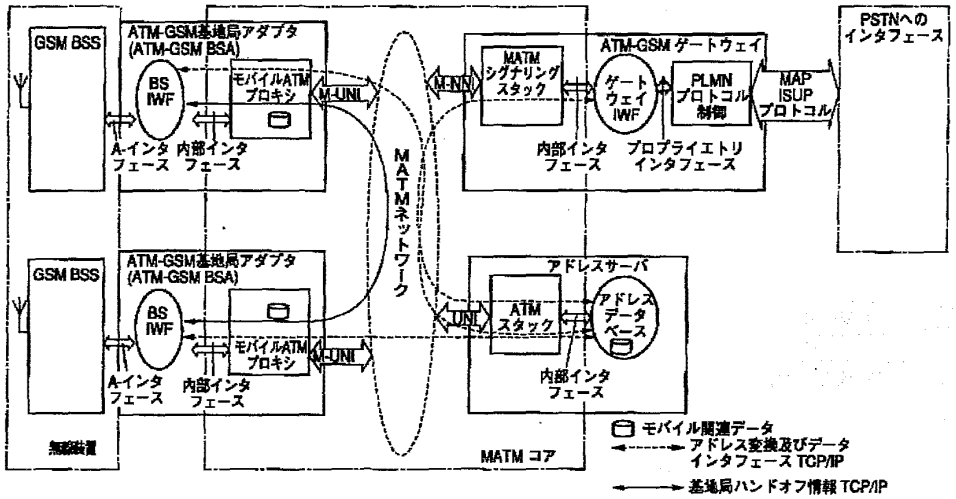
【図６】



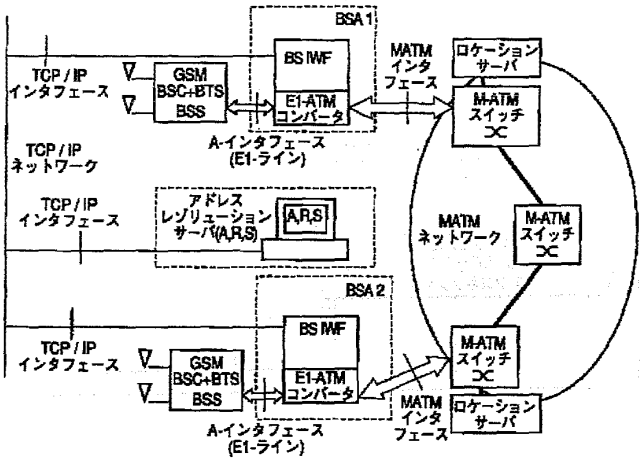
【図７】



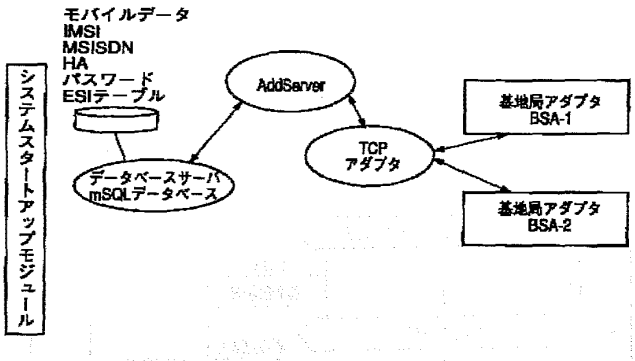
【図８】



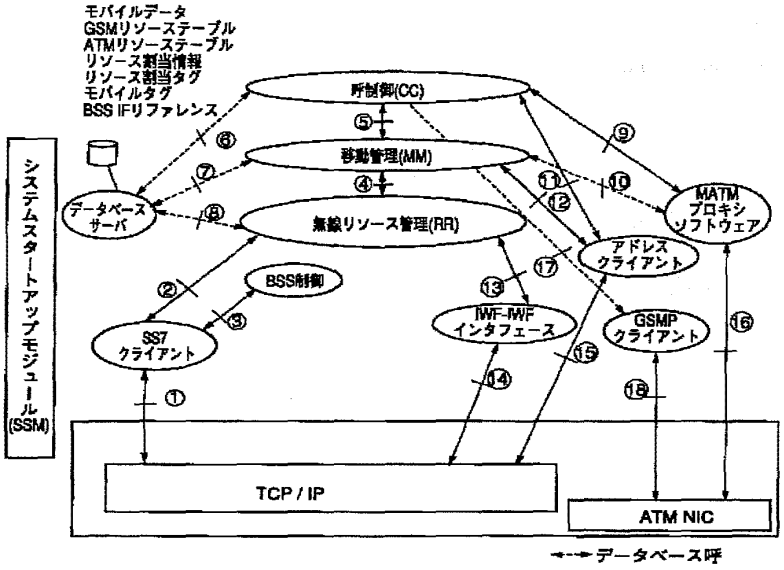
【図９】



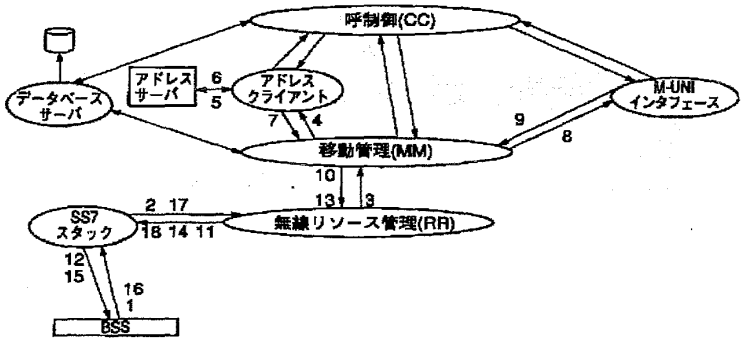
【図２０】



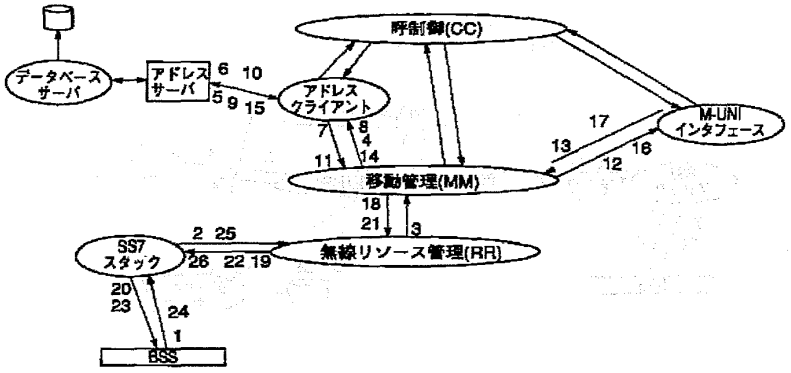
【図１１】


モバイルデータ
GSMリソーステーブル
ATMリソーステーブル
リソース割当情報
リソース割当タグ
モバイルタグ
BSS IFリファレンス
システムスタートアップモジュール(SSM)
呼制御(CC)
移動管理(MM)
データベースサーバ
無線リソース管理(RR)
BSS制御
SS7クライアント
IWF-IWFインタフェース
GSMPクライアント
MATMプロキシソフトウェア
アドレスクライアント
TCP / IP
ATM NIC
データベース呼

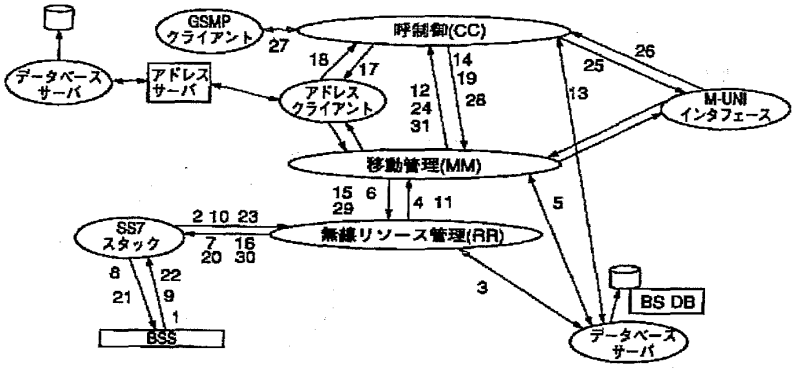
【図１２】


呼制御(CC)
データベースサーバ
アドレスサーバ
アドレスクライアント
M-UNIインタフェース
移動管理(MM)
SS7スタック
無線リソース管理(RR)
BSS

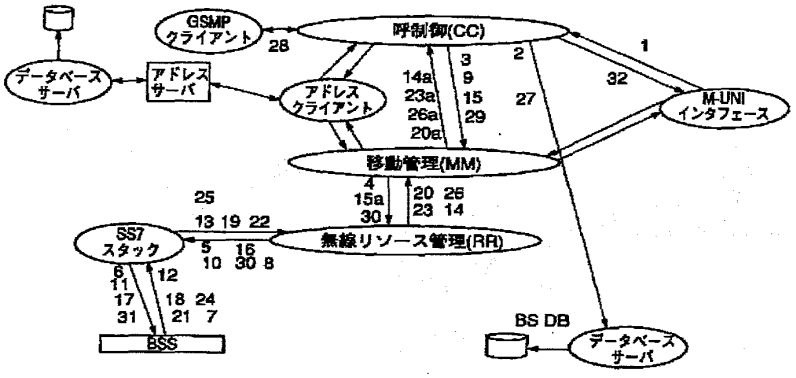
【図１３】


呼制御(CC)
データベースサーバ
アドレスサーバ
アドレスクライアント
M-UNIインタフェース
移動管理(MM)
SS7スタック
無線リソース管理(RR)
BSS

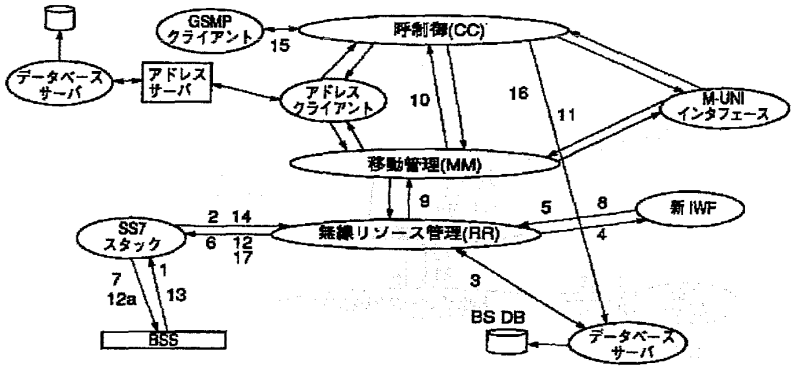
【図１４】


GSMP
クライアント
呼制御(CC)
データベース
サーバ
アドレス
サーバ
アドレス
クライアント
M-UNI
インタフェース
移動管理(MM)
SS7
スタック
無線リソース管理(RR)
BSS
BS DB
データベース
サーバ

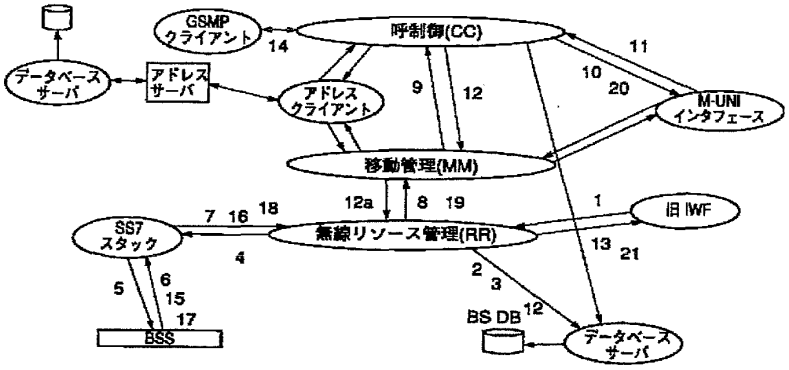
【図１５】


GSMP
クライアント
呼制御(CC)
データベース
サーバ
アドレス
サーバ
アドレス
クライアント
M-UNI
インタフェース
移動管理(MM)
SS7
スタック
無線リソース管理(RR)
BSS
BS DB
データベース
サーバ

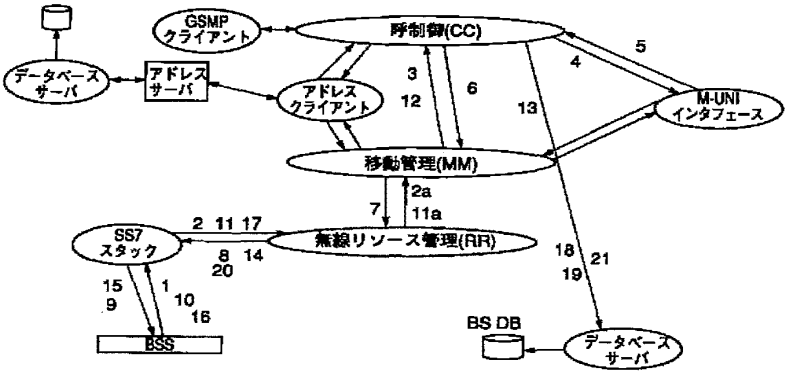
【図１６】


GSMP
クライアント
呼制御(CC)
データベース
サーバ
アドレス
サーバ
アドレス
クライアント
M-UNI
インタフェース
移動管理(MM)
新 IWF
SS7
スタック
無線リソース管理(RR)
BSS
BS DB
データベース
サーバ

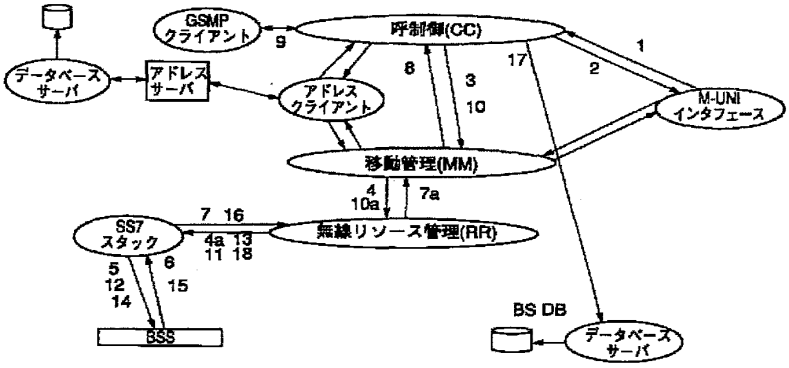
【図１７】


GSMP
クライアント
呼制御(CC)
データベース
サーバ
アドレス
サーバ
アドレス
クライアント
M-UNI
インタフェース
移動管理(MM)
SS7
スタック
無線リソース管理(RR)
旧 IWF
BSS
BS DB
データベース
サーバ

【図１８】


GSMP
クライアント
呼制御(CC)
データベース
サーバ
アドレス
サーバ
アドレス
クライアント
M-UNI
インタフェース
移動管理(MM)
SS7
スタック
無線リソース管理(RR)
BSS
BS DB
データベース
サーバ

【図１９】


GSMP
クライアント
呼制御(CC)
データベース
サーバ
アドレス
サーバ
アドレス
クライアント
M-UNI
インタフェース
移動管理(MM)
SS7
スタック
無線リソース管理(RR)
BSS
BS DB
データベース
サーバ

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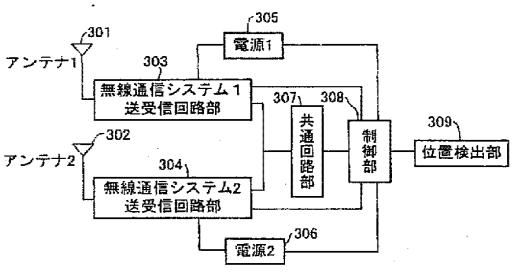
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(54)【発明の名称】携帯端末

(57)【要約】
【課題】広範囲のエリアをカバーするセルラー方式の第１の無線通信システムと、ホットスポット方式の第２の無線通信システムの双方と通信が可能な携帯端末において、消費電流の低減を考慮しつつ、無線通信システム間の接続および接続切り替えを行う。
【解決手段】携帯端末の位置を検出する位置検出手段（位置検出部３０９）を備え、基地局もしくは携帯端末にて第２の無線通信システムのスポットエリア情報を所有する。位置検出手段（位置検出部３０９）で得られた携帯端末位置情報とスポットエリア位置情報に基づいて、第２の無線通信システムのスポットエリア内か否かを判断し、スポットエリア内に携帯端末が位置しているときにだけ、第２の無線通信システムの送受信部（「無線通信システム２」送受信回路部３０４）に関する電源（「電源２」３０６）をオンにする。
【選択図】　図３



【特許請求の範囲】
【請求項１】
コアネットワークおよび無線アクセスネットワークにより構成され、広範囲のエリアをカバーするセルラー方式の第１の無線通信システムと、無線ローカルエリアネットワーク制御センタおよび無線ローカルエリアネットワークのアクセスネットワークにより構成されるホットスポット方式の第２の無線通信システムの双方と通信が可能な携帯端末において、
携帯端末の位置の検出を行う位置検出手段と、
前記位置検出手段で得られる携帯端末位置情報を利用することにより、前記第２の無線通信システムが検出された際に、前記第２の無線通信システムの送受信回路部に対して電源を供給するように制御する制御部と、
前記第１の無線通信システムと前記第２の無線通信システムの通信を切り替える通信切替手段とを有し、
前記第１の無線通信システムと通信をしている際には、前記第２の無線通信システムの送受信回路部に対して電源を供給しないことを特徴とする携帯端末。
【請求項２】
前記位置検出手段により得られる携帯端末位置情報と、基地局より入手した前記第２の無線通信システムのエリア位置情報を利用することにより、前記第２の無線通信システムを検出することを特徴とする請求項１記載の携帯端末。
【請求項３】
前記位置検出手段により得られる携帯端末位置情報と、携帯端末自身で所有している前記第２の無線通信システムのエリア位置情報を利用することにより、前記第２の無線通信システムを検出することを特徴とする請求項１記載の携帯端末。
【請求項４】
携帯端末の移動速度を求める移動速度検出手段と、
携帯端末における送信と受信のデータ伝送速度を演算する通信速度検出手段とを備えたことを特徴とする請求項１記載の携帯端末。
【請求項５】
前記位置検出手段および前記移動速度検出手段としてＧＰＳを用いることを特徴とする請求項４記載の携帯端末。
【請求項６】
前記移動速度検出手段により検出された携帯端末移動速度が予め設定された閾値よりも小さい場合には、前記第２の無線通信システムへの接続処理を行い、
前記移動速度検出手段により検出された携帯端末移動速度が予め設定された閾値よりも大きい場合には、前記第１の無線通信システムへの接続処理を行うことを特徴とする請求項４または５記載の携帯端末。
【請求項７】
前記第１の無線通信システムと通信中に、前記移動速度検出手段により検出された携帯端末移動速度が予め設定された閾値よりも小さい場合には、前記第２の無線通信システムへの接続切り替え処理を行うとともに、前記移動速度検出手段により検出された携帯端末移動速度が予め設定された閾値よりも大きい場合には、前記第１の無線通信システムとの通信を維持し、
前記第２の無線通信システムと通信中に、前記移動速度検出手段により検出された携帯端末移動速度が予め設定された閾値よりも大きい場合には、前記第１の無線通信システムへの接続切り替え処理を行うとともに、前記移動速度検出手段により検出された携帯端末移動速度が予め設定された閾値よりも小さい場合には、前記第２の無線通信システムとの通信を維持することを特徴とする請求項４または５記載の携帯端末。
【請求項８】
前記第１の無線通信システムと通信中に、前記通信速度検出手段により検出された携帯端末データ通信速度が予め設定された閾値よりも大きい場合には、前記第２の無線通信シス

テムへの接続切り替え処理を行うとともに、前記通信速度検出手段により検出された携帯端末データ通信速度が予め設定された閾値よりも小さい場合には、前記第１の無線通信システムとの通信を維持し、
前記第２の無線通信システムと通信中に、前記通信速度検出手段により検出された携帯端末データ通信速度が予め設定された閾値よりも小さい場合には、前記第１の無線通信システムへの接続切り替え処理を行うとともに、前記通信速度検出手段により検出された携帯端末データ通信速度が予め設定された閾値よりも大きい場合には、前記第２の無線通信システムとの通信を維持することを特徴とする請求項４または５記載の携帯端末。
【請求項９】
コアネットワークおよび無線アクセスネットワークにより構成され、広範囲のエリアをカバーするセルラー方式の第１の無線通信システムと、無線ローカルエリアネットワーク制御センタおよび無線ローカルエリアネットワークのアクセスネットワークにより構成されるホットスポット方式の第２の無線通信システムの双方と通信が可能な携帯端末において、
携帯端末の移動速度を求める移動速度検出手段と、
携帯端末における送信と受信のデータ伝送速度を演算する通信速度検出手段と、
携帯端末の移動速度あるいはデータ伝送速度の状態に基づいて、前記第２の無線通信システムの送受信回路部に対して電源を供給するように制御する制御部と、
前記第１の無線通信システムと前記第２の無線通信システムの通信を切り替える通信切替手段とを有し、
前記第１の無線通信システムと通信をしている際には、前記第２の無線通信システムの送受信回路部に対して電源を供給しないことを特徴とする携帯端末。
【請求項１０】
携帯端末の電源を投入した際には、前記第１の無線通信システムと接続を行い、
前記第１の無線通信システムと通信中に、前記移動速度検出手段により検出された携帯端末移動速度が予め設定された閾値よりも小さい場合には、前記第２の無線通信システムへの接続切り替え処理を行うとともに、前記移動速度検出手段により検出された携帯端末移動速度が予め設定された閾値よりも大きい場合には、前記第１の無線通信システムとの通信を維持し、
前記第２の無線通信システムと通信中に、前記移動速度検出手段により検出された携帯端末移動速度が予め設定された閾値よりも大きい場合には、前記第１の無線通信システムへの接続切り替え処理を行うとともに、前記移動速度検出手段により検出された携帯端末移動速度が予め設定された閾値よりも小さい場合には、前記第２の無線通信システムとの通信を維持することを特徴とする請求項９記載の携帯端末。
【請求項１１】
携帯端末の電源を投入した際には、前記第１の無線通信システムと接続を行い、
前記第１の無線通信システムと通信中に、前記通信速度検出手段により検出された携帯端末データ通信速度が予め設定された閾値よりも大きい場合には、前記第２の無線通信システムへの接続切り替え処理を行うとともに、前記通信速度検出手段により検出された携帯端末データ通信速度が予め設定された閾値よりも小さい場合には、前記第１の無線通信システムとの通信を維持し、
前記第２の無線通信システムと通信中に、前記通信速度検出手段により検出された携帯端末データ通信速度が予め設定された閾値よりも小さい場合には、前記第１の無線通信システムへの接続切り替え処理を行うとともに、前記通信速度検出手段により検出された携帯端末データ通信速度が予め設定された閾値よりも大きい場合には前記第２の無線通信システムとの通信を維持することを特徴とする請求項９記載の携帯端末。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】
本発明は、携帯端末に関し、特に、コアネットワークおよび無線アクセスネットワークに

より構成され、広範囲のエリアをカバーするセルラー方式の第１の無線通信システムと、無線ローカルエリアネットワーク制御センタおよび無線ローカルエリアネットワークのアクセスネットワークにより構成されるホットスポット方式の第２の無線通信システムの双方と通信が可能な携帯端末に関するものである。

【０００２】

【従来の技術】

現在、様々なセルラー方式の移動通信サービスが普及しており、サービスエリアも広範囲にわたっている。例えばＷ－ＣＤＭＡ（Ｗｉｄｅｂａｎｄ　ＣｏｄｅＤｉｖｉｓｉｏｎ　Ｍｕｌｔｉｐｌｅ　Ａｃｃｅｓｓ）セルラー方式移動通信システムでは、最大３８４ｋｂｐｓのデータ伝送速度を実現し、高速移動にも対応可能となっている。

【０００３】

また近年、高速データ通信を実現する公衆無線ＬＡＮ（Ｌｏｃａｌ　ＡｒｅａＮｅｔｗｏｒｋ）サービスが普及しつつある。本サービスはホテルや駅などの公衆エリアのサービスになっており、サービスエリアはスポット的に存在する。

【０００４】

従来、このような複数の無線通信サービスに対応した携帯端末において、無線通信システムの接続方法や切り替え方法（ハンドオーバー）が検討されており、通信接続の中断などを感じさせずにシームレスに接続を切り替える（ハンドオーバーする）技術が提案されている（例えば、特許文献１参照）。

【０００５】

【特許文献１】

特開２００２－１９９４２６号公報

【０００６】

【発明が解決しようとする課題】

しかしながら、異なる複数の無線通信システムにおける通信システム接続方法や接続切り替え方法に関する従来技術では、主にシームレスな接続方法について述べられており、携帯端末の消費電流を考慮した接続方法に関する技術は詳細には述べられていない。

【０００７】

特に、無線ローカルエリアネットワーク（ＷＬＡＮ）制御センタ、無線ローカルエリアネットワークのアクセスネットワークにより構成されている一般的なホットスポット方式無線通信システムにおける携帯端末の消費電流が比較的大きく、待ち受け状態における消費電流をいかに小さくするかが課題となっている。また、待ち受け制御技術を駆使して、待ち受け電流を減らしたとしても電流値を「０」にすることは不可能である。

【０００８】

本発明は、上述した事情に鑑み提案されたもので、広範囲のエリアをカバーするセルラー方式の第１の無線通信システムと、一般的なホットスポット方式の第２の無線通信システムとの双方と通信が可能な携帯端末において、携帯端末の消費電流の低減を考慮しながら、無線通信システム間の接続および接続切り替えを行うことを目的とする。

【０００９】

【課題を解決するための手段】

本発明に係る携帯端末は、コアネットワークおよび無線アクセスネットワークにより構成され、広範囲のエリアをカバーするセルラー方式の第１の無線通信システムと、無線ローカルエリアネットワーク制御センタおよび無線ローカルエリアネットワークのアクセスネットワークにより構成されるホットスポット方式の第２の無線通信システムの双方と通信が可能な携帯端末において、

携帯端末の位置の検出を行う位置検出手段と、前記位置検出手段で得られる携帯端末位置情報を利用することにより、前記第２の無線通信システムが検出された際に、前記第２の無線通信システムの送受信回路部に対して電源を供給するように制御する制御部と、前記第１の無線通信システムと前記第２の無線通信システムの通信を切り替える通信切替手段とを有し、前記第１の無線通信システムと通信をしている際には、前記第２の無線通信シ

ステムの送受信回路部に対して電源を供給しないことを特徴とするものである。

【００１０】

このような構成からなる携帯端末では、第２の無線通信システムと通信を行っていない場合には、第２の無線通信システムの送受信回路に対して電源を供給しないため、消費電力を低減することができる。

【００１１】

また、前記携帯端末において、前記位置検出手段により得られる携帯端末位置情報と、基地局より入手した前記第２の無線通信システムのエリア位置情報を利用することにより、前記第２の無線通信システムを検出することを特徴とする。

【００１２】

このような構成からなる携帯端末では、メモリ容量を比較的多く確保することが可能な基地局において、第２の無線通信システムの詳細なエリア位置情報を格納しておき、このエリア位置情報を携帯端末で利用することにより、第２の無線通信システムの利用可能エリアを精度よく検出することができるため、消費電流の無駄使いを防止することを特徴とする。

【００１３】

また、前記携帯端末において、前記位置検出手段により得られる携帯端末位置情報と、携帯端末自身で所有している前記第２の無線通信システムのエリア位置情報を利用することにより、前記第２の無線通信システムを検出することを特徴とする。

【００１４】

このような構成からなる携帯端末では、基地局から第２の無線通信システムのエリア位置情報を取得することができない場合であっても、第２の無線通信システムを検出することができる。

【００１５】

また、前記携帯端末において、携帯端末の移動速度を求める移動速度検出手段と、携帯端末における送信と受信のデータ伝送速度を演算する通信速度検出手段とを備えることを特徴とする。

【００１６】

このような構成からなる携帯端末では、移動速度検出手段により検出した携帯端末の移動速度に応じて、スポット的に配置された第２の無線通信システムを適宜選択することにより、携帯端末に与える負荷を軽減することができる。また、通信速度検出手段により検出したデータ伝送速度に応じて、第２の無線通信システムを使用するか否かを決定することにより、第２の無線通信システムの送受信回路に対する電源の供給が制御されるため、さらに消費電力を低減することができる。

【００１７】

また、前記携帯端末において、前記位置検出手段および前記移動速度検出手段はＧＰＳを用いて構成することを特徴とする。

【００１８】

このような構成からなる携帯端末では、移動速度検出手段に対して位置検出手段の機能を持たせることにより、回路規模を削減することができる。

【００１９】

また、前記携帯端末において、前記移動速度検出手段により検出された携帯端末移動速度が予め設定された閾値よりも小さい場合には、前記第２の無線通信システムへの接続処理を行い、前記移動速度検出手段により検出された携帯端末移動速度が予め設定された閾値よりも大きい場合には、前記第１の無線通信システムへの接続処理を行うことを特徴とする。

【００２０】

このような構成からなる携帯端末では、移動速度検出手段により検出した携帯端末の移動速度に応じて、スポット的に配置された第２の無線通信システムを適宜選択することにより、携帯端末に与える負荷を軽減することができる。

【００２１】
また、前記携帯端末において、前記第１の無線通信システムと通信中に、前記移動速度検出手段により検出された携帯端末移動速度が予め設定された閾値よりも小さい場合には、前記第２の無線通信システムへの接続切り替え処理を行うとともに、前記移動速度検出手段により検出された携帯端末移動速度が予め設定された閾値よりも大きい場合には、前記第１の無線通信システムとの通信を維持し、前記第２の無線通信システムと通信中に、前記移動速度検出手段により検出された携帯端末移動速度が予め設定された閾値よりも大きい場合には、前記第１の無線通信システムへの接続切り替え処理を行うとともに、前記移動速度検出手段により検出された携帯端末移動速度が予め設定された閾値よりも小さい場合には、前記第２の無線通信システムとの通信を維持することを特徴とする。

【００２２】
このような構成からなる携帯端末では、移動速度検出手段により検出した携帯端末の移動速度に応じて、第１の無線通信システムと第２の無線通信システムを適宜切り替えることにより、携帯端末に与える負荷を軽減することができる。

【００２３】
また、前記携帯端末において、前記第１の無線通信システムと通信中に、前記通信速度検出手段により検出された携帯端末データ通信速度が予め設定された閾値よりも大きい場合には、前記第２の無線通信システムへの接続切り替え処理を行うとともに、前記通信速度検出手段により検出された携帯端末データ通信速度が予め設定された閾値よりも小さい場合には、前記第１の無線通信システムとの通信を維持し、前記第２の無線通信システムと通信中に、前記通信速度検出手段により検出された携帯端末データ通信速度が予め設定された閾値よりも小さい場合には、前記第１の無線通信システムへの接続切り替え処理を行うとともに、前記通信速度検出手段により検出された携帯端末データ通信速度が予め設定された閾値よりも大きい場合には、前記第２の無線通信システムとの通信を維持することを特徴とする。

【００２４】
このような構成からなる携帯端末では、通信速度検出手段により検出された携帯端末データ通信速度が予め設定された閾値よりも小さい場合には、第１の無線通信システムが使用され、第２の無線通信システムの送受信回路に対して電源を供給しないため、消費電力を低減することができる。

【００２５】
また、本発明に係る携帯端末は、コアネットワークおよび無線アクセスネットワークにより構成され、広範囲のエリアをカバーするセルラー方式の第１の無線通信システムと、無線ローカルエリアネットワーク制御センタおよび無線ローカルエリアネットワークのアクセスネットワークにより構成されるホットスポット方式の第２の無線通信システムの双方と通信が可能な携帯端末において、
携帯端末の移動速度を求める移動速度検出手段と、携帯端末における送信と受信のデータ伝送速度を演算する通信速度検出手段と、携帯端末の移動速度あるいはデータ伝送速度の状態に基づいて、前記第２の無線通信システムの送受信回路部に対して電源を供給するように制御する制御部と、前記第１の無線通信システムと前記第２の無線通信システムの通信を切り替える通信切替手段とを有し、前記第１の無線通信システムと通信をしている際には、前記第２の無線通信システムの送受信回路部に対して電源を供給しないことを特徴とするものである。

【００２６】
このような構成からなる携帯端末では、位置検出手段を備えていない場合であっても、第２の無線通信システムと通信を行っていない場合には、第２の無線通信システムの送受信回路に対して電源を供給しないため、消費電力を低減することができる。

【００２７】
また、前記携帯端末において、携帯端末の電源を投入した際には、前記第１の無線通信システムと接続を行い、前記第１の無線通信システムと通信中に、前記移動速度検出手段に

より検出された携帯端末移動速度が予め設定された閾値よりも小さい場合には、前記第２の無線通信システムへの接続切り替え処理を行うとともに、前記移動速度検出手段により検出された携帯端末移動速度が予め設定された閾値よりも大きい場合には、前記第１の無線通信システムとの通信を維持し、前記第２の無線通信システムと通信中に、前記移動速度検出手段により検出された携帯端末移動速度が予め設定された閾値よりも大きい場合には、前記第１の無線通信システムへの接続切り替え処理を行うとともに、前記移動速度検出手段により検出された携帯端末移動速度が予め設定された閾値よりも小さい場合には、前記第２の無線通信システムとの通信を維持することを特徴とする。

【００２８】

このような構成からなる携帯端末では、移動速度検出手段により検出した携帯端末の移動速度に応じて、スポット的に配置された第２の無線通信システムを適宜選択することにより、携帯端末に与える負荷を軽減することができる。

【００２９】

また、前記携帯端末において、携帯端末の電源を投入した際には、前記第１の無線通信システムと接続を行い、前記第１の無線通信システムと通信中に、前記通信速度検出手段により検出された携帯端末データ通信速度が予め設定された閾値よりも大きい場合には、前記第２の無線通信システムへの接続切り替え処理を行うとともに、前記通信速度検出手段により検出された携帯端末データ通信速度が予め設定された閾値よりも小さい場合には、前記第１の無線通信システムとの通信を維持し、前記第２の無線通信システムと通信中に、前記通信速度検出手段により検出された携帯端末データ通信速度が予め設定された閾値よりも小さい場合には、前記第１の無線通信システムへの接続切り替え処理を行うとともに、前記通信速度検出手段により検出された携帯端末データ通信速度が予め設定された閾値よりも大きい場合には前記第２の無線通信システムとの通信を維持することを特徴とする。

【００３０】

このような構成からなる携帯端末では、通信速度検出手段により検出したデータ伝送速度に応じて、第２の無線通信システムを使用するか否かを決定することにより、第２の無線通信システムの送受信回路に対する電源の供給が制御されるため、さらに消費電力を低減することができる。

【００３１】

【発明の実施の形態】

以下、図面を参照して、本発明に係る携帯端末の実施形態を説明する。

【００３２】

図１は、本発明の実施形態に係る携帯端末を利用した無線通信システムの全体構成を示す模式図、図２は、本発明の実施形態に係る携帯端末を利用した無線通信システムのセル範囲を示す模式図である。

【００３３】

本発明の実施形態に係る携帯端末を利用した「無線通信システム１」は、コアネットワーク（ＣＮ）１０５、無線アクセスネットワーク（ＲＡＮ）１０６、および基地局である「ＢＳ１－１」１０７、「ＢＳ１－２」１０８、「ＢＳ１－３」１０９・・・から構成されており、「ゲートウェイ１」１０３を介してインターネット１０１に接続されている。

【００３４】

なお、「無線通信システム１」は、図２に示すように、広範囲のサービスエリアをカバーしたシステムとなっている。本実施形態では、最大３８４ｋｂｐｓのデータ伝送速度を実現し、高速移動にも対応可能なＷ－ＣＤＭＡ（Ｗｉｄｅｂａｎｄ Ｃｏｄｅ Ｄｉｖｉｓｉｏｎ Ｍｕｌｔｉｐｌｅ Ａｃｃｅｓｓ）セルラー方式移動通信システムを例に取り上げているが、本発明はＷ－ＣＤＭＡシステムに限定されるものではなく、ＧＳＭ（Ｇｌｏｂａｌ Ｓｙｓｔｅｍ Ｍｏｂｉｌｅ Ｃｏｍｍｕｎｉｃａｔｉｏｎｓ）などの他のセルラー方式システムを広帯域無線通信システムとして適用することが可能である。

【００３５】

「無線通信システム２」は、図１に示すように、無線ローカルネットワーク（ＷＬＡＮ）制御センタ１１０、無線ローカルネットワークのアクセスネットワーク１１１、および基地局である「ＢＳ２－１」１１２、「ＢＳ２－２」１１３、「ＢＳ２－３」１１４・・・から構成されており、「ゲートウェイ２」１０４を介してインターネット１０１に接続されている。また、インターネット１０１にはＷＥＢサーバ１０２が接続されている。

【００３６】

なお、「無線通信システム２」のサービスエリアは、図２に示すように、スポット的に存在している。本実施形態では、低速移動で最大５４Ｍｂｐｓのデータ伝送速度を実現できるＩＥＥＥ８０２．１１ｂ、ＩＥＥＥ８０２．１１ａ、およびＩＥＥＥ８０２．１１ｇ規格の無線ローカルエリアネットワークシステムを例に取り上げているが、本発明はＩＥＥＥ８０２．１１ｂ、ＩＥＥＥ８０２．１１ａ、およびＩＥＥＥ８０２．１１ｇ規格のシステムに限定されるものではなく、１００Ｍｂｐｓを超える次世代無線ローカルエリアネットワークのＵＷＢ（Ｕｌｔｒａ　ＷｉｄｅＢａｎｄ）などの高速無線ローカルエリアネットワークシステムとして適用することが可能である。

本発明の実施形態に係る携帯端末は、上述した複数の通信システムと通信可能な携帯端末である。

【００３７】

＜第１の実施形態＞

図３は、本発明の第１の実施形態に係る携帯端末の構成を示すブロック図である。

【００３８】

本発明の第１の実施形態に係る携帯端末は、図３に示すように、「無線通信システム１」の無線信号を受信する「アンテナ１」３０１、「無線通信システム２」の無線信号を受信する「アンテナ２」３０２、「アンテナ１」３０１で受信した信号の送受信に関する処理を行う「無線通信システム１」送受信回路部３０３、「アンテナ２」３０２で受信した信号の送受信に関する処理を行う「無線通信システム２」送受信回路部３０４、「無線通信システム１」送受信回路部３０３の電源電圧をオンオフ可能な「電源１」３０５、「無線通信システム２」送受信回路部３０４の電源電圧をオンオフ可能な「電源２」３０６、「無線通信システム１」と「無線通信システム２」における共通の信号処理を行う共通回路部３０７、「無線通信システム１」と「無線通信システム２」の切り替え、および「電源１」３０５と「電源２」３０６の電源電圧のオンオフやその他の制御を行う制御部３０８、携帯端末の位置の検出を行う位置検出部３０９から構成されている。

【００３９】

また、第１の実施形態では、携帯端末の位置する場所が「無線通信システム２」のエリア内か否かを検出するために、「無線通信システム２」のエリア位置情報が必要である。このため、「無線通信システム２」のエリア位置情報を本携帯端末で所有する場合には、さらに「無線通信システム２」のエリア位置情報を格納するメモリが必要になる。携帯端末内のメモリを利用する場合は、なるべくメモリ容量を少なくするため、「無線通信システム２」のエリア位置の座標のみをメモリに格納することが考えられる。もし、基地局でこの情報を所有する場合には、さらに詳細なエリア位置情報を格納することが考えられ、この場合には、本携帯端末をさらに精度よく検出することが可能であり、「無線通信システム２」送受信回路部３０４の電源をオンにして、「無線通信システム２」のサーチを行ったときには、ほぼ確実に本携帯端末と接続される。

【００４０】

図６は、第１の実施形態において、携帯端末の電源をオンにしてから、「無線通信システム１」または「無線通信システム２」に接続し、あるいは接続切替（ハンドオーバー）を行う場合のフローチャートである。

【００４１】

大まかな流れとして、「無線通信システム２」が圏内であれば「無線通信システム２」と接続し、圏外であれば「無線通信システム１」と接続し、待ち受け時もしくは「無線通信システム１」との接続時には「無線通信システム２」の電源をオフにする制御を行ってい

る。

【００４２】

以下、第１の実施形態に係る携帯端末の動作原理を、図３および図６を参照して詳細に説明する。

【００４３】

まず、携帯端末の電源をオンにすると（Ｓ６０１）、「無線通信システム１」送受信回路部３０３の電源電圧が「電源１」３０５より供給され、「無線通信システム１」に関する電源がすべてオンとなり（Ｓ６０２）、待ち受け状態に入る（Ｓ６０３）。そして、ユーザ接続要求があった場合には（Ｓ６０４）、位置検出部３０９で携帯端末の位置の検出を行い（Ｓ６０５）、検出された携帯端末の位置情報と、基地局あるいは携帯端末自身で所有する「無線通信システム２」のエリア位置情報に基づいて、「無線通信システム２」のエリア内か否かを判断する（Ｓ６０６）。

【００４４】

ここで、「無線通信システム２」のエリア内であれば、「無線通信システム２」送受信回路部３０４の電源電圧が「電源２」３０６より供給され、「無線通信システム２」に関する電源がすべてオンとなる（Ｓ６０８）。

【００４５】

続いて、「無線通信システム２」の基地局のサーチを行い（Ｓ６０９）、「無線通信システム２」が圏内であるか否かを判断する（Ｓ６１０）。ここで、「無線通信システム２」が圏内であれば「無線通信システム２」と接続し（Ｓ６２４）、「無線通信システム２」が圏外であれば「電源２」３０６からの電源電圧の供給を停止し、「無線通信システム２」送受信回路部３０４の電源をオフとする（Ｓ６１１）。

【００４６】

さらに、「無線通信システム１」が圏内であるか否かを判断し（Ｓ６０７）、「無線通信システム１」が圏内であれば「無線通信システム１」と接続し（Ｓ６１２）、「無線通信システム１」が圏外であれば再び待ち受け状態に入る。

【００４７】

同様に、ステップ６０６（Ｓ６０６）の判断処理において、「無線通信システム２」のエリア内でなければ、「無線通信システム１」が圏内であるか否かを判断し（Ｓ６０７）、「無線通信システム１」の圏内であれば「無線通信システム１」と接続（Ｓ６１２）し、「無線通信システム１」の圏外であれば再び待ち受け状態に入る。

【００４８】

次に、「無線通信システム１」と通信中に、「無線通信システム２」へハンドオーバーする場合について説明する。

【００４９】

「無線通信システム１」と通信中に、「無線通信システム２」へハンドオーバーする場合には、「無線通信システム１」の通信状態（Ｓ６１３）から、「無線通信システム１」の受信品質や圏内圏外の更新処理を行う（Ｓ６１４）。ここで、別の「無線通信システム１」の基地局にハンドオーバーする必要があるか否かを判断し（Ｓ６１５）、別の「無線通信システム１」の基地局にハンドオーバーする必要がある場合にはハンドオーバー処理を行い（Ｓ６１６）、別の「無線通信システム１」の基地局に接続される。

【００５０】

一方、別の「無線通信システム１」の基地局にハンドオーバーする必要がない場合には、位置検出部３０９で携帯端末の位置の検出を行い（Ｓ６１７）、上記と同様の方法で「無線通信システム２」がエリア内か否かを判断する（Ｓ６１８）。そして、「無線通信システム２」がエリア外と判断された場合には、「無線通信システム１」との通信を維持する。ただし、「無線通信システム１」が圏外となっていれば待ち受け状態に移行する（Ｓ６２３，Ｓ６０３）。

【００５１】

一方、「無線通信システム２」がエリア内と判断された場合には、上記ステップ６０８（

Ｓ６０８）～ステップ６１０（Ｓ６１０）と同様に、「無線通信システム２」の電源をオンにした後、サーチを行い、「無線通信システム２」が圏内であるか否かを判断する（Ｓ６１９～Ｓ６２１）。そして、「無線通信システム２」が圏内であれば、「無線通信システム２」へハンドオーバーする（Ｓ６２４）。一方、「無線通信システム２」が圏外であれば「無線通信システム２」の電源をオフにした後（Ｓ６２２）、「無線通信システム１」との通信を維持する。

【００５２】

次に、「無線通信システム２」と通信中に、「無線通信システム１」へハンドオーバーする場合について説明する。

【００５３】

「無線通信システム２」と通信中に、「無線通信システム１」へハンドオーバーする場合には、「無線通信システム２」の通信状態（Ｓ６２５）から、「無線通信システム２」の受信品質や圏内圏外の更新処理を行う（Ｓ６２６）。

【００５４】

ここで、別の「無線通信システム２」の基地局にハンドオーバーする必要が有るか否かを判断し（Ｓ６２７）、別の「無線通信システム２」の基地局にハンドオーバーする必要が有る場合にはハンドオーバー処理を行い（Ｓ６２８）、別の「無線通信システム２」の基地局に接続される。

【００５５】

一方、別の「無線通信システム２」の基地局にハンドオーバーする必要がない場合には、「無線通信システム２」が圏内であるか否かの判断を行い（Ｓ６２９）、「無線通信システム２」が圏内であれば「無線通信システム２」との通信を維持する。一方、「無線通信システム２」が圏外であれば「無線通信システム２」送受信回路部３０４の電源をオフにした後（Ｓ６３０）、「無線通信システム１」へハンドオーバーする（Ｓ６３１，Ｓ６１２）。ただし、「無線通信システム１」も圏外になっていれば待ち受け状態に入る。

【００５６】

以上の処理を行うことにより、「無線通信システム２」との通信中以外、すなわち「無線通信システム１」との通信中および待ち受け時には、「無線通信システム２」送受信回路３０４の「電源２」３０６がオフになっていることにより、消費電流を低減することが可能となる。

【００５７】

上記第１の実施形態は、「無線通信システム２」に接続可能であれば、自動的に「無線通信システム２」に接続する構成となっているが、「無線通信システム１」と「無線通信システム２」の切り替えをマニュアル動作により行うことも可能である。

【００５８】

また、上記第１の実施形態では、一方の無線通信システムが圏外になった時点で他方の無線通信システムにハンドオーバーを行っているが、一方の無線通信システムが圏外になってから他方の無線通信システムにハンドオーバーを行うのではなく、受信品質が予め決められた閾値を下回ったときに、他方の無線通信システムへの接続を行うことで「無線通信システム１」と「無線通信システム２」を同時に受信し、どちらか一方の無線通信システムの受信品質が予め決められた閾値を上回ったか、もしくは圏外に陥ったときに、受信品質の劣悪な、もしくは圏外に陥った無線通信システムの接続を切断することによりハンドオーバーを行うことが可能である。この場合には、受信の瞬断が起こらず滑らかなハンドオーバー（ソフトハンドオーバー）が可能となる。

【００５９】

＜第２の実施形態＞

図４は、本発明の第２の実施形態に係る携帯端末の構成を示すブロック図である。

【００６０】

本発明の第２の実施形態に係る携帯端末は、図４に示すように、上記第１の実施形態に係る携帯端末に対して、さらに移動速度検出部４１０および通信速度検出部４１１を備えて

構成されている。

【００６１】

すなわち、第２の実施形態に係る携帯端末は、図４に示すように、「無線通信システム１」の無線信号を受信する「アンテナ１」４０１、「無線通信システム２」の無線信号を受信する「アンテナ２」４０２、「アンテナ１」４０１で受信した信号の送受信に関する処理を行う「無線通信システム１」送受信回路部４０３、「アンテナ２」４０２で受信した信号の送受信に関する処理を行う「無線通信システム２」送受信回路部４０４、「無線通信システム１」送受信回路部４０３の電源電圧をオンオフ可能な「電源１」４０５、「無線通信システム２」送受信回路部４０４の電源電圧をオンオフ可能な「電源２」４０６、「無線通信システム１」と「無線通信システム２」における共通の信号処理を行う共通回路部４０７、「無線通信システム１」と「無線通信システム２」の切り替え、および「電源１」４０５と「電源２」４０６の電源電圧のオンオフやその他の制御を行う制御部３０８、携帯端末の位置の検出を行う位置検出部４０９、携帯端末の移動速度を求める移動速度検出部４１０、携帯端末における送信と受信のデータ伝送速度を演算する通信速度検出部４１１から構成されている。

【００６２】

このような構成からなる携帯端末においては、移動速度検出部４１０により検出された携帯端末の移動速度が予め決められた閾値よりも大きい場合には、高速でも対応可能な「無線通信システム１」との接続を行い、携帯端末の移動速度が予め決められた閾値よりも小さい場合には、高速データ通信の可能な「無線通信システム２」と接続を行うという制御が可能である。

【００６３】

また、「無線通信システム１」と通信中に、移動速度検出部４１０により検出された携帯端末の移動速度が予め決められた閾値よりも小さく、かつ通信速度検出部４１１により検出されたデータ通信速度が予め決められた閾値よりも大きい場合には、「無線通信システム２」へハンドオーバーし、「無線通信システム２」と通信中に、移動速度検出部４１０により検出された携帯端末の移動速度が予め決められた閾値よりも大きい、または通信速度検出部４１１により検出されたデータ通信速度が予め決められた閾値よりも小さい場合には、「無線通信システム１」へハンドオーバーするという制御が可能となる。

【００６４】

このような制御を行うことにより、携帯端末の移動速度が速い場合に、スポット的に配置された「無線通信システム２」の全てに対して接続を試みることがないので、携帯端末に負荷を与えることがない。また、データ通信速度が小さい場合には、「無線通信システム１」を使用することにより、「無線通信システム２」に関する電源がオフになるため、さらに消費電流を低減することが可能となる。

【００６５】

なお、近年では、ＧＰＳ搭載携帯端末が市場に投入されている。そこで、例えば、位置検出部４０９と移動速度検出部４１０にＧＰＳを利用することにより、位置検出手段と移動速度検出手段の双方の機能を満たすことも可能であり、回路規模を削減することが可能となる。

【００６６】

＜第３の実施形態＞

図５は、本発明の第３の実施形態に係る携帯端末の構成を示すブロック図である。

【００６７】

本発明の第３の実施形態に係る携帯端末は、図５に示すように、上記第１の実施形態に係る携帯端末に対して、さらに移動速度検出部５１０および通信速度検出部５１１を備えるとともに、位置検出部を省略して構成されている。

【００６８】

すなわち、第３の実施形態に係る携帯端末は、図５に示すように、「無線通信システム１」の無線信号を受信する「アンテナ１」５０１、「無線通信システム２」の無線信号を受

信する「アンテナ２」５０２、「アンテナ１」５０１で受信した信号の送受信に関する処理を行う「無線通信システム１」送受信回路部５０３、「アンテナ２」５０２で受信した信号の送受信に関する処理を行う「無線通信システム２」送受信回路部５０４、「無線通信システム１」送受信回路部５０３の電源電圧をオンオフ可能な「電源１」５０５、「無線通信システム２」送受信回路部５０４の電源電圧をオンオフ可能な「電源２」５０６、「無線通信システム１」と「無線通信システム２」における共通の信号処理を行う共通回路部５０７、「無線通信システム１」と「無線通信システム２」の切り替え、および「電源１」５０５と「電源２」５０６の電源電圧のオンオフやその他の制御を行う制御部５０８、携帯端末の移動速度を求める移動速度検出部５１０、携帯端末における送信と受信のデータ伝送速度を演算する通信速度検出部５１１から構成されている。

【００６９】

図７は、第３の実施の形態において、携帯端末の電源をオンにしてから、「無線通信システム１」または「無線通信システム２」に接続し、あるいは接続切替（ハンドオーバー）を行う場合のフローチャートである。

【００７０】

大まかな流れとして、最初に「無線通信システム１」と接続され、携帯端末の移動速度が遅く、かつデータ通信速度が速い場合には、「無線通信システム２」へ接続を切り替え、待ち受け時もしくは「無線通信システム１」への接続時には、「無線通信システム２」の電源をオフにする制御を行っている。

【００７１】

以下、第３の実施形態に係る携帯端末の動作原理を、図５および図７を参照して詳細に説明する。

【００７２】

まず、携帯端末の電源をオンにすると（Ｓ７０１）、「無線通信システム１」送受信回路部５０３の電源電圧が「電源１」５０５より供給され、「無線通信システム１」に関する電源がすべてオンとなり（Ｓ７０２）、待ち受け状態に入る（Ｓ７０３）。そして、ユーザ接続要求があった場合には（Ｓ７０４）、「無線通信システム１」が圏内であるか否かの判断が行われ（Ｓ７０５）、「無線通信システム１」が圏内であれば「無線通信システム１」と接続される。一方、「無線通信システム１」が圏外であれば、「無線通信システム２」送受信回路部５０４の電源電圧が「電源２」５０６より供給され、「無線通信システム２」に関する電源がすべてオンとなる（Ｓ７０６）。

【００７３】

続いて、「無線通信システム２」の基地局のサーチを行い（Ｓ７０７）、「無線通信システム２」が圏内であるか否かを判断する（Ｓ７０８）。ここで、「無線通信システム２」が圏内であれば「無線通信システム２」と接続し（Ｓ７２１）、「無線通信システム２」が圏外であれば「電源２」５０６からの電源電圧の供給を停止し、「無線通信システム２」送受信回路部５０４の電源をオフとした後（Ｓ７０９）、再び待ち受け状態に入る。

【００７４】

次に、「無線通信システム１」と通信中に、「無線通信システム２」へハンドオーバーする場合について説明する。

【００７５】

「無線通信システム１」と通信中に、「無線通信システム２」へハンドオーバーする場合には、「無線通信システム１」の通信状態（Ｓ７１１）から、「無線通信システム１」の受信品質、圏内圏外、移動速度、通信速度の更新処理を行う（Ｓ７１２）。ここで、別の「無線通信システム１」の基地局にハンドオーバーする必要があるか否かを判断し（Ｓ７１３）、別の「無線通信システム１」の基地局にハンドオーバーする必要がある場合にはハンドオーバー処理を行い（Ｓ７１４）、別の「無線通信システム１」の基地局に接続される。また、「無線通信システム１」が圏外になっていれば、「無線通信システム２」への接続を試みる（Ｓ７１５）。

【００７６】

続いて、移動速度検出部５１０により検出された携帯端末の移動速度が予め決められた閾値よりも小さいか否か、かつ通信速度検出部５１１により検出されたデータ通信速度が予め決められた閾値よりも大きいか否かを判断する（Ｓ７１６）。ここで、移動速度検出部５１０により検出された携帯端末の移動速度が予め決められた閾値よりも小さく、かつ通信速度検出部５１１により検出されたデータ通信速度が予め決められた閾値よりも大きい場合には、上記ステップ７０６（Ｓ７０６）～ステップ７０８（Ｓ７０８）と同様に、「無線通信システム２」に関する電源をオンにした後、サーチを行い、「無線通信システム２」が圏内であるか否かを判断する（Ｓ７１７～Ｓ７１９）。

【００７７】

そして、「無線通信システム２」が圏内であれば、「無線通信システム２」へハンドオーバーする（Ｓ７２１）。一方、「無線通信システム２」が圏外であれば、「無線通信システム２」の電源をオフにした後（Ｓ７２０）、「無線通信システム１」との通信を維持する。

【００７８】

また、ステップ７１６（Ｓ７１６）の判断において、携帯端末の移動速度が予め決められた閾値よりも大きい場合、あるいはデータ通信速度が予め決められた閾値よりも小さい場合には、そのまま「無線通信システム１」との接続を維持する。

【００７９】

次に、「無線通信システム２」と通信中に、「無線通信システム１」へハンドオーバーする場合について説明する。

【００８０】

「無線通信システム２」と通信中に、「無線通信システム１」へハンドオーバーする場合には、「無線通信システム２」の通信状態（Ｓ７２２）から、「無線通信システム２」の受信品質、圏内圏外、移動速度、通信速度の更新処理を行う（Ｓ７２３）。

【００８１】

ここで、別の「無線通信システム２」の基地局にハンドオーバーする必要があるか否かを判断し（Ｓ７２４）、別の「無線通信システム２」の基地局にハンドオーバーする必要がある場合には、ハンドオーバー処理を行い（Ｓ７２５）、別の「無線通信システム２」の基地局に接続される。

【００８２】

一方、別の「無線通信システム２」の基地局にハンドオーバーする必要がない場合には、「無線通信システム２」が圏内であるか否かの判断を行い（Ｓ７２６）、「無線通信システム２」が圏外であれば「無線通信システム１」への接続を試みる（Ｓ７２９）。

【００８３】

続いて、移動速度検出部５１０により検出された携帯端末の移動速度が予め決められた閾値よりも小さいか否か、かつ通信速度検出部５１１により検出されたデータ通信速度が予め決められた閾値よりも大きいか否かを判断する（Ｓ７２７）。ここで、移動速度検出部５１０により検出された携帯端末の移動速度が予め決められた閾値よりも小さく、かつ通信速度検出部５１１により検出されたデータ通信速度が予め決められた閾値よりも大きい場合には、「無線通信システム２」との接続を維持する。

【００８４】

一方、移動速度検出部５１０により検出された携帯端末の移動速度が予め決められた閾値よりも大きい場合、あるいは通信速度検出部５１１により検出されたデータ通信速度が予め決められた閾値よりも小さい場合には、「無線通信システム１」が圏内であるか否かを判断する（Ｓ７２８）。

【００８５】

ここで、「無線通信システム１」が圏内であれば、「無線通信システム２」に関する電源をオフにした後（Ｓ７３０）、「無線通信システム１」にハンドオーバーし（Ｓ７１０）、圏外であれば「無線通信システム２」との接続を維持する。

【００８６】

以上の処理を行うことにより、第１の実施形態が有していた位置検出部を設けることなく、「無線通信システム２」との通信中以外、すなわち「無線通信システム１」との通信中および待ち受け時には、「無線通信システム２」送受信回路５０４の電源がオフになり、消費電流を低減することが可能となる。

【００８７】

また、このような制御を行うことにより、携帯端末の移動速度が速い場合に、スポット的に配置された「無線通信システム２」の全てに対して接続を試みることがないので、携帯端末に負荷を与えることがない。また、データ通信速度が小さい場合には、「無線通信システム１」を使用することにより、「無線通信システム２」に関する電源がオフになるため、さらに消費電流を低減することが可能となる。さらに、第３の実施形態においても、第１の実施形態の場合と同様に、マニュアル切り替えやソフトハンドオーバー処理が可能である。

【００８８】

【発明の効果】

本発明に係る携帯端末は、上述した構成を備えているため、以下の効果を奏することができる。

すなわち、本発明に係る携帯端末によれば、第２の無線通信システムとの通信中以外、すなわち第１の無線通信システムとの通信中および待ち受け時には、第２の無線通信システムの送受信回路の電源がオフになっているので、消費電流を低減することが可能となる。

【００８９】

また、本発明に係る携帯端末によれば、メモリ容量を比較的多く確保することが可能な基地局において、第２の無線通信システムの詳細なエリア位置情報を格納しておき、このエリア位置情報を携帯端末で利用することにより、第２の無線通信システムのエリアを精度よく検出することが可能となる。このため、第２の無線通信システムに関する電源をオンとして、第２の無線通信システムのサーチを行った場合には、ほぼ確実に本携帯端末と接続されるため、消費電流の無駄使いを防ぐことが可能となる。

【００９０】

また、本発明に係る携帯端末によれば、基地局から第２の無線通信システムのエリア位置情報を取得することができない場合であっても、第２の無線通信システムを検出することができる。このため、基地局から第２の無線通信システムエリア情報を取得できない場合であっても、携帯端末を効率的に使用することができる。

【００９１】

また、本発明に係る携帯端末によれば、移動速度検出手段により検出した携帯端末の移動速度が速い場合には、スポット的に配置された第２の無線通信システムの全てに対して接続を試みる必要がなく、携帯端末の負荷を軽減することが可能となる。

【００９２】

また、本発明に係る携帯端末によれば、通信速度検出手段により検出したデータ通信速度が小さい場合には、第１の無線通信システムを使用することにより、第２の無線通信システムに関する電源がオフになるため、さらに消費電流を低減することが可能となる。

【００９３】

また、本発明に係る携帯端末によれば、ＧＰＳを利用することにより、位置検出手段と移動速度検出手段の双方の機能を満たすことが可能であり、回路規模を削減することが可能となる。

【００９４】

また、本発明に係る携帯端末によれば、位置検出手段を備えていない場合であっても、第２の無線通信システムと通信を行っていない場合、すなわち第１の無線通信システムとの通信中および待ち受け時には、第２の無線通信システムの送受信回路に対して電源を供給しないため、消費電力を低減することができる。

【００９５】

また、本発明に係る携帯端末によれば、通信速度検出手段により検出したデータ伝送速度

に応じて、第２の無線通信システムを使用するか否かを決定することができる。すなわち、通信速度検出手段により検出したデータ伝送速度が小さい場合には、第１の無線通信システムを使用して、第２の無線通信システムの送受信回路に対する電源の供給が制御されるため、さらに消費電力を低減することができる。

【図面の簡単な説明】

【図１】本発明の実施形態に係る携帯端末を利用した無線通信システムの全体構成を示す模式図である。

【図２】本発明の実施形態に係る携帯端末を利用した無線通信システムのセル範囲を示す模式図である。

【図３】本発明の第１の実施形態に係る携帯端末の構成を示すブロック図である。

【図４】本発明の第２の実施形態に係る携帯端末の構成を示すブロック図である。

【図５】本発明の第３の実施形態に係る携帯端末の構成を示すブロック図である。

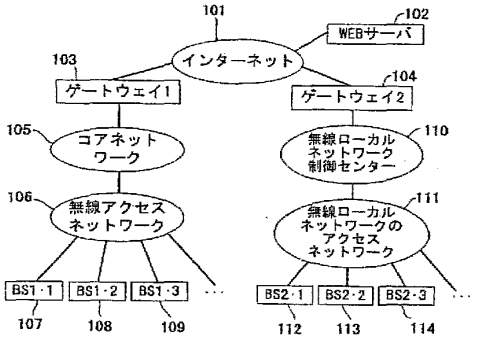
【図６】本発明の第１の実施形態に係る携帯端末における処理の手順を示すフローチャートである。

【図７】本発明の第３の実施形態に係る携帯端末における処理の手順を示すフローチャートである。

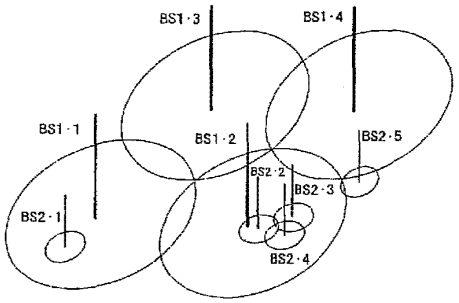
【符号の説明】

１０１　インターネット
１０２　ＷＥＢサーバ
１０３，１０４　ゲートウェイ
１０５　コアネットワーク
１０６　無線アクセスネットワーク
１０７，１０８，１０９　ＢＳ（「無線通信システム１」の基地局）
１１０　無線ローカルネットワーク制御センタ
１１１　無線ローカルネットワークのアクセスネットワーク
１１２，１１３，１１４　ＢＳ（「無線通信システム２」の基地局）
３０１，４０１，５０１　アンテナ１
３０２，４０２，５０２　アンテナ２
３０３，４０３，５０３　「無線通信システム１」送受信回路部
３０４，４０４，５０４　「無線通信システム２」送受信回路部
３０５，４０５，５０５　電源１
３０６，４０６，５０６　電源２
３０７，４０７，５０７　共通回路部
３０８，４０８，５０８　制御部
３０９，４０９　位置検出部
４１０，５１０　移動速度検出部
４１１，５１１　通信速度検出部

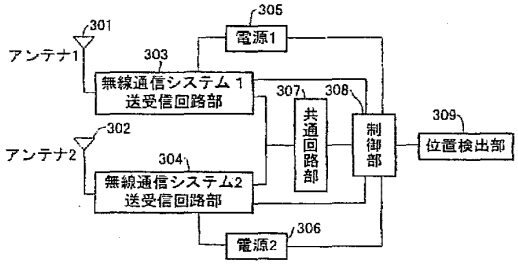
【図１】



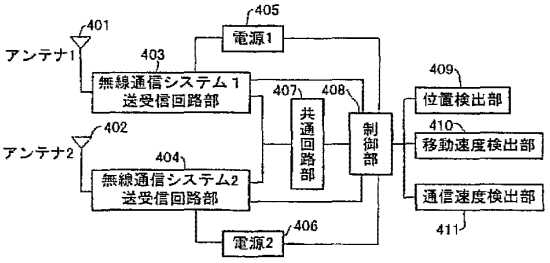
【図２】



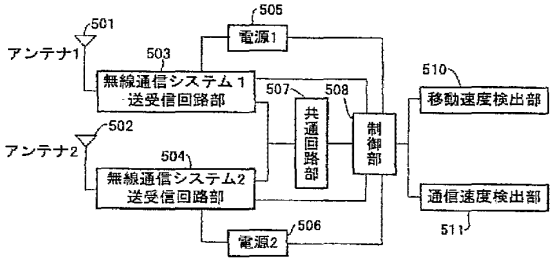
【図３】



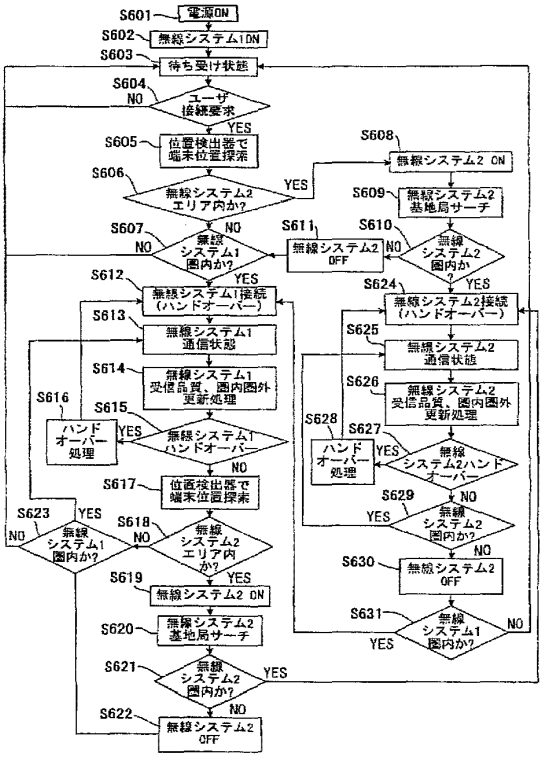
【図４】



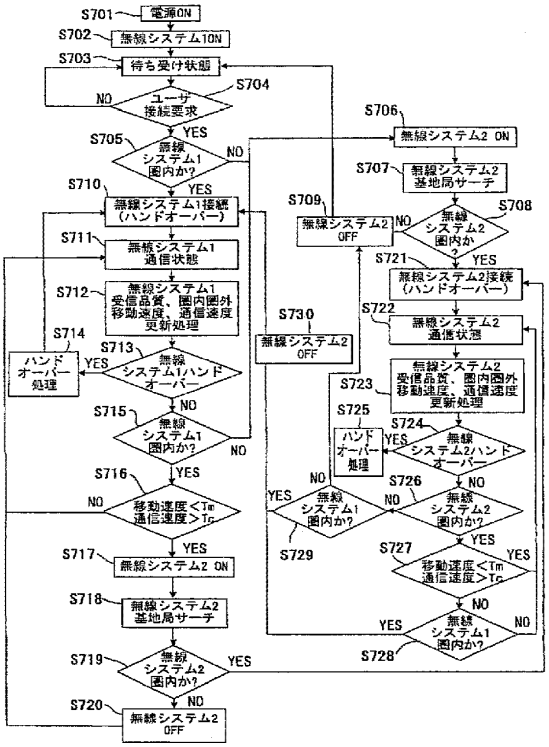
【図５】



【図６】



【図７】


S701 電源ON
S702 無線システム1ON
S703 待ち受け状態
S704 ユーザ接続要求
NO
YES
S705 無線システム1圏内か?
NO
YES
S706 無線システム2 ON
S707 無線システム2基地局サーチ
S708 無線システム2圏内か?
NO
YES
S709 無線システム2 OFF
S710 無線システム1接続(ハンドオーバー)
S711 無線システム1通信状態
S712 無線システム1受信品質、圏内圏外移動速度、通信速度更新処理
S713 無線システム1ハンドオーバー
YES
S714 ハンドオーバー処理
NO
S715 無線システム1圏内か?
NO
YES
S716 移動速度<Tm 通信速度>Tc
NO
YES
S717 無線システム2 ON
S718 無線システム2基地局サーチ
S719 無線システム2圏内か?
YES
NO
S720 無線システム2 OFF
S721 無線システム2接続(ハンドオーバー)
S722 無線システム2通信状態
S723 無線システム2受信品質、圏内圏外移動速度、通信速度更新処理
S724 無線システム2ハンドオーバー
YES
NO
S725 ハンドオーバー処理
S726 無線システム2圏内か?
NO
YES
S727 移動速度<Tm 通信速度>Tc
YES
NO
S728 無線システム1圏内か?
YES
NO
S729 無線システム1圏内か?
YES
NO
S730 無線システム2 OFF

フロントページの続き

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FF15 FF17 HH22 JJ37 JJ52 JJ56 KK05
5K101 KK08 LL05 LL12 NN41 NN45 QQ07 QQ11 RR04

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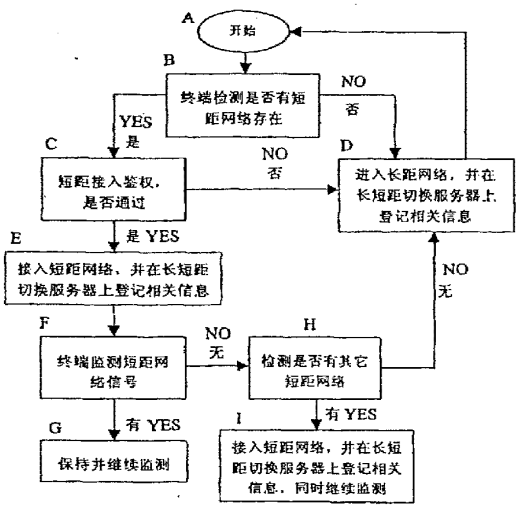
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本国际公布:
— 包括国际检索报告。

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(54) Title: A COMBINED LONG AND SHORT DISTANCE WIRELESS COMMUNICATION SYSTEM AND ITS METHOD

(54) 发明名称: 长短距结合的无线通信系统及其方法



A...START
B...TERMINAL DETECTS WHETHER OR NOT THERE IS A SHORT DISTANCE NETWORK
C...IDENTIFICATION OF SHORT DISTANCE ACCESS RIGHT IS PASSED?
D...ACCESSES *LONG* DISTANCE NETWORK AND REGISTERS RELATIVE INFORMATION ON THE LONG AND SHORT DISTANCE SWITCH SERVER
E...ACCESSES THE SHORT DISTANCE NETWORK AND REGISTERS RELATIVE INFORMATION ON THE LONG AND SHORT DISTANCE SWITCH SERVER
F...TERMINAL MONITORS WHETHER OR NOT THERE ARE SIGNALS FROM THE SHORT DISTANCE NETWORK
G...REMAINS AND CONTINUES MONITORING
H...DETECTS WHETHER OR NOT THERE IS *ANOTHER SHORT DISTANCE NETWORK*
I...ACCESSES THE SHORT DISTANCE NETWORK AND REGISTERS RELATIVE INFORMATION ON THE LONG AND SHORT DISTANCE SWITCH SERVER

(57) **Abstract:** A combined long and short distance wireless communication system and its method, in which a dual distance terminal is used to provide subscribers with the long and short distance wireless service and guarantee that this service isn't interrupted when switching between different networks; a remote distance base station is used to provide for the dual distance terminal the function for performing remote distance wireless access; a short distance AP is used to provide for the dual distance terminal the function for performing short distance wireless access; a dual distance network server which connects the remote distance base station and the short distance AP is used for the dual distance terminal to implement switch between networks and access the switched network. The present invention can make the dual distance terminal in this wireless long and short distance system coverage be in communication with long distance networks and simultaneously automatically switch to short distance wireless local area networks when entering them so as to guarantee gapless switch of traffic stream and at the same time access different short distance local area networks for subscribers of different orders in different priority by right identification.

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WO 03/056719 A1



(57) 摘要

一种长短距相结合的无线通信系统及其方法，其双距终端用于提供给用户长短距无线服务，且保证此服务在不同网络间切换时不被中断；远距基站用于为双距终端提供进行远距离无线接入功能；短距 AP 用于为双距终端提供进行短距无线接入功能；双距网络服务器连接远距基站和短距 AP，用于对双距终端实现网络的切换，并使终端接入切换后的网络中。本发明将使处于本无线长短距体系覆盖的双距终端可以保持与长距网络进行通信，同时可以使终端在进入短距无线局域网覆盖范围时自动转换到短距无线局域网中，保证业务流的无缝切换；同时保证对于不同级别的用户通过不同的优先级经过鉴权接入不同的短距局域网络。

长短距结合的无线通信系统及其方法

技术领域

本发明涉及一种无线通信系统及其实现，尤其是一种将长短距无线通信技术结合并实现无缝切换链接的无线通信系统，属于通信技术领域。

背景技术

目前的通讯网络机制， GSM/GPRS 和未来的 3G 都是长距通信。长距通信的主要特点是：覆盖面积大，铺设费用低，运行费用高，低传输速率等。其表现为“海洋”的概念。目前诸如 802.11 和 BT 等，则为短距通信方式。其特点是，在办公区域、特定的商业区域等，覆盖范围有限、铺设费用高，运行费用低，高传输速率等。其表现为“岛屿”的概念，一一孤立，明显具有区域限制的特性。

在 GSM900/1800 网络、GSM/GPRS 与第三代移动通信的交互网络中，其所体现的是均为长距的概念，即“海洋”的概念。其采用的工作方式均为 TDMA、CDMA 等多址方式，而在长短距网络中，短距则大多采用 CSMA/CA 等适用与短距传输的工作方式，同时，在长距网络中其发射功率均会很大，但由于局域网络的限制，如 WLAN 网络，其发射功率将受到限制，从而体现出“岛屿”的特性，另外，相对于长距网络，短距网络具有带宽较宽、传输速率快、费用低廉等优势。

如果能将长短距网络结合起来，实现优势互补，使得终端按照不同请求可以同时接收来自长距和短距两方面的服务，如利用长距获得语音服务，而通过短距获得数据业务的服务，即在长短距网络中明显存在位于长距网络覆盖范围内的短距通信特征。则是对现有技术的一个较大的贡献。目前尚未检索到能够实现上述功能的相关文献。

发明内容

本发明的目的在于提出一种长短距结合技术的无线通信系统及其方法；

本发明的另一个目的是提出一种长短距结合技术的无线通信双距终端；

IPR2025-00447 Page 00188

本发明的另一个目的是提出一种长短距结合技术的双距网络服务器；

本发明能够在保证无线长距通信的同时，使用户在进入相应的短距覆盖区域时，进行自动切换、容量评估和安全问题等为内容的无缝切换，为短距通信并通过短距无线接入点接入整个网络，从而实现两种网络资源更有效的综合利用。

本发明的目的是通过如下技术方案实现的：

一种长短距结合的无线通信系统，包括：双距终端、远距基站，短距AP及双距网络服务器；

双距终端用于提供给用户长短距无线服务；

远距基站用于为双距终端提供进行远距离无线接入功能；

短距AP用于为双距终端提供进行短距无线接入功能；

双距网络服务器连接远距基站、短距AP，用于对双距终端实现网络的切换，并使终端接入切换后的网络中。

一种长短距结合的无线通信方法，采用长短距结合的无线通信系统，双距终端开机以后，首先扫描检测，判断是否处于某一短距AP服务范围内，如果是，则通过短距AP接入网络进入短距网络，并通知双距归属服务器其所在位置；如果不在任何一个短距AP内，则搜索长距服务的基站，通过长距接入网络进入长距网络，并通知双距归属服务器其所在位置。

一种用于所述长短距结合无线通信系统的双距网络服务器，包括：

数据服务功能实体，用于检测是否有长短距数据传输发生，如有长短距数据传输发生，则为该数据传输提供接续服务；

存储器功能实体，用于存储切换时可能出现的丢失数据；并在终端切换完毕后将存储数据通过数据服务功能实体转发给终端，从而实现终端在双距网络中的无缝切换；

双距归属服务器，用于记载所管辖的双距终端的双距特性参数，在有双距切换发生时可通过数据服务功能实体获取终端切换信息，并进行终端数据的更

IPR2025-00447 Page 00189

新；在有对终端的查询时，告知数据服务功能实体终端相关双距信息；

对外网络接口，用于连接双距网络及外部网络的接口。

本发明所述双距终端要实现在长短两种网络中的移动，必须有适应两种网络特点的结构。它至少包括：

短距通信功能实体，包括短距射频功能模块，以及实现物理层和部分MAC层或链路层的功能，用于在短距网络中工作，获取数据信息；

长距通信功能实体，包括长距射频功能模块，以及实现物理层和部分链路层的功能；

双网切换判决策略功能实体，用于在相应的双距切换判决条件下对所处网络进行切换动作，并命令短距通信功能实体或长距通信功能实体向双距网络服务器发出信标信号。

通用功能实体，用于实现基本终端所具有的显示及输入输出功能。

本发明长短距无线通信的结合给人们带来了很多便利，并在根本上改变了目前长距、短距体制分立的局面。本发明具有如下明显优点：

在任何时候都可以通过无线长距实现实时传输；

在终端进入被允许的无线短距局域网时，可以自动优先转换到短距通信体制中，并保证用户正在传输的业务流不被间断，实现无缝切换；

在用户离开短距无线局域网时，可以保证终端自动切换到长距网络中，并保证用户正在传输的业务流不被间断，实现无缝切换；

在本系统中的其他用户终端对任一被允许访问的终端进行呼叫和查询时，该系统可以保证用户不论在任何短距局域网还是长距网络中都可被访问。

附图说明

图1为本发明系统构成示意图。

图2为本发明工作流程示意图。

图3为双距网络服务器功能模块结构示意图。

图4为双距网络服务器进行切换时的流程图。

IPR2025-00447 Page 00190

图5为双距终端功能结构示意图。

具体实施方式

本发明将无线通信系统构架为“海洋+岛屿”的结构，其中长距基站用以覆盖所有有效地区；短距AP用以覆盖用户相对密集的地区，如办公区，住宅区、商用区等；一个长短距服务器，将短距AP与长距基站相连，双距终端，在整个有短距AP和长距基站所覆盖的区域之间自由活动。

本发明的基本工作原理如下：

当双距终端开机以后，终端首先检测是否处于某一短距AP服务范围内，如果是则通过短距AP接入网络，并通知双距归属服务器其所在位置；如果不在任何一个短距AP内，则将搜索长距服务的基站，通过长距接入网络，并通知双距归属服务器其所在位置。

当一个处于长距网络的双距终端进入任何一个短距AP服务区域时，用户将检测短距AP，如果其短距信号处于一定阈值以上，双距终端将自动切换到短距频段，并开始由短距AP接入网络，其正在由长距承担的数据传输将由短距网络负责，实现无缝切换，且终端将通知其归属服务器其所在区域，服务器将负责网络中的其它终端对其的查询与通信。

当一个处于短距网络中的双距终端离开该短距区域进入长距网络时，终端将检测短距AP信号，如其短距信号低于一顶阈值时，双距终端将自动切换到长距网络，其正在由短距承担的数据传输将由长距网络负责，实现无缝切换，且终端将通知其归属服务器其已处于长距网络范围内，服务器将负责网络中的其它终端对其的查询与通信。

当一个处于长距网络的双距终端请求进入任何一个短距AP服务区域时，如果其所在区域的AP因安全或其它问题拒绝无线终端接入，则无线终端将依然保持长距通信。

当一个双距终端从一个短距小区移动到另一个短距小区时，双距终端将判别即将进入的短距AP，并把相应小区信息传送至双距网络服务器，从而实现短

IPR2025-00447 Page 00191

距小区之间的切换。双距终端将通知双距网络服务器中的归属服务器其已处于另一短距网络范围内，归属服务器将负责网络中的其它终端对其的查询与通信。

现以长距GSM/GPRS与短距WLAN的双距结合的无线通信系统为例，对本发明加以说明。所述无线通信系统的网络框架由GSM/GPRS基站及与长距接入相关的网络功能实体、无线局域网AP及与短距接入相关的网络功能实体、链接长距GSM/GPRS网络和短距无线局域网络的双距网络服务器、兼容双距的双距终端构成。其基本网络结构如图1所示。但本发明不局限于图1的实例，还包括长距3G与短距WLAN结合框架或其他长距、短距通信方式的结合框架。

参见图1和图2，下面以GSM/GPRS与WLAN相结合的双距网络为实施例，具体说明如下：

1、在双距网络中，双距终端开机后

对本发明所述系统而言，当用户在开机以后，双距终端将自动搜索当前所处网络环境，如果双距终端检测目前有无线局域网WLAN网络存在并不需要鉴权，则双距终端将直接接入WLAN网络；如果检测结果发现当前WLAN网络需要鉴权，则双距终端通过WLAN进行接入鉴权，如果鉴权成功双距终端将接入当前WLAN网络，如果不成功，双距终端将继续检测并进入到长距GPRS网络。

当双距终端接入WLAN网络后，双距终端可以通过WLAN短距网络接入双距服务器进行数据传输。

2、网络间的切换

2.1 从短距WLAN网络到长距GPRS网络的切换

当双距终端即将离开短距WLAN网络进入GPRS网络时，用户可通过相应的切换策略进行判断，如果已达到切换策略门限（该切换策略门限可指短距网络信号不可用门限，也可为短距网络信号非最优的门限），则双距终端将利用切换策略终止通过WLAN射频功能实体进行传输的数据，开始启动长距通信功能实体并利用该功能实体实现后续可能发生的数据传输；如该双距终端的服务等级要

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IPR2025-00447 Page 00192

求其切换为无缝切换，则用户在终止WLAN射频功能实体正在传输的数据时，还将通过终端中的短距通信功能实体发射一个长短距切换的信标信号给即将切离的短距AP，并由该短距AP将该信标信号传至双距网络服务器，该双距网络服务器接收到相应的信标信号后将通知双距终端即将接入的长距通信功能实体，并根据双距终端的服务等级确定其在长距网络功能实体中的服务队列位置。

同时，双距网络服务器还可通过存储方式将该切换过程中可能丢失的数据包进行保护，待切换完成后再转发给该双距终端，从而可保证双距终端在切换过程中的数据不会丢失。

2.2 从长距GPRS网络到短距WLAN网络的切换

当双距终端即将从长距GPRS网络进入到短距WLAN网络时，双距终端可通过相应的切换策略进行判断，如果已达到切换策略门限，则双距终端将利用切换策略终止通过长距通信功能实体进行传输的数据，开始启动短距通信功能实体并利用该功能实体实现后续可能发生的数据传输。

双距终端在终止长距通信功能实体正在传输的数据时，还将通过双距终端中的基站及相应的GPRS网络功能实体发射一个长短距切换的信标信号给即将切离的GPRS服务功能实体，并由GPRS功能实体将该信标信号传至双距网络服务器，所述双距网络服务器接收到相应的信标信号后将通知短距网络功能实体，并根据双距终端的服务等级确定其在短距网络功能实体中的优先权。

同时，双距网络服务器还可通过存储方式将该切换过程中可能丢失的数据包进行保护，待切换完成后再转发给该双距终端，从而保证双距终端在切换过程中的数据不会丢失。

2.3 从一个短距网络到另一个短距网络的切换

当一个双距终端从一个短距小区移动到另一个短距小区时，双距终端将判别即将进入的短距AP，并把相应小区信息传送至双距网络服务器，从而实现短距小区之间的切换。双距终端将通知双距网络服务器中的归属服务器其已处于另一短距网络范围内，归属服务器将负责网络中的其它终端对其的查询与通

IPR2025-00447 Page 00193

信。

2.4自动切换

用户可以根据需要，预先自定义切换的优先级别，使得双距终端进行自动切换，例如：按照费用，传输速率，质量稳定性能等设置优先级别等，由双距终端根据优先条件自动识别切换。再有，当用户处于短距覆盖范围内时，也可选择不使用短距AP，而直接选择长距进行通信。

3、扫描与检测

对于长短距网络框架而言，一个很重要的问题就是(1) 双距终端始终保持长距和短距射频实体处于工作状态，实时地检测可能存在的长距或短距网络环境，并不断反馈给双距终端切换管理机制，并定时或必要时通过现有网络上报给双距网络服务器；

(2) 双距终端始终保持支持现有所处网络的射频功能实体处于工作状态，而对其他网络定期或不定期的启动相应射频功能实体对候选网络进行检测；

(3) 双距终端可始终保持支持现有所处网络的射频功能实体处于工作状态，而对其他网络不做扫描检测，而只有当现有网络不可用时，才对其他网络进行检测；

所述不定期的启动相应射频功能实体对候选网络进行检测，可以通过一些特定算法对候选网络进行检测，例如，以最后发现有其他网络存在的时间间隔为函数的变步长检测方法。

4、切换策略

切换策略可根据网络实现者的不同情况进行选择，以下是两种切换策略的举例，但本发明所包含的切换策略并不仅局限于以下两种：

(1)优先级网络切换策略；即只要发现有优先级高的网络存在，就切换到该网络中，不论现有网络是否可用；用户可以根据需要自行定义各类无线网络的优先级别，如传输速率、使用费用等；

(2)仅在当前使用的无线网络信号不存在时，切换到其他无线网络；该切

IPR2025-00447 Page 00194

换策略是指：当且仅当双距终端现处无线网络不可用时才进行切换，如现处网络可用，则即使存在高优先级网络也不进行切换。

图3 为双距网络服务器功能模块结构示意图。双距网络服务器可分为如下几个部分：

数据服务功能实体

用于检测是否有长短距数据传输发生，所述该数据传输是指：

长距和短距网络之间的双距终端之间的数据传输；

长距或短距网络中的双距终端对外部网络的数据传输。

长（短）距网络内的双距终端间的数据传输可由长（短）距网络功能实体完成；如有长短距数据传输发生，则为该数据传输提供接续服务。

检测长（短）距网路功能实体转发的双距终端的信标信号，判断双距终端是否在长短距网络间是否有切换发生，如有切换发生，则将新的终端信息（如该终端切换后的网络名）通知给双距归属寄存器。

存储器功能实体

用于存储切换时可能出现的丢失数据；并在终端切换完毕后将存储数据通过数据服务功能实体转发给终端，从而实现终端在双距网络中的无缝切换。

双距归属服务器

用于记载所管辖的双距终端的双距特性参数，如所处网络状况，终端优先级参数等；在有双距切换发生时可通过数据服务功能实体获取终端切换信息，并进行终端数据的更新；在有对终端的查询时，可告知数据服务功能实体终端相关双距信息。

对外网络接口

用于连接双距网络及外部网络的接口，所述对外网络接口包括：无线接口，与有线网络的接口、与其它无线网络的接口。

图4为双距网络服务器进行切换时的流程图。当双距终端从一个网络向另一个网络移动时，双距网络服务器配合双距终端进行切换。其切换过程如下：

IPR2025-00447 Page 00195

第一步，通过长（或短）距网络功能实体，检测用户双距信标信号，查看是否有切换发生，如果没有，则继续检测；如果有，则

第二步，更新双距归属寄存器中用户信息；

第三步，判断当前是否有数据传输，如果没有，回到第一步；

第四步，判断是否需要无缝切换，如果不需要，回到第一步；

第五步，进行数据缓存，并在切换动作完毕后将所缓存数据发送给用户。

图5为双距终端功能结构示意图。本发明所述双距终端要实现在长短两种网络中的移动，必须有适应两种网络特点的结构。它至少包括:

短距通信功能实体，包括短距射频功能模块,以及实现物理层和部分MAC层或链路层的功能，用于在短距网络中工作，获取数据信息；

长距通信功能实体，包括长距射频功能模块,以及实现物理层和部分链路层的功能；

双网切换判决策略功能实体，用于在相应的双距切换判决条件下对所处网络进行切换动作，并命令短距通信功能实体或长距通信功能实体向双距网络服务器发出信标信号。

通用功能实体，包括基本终端所具有的显示及输入输出功能；

所述双距终端通过双网切换判决策略功能实体控制长（短）通信功能实体中的射频功能模块的工作状态，即(1)长短距射频模块同时工作；(2)根据情况，变步长工作；(3)仅在一种网络不存在后，才启动另一射频实体进行工作进行搜寻网络。

本发明所述双距终端中，作为可选部分，还可包括：数据管理及数据缓存功能实体，用于在切换过程中对相应的数据进行管理及缓存。

双距终端与与以往终端不同，它同时具有长距和短距功能实体；因此，它可同时检测或自动搜索可能存在的短距如WLAN及长距GSM/GPRS或3G网络，它还可通过短距和长距功能实体进行短距或长距数据业务（包括属于一种特殊数据业务的语音）传输。与以往终端另一个不同之处在于，它还具有一个双网切换

IPR2025-00447 Page 00196

判决策略功能实体，用于在相应的双距切换判决条件下对所处网络进行切换动作，并命令短距通信功能实体或长距通信功能实体向双距网络服务器发出信标信号。同时，它还可选的具有一个数据管理及数据缓存功能实体，其目的是在切换过程中对相应的数据进行管理及缓存，从而保证终端的通用功能实体所需的数据传输不因切换而造成中断。

最后所应说明的是：以上实施例仅用以说明而非限制本发明的技术方案，尽管参照上述实施例对本发明进行了详细说明，本领域的普通技术人员应当理解：依然可以对本发明进行修改或者等同替换，而不脱离本发明的精神和范围的任何修改或局部替换，其均应涵盖在本发明的权利要求范围当中。

IPR2025-00447 Page 00197

权 利 要 求 书

1. 一种长短距结合的无线通信系统，其特征在于：包括双距终端、远距基站，短距AP及双距网络服务器；

双距终端用于提供给用户长短距无线服务；

远距基站用于为双距终端提供进行远距离无线接入功能；

短距AP用于为双距终端提供进行短距无线接入功能；

双距网络服务器连接远距基站、短距AP，用于对双距终端实现网络的切换，并使终端接入切换后的网络中。

2. 根据权利要求1所述的长短距结合的无线通信系统，其特征在于：所述远距基站包括与远距基站有关的长距网络设备。

3. 根据权利要求1所述的长短距结合的无线通信系统，其特征在于：所述短距接入点包括与短距接入点有关的短距网络设备。

4. 一种用于权利要求1所述的长短距结合无线通信系统的双距网络服务器，其特征在于，包括：

数据服务功能实体，用于检测是否有长短距数据传输发生，如有长短距数据传输发生，则为该数据传输提供接续服务；

存储器功能实体，用于存储切换时可能出现的丢失数据；并在终端切换完毕后将存储数据通过数据服务功能实体转发给终端，从而实现终端在双距网络中的无缝切换；

双距归属服务器，用于记载所管辖的双距终端的双距特性参数，在有双距切换发生时可通过数据服务功能实体获取终端切换信息，并进行终端数据的更新；在有对终端的查询时，告知数据服务功能实体终端相关双距信息；

对外网络接口，用于连接双距网络及外部网络的接口。

5. 根据权利要求4所述的双距网络服务器，其特征在于，所述对外网络接口包括： 与有线网络的接口、与其它无线网络的接口。

6. 一种用于权利要求1所述长短距结合无线通信系统的双距终端，其特征

IPR2025-00447 Page 00198

在于，所述双距终端包括：

短距通信功能实体，包括射频功能模块，以及实现物理层和部分MAC层或链路层的功能，用于在短距网络中工作，获取数据信息；

长距通信功能实体，包括射频功能模块，以及实现物理层和部分链路层的功能；

双网切换判决策略功能实体，用于在相应的双距切换判决条件下对所处网络进行切换动作，并命令短距通信功能实体或长距通信功能实体向双距网络服务器发出信标信号。

通用功能实体，包括基本终端所具有的显示及输入输出功能。

7. 根据权利要求 6 所述的双距终端，其特征在于，所述双距终端中，还可包括：数据管理及数据缓存功能实体，用于存储在切换中出现的丢失数据，并在切换完毕后向终端上层通用功能实体进行转发。

8. 一种长短距结合的无线通信方法，采用长短距结合的无线通信系统，其特征在于：双距终端开机以后，首先扫描检测，判断是否处于某一短距 AP 服务范围内，如果是，则通过短距 AP 接入网络进入短距网络，并通知双距归属服务器其所在位置；如果不在任何一个短距 AP 内，则搜索长距服务的基站，通过长距接入网络进入长距网络，并通知双距归属服务器其所在位置。

9. 根据权利要求 8 所述的长短距结合的无线通信方法，其特征在于，如果双距终端检测处于某一短距 AP 服务范围内有无线局域网 WLAN 网络存在并不需要鉴权，则双距终端将直接接入 WLAN 网络；如果检测结果发现当前 WLAN 网络需要鉴权，则双距终端通过 WLAN 进行接入鉴权，如果鉴权成功终端将接入当前 WLAN 网络，如果不成功，双距终端将继续检测并进入到长距 GPRS 网络。

10. 根据权利要求9所述的长短距结合的无线通信方法，其特征在于，当双距终端接入WLAN网络后，双距终端可以通过WLAN短距网络接入双距服务器进行数据传输。

11. 根据权利要求9或10所述的长短距结合的无线通信方法，其特征在于，

IPR2025-00447 Page 00199

当双距终端即将离开短距WLAN网络进入GPRS网络时，则进行从短距网络到长距网络的切换，双距终端通过相应的切换策略进行判断，如果已达到切换策略门限，则双距终端将利用切换策略终止通过短距射频功能实体进行传输的数据，开始启动长距通信功能实体并利用该功能实体实现后续可能发生的数据传输。

12. 根据权利要求11所述的长短距结合的无线通信方法，其特征在于，所述切换策略门限可为短距网络信号不可用门限，也可为短距网络信号非最优的门限。

13. 根据权利要求11所述的长短距结合的无线通信方法，其特征在于，进行从短距网络到长距网络的切换时，如该双距终端的服务等级要求其切换为无缝切换，则用户在终止WLAN射频功能实体正在传输的数据时，还将通过终端中的短距通信功能实体发射一个长短距切换的信标信号给即将切离的短距AP，并由该短距AP将该信标信号传至双距网络服务器，该双距网络服务器接收到相应的信标信号后将通知双距终端即将接入的长距网络功能实体，并根据双距终端的服务等级确定其在长距网络功能实体中的服务队列位置。

14. 根据权利要求13所述的长短距结合的无线通信方法，其特征在于，还包括所述双距网络服务器通过存储方式将该切换过程中可能丢失的数据包进行保护，待切换完成后再转发给该双距终端，从而可保证双距终端在切换过程中的数据不会丢失。

15. 根据权利要求8所述的长短距结合的无线通信方法，其特征在于，当双距终端即将从长距网络进入到短距WLAN网络时，则进行从长距网络到短距网络的切换，双距终端可通过相应的切换策略进行判断，如果已达到切换策略门限，则双距终端将利用切换策略终止通过长距网络功能实体进行传输的数据，开始启动短距通信功能实体并利用该功能实体实现后续可能发生的数据传输。

16. 根据权利要求15所述的长短距结合的无线通信方法，其特征在于，如双距终端的服务等级要求所述从长距网络到短距网络的切换为无缝切换的时候，双距终端在终止长距通信功能实体正在传输的数据时，还将通过双距终端

IPR2025-00447 Page 00200

中的基站及相应的长距网络功能实体发射一个长短距切换的信标信号给即将切离的长距网络功能实体，并由长距网络实体将该信标信号传至双距网络服务器，所述双距网络服务器接收到相应的信标信号后将通知短距通信功能实体，并根据双距终端的服务等级确定其在短距网络功能实体中的优先权。

17. 根据权利要求16所述的长短距结合的无线通信方法，其特征在于，双距网络服务器还可通过存储方式将该切换过程中可能丢失的数据包进行保护，待切换完成后再转发给该双距终端，从而保证双距终端在切换过程中的数据不会丢失。

18. 根据权利要求 9 或 10 所述的长短距结合的无线通信方法，其特征在于，当一个双距终端从一个短距小区移动到另一个短距小区时，双距终端将判别即将进入的短距 AP，并把相应小区信息传送至双距网络服务器，从而实现短距小区之间的切换。

19. 根据权利要求 18 所述的长短距结合的无线通信方法，其特征在于，当一个双距终端从一个短距小区移动到另一个短距小区时，还包括：双距终端将通知双距网络服务器中的归属服务器其已处于另一短距网络范围内，归属服务器将负责网络中的其它终端对其的查询与通信。

20. 根据权利要求8所述的长短距结合的无线通信方法，其特征在于，所述双距终端对长短距网络进行扫描检测，可以采取以下三种方式之一：

(1) 双距终端始终保持长距和短距射频实体处于工作状态，实时地检测可能存在的长距或短距网络环境，并不断反馈给双距终端切换管理机制，并定时或必要时通过现有网络上报给双距网络服务器；

(2) 双距终端始终保持支持现有所处网络的射频功能实体处于工作状态，而对其他网络定期或不定期的启动相应射频功能实体对候选网络进行检测；

(3) 双距终端可始终保持支持现有所处网络的射频功能实体处于工作状态，而对其他网络不做扫描检测，而只有当现有网络不可用时，才对其他网络进行检测。

IPR2025-00447 Page 00201

21. 根据权利要求20所述的长短距结合的无线通信方法，其特征在于，所述不定期的启动相应射频功能实体对候选网络进行检测，可以通过例如以最后发现有其他网络存在的时间间隔为函数的变步长检测方法的特定算法，对候选网络进行检测。

22. 根据权利要求11所述的长短距结合的无线通信方法，其特征在于，所述切换策略包括以下两种切换策略：

(1) 优先级网络切换策略；即只要发现有优先级高的网络存在，就切换到该网络中，不论现有网络是否可用；

(2) 仅在当前使用的无线网络信号不存在时，切换到其他无线网络。

23. 根据权利要求15所述的长短距结合的无线通信方法，其特征在于，所述切换策略包括以下两种切换策略：

(1) 优先级网络切换策略；即只要发现有优先级高的网络存在，就切换到该网络中，不论现有网络是否可用；

(2) 仅在当前使用的无线网络信号不存在时，切换到其他无线网络。

24. 根据权利要求18所述的长短距结合的无线通信方法，其特征在于，所述切换策略包括以下两种切换策略：

(1) 优先级网络切换策略；即只要发现有优先级高的网络存在，就切换到该网络中，不论现有网络是否可用；

(2) 仅在当前使用的无线网络信号不存在时，切换到其他无线网络。

25. 根据权利要求 22、23 或 24 所述的长短距结合的无线通信方法，其特征在于，所述第二种切换策略是指：当且仅当双距终端现处无线网络不可用时才进行切换，如现处网络可用，则即使存在高优先级网络也不进行切换。

26. 根据权利要求 8 所述的长短距结合的无线通信方法，其特征在于，还包括：当双距终端从一个网络向另一个网络移动时，由双距网络服务器配合双距终端进行切换。

27. 根据权利要求 26 所述的长短距结合的无线通信方法，其特征在于，

IPR2025-00447 Page 00202

所述双距网络服务器配合双距终端进行切换过程如下：

第一步，通过长（或短）距网络功能实体，检测用户双距信标信号，查看是否有切换发生，如果没有，则继续检测；如果有，则

第二步，更新双距归属寄存器中用户信息；

第三步，判断当前是否有数据传输，如果没有，回到第一步；

第四步，判断是否需要无缝切换，如果不需要，回到第一步；

第五步，进行数据缓存，并在切换动作完毕后将所缓存数据发送给用户。

28. 根据权利要求 15 所述的长短距结合的无线通信方法，其特征在于，当一个处于长距网络的双距终端请求进入任何一个短距 AP 服务区域时，如果其所在区域的 AP 因安全或其它问题拒绝无线终端接入，则无线终端将依然保持长距通信。

29. 根据权利要求 8 所述的长短距结合的无线通信方法，其特征在于，用户可以根据需要，预先自定义切换的优先级别，使得双距终端进行自动切换。

DOCID: <WO 03056719A1 I >

IPR2025-00447 Page 00203

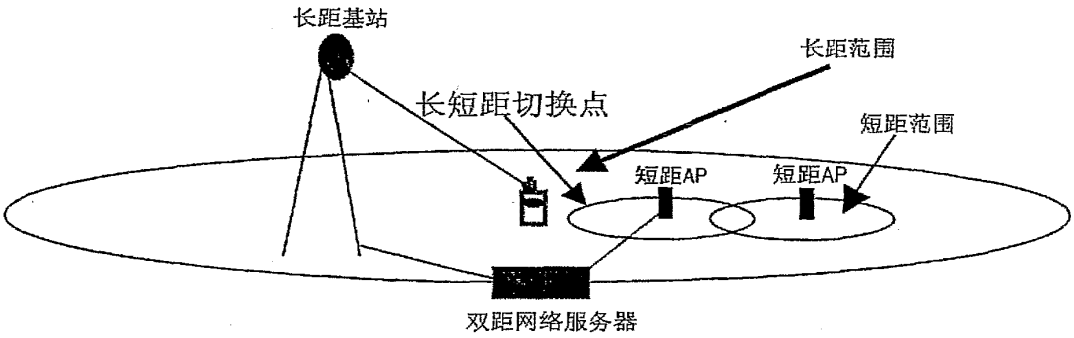

长距基站
长距范围
长短距切换点
短距范围
短距AP
短距AP
双距网络服务器

图 1

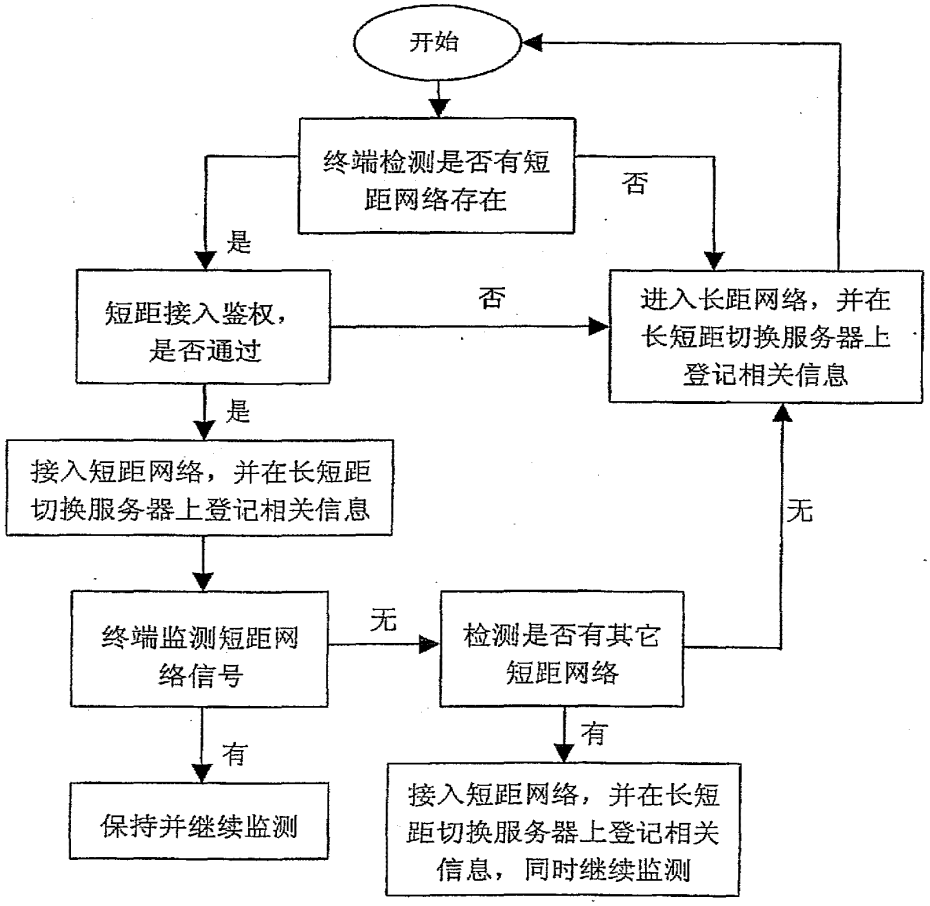

开始
终端检测是否有短距网络存在
否
是
短距接入鉴权，是否通过
否
进入长距网络，并在长短距切换服务器上登记相关信息
是
接入短距网络，并在长短距切换服务器上登记相关信息
无
终端监测短距网络信号
无
检测是否有其它短距网络
有
有
保持并继续监测
接入短距网络，并在长短距切换服务器上登记相关信息，同时继续监测

图 2

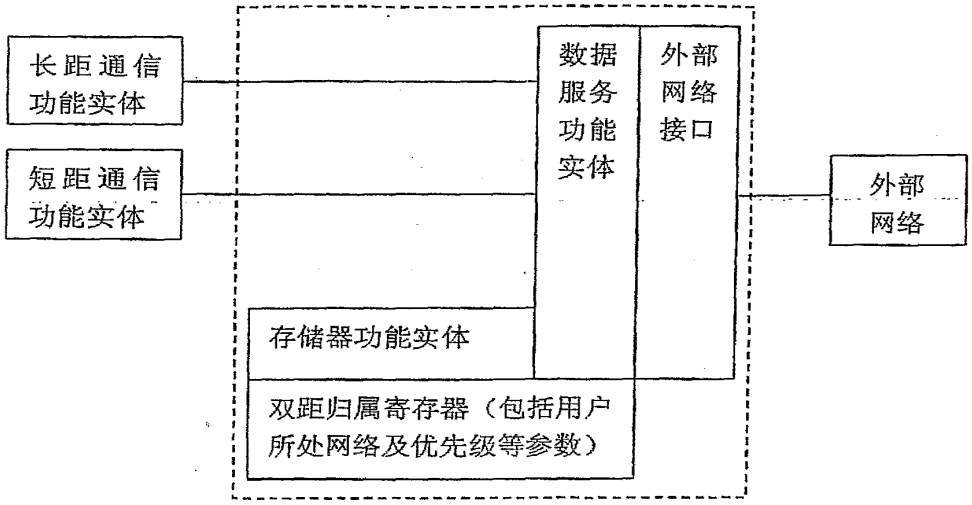

长距通信功能实体
短距通信功能实体
数据服务功能实体
外部网络接口
外部网络
存储器功能实体
双距归属寄存器（包括用户所处网络及优先级等参数）

图 3

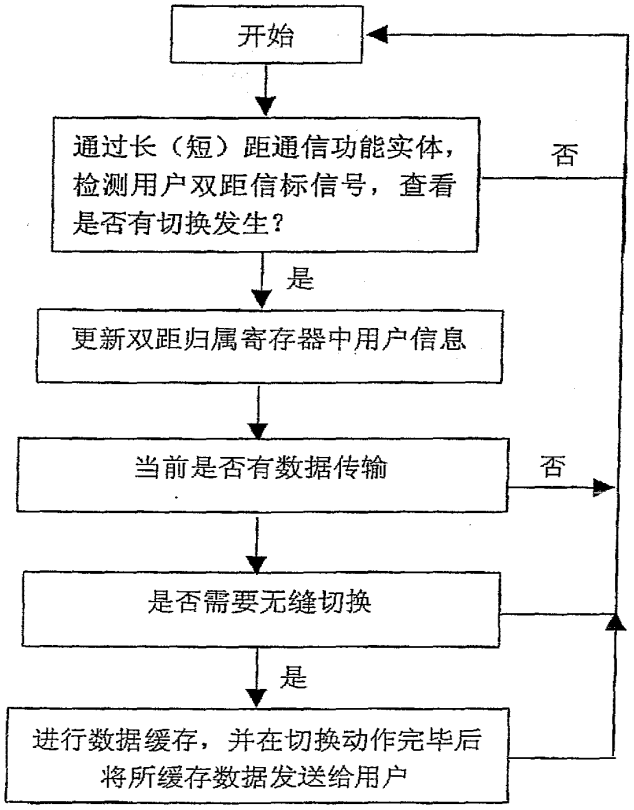

开始
通过长（短）距通信功能实体，检测用户双距信标信号，查看是否有切换发生？
否
是
更新双距归属寄存器中用户信息
当前是否有数据传输
否
是否需要无缝切换
是
进行数据缓存，并在切换动作完毕后将所缓存数据发送给用户

图 4

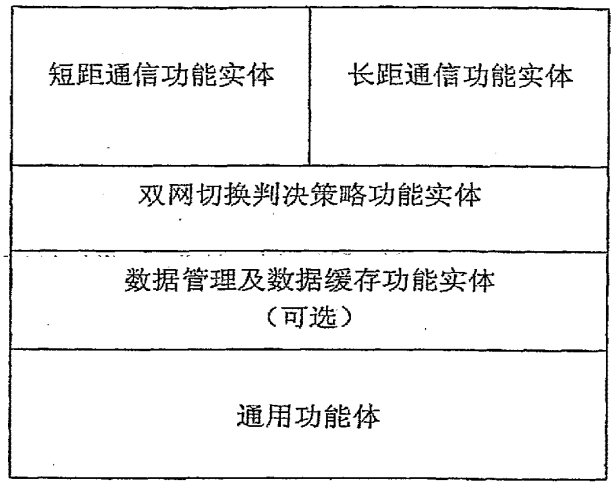


图 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN02/00914

A. CLASSIFICATION OF SUBJECT MATTER

IPC[7]: H04B 7/26 H04Q 7/32

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 7/26 H04Q 7/32

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 practicable, search terms used)

WPI、EPODOC、PAJ、CNPAT

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,210,785 A (CANON KK, JP) 11 May 1993 (11.05.93) See Col. 1,line57 to Col. 11,line43 and Fig.1-10	1-3、6、8-13、15、16、18-20、22-26
A		4、5、14、17
Y	WO 94/00946 A1 (MOTOROLA INC.) 6 Jan. 1994 (06.01.94) See the whole document	1-3、6-13、15、16、20-26、28、29
A		4、5、14、17
Y	JP 58-151136 A (NIPPON ELECTRIC CO) 8 Sep. 1983 (08.09.83) See the whole document	1-3、6-13、15、16、18-26、28、29
A		4、5、14、17
Y	US 5,127,042 A (MOTOROLA INC.) 30 Jun. 1992 (30.06.92) See the whole document	1-3、6、8、15、16、20、22-26、28、29

☐ Further documents are listed in the continuation of Box C. ☒ See patent family 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 application or patent 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

"&" document member of the same patent family

Date of the actual completion of the international search
21. Feb 2003 (21. 02. 2003)

Date of mailing of the international search report
20 MAR 2003 (20.03.03)

Name and mailing address of the ISA/CN
6 Xitucheng Rd., Jimen Bridge, Haidian District,
100088 Beijing, China
Facsimile No. 86-10-62019451

Authorized officer
GUO QUN

Telephone No. 86-10-62093785

TERNATIONAL SEARCH REPORT

Information patent family members

Search request No.
PCT/CN02/00914

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5 210 785 A	11.05.1993	JP 1 220 922 A	04.09.1989
		JP 1 288 026 A	20.11.1989
		US 5 517 553 A	14.05.1996
		US 5 724 647 A	03.03.1998
WO 9 400 946 A1	06.01.1994	MX 9 303 781 A	01.12.1993
		FR 2 693 067 AB	31.12.1993
		CA 2 115 657 AC	06.01.1994
		CN 1 085 707 A	20.04.1994
		US 5 442 680 A	15.08.1995
		IT 1 262 367 B	19.06.1996
JP 58 151 136 A	08.09.1983	None	
US 5 127 042 A	30.06.1992	GB 2 225 512 AB	30.05.1990
		JP 3 001 621 A	08.01.1991
		US 4 989 230 A	29.01.1991
		CA 1 292 041 A	12.11.1991
		US 5 367 558 A	22.11.1994
		US 5 463 674 A	31.10.1995
		HK 42 596 A	22.03.1996
		JP 8 237 747 A	13.09.1996
		JP 2 000 209 664 A	28.07.2000
		US 6 141 560 A	31.10.2000

Form PCT/ISA /210 (extra sheet6) (July 1998)

国际检索报告

国际申请号 PCT/CN02/00914

A. 主题的分类

IPC[7]: H04B 7/26 H04Q 7/32

按照国际专利分类表(IPC)或者同时按照国家分类和IPC两种分类

B. 检索领域

检索的最低限度文献(标明分类体系和分类号)

IPC[7]: H04B 7/26 H04Q 7/32

包含在检索领域中的除最低限度文献以外的检索文献

在国际检索时查阅的电子数据库(数据库的名称和，如果实际可行的，使用的检索词)

WPI、EPODOC、PAJ、CNPAT

C. 相关文件

类 型*	引用文件，必要时，指明相关段落	相关的权利要求编号
Y	US 5,210,785 A（日本 CANON KK）1993 年 5 月 11 日（11.05.93） 说明书第 1 栏第 57 行至第 11 栏第 43 行，图 1-10	1-3、6、8-13、15、16、18-20、22-26
A		4、5、14、17
Y	WO 94/00946 A1（摩托罗拉公司）1994 年 1 月 6 日（06.01.94） 说明书摘要及附图	1-3、6-13、15、16、20-26、28、29
A		4、5、14、17
Y	JP 58-151136 A（日本电气株式会社）1983 年 9 月 8 日（08.09.83） 说明书摘要及附图	1-3、6-13、15、16、18-26、28、29
A		4、5、14、17
Y	US 5,127,042 A（摩托罗拉公司）1992 年 6 月 30 日（30.06.92） 说明书摘要及附图	1-3、6、8、15、16、20、22-26、28、29

☐ 其余文件在C栏的续页中列出。 ☒ 见同族专利附件。

* 引用文件的专用类型：

"A" 明确叙述了被认为不是特别相关的一般现有技术的文件

"E" 在国际申请日的当天或之后公布的在先的申请或专利

"L" 可能引起对优先权要求的怀疑的文件，为确定另一篇引用文件的公布日而引用的或者因其他特殊理由而引用的文件

"O" 涉及口头公开、使用、展览或其他方式公开的文件

"P" 公布日先于国际申请日但迟于所要求的优先权日的文件

"T" 在申请日或优先权日之后公布的在后文件，它与申请不相抵触，但是引用它是为了理解构成发明基础的理论或原理

"X" 特别相关的文件，仅仅考虑该文件，权利要求所记载的发明就不能认为是新颖的或不能认为是有创造性

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"&" 同族专利成员的文件

国际检索实际完成的日期	国际检索报告邮寄日期
21.2 月 2003（21.02.03）	20. 3月 2003 (20.03.03)
国际检索单位名称和邮寄地址 ISA/CN 中国北京市海淀区西土城路 6 号(100088) 传真号： 86-10-62019451	受权官员 郭 群 电话号码：86-10-62093785

PCT/ISA/210 表(第 2 页)(1998 年 7 月)

国际检索报告
关于同族专利成员的情报

国际申请号
PCT/CN02/00914

检索报告中引用的专利文件	公布日期	同族专利成员	公布日期
US 5 210 785 A	11.05.1993	JP 1 220 922 A	04.09.1989
		JP 1 288 026 A	20.11.1989
		US 5 517 553 A	14.05.1996
		US 5 724 647 A	03.03.1998
WO 9 400 946 A1	06.01.1994	MX 9 303 781 A	01.12.1993
		FR 2 693 067 AB	31.12.1993
		CA 2 115 657 AC	06.01.1994
		CN 1 085 707 A	20.04.1994
		US 5 442 680 A	15.08.1995
		IT 1 262 367 B	19.06.1996
JP 58 151 136 A	08.09.1983	无	
US 5 127 042 A	30.06.1992	GB 2 225 512 AB	30.05.1990
		JP 3 001 621 A	08.01.1991
		US 4 989 230 A	29.01.1991
		CA 1 292 041 A	12.11.1991
		US 5 367 558 A	22.11.1994
		US 5 463 674 A	31.10.1995
		HK 42 596 A	22.03.1996
		JP 8 237 747 A	13.09.1996
		JP 2 000 209 664 A	28.07.2000
		US 6 141 560 A	31.10.2000

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

(19) World Intellectual Property Organization
International Bureau

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12 February 2004 (12.02.2004)

PCT

(10) International Publication Number
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(51) International Patent Classification[7]: H04J

(74) Agents: PACE, Lalita, W. et al.; MOTOROLA, INC., Intellectual Property Department, 1303 East Algonquin Road, Schaumburg, IL 60196 (US).

(21) International Application Number:
PCT/US2003/023637

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(25) Filing Language: English

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(30) Priority Data:
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(71) Applicant: MOTOROLA, INC. [US/US]; 1303 East Algonquin Road, Schaumburg, IL 60196 (US).

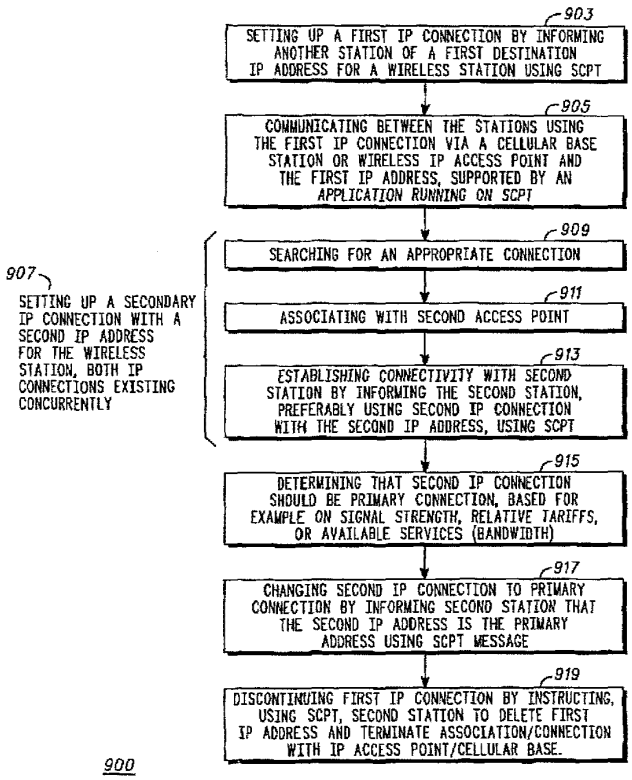
(72) Inventors: DORENBOSCH, Jheroen, P.; 594 CR 3585, Paradise, TX 76073 (US). RAYMER, David, L.; 6528 Levitt Drive, Watauga, TX 76148 (US).

(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, GB, GD, GE, 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, SY, 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, MD, 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).

[Continued on next page]

(54) Title: METHOD AND APPARATUS FOR EFFECTING A HANDOFF BETWEEN TWO IP CONNECTIONS FOR TIME CRITICAL COMMUNICATIONS



(57) Abstract: A method (900) of and wireless communications unit (800) for effecting a handoff from a first Internet Protocol (IP) connection(221) to a second IP connection (331) for a time critical communication is disclosed. The method includes communicating (905) between a first wireless station (219) and a second station (331) using the first IP connection and a first IP address (223) for the first wireless station; setting up (907) the second IP connection with a second IP address for the first wireless station, the first IP connection being a primary connection and the second IP connection being a secondary connection; determining (915) that the second IP connection should be the primary connection; and changing (917) the second IP connection to the primary connection by informing the second station that the second IP address is the primary address using stream control transmission protocol (SCTP) messages.

WO 2004/013998 A2

Published:
— *without international search report and to be republished upon receipt of that report*

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.

METHOD AND APPARATUS FOR EFFECTING A HANDOFF BETWEEN TWO IP CONNECTIONS FOR TIME CRITICAL COMMUNICATIONS

FIELD OF THE INVENTION

This invention relates in general to communication systems, and more specifically to a method and apparatus for effecting a handoff of time critical communications from one IP connection to another.

BACKGROUND OF THE INVENTION

Communications systems are known and continue to evolve rapidly as is quite evident in wireless communications systems. Systems have and are being deployed that allow packet data enabled mobile stations access to packet data networks such as the Internet or internet like networks that utilize IP addresses and various packet data transport protocols such as internet protocol (IP), transport control protocol (TCP), universal datagram protocol (UDP) and more recently stream control transmission protocol (SCTP). Many second+ and third generation cellular and cellular like systems, such as GPRS (general packet radio service), CDMA (code division multiple access) 2000, Wideband CDMA, UMTS (Universal mobile telecommunications service) rely on or support such packet data protocols. Such cellular systems are typically arranged and constructed to provide handoff for a communications from one cellular fixed

point to another more or less transparent to or with little or no indication to a user of the system.

Other communications systems are gaining popularity and these may be characterized as wireless small or local area systems that provide services to users, typically after proper authorization and authentication procedures have been successful. Such wireless systems include ones based on or designed around IEEE 802.11. Most of these systems are designed to be low cost and largely intended to eliminate hooking up wires and cables. Thus these systems for the most part have not dealt with mobility issues, such as handing off a communications from one fixed or access point to another in the midst of a communications much less accepting or initiating handoffs from and to cellular or cellular like systems. Some 802.11 systems do have the ability to pick up a communication that has been dropped by one fixed point at another fixed point provided the fixed points are part of the same subnet, referred to as a basic services set or BSS in 802.11 systems however this can take several seconds and is not suitable for handling mobile users with real-time or time critical needs.

Clearly a need exists for methods and apparatus for effecting a handoff of time critical communications from one IP connection to another. Preferably this will be transparent to the systems, network operators, and users and employ SCTP techniques.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying figures, where like reference numerals refer to identical or functionally similar elements throughout the separate views and which together with the detailed description below are incorporated in and form part of the specification, serve to further illustrate various embodiments and to explain various principles and advantages all in accordance with the present invention.

FIG. 1 depicts, in a simplified and exemplary form, a system level diagram of a communications system utilizing stream control transmission protocol to support multiple connections between stations;

FIG. 2 through FIG. 4 are system level diagrams depicting a preferred embodiment of a handoff of a communications between two wireless IP connections using two wireless IP access points according to the present invention;

FIG. 5 through FIG. 7 are system level diagrams depicting another embodiment of a handoff of a communications between two IP connections using a cellular system and wireless IP access point in accordance with the present invention;

FIG. 8 depicts functional block diagram of a preferred embodiment of a wireless communications unit suitable for use in the systems of FIG. 2 through FIG. 7 according to the present invention; and

FIG. 9 shows a flow chart of a preferred method of effecting a handoff

of a time critical communications between two IP connections according to the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

In overview form the present disclosure concerns communications systems that provide service to wireless communications units or more specifically users thereof operating therein. More particularly various inventive concepts and principles embodied in methods and apparatus for effecting a handoff of time critical communications from one IP connection to another using SCTP messages are disclosed and discussed. The communications systems of particular interest are at least partly wireless and are those being developed and deployed such as 802.11 local area systems and such local area systems together with second plus and third generation cellular and cellular like systems, such as GPRS (general packet radio service), CDMA (code division multiple access) 2000, Wideband CDMA, UMTS (Universal mobile telecommunications service) that need to address mobility concerns within the local areas systems and between the local area and other systems, such as cellular systems.

As further discussed below various inventive principles and combinations thereof are advantageously employed to induce the end points or stations that are communicating to set up alternative IP connections that may be used as required to effect a handoff when needed or desired without further intervention by any of the system components or equipment in a fashion that is

transparent to the user and user communications, thus alleviating various problems associated with known systems provided these principles or equivalents thereof are utilized.

The instant disclosure is provided to further explain in an enabling fashion the best modes of making and using various embodiments in accordance with the present invention. The disclosure is further offered to enhance an understanding and appreciation for the inventive principles and advantages thereof, rather than to limit in any manner the invention. The invention is defined solely by the appended claims including any amendments made during the pendency of this application and all equivalents of those claims as issued.

It is further understood that the use of relational terms, if any, such as first and second, top and bottom, and the like are used solely to distinguish one from another entity or action without necessarily requiring or implying any actual such relationship or order between such entities or actions. Much of the inventive functionality and many of the inventive principles are best implemented with or in software programs or instructions and integrated circuits (ICs) such as application specific ICs. It is expected that one of ordinary skill, notwithstanding possibly significant effort and many design choices motivated by, for example, available time, current technology, and economic considerations, when guided by the concepts and principles disclosed herein will be readily capable of generating such software instructions and programs and ICs with minimal experimentation. Therefore, in the interest of brevity and minimization of any risk of obscuring the principles and concepts according to

the present invention, further discussion of such software and ICs, if any, will be limited to the essentials with respect to the principles and concepts within the preferred embodiments.

Referring to FIG. 1, a simplified and exemplary system level diagram of a communications system utilizing stream control transmission protocol to support multiple IP connections between stations, specifically station A 103 and station B 105, will be discussed and described. In FIG. 1 Station A 103, depicted as a mobile wireless communications unit, such as a cellular or subscriber handset or messaging unit or the like is in communication with station B 105, shown as a portable laptop computer, via a first network 107 and first IP connection 109 with station A having a first IP address, IP A1 111 and station B having a first IP address, IP B1 113. Station A and station B are also sharing a second IP connection 115 via a second network 116 with station A having a second IP address, IP A2 117 and station B a second IP address, IP B2 119. A third IP connection 121 is shown with station A using its second IP address, IP A2 117 and station B using a third IP address, IP B3 123.

The above multiple connection arrangement is made possible using a relatively new transmission protocol, known as Stream Control Transmission Protocol (SCTP) that was recently standardized by the Internet Engineering Task Force (IETF). It operates at the same layer as TCP and UDP and can be viewed as a more capable version of TCP. SCTP was designed to provide a way for an application on an endpoint or station to manage concurrent reliable streams with another station such that the streams will not block each other.

SCTP can also mix reliable streams with best effort streams. SCTP is also expected to increase availability by allowing a station to specify to another endpoint or station that it has more than one IP destination address. The other endpoint will pick one of the addresses as the primary destination address. When that address fails, the SCTP layer will automatically switch to an alternative destination address. The switching does not need any help from the application that uses the SCTP layer. Especially when the alternative addresses use different networks, system reliability goes up tremendously. However, an SCTP fail-over switching can take several seconds and this is too slow for time critical communications such as voice or video. This disclosure discusses and discloses various concepts and principles that will address this concern.

SCTP does not allow an endpoint such as station A or B to change the addresses it has supplied to the other endpoint without first suspending and reinitializing the IP connection. It can also not specify which of the addresses should be used by the other endpoint as the primary destination address. SCTP is being extended to allow operators to change IP equipment within a station or endpoint without having to re-initialize the SCTP transport (see draft-ietf-tsvwg-addip-sctp-03.txt). The IETF draft defines SCTP extension messages that an endpoint can use to inform the other endpoint that; a destination address is to be deleted, a destination address is to be added, or a specified address is to be used as the primary destination address. These SCTP extension messages can be used in a novel and advantageous manner to support and effect a timely

handoff between IP connections. Co-pending patent application by Dorenbosch et al., titled METHOD AND APPARATUS FOR EFFECTING A SEAMLESS HANDOFF BETWEEN IP CONNECTIONS, having a like filing date and assigned to the same assignee as here discusses a novel and inventive technique for effecting handoffs with a station using TCP/UDP that employs a gateway. Here we discuss and describe various aspects of a novel and inventive technique to effect the handoff between stations using SCTP schemes.

Referring to FIG. 2 through FIG. 4 system level diagrams depicting a handoff of a communications between two wireless IP connections using two wireless IP access points will be described and discussed. While it is expected that various access points according to various standards and technologies, such as HiperLAN, Bluetooth, other local area network technologies, and etc. could be used to effect a hand off within or between there respective systems or networks, the present disclosure will focus on the requisites for doing so and the preferred embodiment that uses an IEEE 802.11 network. Initially with reference to FIG. 2 some definitions and terminology that generally apply to 802.11 networks will be introduced.

Wireless IP using 802.11 is becoming increasingly popular. For example, many of the popular coffee shops now provide 802.11b connectivity to their customers. Customers can browse the internet or their company's intranet, read and reply to email while enjoying a latte. Wireless IP can also provide real time services such as Voice over IP and video conferencing. An 802.11 coverage area is called a Basic Service Set (BSS), such as BSS A 203

and BSS B 205. The 802.11 standard supports Isolated BSSs with an ad-hoc network of mobile stations, but a typical BSS contains an Access Point (AP), such as access point A 209 and access point B 211 that provides a bridge to or access to other wireless and wired LANs, such as the distribution system 213 and from there via the portal 215 to the Internet 217, for example.

Each BSS contains a single AP and some number of stations, such as station A 219. Within a BSS, an association such as wireless IP connection 221 can only be formed with one AP at any one time. This association rule makes it possible to route or distribute IP data to the station in a defined manner, as it is known what AP is associated with the station. Station A has a destination address or IP address of IP A1 223 for a first IP connection and messages with that address are routed via AP A 209 to the station. Note that if station A is running an application on top of SCTP as the transport layer and sets up an additional IP connection or association with a second IP address, IP An 225, the station may appear as another station to the AP A 209. If station A 219 and station B 227 wish to communicate or exchange information an IP connection is established between them using the IP address IP B1 as a destination address for station B 227 and either IP A1 223 or IP An 225 depending on which is the primary destination address for station A as arbitrarily determined by station B or as directed by station A using SCTP messages. Note while the second IP address IP An may have or generate some academic interest it will not have much utility as far as increasing availability of station A.

A mobile station such as station A 219 can roam from one BSS into the next BSS and connect to another AP. The 802.11 standards also define an Extended Services Set (ESS) of coordinated BSSs to simplify roaming. This for example may allow a customer to roam from the coffee shop into a neighboring bookstore and continue to browse the Internet assuming both establishments are part of the same ESS. The customer's station first breaks the connection or drops the association with the AP in the coffee shop and then associates with the AP in the bookstore. This can all occur fast enough to accommodate browser operation with a few second interruption, however, it is not fast enough for real time or time critical applications, such as voice or voice over IP.

FIG. 2 in addition to serving as a backdrop for a description of how 802.11 networks operate is also a first stage for effecting a handoff from a first IP connection to a second IP connection for a time critical communication. Station A 219 operating within BSS A 203 first associates an IP connection 221 using IP address IP A1 223 with AP A 209. An application on station A that needs to communicate with an application on station B communicates over the SCTP transport layer and uses SCTP messages to inform station B that IP A1 is the primary destination address prior to starting any communications. Thus communicating between the wireless station, station A, and the second station, station B, using the first IP connection and the IP address IP A1 for the wireless station and IP B1 for the other station is undertaken.

Referring to FIG. 3 the next step in effecting a handoff will be discussed and described. FIG. 3 shows the relevant entities from FIG. 2 with like

reference numerals and demonstrates setting up a second IP connection 331 with a second IP address 333 for the mobile or wireless station, station A 219, where the original or first IP connection 221 is the primary connection and is "awake" and ready to support or provide or continue to provide ongoing communications while the second IP connection is secondary or in a "doze" (low battery consumption) state. Thus both IP connections exist concurrently. Setting up the second IP connection further includes searching for an appropriate wireless IP connection, associating with a second wireless IP access point, such as AP B 211, and establishing connectivity with the second station B by informing the second station of the second IP address 333 using SCTP. Note that the searching, associating, and establishing are undertaken independent of the application supporting the communicating. Searching for the appropriate wireless IP connection may include one or more of determining that an available wireless IP connection includes a wireless IP access point and suitable services, that the wireless station A is able to successfully authenticate with the access point, and that connectivity to the second station is available. 17. The associating with the second wireless IP access point while described in detail herein as associating with an 802.11 access point, may be associating with a Bluetooth access point, a HiperLAN access point, or other a local area network (LAN) access point now known or as later defined.

In somewhat more detail, when the wireless station A learns (in known 802.11 specified ways) that it is within coverage of another BSS, such as BSS B 205 and expects that it may have to switch, it uses at least a second one of its IP

connections 331 to associate with the AP B 211 of the other BSS. The station A continues to use the first IP connection 221 to communicate with the AP A 209 of the origination BSS A 203. The first IP address IP A1 223 also remains the primary address for SCTP. However, station A uses the SCTP messages to instruct the other station with SCTP capabilities to add the second IP address IP A2 333 as an alternative destination address.

This will require that the radio/mobility software interact with the SCTP layer. If the second IP address IP A2 was previously known to the other SCTP endpoint, station B, station A must first instruct station B to delete the second IP address as a destination address. If the second IP connection was previously associated with the origination AP, AP A 209, station A must first disassociate the second connection from the origination AP. For example If IP A2 were IP An from FIG. 2 these issues would arise. A more complex and capable and thus likely more expensive station may maintain two independent wireless IP connections, one with each AP. However, the STA may also share wireless IP resources between the APs of the origination and target BSS. The 802.11 connection of the second IP connection with the target AP, AP b 211 would be in the 'power save' mode, and the first connection with the origination AP would be in either the 'active' or 'power save' mode, as appropriate for the application. If the first connection is 'active', the second connection can steal time from it to occasionally wake up to listen for 802.11 beacons in the target BSS and to communicate with AP B 211. This will appear to the application as small RF imperfections that can be ironed out by the vocoders.

If the first connection with the origination AP fails for some reason, the station A should bring its second IP connection to the 'active' mode as soon as possible. Without any prodding from the mobile station, the other station B will independently and automatically switch over to the second IP address. Even though this error case is not handled in real-time, it provides a more reliable connection than standard 802.11. For improved performance, the station A endpoint will use the first or the second IP address to instruct the other SCTP endpoint, station B, to add the second IP address. Preferably it used the second IP address because that will establish the proper settings in the APs, the Distribution System(s) and any new routers in the path between the stations.

Given that a first and second IP connection has been established the wireless station, station A, will determine at some point that the second IP connection 331 should be the primary connection. This determining that the second IP connection should be the primary connection may include or be motivated by one or more of determining that a signal from the first wireless IP access point, AP A 209 is weakening, that loading levels for the second IP connection are favorable over those of AP A, that services are desired that are available via the second IP connection or perhaps that favorable tariffs are available if the second IP connection is used. When station A determines it is time to switch over to BSS B or AP B 211 it will use SCTP messages to inform the station B that the second IP address, IP A2 has becomes the primary SCTP destination address. bring the second connection with AP B 211 to the 'active'

mode. Optionally or if required, inform station B that it must delete the first IP address and disassociate the first IP connection 221 from AP A 209.

The result after the handoff has been implemented is demonstrated in FIG. 4. Station A may inform the station B of the new primary address, IP A2 via the first connection and then wait for confirmation on that connection. Preferably station A informs the other endpoint of the new primary address via the second connection, after bringing that connection to the 'active' mode. Preferably Station A times the switchover such that it starts during an idle period in the time critical or real-time voice communications. Station A may wait to disassociate with AP A until it is out of the coverage area of the AP A since having more than one connection increases reliability. Station A may associate the first IP connection with AP B, after it has disassociated from AP A, and inform the other endpoint that it has now become an alternative SCTP destination address. IF station A moves between BSSs of the same ESS, the STA can combine the steps of disassociation and association of the first IP connection into a single re-association. Note that the above techniques work even if the handoff is between ESSs. In contrast, as the standards for 802.11 make clear, without the use of the principles and concepts herein described an ESS transition will result in disruption of services.

Referring to FIG. 5 through FIG. 7 system level diagrams depicting a hand off of a communications between two IP connections one using a cellular system and the other a wireless IP access point will be discussed and described. FIG. 5 shows a station A 503 such as a cellular handset or the like with an IP

address, IP A1 504, communicating with a station B 505 having an IP address, IP B1 506, over an IP connection 507 that as here depicted is wireless. This IP connection 507 is via a cellular system including a cellular base station that is part of a radio access network 509 that is coupled via a cellular core 510 to a wired network, such as the Internet 511. Further depicted is an 802.11 network including an access point (AP) 517 with a coverage area or basic service set (BSS) 515 that is coupled via a distribution system 519 and portal 521 to the Internet 511.

As an overview, the handoff from or to a cellular system and a wireless IP network includes setting up a first IP connection including informing station B of the first IP address, IP A1, using SCTP. Then communicating, using an application that runs on SCTP between the wireless station, station A, and station B using the first IP connection 507 and first IP address for station A, setting up the second IP connection with a second IP address for station A, where the first IP connection is a primary connection and the second IP connection is a secondary connection, with both existing concurrently. Determining that the second IP connection should be the primary connection; and changing the second IP connection to the primary connection by informing the second station that the second IP address is the primary address using SCTP messages, wherein the time critical communication is immediately switched over to the second IP connection.

Referring to FIG. 5 the wireless station, station A is depicted before it moves into an 802.11 coverage area. The mobile uses IP over its cellular

connection. It has at least one IP address (IP A1). An application on station A that supports both cellular and wireless IP will run on SCTP and may be conditioned to run on SCTP when or if it determines that the station supports both cellular and wireless IP. Station A informs the other endpoint, station B, of the IP address, IP A1 504 associated with the IP connection 507 or cellular connection. Station B will use the specified cellular IP addresses (A1) as the primary destination address. Station B is shown connected via the internet, but could also be connected to the cellular core or to the cellular Radio Access Network (RAN). Real-time applications preferably would use Session Initiation Protocol to setup the real time or time critical session over SCTP. The use of SIP over SCTP is not sufficient. For this handoff process to work, the bearer has to run over SCTP as well. SIP uses Session Description Language (SDL) to specify how the real-time data is to be sent between the endpoints. SIP relies on the Session Description Protocol (SDP) to provide media negotiation functionality. A novel extension can be claimed for SDP. Currently SDP can specify that voice or video data will use RTP over UDP. An improvement would allow a specification that the voice or video runs over SCTP instead, on a best effort stream. The mobile endpoint, station A may or may not use additional IP addresses over the cellular connection and provide them to station B as alternative SCTP destination addresses. However, the use of multiple connections via the same cellular connection does not increase availability all that much.

Referring to Fig. 6 the results of setting up the second IP connection 625

with a second IP address, IP A2 623 for the wireless station A, where the first IP connection remains the primary connection and the second IP connection is a secondary connection, with both existing concurrently are depicted. Setting up the second IP connection further includes searching for an appropriate connection, associating with a wireless IP access point, and establishing connectivity with the second station by informing the second station of the second IP address using SCTP. The searching, associating, and establishing are undertaken independent of and transparent to the application supporting communicating. The searching for the appropriate wireless IP connection further includes one or more of determining that an available connection includes an access point and suitable services, that the wireless station A is able to successfully authenticate with the access point, or that connectivity to station B is available. While our discussion here have described associating with a wireless IP access point that is an 802.11 access point it is expected that other local area access technologies will also benefit from the concepts and principles discussed here. Informing station B of the second IP address using SCTP, preferably, uses the second IP connection thereby initializing that connection.

In more detail an 802.11 capable mobile, such as station A 503 will regularly scan for an appropriate Wireless IP connection. When it finds an appropriate one it associates with the Access Point, authenticates, and establishes connectivity with the wired networks. Note that the BSS 515 may be associated with the cellular Service Provider (SP) and the wireless station A may even be able to use a SIM card for authentication. Alternatively the BSS

may not be associated with the SP. There may or may not be a roaming agreement between the cellular SP and the operator of the BSS. Interestingly, the invention works without a roaming agreement. The mobile may be able to authenticate independently with the BSS and gain access to the wired networks. This may be done without any knowledge to the cellular SP. In any event in the process, the wireless station may acquire a new IP address (via DHCP, for example). The mobile may also be able to use an existing IP address. In any case, the mobile has at least one second IP address, IP A2 623 that is used over the 802.11 IP connection 625. The mobile or station A then uses SCTP extension messages to instruct the other SCTP endpoint, station B 505, to add the second IP address as an alternative destination address for station A. During this process, the application on the mobile continues to use the first IP address over the cellular based IP connection to communicate with station B. While all this is done, the application on station B continues to use the first IP address as the primary address for SCTP, and application data continues to flow through the cellular system.

Note that the acquisition of the second IP address is not done by the application. It is done by the radio/mobility software within station A. This radio/mobility software also interacts with the SCTP layer to inform station B of the second IP address, IP A2 623. If the second IP address was previously associated with the cellular connection, the mobile must first disassociate the second IP address from the cellular connection. In that case, it must first inform station B to delete the second address. If the cellular connection now fails for

some reason, the other endpoint will automatically switch over to the 802.11 connection. The mobile preferably should keep its 802.11 connection in the 'active' mode. Even though this error case is not handled in real-time, it already provides a more reliable connection than prior art approaches. Station A can use the first or the second IP address to instruct station B to add the second IP address. Preferably, it uses the second address because that will establish the proper settings in the AP 517, the Distribution System 519 and any new routers in the path between the endpoints or stations.

FIG. 7 shows the results of the next processes in the handoff from the cellular to the wireless IP system. Once the second IP connection is set up at some point the wireless station A determines that the second IP connection should be the primary connection. Determining that the second IP connection should be the primary connection may include one or more of determining that a signal from the cellular base station is weakening, that tariffs for the second IP connection are favorable, or that services, such as higher bandwidth are needed or desired that are available via the second IP connection. In any event station A is now ready to switch over to the wireless IP access point 511 and use 802.11. Station A will bring the second connection with the 802.11 AP 517 to the 'active' mode, if it was not already 'active' and using SCTP extension messages inform station B that the second IP address is now the primary SCTP destination address. The application on station B will now start using the second IP address 623 as the destination address for station A. Note that in this

case given the principles and concepts hereof the switch is more or less immediate and completely transparent to the application.

Likely the 802.11 AP is indoors and cellular coverage may be marginal. When station A observes that the cellular connection is deteriorating it may inform station B that it must delete the first IP address and drop the cellular IP connection. Note that the application will continue to operate normally. Station A may inform station B of the new primary address via the first connection and then wait for confirmation on that connection. Preferably, station A informs station B of the new primary address via the second IP connection, after bringing that connection to the 'active' mode. Preferably, station A times the switchover such that it starts during a an idle or silent period in the time critical communication such as a pause or a silence in a real-time voice conversation. Station A may choose to wait to drop the first IP connection 504 until it is out of the coverage area of the cellular system; since having more than one connection increases reliability. Station A may also associate the first IP connection with the 802.11 AP 517, after it has disassociated it from the cellular system, and inform station B that it has now become an alternative SCTP destination address.

Roaming back to cellular is essentially the reverse of the previously discussed process. The application is running over SCTP using an 802.11 connection on a first IP address. Station B is using the first IP address as the primary destination address. If needed, station A establishes a connection with the cellular system that supports data transfer on a second IP address. The

second IP address can be static or can be obtained dynamically. Special provisions may be needed to obtain the appropriate Quality Of Service, like the establishment of a secondary PDP context in UMTS systems. The software in the mobile then uses the SCTP extension messages to inform the SCTP layer in station B about the availability of the second IP address. The software in station A then uses the SCTP messages to instruct the SCTP layer in the other endpoint to use the second IP address as the primary destination address.

The mobile may now tear down the 802.11 IP connection. Before doing so, it should use the SCTP messages to instruct the SCTP layer in station B to delete the first IP address.

Referring to FIG. 8 a functional block diagram of a preferred embodiment of a wireless communications unit 800 suitable for use in the systems of FIG. 2 through FIG. 7 as the wireless station or station A will be discussed and described. The wireless communications unit 800 is arranged and constructed to effect a handoff from a first Internet Protocol (IP) connection to a second IP connection for a time critical communication. The wireless communications unit includes, coupled to a known antenna 801, a conventional wireless transceiver 803 and a controller 805 cooperatively arranged for communicating with a second station using the first IP connection and a first IP address for the wireless communications unit. The controller is further coupled to a conventional user input output 807, including for example a display, keyboard, or audio transducers, and is operable for: setting up the second IP connection with a second IP address for the wireless communications unit

where the first IP connection is a primary connection and the second IP connection is a secondary connection, with both existing concurrently; determining that the second IP connection should be the primary connection; and changing the second IP connection to the primary connection by informing the second station that the second IP address is the primary address using stream control transmission protocol (SCTP) messages, wherein the time critical communication is immediately switched over to the second IP connection.

To do so the wireless transceiver 803 will require a wireless IP transceiver 808 and may require an additional cellular or local area network transceiver 809. The controller 805 includes a processor 811, preferably a microprocessor or digital signal processor both known and widely available, coupled to an optional port 813 that provides an interface to one or more devices such as a portable computer, personal digital assistant, network interface card, modem, or the like one or more of which may be fully integrated with the wireless communications unit. The processor is inter coupled to a memory 815 that includes, as appropriate for the particular unit, some combination of RAM, ROM, PROM, EEPROM or other electronic or magnetic storage media that is used to store software routines or instructions as well as data and parameters for such routines and instructions and the unit that when executed by the processor result in the wireless communications unit operating as required to support various known functions as well as handoff processes as disclosed herein. These software instructions or routines include one or more applications 817, for example voice over IP telephony, an email client or

browser that support communication with other stations or hosts and run on top of an SCTP transport layer, and mobility management routines 819 that handles various duties associated with roaming or moving from one access point to another, including handoff procedures. Further included is the basic and known operating system 821, data and parameters information 823, and many other routines 825 that one of ordinary skill would recognize and be familiar with.

Note that for the wireless communications unit in order to effect a handoff from or to an IP connection via a cellular base station to or from an IP connection via a local area wireless IP network, such as an 802.11 network will require that the wireless transceiver 803 include a cellular transceiver and capabilities to operate on cellular systems. If the handoff is from one wireless IP network to another such network the wireless transceiver may only require the wireless IP transceiver 808 in many instances as certain of these networks, such as Bluetooth, are set up and organized so that one transceiver is able to maintain multiple IP connections. In other examples a second technology dependent transceiver will be required, for example when operating between and 802.11 wireless IP network and a Bluetooth based network As above discussed the wireless communications unit will operate in accordance with SCTP conventions and independent of applications to communicate its own destination IP addresses and establish the proper priorities of such IP addresses and thus IP connections with other endpoints or stations and thereby effect a handoff of communications in a virtual real time manner between IP connections as judged appropriate based on similar motivations and

circumstances as earlier discussed.

In conclusion with reference to FIG. 9 a flow chart of a preferred method of effecting a handoff of a time critical communications between two IP connections will be discussed and described. This discussion will be in the nature of a summary and thus at an overview level. This method may be practiced advantageously, for example, by the wireless communications unit of FIG 8 operating in a suitable system such as those shown in FIG. 2 through FIG. 7. FIG. 9 depicts a method of effecting a handoff from a first Internet Protocol (IP) connection to a second IP connection for a time critical communication and begins at 903 with setting up a first IP connection by informing a second station of a first destination IP address for a wireless station using SCTP messages. By SCTP conventions this will be the primary IP address and thus IP connection between the two stations. Then at 905 the method depicts communicating between the wireless station and the second station via a cellular base station or wireless IP access point such as an 802.11 access point using the first IP connection and first IP address for the wireless station; supported by an application running on an SCTP transport layer.

At 907 the method shows setting up the second IP connection with a second IP address for the first wireless station where the first IP connection is a primary connection and the second IP connection is a secondary connection with both existing concurrently. In more detail setting up the second connection includes searching for an appropriate connection 909, associating with a second access point 911, such as a wireless IP access point, and establishing

connectivity with the second station by informing, preferably using the second IP connection, the second station of the second IP address using SCTP messages. Note that 909, 911, and 913 are preferably undertaken independently of and transparently to the application supporting the communicating.

Searching 909 for the appropriate wireless IP connection may include one or more of determining that an available connection includes an access point and suitable services, that the first wireless station is able to successfully authenticate with and access the access point, and that connectivity to the second station is available. Associating with a wireless IP access point can include associating with one of an 802.11 access point, a Bluetooth access point, a HiperLAN access point, and a local area network (LAN) access point according to the provisions for each such access point.

Then 915 shows determining that the second IP connection should be the primary connection, based for example on one or more of determining that a signal from the cellular base station or wireless IP access point is weakening, that tariffs for the second IP connection are favorable, or that services, such as bandwidth or security, etc. are desired and available via the second IP connection. Next 917 shows changing the second IP connection to the primary connection by informing the second station that the second IP address is the primary address using SCTP messages. Doing this results in immediately switching the time critical communication over to the second IP connection. Then 919 indicates, when the second IP connection becomes the primary connection, discontinuing the first IP connection by for example instructing the

second station to delete the first IP address using SCTP messages and terminating any session via the cellular base station or with the first wireless IP access point.

The apparatus and methods discussed and described above, and the inventive principles and concepts thereof are intended to and will alleviate problems caused by the lack of mobility considerations with prior art wireless IP systems. Using these principles of establishing a secondary IP connection using SCTP commands and messages that exists concurrently with a first IP connection between stations using SCTP transport layers will allow a communications device to effect a handoff of time critical communications at the will of the communications device and thus facilitate connectivity for mobile individuals. For example these principles and concepts can be used to effect a handoff between disparate cellular packet data systems that do not otherwise support a fast handoff, such as UMTS and CDMA systems as well be apparent to one of ordinary skill given the teachings herein.

This disclosure is intended to explain how to fashion and use various embodiments in accordance with the invention rather than to limit the true, intended, and fair scope and spirit thereof. The foregoing description is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Modifications or variations are possible in light of the above teachings. The embodiment(s) was chosen and described to provide the best illustration of the principles of the invention and its practical application, and to enable one of ordinary skill in the art to utilize the invention in various

embodiments and with various modifications as are suited to the particular use contemplated. All such modifications and variations are within the scope of the invention as determined by the appended claims, as may be amended during the pendency of this application for patent, and all equivalents thereof, when interpreted in accordance with the breadth to which they are fairly, legally, and equitably entitled.

CLAIMS

What is claimed is:

1. A method of effecting a handoff from a first Internet Protocol (IP) connection to a second IP connection for a time critical communication, the method comprising:

communicating between a first wireless station and a second station using the first IP connection and a first IP address for the first wireless station;

setting up the second IP connection with a second IP address for the first wireless station, the first IP connection being a primary connection and the second IP connection being a secondary connection, both existing concurrently;

determining that the second IP connection should be the primary connection; and

changing the second IP connection to the primary connection by informing the second station that the second IP address is the primary address using stream control transmission protocol (SCTP) messages,

wherein the time critical communication is immediately switched over to the second IP connection.

2. The method of claim 1 wherein said communicating between said first wireless station and said second station using the first IP connection further uses a cellular base station, said communicating supported by an application on the first wireless station that runs on SCTP.

3. The method of claim 2 further including informing said second station of the first IP address using SCTP before starting said communicating.

4. The method of claim 2 wherein said setting up the second IP connection further includes searching for an appropriate connection, associating with a wireless IP access point, and establishing connectivity with the second station by informing said second station of the second IP address using SCTP.

5. The method of claim 4 wherein said searching, said associating, and said establishing are undertaken independent of said application supporting said communicating.

6. The method of claim 4 wherein said searching for said appropriate wireless IP connection further includes one of determining that an available connection includes an access point and suitable services, that said first wireless station is able to successfully authenticate with said access point, and that connectivity to said second station is available.

7. The method of claim 4 wherein said associating with a wireless IP access point further includes associating with one of an 802.11 access point, a Bluetooth access point, a HiperLAN access point, and a local area network (LAN) access point.

8. The method of claim 4 wherein said informing said second station of the second IP address using SCTP uses said second connection thereby initializing said second connection.

9. The method of claim 2 wherein said determining that the second IP connection should be the primary connection further includes one of determining that a signal from said cellular base station is weakening, that tariffs for the second IP connection are favorable, and that services are desired that are available via the second IP connection.

10. The method of claim 2 further including, when the second IP connection becomes the primary connection, discontinuing the first IP connection.

11. The method of claim 10 wherein said discontinuing the first IP connection further includes instructing the second station to delete the first IP address using SCTP messages and terminating any session via said cellular base station.

12. The method of claim 1 wherein said communicating between said first wireless station and said second station using the first IP connection further uses a first wireless IP access point, said communicating supported by an application on the first wireless station that runs on SCTP.

13. The method of claim 12 further including informing said second station of the first IP address using SCTP before starting said communicating.

14. The method of claim 12 wherein said setting up the second IP connection further includes searching for an appropriate wireless IP connection, associating with a second wireless IP access point, and establishing connectivity with the second station by informing said second station of the second IP address using SCTP.

15. The method of claim 14 wherein said searching, said associating, and said establishing are undertaken independent of said application supporting said communicating.

16. The method of claim 14 wherein said searching for said appropriate wireless IP connection further includes one of determining that an available wireless IP connection includes a wireless IP access point and suitable services, that said first wireless station is able to successfully authenticate with said access point, and that connectivity to said second station is available.

17. The method of claim 14 wherein said associating with said second wireless IP access point further includes associating with one of an 802.11 access point, a Bluetooth access point, a HiperLAN access point, and a local area network (LAN) access point.

18. The method of claim 14 wherein said informing said second station of the second IP address using SCTP uses said second connection thereby initializing said second connection.

19. The method of claim 12 wherein said determining that the second IP connection should be the primary connection further includes one of determining that a signal from said first wireless IP access point is weakening, that loading levels for the second IP connection are favorable, and that services are desired that are available via the second IP connection.

20. The method of claim 12 further including, when the second IP connection becomes the primary connection, discontinuing the first IP connection by instructing the second station to delete the first IP address using SCTP messages and disassociating with said first wireless access point.

21. The method of claim 2 wherein said setting up the second IP connection further includes searching for an appropriate cellular connection, establishing a connection with a second cellular base station, and establishing connectivity with the second station by informing said second station of the second IP address using SCTP.

22. The method of claim 12 wherein said setting up the second IP connection further includes searching for an appropriate cellular connection, establishing a connection with a second cellular base station, and establishing connectivity with the second station by informing said second station of the second IP address using SCTP.

23. A wireless communications unit arranged and constructed to effect a handoff from a first Internet Protocol (IP) connection to a second IP connection for a time critical communication, the wireless communications unit comprising:

a wireless transceiver and a controller cooperatively arranged for communicating with a second station using the first IP connection and a first IP address for the wireless communications unit;

said controller further for:

setting up the second IP connection with a second IP address for the wireless communications unit, the first IP connection being a primary connection and the second IP connection being a secondary connection, both existing concurrently;

determining that the second IP connection should be the primary connection; and

changing the second IP connection to the primary connection by informing the second station that the second IP address is the primary address using stream control transmission protocol (SCTP) messages,

wherein the time critical communication is immediately switched over to the second IP connection.

24. The wireless communications unit of claim 23 wherein said wireless transceiver includes a cellular transceiver for communicating with said second station using the first IP connection through a cellular base station, said communicating supported by an application executed by said controller, said application running on SCTP.

25. The wireless communications unit of claim 24 further including informing said second station of the first IP address using SCTP before starting said communicating.

26. The wireless communications unit of claim 24 wherein said transceiver further includes a wireless IP transceiver cooperatively operating with said controller for setting up the second IP connection and further for searching for an appropriate wireless IP connection, associating with a wireless IP access point, and establishing connectivity with the second station by informing said second station of the second IP address using SCTP.

27. The wireless communications unit of claim 26 wherein said searching, said associating, and said establishing are undertaken independent of said application supporting said communicating.

28. The wireless communications unit of claim 26 wherein said searching for said appropriate wireless IP connection further includes one of determining that an available connection includes an access point and suitable services, that said first wireless station is able to successfully authenticate with said access point, and that connectivity to said second station is available.

29. The wireless communications unit of claim 26 wherein said associating with a wireless IP access point further includes associating with one of an 802.11 access point, a Bluetooth access point, a HiperLAN access point, and a local area network (LAN) access point and said transceiver further includes a second transceiver, respectively compatible with one of 802.11, Bluetooth, HiperLAN, and local area network systems.

30. The wireless communications unit of claim 26 wherein said informing said second station of the second IP address using SCTP uses said second transceiver and said second connection thereby initializing said second connection.

31. The wireless communications unit of claim 24 wherein said determining that the second IP connection should be the primary connection further includes one of determining that a signal from said cellular base station is weakening,

that tariffs for the second IP connection are favorable, and that services are desired that are available via the second IP connection.

32. The wireless communications unit of claim 24 further including, when the second IP connection becomes the primary connection, discontinuing the first IP connection by instructing, using SCTP messages, the second station to delete the first IP address and terminating any session via said cellular base station.

33. The wireless communications unit of claim 23 wherein said wireless transceiver includes a wireless IP transceiver for communicating with said second station using the first IP connection through a wireless IP access point, said communicating supported by an application executed by said controller, said application running on SCTP.

34. The wireless communications unit of claim 33 further including informing said second station of the first IP address using SCTP before starting said communicating.

35. The wireless communications unit of claim 33 wherein said wireless IP transceiver cooperatively operates with said controller for setting up the second IP connection and further for searching for an appropriate wireless IP connection, associating with a second wireless IP access point, and establishing

connectivity with the second station by informing said second station of the second IP address using SCTP.

36. The wireless communications unit of claim 35 wherein said searching, said associating, and said establishing are undertaken independent of said application supporting said communicating.

37. The wireless communications unit of claim 35 wherein said searching for said appropriate wireless IP connection further includes one of determining that an available wireless IP connection includes a wireless IP access point and suitable services, that said first wireless station is able to successfully authenticate with said access point, and that connectivity to said second station is available.

38. The wireless communications unit of claim 35 wherein said associating with said second wireless IP access point further includes associating with one of an 802.11 access point, a Bluetooth access point, a HiperLAN access point, and a local area network (LAN) access point and said transceiver further includes a second transceiver respectively compatible with one of 802.11, Bluetooth, HiperLAN, and local area network systems.

39. The wireless communications unit of claim 35 wherein said informing said second station of the second IP address using SCTP uses said second

transceiver and said second connection thereby initializing said second connection.

40. The wireless communications unit of claim 33 wherein said determining that the second IP connection should be the primary connection further includes one of determining that a signal from said first wireless IP access point is weakening, that loading levels for the second IP connection are favorable, and that services are desired that are available via the second IP connection.

41. The wireless communications unit of claim 33 further including, when the second IP connection becomes the primary connection, discontinuing the first IP connection by instructing the second station to delete the first IP address and disassociating with said first wireless access point.

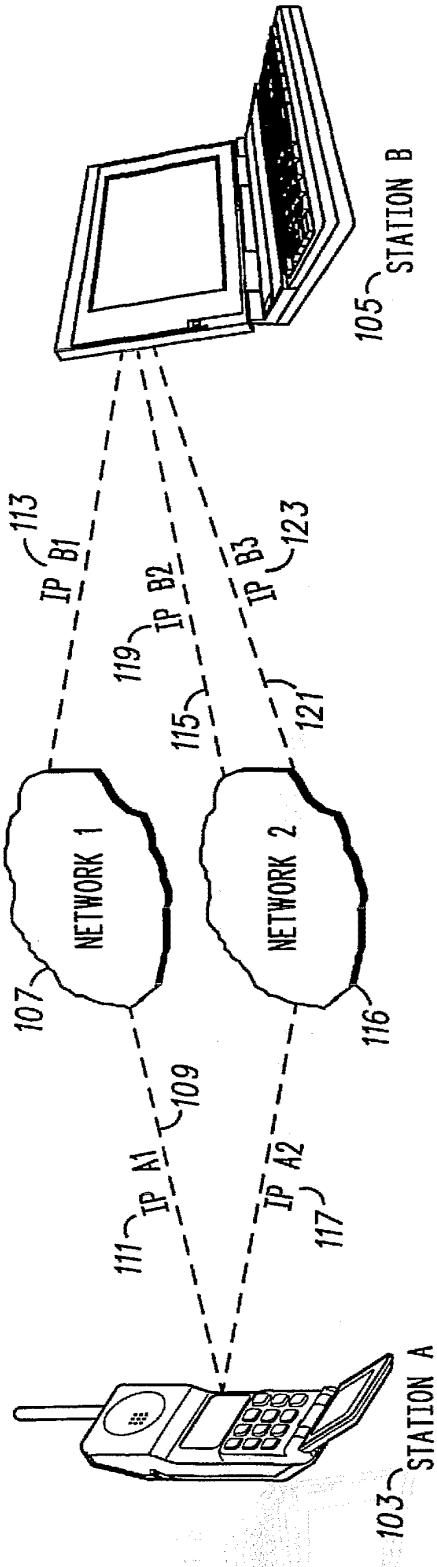

STATION B
105
113
IP B1
123
IP B3
119
IP B2
115
121
NETWORK 1
NETWORK 2
107
116
109
111
IP A1
IP A2
117
STATION A
103

FIG. 1

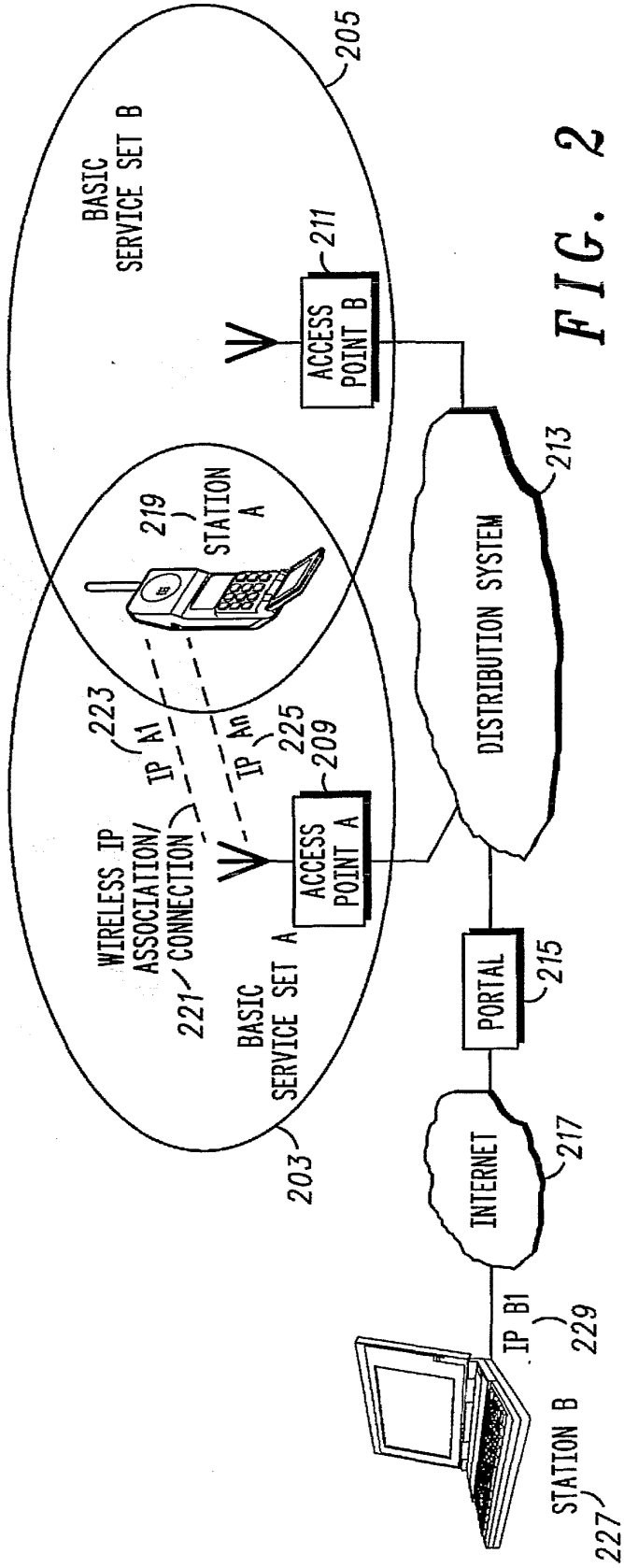

205
BASIC SERVICE SET B
211
ACCESS POINT B
219
STATION A
223
IP A1
IP An
225
209
WIRELESS IP ASSOCIATION/ CONNECTION
221
ACCESS POINT A
BASIC SERVICE SET A
203
DISTRIBUTION SYSTEM
213
PORTAL
215
INTERNET
217
IP B1
229
STATION B
227

FIG. 2

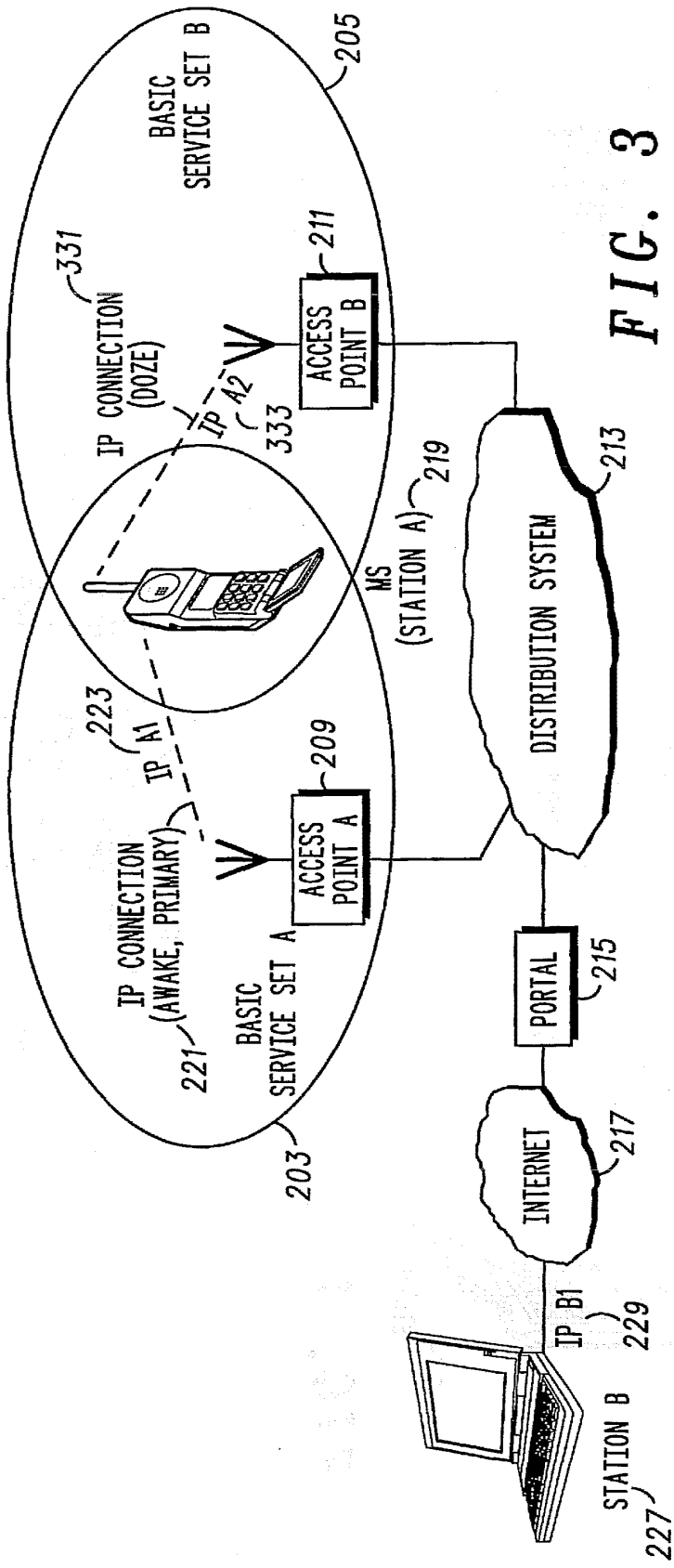

BASIC SERVICE SET B
205
331
IP CONNECTION (DOZE)
IP A2
333
ACCESS POINT B
211
MS (STATION A)
219
213
DISTRIBUTION SYSTEM
223
IP A1
209
IP CONNECTION (AWAKE, PRIMARY)
221
ACCESS POINT A
BASIC SERVICE SET A
203
PORTAL
215
INTERNET
217
IP B1
229
STATION B
227

FIG. 3

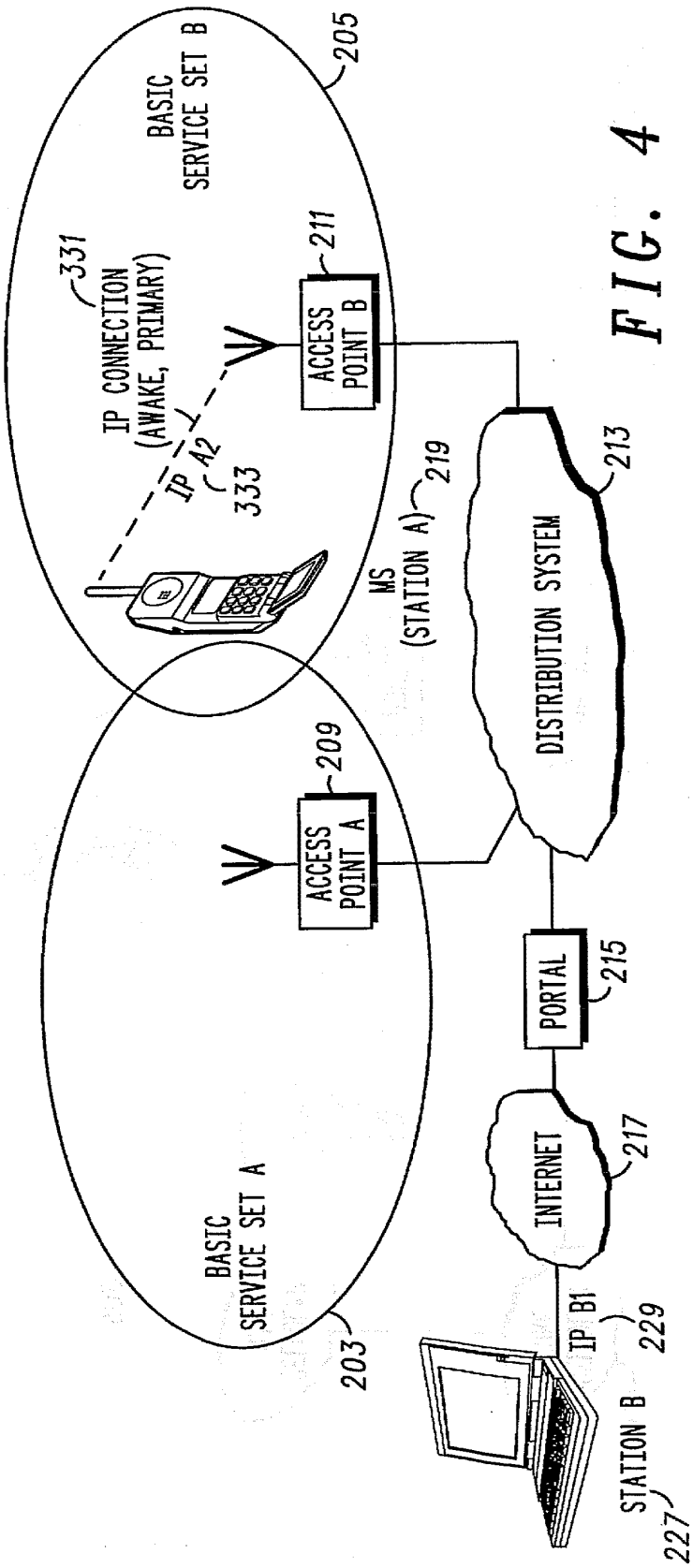

BASIC SERVICE SET B
205
331
IP CONNECTION (AWAKE, PRIMARY)
IP 42
333
ACCESS POINT B
211
MS (STATION A)
219
DISTRIBUTION SYSTEM
213
ACCESS POINT A
209
BASIC SERVICE SET A
203
PORTAL
215
INTERNET
217
IP B1
229
STATION B
227

FIG. 4

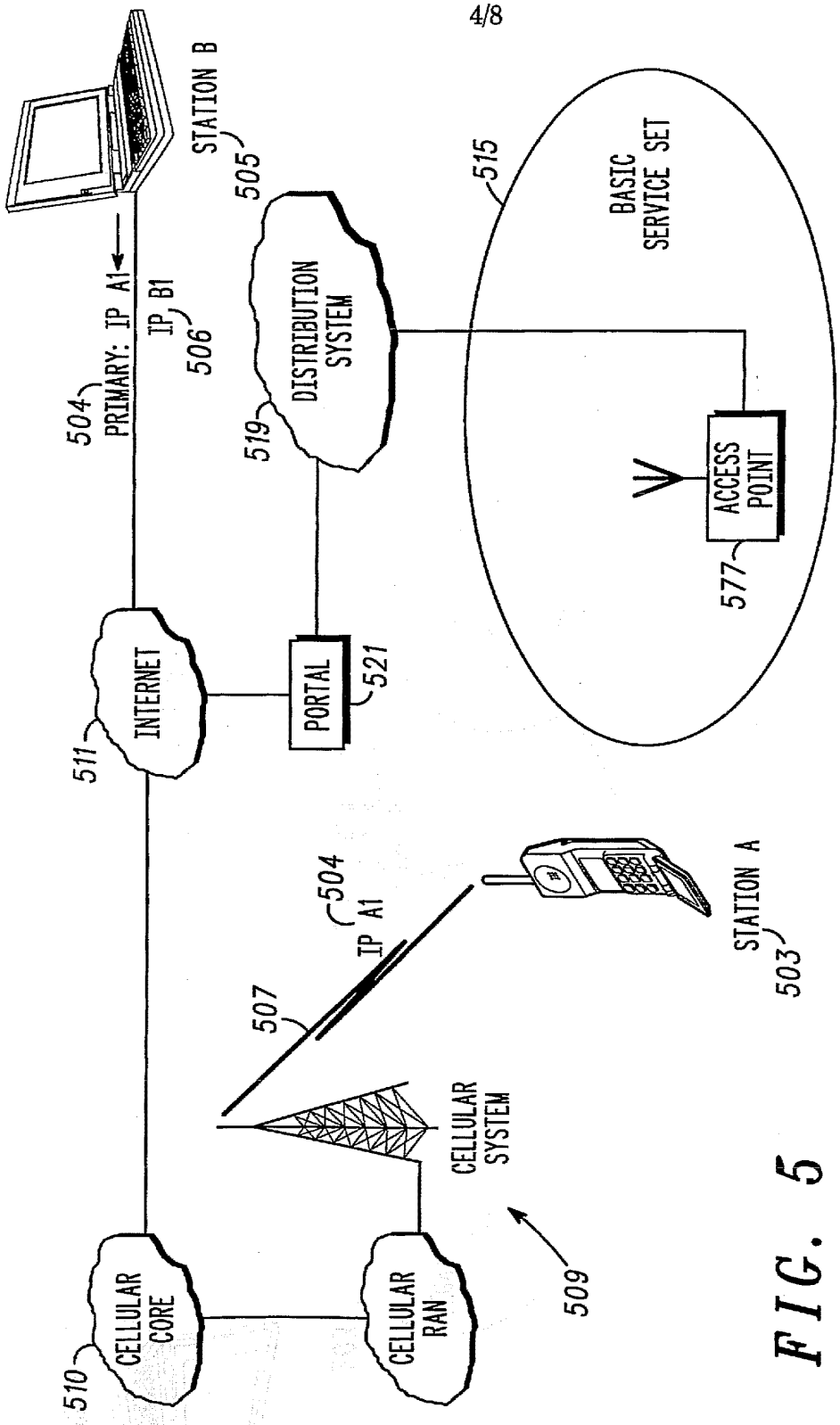

STATION B
505
BASIC SERVICE SET
515
DISTRIBUTION SYSTEM
519
PRIMARY: IP A1
504
IP B1
506
ACCESS POINT
577
INTERNET
511
PORTAL
521
504
IP A1
507
STATION A
503
CELLULAR SYSTEM
509
CELLULAR CORE
510
CELLULAR RAN

FIG. 5

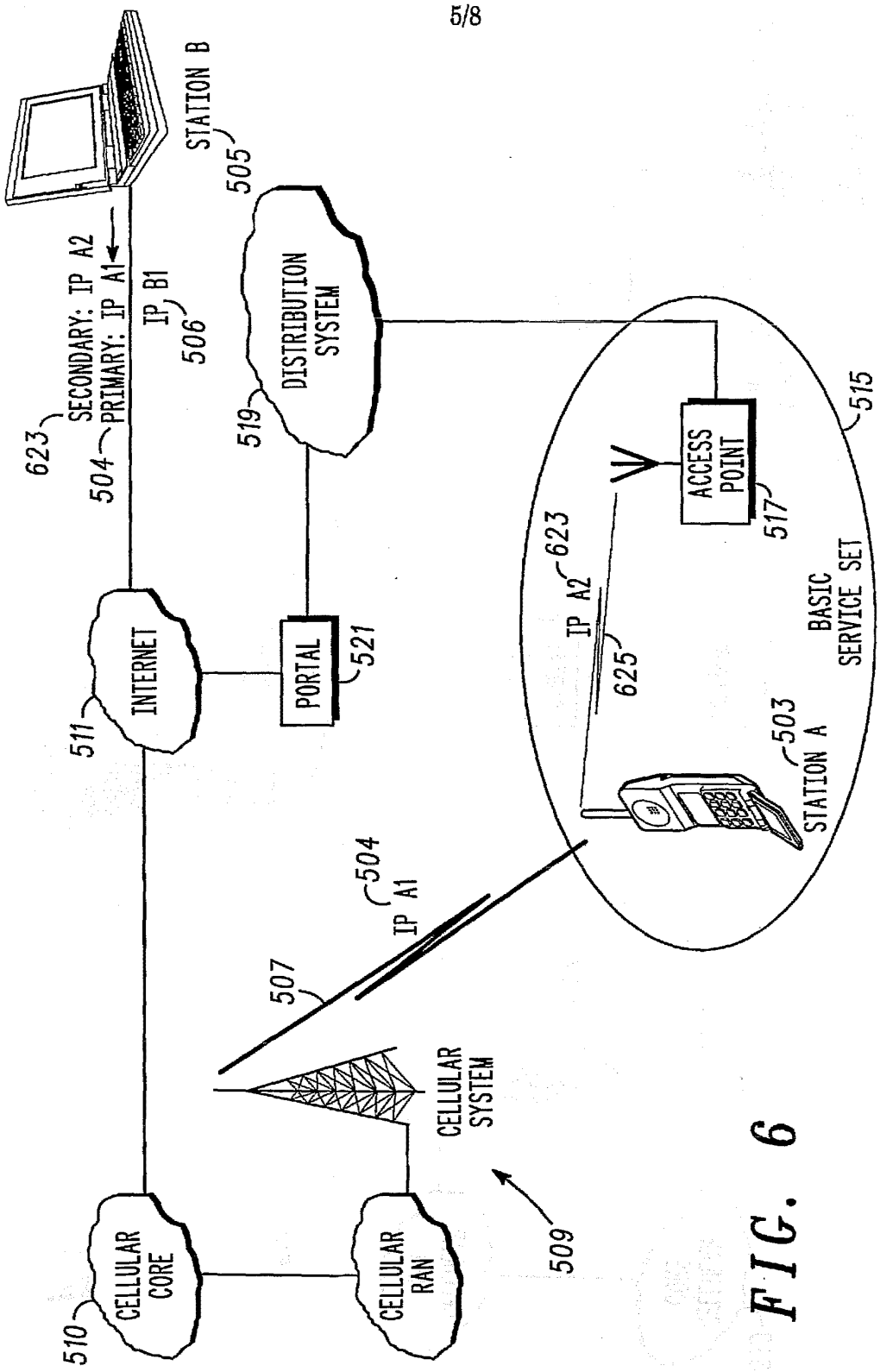

STATION B
505
SECONDARY: IP A2
PRIMARY: IP A1
623
504
IP B1
506
DISTRIBUTION SYSTEM
519
INTERNET
511
PORTAL
521
ACCESS POINT
517
515
623
IP A2
625
BASIC SERVICE SET
503
STATION A
504
IP A1
507
CELLULAR SYSTEM
509
CELLULAR CORE
510
CELLULAR RAN

FIG. 6

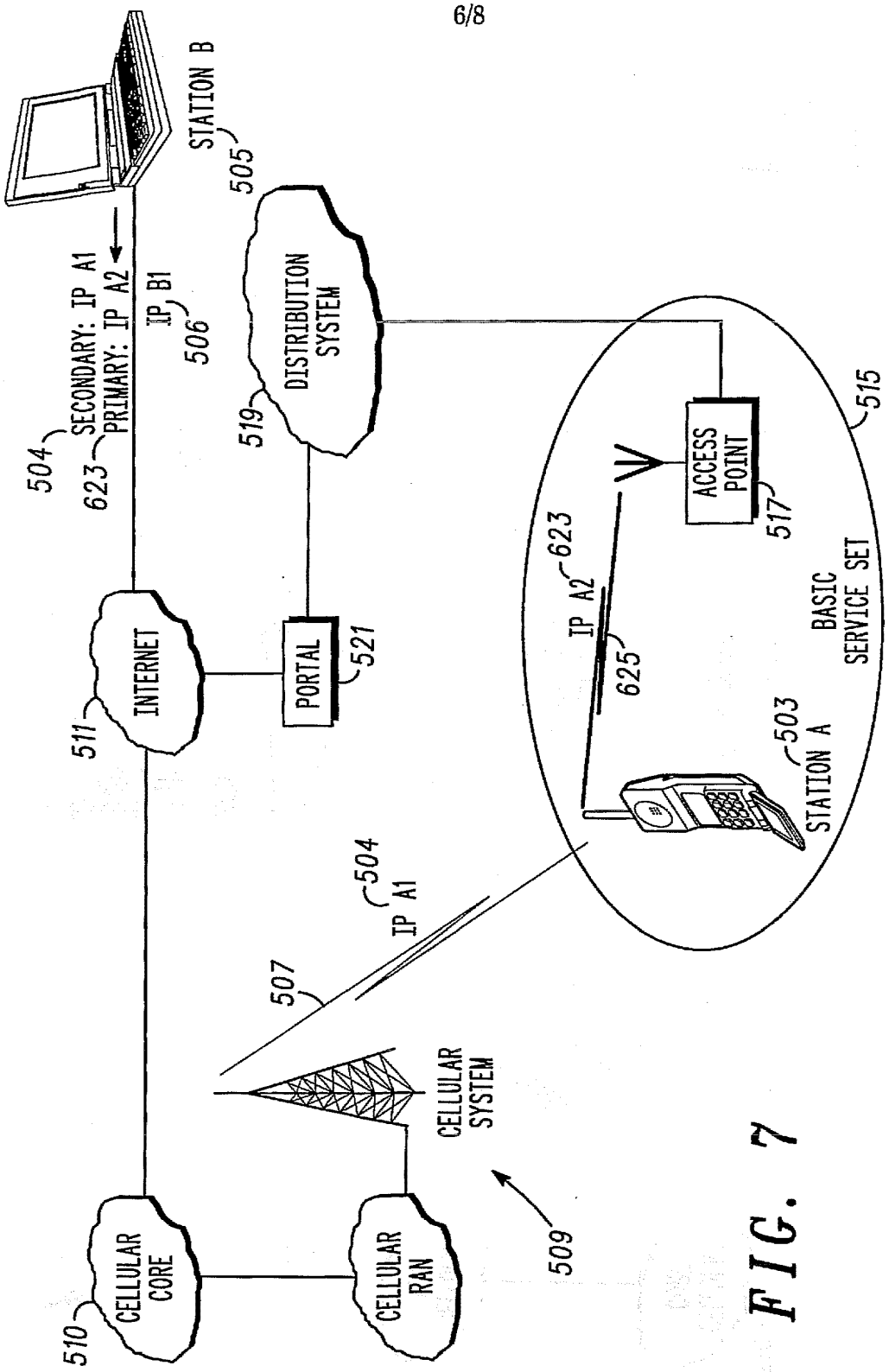

STATION B
505
SECONDARY: IP A1
PRIMARY: IP A2
IP B1
506
504
623
DISTRIBUTION SYSTEM
519
INTERNET
511
PORTAL
521
ACCESS POINT
517
515
623
IP A2
625
BASIC SERVICE SET
503
STATION A
504
IP A1
507
CELLULAR SYSTEM
509
CELLULAR CORE
510
CELLULAR RAN

FIG. 7

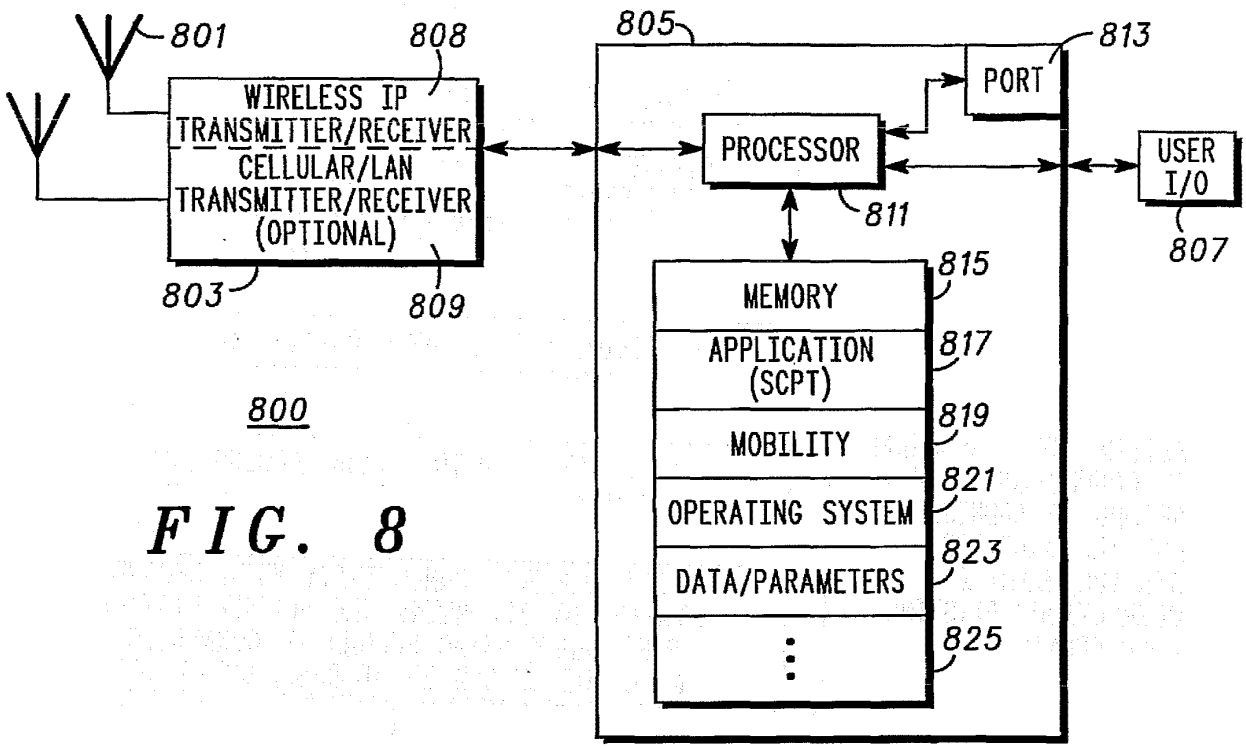

801
808
WIRELESS IP TRANSMITTER/RECEIVER
CELLULAR/LAN TRANSMITTER/RECEIVER (OPTIONAL)
803
809
805
813
PORT
PROCESSOR
811
USER I/O
807
815
MEMORY
817
APPLICATION (SCPT)
819
MOBILITY
821
OPERATING SYSTEM
823
DATA/PARAMETERS
825
800

FIG. 8

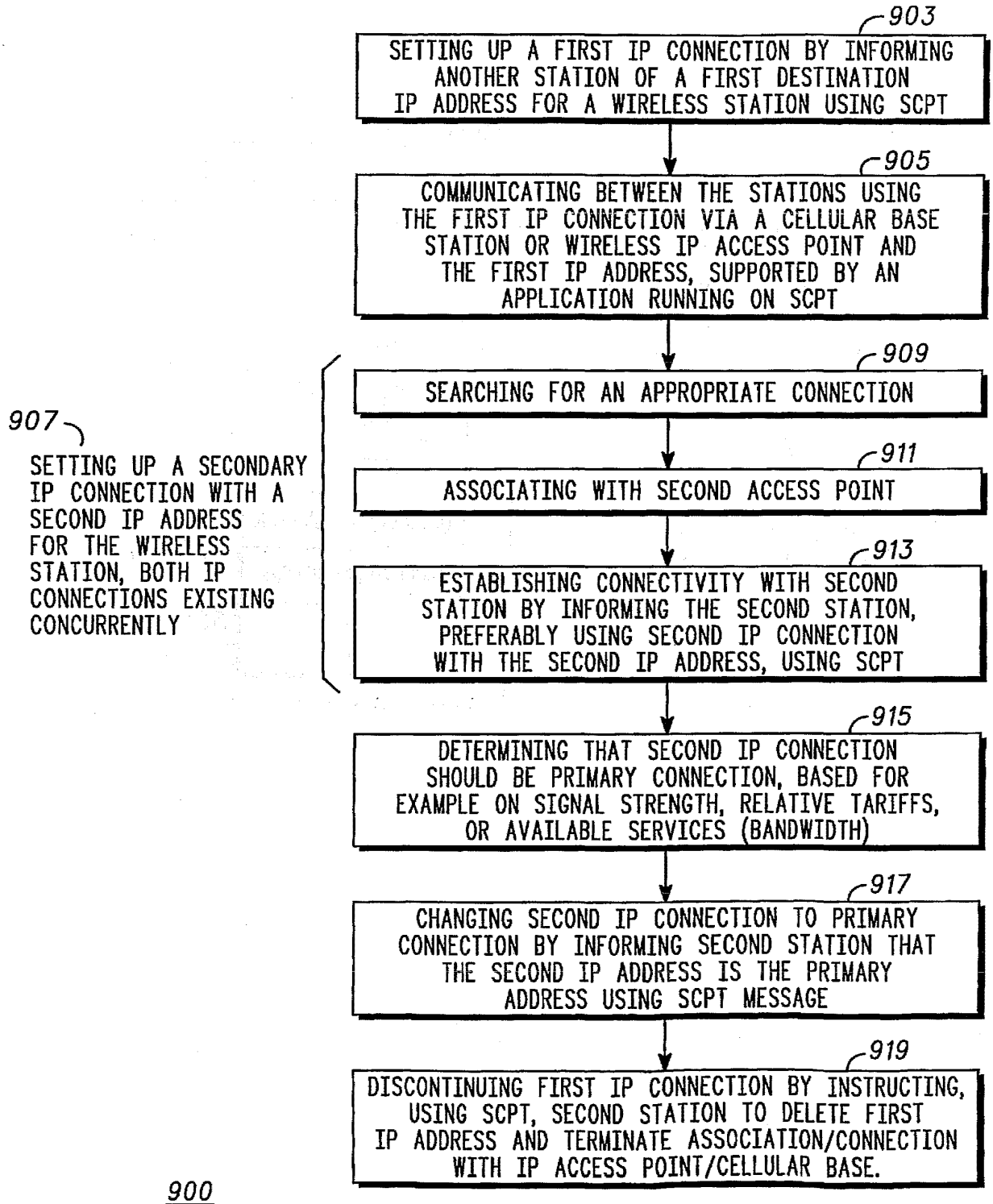

903
SETTING UP A FIRST IP CONNECTION BY INFORMING ANOTHER STATION OF A FIRST DESTINATION IP ADDRESS FOR A WIRELESS STATION USING SCPT
905
COMMUNICATING BETWEEN THE STATIONS USING THE FIRST IP CONNECTION VIA A CELLULAR BASE STATION OR WIRELESS IP ACCESS POINT AND THE FIRST IP ADDRESS, SUPPORTED BY AN APPLICATION RUNNING ON SCPT
909
SEARCHING FOR AN APPROPRIATE CONNECTION
907
SETTING UP A SECONDARY IP CONNECTION WITH A SECOND IP ADDRESS FOR THE WIRELESS STATION, BOTH IP CONNECTIONS EXISTING CONCURRENTLY
911
ASSOCIATING WITH SECOND ACCESS POINT
913
ESTABLISHING CONNECTIVITY WITH SECOND STATION BY INFORMING THE SECOND STATION, PREFERABLY USING SECOND IP CONNECTION WITH THE SECOND IP ADDRESS, USING SCPT
915
DETERMINING THAT SECOND IP CONNECTION SHOULD BE PRIMARY CONNECTION, BASED FOR EXAMPLE ON SIGNAL STRENGTH, RELATIVE TARIFFS, OR AVAILABLE SERVICES (BANDWIDTH)
917
CHANGING SECOND IP CONNECTION TO PRIMARY CONNECTION BY INFORMING SECOND STATION THAT THE SECOND IP ADDRESS IS THE PRIMARY ADDRESS USING SCPT MESSAGE
919
DISCONTINUING FIRST IP CONNECTION BY INSTRUCTING, USING SCPT, SECOND STATION TO DELETE FIRST IP ADDRESS AND TERMINATE ASSOCIATION/CONNECTION WITH IP ACCESS POINT/CELLULAR BASE.
900

FIG. 9

D2

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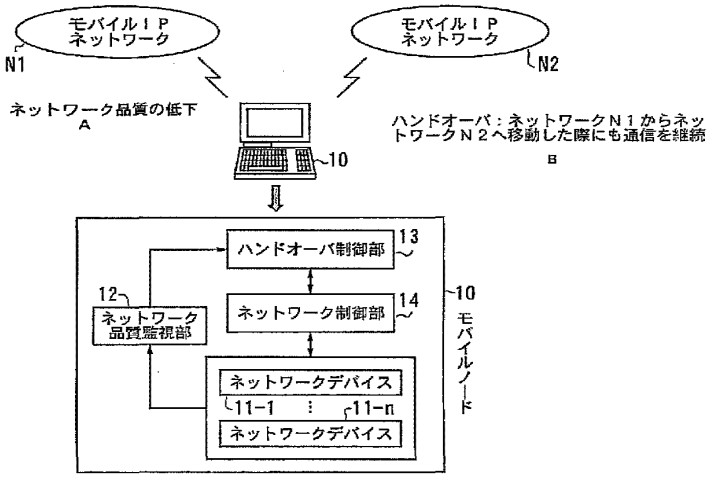
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[続葉有]

(54) Title: MOBILE NODE

(54) 発明の名称: モバイルノード



N1...MOBILE IP NETWORK
N2...MOBILE IP NETWORK
A...DEGRADATION OF NETWORK QUALITY
B...HANDOVER: COMMUNICATION IS CONTINUED EVEN WHEN NETWORK N1 IS SWITCHED TO NETWORK N2
10...MOBILE NODE
13...HANDOVER CONTROL PART
14...NETWORK CONTROL PART
12...NETWORK QUALITY MONITOR PART
11-1...NETWORK DEVICE
11-n...NETWORK DEVICE

(57) Abstract: A mobile node (10) for performing a high quality handover processing that causes no communication interruption time and maintains an excellent communication continuation, has an interface function for connection to networks. A network quality monitor part (12) monitors the network quality on the basis of at least one of a radio band and the intensity of a radio wave received by network devices (11-1 through 11-n). In accordance with the state of the network quality, a handover control part (13) transmits, before an interruption of communication, a cover address to an address-registered destination, and changes communication information paths, thereby performing a handover for switching over to the connection of a new network. Receiving a response indicating that the cover address has been updated by the address-registered destination, a network control part (14) maintains, until the interruption of communication, the function of the reception via the current network.

(57) 要約: 通信中断時間を皆無とし、通信の継続性を良好に維持するための高品質なハンドオーバ処理を行うモバイルノード（１０）は、ネットワークと接続するインタフェース機能を有する。ネットワーク品質監視部（１２）は、ネットワークデバイス（１１−１）～（１１−ｎ）が受信する電波強度または無線帯域の少なくとも一方にもとづいて、ネットワーク品質を監視する。ハンドオーバ制御部（１３）は、ネットワーク品質の状態に応じて、通信が切断される前に、気付アドレスをアドレス登録先へ送信して、通信情報の経路を変更し、あらたなネットワークに接続先を切替えるためのハンドオーバを行う。ネットワーク制御部（１４）は、気付アドレスがアドレス登録先で更新されたことを示す応答を受信し、通信が切断されるまでは、切替え前のネットワークとの受信機能を維持する。

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(81) 指定国 (国内): 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, GB, GD, GE, 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, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) 指定国 (広域): ARIPO 特許 (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), ユーラシア特許 (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), ヨーロッパ特許 (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, SI, SK, TR), OAPI 特許 (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

添付公開書類:
— 国際調査報告書

２文字コード及び他の略語については、定期発行される各*PCT*ガゼットの巻頭に掲載されている「コードと略語のガイダンスノート」を参照。

能を有していれば、別のネットワークへ移動したとしても、ユーザは引き続きストリーミング音楽を聴くことが可能になる。このようなハンドオーバ制御は、ユーザにわからないように瞬時に行う必要があるが、音声情報のみの通信よりもむしろ、データ通信に対して非常に重要なものとなる。

従来のハンドオーバ技術では、現在接続中のネットワークとの切断を検出した場合に、あらかじめ設定されたユーザのポリシー及びそのときに使用可能なネットワークを自動的に選択して、ネットワークの切替えを実施していた。

また、受信電界強度を測定し、測定結果が基準値以下になったら弱電界強度で使用されていると判断して、他基地局にハンドオーバ処理を行う技術が提案されている。例えば、特開２０００－５０３３７号公報（段落番号〔０００５〕～〔００１０〕，第２図）参照。

しかし、上記のような従来技術では、前者の場合、接続されているネットワークの切断を検出した後に、ハンドオーバ処理を実施するため、切断されてからネットワーク接続の切替えが完了するまでは通信が途切れるため（中断されるため）、パケット受信中にネットワーク接続の切替えが行われると、パケットロスが発生するという問題があった。

例えば、ストリーミング放送聴取中であれば、画像や音声が途絶えることになり、この間にストリーミングデータ等のパケットが届いた場合には、パケットロスが発生してしまう。

一方、従来技術（特開２０００－５０３３７号公報）に関しては、ネットワークの切断後ではなく、受信電界強度が基準値以下になったときにハンドオーバを行う構成であるが、ネットワーク切替えに伴うモバイルノードの登録処理については何ら考慮されていないので、ハンドオーバ処理後に通信を再開できないおそれがあるといった問題があった。

すなわち、ネットワーク切替え後であってもそれに伴うモバイルＩＰの登録処理がネットワーク側で完了していなければ、あらたな移動先のネットワークで正常に通信を開始することはできない。したがって、モバイルノードは、移動前の旧ネットワークを経由したパケットをハンドオーバ処理後においても所定の時間は受信を許容する必要がある。

明　細　書

モバイルノード

技術分野

本発明は、モバイルノードに関し、特にモバイルＩＰ（Internet Protocol）ネットワーク上で通信を行うモバイルノードに関する。

背景技術

近年、マルチメディアの進展に伴い、情報ネットワークに対する要求は高度化、多様化してきており、ユビキタス・ネットワーク社会の実現に向けて急速に開発が進められている（ユビキタス（ubiquitous）とは、ラテン語で「同時に至る所にある、遍在する」という意味である）。ユビキタス・ネットワークは、いつでもどこでも簡単にコンピューターを利用できる環境（ユビキタス・コンピューティング）を目指して、情報化社会の次ステージとして注目されている。

ユビキタス環境で重要なことは、ユーザが任意のタイミングでネットワークに接続できるということである。したがって、ケーブル接続によって自由度が制限されることのない無線通信に関する期待が最も高く、このため近年では、モバイルノードの高機能化が進んでおり、また１つのモバイルノードで複数のネットワーク（モバイルＩＰネットワーク）に多種多様な方法で接続する環境も整備化されてきている。

一方、モバイルＩＰの普及の鍵となる技術にハンドオーバがある。ハンドオーバとは、モバイルノードが現在のネットワークで通信中に、他のネットワークに移動した場合にも通信を継続できるように、ネットワークの接続先を自動的に切替る技術のことである。

例えば、カフェのテーブルで、無線ＬＡＮ（Local Area Network）機能の付いたＰＤＡ（Personal Digital Assistants：携帯情報端末）で音楽を聴いている人が、別の無線ＬＡＮ基地局を備えた隣のブティックに移動した場合（ＰＤＡや無線ＬＡＮはすべてモバイルＩＰに対応しているものとする）、ハンドオーバ機

また、無線ネットワークは、一度接続が確立してもすぐに切断されるといったことがある（例えば、電波受信エリア境界付近にいる場合）。したがって、ネットワーク接続のバタツキを防ぐためには切替え先となるネットワークが安定した状態となった上でハンドオーバ処理を実施するといったことも重要となってくる。

発明の開示

本発明はこのような点に鑑みてなされたものであり、通信中断時間を皆無とし、通信の継続性を良好に維持するための高品質なハンドオーバ処理を行うモバイルノードを提供することを目的とする。

本発明では上記課題を解決するために、図１に示すような、モバイルＩＰネットワーク上で通信を行うモバイルノード１０において、ネットワークと接続するインタフェース機能を有するネットワークデバイス１１－１～１１－ｎと、ネットワークデバイス１１－１～１１－ｎが受信する電波強度または無線帯域の少なくとも一方にもとづいて、ネットワーク品質を監視するネットワーク品質監視部１２と、ネットワーク品質の状態に応じて、通信が切断される前に、気付アドレスをアドレス登録先へ送信して、通信情報の経路を変更し、あらたなネットワークに接続先を切替えるためのハンドオーバを行うハンドオーバ制御部１３と、気付アドレスがアドレス登録先で更新されたことを示す応答を受信し、通信が切断されるまでは、切替え前のネットワークとの受信機能を維持するネットワーク制御部１４と、を有することを特徴とするモバイルノード１０が提供される。

ここで、ネットワークデバイス１１－１～１１－ｎは、ネットワークと接続するインタフェース機能を有する。ネットワーク品質監視部１２は、ネットワークデバイス１１－１～１１－ｎが受信する電波強度または無線帯域の少なくとも一方にもとづいて、ネットワーク品質を監視する。ハンドオーバ制御部１３は、ネットワーク品質の状態に応じて、通信が切断される前に、気付アドレスをアドレス登録先へ送信して、通信情報の経路を変更し、あらたなネットワークに接続先を切替えるためのハンドオーバを行う。ネットワーク制御部１４は、気付アドレスがアドレス登録先で更新されたことを示す応答を受信し、通信が切断されるまでは、切替え前のネットワークとの受信機能を維持する。

本発明の上記および他の目的、特徴および利点は本発明の例として好ましい実施の形態を表す添付の図面と関連した以下の説明により明らかになるであろう。

図面の簡単な説明

図１は、本発明のモバイルノードの原理図である。

図２は、モバイルノードの動作を示すシーケンス図である。

図３は、モバイルノードの構成を示す図である。

図４は、ネットワーク品質低下によるハンドオーバを示す図である。

図５は、ネットワーク品質復旧によるハンドオーバを示す図である。

図６は、ネットワーク品質監視部の動作を示すフローチャートである。

図７は、電波強度監視部の動作概念を示す図である。

図８は、電波強度監視部の動作を示すフローチャートである。

図９は、急激劣化閾値を用いた電波強度監視部の動作概念を示す図である。

図１０は、無線帯域監視部の動作を示すフローチャートである。

図１１は、品質管理テーブルを示す図である。

図１２は、ネットワーク状態管理部の動作を示すフローチャートである。

図１３は、ネットワーク切替え制御部の動作を示すフローチャートである。

図１４は、ネットワーク切替え制御部の動作を示すフローチャートである。

図１５は、経路制御用のルータ情報リストを示す図である。

図１６は、ネットワーク制御部の動作を示すフローチャートである。

図１７は、インタフェース処理部の動作を示すフローチャートである。

図１８は、リンク処理部の動作を示すフローチャートである。

図１９は、アクセスポイント切替えのハンドオーバを説明するための図である。

発明を実施するための最良の形態

以下、本発明の実施の形態を図面を参照して説明する。図１は本発明のモバイルノードの原理図である。モバイルノード１０は、モバイルＩＰネットワーク上で通信を行う端末装置であり、ノートパソコン、ＰＤＡ、携帯電話機などに該当する。なお、本発明の機能は、モバイルＩＰｖ４、モバイルＩＰｖ６のいずれに

も適用可能である。

ネットワークデバイス１１－１～１１－ｎは、ネットワークと接続するインタフェース機能をそれぞれ有し、例えば、ＮＩＣ（ネットワーク・インタフェース・カード）に該当する。モバイルノード１０は、無線ＬＡＮや第３世代携帯電話ネットワークのＦＯＭＡ（登録商標、以下省略）などのネットワークと接続するネットワークデバイスを複数搭載し、１端末で複数のネットワークと接続することができる。

ネットワーク品質監視部１２は、ネットワークデバイス１１－１～１１－ｎが受信する電波強度または無線帯域の少なくとも一方にもとづいて、ネットワーク品質を監視する。

ハンドオーバ制御部１３は、ネットワーク品質の状態に応じて、通信が切断される前に、気付アドレス（ＣｏＡ：Care of Address）をアドレス登録先（ホームエージェントなど）へ送信して、通信情報（ＩＰパケット）の経路を変更し、あらたなネットワークに接続先を切替えるためのハンドオーバを行う。ネットワークの接続切替えとしては、現在通信しているモバイルＩＰネットワークからあらたなモバイルＩＰネットワークへの切替えを行う。

なお、気付アドレスとは、モバイルノード１０が移動先のネットワークで一時的に使用するＩＰアドレスのことである。また、ホームエージェント（ＨＡ：Home Agent）とは、モバイルノード１０のホームネットワークに存在して、モバイルノード１０宛の情報を配信したり、モバイルノード１０の位置を認識するノードである。

また、接続先のネットワーク選択については、ハンドオーバ制御部１３は、ユーザが設定可能なユーザ優先度（ネットワーク接続の優先順位）を記憶し、ネットワーク品質の変化に応じて、優先順位の高いネットワークへハンドオーバを行うようにする。または、ネットワーク品質監視部１２で管理される、後述のネットワーク品質指標にもとづいてハンドオーバを行うようにする。

ネットワーク制御部１４は、気付アドレスがアドレス登録先で更新されたことを示す応答を受信し、切替え前のネットワークとの通信が切断されるまでは、切替え前のネットワークとのパケット受信機能を維持する。

ここで、モバイルノード１０が最初、ネットワークＮ１と通信を行っており、ネットワークＮ２へ移動した場合、本発明では、ネットワークＮ１のネットワーク品質の低下を認識すると、ハンドオーバ処理を行い（すなわち、ネットワークが切断される前にネットワーク品質の低下を認識するとハンドオーバを行う）、ネットワークＮ２と接続して通信を継続する。また、このとき、切替え前のネットワークＮ１との通信が切断されるまでは、ネットワークＮ１から送信されるパケットを受信する。これにより、パケットロスを生じることのない（通信中断時間が皆無）ハンドオーバが可能になる。

次にシーケンス図を用いて全体動作について説明する。図２はモバイルノード１０の動作を示すシーケンス図である。最初、モバイルノード１０は、無線ＬＡＮを介して通信を行っており、携帯電話ネットワーク（ＦＯＭＡなど）側へ移動して、その後、携帯電話ネットワークを介して通信を行うものとする。

〔Ｓ１〕モバイルノード１０において、無線ＬＡＮを介して通信を行っている場合に携帯電話ネットワーク側へ移動し、無線ＬＡＮから離れていくことで、無線ＬＡＮとのネットワーク品質が低下する。なお、ネットワーク品質の状態変化は、実際にはモバイルノード１０の移動とは関係なく、モバイルノード１０で検出されるものである。

〔Ｓ２〕モバイルノード１０は、現在通信している無線ＬＡＮとのネットワーク品質の低下を示すイベントを検出し、ハンドオーバ処理を起動する。

〔Ｓ３〕モバイルノード１０は、ＲＳ（Router Solicitation）を携帯電話ネットワークを介してアクセスルータ（ＡＲ：Access Router）へ送信する。ＲＳとは、プレフィクス情報（ＩＰｖ６ならば、１２８ビット長のＩＰｖ６アドレスの上位６４ビットのネットワーク識別子のこと）の取得要求のことであり、ＡＲは、ＩＰネットワークと携帯電話ネットワークとのトラフィック・ルーティングを行うルータのことである。

〔Ｓ４〕ＡＲは、ＲＡ（Router Advertisement：プレフィクス情報の通知）を携帯電話ネットワークを介してモバイルノード１０へ返信する。

〔Ｓ５〕モバイルノード１０は、ＢＵ（Binding Update：気付アドレスの登録要求）を携帯電話ネットワークを介してＨＡへ送信する。

〔Ｓ６〕ＨＡは、ＢＡ（Binding Acknowledgement：気付アドレスの登録応答）を携帯電話ネットワークを介してモバイルノード１０へ返信する。

〔Ｓ７〕モバイルノード１０は、無線ＬＡＮで行っていた通信を、携帯電話ネットワーク、ＡＲ、ＨＡを通じて継続する。

〔Ｓ８〕モバイルノード１０と無線ＬＡＮとの通信が切断する。なお、ステップＳ１のネットワーク品質低下からステップＳ８の切断までは、モバイルノード１０は無線ＬＡＮからのパケットの受信を継続して行っている。

次にモバイルノード１０の構成について説明する。図３はモバイルノード１０の構成を示す図である。図中、太実線矢印はデータを示し、細実線矢印は制御信号を示す。モバイルノード１０は、ネットワークデバイス１１、ネットワーク品質監視部１２、モバイルＩＰ制御部（本発明のハンドオーバ制御部に該当）１３、ネットワーク制御部１４、アプリケーション１５、パケット入力部１６、パケット出力部１７を有する。

アプリケーション１５は、上位アプリケーションであり、他ノードとの通信を実施したり、ユーザにサービスを提供するソフトウェアである。アプリケーション１５は、ネットワークデバイス１１の通信インタフェースの停止（ダウン）処理や、ダイヤルアップの電話接続等のリンク切断処理を実施するアプリケーションを含んでおり、ユーザの指示によりネットワーク制御部１４に対してインタフェースダウン処理またはリンク切断処理を要求する。

モバイルＩＰ制御部１３は、ネットワーク状態管理部１３ａ、ネットワーク切替え制御部１３ｂ、ハンドオーバ実行部１３ｃ、端末管理部１３ｄから構成され、モバイルノード１０の全体管理やハンドオーバ制御を行う。

ネットワーク状態管理部１３ａは、ネットワーク品質監視部１２からのネットワーク品質変化イベントを受信すると、品質状況に応じてネットワーク切替え要求をネットワーク切替え制御部１３ｂに通知する。

ネットワーク切替え制御部１３ｂは、ネットワーク切替え要求にしたがい、ネットワーク品質の変化（例えば、電波強度の低下／復旧、無線帯域の不足／復旧、ネットワーク接続の切断／確立）に応じて、ハンドオーバ実行部１３ｃにハンドオーバ要求を出力し、また、ネットワーク切替えのための指示をネットワーク制

御部１４に出力する。

ハンドオーバ実行部１３ｃは、ハンドオーバ要求にもとづき、モバイルＩＰハンドオーバを実行する。端末管理部１３ｄは、モバイルノード情報を管理し、モバイルノード１０の通信制御及び必要に応じてネットワーク切替え要求をネットワーク切替制御部１３ｂに出力する。また、パケットデータ出力要求をパケット出力部１７へ送信する。

パケット入力部１６は、ネットワークデバイス１１を介して受信したパケットデータの入力処理を行う。パケット出力部１７は、パケットデータ出力要求に応じて、ネットワークデバイス１１を介して、該当ネットワークへパケットデータを送信する。

ネットワーク制御部１４は、パケット送受信制御部１４ａ、インタフェース処理部１４ｂ、リンク制御部１４ｃから構成され、ネットワークデバイス１１の管理及びパケット送受信の全体管理を行う。

パケット送受信制御部１４ａは、パケットの送信／受信制御を行い、ネットワーク切替え時には、切替え前の旧ネットワークとのパケット受信機能を維持したまま、切替え後の新ネットワークとの送受信を実施する。

インタフェース処理部１４ｂは、ネットワークデバイス１１のパケット入出力インタフェースの状態管理制御を行う。さらに、アプリケーション１５の要求により、インタフェースのダウン処理を実施する場合には、対象となるネットワークデバイスの通信インタフェースが現在接続中であれば、ネットワーク切替え要求をネットワーク切替え制御部１３ｂにて実施して、ハンドオーバを実行し、その後（ネットワーク切替え完了後）にダウン処理を行う。また、ネットワークデバイスのインタフェースがアップ（起動）した場合は、該当のネットワークデバイスが有効になったことをネットワーク切替え制御部１３ｂに通知する。

リンク制御部１４ｃは、ネットワークデバイス１１が通信を行うネットワークのリンクの状態管理制御を行う。また、アプリケーション１５の指示によりリンクの切断処理の開始時に、対象となるリンクが現在接続中であれば、ネットワーク切替え要求をネットワーク切替え制御部１３ｂに実施し、ハンドオーバを実行し、その後（ネットワーク切替え完了後）にリンクの切断処理を行う。さらに、

ネットワークデバイスのリンクがアップ（接続確立）した場合は、ネットワークの接続が確立したことをネットワーク切替え制御部１３ｂに通知する。

ネットワークデバイス１１は、ネットワーク種別に応じてネットワークとのインタフェース接続制御及び接続状態の管理を行う。例えば、ネットワーク種別としては、無線ＬＡＮ１１－１、ＦＯＭＡ１１－２、Bluetooth１１－３、ＰＤＣ（Personal Digital Cellular）１１－４等のネットワークデバイス（ＮＩＣのこと）が存在する（なお、無線インタフェースのデバイスだけでなく、有線インタフェースを持つデバイスを備えてもよい）。

ネットワーク品質監視部１２は、電波強度監視部１２ａ、無線帯域監視部１２ｂから構成される。電波強度監視部１２ａは、各種ネットワークデバイス１１の電波強度を、固定または可変に設定された周期で、またはパケット受信を契機として監視する（周期監視とパケット受信を契機とした監視との両方を用いてもよい）。そして、ネットワーク品質の変化を検出した場合には、ネットワーク状態管理部１３ａにネットワーク品質変化イベントを送信する。

無線帯域監視部１２ｂは、各種ネットワークデバイス１１の無線帯域状態を、固定または可変に設定された周期で、またはパケット受信を契機として監視する（周期監視とパケット受信を契機とした監視との両方を用いてもよい）。そして、ネットワーク品質の変化を検出した場合には、ネットワーク状態管理部１３ａにネットワーク品質変化イベントを送信する。

次にネットワーク品質が低下した際の本発明のハンドオーバについて詳しく説明する。図４はネットワーク品質低下によるハンドオーバを示す図である。最初にネットワークのシステム構成（図のシステムは一例である）について説明する。

ＩＰネットワーク１０１には、ＨＡ２０、コレスポンデント・ノード（ＣＮ：Correspondent Node）１０４、ＡＲ（アクセスルータ）３１、４１が接続する。無線ＬＡＮ１０２には、ＡＲ３１、アクセスポイント（ＡＰ：Access Point）３２が接続し、携帯電話ネットワーク（ＦＯＭＡ等）１０３には、ＡＲ４１、無線基地局（ＢＳ：Base Station）４２が接続する。

図に示すようなネットワークシステムに対して、モバイルノード１０は、無線ＬＡＮ１０２から携帯電話ネットワーク１０３への異種ネットワーク間における

ハンドオーバを行うものとする。

〔Ｓ１１〕モバイルノード１０は、ネットワークデバイス１１－１（無線ＬＡＮ用のＮＩＣ）を用いて、ＣＮ１０４とＩＰネットワーク１０１、ＡＲ３１、無線ＬＡＮ１０２、ＡＰ３２を通じて通信を行っており、ＣＮ１０４からパケットがモバイルノード１０に向けて送信されている。

〔Ｓ１２〕ＮＩＣ１１－１が受信する電波強度の低下、または無線帯域の不足が生じると、モバイルノード１０は現在通信を行っているネットワーク接続が切断する前にネットワーク品質の低下を検出し、メインインタフェースをネットワークデバイス１１－２（携帯電話ネットワーク用のＮＩＣ）に変更して、ＮＩＣ１１－２から通信可能な携帯電話ネットワーク１０３上にあるＡＲ４１へＲＳを送信する。

〔Ｓ１３〕ＡＲ４１はＲＳを受信すると直ちにＲＡをモバイルノード１０へ返信する。

〔Ｓ１４〕モバイルノード１０は、ＲＡを受信すると携帯電話ネットワーク１０３内で使用する気付アドレスを生成し、ＡＲ４１をデフォルトルータとして選択する。そして、ＮＩＣ１１－１を使用した経路からの上りのパケット送信を抑止する。その後、ＨＡ２０にＢＵの送信（気付アドレスの送信）を行う。

なお、デフォルトルータとは、すべてのルータに、例えば、インターネット上のすべてのホストやネットワークに対する経路をあらかじめ設定しておくのは無理があるので、最も頻繁に使う汎用的な経路（デフォルトルート）のルーティングを行うルータのことである。

〔Ｓ１５〕ＨＡ２０は、モバイルノード１０よりＢＵを受けとると、モバイルノード１０のホームアドレスと気付アドレスとが対応するデータベースを更新し（すなわち、気付アドレスの更新）、応答としてＢＡを返信する。

〔Ｓ１６〕モバイルノード１０は、通信中であったＣＮ１０４にもＢＵを送信する。

〔Ｓ１７〕ＣＮ１０４は、以後新しい経路である、ＩＰネットワーク１０１、ＡＲ４１、携帯電話ネットワーク１０３、ＢＳ４２を通じてパケットをモバイルノード１０に送信する。

なお、上記の一連のシーケンス中、ＮＩＣ１１－１は無線ＬＡＮ１０２との接続状態を維持しているため、パケット受信は継続されるので、ＣＮ１０４がＢＵを受信する前にモバイルノード１０に向けて無線ＬＡＮ１０２を介してパケットを送信した場合でも、ＮＩＣ１１－１を使用して受信することができる。したがってパケットのロスを生じることなくハンドオーバすることが可能となる。

次にネットワーク品質の復旧に伴う本発明のハンドオーバについて詳しく説明する。図５はネットワーク品質復旧によるハンドオーバを示す図である。図４で上述したハンドオーバで、モバイルノード１０が携帯電話ネットワーク１０３を介してＣＮ１０４と通信を行っている場合に、無線ＬＡＮ１０２側のネットワーク品質が復旧したものとする。

〔Ｓ２１〕モバイルノード１０は、ＮＩＣ１１－２を用いて、ＣＮ１０４とＩＰネットワーク１０１、ＡＲ４１、携帯電話ネットワーク１０３、ＢＳ４２を通じて通信を行っており、ＣＮ１０４からパケットがモバイルノード１０に向けて送信されている。

〔Ｓ２２〕ＮＩＣ１１－１方向（無線ＬＡＮ１０２）のネットワーク品質が復旧すると、モバイルノード１０はその旨を検出し、メインインタフェースをＮＩＣ１１－２からＮＩＣ１１－１へ変更して、無線ＬＡＮ１０２上にあるＡＲ３１へＲＳを送信する。

〔Ｓ２３〕ＡＲ３１は、ＲＳを受信すると直ちにＲＡをモバイルノード１０へ返信する。

〔Ｓ２４〕モバイルノード１０は、ＲＡを受信すると、無線ＬＡＮ１０２で使用する気付アドレスを生成し、メインインタフェースとして選択したＮＩＣ１１－１方向の経路をデフォルトルートにする。また、ＮＩＣ１１－２を使用した経路からの上りパケット送信を抑止する。その後にＢＵにより新しく生成した気付アドレスをＨＡ２０に通知する。

〔Ｓ２５〕ＨＡ２０は、ＢＵを受信すると、モバイルノード１０のホームアドレスと気付アドレスとが対応するデータベースを更新し、応答としてＢＡを返信する。

〔Ｓ２６〕モバイルノード１０は、通信中であったＣＮ１０４にもＢＵを送信す

る。

〔Ｓ２７〕ＣＮ１０４は、以後新しい経路である、ＩＰネットワーク１０１、ＡＲ３１、無線ＬＡＮ１０２、ＡＰ３２を通じてパケットをモバイルノード１０に送信する。

なお、上記の一連のシーケンス中、ＮＩＣ１１－２は携帯電話ネットワーク１０３との接続状態を維持しているため、パケット受信は継続されるので、ＣＮ１０４がＢＵを受信する前にモバイルノード１０に向けて携帯電話ネットワーク１０３を介しパケットを送信した場合でも、ＮＩＣ１１－２を使用して受信することができる。したがってパケットのロスを生じることなくハンドオーバすることが可能となる。

また、ここでのネットワーク品質の復旧に伴うハンドオーバについては、無線ＬＡＮ１０２方向のネットワークの優先順位が、携帯電話ネットワーク１０３よりも高いものとして、携帯電話ネットワーク１０３から無線ＬＡＮ１０２へのネットワーク切替えを行ったが、携帯電話ネットワーク１０３と無線ＬＡＮ１０２との優先順位が同程度のような場合では、携帯電話ネットワーク１０３のネットワーク品質が低下しなければ、必ずしもネットワーク品質の復旧に伴うハンドオーバを行う必要はない。

なお、上記で説明したハンドオーバは、無線ＬＡＮと携帯電話ネットワーク間のハンドオーバについて示したが、無線ＬＡＮの電波強度低下に伴う切替え先となるネットワークは例えば、Ethernet（登録商標）のような有線のネットワークでもよい。また、ネットワーク品質として、電波強度、無線帯域を測定する場合を示したが、有線ネットワークなどの場合は、ネットワークの接続確立が契機となり、このネットワーク接続確立を検出することで、有線ネットワークへのハンドオーバ処理を行うことも可能である。

次にネットワーク品質監視部１２の動作について説明する。ネットワーク品質監視部１２は、品質監視用のタイマを持っており、監視周期はアプリケーションから書き換え可能である。また、品質監視はタイマに設定された周期ごとに処理が起動される。さらに、タイマ起動以外にも、品質測定対象のネットワークデバイスがパケットを受信した契機にもネットワーク品質監視機能が呼び出される。

周期監視はタイマ満了時に動作するタイマハンドラが本機能を起動し、パケット受信を契機にした監視はハードウェア割り込みハンドラが起動する。どちらの処理により起動されたかを識別するためには、起動元のハンドラが、自身を識別するためのＩＤを、ネットワーク品質監視部１２の起動時のパラメータとして設定するといった方法による。

また、品質監視が過剰に起動されシステムのパフォーマンスに影響を与えることを防止するために（すなわち、処理が過負荷になるのを防止するために）、過剰監視防止用タイマを設けて必要以上に監視処理が実行されないようにする。ネットワーク品質監視機能が起動されると、過剰監視防止タイマのチェックが行われた後、すべての実装されたネットワークデバイス１１－１～１１－ｎについて電波強度監視部１２ａ及び無線帯域監視部１２ｂを用いてネットワーク品質を測定する。

図６はネットワーク品質監視部１２の動作を示すフローチャートである。

〔Ｓ３１〕過剰防止用タイマは満了しているか否かを判断する。満了（タイムカウント終了）ならばステップＳ３２へ、そうでなければ終了する。なお、過剰防止用タイマがタイムカウントしている場合はネットワーク品質の測定は行わない。

〔Ｓ３２〕実装されたすべてのネットワーク品質測定対象のネットワークデバイス１１－１～１１－ｎについてステップＳ３２ａ～ステップＳ３２ｅの該当処理を行う。

〔Ｓ３２ａ〕デバイス状態が接続か否か（ネットワークデバイス１１が装置に接続されているか否か）を判断する。接続ならステップＳ３２ｂへ、切断ならステップＳ３３へいく。

〔Ｓ３２ｂ〕ネットワーク状態が接続か否か（ネットワークデバイス１１が現在通信を行っているか否か）を判断する。接続ならステップＳ３２ｅへ、切断ならステップＳ３３へいく。

〔Ｓ３２ｃ〕電波強度監視部１２ａの処理を起動する。

〔Ｓ３２ｄ〕電波強度が通常状態ならばステップＳ３２ｅへ、低下状態ならばステップＳ３３へいく。

〔Ｓ３２ｅ〕無線帯域監視部１２ｂの処理を起動する。

〔Ｓ３３〕タイムアウトの呼び出しがあるか否かを判断する。呼び出しがあれば監視タイマ値に設定した時間後にスタートへ戻り、なければパケット受信契機によるネットワーク品質測定の起動であるためステップＳ３４へいく。

〔Ｓ３４〕過剰監視防止用タイマを起動し、ネットワーク品質測定処理を停止する。

次に電波強度監視部１２ａの動作について説明する。図７は電波強度監視部１２ａの動作概念を示す図である。縦軸は電波強度、横軸は時間であり、受信電波の波形を示している。

電波強度監視部１２ａは、電波状態の低下・復旧を判定するための２つの閾値を持つ。１つは電波強度が低下したことを判定するための低下閾値（圏外閾値）であり、もう１つは電波強度が復旧したことを判定するための復旧閾値（圏内閾値）である。これらの閾値の設定はアプリケーション１５の操作により任意に変更することができる。

ここで、１つの閾値しか設けていないと、閾値をまたぐ小さな電波強度の変化が頻繁に発生した場合に、その都度制御を切替えてしまうと、システムの処理負荷が増大してしまう。したがって、本発明では、低下・復旧の２種類の閾値を設けて、システムの処理負荷増大を防止する。また、電波強度の測定は図の場合、２００ｍｓ単位で測定している様子を示している。

電波強度監視部１２ａは、まず、通信中の無線チャネルの電波強度を読み出す。電波強度を読み出すには、例えば、無線ＬＡＮカードとのインタフェースを使って電波状態を問い合わせる、という方法がある。

電波強度の低下は、読み出した電波強度が低下閾値よりも低いことによって検出され、その場合にハンドオーバが実行される。ただし、レベルＬ１のように、低下閾値を下回っても短い時間で低下閾値を上回ってしまうような場合ではハンドオーバは行わない。なぜなら、電波状態が低下閾値付近で揺らいでいるような状態でハンドオーバを実行するとネットワーク切替えにバタツキが生じ、安定した接続制御が行えなくなるからである。

したがって、本発明では、受信する電波の品質が低下閾値を例えば、一定時間連続して下回った場合に、ネットワーク品質の低下と認識してはじめてハンドオ

ーバを実行する。例えば、図の場合、低下閾値をおよそ６００ｍｓ間下回ったレベルＬ２でハンドオーバを行うようにする。

なお、電波強度の低下を検出した場合、電波強度監視部１２ａは、ネットワーク状態管理部１３ａへ電波強度低下を通知し、自身の電波状態を低下に設定する。電波強度が低下となったため、それ以外の品質監視（無線帯域）については実施しない。その後、本機能がタイムアウトにより起動した場合、次回起動用のタイマを設定する。

一方、電波強度の復旧は、電波強度が低下状態から以後に読み出した電波強度が復旧閾値よりも大きな値であったときに検出され、その場合にハンドオーバが実行される。ただし、レベルＬ３のように、復旧閾値を上回っても短い時間で復旧閾値を下回ってしまうような場合にはハンドオーバは行わない。なぜなら、上記と同様な理由により、電波状態が復旧閾値付近で揺らいでいるような状態でハンドオーバを実行するとネットワーク切替えにバタツキが生じ、安定した接続制御が行えなくなるからである。

したがって、本発明では、受信する電波の品質が復旧閾値を例えば、一定時間連続して上回った場合に、ネットワーク品質の復旧と認識してはじめてハンドオーバを実行する。例えば、図の場合、復旧閾値をおよそ６００ｍｓ間上回ったレベルＬ４でハンドオーバを行っている。

なお、電波強度が復旧した場合、電波強度監視部１２ａは、ネットワーク状態管理部１３ａへ電波強度復旧を通知し、自身の電波強度状態を通常に設定し、その後に、無線帯域監視を実行することになる。また、さらに無線電波強度の値に移動平均等の統計手法を合わせて用いれば、一時的な電波強度の強弱の影響をより少なくすることができる。

図８は電波強度監視部１２ａの動作を示すフローチャートである。

〔Ｓ４１〕電波強度を読み出す。

〔Ｓ４２〕電波強度状態を判断する。通常ならばステップＳ４３へ、低下ならばステップＳ４６へいく。

〔Ｓ４３〕電波強度が例えば、一定時間連続して低下閾値より下回るか否かを判断する。下回ればステップＳ４４へ、そうでなければ終了する。

〔Ｓ４４〕電波強度低下をネットワーク状態管理部１３ａへ通知する。

〔Ｓ４５〕ネットワーク状態管理部１３ａに対し、電波強度状態が低下に設定される。

〔Ｓ４６〕電波強度が例えば、一定時間連続して復旧閾値より上回るか否かを判断する。上回ればステップＳ４７へ、そうでなければ終了する。

〔Ｓ４７〕電波強度復旧をネットワーク状態管理部１３ａへ通知する。

〔Ｓ４８〕ネットワーク状態管理部１３ａに対し、電波強度状態が通常に設定される。

次に急激劣化閾値を用いて電波強度の低下を認識しハンドオーバを行う場合について説明する。図９は急激劣化閾値を用いた電波強度監視部１２ａの動作概念を示す図である。縦軸は電波強度、横軸は時間である。

電波強度監視部１２ａは、低下閾値よりさらに低い値で急激劣化閾値を持っている。電波強度の測定時、電波強度が急激劣化閾値を下回ったときは、現在通信中のネットワークとの接続が維持できないと判断し、ハンドオーバを即時に開始させる。例えば、図の場合、２００ｍｓｅｃ単位で２回連続して急激劣化閾値を超えたレベルＬ５でハンドオーバが行われる。

このように、無線ＬＡＮのアクセスポイントの故障など予期せぬ事象により、現在使用中の電波が急激に劣化した場合、ネットワークの接続が切断される可能性がある。したがって、本発明では、このような場合に備えて、急激劣化閾値を設定し、瞬時にハンドオーバを行うことで、通信中断時間を最小限にする。

次に無線帯域監視部１２ｂの動作について説明する。無線帯域監視部１２ｂは、電波強度監視部１２ａと同様に、無線帯域の不足（ある無線帯域を使用するユーザ数が増加）・復旧の２つの閾値を用いて検出する。すなわち、帯域不足を判定するための閾値として不足閾値、帯域復旧判定のための閾値として復旧閾値を持つことになる。

無線帯域と閾値の比較については、電波強度監視の場合と同様である。なお、無線帯域読み出しの手段としては、実際に送受信されるパケットの平均転送速度を常時監視して結果を蓄積し、その情報を読み出したりする方法や、通信事業者が独自にプロトコルに実装した制御情報を見る方法などがある。

図１０は無線帯域監視部１２ｂの動作を示すフローチャートである。

〔Ｓ５１〕利用可能な無線帯域を読み出す。

〔Ｓ５２〕無線帯域状態を判断する。通常ならばステップＳ５３へ、不足ならばステップＳ５６へいく。

〔Ｓ５３〕無線帯域が例えば、一定時間連続して、不足閾値より下回るか否かを判断する。下回ればステップＳ５４へ、そうでなければ終了する。

〔Ｓ５４〕無線帯域不足をネットワーク状態管理部１３ａへ通知する。

〔Ｓ５５〕ネットワーク状態管理部１３ａに対し、無線帯域が不足に設定される。

〔Ｓ５６〕無線帯域が例えば、一定時間連続して、復旧閾値より上回るか否かを判断する。上回ればステップＳ５７へ、そうでなければ終了する。

〔Ｓ５７〕無線帯域復旧をネットワーク状態管理部１３ａへ通知する。

〔Ｓ５８〕ネットワーク状態管理部１３ａに対し、無線帯域状態が通常に設定される。

次にネットワーク品質監視部１２が管理する品質管理テーブルについて説明する。図１１は品質管理テーブルを示す図である。品質管理テーブルＴ１は、ネットワークデバイス１１－１～１１－ｎに対応して設けられる。

品質管理テーブルＴ１の各項目に対し、デバイス識別子とは該当ネットワークデバイスが無線ＬＡＮなのか携帯電話ネットワークなのか等を示す識別子である。電波状態とは、現在の通信における電波強度である。帯域状態とは現在の通信における無線帯域品質である。デバイス状態とは、該当ネットワークデバイスが使用可か不可か（装置に接続されているか否か）が示される。ネットワーク状態とは、メインインタフェースとして現在通信に使われているか否かが示される。

電波強度低下閾値とは、低下閾値の設定値である。電波強度復旧閾値とは、復旧閾値の設定値である。帯域不足閾値とは、帯域不足閾値の設定値である。帯域復旧閾値とは、帯域復旧閾値の設定値である。監視周期とは、例えば、２００ｍｓなどと設定される。

ネットワーク品質指標とは、ネットワーク品質とユーザの優先度とを重み付けして算出した指標のことである。ネットワーク品質と優先度とをそれぞれ数値化して、α×ネットワーク品質＋β×優先度（α、βは定数）といったようにネッ

トワーク品質指標を算出する。

このようなネットワーク品質指標にもとづきハンドオーバを行えば、より柔軟性のあるハンドオーバが可能になる。例えば、ネットワークＮ１はユーザ優先度が高であり、ネットワークＮ２はユーザ優先度が中である場合、優先度だけで切替えるべきネットワークを選択してしまうと、常にネットワークＮ１が選択されてしまう。

一方、ネットワークＮ１に対して優先度が高で品質が低であり、ネットワークＮ２に対して優先度が中で品質が高という場合には、ネットワークＮ１、Ｎ２に対してネットワーク品質指標を算出すれば、ネットワークＮ２が切替えるべきネットワークとして選択されることになる（すなわち、ネットワーク品質と優先度が加味された選択がなされることになる）。本発明では、ユーザ優先度にもとづくネットワーク切替え、またはネットワーク品質指標にもとづくネットワーク切替えの両方に対応可能である。

次にネットワーク状態管理部１３ａの動作について説明する。ネットワーク状態管理部１３ａは、現在メインとして使用中のインタフェース（ネットワークデバイス）及びインタフェース毎のネットワーク品質状態（通常・低下）を保持している。

電波強度監視部１２ａより電波強度低下の通知を受信した場合、そのインタフェースの電波状態が通常であれば、設定値を品質低下状態に変更する。そして対象のインタフェースがメインとして使用されていれば、ネットワーク切替え要求をネットワーク切替え制御部１３ｂへ送信する。

また、電波強度監視部１２ａより復旧が通知された場合、対象インタフェースの電波強度が低下状態であれば、品質を通常に戻し、ネットワーク切替え制御部１３ｂへネットワーク切替え要求を送信する。なお、無線帯域品質についても上記と同様な制御が行われる。

図１２はネットワーク状態管理部１３ａの動作を示すフローチャートである。

〔Ｓ６１〕ネットワーク品質監視イベントを受信したか否かを判断する。受信した場合は、イベント種別で分岐する。

〔Ｓ６２〕電波強度低下イベントを受信した場合、イベント対象の現在のインタ

フェース（ネットワークデバイス）の品質が低下状態か通常状態かを判断する。低下状態ならば設定はそのままなので変えずに、ステップＳ６１へ戻る。通常状態の場合はステップＳ６３へ行く。

〔Ｓ６３〕イベント対象のネットワークデバイスの設定を通常状態から低下状態に設定する。

〔Ｓ６４〕イベント対象のネットワークデバイスがメインインタフェースか否かを判断する。メインでなければステップＳ６１へ戻り、メインならばステップＳ６５へいく。

〔Ｓ６５〕ネットワーク切替え要求をネットワーク切替え制御部１３ｂへ送信する。

〔Ｓ６６〕無線帯域不足イベントを受信した場合、イベント対象の現在のインタフェース（ネットワークデバイス）の品質が帯域不足状態か通常状態かを判断する。帯域不足状態ならば設定はそのままなので変えずに、ステップＳ６１へ戻る。通常状態の場合はステップＳ６７へ行く。

〔Ｓ６７〕イベント対象のネットワークデバイスの設定を通常状態から帯域不足状態に設定し、ステップＳ６４へいく。

〔Ｓ６８〕電波強度復旧イベントを受信した場合、イベント対象の現在のインタフェース（ネットワークデバイス）の品質が低下状態か通常状態かを判断する。通常状態ならば設定はそのままなので変えずに、ステップＳ６１へ戻る。低下状態の場合はステップＳ６９へ行く。

〔Ｓ６９〕イベント対象のネットワークデバイスの設定を低下状態から通常状態に設定し、ステップＳ６５へいく。

〔Ｓ７０〕無線帯域復旧イベントを受信した場合、イベント対象の現在のインタフェース（ネットワークデバイス）の品質が不足状態か通常状態かを判断する。通常状態ならば設定はそのままなので変えずに、ステップＳ６１へ戻る。帯域不足状態の場合はステップＳ７１へ行く。

〔Ｓ７１〕イベント対象のネットワークデバイスの設定を不足状態から通常状態に設定し、ステップＳ６５へいく。

次にネットワーク切替え制御部１３ｂの動作について説明する。ネットワーク

切替え制御部１３ｂは、実装されているネットワークデバイスが、優先付けして管理する。ネットワーク切替え制御部１３ｂがネットワーク切替え要求を受信した場合、実装されているネットワークデバイスのネットワーク状態を優先度の高い順に検索し、最も優先される、通常状態のインタフェースを特定し、それをメインインタフェースとする。

メインインタフェースが変更された場合には、ネットワーク制御部１４へメインインタフェース変更要求を送信し、かつハンドオーバ実行部１３ｃへＲＳ送信要求をそれぞれ送信し、自身の状態をＲＡ受信待ちとする。そして、これを契機にネットワークのＡＲへＲＳが送信される。ＲＳは変更したメインインタフェースから出力される。

ＡＲからのＲＡ受信はパケット入力部１６から端末管理部１３ｄを通ってネットワーク切替え制御部１３ｂへ通知される。メインインタフェースでＲＡを受信すると、ネットワーク切替え制御部１３ｂはネットワーク制御部１４へ経路切替え要求を送信し、デフォルトルートの切替えを実施した後、ＨＡへのＢＵ送信をハンドオーバ実行部１３ｃへ要求する。最後にＨＡから返信されたＢＡ受信により、ハンドオーバは完了する。

図１３はネットワーク切替え制御部１３ｂの動作を示すフローチャートである。

〔Ｓ８１〕イベントを受信したか否かを判断する。受信した場合は、イベント種別で分岐する。

〔Ｓ８２〕ネットワーク切替え要求を受信した場合、すべてのネットワークについて優先度の高い順にステップＳ８２ａ～ステップＳ８２ｆの該当処理を行う。

〔Ｓ８２ａ〕インタフェース状態は通常状態か否かを判断する。通常でない場合はステップＳ８１へ、通常の場合はステップＳ８２ｂへいく。

〔Ｓ８２ｂ〕メインインタフェースとして該当のネットワークデバイスを選択する。

〔Ｓ８２ｃ〕メインインタフェースを変更するか否かを判断する。変更する場合はステップＳ８２ｄへ、変更しない場合はステップＳ８１へいく。

〔Ｓ８２ｄ〕ネットワーク制御部１４へメインインタフェース変更要求を送信する。

〔Ｓ８２ｅ〕ハンドオーバ実行部１３ｃへＲＳ送信要求を送信し、ステップＳ８２ｆへいく。

〔Ｓ８２ｆ〕状態をＲＡ受信待ちとし、ステップＳ８１へ戻る。

〔Ｓ８３〕イベント種別がＲＡ受信の場合、状態がＲＡ受信待ちか否かを判断する。ＲＡ受信待ちならステップＳ８３ａへいき、そうでなければ終了する。

〔Ｓ８３ａ〕メインインタフェースからの受信か否かを判断する。メインインタフェースからの受信の場合はステップＳ８３ｂへいき、そうでなければ終了する。

〔Ｓ８３ｂ〕ネットワーク制御部１４へ経路切替え要求を送信する。

〔Ｓ８３ｃ〕ハンドオーバ実行部１３ｃへＢＵ送信を要求する。

〔Ｓ８３ｄ〕状態をＢＡ受信待ちにし、ステップＳ８１へ戻る。

〔Ｓ８４〕イベント種別がＢＡ受信の場合、状態がＢＡ受信待ちか否かを判断する。ＢＡ受信待ちならステップＳ８４ａへいき、そうでなければ終了する。

〔Ｓ８４ａ〕メインインタフェースからの受信か否かを判断する。メインインタフェースからの受信の場合はステップＳ８４ｂへいき、そうでなければ終了する。

〔Ｓ８４ｂ〕状態をネットワーク切替え要求待ちにし、ステップＳ８１へ戻る。

図１４はネットワーク切替え制御部１３ｂの動作を示すフローチャートである。ネットワーク品質指標にもとづく切替え制御のフローチャートである。

〔Ｓ８５〕イベントを受信したか否かを判断する。受信した場合は、イベント種別で分岐する。

〔Ｓ８６〕ネットワーク切替え要求を受信した場合、すべてのネットワークについてネットワーク品質指標の高い順にステップＳ８６ａ～ステップＳ８６ｆの該当処理を行う。

〔Ｓ８６ａ〕インタフェース状態は通常状態か否かを判断する。通常でない場合はステップＳ８５へ、通常の場合はステップＳ８６ｂへいく。

〔Ｓ８６ｂ〕メインインタフェースとして該当のネットワークデバイスを選択する。

〔Ｓ８６ｃ〕メインインタフェースを変更するか否かを判断する。変更する場合はステップＳ８６ｄへ、変更しない場合はステップＳ８５へいく。

〔Ｓ８６ｄ〕ネットワーク制御部１４へメインインタフェース変更要求を送信す

る。

〔Ｓ８６ｅ〕ハンドオーバ実行部１３ｃへＲＳ送信要求を送信し、ステップＳ８６ｆへいく。

〔Ｓ８６ｆ〕状態をＲＡ受信待ちとし、ステップＳ８５へ戻る。

〔Ｓ８７〕イベント種別がＲＡ受信の場合、状態がＲＡ受信待ちか否かを判断する。ＲＡ受信待ちならステップＳ８７ａへいき、そうでなければ終了する。

〔Ｓ８７ａ〕メインインタフェースからの受信か否かを判断する。メインインタフェースからの受信の場合はステップＳ８７ｂへいき、そうでなければ終了する。

〔Ｓ８７ｂ〕ネットワーク制御部１４へ経路切替え要求を送信し、ステップＳ８５へ戻る。

〔Ｓ８７ｃ〕ハンドオーバ実行部１３ｃへＢＵ送信を要求する。

〔Ｓ８７ｄ〕状態をＢＡ受信待ちにする。

〔Ｓ８８〕イベント種別がＢＡ受信の場合、状態がＢＡ受信待ちか否かを判断する。ＢＡ受信待ちならステップＳ８８ａへいき、そうでなければ終了する。

〔Ｓ８８ａ〕メインインタフェースからの受信か否かを判断する。メインインタフェースからの受信の場合はステップＳ８８ｂへいき、そうでなければ終了する。

〔Ｓ８８ｂ〕状態をネットワーク切替え要求待ちにし、ステップＳ８５へ戻る。

次にネットワーク制御部１４の動作について説明する。ネットワーク制御部１４は、メインインタフェース変更要求を受信した場合は、メインインタフェースの切替えを行い、また経路切替え要求を受信した場合は、デフォルトルートを指定のインタフェース方向とし、それ以外のインタフェースへの送信経路を無効にすることで、指定インタフェース向け以外にパケットが送信できないようにする。

図１５は経路制御用のルータ情報リストを示す図である。ルータ情報リストＴ２は、ネットワーク制御部１４で管理される。図において最上段にあるルータ情報に対応したインタフェースがメインインタフェースである。

ルータ情報リストＴ２の各項目に対し、ルータリスト識別子とは、無線ＬＡＮのルータリストなのか携帯電話ネットワークのルータリストなのか等を示す識別子である。ルータアドレスとは、該当ネットワークデバイスの現在の通信において接続するルータのアドレスである。デバイス名とは、ネットワークデバイスの

名称（無線ＬＡＮデバイスなのか携帯電話ネットワークデバイスなのか）である。

電波強度状態とは、現在の通信における電波強度である。帯域状態とは、現在の通信における無線帯域品質である。デバイス状態とは、該当ネットワークデバイスが使用可か不可かが示される。ネットワーク状態とは、メインインタフェースとして現在使われているか否かが示される。

図１６はネットワーク制御部１４の動作を示すフローチャートである。

〔Ｓ９１〕イベントを受信したか否かを判断する。受信した場合は、イベント種別で分岐する。

〔Ｓ９２〕経路切替え要求を受信した場合、デフォルトルートを指定のインタフェース方向とする。

〔Ｓ９３〕指定インタフェース以外の送信経路を無効にし、ステップＳ９１へ戻る。

〔Ｓ９４〕メインインタフェース変更要求を受信した場合、メインインタフェースを指定のネットワークインタフェースに切替え、ステップＳ９１へ戻る。

次にネットワークデバイスの停止・起動に伴う本発明のハンドオーバについて説明する。ネットワークデバイス１１の起動・停止の操作はアプリケーション１５から可能であるが、本発明では停止が要求されて実際にネットワークデバイスが停止する前にあらかじめインタフェースを切替えることにより、ハンドオーバ処理を高速に行う。これにより、使用中インタフェースの停止に伴うパケットロスを減らすことができる。

また、ネットワークデバイス１１が停止状態にあるとき、起動を要求された場合にはインタフェースの起動処理を実施した後に切替えを要求する。これは起動処理が完了する前に切替え要求を送信すると、通信できないネットワークデバイスを向いたネットワークがデフォルトルートになりパケットの損失が発生する可能性があるためである。

ネットワーク制御部１４内のインタフェース処理部１４ｂは、インタフェースの停止要求を受信した場合、ネットワークデバイスの品質を停止の状態に変更した後、ネットワーク切替え制御部１３ｂへネットワーク切替え要求を送信する。

そして、ネットワーク切替え制御部１３ｂにおいて、ネットワーク品質が通常

状態のネットワークデバイスのうち優先順位が最も高いものが選択され、そのデバイスの向いたネットワークへのハンドオーバ処理が行われる。

その後、インタフェース処理部１４ｂは、ネットワークデバイスのインタフェースを切断する。また、デバイス起動要求を受信した場合には、ネットワークデバイスの起動処理実行後に、ネットワーク切替え要求をネットワーク切替え制御部１３ｂへ送信する。

図１７はインタフェース処理部１４ｂの動作を示すフローチャートである。

〔Ｓ１０１〕イベントを受信したか否かを判断する。受信した場合は、イベント種別で分岐する。

〔Ｓ１０２ａ〕起動要求を受信した場合、デバイス状態が通常か否かを判断する。通常ならステップＳ１０１へ戻り、そうでなければステップＳ１０２ｂへいく。

〔Ｓ１０２ｂ〕デバイス起動処理を行う。

〔Ｓ１０２ｃ〕デバイスの品質を通常状態にする。

〔Ｓ１０２ｄ〕ネットワーク切替え要求をネットワーク切替え制御部１３ｂへ通知し、ステップＳ１０１へ戻る。

〔Ｓ１０３ａ〕停止要求を受信した場合、デバイス状態が通常か否かを判断する。通常ならステップＳ１０１へ戻り、そうでなければステップＳ１０３ｂへいく。

〔Ｓ１０３ｂ〕デバイスの品質を停止予約状態にする。

〔Ｓ１０３ｃ〕ネットワーク切替え要求をネットワーク切替え制御部１３ｂへ通知し、ステップＳ１０１へ戻る。

〔Ｓ１０４〕切替え完了通知を受信した場合、停止予約状態のデバイスをすべて停止し、状態を停止にし、ステップＳ１０１へ戻る。

以上説明したように、上位アプリケーションからのインタフェースダウン（停止）処理が要求された場合に、対象となるインタフェースが接続されたネットワークが、カレントネットワークの場合は、即座にダウン（停止）処理を実施するのではなく、他のネットワークへのネットワーク切替処理及びハンドオーバ制御を実施し、処理完了後にダウン（停止）処理を実施する。これにより、モバイルノード１０が通信中であってもインタフェースダウン処理により、通信を中断することなく通信を継続することが可能になる。

次にリンクの切断・接続に伴う本発明のハンドオーバについて説明する。ネットワークの接続・切断の操作は、アプリケーション１５から可能であるが、本発明では、リンク切断が要求されて実際に切断する前にあらかじめネットワークを切替えてハンドオーバ処理を高速に行う。これにより、使用中ネットワークの停止に伴うパケットロスを減らすことができる。

また、ネットワークデバイスが切断状態にあるとき、リンク接続を要求された場合は、インタフェースの接続処理を実施した後に切替えを要求する。これはリンク接続処理が完了する前に切替え要求を送信すると、通信できないネットワークがデフォルトルートになりパケットの損失が発生する可能性があるためである。

図１８はリンク処理部１４ｃの動作を示すフローチャートである。

〔Ｓ１１１〕イベントを受信したか否かを判断する。受信した場合は、イベント種別で分岐する。

〔Ｓ１１２ａ〕起動要求を受信した場合、リンク状態が接続か否かを判断する。接続ならステップＳ１１１へ戻り、そうでなければステップＳ１１２ｂへいく。

〔Ｓ１１２ｂ〕リンク接続処理を行う。

〔Ｓ１１２ｃ〕リンク状態を通常状態にする。

〔Ｓ１１２ｄ〕ネットワーク切替え要求をネットワーク切替え制御部１３ｂへ通知し、ステップＳ１１１へ戻る。

〔Ｓ１１３ａ〕切断要求を受信した場合、リンク状態が接続か否かを判断する。接続ならステップＳ１１１へ戻り、そうでなければステップＳ１１３ｂへいく。

〔Ｓ１１３ｂ〕リンクの状態を切断予約状態にする。

〔Ｓ１１３ｃ〕ネットワーク切替え要求をネットワーク切替え制御部１３ｂへ通知し、ステップＳ１１１へ戻る。

〔Ｓ１１４〕切替え完了通知を受信した場合、切断予約状態のネットワークをすべて切断し、状態を切断にし、ステップＳ１１１へ戻る。

以上説明したように、上位アプリケーションからの電話切断等のリンク切断処理が要求された場合に、対象となるリンクが、カレントネットワークの場合は、即座にリンク切断処理を実施するのではなく、他のネットワークへのネットワーク切替え処理及びハンドオーバ制御を実施し、処理完了後にリンク切断処理を実

施する。これにより、モバイルノードが通信中であってもリンク切断処理により、通信を中断することなく通信を継続することが可能になる。

次にアクセスポイントを切替えることによる本発明のハンドオーバについて説明する。図１９はアクセスポイント切替えのハンドオーバを説明するための図である。無線ＬＡＮは、アクセスポイント５１、５２と接続する。最初、モバイルノード１０はアクセスポイント５１を介して通信を行っているとする。

アクセスポイント５１の電波強度が低下すると、モバイルノード１０は、ハンドオーバを行う。上述してきたハンドオーバでは、異種ネットワーク間のハンドオーバを対象にしたが、ここの例では同一のネットワーク内のアクセスポイントを切替えるものとする。

図の場合、アクセスポイント５１の電波強度が低下した場合には、切替え先をアクセスポイント５２にしてハンドオーバを行う。このように、接続中の無線通信の電波強度が弱まったとき、次の接続先メディア候補として無線ＬＡＮが選択された場合、現在接続の無線通信が接続不可となる前に接続可能なアクセスポイントを検索する。そして、接続中の無線通信との接続が維持できなくなった際、事前に検索しておいたアクセスポイントへ瞬時にハンドオーバを実現し通信を継続する。なお、このようなアクセスポイントのハンドオーバの詳細制御は、異種ネットワーク間のハンドオーバ制御と同様であるため、詳細制御の説明は省略する。

また、上記の例では、同一の無線ＬＡＮにおけるアクセスポイントの切替えについて示したが、異なる無線ＬＡＮ間でアクセスポイントの切替えを行ってもよい（例えば、無線ＬＡＮ５ａ上のアクセスポイント５１ａから無線ＬＡＮ５ｂ上のアクセスポイント５１ｂへの切替え）。

以上説明したように、本発明によれば、モバイルＩＰネットワーク上でのハンドオーバにおいて、ネットワークとの通信中断時間が皆無となるのでパケットロスの発生をなくすことができる。したがって、音声や画像などのＩＰ通信が途切れることなく、ネットワークのシームレスなハンドオーバをユーザに提供することが可能になる。

例えば、ユーザが本発明の機能を実装したＩＰ電話を用いて、通話を行ってい

る場合にネットワーク切替えに伴う通信中断をユーザに意識させることがない。また、ユーザが動画などのストリーミングデータを見ながら移動している場合にも、ネットワーク切替えに伴う動画の停止等が起きない。

さらに、本発明によれば、電波強度／無線帯域のそれぞれの閾値に対して、低下閾値及び復旧閾値を設け、ネットワークの切替え制御を行うことにより、安定した状態でのネットワーク接続を制御することができる。このため、無線ネットワークの境界付近等の電波強度が変化する領域であっても、ネットワークのバタツキ及びそれに伴うノイズの発生を最小限に抑えることができ、安定した品質のよい通信をユーザに提供することが可能になる。

以上説明したように、本発明のモバイルノードは、ネットワーク品質の状態に応じて、通信が切断される前に、気付アドレスをアドレス登録先へ送信して、通信情報の経路を変更し、あらたなネットワークに接続先を切替えるためのハンドオーバを行い、気付アドレスがアドレス登録先で更新され、通信が切断されるまでは、切替え前のネットワークとの受信機能を維持する構成とした。これにより、通信中断時間を皆無とし、また通信の継続性を良好に維持することができるので、モバイルＩＰネットワーク上での通信品質の向上を図ることが可能になる。

上記については単に本発明の原理を示すものである。さらに、多数の変形、変更が当業者にとって可能であり、本発明は上記に示し、説明した正確な構成および応用例に限定されるものではなく、対応するすべての変形例および均等物は、添付の請求項およびその均等物による本発明の範囲とみなされる。

請 求 の 範 囲

1． モバイルＩＰネットワーク上で通信を行うモバイルノードにおいて、

ネットワークと接続するインタフェース機能を有するネットワークデバイスと、

前記ネットワークデバイスが受信する電波強度または無線帯域の少なくとも一方にもとづいて、ネットワーク品質を監視するネットワーク品質監視部と、

ネットワーク品質の状態に応じて、通信が切断される前に、気付アドレスをアドレス登録先へ送信して、通信情報の経路を変更し、あらたなネットワークに接続先を切替えるためのハンドオーバを行うハンドオーバ制御部と、

前記気付アドレスがアドレス登録先で更新されたことを示す応答を受信し、通信が切断されるまでは、切替え前のネットワークとの受信機能を維持するネットワーク制御部と、

を有することを特徴とするモバイルノード。

2． 前記ネットワーク品質監視部は、現在通信しているネットワークのネットワーク品質の低下を認識すると、前記ハンドオーバ制御部は、あらたなネットワークへ接続先を切替えることを特徴とする請求の範囲第１項記載のモバイルノード。

3． 前記ネットワーク品質監視部は、切替え前のネットワークのネットワーク品質が復旧したことを認識すると、前記ハンドオーバ制御部は、元の切替え前のネットワークに接続先を戻すことを特徴とする請求の範囲第１項記載のモバイルノード。

4． 前記ハンドオーバ制御部は、ネットワーク接続の優先順位を記憶し、ネットワーク品質の変化に応じて、優先順位の高いネットワークへハンドオーバを行うことを特徴とする請求の範囲第１項記載のモバイルノード。

5． 前記ネットワーク品質監視部は、電波の品質低下を検出するための低下閾値と、品質復旧を検出するための復旧閾値とを有し、前記ハンドオーバ制御部は、受信する電波の品質が低下閾値を下回った場合には、ネットワーク品質低下に伴うハンドオーバを行い、受信する電波の品質が復旧閾値を上回った場合には、ネットワーク復旧に伴うハンドオーバを行うことを特徴とする請求の範囲第１項記

載のモバイルノード。

６． 前記ネットワーク品質監視部は、受信する電波の品質が低下閾値を一定時間安定して下回った場合に、ネットワーク品質の低下と認識してハンドオーバ要求を出力し、受信する電波の品質が復旧閾値を一定時間安定して上回った場合に、ネットワーク復旧と認識してハンドオーバ要求を出力することを特徴とする請求の範囲第５項記載のモバイルノード。

７． 前記ネットワーク品質監視部は、急激劣化閾値を有し、受信する電波が前記急激劣化閾値を下回った場合には、ネットワーク品質の低下と認識して即時にハンドオーバ要求を出力し、前記ハンドオーバ制御部は、ハンドオーバを行うことを特徴とする請求の範囲第１項記載のモバイルノード。

８． 前記ネットワーク品質監視部は、現在利用可能な無線帯域の不足を検出するための不足閾値と、無線帯域不足の復旧を検出するための復旧閾値とを有し、前記ハンドオーバ制御部は、無線帯域が不足閾値を下回った場合には、ネットワーク品質低下に伴うハンドオーバを行い、無線帯域が復旧閾値を上回った場合には、ネットワーク復旧に伴うハンドオーバを行うことを特徴とする請求の範囲第１項記載のモバイルノード。

９． 前記ネットワーク品質監視部は、固定または可変に設定された周期でのネットワーク品質の監視、またはパケット受信を契機としたネットワーク品質の監視の少なくとも一方を行うことを特徴とする請求の範囲第１項記載のモバイルノード。

１０． 前記ネットワーク制御部が、前記ネットワークデバイスの停止要求を検出した場合は、前記ハンドオーバ制御部は、前記ネットワークデバイスが停止する前にハンドオーバを行い、前記ネットワーク制御部が、前記ネットワークデバイスの起動要求を検出した場合は、前記ハンドオーバ制御部は、前記ネットワークデバイスの起動処理完了後にハンドオーバを行うことを特徴とする請求の範囲第１項記載のモバイルノード。

１１． 前記ネットワーク制御部が、前記ネットワークデバイスが使用するネットワークとのリンクの切断要求を検出した場合、前記ハンドオーバ制御部は、リンクが切断する前にハンドオーバを行い、前記ネットワーク制御部が前記ネット

ワークデバイスの接続要求を検出した場合は、前記ハンドオーバ制御部は、前記ネットワークデバイスの接続処理完了後にハンドオーバを行うことを特徴とする請求の範囲第１項記載のモバイルノード。

１２．　前記ネットワーク品質監視部は、ネットワーク品質と優先度とに重み付けして算出したネットワーク品質指標を管理し、前記ハンドオーバ制御部は前記ネットワーク品質指標にもとづき、ハンドオーバを行うことを特徴とする請求の範囲第１項記載のモバイルノード。

１３．　ネットワークに第１のアクセスポイントと第２のアクセスポイントが存在する際に、前記ネットワーク品質監視部は、現在通信中の第１のアクセスポイントからのネットワーク品質の低下を認識し、かつ第２のアクセスポイントのネットワーク品質から第２のアクセスポイントとの接続を可能と判断した場合は、前記ハンドオーバ制御部は、第１のアクセスポイントから第２のアクセスポイントへのハンドオーバを行うことを特徴とする請求の範囲第１項記載のモバイルノード。

１４．　モバイルＩＰネットワーク上での通信に対してハンドオーバを行うハンドオーバ方法において、

モバイルノードが複数のインタフェースのネットワークデバイスを実装し、モバイルノードが複数のネットワーク間を移動する場合であって、

前記ネットワークデバイスが受信する電波強度または無線帯域の少なくとも一方にもとづいて、ネットワーク品質を監視し、

ネットワーク品質の状態に応じて、通信が切断される前に、気付アドレスをアドレス登録先へ送信し、

前記気付アドレスがアドレス登録先で更新されたことを示す応答を受信し、通信が切断されるまでは、切替え前のネットワークとの受信機能を維持し、

前記気付アドレスの送信後に、通信情報の経路を変更し、あらたなネットワークに接続先を切替えるためのハンドオーバを行うことを特徴とするハンドオーバ方法。

１５．　現在通信しているネットワークのネットワーク品質の低下を認識すると、あらたなネットワークへ接続先を切替えることを特徴とする請求の範囲第１４項

記載のハンドオーバ方法。

１６．　切替え前のネットワークのネットワーク品質が復旧したことを認識すると、元の切替え前のネットワークに接続先を戻すことを特徴とする請求の範囲第１４項記載のハンドオーバ方法。

１７．　ネットワーク接続の優先順位を記憶し、ネットワーク品質の変化に応じて、優先順位の高いネットワークへハンドオーバを行うことを特徴とする請求の範囲第１４項記載のハンドオーバ方法。

１８．　電波の品質低下を検出するための低下閾値と、品質復旧を検出するための復旧閾値とを有し、受信する電波の品質が低下閾値を下回った場合には、ネットワーク品質低下に伴うハンドオーバを行い、受信する電波の品質が復旧閾値を上回った場合には、ネットワーク復旧に伴うハンドオーバを行うことを特徴とする請求の範囲第１４項記載のハンドオーバ方法。

１９．　受信する電波の品質が低下閾値を一定時間安定して下回った場合に、ネットワーク品質の低下と認識してハンドオーバを行い、受信する電波の品質が復旧閾値を一定時間安定して上回った場合に、ネットワーク復旧と認識してハンドオーバを行うことを特徴とする請求の範囲第１８項記載のハンドオーバ方法。

２０．　急激劣化閾値を有し、受信する電波が前記急激劣化閾値を下回った場合には、ネットワーク品質の低下と認識して、即時にハンドオーバを行うことを特徴とする請求の範囲第１４項記載のハンドオーバ方法。

２１．　現在利用可能な無線帯域の不足を検出するための不足閾値と、無線帯域不足の復旧を検出するための復旧閾値とを有し、無線帯域が不足閾値を下回った場合には、ネットワーク品質低下に伴うハンドオーバを行い、無線帯域が復旧閾値を上回った場合には、ネットワーク復旧に伴うハンドオーバを行うことを特徴とする請求の範囲第１４項記載のハンドオーバ方法。

２２．　固定または可変に設定された周期でのネットワーク品質の監視、またはパケット受信を契機としたネットワーク品質の監視の少なくとも一方を行うことを特徴とする請求の範囲第1.4項記載のハンドオーバ方法。

２３．　前記ネットワークデバイスの停止要求を検出した場合は、前記ネットワークデバイスが停止する前にハンドオーバを行い、前記ネットワークデバイスの

起動要求を検出した場合は、前記ネットワークデバイスの起動処理完了後にハンドオーバを行うことを特徴とする請求の範囲第１４項記載のハンドオーバ方法。

２４．　前記ネットワークデバイスが使用するネットワークとのリンクの切断要求を検出した場合は、リンクが切断する前にハンドオーバを行い、前記ネットワークデバイスの接続要求を検出した場合は、前記ネットワークデバイスの接続処理完了後にハンドオーバを行うことを特徴とする請求の範囲第１４項記載のハンドオーバ方法。

２５．　ネットワーク品質と優先度とに重み付けして算出したネットワーク品質指標にもとづき、ハンドオーバを行うことを特徴とする請求の範囲第１４項記載のハンドオーバ方法。

２６．　ネットワークに第１のアクセスポイントと第２のアクセスポイントが存在する際に、現在通信中の第１のアクセスポイントからのネットワーク品質の低下を認識し、かつ第２のアクセスポイントのネットワーク品質から第２のアクセスポイントとの接続を可能と判断した場合は、第１のアクセスポイントから第２のアクセスポイントへのハンドオーバを行うことを特徴とする請求の範囲第１４項記載のハンドオーバ方法。

２７．　モバイルＩＰネットワーク上で通信を行うモバイルＩＰシステムにおいて、

ネットワークと接続するインタフェース機能を有するネットワークデバイスと、前記ネットワークデバイスが受信する電波強度または無線帯域の少なくとも一方にもとづいて、ネットワーク品質を監視するネットワーク品質監視部と、ネットワーク品質の状態に応じて、通信が切断される前に、気付アドレスをアドレス登録先へ送信して、通信情報の経路を変更し、あらたな第１のネットワークに接続先を切替えるためのハンドオーバを行うハンドオーバ制御部と、前記気付アドレスがアドレス登録先で更新されたことを示す応答を受信し、通信が切断されるまでは、切替え前の第２のネットワークとの受信機能を維持するネットワーク制御部と、から構成されるモバイルノードと、

前記気付アドレスを受信し、前記モバイルノード宛の情報の配信及び位置を認識するホームエージェントと、

前記気付アドレスを受信するデフォルトルータと接続し、通信が切断されるまでは、第２のネットワークを介して通信情報を送信し、ハンドオーバ処理後、第１のネットワークを介して前記モバイルノードと通信を行うコレスポンデント・ノードと、

を有することを特徴とするモバイルＩＰシステム。

２８．　モバイルＩＰネットワーク上で通信を行うモバイルノードにおいて、

複数の異なるモバイルＩＰネットワークと通信可能なインタフェース機能を有するネットワークデバイスと、

前記ネットワークデバイスを介して、複数のモバイルＩＰネットワークの各品質状態に応じて、現在の通信しているモバイルＩＰネットワークから他方のモバイルＩＰネットワークに切替えを行うハンドオーバ制御部と、

を有することを特徴とするモバイルノード。

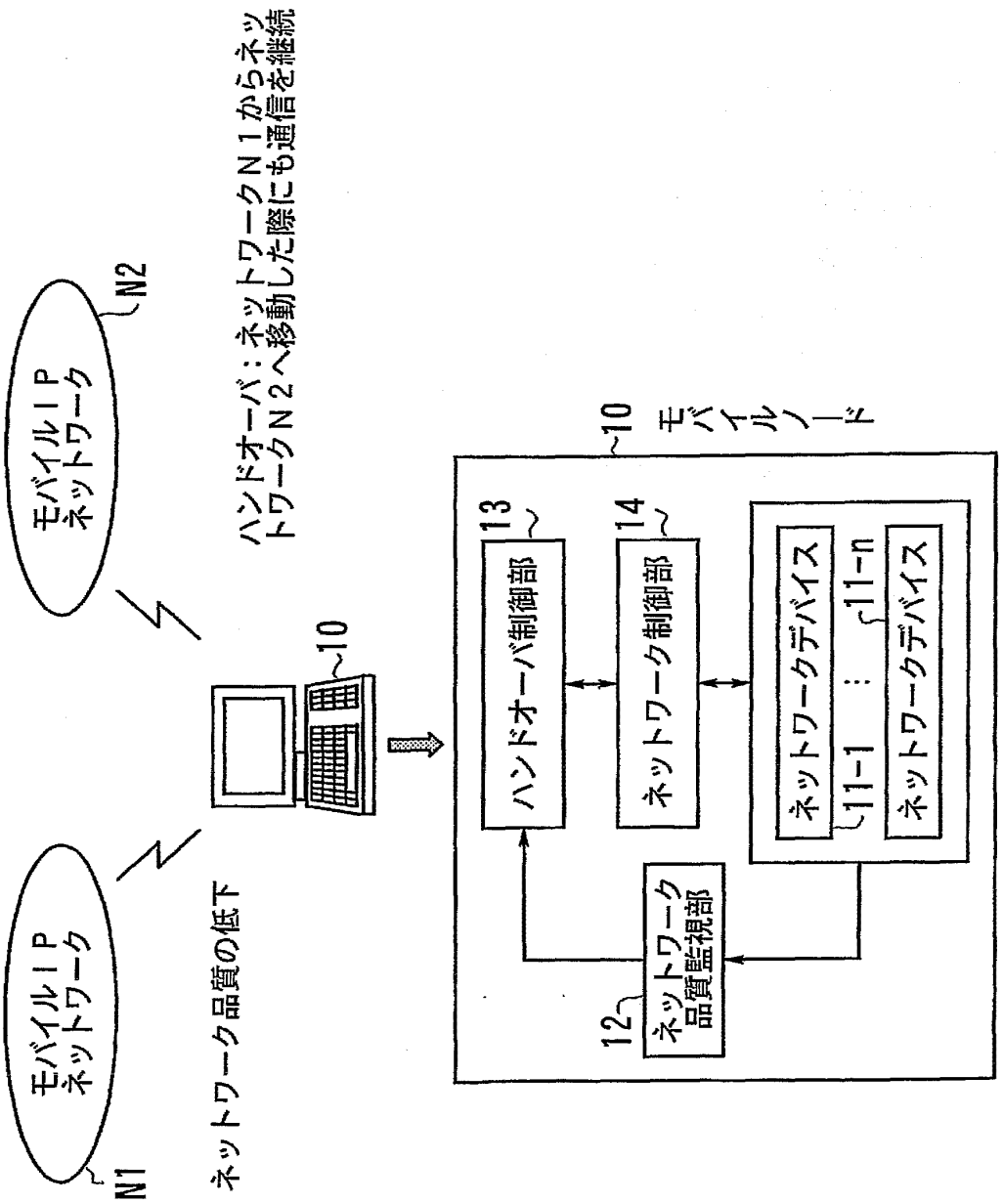

モバイルＩＰ
ネットワーク
N2
ハンドオーバ：ネットワークＮ１からネットワークＮ２へ移動した際にも通信を継続
10
モバイルノード
13
ハンドオーバ制御部
14
ネットワーク制御部
ネットワークデバイス
11-1
11-n
ネットワークデバイス
12
ネットワーク品質監視部
ネットワーク品質の低下
モバイルＩＰ
ネットワーク
N1

図１

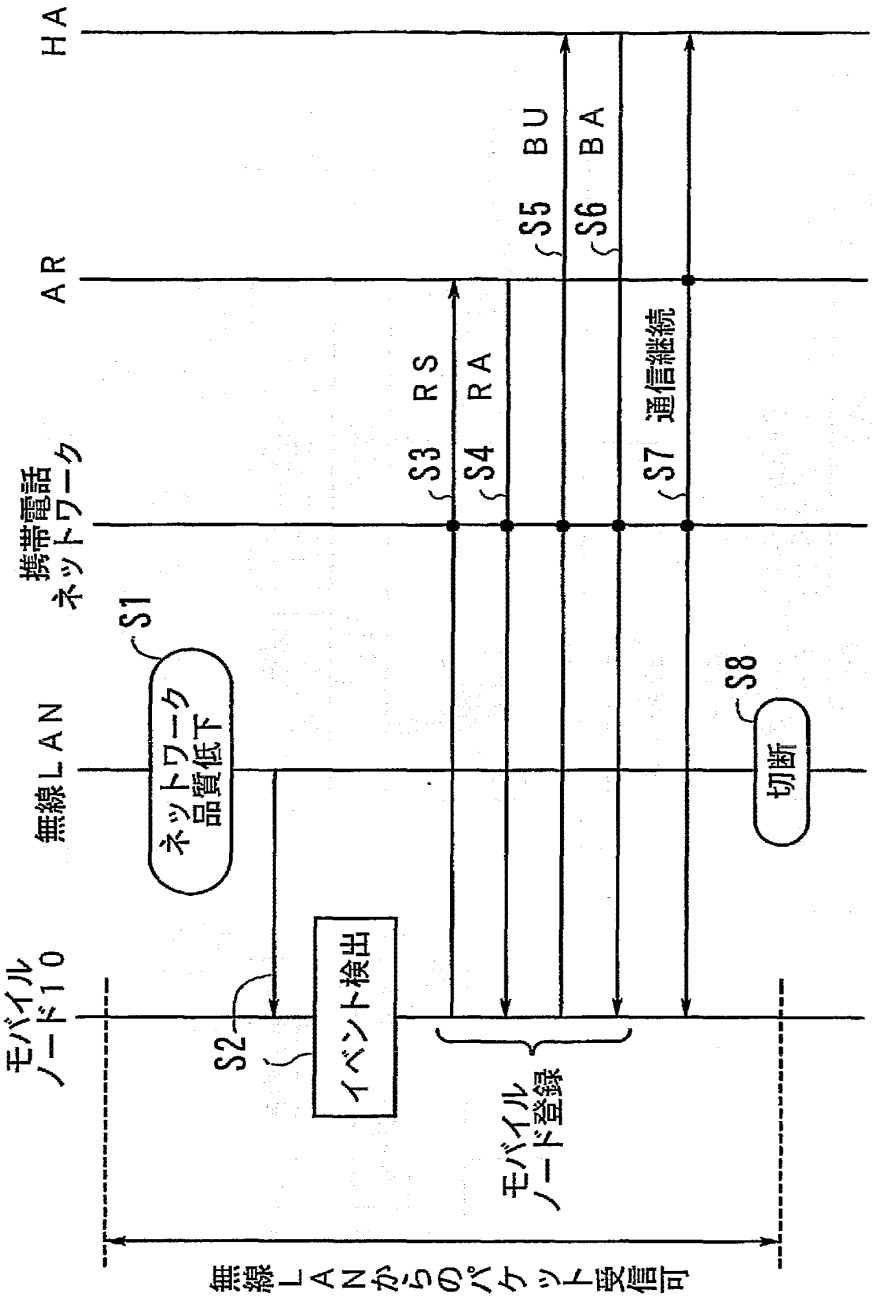

HA
AR
携帯電話ネットワーク
無線LAN
モバイルノード10
S1
ネットワーク品質低下
S2
イベント検出
S3 RS
S4 RA
S5 BU
S6 BA
S7 通信継続
S8
切断
モバイルノード登録
無線LANからのパケット受信可

図2

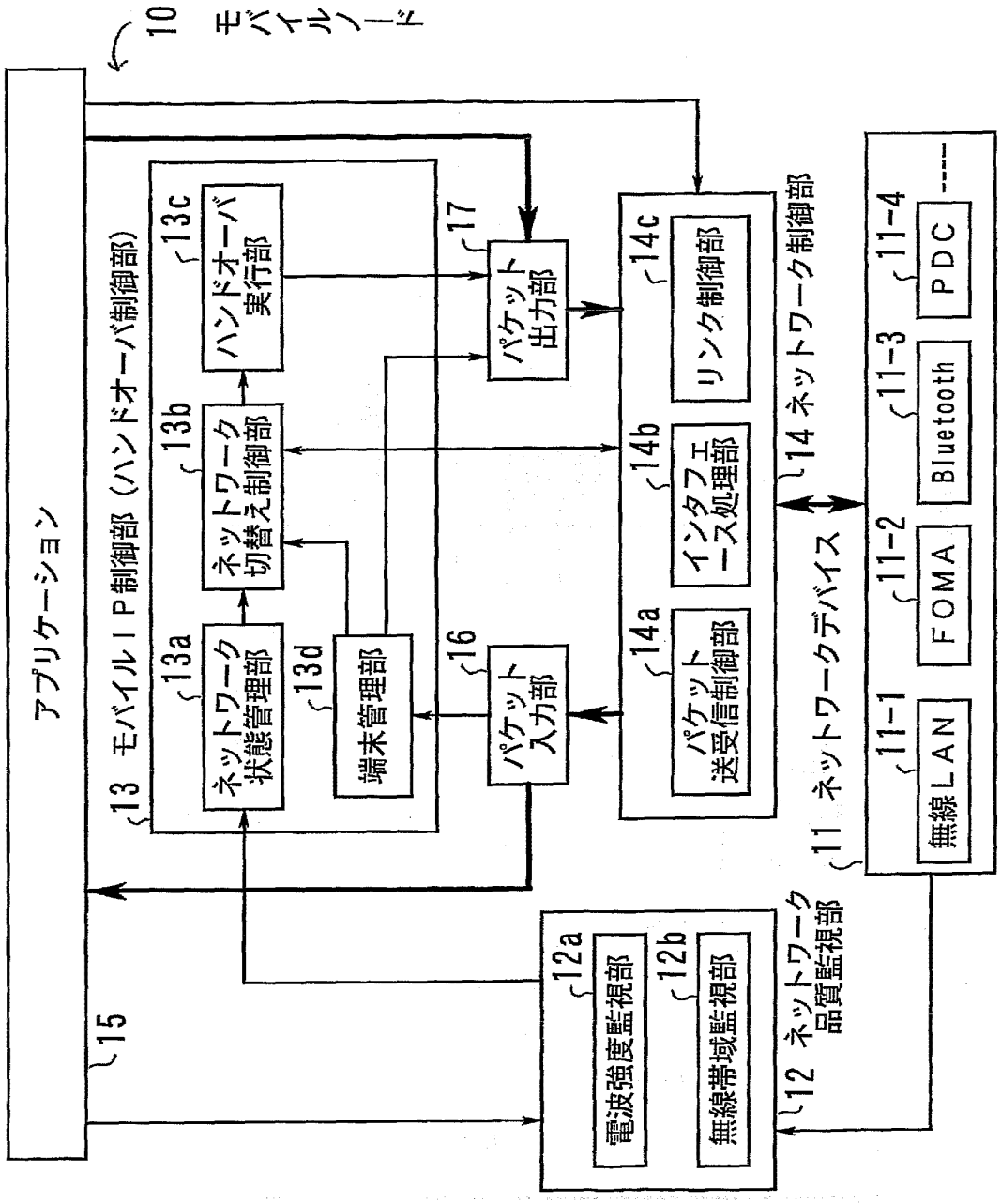

10 モバイルノード
アプリケーション
13 モバイルIP制御部（ハンドオーバ制御部）
13a ネットワーク状態管理部
13b ネットワーク切替え制御部
13c ハンドオーバ実行部
13d 端末管理部
16 パケット入力部
17 パケット出力部
14a パケット送受信制御部
14b インタフェース処理部
14c リンク制御部
14 ネットワーク制御部
11 ネットワークデバイス
11-1 無線LAN
11-2 FOMA
11-3 Bluetooth
11-4 PDC
12 ネットワーク品質監視部
12a 電波強度監視部
12b 無線帯域監視部
15

図3

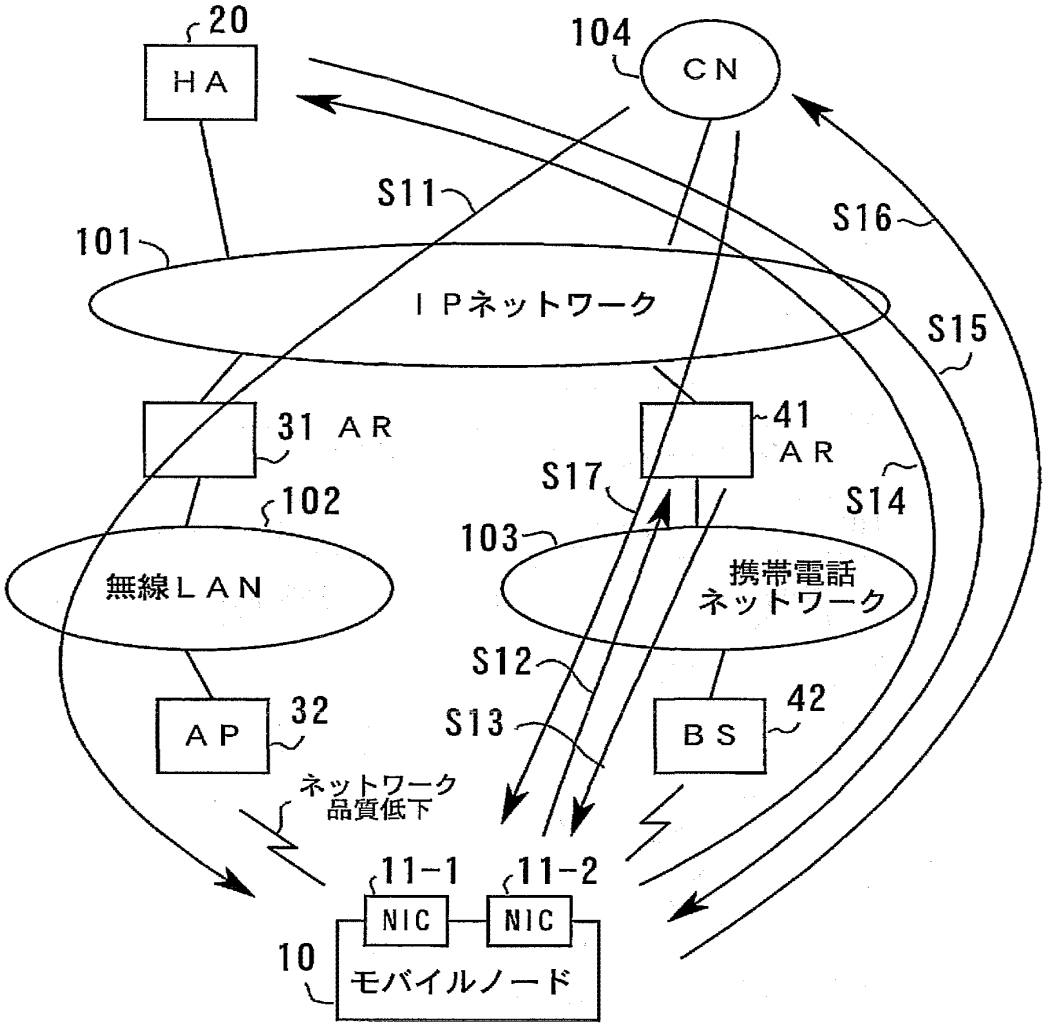

20
HA
104
CN
S11
S16
101
IPネットワーク
S15
31 AR
41
AR
S17
S14
102
103
無線LAN
携帯電話
ネットワーク
S12
S13
AP
32
BS
42
ネットワーク
品質低下
11-1
11-2
NIC
NIC
10
モバイルノード

図 4

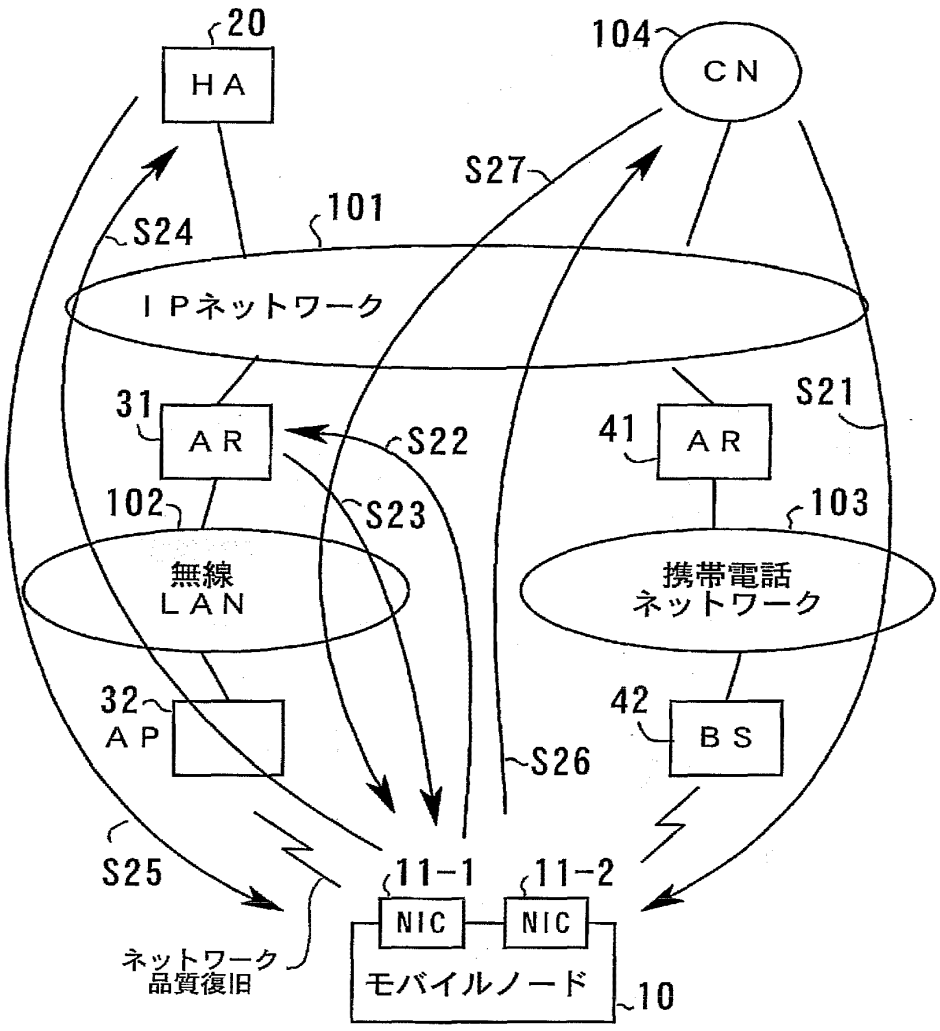

20
HA
104
CN
S27
S24
101
IPネットワーク
31
AR
S22
41
AR
S21
102
S23
103
無線
LAN
携帯電話
ネットワーク
32
AP
42
BS
S26
S25
11-1
11-2
NIC
NIC
ネットワーク
品質復旧
モバイルノード
10

図 5

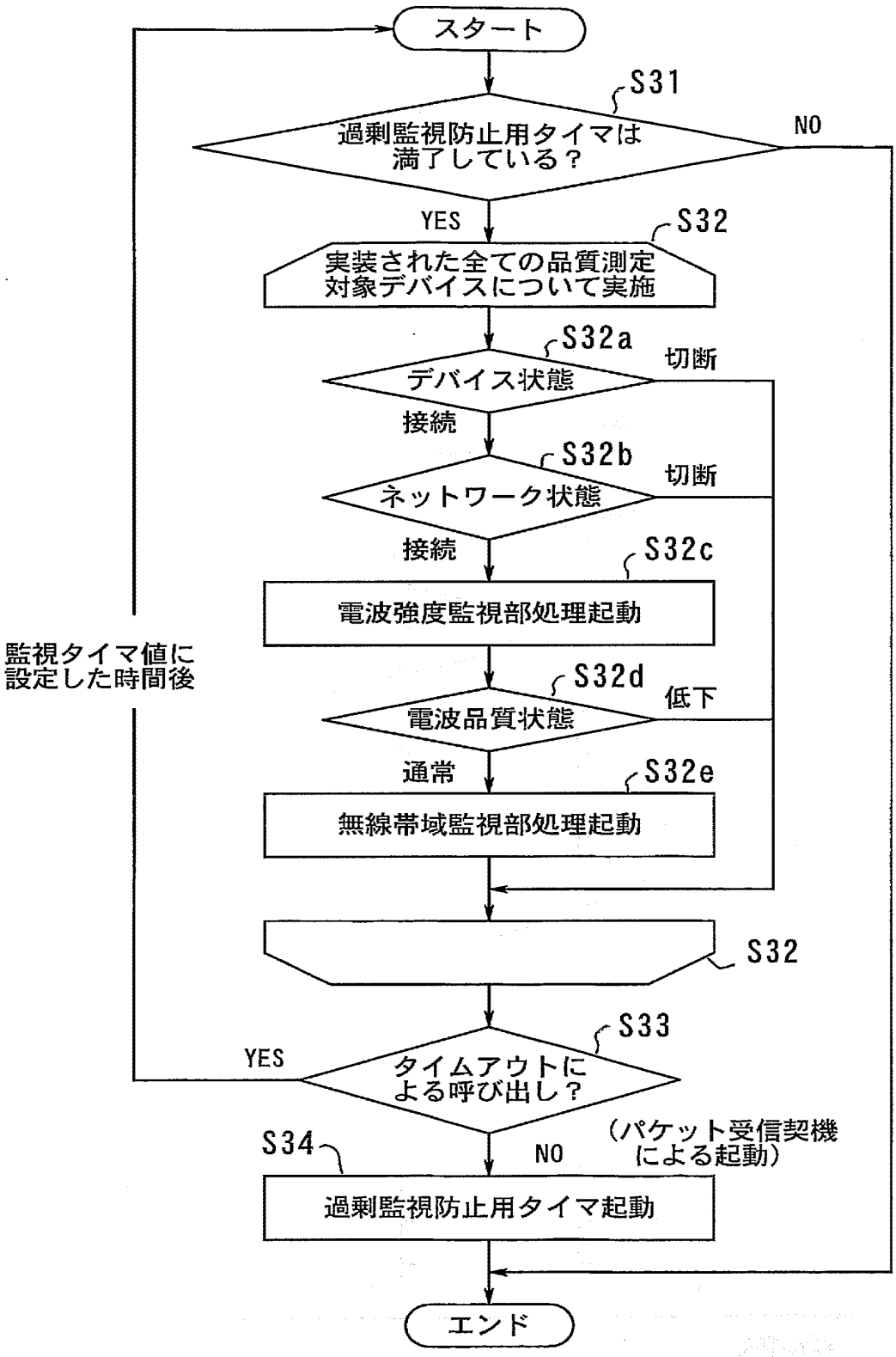

スタート
S31
過剰監視防止用タイマは満了している？
NO
YES
S32
実装された全ての品質測定対象デバイスについて実施
S32a
デバイス状態
切断
接続
S32b
ネットワーク状態
切断
接続
S32c
電波強度監視部処理起動
S32d
電波品質状態
低下
通常
S32e
無線帯域監視部処理起動
S32
S33
タイムアウトによる呼び出し？
YES
監視タイマ値に設定した時間後
S34
NO
（パケット受信契機による起動）
過剰監視防止用タイマ起動
エンド

図６

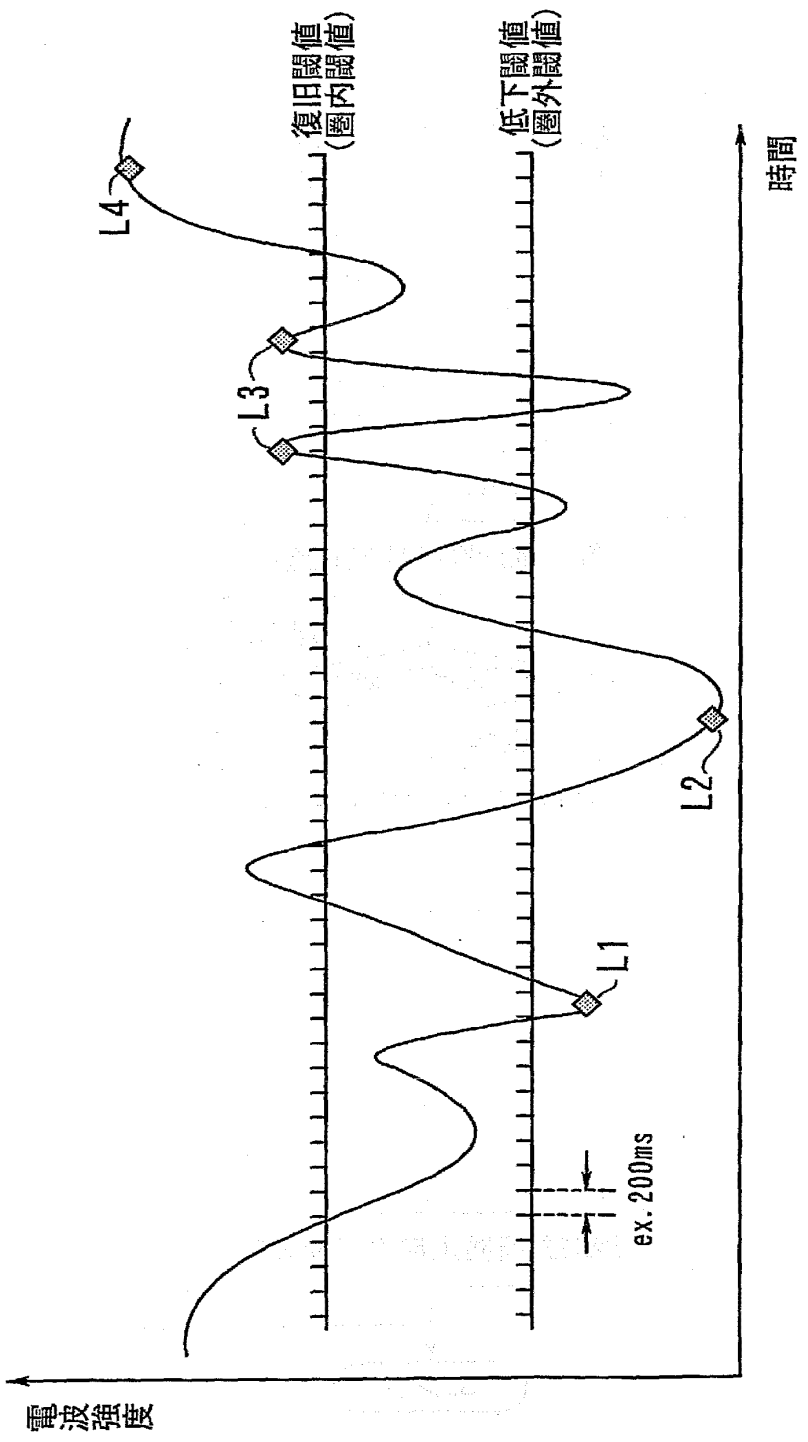


図7

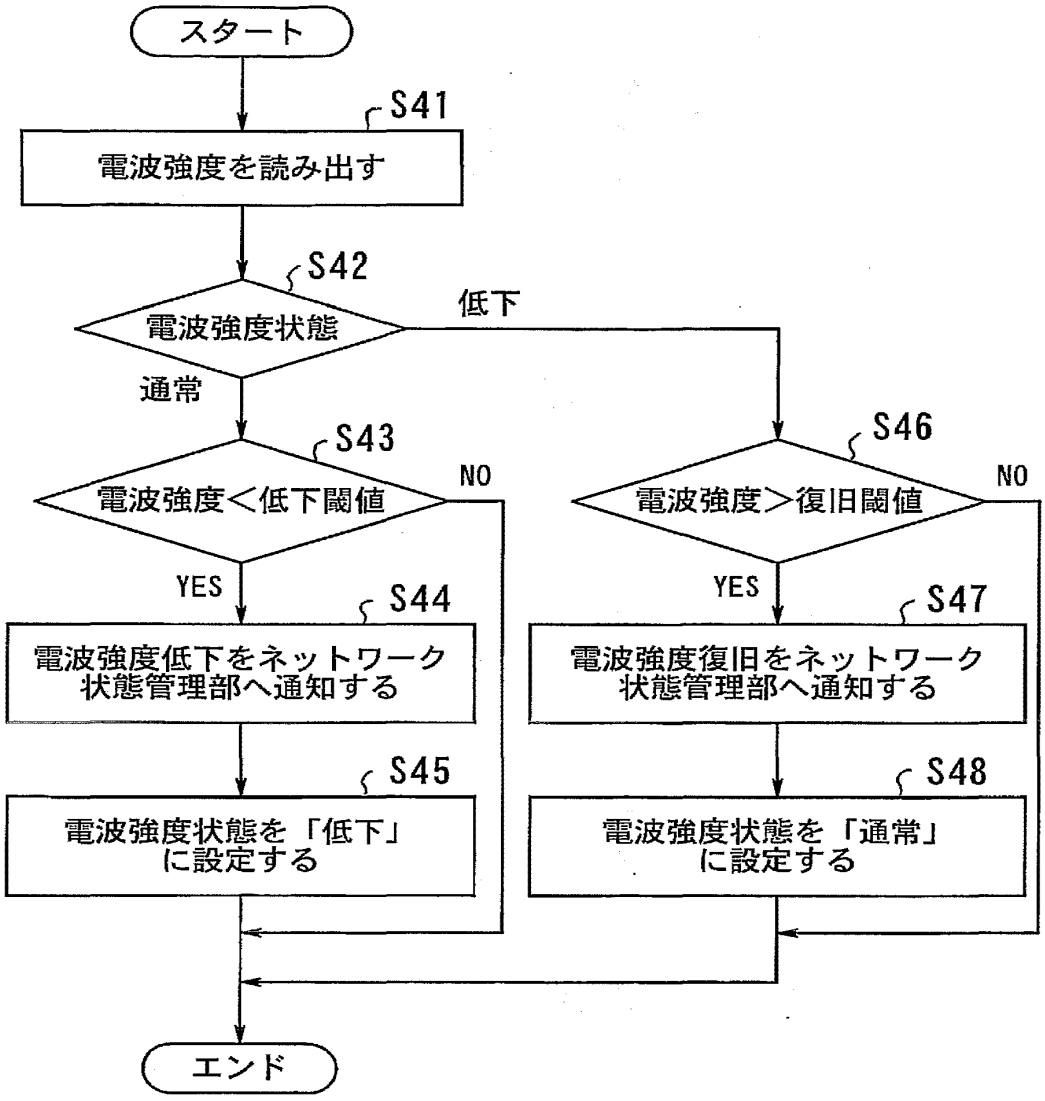

スタート
S41
電波強度を読み出す
S42
電波強度状態
低下
通常
S43
電波強度＜低下閾値
NO
YES
S44
電波強度低下をネットワーク状態管理部へ通知する
S45
電波強度状態を「低下」に設定する
S46
電波強度＞復旧閾値
NO
YES
S47
電波強度復旧をネットワーク状態管理部へ通知する
S48
電波強度状態を「通常」に設定する
エンド

図８

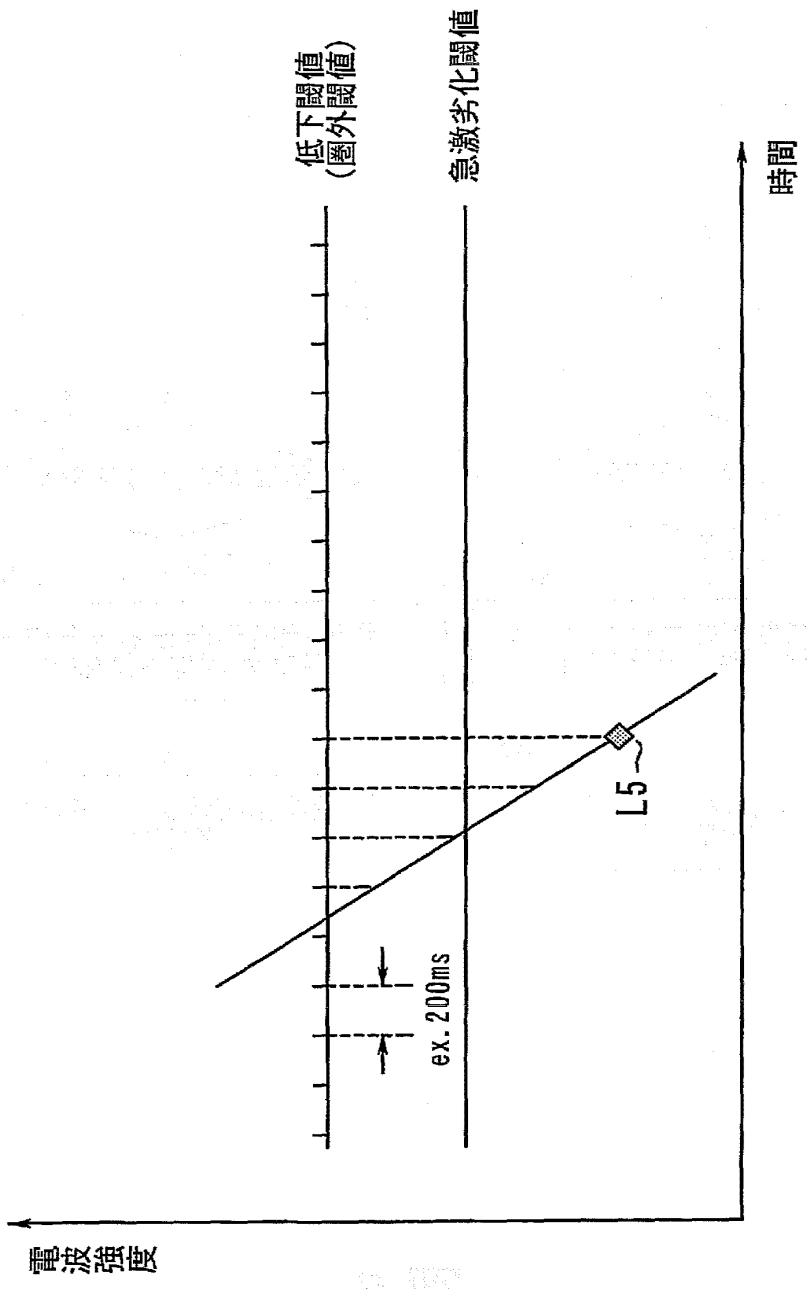


図9

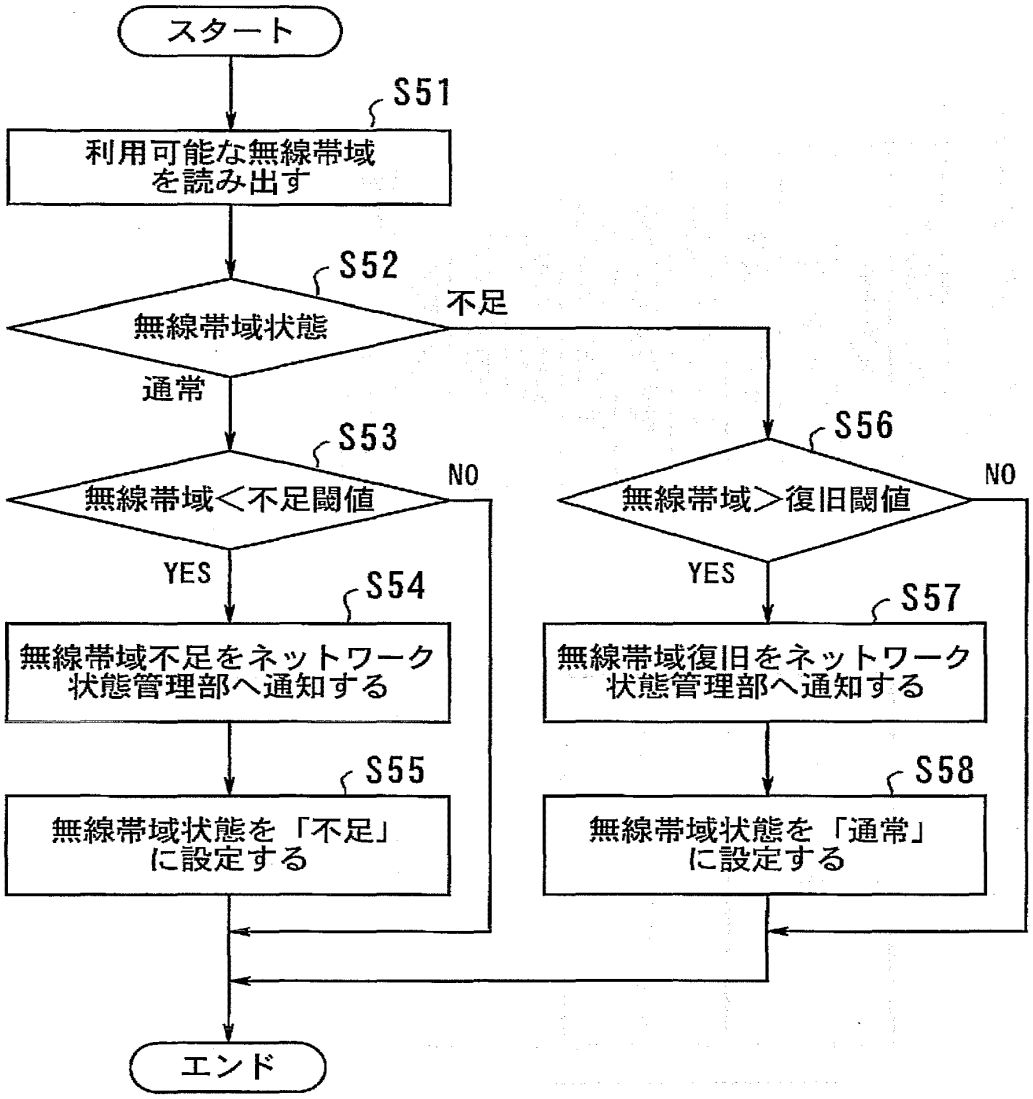
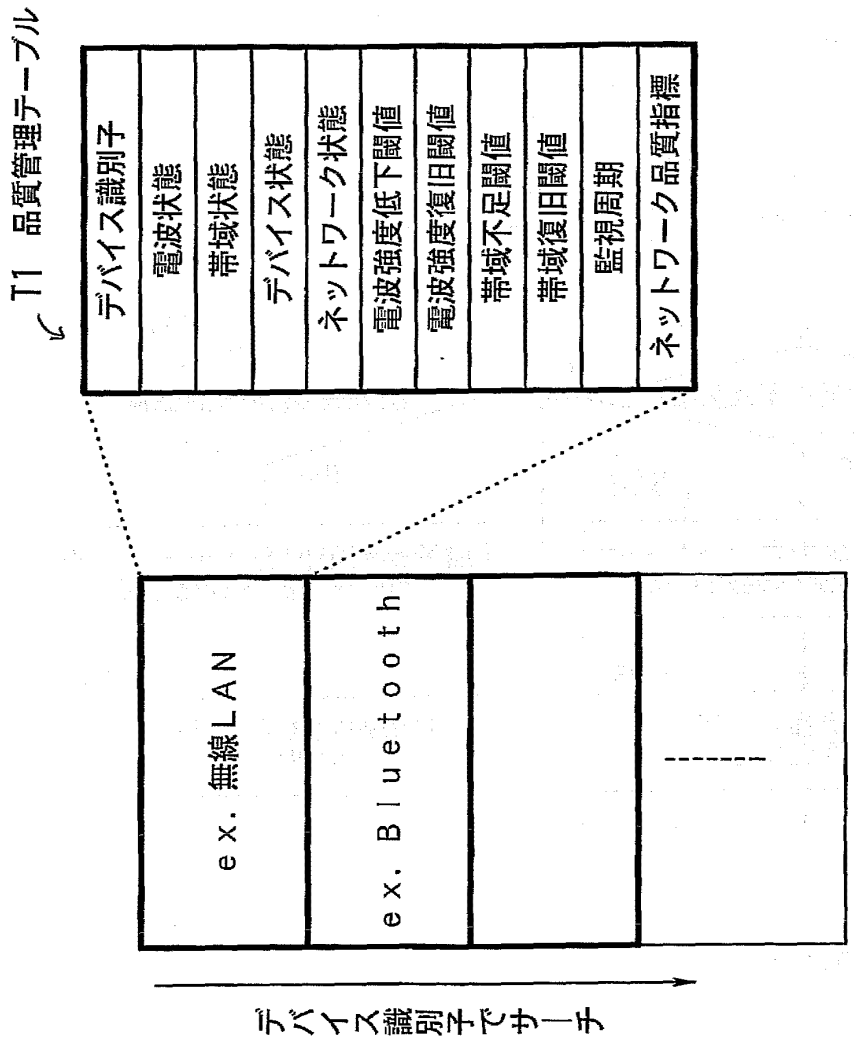

スタート
S51
利用可能な無線帯域を読み出す
S52
無線帯域状態
不足
通常
S53
無線帯域＜不足閾値
NO
YES
S54
無線帯域不足をネットワーク状態管理部へ通知する
S55
無線帯域状態を「不足」に設定する
S56
無線帯域＞復旧閾値
NO
YES
S57
無線帯域復旧をネットワーク状態管理部へ通知する
S58
無線帯域状態を「通常」に設定する
エンド

図１０


T1 品質管理テーブル
デバイス識別子
電波状態
帯域状態
デバイス状態
ネットワーク状態
電波強度低下閾値
電波強度復旧閾値
帯域不足閾値
帯域復旧閾値
監視周期
ネットワーク品質指標
ex. 無線LAN
ex. Bluetooth

デバイス識別子データ

図11

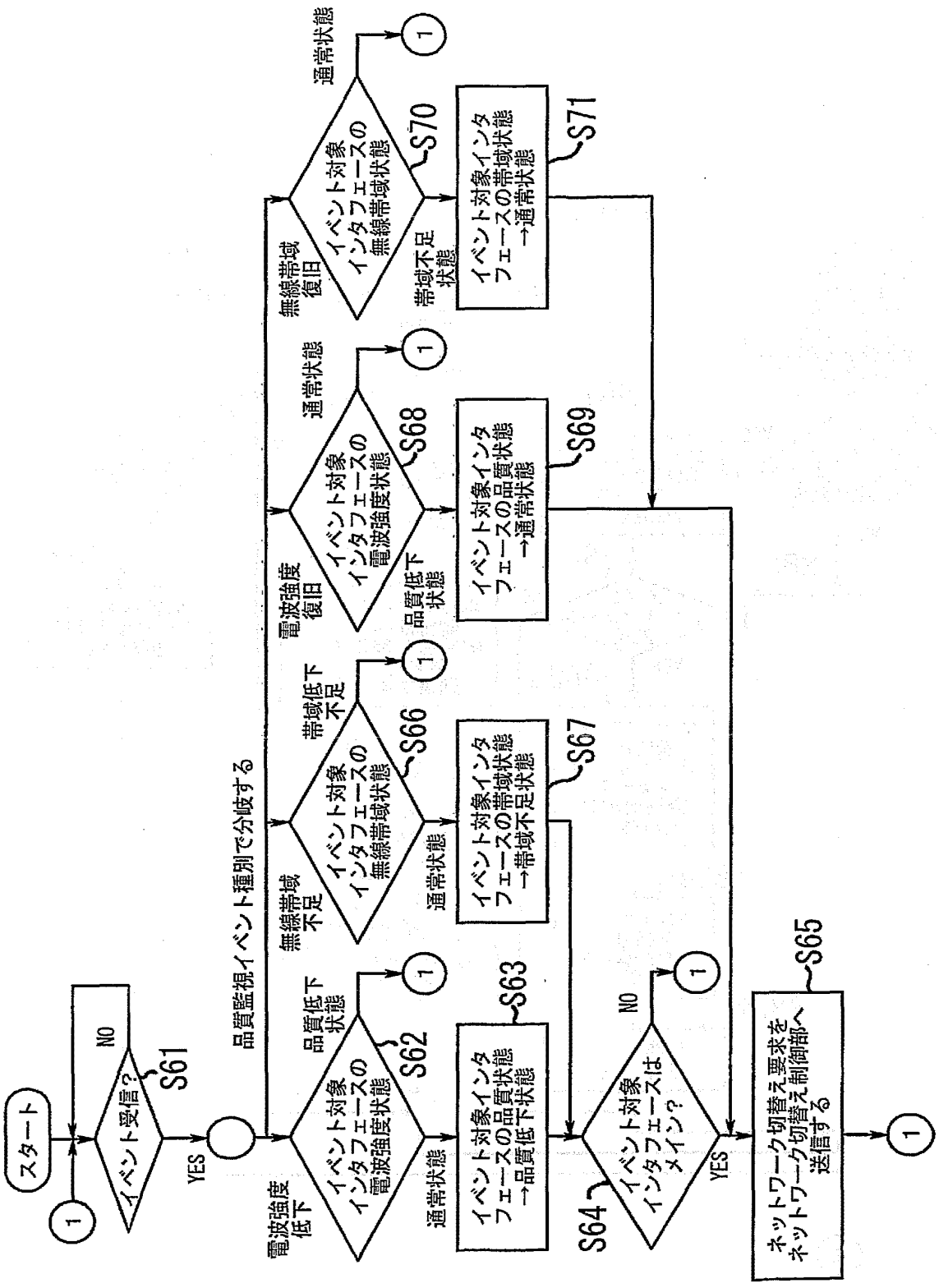

スタート
イベント受信?
S61
NO
YES
品質監視イベント種別で分岐する
電波強度低下
イベント対象インタフェースの電波強度状態
S62
品質低下状態
通常状態
イベント対象インタフェースの品質状態→品質低下状態
S63
無線帯域不足
イベント対象インタフェースの無線帯域状態
S66
帯域低下不足
通常状態
イベント対象インタフェースの帯域状態→帯域不足状態
S67
電波強度復旧
イベント対象インタフェースの電波強度状態
S68
通常状態
品質低下状態
イベント対象インタフェースの品質状態→通常状態
S69
無線帯域復旧
イベント対象インタフェースの無線帯域状態
S70
通常状態
帯域不足状態
イベント対象インタフェースの帯域状態→通常状態
S71
S64
イベント対象インタフェースはメイン?
NO
YES
S65
ネットワーク切替え要求をネットワーク切替え制御部へ送信する
1

図12

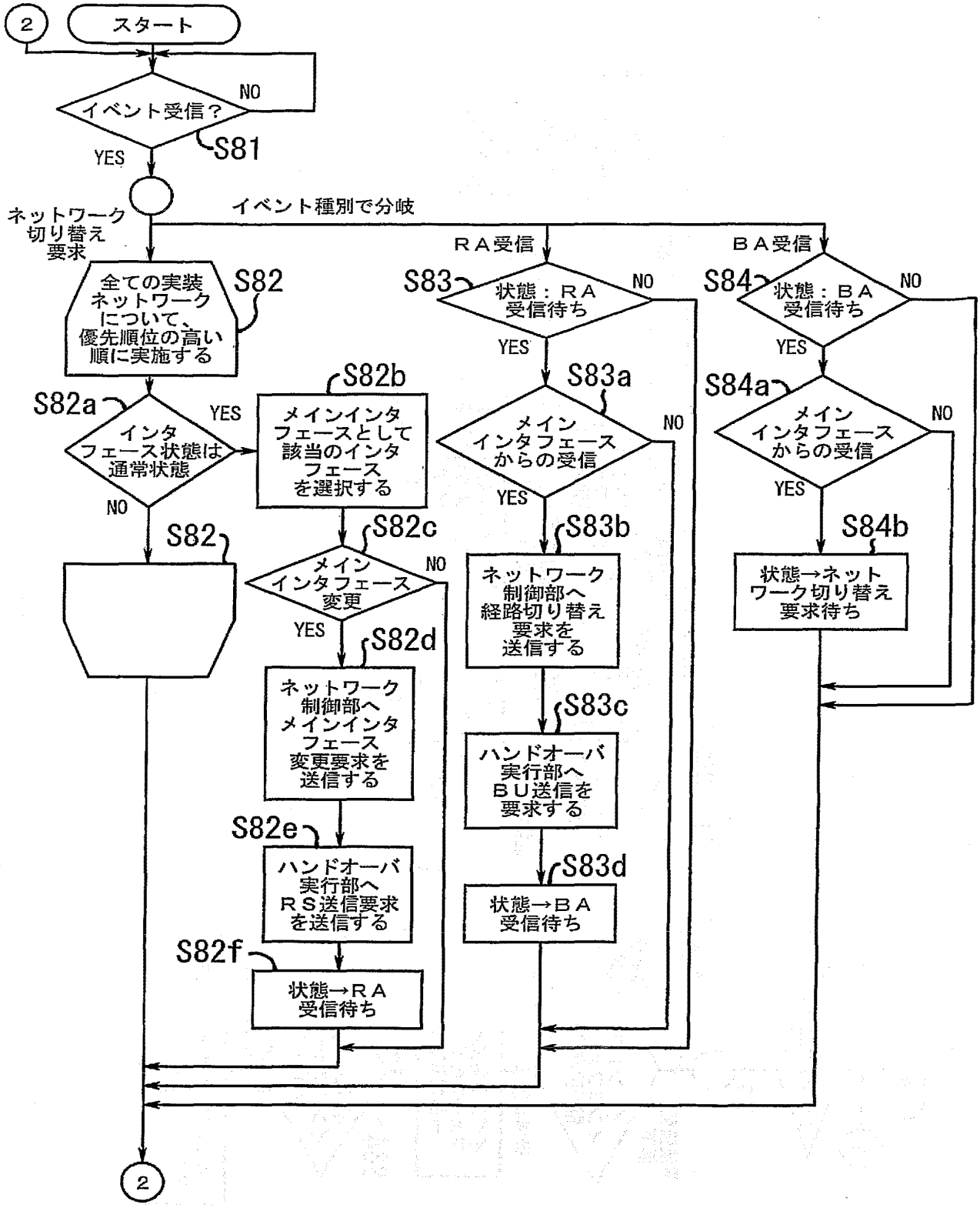


図１３

差替え用紙（規則26）

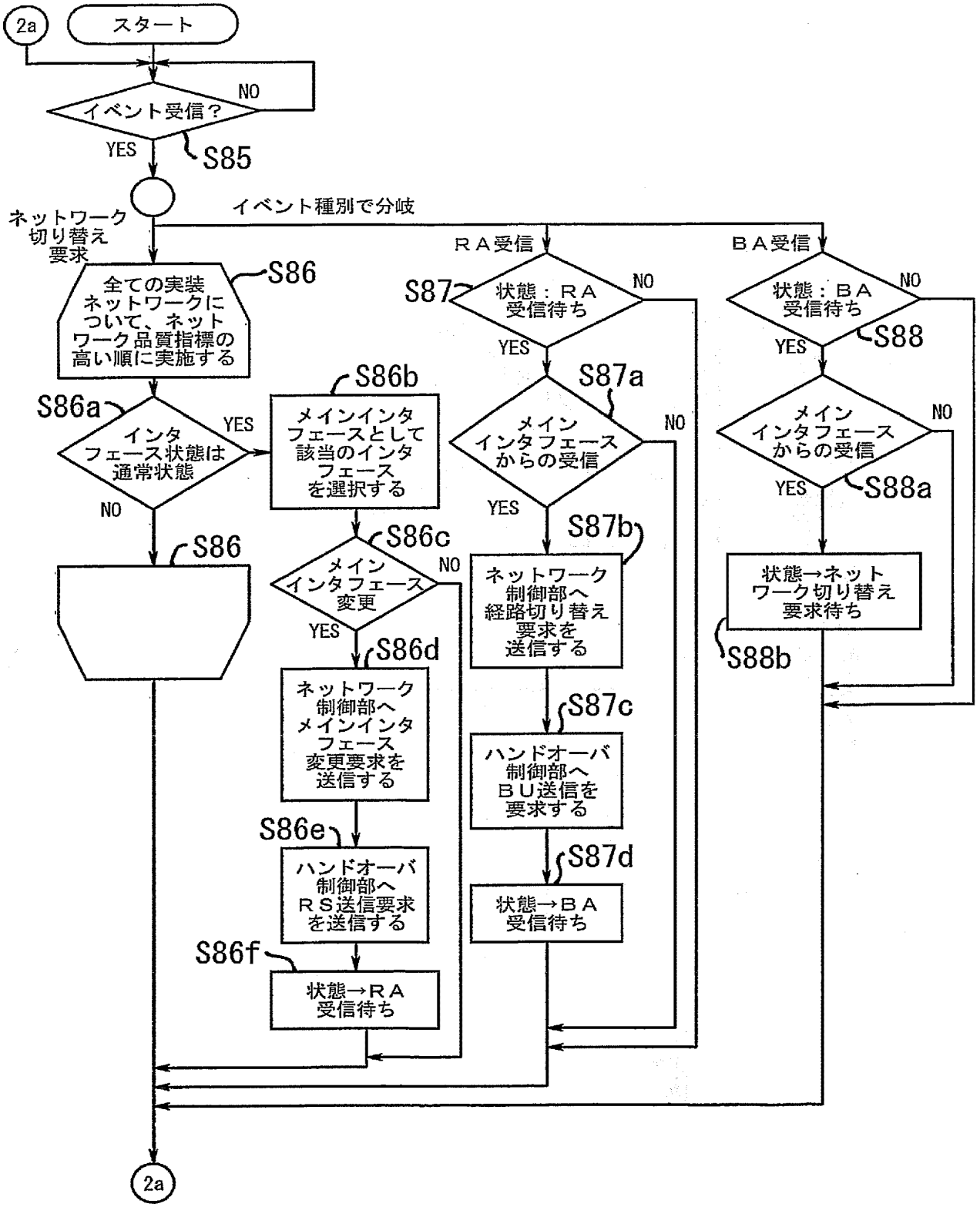

2a
スタート
NO
イベント受信？
YES
S85
ネットワーク
切り替え
要求
イベント種別で分岐
ＲＡ受信
ＢＡ受信
全ての実装
ネットワークに
ついて、ネット
ワーク品質指標の
高い順に実施する
S86
S87
状態：ＲＡ
受信待ち
NO
YES
状態：ＢＡ
受信待ち
NO
YES
S88
S86a
インタ
フェース状態は
通常状態
YES
NO
S86b
メインインタ
フェースとして
該当のインタ
フェース
を選択する
S87a
メイン
インタフェース
からの受信
NO
YES
メイン
インタフェース
からの受信
NO
YES
S88a
S86
S86c
メイン
インタフェース
変更
NO
YES
S87b
ネットワーク
制御部へ
経路切り替え
要求を
送信する
状態→ネット
ワーク切り替え
要求待ち
S88b
S86d
ネットワーク
制御部へ
メインインタ
フェース
変更要求を
送信する
S87c
ハンドオーバ
制御部へ
ＢＵ送信を
要求する
S86e
ハンドオーバ
制御部へ
ＲＳ送信要求
を送信する
S87d
状態→ＢＡ
受信待ち
S86f
状態→ＲＡ
受信待ち
2a

図１４

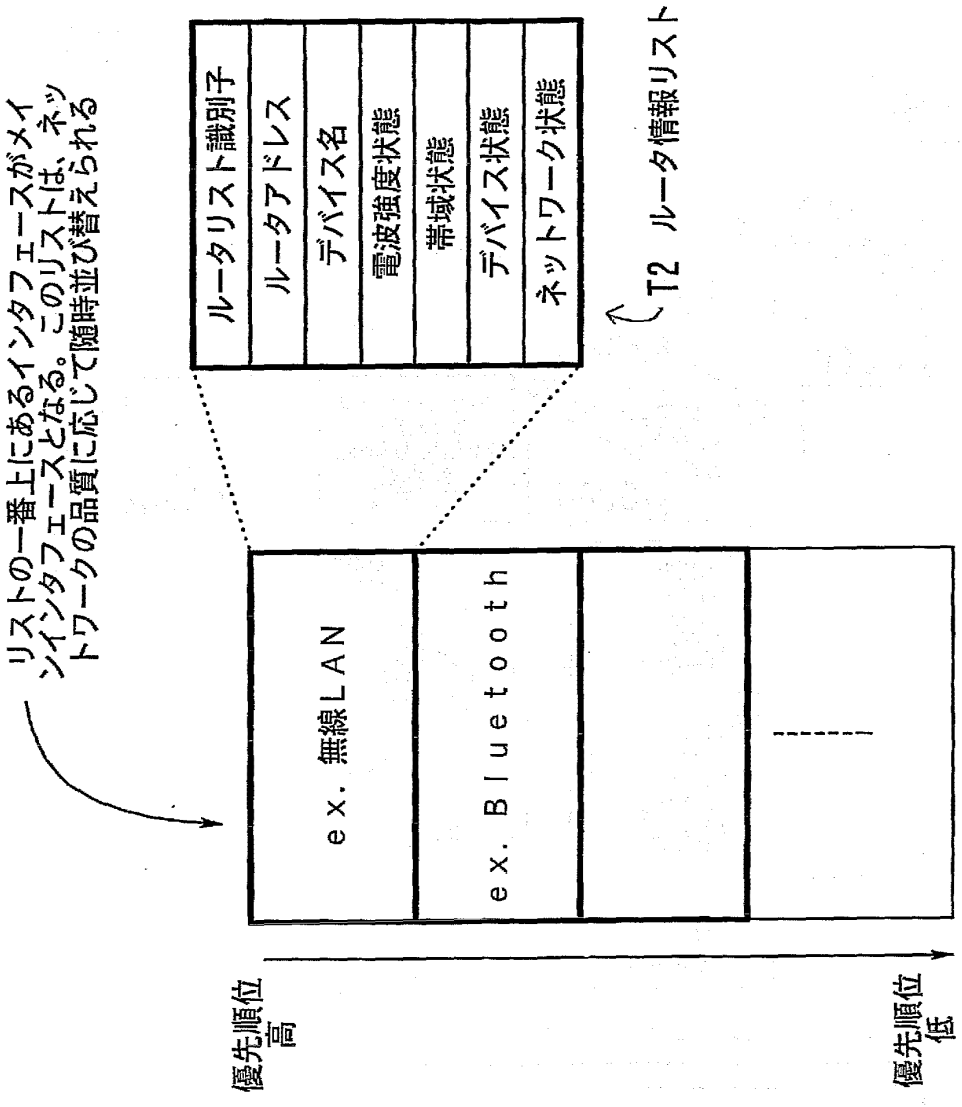

リストの一番上にあるインタフェースがメインインタフェースとなる。このリストは、ネットワークの品質に応じて随時並び替えられる
ルータリスト識別子
ルータアドレス
デバイス名
電波強度状態
帯域状態
デバイス状態
ネットワーク状態
T2 ルータ情報リスト
ex. 無線LAN
ex. Bluetooth
優先順位高
優先順位低

図15

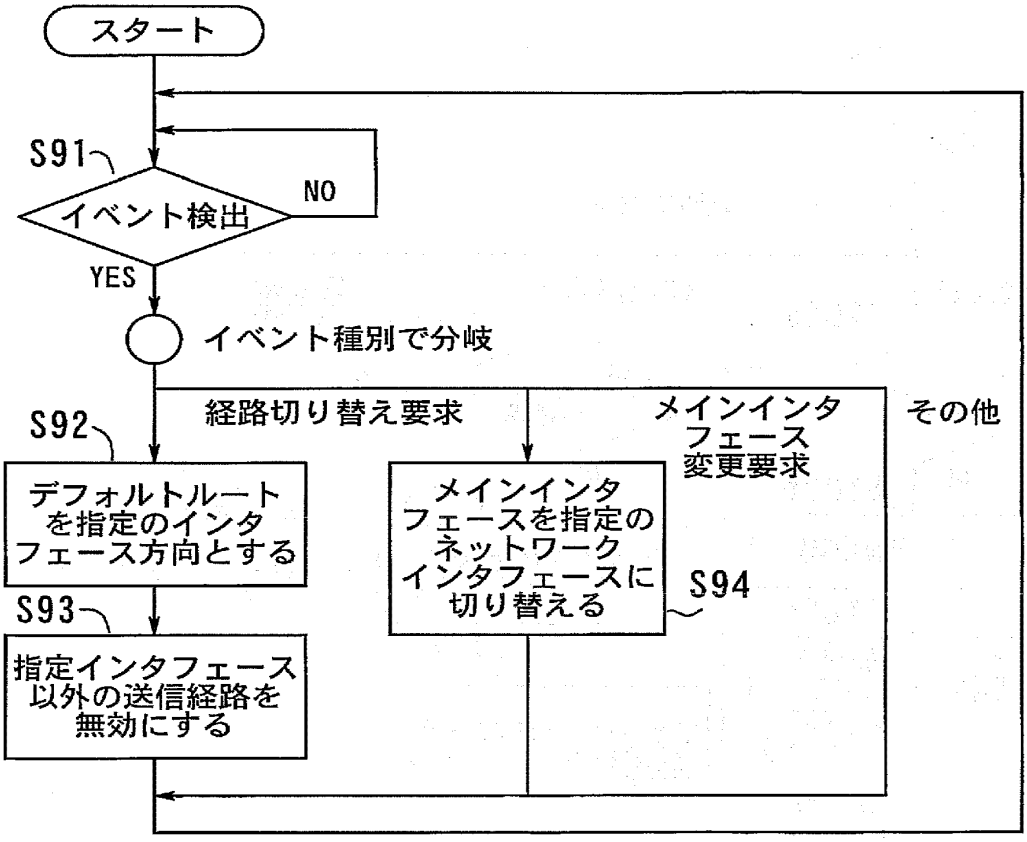

スタート
S91
イベント検出
NO
YES
イベント種別で分岐
経路切り替え要求
メインインタフェース変更要求
その他
S92
デフォルトルートを指定のインタフェース方向とする
S93
指定インタフェース以外の送信経路を無効にする
メインインタフェースを指定のネットワークインタフェースに切り替える
S94

図１６

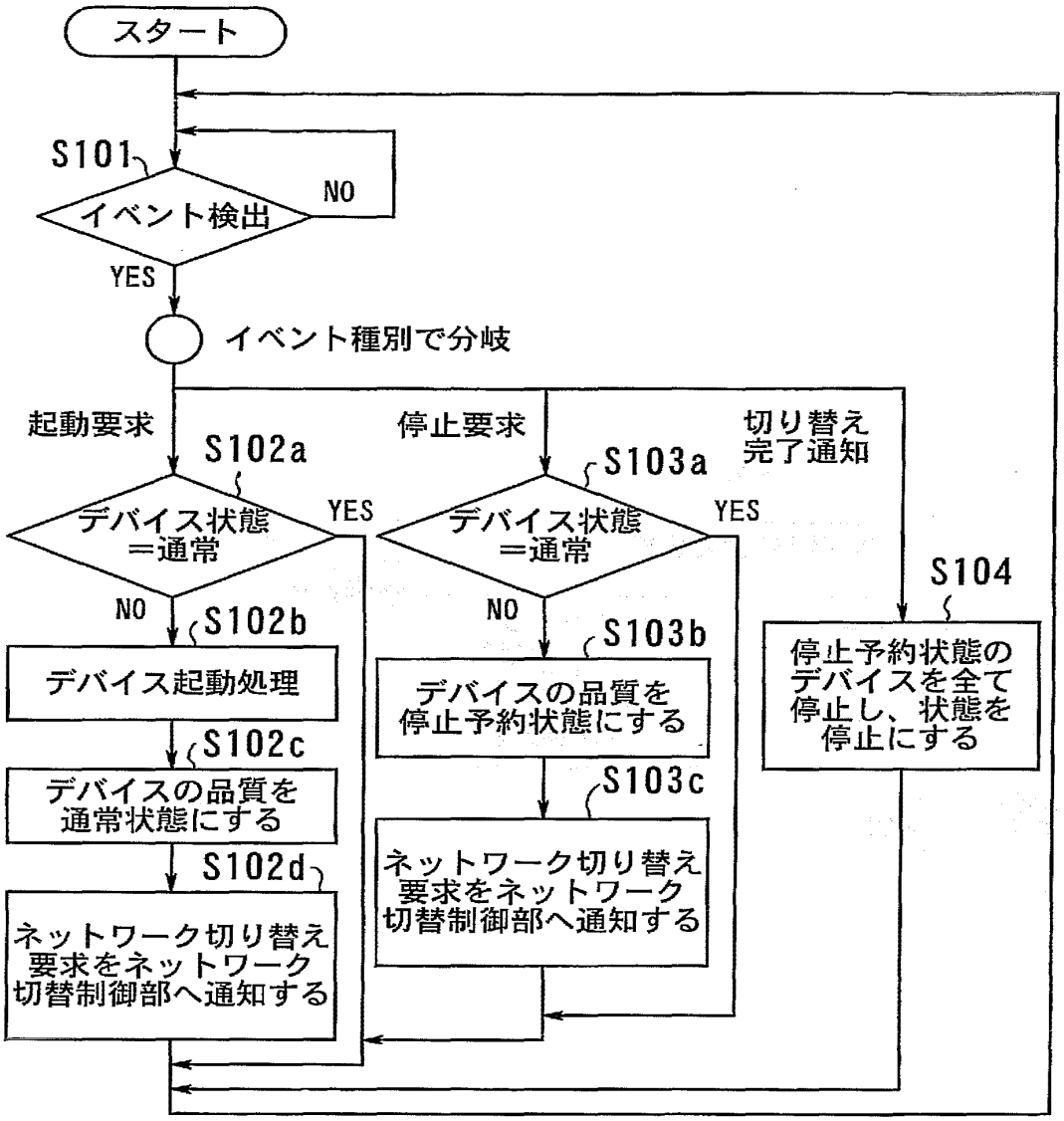

スタート
S101
イベント検出
NO
YES
イベント種別で分岐
起動要求
停止要求
切り替え
完了通知
S102a
デバイス状態
＝通常
YES
NO
S102b
デバイス起動処理
S102c
デバイスの品質を
通常状態にする
S102d
ネットワーク切り替え
要求をネットワーク
切替制御部へ通知する
S103a
デバイス状態
＝通常
YES
NO
S103b
デバイスの品質を
停止予約状態にする
S103c
ネットワーク切り替え
要求をネットワーク
切替制御部へ通知する
S104
停止予約状態の
デバイスを全て
停止し、状態を
停止にする

図１７

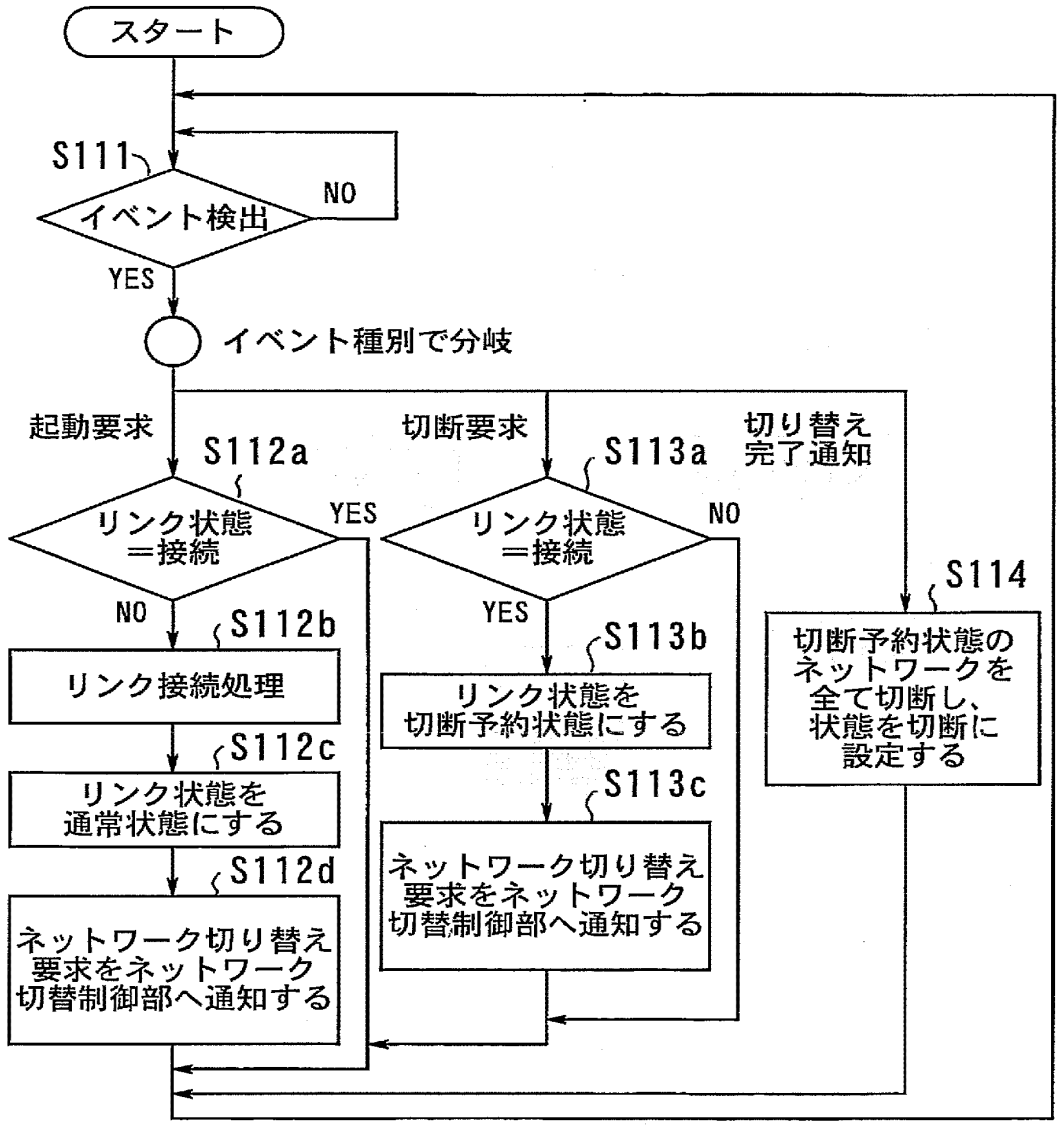

スタート
S111
イベント検出
NO
YES
イベント種別で分岐
起動要求
切断要求
切り替え
完了通知
S112a
リンク状態
＝接続
YES
NO
S112b
リンク接続処理
S112c
リンク状態を
通常状態にする
S112d
ネットワーク切り替え
要求をネットワーク
切替制御部へ通知する
S113a
リンク状態
＝接続
NO
YES
S113b
リンク状態を
切断予約状態にする
S113c
ネットワーク切り替え
要求をネットワーク
切替制御部へ通知する
S114
切断予約状態の
ネットワークを
全て切断し、
状態を切断に
設定する

図１８

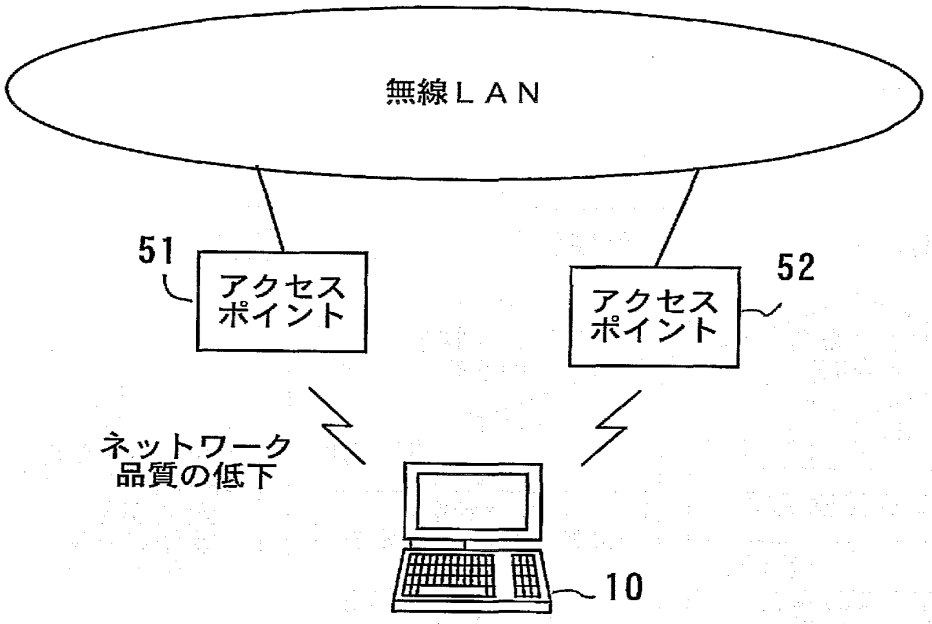


図１９

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP02/13331

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] H04Q7/38, H04L12/28, H04L12/46, H04L12/56

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)
Int.Cl[7] H04Q7/00-7/38, H04L12/28, H04L12/46, H04L12/56

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

Jitsuyo Shinan Koho	1922-1996	Toroku Jitsuyo Shinan Koho	1994-2003
Kokai Jitsuyo Shinan Koho	1971-2003	Jitsuyo Shinan Toroku Koho	1996-2003

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2000-115236 A (Oki Electric Industry Co., Ltd.), 21 April, 2000 (21.04.00), Abstract; Claims (Family: none)	1-28
Y	JP 2002-125254 A (Mitsubishi Electric Corp.), 26 April, 2002 (26.04.02), Par. No. [0008] & EP 1199841 A2 & US 2002/0045450 A1	1-28
Y	JP 6-45990 A (Oki Electric Industry Co., Ltd.), 18 February, 1994 (18.02.94), Abstract (Family: none)	1-28

[X] Further documents are listed in the continuation of Box C. [ ] See patent family 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
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"O" document referring to an oral disclosure, use, exhibition or other means
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"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
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
01 April, 2003 (01.04.03)	22 April, 2003 (22.04.03)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP02/13331

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 10-126830 A (Matsushita Electric Industrial Co., Ltd.), 15 May, 1998 (15.05.98), Abstract & EP 837617 A2 & CN 1183014 A & KR 259907 A & US 6233454 B1	1-28
A	JP 2001-258058 A (NTT Docomo Inc.), 21 September, 2001 (21.09.01), Par. Nos. [0052] to [0058] (Family: none)	1-28

国際調査報告	国際出願番号　ＰＣＴ／ＪＰ０２／１３３３１

A.　発明の属する分野の分類（国際特許分類（ＩＰＣ））
Ｉｎｔ．Ｃｌ⁷　Ｈ０４Ｑ７／３８
Ｉｎｔ．Ｃｌ⁷　Ｈ０４Ｌ１２／２８，　Ｈ０４Ｌ１２／４６，　Ｈ０４Ｌ１２／５６

B.　調査を行った分野

調査を行った最小限資料（国際特許分類（ＩＰＣ））
Ｉｎｔ．Ｃｌ⁷　Ｈ０４Ｑ７／００－７／３８
Ｉｎｔ．Ｃｌ⁷　Ｈ０４Ｌ１２／２８，　Ｈ０４Ｌ１２／４６，　Ｈ０４Ｌ１２／５６

最小限資料以外の資料で調査を行った分野に含まれるもの
日本国実用新案公報　　１９２２－１９９６年
日本国公開実用新案公報　　１９７１－２００３年
日本国登録実用新案公報　　１９９４－２００３年
日本国実用新案登録公報　　１９９６－２００３年

国際調査で使用した電子データベース（データベースの名称、調査に使用した用語）

C.　関連すると認められる文献

引用文献のカテゴリー＊	引用文献名　及び一部の箇所が関連するときは、その関連する箇所の表示	関連する請求の範囲の番号
Ｙ	ＪＰ　２０００－１１５２３６　Ａ（沖電気工業株式会社）２０００．０４．２１，要約、特許請求の範囲（ファミリーなし）	1-28
Ｙ	ＪＰ　２００２－１２５２５４　Ａ（三菱電機株式会社）２００２．０４．２６，第８段落 ＆　ＥＰ　１１９９８４１　Ａ２ ＆　ＵＳ　２００２／００４５４５０　Ａ１	1-28

☒ Ｃ欄の続きにも文献が列挙されている。　　☐ パテントファミリーに関する別紙を参照。

＊　引用文献のカテゴリー
「Ａ」特に関連のある文献ではなく、一般的技術水準を示すもの
「Ｅ」国際出願日前の出願または特許であるが、国際出願日以後に公表されたもの
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「Ｏ」口頭による開示、使用、展示等に言及する文献
「Ｐ」国際出願日前で、かつ優先権の主張の基礎となる出願の日の後に公表された文献
「Ｔ」国際出願日又は優先日後に公表された文献であって出願と矛盾するものではなく、発明の原理又は理論の理解のために引用するもの
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「＆」同一パテントファミリー文献

国際調査を完了した日	国際調査報告の発送日
０１．０４．０３	22.04.03

国際調査機関の名称及びあて先	特許庁審査官（権限のある職員）	
日本国特許庁（ＩＳＡ／ＪＰ） 郵便番号１００－８９１５ 東京都千代田区霞が関三丁目４番３号	青木　健	５Ｊ　９５７１
	電話番号　０３－３５８１－１１０１　内線　３５３４	

様式ＰＣＴ／ＩＳＡ／２１０（第２ページ）（１９９８年７月）

C（続き）．　関連すると認められる文献

引用文献のカテゴリー＊	引用文献名　及び一部の箇所が関連するときは、その関連する箇所の表示	関連する請求の範囲の番号
Y	JP　6－45990　A（沖電気工業株式会社） 1994．02．18，要約（ファミリーなし）	1-28
Y	JP　10－126830　A（松下電器産業株式会社） 1998．05．15，要約 & EP 837617 A2 & CN 1183014 A & KR 259907 A & US 6233454 B1	1-28
A	JP　2001－258058　A（株式会社エヌ・ティ・ティ・ドコモ）2001．09．21，第52－58段落（ファミリーなし）	1-28

Electronic Acknowledgement Receipt

EFS ID:	20607798
Application Number:	14510766
International Application Number:	
Confirmation Number:	2888
Title of Invention:	MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLER
First Named Inventor/Applicant Name:	Vasudevan Ganesan
Customer Number:	28960
Filer:	Jonathan O Owens
Filer Authorized By:	
Attorney Docket Number:	HAVA-00402
Receipt Date:	04-NOV-2014
Filing Date:	09-OCT-2014
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Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	US_Form_SB_08a_11_4_2014.pdf	614865 8670455e63190e1b400fe11595090740 1a203f6e	no	11

Warnings:	
Information:	

2	Foreign Reference	DE20310113.pdf	948986 83850ce7dc4754b9e8f2b851a81512825701f297	no	14
Warnings:					
Information:					
3	Foreign Reference	EP0936777.pdf	521487 bb52dc332678bf9ac1c80e0adad3191ae1a3995c	no	8
Warnings:					
Information:					
4	Foreign Reference	EP1471665.pdf	1403091 c5c47d1d30bc665f5bd8c9a60a3441e9314b14c1	no	16
Warnings:					
Information:					
5	Foreign Reference	GB2287858.pdf	1291974 dd3d9cadb64570f5381c841aff66480233cc2210	no	20
Warnings:					
Information:					
6	Foreign Reference	JP200226994.pdf	2923073 176fe27f91bb084fcb6ee9c2a5eee1059cc92404	no	28
Warnings:					
Information:					
7	Foreign Reference	JP2004320473.pdf	1673925 3452bca343893d9a704470dcd4559d091d3ee516	no	18
Warnings:					
Information:					
8	Foreign Reference	WO03056719.pdf	1898433 9d23898d2618d3def423d7a9c66424cffa1970b0	no	26
Warnings:					
Information:					
9	Foreign Reference	WO2004013998.pdf	2523267 495e77c232dfbb57f05aa51ff8770575481e9520	no	48
Warnings:					
Information:					
10	Foreign Reference	WO2004057903.pdf	3838484 b0db41c94afdd2f8eaaa4769ac5965a0eafb55df	no	58
Warnings:					
Information:					

11	Non Patent Literature	Other1.pdf	1785620 1c96687cc34687470986b95c48013b37e5d97ea9	no	20
Warnings:					
Information:					
12	Non Patent Literature	Other2.pdf	4350885 e2f258bbff9bcd38c47c342ead86e5637df45233	no	45
Warnings:					
Information:					
13	Non Patent Literature	Other3.pdf	2341625 770e4061a9c5decd17e8c9021c24c302c6733047	no	24
Warnings:					
Information:					
14	Non Patent Literature	Other4.pdf	15860457 404a58cf72b033329b9dcfffa34b6517f17f6b62	no	162
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			Total Files Size (in bytes):	41976172	

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National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PATENT
Attorney Docket No.: HAVA-00402

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	)	Group Art Unit: 2414
	)	
Vasudevan Ganesan	)	Examiner:
	)	
Application No.: 14/510,766	)	**RESPONSE TO NOTICE TO FILE CORRECTED APPLICATION PAPERS**
	)	
Filed: October 9, 2014	)	
	)	
For: **MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLER**	)	162 N. Wolfe Road Sunnyvale, California 94086 (408) 530-9700
	)	
	)	Customer No. 28960

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

Madam:

Please find the REMARKS on page 2 of this paper.

REMARKS

In response to the Notice to File Corrected Application Papers, an accompanying substitute specification is included. Both, a marked up and a clean version are included. The substitute specification contains no new matter.

Respectfully submitted,
HAVERSTOCK & OWENS LLP

Dated: December 11, 2014

By: /Jonathan O. Owens/
Jonathan O. Owens
Reg. No. 37,902
Attorneys for Applicant

MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLER

Related Applications

This Patent Application is a continuation application of co-pending U.S. Patent Application No. 13/240,776, filed on September 22, 2011, and entitled "MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLER," which is a divisional application of co-pending U.S. Patent Application No. 11/330,675, filed on January 11, 2006, and entitled "MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLER," which ~~This application~~ claims priority of U.S. provisional application, serial number 60/643,829, filed January 14, 2005, and entitled "TELEPHONE COMMUNICATIONS PROCESSING CONTROLLER," by the same inventors~~. This application incorporates U.S. provisional application, serial number 60/643,829, filed January 14, 2005, and entitled "TELEPHONE COMMUNICATIONS PROCESSING CONTROLLER," in its entirety by reference. This application~~ and is ~~also~~ a continuation-in-part of U.S. Patent Application, serial number 11/031,498, filed January 6, 2005, and entitled "TELEPHONE WITH AUTOMATIC SWITCHING BETWEEN CELLULAR AND VOIP NETWORKS", all of which are ~~is~~ hereby incorporated by reference. U.S. Patent Application, serial no. 11/031,498 claims priority of U.S. provisional application, serial number 60/534,466, filed January 6, 2004, and entitled "RADIOTELEPHONE WITH AUTOMATIC SWITCHING BETWEEN CELLULAR AND WI-FI NETWORKS USING WI-FI SIGNAL STRENGTH VALUES," the content of which is also incorporated herein by reference in its entirety.

Field of the Invention

The present invention relates to the field of network communication processing. In particular, the present invention relates to seamlessly switching communications among Voice over Internet (VOIP), public cellular, and public circuit switched networks.

Background of the Invention

Current telephone communications occur over wireless cellular networks, such as GSM, CDMA, and CDMA2000, Voice Over Internet (VOIP), or circuit switched network, such as PSTN. Current state of the art of most telephones used with such networks is that each telephone is restricted for use with only one specific network. For example, a cellular phone works in a cellular network; a VOIP phone works in VOIP network, and a landline phone works in a circuit switched network. Such limitations imply that an in-progress telephone communication cannot be seamlessly switched among cellular, VOIP, and circuit switched networks without losing the connection.

Such wireless networks use regulated portions of the radio spectrum and are shared by many users. The infrastructure costs of wireless networks are relatively high due to the size and complexity of the network equipment. There is a wide variance in the performance of different wireless networks. For example, a conventional wireless cellular network covers a relatively large geographical area, but provides a relatively low bandwidth. Other wireless networks, such as CDMA2000-EV-DO/DV networks, offer higher bandwidth and enhanced data services, such as web browsing. However, these networks also pack many users into a relatively small portion of the regulated spectrum. Other types of wireless networks are adapted to improve spectral efficiency with increased speed and smaller coverage areas. For example, an IEEE 802.11x (or WiFi) network may transmit at speeds up to 11 Mbps using a Direct Sequence Spread Spectrum (DSSS) mode or at speeds up to 54 Mbps using an Orthogonal Frequency Division Multiplexing (OFDM) mode.

A network wireless access point conforming to a WiFi (e.g., IEEE 802.11b) network may cover an area of a few hundred feet in diameter. Each such network access point is connected to a larger network (e.g., Internet). One such example is WiFi VOIP (Wireless Fidelity Voice over Internet Protocol), through which a communication device user can place a wireless telephone call over the Internet, using the technology specified in IEEE 802.xx at the network access point. VOIP is a method for taking analog audio signals and converting them into digital data that can

be transmitted over the Internet. Conventional VOIP telephone communications are enabled by VOIP network carriers, which utilize VOIP networks (e.g. the Internet), to place VOIP based telephone calls. VOIP enabled and compatible networks include VOIP switching for proper routing and billing of VOIP based telephone calls.

In order to cover larger geographical areas, a relatively large number of IEEE 802.11x, for example, network access points and relatively large wire-line back haul networks are required. In part, due to the relatively small geographical coverage area of each network access point, the resulting IEEE 802.11x based network may thus be prohibitively expensive to set up. Further, the small coverage areas may lead to many "dead zones" in which mobile communication device users are unable to place telephone calls using the VOIP network.

Conventional VOIP phones, which function in a WiFi coverage area (hotspot) corresponding to a WiFi access point, offers relatively inexpensive telephone communications. However, the WiFi availability is limited due to the small geographical area supported by each WiFi access point.

Conventional cellular phones, which function in a cell coverage area within the cellular network, are relatively expensive for telephone communications and have limited multimedia capabilities. Cellular networks and availability to the network covers a much wider, extensive geographical area.

Conventional landline phones, which function in a circuit switched network such as most residences, do not offer extensive telephone communication features, for example video. Such landline phones also do not offer the mobility provided by mobile communications devices such as the VOIP phones or the cellular phones.

Summary of the Invention

The present invention is directed to an interface server, referred to as a nomadic server, and a related system that provides seamless roaming of a mobile communication device between different types of wireless networks, such as WiFi and cellular networks for voice, data and video

communication. Use of the nomadic server enables a combination of WiFi and cellular networks for providing access to the mobile communication device and makes use of the VOIP networks for switching the calls wherever possible.

The nomadic server is a telephone communication processing and switching server that will "hold" the present, in-progress telephone communications without dropping, while roaming between WiFi access points and cellular networks, without losing the present, in-progress communication. For example, a telephone communication can be seamlessly switched between VOIP and cellular telephone networks using the nomadic server. Nomadic server resources interface with the VOIP and cellular network switches to provide the hand-off between networks. This approach enables switching of telephone communications over a VOIP network wherever possible either through WiFi or through cellular networks.

In one aspect of the present invention, a method provides communications for a mobile communication device that roams between multiple different types of wireless networks. The method comprises establishing a first communication link between the mobile communication device and an end destination device, wherein the first communication link includes a first wireless communication link between the mobile communication device and a first type of wireless network, monitoring a signal strength of the first wireless communication link, when the signal strength drops below a predetermined threshold, establishing a second communication link between an interface server and the end destination device, notifying the mobile communication device to terminate transmission over the first communication link, and re-directing the second communication link from the interface server to the mobile communication device, thereby establishing a second wireless communication link between the mobile communication device and the second type of wireless network. The first type of wireless communication link can comprise a WiFi communication link, and the first type of wireless network can include a WiFi network access point. The second type of wireless network can include a wireless cellular network. Establishing the first communication link can include routing through a VOIP network. Establishing the first communication link can include routing through a cellular network.

Establishing the second communication link can include routing through a VOIP network. Establishing the second communication link can include routing through a cellular network.

The method can also include providing a connectivity status by the mobile communication device to the interface server while the mobile communication device is within a first coverage area of the first type of wireless network. The method can also include providing a routing association to a mobile switching center within the second type of wireless network, wherein the routing association associates the mobile communication device to the interface server. The method can also include routing a termination communication intended for the mobile communication device from the mobile switching center to the interface server according to the routing association when the connectivity status is active, and routing the termination communication from the interface server to the mobile communication device over the first type of wireless network. The method can also include when the connectivity status is not provided to the interface server, the router association is removed from the mobile switching center. The method can also include registering the mobile communication device with a mobile switching center within the second type of wireless network when the signal strength drops below the predetermined threshold. The method can also include setting up the second communication link with the end destination device and forwarding the second communication link to the interface server.

In another aspect of the present invention, a method provides communications for a mobile communication device that roams between multiple WiFi coverage areas. The method includes associating the mobile communication device with a nomadic server, wherein the nomadic server is coupled to one or more WiFi access points, establishing a first WiFi communication link between the mobile communication device and a first WiFi access point, registering the mobile communication device with the nomadic server including providing an IP address of the first WiFi access point to the nomadic server, configuring a communication path to the mobile communication device via the nomadic server according to the IP address of the first WiFi access point and the first WiFi communication link, detecting movement of the mobile

communication device into a coverage area of a second WiFi access point, registering the mobile communication device with the nomadic server including an IP address of the second WiFi access point, establishing a second WiFi communication link between the mobile communication device and the second WiFi access point, and re-configuring the communication path according to the IP address of the second WiFi access point and the second WiFi communication link. The method can also include associating the mobile communication device to the nomadic server at the mobile switching center. The method can also include providing a routing association to a mobile switching center within a cellular network, wherein the routing association associates the mobile communication device to the interface server. The method can also include routing a termination communication intended for the mobile communication device from the mobile switching center to the interface server according to the routing association, and routing the termination communication from the interface server to the mobile communication device over the communication path. Registering the mobile communication device with the nomadic server can provide a connectivity status of the mobile communication device while the mobile communication device is within a specific coverage area of a specific WiFi access point.

In yet another aspect of the present invention, a system provides communications for a mobile communication device that roams between multiple different types of wireless networks. The system includes a plurality of different types of wireless networks, the mobile communication device configured to access the plurality of wireless networks, and an interface server coupled to the plurality of wireless networks, wherein the interface server maintains a seamless communication link between the mobile communication device and an end destination device as the mobile communication device roams from a first wireless coverage area associated within a first type of wireless network to a second wireless coverage area associated with a second type of wireless network, the interface server is configured to establish a second communication link over the second type of wireless network while a first communication link between the mobile communication device and the end destination device over the first type of wireless network is active, wherein the second communication link is initially set up to be

forwarded to the interface server and subsequently the second communication link is routed to the mobile communication device as the first communication link is terminated. The first communication link can include a first wireless communication link between the mobile communication device and the first type of wireless network. The first wireless coverage area can be a WiFi coverage area, and the first wireless communication link can be a WiFi communication link between the mobile communication device and a WiFi access point. The first communication link can include a routing path through a VOIP network. The first communication link can include a routing path through a cellular network. The second communication link can include a second wireless communication link between the mobile communication device and the second type of wireless network. The second wireless coverage area can be a cellular coverage area and the second wireless communication link can be a wireless cellular communication link between the mobile communication device and a cellular base station. The second communication link can include a routing path through a VOIP network. The second communication link can include a routing path through a cellular network. The second type of wireless network can include a wireless cellular network.

In still yet another aspect of the present invention, an interface server maintains a seamless communication link between a mobile communication device and an end destination device as the mobile communication device roams from a first wireless coverage area associated within a first type of wireless network to a second wireless coverage area associated with a second type of wireless network, the interface server is configured to establish a second communication link over the second type of wireless network while a first communication link between the mobile communication device and the end destination device over the first type of wireless network is active, wherein the second communication link is initially set up to be forwarded to the interface server and subsequently the second communication link is routed to the mobile communication device as the first communication link is terminated. The interface server can also include a first inter-network function block to maintain current configuration and status information associated with the first communication link. The first wireless coverage area

can be a WiFi coverage area, and the first communication link can be a WiFi communication link between the mobile communication device and a WiFi access point. The interface server can also include a second inter-network function block to maintain current configuration and status information associated with the second communication link. The interface server can also include a provisioning server to provide the mobile communication device with configuration information.

Brief Description of the Several Views of the Drawings

Figure 1 illustrates an exemplary system of interconnected networks in which a nomadic server is coupled to a cellular network, a wireless IP network, and a public switched telephone network.

Figure 2 illustrates a simplified high-level block diagram of one embodiment of the mobile communication device.

The present invention is described relative to the several views of the drawings. Where appropriate and only where identical elements are disclosed and shown in more than one drawing, the same reference numeral will be used to represent such identical elements.

Detailed Description of the Invention

Embodiments of a nomadic server enable telephone communications that can be initiated using VOIP while within a VOIP access point, such as a WiFi hotspot, and enable telephone communications that can be initiated using a cellular network while within a cellular area and outside of a VOIP access point. When a caller roams outside the range of a VOIP access point, the nomadic server functions to "hold" the current telephone communication while switching occurs from the VOIP access point to the cellular network. Similarly, when a caller roams into the range of a VOIP access point while engaged in a telephone communication on the cellular network, the nomadic server functions to "hold" the current telephone communication while

switching occurs from the cellular network to the VOIP access point. The nomadic server remains engaged, or active, in the telephone communication while switching from one network to another. After switching is completed, the nomadic server disengages from the telephone communication.

Figure 1 illustrates an exemplary system of interconnected networks in which a nomadic server 80 is coupled to a cellular network, a wireless IP network, and a public switched telephone network (PSTN) 60. The cellular network shown in Figure 1 includes a mobile switching center 20 coupled to a public land mobile network 30, and a plurality of base stations 10 coupled to the mobile switching center 20. For clarity, the cellular network shown in Figure 1 is a simplified cellular network architecture. For example, the cellular network in Figure 1 includes only a single mobile switching center, however it is understood that the cellular network includes multiple mobile switching centers. Further, it will be apparent to those skilled in the art, that the functionality of the mobile switching center could alternatively be incorporated into either the base station or any other cellular network infrastructure, or into the nomadic server. Accordingly, as used herein, the term mobile switching center refers to the mobile switching center or any appropriate device within the cellular network equipment infrastructure which performs the functionality of a mobile switching center. Figure 1 shows four base stations 10 coupled to the mobile switching center 20. Alternatively, more or less than four base stations can be coupled to each mobile switching center.

The wireless IP network shown in Figure 1 includes a plurality of wireless IP access points 40 coupled to the Internet 50. Examples of a wireless IP access point include, but are not limited to, a wireless or wired broadband termination element, a wireless or wired modem, a wireless or wired router, and a WiFi access point.

In this example, the nomadic server 80 is coupled to the PSTN 60 through the softswitch 70. The softswitch 70 provides an interface for the nomadic server 80 to legacy networks, such as the PSTN.

A mobile communication device 90 is preferably a dual mode telephone that provides VoIP client functionality over a WiFi network and GSM/CDMA mobile telephony functionality over a cellular network. The mobile communication device 90 can also be configured to automatically switch an existing communication from a cellular network to a wireless IP network, or to switch an existing communication from an IP network to a cellular network. Such a mobile communication device is described in co-pending and co-owned U.S. Patent Application Serial No.11/031,498, filed January 6, 2005, and entitled "TELEPHONE WITH AUTOMATIC SWITCHING BETWEEN CELLULAR AND VOIP NETWORKS", which is hereby incorporated by reference. Alternative types of mobile communication devices include, but are not limited to, laptop computers, music players/recorders, PDAs, telephones, or any conventional mobile communication device capable of receiving broadband content over a wireless connection.

Figure 2 illustrates a simplified high-level block diagram of one embodiment of the mobile communication device 90. The mobile communication device 90 includes a WiFi portion and a cellular portion. The cellular part uses either GSM or CDMA, and access to a communications network is provided through the nearest base station 10. The WiFi portion uses the VOIP client to originate and terminate communications over the WiFi network. The mobile communication device 90 is adapted to automatically switch communications between cellular and VOIP networks. The mobile communication device 90 includes a cellular communication module 93 coupled to a cellular antenna 91, a WiFi communication module 94 coupled to a WiFi antenna 92, an audio/video amplifier 95, a network switch unit 96, a timer unit 97, a WiFi signal level strength monitor 98, a microphone 100, a speaker 99, and a display monitor 101. The mobile communication device 90 is adapted to establish and maintain communication via either the cellular communication module 93 coupled to a cellular base station 10 (Figure 1), and/or via the WiFi communication module 94 coupled to a WiFi access point 40 (Figure 1). The cellular communication module 93 further includes a transceiver 102 adapted to transmit signals to and receive signals from a cellular network. The WiFi communication module 94 further includes a

transceiver 103 adapted to transmit signals to and receive signals from an IP network. Depending on the level of the detected WiFi signal emitted from a WiFi access point, a call initially established via cellular communication module ~~83~~ 93 can be switched to be handled by the WiFi communication module 94, or a call initially established via the WiFi communication module 94 can be switched to be handled by the cellular communication module 93.

Referring back to Figure 1, the nomadic server 80 enables a seamless handoff from one wireless access point to another as the mobile telephone device 90 roams from one WiFi coverage area to another WiFi coverage area, or roams outside a WiFi coverage area but still within a cellular network coverage area. The nomadic server 80 includes a cellular inter-working function (CIWF) block 82, a WiFi inter-working function (WIWF) block 84, and a provisioning server 86. The nomadic server 80 and the mobile switching center 20 are either "tightly" coupled or "loosely" coupled. When tightly coupled, the nomadic server 80 and the mobile switching center 20 are coupled together by a local area network (LAN), or a wide area network (WAN) or any other appropriate interface, using either a proprietary or non-proprietary interface of the mobile switching center 20. In this manner, the nomadic server 80 is able to communicate to the mobile switching center 20 through this interface. When loosely coupled, the nomadic server 80 and the mobile switching center 20 are coupled using an Integrated Services Digital Network (ISDNC) trunk, or by using a softswitch or any other appropriate interface. In this context, a softswitch is defined variously as a media gateway controller, call agent or gate keeper, used to control connections at the junction point between circuit and packet networks.

The nomadic server 80 is coupled to one or more mobile switching centers 20 for communicating signaling and media traffic. A point of interconnection (PoI), is formed between each mobile switching center 20 and the nomadic server 80. Within any given network, one or more nomadic servers 80 can be implemented. Each mobile communication device 90 is associated with a home nomadic server, in this case the nomadic server 80. Each nomadic server can be the home nomadic server for one or more mobile communication devices. Preferably, a mobile switching center is interfaced to only one nomadic server such that a home mobile

switching center is interfaced to the home nomadic server. In this manner, the mobile communication device is associated with a home mobile switching center. Alternatively, multiple mobile switching centers are coupled to any given nomadic server.

When the mobile communication device 90 originates a call within a WiFi coverage area, a WiFi communication link is established with the nomadic server 80. The call can be completed by the nomadic server 80 over the cellular network or the VOIP network. If the call is completed over the cellular network, then the call is routed through any mobile switching center coupled to the nomadic server 80. If the call is completed over the VOIP network, then the call is routed through a softswitch 70 of a service provider, using the Session Initiation Protocol (SIP) or any other appropriate protocols, such as H323. In other words, if the mobile communication device 90 is located within a WiFi coverage area, then the first leg of the call is routed over a WiFi communication link and the remaining portion of the call can be routed over either the cellular network, the VOIP network, or the PSTN.

In operation, a first call is established by the mobile communication device 90 by first determining if it is in a WiFi coverage area. Such a determination is preferably made by measuring a signal strength or other criteria of the nearest WiFi access point 40, and if the signal strength or other criteria is above a predetermined threshold, then a WiFi communication link is established. If WiFi access is not available, then the mobile communication device 90 establishes a cellular communication link with the nearest base station 10. When the mobile communication device 90 first establishes a WiFi communication link, the mobile communication device 90 establishes a communication link with the provisioning server 86 over the WiFi communication link. The WiFi communication link includes the WiFi access point 40, and the Internet 50. The provisioning server 86 provides the mobile communication device 90 with configuration information including an identification of its home nomadic server, which in this case is the nomadic server 80. The mobile communication device 90 preferably uses XML over SSL for communicating with the provisioning server 86 over the Internet 50.

The mobile communication device 90 also registers with the nomadic server 80. In some embodiments, a SIP REGISTER method or any other appropriate protocol, such as H323, with authentication is used between the mobile communication device 90 and the nomadic server 80. The nomadic server 80 also maintains configuration information of the mobile switching center 20. The nomadic server 80 updates the mobile switching center 20 with a current location of the mobile communication device 90. The current location refers to the WiFi access point associated with the WiFi coverage area in which the mobile communication device 90 is currently located. The nomadic server 80 updates the mobile switching center 20 with the location of the mobile communication device 90 at a specified periodicity. In this manner, the mobile switching center 20 maintains a current location of the mobile communication device 90. Using this location information, calls received over the cellular network for the mobile communication device 90 are directed from the mobile switching center 20 over the WiFi communication link via the nomadic server 80.

As long as the mobile communication device 90 maintains a WiFi communication link with the wireless access point 40, irrespective of the cellular network coverage, the mobile communication device 90 registers with its home nomadic server, the nomadic server 80 in this case. The nomadic server 80 in turn updates the current location of the mobile communication device 90 in the mobile switching center 20. When a signal strength or other criteria of the WiFi communication link weakens below a predetermined threshold, the mobile communication device 90 notifies the nomadic server 80. In response, the nomadic server 80 stops sending location updates to the mobile switching center 20. Additionally, the mobile communication device 90 stops sending SIP registrations to the nomadic server 80, and the mobile communication device 90 initiates registration with the nearest mobile switching center. In this manner, subsequent calls originating from or terminating at the mobile communication device 90 are handled by the mobile switching center. The nearest mobile switching center can be the home mobile switching center of the mobile communication device 90 or another mobile switching center, referred to as a visitor mobile switching center, within the cellular network.

While the first call is still established over the WiFi communication link, the mobile communication device 90 sets up a second call to the same end destination as the first call currently setup over the WiFi communication link, thereby establishing a cellular communication link. If the cellular communication link is established via the home mobile switching center, then the second call is routed to the nomadic server 80 via the PoI between the home mobile switching center and the nomadic server 80. In response, the nomadic server 80 determines if the first call over the WiFi communication link is still in progress. If so, access is switched from the WiFi communication link to the cellular communication link.

If, however, the cellular communication link is established over a visitor mobile switching center, then the visitor mobile switching center forwards the second call to a visitor nomadic server coupled to the visitor mobile switching center. The visitor nomadic server can not determine the status of the first call over the WiFi communication link, so the visitor nomadic server switches the second call to the end destination. Concurrently, the home nomadic server, which previously received the notification from the mobile communication device 90 about losing the WiFi communication link, waits for a connection request from the home mobile switching center for the second call to be established. However, the home nomadic server will not receive such a connection request since the second call is being processed by the visitor nomadic server. As such, the home nomadic server drops the first call on the WiFi communication link, and the second call is maintained by the mobile communication device 90 over the cellular communication link.

Once a cellular communication link is established between the mobile communication device 90 and the nearest mobile switching center, the mobile communication device 90 does not attempt to establish another WiFi communication link upon re-entering a WiFi coverage area. The mobile communication device 90 attempts access to a WiFi communication link when the mobile communication device 90 is back in an idle state.

As the mobile communication device roams from a first coverage area to a second coverage area, the transition steps vary depending on the type of the second coverage area and on

the original call setup configuration. Roaming from the first coverage area to the second coverage area can generally be accomplished according to one of five different scenarios, each scenario including associated transition steps.

A first scenario includes the mobile communication device roaming from a first WiFi coverage area to a second WiFi coverage area. The first WiFi coverage area is associated with a first WiFi access point, and the second WiFi coverage area is associated with a second WiFi access point. Each WiFi access point includes an IP address. When the mobile communication device is within the first WiFi coverage area, the mobile communication device registers with its home nomadic server over the first WiFi access point. The home nomadic server updates the location of the mobile communication device with the home mobile switching center of the mobile communication device. For incoming calls directed to the mobile communication device, the home mobile switching center routes the calls to the home nomadic server based on the most recent location information.

When the mobile communication device roams into the second WiFi coverage area, the mobile communication device detects the transition. The mobile communication device acquires the IP address from the second WiFi access point and sends the IP address change to the provisioning server of the home nomadic server. The mobile communication device also sends a SIP register message with the new IP address to the home nomadic server. In response, the home nomadic server redirects any incoming calls to the IP address of the second WiFi access point. The location of the mobile communication device maintained by the home mobile switching center is still valid.

A second scenario includes the mobile communication device 90 initiating a call within a first WiFi coverage area, setting up the call over a VOIP network, and roaming from the first WiFi coverage area to a cellular coverage area supported by the home mobile switching center of the mobile communication device 90. In this scenario, the mobile communication device 90 roams from the first WiFi coverage area to a non-WiFi coverage area. When a first call is initiated and setup, a WiFi communication link is established between the mobile

communication device and a first wireless access point associated with the first WiFi coverage area. When the mobile communication device is within the first WiFi coverage area, the mobile communication device registers with its home nomadic server via the first WiFi access point. The first call is routed from the first wireless access point through a VOIP network, such as the Internet.

The mobile communication device monitors a signal strength or other criteria of the WiFi communication link. When the signal strength or other criteria drops below a predetermined threshold, the mobile communication device registers with the nearest mobile switching center, which in this second scenario is the home mobile switching center of the mobile communication device. The mobile communication device also sends a call setup request to the home mobile switching center for a second call with the same end destination as the first call. The second call is setup by the home mobile switching center, and the second call is routed to the CIWF block within the home nomadic server. The CIWF block determines from the WIWF block if the first call is in progress. If the first call is in progress, then the CIWF block sends an affirmative answer message to the home mobile switching center. The home mobile switching center in turn sends the affirmative answer message to the mobile communication device.

In response to receiving the affirmative answer message, the mobile communication device stops media streaming over the WiFi communication link and powers down the WiFi part. The CIWF block then changes the registration of the mobile communication device in the WIWF block with an IP address of the CIWF block. The CIWF block sends a re-invite message to the WIWF block signifying a media switchover to the IP address of the CIWF block from the IP address of the first wireless access point. Media streaming associated with the first call is then redirected to the CIWF block, where the media is then switched over to the home mobile switching center. Media associated with the first call is now associated with the second call, where the media is now streamed from the VOIP network to the WIWF block to the CIWF block to the home mobile switching center to the mobile communication device. The transition according to the second scenario is now complete. If the second call is subsequently

disconnected by the mobile communication device, then the corresponding call breakdown process is supervised by the CIWF block. If the second call is subsequently disconnected by the end destination device, then the corresponding call breakdown process is supervised by both the WIWF block and the CIWF block.

A third scenario includes the mobile communication device initiating a call within a first WiFi coverage area, setting up a back end of the call over a cellular network, and roaming from the first WiFi coverage area to a cellular coverage area supported by the home mobile switching center of the mobile communication device. In this scenario, the mobile communication device roams from the first WiFi coverage area to a non-WiFi coverage area. When a first call is initiated and setup, a WiFi communication link is established between the mobile communication device and a first wireless access point associated with the first WiFi coverage area. When the mobile communication device is within the first WiFi coverage area, the mobile communication device registers with its home nomadic server via the first WiFi access point. The first call is routed from the wireless access point 40 through a cellular network, such as the mobile switching center and either the PLMN or the PSTN.

The mobile communication device monitors a signal strength or other criteria of the WiFi communication link. When the signal strength or other criteria drops below a predetermined threshold, the mobile communication device registers with the nearest mobile switching center, which in this third scenario is the home mobile switching center of the mobile communication device. The mobile communication device also sends a call setup request to the home mobile switching center for a second call with the same end destination as the first call. The second call is setup by the home mobile switching center, and the second call is routed to the CIWF block within the home nomadic server. The CIWF block determines from the WIWF block if the first call is in progress. If the first call is in progress, then the CIWF block sends an affirmative answer message to the home mobile switching center. The home mobile switching center in turn sends the affirmative answer message to the mobile communication device.

In response to receiving the affirmative answer message, the mobile communication device stops media streaming over the WiFi communication link and powers down its WiFi part. The CIWF block then changes the registration of the mobile communication device in the WIWF block with an IP address of the CIWF block. The CIWF block sends a re-invite message to the WIWF block signifying a media switchover to the IP address of the CIWF block from the IP address of the first wireless access point. Media streaming associated with the first call is then redirected to the CIWF block, where the media is then switched over to the home mobile switching center. The media stream associated with the first call is now associated with the second call, where the media stream is now directed from the cellular network to the CIWF block to the home mobile switching center to the mobile communication device. The transition according to the third scenario is now complete. If the second call is subsequently disconnected by the mobile communication device, then the corresponding call breakdown process is supervised by the CIWF block and the home mobile switching center. If the second call is subsequently disconnected by the end destination device, then the corresponding call breakdown process is supervised by the CIWF block.

A fourth scenario includes the mobile communication device initiating a call within a first WiFi coverage area that resides outside a cellular coverage area supported by the home mobile switching center of the mobile communication device, setting up a back end of the call over a VOIP network, and roaming from the first WiFi coverage area to a cellular coverage area supported by a visitor mobile switching center. In this scenario, the mobile communication device roams from the first WiFi coverage area to a non-WiFi coverage area. When a first call is initiated and setup, a WiFi communication link is established between the mobile communication device and a first wireless access point associated with the first WiFi coverage area. When the mobile communication device is within the first WiFi coverage area, the mobile communication device registers with its home nomadic server via the first WiFi access point. In this manner, the WIWF block in the home nomadic server monitors the location of the mobile communication device . The first call is routed from the mobile communication device to the

first wireless access point via the WiFi communication link to the WIWF block of the visitor nomadic server associated with the visitor mobile switching center to the VOIP network

The mobile communication device monitors a signal strength or other criteria of the WiFi communication link. When the signal strength or other criteria drops below a predetermined threshold, the mobile communication device registers with the nearest mobile switching center, which in this fourth scenario is the visitor mobile switching center. The mobile communication device notifies the WIWF block in its home nomadic server that the signal strength or other criteria is below the predetermined threshold. The mobile communication device also sends a call setup request to the visitor mobile switching center for a second call with the same end destination as the first call. The visitor mobile switching center forwards the call setup request to the CIWF block within the visitor nomadic server. Within the visitor nomadic server, the CIWF block determines from the WIWF block if the first call is in progress. Since the mobile communication device has been registering itself with its home nomadic server, and not with the visitor nomadic server, the WIWF block within the visitor nomadic server does not have a record of the first call being in progress. In response, the visitor nomadic server sets up the second call over the cellular network. Concurrently, the home nomadic server tears down the first call over the VOIP network.

A fifth scenario includes the mobile communication device initiating a call within a first WiFi coverage area that resides outside a cellular coverage area supported by the home mobile switching center of the mobile communication device, setting up a back end of the call over a cellular network, and roaming from the first WiFi coverage area to a cellular coverage area supported by a visitor mobile switching center. In this scenario, the mobile communication device roams from the first WiFi coverage area to a non-WiFi coverage area. When a first call is initiated and setup, a WiFi communication link is established between the mobile communication device and a first wireless access point associated with the first WiFi access point. The first call is routed from the mobile communication device to the first wireless access

point via the WiFi communication link to the CIWF block of the visitor nomadic server to the visitor mobile switching center to the cellular network.

The mobile communication device monitors a signal strength or other criteria of the WiFi communication link. When the signal strength or other criteria drops below a predetermined threshold, the mobile communication device registers with the nearest mobile switching center, which in this fifth scenario is the visitor mobile switching center. When the mobile communication device is within the first WiFi coverage area, the mobile communication device registers with its home nomadic server via the first WiFi access point. In this manner, the WIWF block in the home nomadic server monitors the location of the mobile communication device. The mobile communication device notifies the WIWF block in its home nomadic server that the signal strength or other criteria is below the predetermined threshold. The mobile communication device also sends a call setup request to the visitor mobile switching center for a second call with the same end destination as the first call. The visitor mobile switching center forwards the call setup request to the CIWF block within the visitor nomadic server. Within the visitor nomadic server, the CIWF block determines from the WIWF block if the first call is in progress. Since the mobile communication device has been registering itself with its home nomadic server, and not with the visitor nomadic server, the WIWF block within the visitor nomadic server does not have a record of the first call being in progress. In response, the visitor nomadic server sets up the second call over the cellular network. Concurrently, the home nomadic server tears down the first call over the cellular network and the first WiFi communication link.

It is understood that the five scenarios described above are not exhaustive or inclusive of all scenarios in which the mobile communication device can roam from a first coverage area to a second coverage area with the support of the nomadic server. It is understood that other scenarios are also contemplated.

In some embodiments, the nomadic server 80 also communicates to other nomadic services over the Internet to route and complete calls using VOIP. This server-to-server

communication can be used for all calls, even for cellular to cellular calls. In such a situation, the cellular telephone communication is transmitted from the initiating cellular telephone to the appropriate base station. From this base station, the communication is routed to the appropriate nomadic server 80, which in some embodiments is the nomadic server 80 that is the closest to the receiving base station 10. This initiating nomadic server 80 then transmits the communication over the Internet, to the nomadic server 80 that is closest to the appropriate base station 10 corresponding to the location of the receiver's cellular telephone. This receiving nomadic server 80 then transmits the communication to this receiving base station 10, which transmits the communication to the receiver's cellular telephone. In this manner, the only portions of the transmission that are communicated over the cellular telephone network, are the initial leg, from the initiating cellular telephone to the appropriate base station, and the final leg, from the appropriate base station to the receiver's cellular telephone. The remaining, intermediate, portions of the transmission are communicated between the appropriate nomadic servers over the Internet, which allows the call to be completed more efficiently than if the call was transmitted completely over the cellular network in the traditional manner. As will be apparent to those skilled in the art, communications are directed in both directions in this manner in order to complete the call between the initiator and the receiver, with the initial and final portions of the transmission routed over the cellular network and the remaining intermediate portions of the transmission routed between nomadic servers 80, over the Internet 50.

The present invention has been described in terms of specific embodiments incorporating details to facilitate the understanding of the principles of construction and operation of the invention. As such, references herein to specific embodiments and details thereof are not intended to limit the scope of the claims appended hereto. It will be apparent to those skilled in the art that modifications can be made to the embodiments chosen for illustration without departing from the spirit and scope of the invention.

Abstract of the Disclosure

A nomadic server and a related system provides seamless roaming for a mobile communication device between different types of wireless networks, such as WiFi and cellular networks for voice, data and video communication. Use of the nomadic server enables a combination of WiFi and cellular networks for providing access to the cellular phones and make use of the VOIP networks for switching the calls wherever possible. The nomadic server is a telephone communication processing and switching server that will "hold" the present, in-progress telephone communications without dropping, while roaming without losing the present, in-progress communication. For example, a telephone communication can be seamlessly switching between VOIP and cellular telephone networks using the nomadic server. Nomadic server resources interface with the VOIP and cellular network switches to provide the hand-off between networks. This approach enables switching of telephone communications over a VOIP network wherever possible either through WiFi or through cellular networks.

MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLER

Related Applications

This Patent Application is a continuation application of co-pending U.S. Patent Application No. 13/240,776, filed on September 22, 2011, and entitled "MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLER," which is a divisional application of co-pending U.S. Patent Application No. 11/330,675, filed on January 11, 2006, and entitled "MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLER," which claims priority of U.S. provisional application, serial number 60/643,829, filed January 14, 2005, and entitled "TELEPHONE COMMUNICATIONS PROCESSING CONTROLLER," by the same inventors and is a continuation-in-part of U.S. Patent Application, serial number 11/031,498, filed January 6, 2005, and entitled "TELEPHONE WITH AUTOMATIC SWITCHING BETWEEN CELLULAR AND VOIP NETWORKS", all of which are hereby incorporated by reference. U.S. Patent Application, serial no. 11/031,498 claims priority of U.S. provisional application, serial number 60/534,466, filed January 6, 2004, and entitled "RADIOTELEPHONE WITH AUTOMATIC SWITCHING BETWEEN CELLULAR AND WI-FI NETWORKS USING WI-FI SIGNAL STRENGTH VALUES," the content of which is also incorporated herein by reference in its entirety.

Field of the Invention

The present invention relates to the field of network communication processing. In particular, the present invention relates to seamlessly switching communications among Voice over Internet (VOIP), public cellular, and public circuit switched networks.

Background of the Invention

Current telephone communications occur over wireless cellular networks, such as GSM, CDMA, and CDMA2000, Voice Over Internet (VOIP), or circuit switched network, such as PSTN. Current state of the art of most telephones used with such networks is that each telephone is restricted for use with only one specific network. For example, a cellular phone works in a cellular network; a VOIP phone works in VOIP network, and a landline phone works in a circuit switched network. Such limitations imply that an in-progress telephone communication cannot be seamlessly switched among cellular, VOIP, and circuit switched networks without losing the connection.

Such wireless networks use regulated portions of the radio spectrum and are shared by many users. The infrastructure costs of wireless networks are relatively high due to the size and complexity of the network equipment. There is a wide variance in the performance of different wireless networks. For example, a conventional wireless cellular network covers a relatively large geographical area, but provides a relatively low bandwidth. Other wireless networks, such as CDMA2000-EV-DO/DV networks, offer higher bandwidth and enhanced data services, such as web browsing. However, these networks also pack many users into a relatively small portion of the regulated spectrum. Other types of wireless networks are adapted to improve spectral efficiency with increased speed and smaller coverage areas. For example, an IEEE 802.11x (or WiFi) network may transmit at speeds up to 11 Mbps using a Direct Sequence Spread Spectrum (DSSS) mode or at speeds up to 54 Mbps using an Orthogonal Frequency Division Multiplexing (OFDM) mode.

A network wireless access point conforming to a WiFi (e.g., IEEE 802.11b) network may cover an area of a few hundred feet in diameter. Each such network access point is connected to a larger network (e.g., Internet). One such example is WiFi VOIP (Wireless Fidelity Voice over Internet Protocol), through which a communication device user can place a wireless telephone call over the Internet, using the technology specified in IEEE 802.xx at the network access point. VOIP is a method for taking analog audio signals and converting them into digital data that can

be transmitted over the Internet. Conventional VOIP telephone communications are enabled by VOIP network carriers, which utilize VOIP networks (e.g. the Internet), to place VOIP based telephone calls. VOIP enabled and compatible networks include VOIP switching for proper routing and billing of VOIP based telephone calls.

In order to cover larger geographical areas, a relatively large number of IEEE 802.11x, for example, network access points and relatively large wire-line back haul networks are required. In part, due to the relatively small geographical coverage area of each network access point, the resulting IEEE 802.11x based network may thus be prohibitively expensive to set up. Further, the small coverage areas may lead to many "dead zones" in which mobile communication device users are unable to place telephone calls using the VOIP network.

Conventional VOIP phones, which function in a WiFi coverage area (hotspot) corresponding to a WiFi access point, offers relatively inexpensive telephone communications. However, the WiFi availability is limited due to the small geographical area supported by each WiFi access point.

Conventional cellular phones, which function in a cell coverage area within the cellular network, are relatively expensive for telephone communications and have limited multimedia capabilities. Cellular networks and availability to the network covers a much wider, extensive geographical area.

Conventional landline phones, which function in a circuit switched network such as most residences, do not offer extensive telephone communication features, for example video. Such landline phones also do not offer the mobility provided by mobile communications devices such as the VOIP phones or the cellular phones.

Summary of the Invention

The present invention is directed to an interface server, referred to as a nomadic server, and a related system that provides seamless roaming of a mobile communication device between different types of wireless networks, such as WiFi and cellular networks for voice, data and video

IPR2025-00447 Page 00347

communication. Use of the nomadic server enables a combination of WiFi and cellular networks for providing access to the mobile communication device and makes use of the VOIP networks for switching the calls wherever possible.

The nomadic server is a telephone communication processing and switching server that will "hold" the present, in-progress telephone communications without dropping, while roaming between WiFi access points and cellular networks, without losing the present, in-progress communication. For example, a telephone communication can be seamlessly switched between VOIP and cellular telephone networks using the nomadic server. Nomadic server resources interface with the VOIP and cellular network switches to provide the hand-off between networks. This approach enables switching of telephone communications over a VOIP network wherever possible either through WiFi or through cellular networks.

In one aspect of the present invention, a method provides communications for a mobile communication device that roams between multiple different types of wireless networks. The method comprises establishing a first communication link between the mobile communication device and an end destination device, wherein the first communication link includes a first wireless communication link between the mobile communication device and a first type of wireless network, monitoring a signal strength of the first wireless communication link, when the signal strength drops below a predetermined threshold, establishing a second communication link between an interface server and the end destination device, notifying the mobile communication device to terminate transmission over the first communication link, and re-directing the second communication link from the interface server to the mobile communication device, thereby establishing a second wireless communication link between the mobile communication device and the second type of wireless network. The first type of wireless communication link can comprise a WiFi communication link, and the first type of wireless network can include a WiFi network access point. The second type of wireless network can include a wireless cellular network. Establishing the first communication link can include routing through a VOIP network. Establishing the first communication link can include routing through a cellular network.

Establishing the second communication link can include routing through a VOIP network. Establishing the second communication link can include routing through a cellular network.

The method can also include providing a connectivity status by the mobile communication device to the interface server while the mobile communication device is within a first coverage area of the first type of wireless network. The method can also include providing a routing association to a mobile switching center within the second type of wireless network, wherein the routing association associates the mobile communication device to the interface server. The method can also include routing a termination communication intended for the mobile communication device from the mobile switching center to the interface server according to the routing association when the connectivity status is active, and routing the termination communication from the interface server to the mobile communication device over the first type of wireless network. The method can also include when the connectivity status is not provided to the interface server, the router association is removed from the mobile switching center. The method can also include registering the mobile communication device with a mobile switching center within the second type of wireless network when the signal strength drops below the predetermined threshold. The method can also include setting up the second communication link with the end destination device and forwarding the second communication link to the interface server.

In another aspect of the present invention, a method provides communications for a mobile communication device that roams between multiple WiFi coverage areas. The method includes associating the mobile communication device with a nomadic server, wherein the nomadic server is coupled to one or more WiFi access points, establishing a first WiFi communication link between the mobile communication device and a first WiFi access point, registering the mobile communication device with the nomadic server including providing an IP address of the first WiFi access point to the nomadic server, configuring a communication path to the mobile communication device via the nomadic server according to the IP address of the first WiFi access point and the first WiFi communication link, detecting movement of the mobile

communication device into a coverage area of a second WiFi access point, registering the mobile communication device with the nomadic server including an IP address of the second WiFi access point, establishing a second WiFi communication link between the mobile communication device and the second WiFi access point, and re-configuring the communication path according to the IP address of the second WiFi access point and the second WiFi communication link. The method can also include associating the mobile communication device to the nomadic server at the mobile switching center. The method can also include providing a routing association to a mobile switching center within a cellular network, wherein the routing association associates the mobile communication device to the interface server. The method can also include routing a termination communication intended for the mobile communication device from the mobile switching center to the interface server according to the routing association, and routing the termination communication from the interface server to the mobile communication device over the communication path. Registering the mobile communication device with the nomadic server can provide a connectivity status of the mobile communication device while the mobile communication device is within a specific coverage area of a specific WiFi access point.

In yet another aspect of the present invention, a system provides communications for a mobile communication device that roams between multiple different types of wireless networks. The system includes a plurality of different types of wireless networks, the mobile communication device configured to access the plurality of wireless networks, and an interface server coupled to the plurality of wireless networks, wherein the interface server maintains a seamless communication link between the mobile communication device and an end destination device as the mobile communication device roams from a first wireless coverage area associated within a first type of wireless network to a second wireless coverage area associated with a second type of wireless network, the interface server is configured to establish a second communication link over the second type of wireless network while a first communication link between the mobile communication device and the end destination device over the first type of wireless network is active, wherein the second communication link is initially set up to be

forwarded to the interface server and subsequently the second communication link is routed to the mobile communication device as the first communication link is terminated. The first communication link can include a first wireless communication link between the mobile communication device and the first type of wireless network. The first wireless coverage area can be a WiFi coverage area, and the first wireless communication link can be a WiFi communication link between the mobile communication device and a WiFi access point. The first communication link can include a routing path through a VOIP network. The first communication link can include a routing path through a cellular network. The second communication link can include a second wireless communication link between the mobile communication device and the second type of wireless network. The second wireless coverage area can be a cellular coverage area and the second wireless communication link can be a wireless cellular communication link between the mobile communication device and a cellular base station. The second communication link can include a routing path through a VOIP network. The second communication link can include a routing path through a cellular network. The second type of wireless network can include a wireless cellular network.

In still yet another aspect of the present invention, an interface server maintains a seamless communication link between a mobile communication device and an end destination device as the mobile communication device roams from a first wireless coverage area associated within a first type of wireless network to a second wireless coverage area associated with a second type of wireless network, the interface server is configured to establish a second communication link over the second type of wireless network while a first communication link between the mobile communication device and the end destination device over the first type of wireless network is active, wherein the second communication link is initially set up to be forwarded to the interface server and subsequently the second communication link is routed to the mobile communication device as the first communication link is terminated. The interface server can also include a first inter-network function block to maintain current configuration and status information associated with the first communication link. The first wireless coverage area

can be a WiFi coverage area, and the first communication link can be a WiFi communication link between the mobile communication device and a WiFi access point. The interface server can also include a second inter-network function block to maintain current configuration and status information associated with the second communication link. The interface server can also include a provisioning server to provide the mobile communication device with configuration information.

Brief Description of the Several Views of the Drawings

Figure 1 illustrates an exemplary system of interconnected networks in which a nomadic server is coupled to a cellular network, a wireless IP network, and a public switched telephone network.

Figure 2 illustrates a simplified high-level block diagram of one embodiment of the mobile communication device.

The present invention is described relative to the several views of the drawings. Where appropriate and only where identical elements are disclosed and shown in more than one drawing, the same reference numeral will be used to represent such identical elements.

Detailed Description of the Invention

Embodiments of a nomadic server enable telephone communications that can be initiated using VOIP while within a VOIP access point, such as a WiFi hotspot, and enable telephone communications that can be initiated using a cellular network while within a cellular area and outside of a VOIP access point. When a caller roams outside the range of a VOIP access point, the nomadic server functions to "hold" the current telephone communication while switching occurs from the VOIP access point to the cellular network. Similarly, when a caller roams into the range of a VOIP access point while engaged in a telephone communication on the cellular network, the nomadic server functions to "hold" the current telephone communication while

switching occurs from the cellular network to the VOIP access point. The nomadic server remains engaged, or active, in the telephone communication while switching from one network to another. After switching is completed, the nomadic server disengages from the telephone communication.

Figure 1 illustrates an exemplary system of interconnected networks in which a nomadic server 80 is coupled to a cellular network, a wireless IP network, and a public switched telephone network (PSTN) 60. The cellular network shown in Figure 1 includes a mobile switching center 20 coupled to a public land mobile network 30, and a plurality of base stations 10 coupled to the mobile switching center 20. For clarity, the cellular network shown in Figure 1 is a simplified cellular network architecture. For example, the cellular network in Figure 1 includes only a single mobile switching center, however it is understood that the cellular network includes multiple mobile switching centers. Further, it will be apparent to those skilled in the art, that the functionality of the mobile switching center could alternatively be incorporated into either the base station or any other cellular network infrastructure, or into the nomadic server. Accordingly, as used herein, the term mobile switching center refers to the mobile switching center or any appropriate device within the cellular network equipment infrastructure which performs the functionality of a mobile switching center. Figure 1 shows four base stations 10 coupled to the mobile switching center 20. Alternatively, more or less than four base stations can be coupled to each mobile switching center.

The wireless IP network shown in Figure 1 includes a plurality of wireless IP access points 40 coupled to the Internet 50. Examples of a wireless IP access point include, but are not limited to, a wireless or wired broadband termination element, a wireless or wired modem, a wireless or wired router, and a WiFi access point.

In this example, the nomadic server 80 is coupled to the PSTN 60 through the softswitch 70. The softswitch 70 provides an interface for the nomadic server 80 to legacy networks, such as the PSTN.

A mobile communication device 90 is preferably a dual mode telephone that provides VoIP client functionality over a WiFi network and GSM/CDMA mobile telephony functionality over a cellular network. The mobile communication device 90 can also be configured to automatically switch an existing communication from a cellular network to a wireless IP network, or to switch an existing communication from an IP network to a cellular network. Such a mobile communication device is described in co-pending and co-owned U.S. Patent Application Serial No.11/031,498, filed January 6, 2005, and entitled "TELEPHONE WITH AUTOMATIC SWITCHING BETWEEN CELLULAR AND VOIP NETWORKS", which is hereby incorporated by reference. Alternative types of mobile communication devices include, but are not limited to, laptop computers, music players/recorders, PDAs, telephones, or any conventional mobile communication device capable of receiving broadband content over a wireless connection.

Figure 2 illustrates a simplified high-level block diagram of one embodiment of the mobile communication device 90. The mobile communication device 90 includes a WiFi portion and a cellular portion. The cellular part uses either GSM or CDMA, and access to a communications network is provided through the nearest base station 10. The WiFi portion uses the VOIP client to originate and terminate communications over the WiFi network. The mobile communication device 90 is adapted to automatically switch communications between cellular and VOIP networks. The mobile communication device 90 includes a cellular communication module 93 coupled to a cellular antenna 91, a WiFi communication module 94 coupled to a WiFi antenna 92, an audio/video amplifier 95, a network switch unit 96, a timer unit 97, a WiFi signal level strength monitor 98, a microphone 100, a speaker 99, and a display monitor 101. The mobile communication device 90 is adapted to establish and maintain communication via either the cellular communication module 93 coupled to a cellular base station 10 (Figure 1), and/or via the WiFi communication module 94 coupled to a WiFi access point 40 (Figure 1). The cellular communication module 93 further includes a transceiver 102 adapted to transmit signals to and receive signals from a cellular network. The WiFi communication module 94 further includes a

transceiver 103 adapted to transmit signals to and receive signals from an IP network. Depending on the level of the detected WiFi signal emitted from a WiFi access point, a call initially established via cellular communication module 93 can be switched to be handled by the WiFi communication module 94, or a call initially established via the WiFi communication module 94 can be switched to be handled by the cellular communication module 93.

Referring back to Figure 1, the nomadic server 80 enables a seamless handoff from one wireless access point to another as the mobile telephone device 90 roams from one WiFi coverage area to another WiFi coverage area, or roams outside a WiFi coverage area but still within a cellular network coverage area. The nomadic server 80 includes a cellular inter-working function (CIWF) block 82, a WiFi inter-working function (WIWF) block 84, and a provisioning server 86. The nomadic server 80 and the mobile switching center 20 are either "tightly" coupled or "loosely" coupled. When tightly coupled, the nomadic server 80 and the mobile switching center 20 are coupled together by a local area network (LAN), or a wide area network (WAN) or any other appropriate interface, using either a proprietary or non-proprietary interface of the mobile switching center 20. In this manner, the nomadic server 80 is able to communicate to the mobile switching center 20 through this interface. When loosely coupled, the nomadic server 80 and the mobile switching center 20 are coupled using an Integrated Services Digital Network (ISDNC) trunk, or by using a softswitch or any other appropriate interface. In this context, a softswitch is defined variously as a media gateway controller, call agent or gate keeper, used to control connections at the junction point between circuit and packet networks.

The nomadic server 80 is coupled to one or more mobile switching centers 20 for communicating signaling and media traffic. A point of interconnection (PoI), is formed between each mobile switching center 20 and the nomadic server 80. Within any given network, one or more nomadic servers 80 can be implemented. Each mobile communication device 90 is associated with a home nomadic server, in this case the nomadic server 80. Each nomadic server can be the home nomadic server for one or more mobile communication devices. Preferably, a mobile switching center is interfaced to only one nomadic server such that a home mobile

switching center is interfaced to the home nomadic server. In this manner, the mobile communication device is associated with a home mobile switching center. Alternatively, multiple mobile switching centers are coupled to any given nomadic server.

When the mobile communication device 90 originates a call within a WiFi coverage area, a WiFi communication link is established with the nomadic server 80. The call can be completed by the nomadic server 80 over the cellular network or the VOIP network. If the call is completed over the cellular network, then the call is routed through any mobile switching center coupled to the nomadic server 80. If the call is completed over the VOIP network, then the call is routed through a softswitch 70 of a service provider, using the Session Initiation Protocol (SIP) or any other appropriate protocols, such as H323. In other words, if the mobile communication device 90 is located within a WiFi coverage area, then the first leg of the call is routed over a WiFi communication link and the remaining portion of the call can be routed over either the cellular network, the VOIP network, or the PSTN.

In operation, a first call is established by the mobile communication device 90 by first determining if it is in a WiFi coverage area. Such a determination is preferably made by measuring a signal strength or other criteria of the nearest WiFi access point 40, and if the signal strength or other criteria is above a predetermined threshold, then a WiFi communication link is established. If WiFi access is not available, then the mobile communication device 90 establishes a cellular communication link with the nearest base station 10. When the mobile communication device 90 first establishes a WiFi communication link, the mobile communication device 90 establishes a communication link with the provisioning server 86 over the WiFi communication link. The WiFi communication link includes the WiFi access point 40, and the Internet 50. The provisioning server 86 provides the mobile communication device 90 with configuration information including an identification of its home nomadic server, which in this case is the nomadic server 80. The mobile communication device 90 preferably uses XML over SSL for communicating with the provisioning server 86 over the Internet 50.

The mobile communication device 90 also registers with the nomadic server 80. In some embodiments, a SIP REGISTER method or any other appropriate protocol, such as H323, with authentication is used between the mobile communication device 90 and the nomadic server 80. The nomadic server 80 also maintains configuration information of the mobile switching center 20. The nomadic server 80 updates the mobile switching center 20 with a current location of the mobile communication device 90. The current location refers to the WiFi access point associated with the WiFi coverage area in which the mobile communication device 90 is currently located. The nomadic server 80 updates the mobile switching center 20 with the location of the mobile communication device 90 at a specified periodicity. In this manner, the mobile switching center 20 maintains a current location of the mobile communication device 90. Using this location information, calls received over the cellular network for the mobile communication device 90 are directed from the mobile switching center 20 over the WiFi communication link via the nomadic server 80.

As long as the mobile communication device 90 maintains a WiFi communication link with the wireless access point 40, irrespective of the cellular network coverage, the mobile communication device 90 registers with its home nomadic server, the nomadic server 80 in this case. The nomadic server 80 in turn updates the current location of the mobile communication device 90 in the mobile switching center 20. When a signal strength or other criteria of the WiFi communication link weakens below a predetermined threshold, the mobile communication device 90 notifies the nomadic server 80. In response, the nomadic server 80 stops sending location updates to the mobile switching center 20. Additionally, the mobile communication device 90 stops sending SIP registrations to the nomadic server 80, and the mobile communication device 90 initiates registration with the nearest mobile switching center. In this manner, subsequent calls originating from or terminating at the mobile communication device 90 are handled by the mobile switching center. The nearest mobile switching center can be the home mobile switching center of the mobile communication device 90 or another mobile switching center, referred to as a visitor mobile switching center, within the cellular network.

While the first call is still established over the WiFi communication link, the mobile communication device 90 sets up a second call to the same end destination as the first call currently setup over the WiFi communication link, thereby establishing a cellular communication link. If the cellular communication link is established via the home mobile switching center, then the second call is routed to the nomadic server 80 via the PoI between the home mobile switching center and the nomadic server 80. In response, the nomadic server 80 determines if the first call over the WiFi communication link is still in progress. If so, access is switched from the WiFi communication link to the cellular communication link.

If, however, the cellular communication link is established over a visitor mobile switching center, then the visitor mobile switching center forwards the second call to a visitor nomadic server coupled to the visitor mobile switching center. The visitor nomadic server can not determine the status of the first call over the WiFi communication link, so the visitor nomadic server switches the second call to the end destination. Concurrently, the home nomadic server, which previously received the notification from the mobile communication device 90 about losing the WiFi communication link, waits for a connection request from the home mobile switching center for the second call to be established. However, the home nomadic server will not receive such a connection request since the second call is being processed by the visitor nomadic server. As such, the home nomadic server drops the first call on the WiFi communication link, and the second call is maintained by the mobile communication device 90 over the cellular communication link.

Once a cellular communication link is established between the mobile communication device 90 and the nearest mobile switching center, the mobile communication device 90 does not attempt to establish another WiFi communication link upon re-entering a WiFi coverage area. The mobile communication device 90 attempts access to a WiFi communication link when the mobile communication device 90 is back in an idle state.

As the mobile communication device roams from a first coverage area to a second coverage area, the transition steps vary depending on the type of the second coverage area and on

the original call setup configuration. Roaming from the first coverage area to the second coverage area can generally be accomplished according to one of five different scenarios, each scenario including associated transition steps.

A first scenario includes the mobile communication device roaming from a first WiFi coverage area to a second WiFi coverage area. The first WiFi coverage area is associated with a first WiFi access point, and the second WiFi coverage area is associated with a second WiFi access point. Each WiFi access point includes an IP address. When the mobile communication device is within the first WiFi coverage area, the mobile communication device registers with its home nomadic server over the first WiFi access point. The home nomadic server updates the location of the mobile communication device with the home mobile switching center of the mobile communication device. For incoming calls directed to the mobile communication device, the home mobile switching center routes the calls to the home nomadic server based on the most recent location information.

When the mobile communication device roams into the second WiFi coverage area, the mobile communication device detects the transition. The mobile communication device acquires the IP address from the second WiFi access point and sends the IP address change to the provisioning server of the home nomadic server. The mobile communication device also sends a SIP register message with the new IP address to the home nomadic server. In response, the home nomadic server redirects any incoming calls to the IP address of the second WiFi access point. The location of the mobile communication device maintained by the home mobile switching center is still valid.

A second scenario includes the mobile communication device 90 initiating a call within a first WiFi coverage area, setting up the call over a VOIP network, and roaming from the first WiFi coverage area to a cellular coverage area supported by the home mobile switching center of the mobile communication device 90. In this scenario, the mobile communication device 90 roams from the first WiFi coverage area to a non-WiFi coverage area. When a first call is initiated and setup, a WiFi communication link is established between the mobile

communication device and a first wireless access point associated with the first WiFi coverage area. When the mobile communication device is within the first WiFi coverage area, the mobile communication device registers with its home nomadic server via the first WiFi access point. The first call is routed from the first wireless access point through a VOIP network, such as the Internet.

The mobile communication device monitors a signal strength or other criteria of the WiFi communication link. When the signal strength or other criteria drops below a predetermined threshold, the mobile communication device registers with the nearest mobile switching center, which in this second scenario is the home mobile switching center of the mobile communication device. The mobile communication device also sends a call setup request to the home mobile switching center for a second call with the same end destination as the first call. The second call is setup by the home mobile switching center, and the second call is routed to the CIWF block within the home nomadic server. The CIWF block determines from the WIWF block if the first call is in progress. If the first call is in progress, then the CIWF block sends an affirmative answer message to the home mobile switching center. The home mobile switching center in turn sends the affirmative answer message to the mobile communication device.

In response to receiving the affirmative answer message, the mobile communication device stops media streaming over the WiFi communication link and powers down the WiFi part. The CIWF block then changes the registration of the mobile communication device in the WIWF block with an IP address of the CIWF block. The CIWF block sends a re-invite message to the WIWF block signifying a media switchover to the IP address of the CIWF block from the IP address of the first wireless access point. Media streaming associated with the first call is then redirected to the CIWF block, where the media is then switched over to the home mobile switching center. Media associated with the first call is now associated with the second call, where the media is now streamed from the VOIP network to the WIWF block to the CIWF block to the home mobile switching center to the mobile communication device. The transition according to the second scenario is now complete. If the second call is subsequently

disconnected by the mobile communication device, then the corresponding call breakdown process is supervised by the CIWF block. If the second call is subsequently disconnected by the end destination device, then the corresponding call breakdown process is supervised by both the WIWF block and the CIWF block.

A third scenario includes the mobile communication device initiating a call within a first WiFi coverage area, setting up a back end of the call over a cellular network, and roaming from the first WiFi coverage area to a cellular coverage area supported by the home mobile switching center of the mobile communication device. In this scenario, the mobile communication device roams from the first WiFi coverage area to a non-WiFi coverage area. When a first call is initiated and setup, a WiFi communication link is established between the mobile communication device and a first wireless access point associated with the first WiFi coverage area. When the mobile communication device is within the first WiFi coverage area, the mobile communication device registers with its home nomadic server via the first WiFi access point. The first call is routed from the wireless access point 40 through a cellular network, such as the mobile switching center and either the PLMN or the PSTN.

The mobile communication device monitors a signal strength or other criteria of the WiFi communication link. When the signal strength or other criteria drops below a predetermined threshold, the mobile communication device registers with the nearest mobile switching center, which in this third scenario is the home mobile switching center of the mobile communication device. The mobile communication device also sends a call setup request to the home mobile switching center for a second call with the same end destination as the first call. The second call is setup by the home mobile switching center, and the second call is routed to the CIWF block within the home nomadic server. The CIWF block determines from the WIWF block if the first call is in progress. If the first call is in progress, then the CIWF block sends an affirmative answer message to the home mobile switching center. The home mobile switching center in turn sends the affirmative answer message to the mobile communication device.

In response to receiving the affirmative answer message, the mobile communication device stops media streaming over the WiFi communication link and powers down its WiFi part. The CIWF block then changes the registration of the mobile communication device in the WIWF block with an IP address of the CIWF block. The CIWF block sends a re-invite message to the WIWF block signifying a media switchover to the IP address of the CIWF block from the IP address of the first wireless access point. Media streaming associated with the first call is then redirected to the CIWF block, where the media is then switched over to the home mobile switching center. The media stream associated with the first call is now associated with the second call, where the media stream is now directed from the cellular network to the CIWF block to the home mobile switching center to the mobile communication device. The transition according to the third scenario is now complete. If the second call is subsequently disconnected by the mobile communication device, then the corresponding call breakdown process is supervised by the CIWF block and the home mobile switching center. If the second call is subsequently disconnected by the end destination device, then the corresponding call breakdown process is supervised by the CIWF block.

A fourth scenario includes the mobile communication device initiating a call within a first WiFi coverage area that resides outside a cellular coverage area supported by the home mobile switching center of the mobile communication device, setting up a back end of the call over a VOIP network, and roaming from the first WiFi coverage area to a cellular coverage area supported by a visitor mobile switching center. In this scenario, the mobile communication device roams from the first WiFi coverage area to a non-WiFi coverage area. When a first call is initiated and setup, a WiFi communication link is established between the mobile communication device and a first wireless access point associated with the first WiFi coverage area. When the mobile communication device is within the first WiFi coverage area, the mobile communication device registers with its home nomadic server via the first WiFi access point. In this manner, the WIWF block in the home nomadic server monitors the location of the mobile communication device . The first call is routed from the mobile communication device to the

first wireless access point via the WiFi communication link to the WIWF block of the visitor nomadic server associated with the visitor mobile switching center to the VOIP network

The mobile communication device monitors a signal strength or other criteria of the WiFi communication link. When the signal strength or other criteria drops below a predetermined threshold, the mobile communication device registers with the nearest mobile switching center, which in this fourth scenario is the visitor mobile switching center. The mobile communication device notifies the WIWF block in its home nomadic server that the signal strength or other criteria is below the predetermined threshold. The mobile communication device also sends a call setup request to the visitor mobile switching center for a second call with the same end destination as the first call. The visitor mobile switching center forwards the call setup request to the CIWF block within the visitor nomadic server. Within the visitor nomadic server, the CIWF block determines from the WIWF block if the first call is in progress. Since the mobile communication device has been registering itself with its home nomadic server, and not with the visitor nomadic server, the WIWF block within the visitor nomadic server does not have a record of the first call being in progress. In response, the visitor nomadic server sets up the second call over the cellular network. Concurrently, the home nomadic server tears down the first call over the VOIP network.

A fifth scenario includes the mobile communication device initiating a call within a first WiFi coverage area that resides outside a cellular coverage area supported by the home mobile switching center of the mobile communication device, setting up a back end of the call over a cellular network, and roaming from the first WiFi coverage area to a cellular coverage area supported by a visitor mobile switching center. In this scenario, the mobile communication device roams from the first WiFi coverage area to a non-WiFi coverage area. When a first call is initiated and setup, a WiFi communication link is established between the mobile communication device and a first wireless access point associated with the first WiFi access point. The first call is routed from the mobile communication device to the first wireless access

point via the WiFi communication link to the CIWF block of the visitor nomadic server to the visitor mobile switching center to the cellular network.

The mobile communication device monitors a signal strength or other criteria of the WiFi communication link. When the signal strength or other criteria drops below a predetermined threshold, the mobile communication device registers with the nearest mobile switching center, which in this fifth scenario is the visitor mobile switching center. When the mobile communication device is within the first WiFi coverage area, the mobile communication device registers with its home nomadic server via the first WiFi access point. In this manner, the WIWF block in the home nomadic server monitors the location of the mobile communication device. The mobile communication device notifies the WIWF block in its home nomadic server that the signal strength or other criteria is below the predetermined threshold. The mobile communication device also sends a call setup request to the visitor mobile switching center for a second call with the same end destination as the first call. The visitor mobile switching center forwards the call setup request to the CIWF block within the visitor nomadic server. Within the visitor nomadic server, the CIWF block determines from the WIWF block if the first call is in progress. Since the mobile communication device has been registering itself with its home nomadic server, and not with the visitor nomadic server, the WIWF block within the visitor nomadic server does not have a record of the first call being in progress. In response, the visitor nomadic server sets up the second call over the cellular network. Concurrently, the home nomadic server tears down the first call over the cellular network and the first WiFi communication link.

It is understood that the five scenarios described above are not exhaustive or inclusive of all scenarios in which the mobile communication device can roam from a first coverage area to a second coverage area with the support of the nomadic server. It is understood that other scenarios are also contemplated.

In some embodiments, the nomadic server 80 also communicates to other nomadic services over the Internet to route and complete calls using VOIP. This server-to-server

communication can be used for all calls, even for cellular to cellular calls. In such a situation, the cellular telephone communication is transmitted from the initiating cellular telephone to the appropriate base station. From this base station, the communication is routed to the appropriate nomadic server 80, which in some embodiments is the nomadic server 80 that is the closest to the receiving base station 10. This initiating nomadic server 80 then transmits the communication over the Internet, to the nomadic server 80 that is closest to the appropriate base station 10 corresponding to the location of the receiver's cellular telephone. This receiving nomadic server 80 then transmits the communication to this receiving base station 10, which transmits the communication to the receiver's cellular telephone. In this manner, the only portions of the transmission that are communicated over the cellular telephone network, are the initial leg, from the initiating cellular telephone to the appropriate base station, and the final leg, from the appropriate base station to the receiver's cellular telephone. The remaining, intermediate, portions of the transmission are communicated between the appropriate nomadic servers over the Internet, which allows the call to be completed more efficiently than if the call was transmitted completely over the cellular network in the traditional manner. As will be apparent to those skilled in the art, communications are directed in both directions in this manner in order to complete the call between the initiator and the receiver, with the initial and final portions of the transmission routed over the cellular network and the remaining intermediate portions of the transmission routed between nomadic servers 80, over the Internet 50.

The present invention has been described in terms of specific embodiments incorporating details to facilitate the understanding of the principles of construction and operation of the invention. As such, references herein to specific embodiments and details thereof are not intended to limit the scope of the claims appended hereto. It will be apparent to those skilled in the art that modifications can be made to the embodiments chosen for illustration without departing from the spirit and scope of the invention.

Abstract of the Disclosure

A nomadic server and a related system provides seamless roaming for a mobile communication device between different types of wireless networks, such as WiFi and cellular networks for voice, data and video communication. Use of the nomadic server enables a combination of WiFi and cellular networks for providing access to the cellular phones and make use of the VOIP networks for switching the calls wherever possible. The nomadic server is a telephone communication processing and switching server that will "hold" the present, in-progress telephone communications without dropping, while roaming without losing the present, in-progress communication. For example, a telephone communication can be seamlessly switching between VOIP and cellular telephone networks using the nomadic server. Nomadic server resources interface with the VOIP and cellular network switches to provide the hand-off between networks. This approach enables switching of telephone communications over a VOIP network wherever possible either through WiFi or through cellular networks.

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1	Applicant Arguments/Remarks Made in an Amendment	Response_12_11_2014.pdf	25240 163a1e0424ffdd8fefef0f84b3d10ca17fbb75e3	no	2

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Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

Vasudevan Ganesan, Cupertino, CA;

Applicant(s)

Vasu Networks Corporation, Cupertino, CA

Power of Attorney: None

Domestic Priority data as claimed by applicant

This application is a CON of 13/240,776 09/22/2011 PAT 8886181
which is a DIV of 11/330,675 01/11/2006 PAT 8078164 *
which claims benefit of 60/643,829 01/14/2005
and is a CIP of 11/031,498 01/06/2005 PAT 7991399
which claims benefit of 60/534,466 01/06/2004
(*)Data provided by applicant is not consistent with PTO records.

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

If Required, Foreign Filing License Granted: 10/15/2014
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 14/510,766**
Projected Publication Date: 04/02/2015
Non-Publication Request: No
Early Publication Request: No

** SMALL ENTITY **

Title

MOBILE TELEPHONE VOIP/CELLULAR SEAMLESS ROAMING SWITCHING CONTROLLER

Preliminary Class

370

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

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NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/510,766	10/09/2014	Vasudevan Ganesan	HAVA-00402

CONFIRMATION NO. 2888

28960
HAVERSTOCK & OWENS LLP
162 N WOLFE ROAD
SUNNYVALE, CA 94086

NOTICE

OC000000072452612

Date Mailed: 12/22/2014

INFORMATIONAL NOTICE TO APPLICANT

Applicant is notified that the above-identified application contains the deficiencies noted below. No period for reply is set forth in this notice for correction of these deficiencies. However, if a deficiency relates to the inventor's oath or declaration, the applicant must file an oath or declaration in compliance with 37 CFR 1.63, or a substitute statement in compliance with 37 CFR 1.64, executed by or with respect to each actual inventor no later than the expiration of the time period set in the "Notice of Allowability" to avoid abandonment. See 37 CFR 1.53(f).

The item(s) indicated below are also required and should be submitted with any reply to this notice to avoid further processing delays.

A new inventor's oath or declaration that identifies this application (e.g., by Application Number and filing date) is required. The inventor's oath or declaration does not comply with 37 CFR 1.63 in that it:

- does not state that the above-identified application was made or authorized to be made by the person executing the oath or declaration.

  Vasudevan Ganesan

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 14/510,766

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	70		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	300		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	360		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	19 minus 20 =	*	x 40 =	0.00	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 minus 3 =	*	x 210 =	0.00			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			0.00			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0.00			
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	730		TOTAL	

APPLICATION AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)		RATE($)	ADDITIONAL FEE($)
Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

PTO/SB/08a (01-10)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	14510766
Filing Date	2014-10-09
First Named Inventor	Vasudevan Ganesan
Art Unit	2414
Examiner Name	Not yet assigned
Attorney Docket Number	HAVA-00402

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

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	1					

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2287858	GB	A	1995-09-27	Crichton et al.		☐
	2	1471665	EP	A1	2004-10-27	Sun et al.		☐
	3	03056719	WO	A1	2003-10-07	Sun et al.		☐

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	14510766
	Filing Date	2014-10-09
	First Named Inventor	Vasudevan Ganesan
	Art Unit	2414
	Examiner Name	Not yet assigned
	Attorney Docket Number	HAVA-00402

If you wish to add additional Foreign Patent Document citation information please click the Add button			Add
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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		☐
If you wish to add additional non-patent literature document citation information please click the Add button			Add

EXAMINER SIGNATURE			
Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14510766
	Filing Date	2014-10-09
	First Named Inventor	Vasudevan Ganesan
	Art Unit	2414
	Examiner Name	Not yet assigned
	Attorney Docket Number	HAVA-00402

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☒ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☐ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Jonathan O. Owens/	Date (YYYY-MM-DD)	2015-03-20
Name/Print	Jonathan O. Owens	Registration Number	37902

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

(12) UK Patent Application (19) GB (11) 2 287 858 (13) A

(43) Date of A Publication 27.09.1995

(21) Application No 9416186.6

(22) Date of Filing 10.08.1994

(30) Priority Data
(31) 9405539 (32) 21.03.1994 (33) GB

(51) INT CL[6]
H04Q 7/38

(52) UK CL (Edition N)
H4L LDSH L1H10

(56) Documents Cited
GB 2204215 A WO 92/12602 A1

(58) Field of Search
UK CL (Edition M) H4K KY4D14H , H4L LDSD LDSF LDSX
INT CL[5] H04Q 7/04
ONLINE : WPI

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(72) Inventor(s)
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Rupinder Singh Oberoi
Howard Thomas

(74) Agent and/or Address for Service
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European Intellectual Property Operation, Midpoint, Alencon Link, BASINGSTOKE, Hampshire, RG21 7PL, United Kingdom

(54) **Method for determining handover in a multicellular environment**

(57) A method for determining whether a handoff is required for a mobile station in a communications system having both macro- and microcells includes the steps of measuring a received signal parameter in the serving cell and from a plurality of neighbouring cells, comparing the values measured for each of the neighbouring cells, with a variable threshold value, and measuring either the time for which the threshold value is exceeded or the number of times the threshold value is exceeded in a given period for use as a handoff criterion.

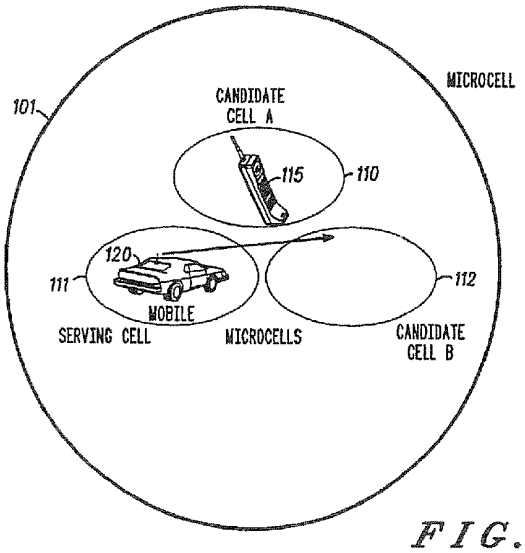


FIG.1

GB 2 287 858 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

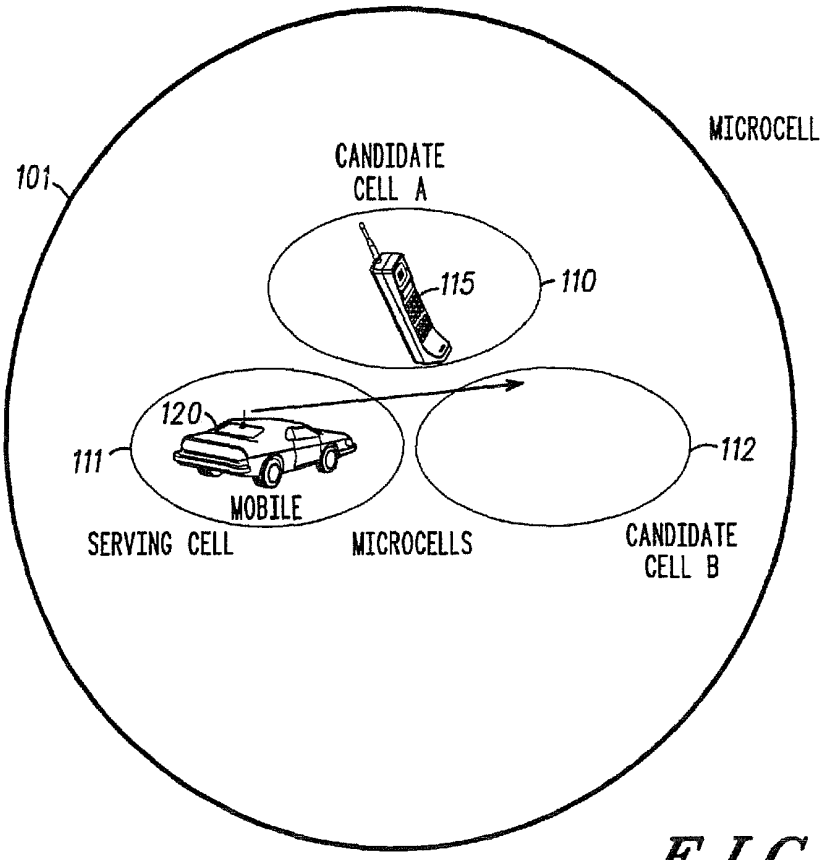

MICROCELL
101
CANDIDATE
CELL A
115
110
120
111
112
MOBILE
SERVING CELL
MICROCELLS
CANDIDATE
CELL B

FIG. 1

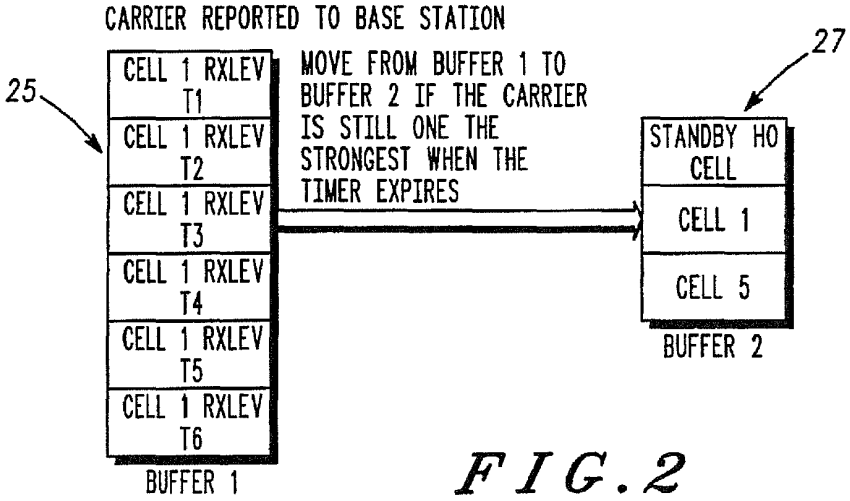

CARRIER REPORTED TO BASE STATION
25
27
CELL 1 RXLEV T1
CELL 1 RXLEV T2
CELL 1 RXLEV T3
CELL 1 RXLEV T4
CELL 1 RXLEV T5
CELL 1 RXLEV T6
BUFFER 1
MOVE FROM BUFFER 1 TO BUFFER 2 IF THE CARRIER IS STILL ONE THE STRONGEST WHEN THE TIMER EXPIRES
STANDBY HO CELL
CELL 1
CELL 5
BUFFER 2

FIG. 2

FIG. 3

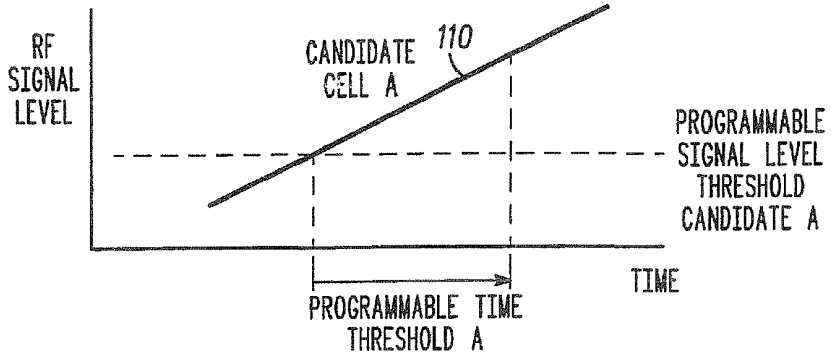


FIG. 4

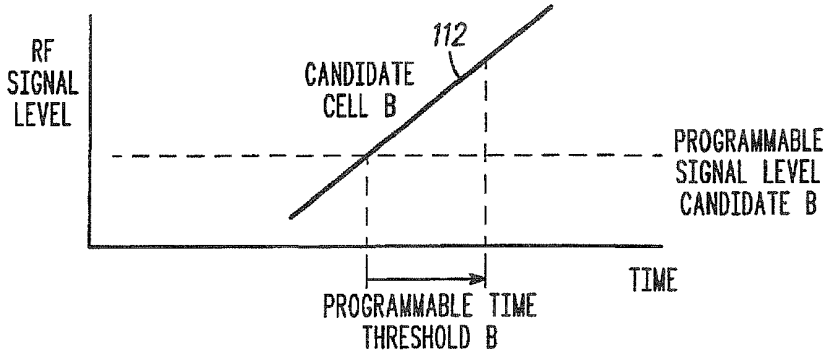
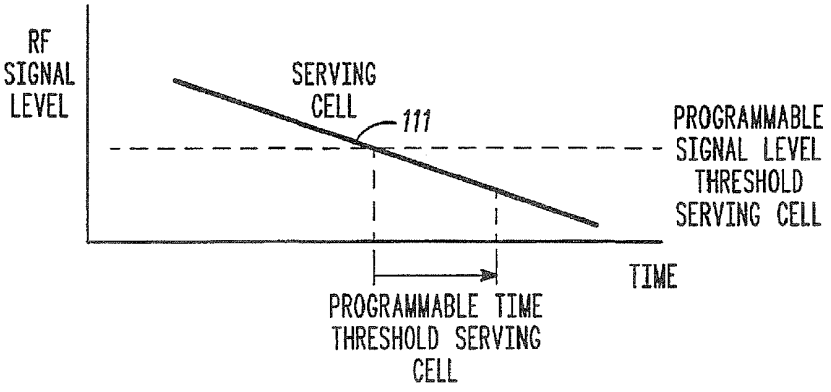


FIG. 5



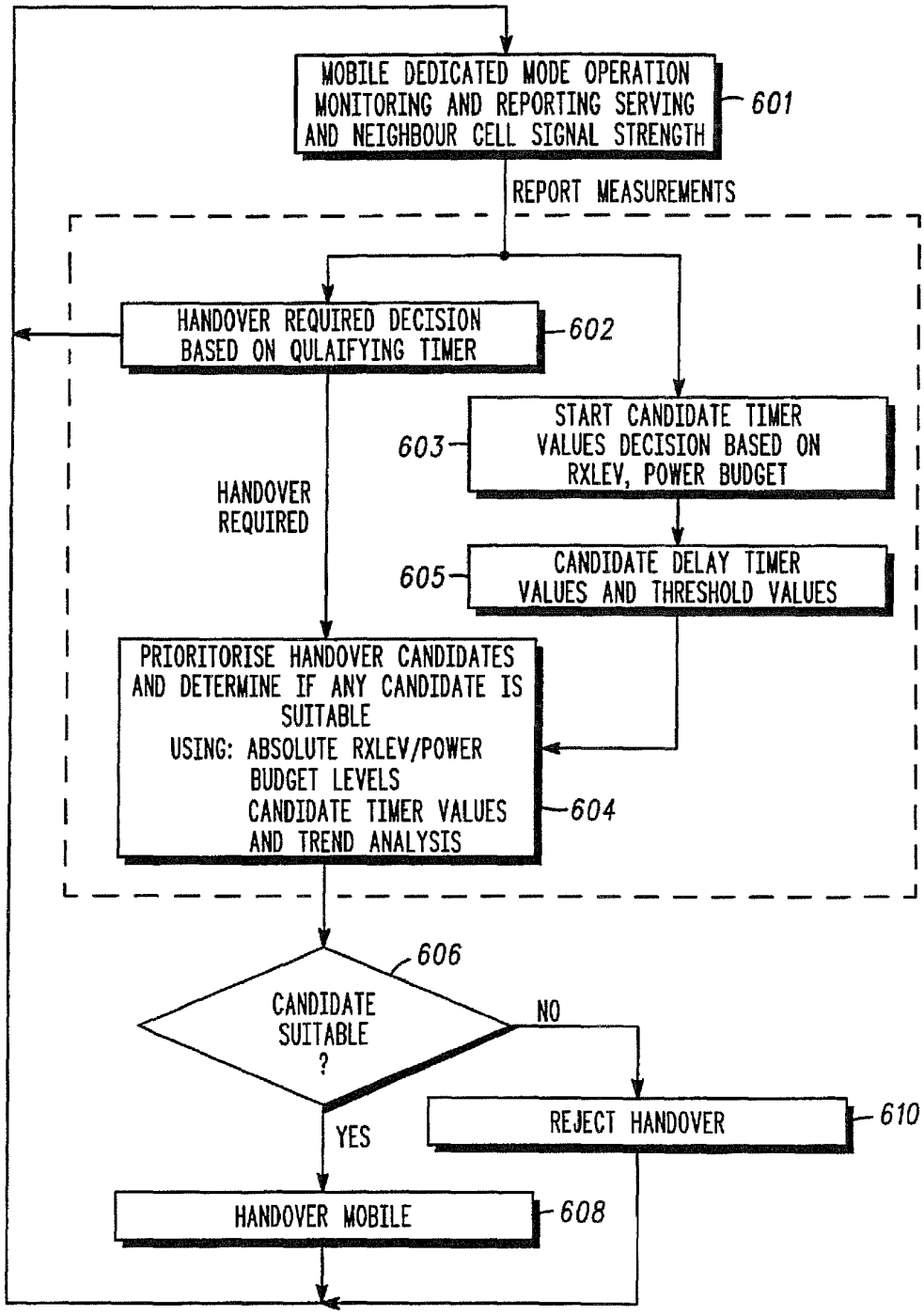

MOBILE DEDICATED MODE OPERATION MONITORING AND REPORTING SERVING AND NEIGHBOUR CELL SIGNAL STRENGTH
601
REPORT MEASUREMENTS
HANDOVER REQUIRED DECISION BASED ON QULAIFYING TIMER
602
START CANDIDATE TIMER VALUES DECISION BASED ON RXLEV, POWER BUDGET
603
HANDOVER REQUIRED
CANDIDATE DELAY TIMER VALUES AND THRESHOLD VALUES
605
PRIORITORISE HANDOVER CANDIDATES AND DETERMINE IF ANY CANDIDATE IS SUITABLE
USING: ABSOLUTE RXLEV/POWER BUDGET LEVELS
CANDIDATE TIMER VALUES
AND TREND ANALYSIS
604
606
CANDIDATE SUITABLE ?
NO
YES
REJECT HANDOVER
610
HANDOVER MOBILE
608

FIG. 6

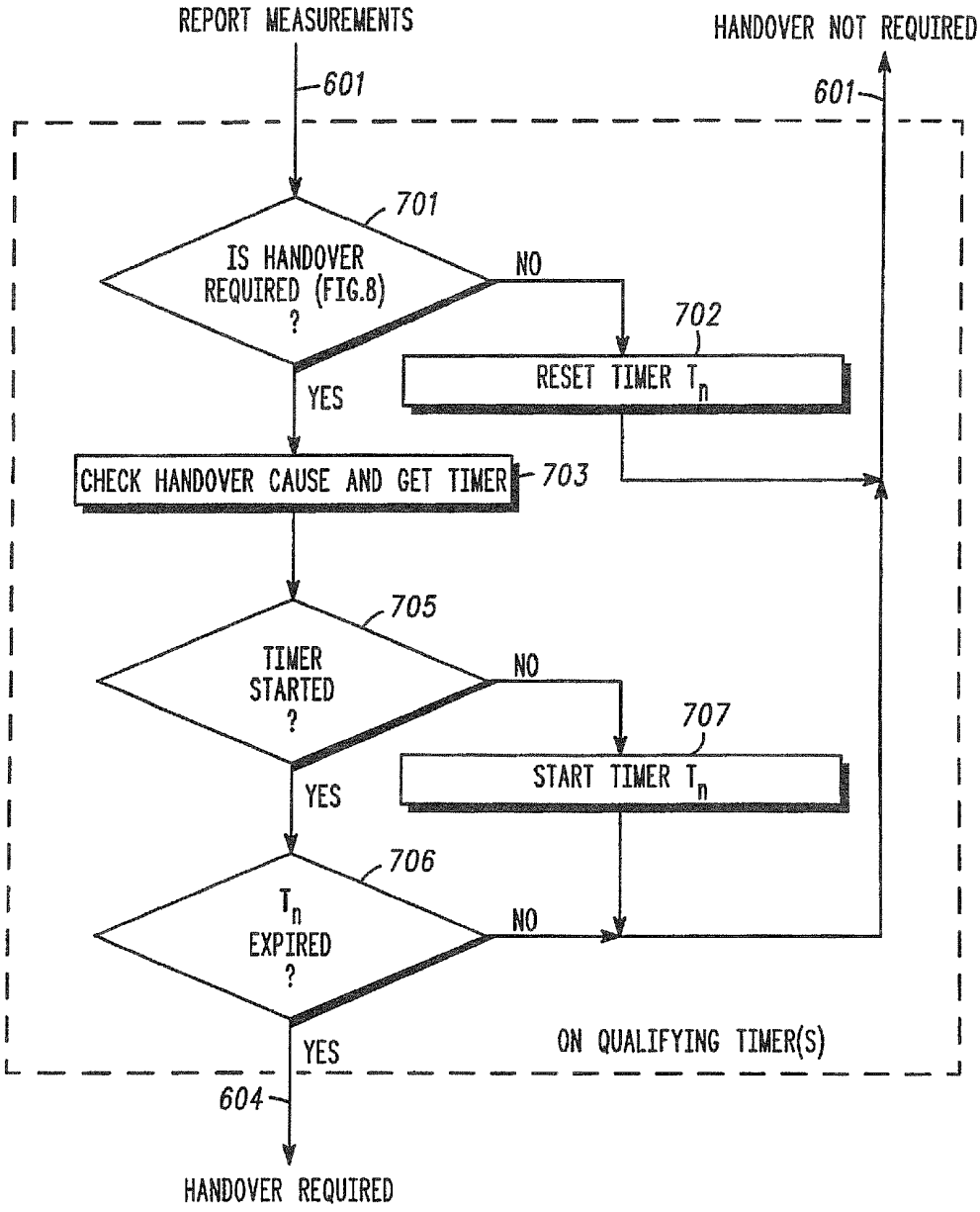

REPORT MEASUREMENTS
601
701
IS HANDOVER REQUIRED (FIG.8) ?
NO
702
RESET TIMER T_n
YES
CHECK HANDOVER CAUSE AND GET TIMER
703
705
TIMER STARTED ?
NO
707
START TIMER T_n
YES
706
T_n EXPIRED ?
NO
YES
ON QUALIFYING TIMER(S)
604
HANDOVER REQUIRED
HANDOVER NOT REQUIRED
601

FIG. 7

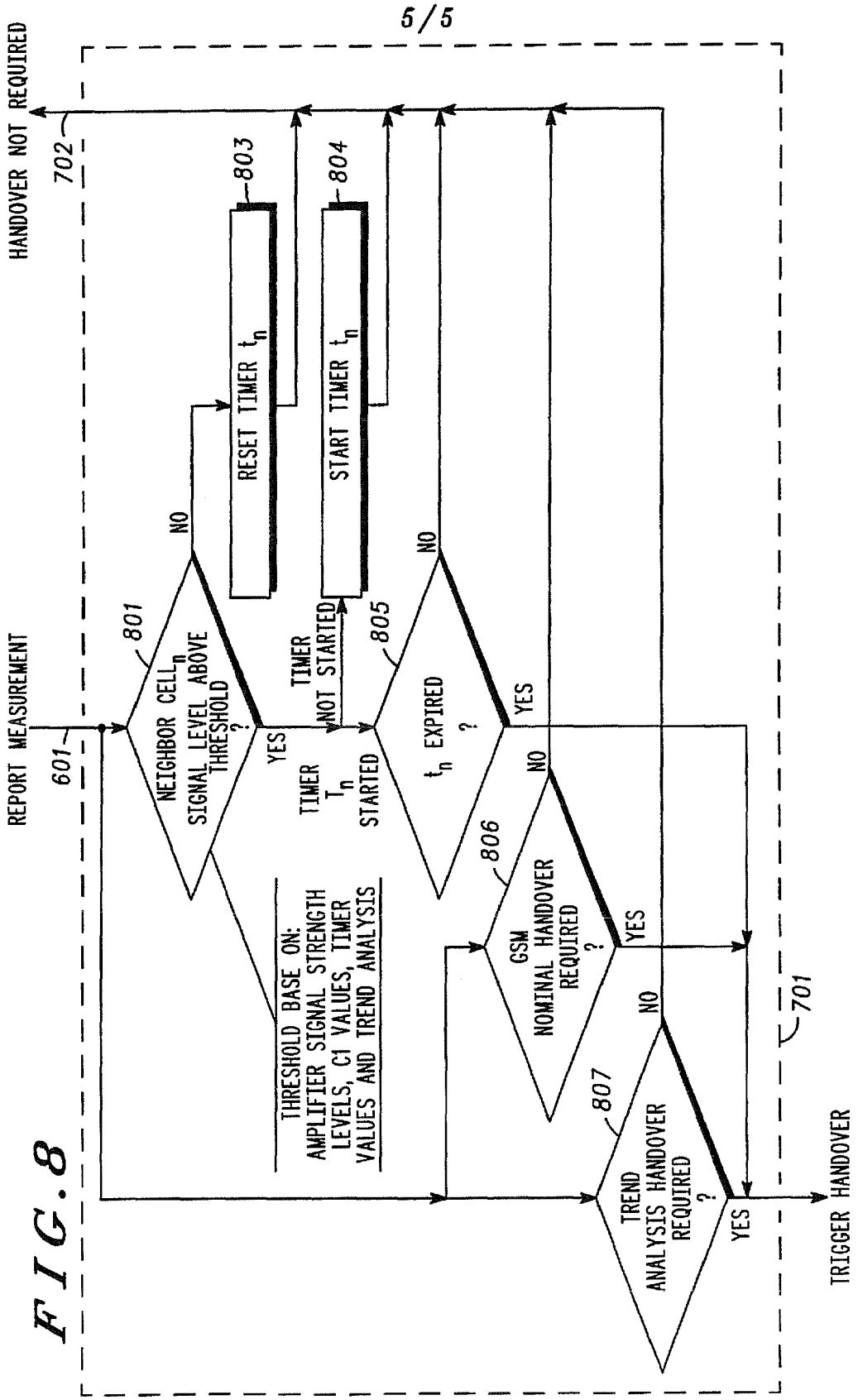

REPORT MEASUREMENT
601
NEIGHBOR CELL$_n$ SIGNAL LEVEL ABOVE THRESHOLD ?
801
NO
YES
RESET TIMER t_n
803
TIMER NOT STARTED
TIMER T_n STARTED
START TIMER t_n
804
t_n EXPIRED ?
805
NO
YES
GSM NOMINAL HANDOVER REQUIRED ?
806
NO
YES
TREND ANALYSIS HANDOVER REQUIRED ?
807
NO
YES
HANDOVER NOT REQUIRED
702
TRIGGER HANDOVER
701
THRESHOLD BASE ON: AMPLIFIER SIGNAL STRENGTH LEVELS, C1 VALUES, TIMER VALUES AND TREND ANALYSIS

FIG.8

METHOD FOR DETERMINING HANDOVER IN A MULTICELLULAR ENVIRONMENT

Field of the Invention

This invention relates in general to a method of determining handovers in a multicellular environment, and more particularly to determining handover in a multicellular environment based on a parameter of an incoming signal from at least one of the neighbouring cells or serving cell.

Background to the Invention

In a cellular environment, at any one time, there is usually one serving cell defined as the cell with the base station that a mobile unit is receiving service from so that the mobile unit may receive and transmit communication and a number of surrounding cells that are referred to as neighbouring cells. The serving cell may also be referred to as the cell that the mobile unit is camped on to.

In a multicellular environment, there may be cells of different sizes where a number of cells of the same size are located within one larger cell (umbrella cell or macrocell). The smaller cells within the umbrella cell may be called microcells. Microcells are created in a dense population of users to allow a greater capacity of users on the cellular system. The microcells facilitate the reuse of frequencies over a smaller distance. Thus, a mobile unit may be located within a microcell as well as an umbrella cell.

Typically, rural areas that do not have a large number of users or do not require a large capacity only need to be divided into larger cells. As the areas grow or the cells get closer to densely populated areas, the larger cells do not have the capacity to facilitate the increased number of users. There are not enough frequencies allocated. So microcells are created within the larger cells and the larger cells become umbrella cells. This allows frequency reuse among the microcells. Such microcellular techniques improve spectral efficiency and increase the capacity of the cellular network.

Microcells have disadvantages. One disadvantage is that in microcellular areas the number of handovers increases and the time available to make handover decisions decreases. For example, having too

many smaller size microcells in an area where there is a fast moving mobile, the fast moving mobile travels through a number of microcells in a short amount of time causing a number of handovers to be processed. Increasing the number of handovers in a short amount of time decreases the call reliability and increases the number of breaks in communication, thus, reducing the quality of communication and in extreme cases, loses calls.

Thus, a fast and reliable method of determining when to handover in a multicellular environment needs to be established. One such method has been proposed in co-pending UK Patent Application No. 9324428.3 entitled "Method for Determining Handover in a Multicellular Environment" filed on November 27, 1993 by Motorola. A related co-pending application that the present application claims priority from is UK Patent Application No. 9405539.9 entitled "Method for Determining Handover Candidate in a Multicellular Environment" filed on March 24, 1994 by Motorola.

Digital cellular communications systems, such as the GSM (Global System for Mobile Communications), integrate a large number of cells in a microcellular environment. It is required in GSM that a mobile station report a received signal level strength of its six strongest neighbouring cells. Current handover techniques choose a handover candidate from one of the strongest neighbouring cells. In a microcellular environment where the signal strengths are varying rapidly, a cell may produce a strong signal level strength in one measurement report and then a weak signal level strength in a next measurement report. Thus, making a handover decision based solely on a first report of signal strengths may result in selecting a base site that would not be a reliable serving cell for the mobile station.

Furthermore, in Phase One GSM there is no scheme to support an overlay macrocellular network and an underlay microcellular network in terms of handovers between the macrocells and the microcells.

Presently, a mobile station monitors the signal strength of a number of neighbour cells and reports this information on a regular basis to the serving base station. The cells that the mobile station monitors is determined by the Basestation Allocation (BA) list sent to it by the base station.

In Phase One GSM systems and Phase Two GSM systems the process of determining the need for a handover and the selection of the best

candidate is separate. In such systems there are two methods that are used to determine that a handover is required:

1) The average signal level falls/link quality/time delay ... below programmable thresholds;

2) The signal strength of neighbour cells exceeds that of the serving cell by a programmable threshold.

The second part of the process is to determine the best handover candidate. It must be separately decided which the best candidate is from those available based on signal strength readings from the serving cell and a number of candidate base stations.

For multicellular environments, it is desirable to make reliable handover decisions based on a number of criteria involving received signal parameters.

Summary of the Invention

According to the present invention, there is provided a method for determining a handover in a multicellular communication system including the steps of measuring received signal parameters received from a serving cell and a plurality of neighbouring cells, comparing received signal parameters with a variable threshold value for each of the plurality of neighbour cells, measuring time received signal parameters are above threshold value for each of the plurality of neighbour cells, and determining handover based on the measured time.

In an alternative embodiment the method includes measuring for a period of time a number of times the received signal parameters are above threshold value for each of the plurality of neighbour cells and determining handover based on the number of times.

In a further embodiment the method includes measuring for a period of time a number of times the received signal parameters are above threshold value for each of the plurality of neighbour cells and determining handover based on the measured number of times.

Brief Description of the Drawing

FIG. 1 illustrates a multicellular environment.

FIG. 2 illustrates a buffer arrangement for an embodiment of the present invention.

FIGS. 3-5 illustrates signal strength variations when a mobile is moving as indicated in FIG. 1.

FIG. 6-8 illustrate flow charts for embodiments of the present invention.

Detailed Description of the Preferred Embodiment

Referring to FIG. 1, a multicellular (or microcellular) environment is shown comprising of at least one macrocell (or umbrella cell) 101 and a plurality of microcells 110, 111, 112. Each cell includes a base station typically located in the geographic area covered by the cell. The base stations are not shown in FIG. 1. A base station 115 typically determines the size and capacity of the cell 110. A communication system may include different sized cells as well as a mobile station 120 which may be receiving service from either a base station of the macrocell 101 or a base station of one of the microcells 111. Receiving service from a particular base station in terms of being able to receive and transmit calls is also referred to as being camped on that particular base station. When a mobile station enters the multicellular environment a decision should be made to determine whether to remain being served by the current cell type or handover to a new cell type. The decision may be dependent upon the speed of the mobile unit.

Two cases may be defined when a mobile station is in a multicellular environment or coverage area. The mobile unit may be moving at a high speed or at a slower speed.

When a fast moving mobile station is in a microcellular environment it is desirable that the mobile station remain on the macrocell 101 to alleviate the number of handovers that would be required in a short amount of time.

On the other hand, when a slow moving mobile station is in a microcellular environment it is desirable that the slow moving mobile station is handed over to a microcell 111. This ensures that the macrocell does not become congested and the maximum traffic is handled by the microcell.

Thus, according to one embodiment of the present invention when the mobile station 120 enters a microcellular environment the received signal parameters received from the serving cell and a plurality of neighbouring cells are measured at the mobile station 120 and sent to the serving cell base

station. The received signal parameters are compared with a respective variable threshold value for each of the plurality of neighbour cells. Then a duration of time is measured time corresponding to how long the received signal parameters are above the respective threshold value for each of the plurality of neighbour cells. Thus, a reliable handover or handover candidate may be determined based on the measured time.

An alternative embodiment of the present invention includes measuring for a period of time a number of times the received signal parameters are above threshold value for each of the plurality of neighbour cells or a percentage of time that the received signal parameters are above the threshold value and determining handover or handover candidate based on the measured number of times or percentage.

Similarly, a further embodiment includes calculating an average of time or an average of the received signal parameter exceeding the respective threshold value.

The method of the present invention may also include taking into account the actual or absolute received signal parameter as well as any history available.

The received signal parameter may be a received signal level, a power level control signal or a timing advance signal.

The method of the present invention may be used for determining a requirement to handover or determining an ordering of a priority of handover candidates or both.

The method of the present invention proposes that a timer be started when the mobile station sees that the received signal parameter, such as the signal strength, of a neighbouring cell is above a programmable level or a variable threshold value. The neighbouring cell may be the serving cell or a candidate cell.

The variable or programmable threshold value is used to start a timer and may be different for each cell. Likewise, a different timer may be associated with each cell. Both the threshold value and the time may be predetermined or adaptively defined.

In a preferred embodiment of the present invention, the timer keeps running while the measured received signal strength level is above the respective cell's threshold value.

The following is examples of criteria in GSM which may be used to determine if a particular cell received signal level is above a threshold value.

A cell has been continuously being reported in the mobile measurement reports (e.g.. SACCH multiframes) and exceeding some programmable threshold over the time Tn. Under this condition the neighbouring cell has the highest probability to be a good handover candidate but it may not take into account fast changes in RXLEV due to fading, shadowing etc.

The cell has been reported at least n out of m times in the mobile measurement report and exceeding some programmable threshold over the time Tn. This method takes into account any fast changes in RXLEV in the neighbouring cell reporting and therefore has a high probability of identifying a good handover candidate. The values of n and m may be optimised for each cell.

The average RXLEV of the cell exceeds a threshold over the time Tn. This method averages out all the peaks and troughs of RXLEV but may not give a very accurate indication of a handover candidate because values are changing so rapidly.

The signal strength threshold could be set such that candidate cells are monitored well before the candidate cell is higher than the serving cell. This would allow microcells to be monitored in advance of time when a handover is required, and make a more informed macrocell/microcell handover decision.

The timer value indicates the length of time that a cell has been a good candidate. The longer this time then the more likely that it is to be a good candidate cell. Microcells will only appear as good cells if sufficient time is spent in the cell (a mobile user is travelling slowly or the cell is a macro cell). RF planning could be used to encourage mobiles onto microcells.

In addition to having a threshold set at which a serving cell indicates that a handover is required due to very poor serving cell signal levels the present invention provides that predetermined (or variable) levels of neighbour cells could be used to indicate that a handover is requested.

Thus, a handover candidate may be determined by the present invention. One possible implementation is that for a cell not to be considered as a handover candidate unless it has been one of the strong cells (RXLEV exceeds given programmable signal level threshold) for a give time Tn. A timer Tn is associated with each cell. It can be different for each of the cells and is defined by the user in the database. The signal level threshold could be different for each cell.

FIG. 2 shows one way in which the timer T_n may be used in determining a handover candidate. In FIG. 2 the mobile station reports the strongest neighbour carriers in terms of received signal levels to the base station. The system controller of the base station puts them in a first buffer 25 and starts a timer T_n. If at the expiry of the timer T_n the cell is still one of the six strongest carriers than it is moved to a second buffer 27 as one of the handover candidates.

Using this method the handover candidate list should always contain at least one cell which is the Standby Handover Cell. Standby Handover Cell is defined as a cell which is cell barred for normal call origination, but is available for any emergency handovers. It may be one of the macrocells (or certain timeslots in a given macrocell). This will ensure that in the cases where a handover is required but there are no suitable microcells available, then the call can be handed over without it being dropped.

RXQUAL and any other criterion currently used in the handover algorithm may also need to be satisfied if the cell is to be considered as handover candidate.

The ordering of the priority of the candidate cells could be determined by the following parameters: values of C1 for each cell, the absolute signal strength of the candidate cells and the serving cells, the value of the timers for each of the candidate cells. The decision could be made on the current values of each parameter or multi-parameter trends could also be used.

Alternatively, the timer does not need to bar the cell being considered as a candidate cell for a period of time. The timer could be used a weighting factor in the ordering of the candidate handover cells. The weighting factor could be any function of time (for example squared law, linear, or exponential).

The decision that a handover is required can be considered as a separate process to that of deciding the best handover candidate cells. An

embodiment of the present invention which may be used to determine handover may include any combination of the following: determining that the signal strength of the serving cell is below a programmable threshold, a timer tn expires, and an algorithm to indicate when a handover is required. The handover decision is determined by the value of the timers and the absolute signal levels levels of either the serving cell or the candidate cells.

FIGS. 3-5 show the signal strength variations when the mobile is moving along the direction indicated by the arrow in FIG. 1. FIG. 3 shows that a received signal level increases for cell A 110 as the mobile 120 travels in the direction as indicated. The received signal level for cell A 110 steadily increases for a time shown on the horizontal axis as a respective programmable time threshold A.

FIG. 4 shows that a received signal level for cell B is above its respective threshold value (level) and steadily increases for its respective programmable time threshold B. The rate of the received signal level of cell B is increasing faster than the rate of the received signal level of A. Thus, cell B may have a higher absolute value for a received signal level while the programmable time for cell A is longer.

FIG. 5 shows the received signal level for the serving cell 111 decreasing as the mobile station moves as indicated. The received signal level of the serving cell drops below its respective threshold level and steadily decreases for its respective programmable time.

FIG. 6 illustrates a flow chart for an embodiment of the present invention. Particularly, in dedicated mode operation a mobile station is monitoring and reporting serving and neighbouring cell signal strengths and link quality as in step 601. The mobile station reports the measurements to the base station and whether a handover is required is determined based on a qualifying timer algorithm as in step 602 and further defined in FIG. 7. A qualifying timer algorithm includes such as are known in GSM and trend analysis as well as that described in accordance with the present invention in FIG. 7.

If a handover is required as determined by a qualifying timer algorithm in step 602, then it is determined as in step 604 which candidates if any are suitable.

Another method is continuously monitoring the measurement reports from each neighbour cell as in step 603.

The ordering or prioritising of handover candidates as in step 604 may be done simultaneously and independently of determining whether a handover is required. Thus, a list of candidates may be constantly generated and updated so that when it is determined that a handover is required handover candidates may be readily available and ordered so the best handover candidate may be handed over to quickly.

Alternatively, the timers used to reorder the priority of handover candidates may be triggered by the handover request from step 602.

Specifically, absolute received signal levels or power budget levels from neighbouring cells may be used in determining whether any cell is a suitable handover candidate. Furthermore, candidate timer values may be used independently for each cell for measuring respective received parameters. Trend analysis may also be used to determine suitable handover candidates and prioritise handover candidates. Particular checks may include minimum RXLEV threshold exceeded availability, Power Budget better than current serving cell and handover margin hysteresis exceeded.

If a suitable handover candidate is determined in step 606 than the mobile station is handed over to the suitable candidate as in step 608. If no suitable candidate is available as determined by step 606 then no handover is performed as in step 610. In both situations the mobile returns to monitoring and reporting as in step 601.

Based on the reported measurements received in step 603, candidate timers are started to determine possible handover candidates as well as possibly prioritisation of candidates. The decision to start the candidate timers may be based on received signal levels and power budget signals.

The timer values and respective threshold values are transferred as in step 605 to the method of determining the handover candidates and prioritisation of candidates in step 604. Therefore, the ordering or prioritisation of handover candidates maybe implemented as an independent process initiated when the need to handover is required.

FIG. 7 shows a flow chart that provides a handover required decision based on a timer method according to the present invention. The method is to ascertain, if any, of the many possible handover causes generated by step 701 has been continuously valid for a programmable handover cause dependent delay and thus should generate a Handover Required command.

A Handover Required command shall indicate the cause that led its generation. In the case when several handover cause dependent timers are expired when a Handover Required command is generated, all causes shall be listed. Additionally, the Handover Required command may include all causes which are valid at the time of generation indicating whether or not the associated timers have expired.

Some causes may have zero timer values, for example, if such a cause might indicate that communication could be lost.

An alternative embodiment of the method could include a mechanism to enable timers to be dynamically varied. For example, if some cause or combination of causes, might indicate that a particular kind of handover would be beneficial even if the timer associated with that cause had not expired.

If a handover is required as in step 701 and as further described in FIG. 8 then the handover cause and respective timer is checked as in step 703. If the timer has been already started as determined in step 705 then it is determined whether the timer has been expired as in step 706. If the timer has expired then a handover is required.

If no handover is required as in step 701 then the respective timer is reset and no handover is required.

If the respective timer has not been started as in step 705 then the timer is started as in step 707 and no handover is required.

The timers of FIG. 7 are handover delay timers.

FIG. 8 further describes a method that triggers a handover situation according to an embodiment of the present invention. From the reported measurements it is determined whether the neighbouring cells signal levels are above a threshold value as in step 801. The threshold value may be variable or predetermined and may vary from cell to cell. The threshold values may also be based on absolute signal strength levels, C1 values, timer values and trend analysis.

If it is determined in step 801 that a neighbour cell signal level is above its respective threshold and its respective timer has been started then it is determined whether the timer has expired as in step 805. If yes, then a handover is triggered, if not, no handover is required. The respective timers may be respective neighbour cell signal level timers.