occur since the base LTE protocols and core elements do not support this type of network topology.

The disclosures of all publications, including patent documents and protocols of standards mentioned in the specification, and of the publications and patent documents and standards cited therein directly or indirectly, are hereby incorporated by reference.

SUMMARY

According to a first aspect of the present invention, there is provided an Internet Protocol (IP)-based cellular communication system operative in conjunction with a moving relay, the system comprising: an IP connectivity gateway coupled to a network router and to a mobility management entity; and a router configured to: route, to the gateway, at least one packet designated to an IP address of at least one first moving relay, wherein the router is configured to: (i) use a tunneling protocol other than a multi-protocol label switching (MPLS) tunneling protocol, and (ii) bounce packets back and forth between itself and the gateway, to allow creation of at least one multi-level tunnel that can support multi-level relay deployment on a standard network, the first moving relay comprises base station functionality, a radio manager and mobile station functionality, all co-located, the base station functionality is operative to communicate via antennae with at least one mobile station thereby defining a first radio link there between, and said base station functionality having a physical connection to the co-located radio manager, the mobile station functionality communicates via antennae with a unit which has base station functionality thereby to define a second radio link, the radio manager comprises: a radio resource manager; and functionality for exchanging information with radio managers included in moving relays other than the first moving relay, the radio manager is configured to use the exchanged information to select, for at least one individual mobile station which seeks to be served by establishing a standard connection, one of: a static base station; and a base station functionality, to which to connect the individual mobile station in order to provide cellular communication services thereto, the system is configured to support multiple relay scenarios with dynamic topology, in which relay connections vary over time, in that at least one mobile station functionality, UE, with plural potential connections to plural nodes respectively, is provided in at least one relay, with IP level relayed information regarding various of

said plural potential connections via at least one relay that said UE is currently connected to, the plural nodes including at least one of (a) base stations and (b) relay nodes' base station functionalities; and decision making functionality is provided to: dynamically derive from said information, a correct IP routing over multiple relays, from among multiple alternative routes available for a one to one entity connection, which will connect said UE to a given final destination via a suitable number of available relay nodes, given a current topology of said available relay nodes, and dynamically select a relay for the UE to be served by, from among said plural potential connections, accordingly.

According to a second aspect of the present invention, there is provided a dynamic hierarchical cellular system implementing multi-hop encapsulation, the system comprising: a core including a mobility management entity (MME) and an IP connectivity gateway interfacing therewith, at least one static base station coupled to the mobility management entity and the IP connectivity gateway in the core, at least one individual moving relay coupled to at least one individual static base station and including a mobile station functionality and a base station functionality; and at least one mobile station coupled to at least one of the static base station and the moving relay, wherein the core comprises an encapsulating router, whose routing operations encapsulate messages to and from the at least one mobile station, without resorting to use of a multi-protocol label switching (MPLS) tunneling protocol, the encapsulating router is coupled to the IP connectivity gateway, to the mobility management entity and to the individual static base station via which the individual moving relay connects to the core, and the router is: (i) operative for re-routing, to the gateway, at least packets designated to an IP address of one of the moving relays, and (ii) configured to bounce packets back and forth between itself and the gateway, to allow creation of at least one multi-level tunnel that can support multi-level relay deployment on a standard network, wherein the system is configured to: implement multi-hop encapsulation, such that, for at least one message destined for an individual base station functionality, the individual base station functionality's header is encapsulated within an individual mobile station functionality's header, so as to allow the message to be routed by the router to the individual base station functionality, via the individual mobile station functionality, support multiple relay scenarios with dynamic topology, in which relay connections vary over time, in that at least one mobile station functionality, UE, with plural potential

connections to plural nodes respectively, is provided in at least one relay, with IP level relayed information regarding various of said plural potential connections via at least one relay that said UE is currently connected to, the plural nodes including at least one of (a) base stations and (b) relay nodes' base station functionalities; and provide decision making functionality to: dynamically derive from said information, a correct IP routing over multiple relays, from among multiple alternative routes available for a one to one entity connection, which will connect said UE to a given final destination via a suitable number of available relay nodes, given a current topology of said available relay nodes, and dynamically select a relay for the UE to be served by, from among said plural potential connections, accordingly.

According to a third aspect of the present invention, there is provided a method for internet protocol (IP) based cellular communication in an IP based cellular communication system comprising a plurality of base stations and a cellular communication system core connected to each of the plurality of base stations and including an IP connectivity gateway operative to receive at least one packet having an IP-address designating a node in the cellular communication system, to add thereto a header of a base station serving the node, and to forward the packet with the header to a router, the method comprising: providing at least one moving relay having a mobile station functionality and a base station functionality which is addressed by the core using the mobile station functionality's IP address; and providing a router coupled to the gateway, configured to recognize packets for the individual base station as designated to a mobile station and operative for routing, packets received from the gateway, as follows: packets whose IP address is any one of the plurality of base stations, are routed to the base stations; and at least one packet designated to an IP address of a mobile station is routed back to the gateway, wherein the router is: (i) operative to receive the packets from an IP connectivity gateway at a cellular communication system core which is connected to each of the plurality of base stations, and (ii) bounce packets back and forth between itself and the gateway, to allow creation of at least one multi-level tunnel that can support multi-level relay deployment on a standard network, at least one of the packets includes: an IP-address designating a node in the cellular communication system, and a header, added by the gateway and recognized by the router, of a base station serving the node, the method is configured to support multiple relay scenarios

with dynamic topology, in which relay connections vary over time, in that at least one mobile station functionality, UE, with plural potential connections to plural nodes respectively, is provided in at least one relay, with IP level relayed information regarding various of said plural potential connections via at least one relay that said UE is currently connected to, the plural nodes including at least one of (a) base stations and (b) relay nodes' base station functionalities, and decision making functionality is provided to: dynamically derive from said information, a correct IP routing over multiple relays, from among multiple alternative routes available for a one to one entity connection, which will connect said UE to a given final destination via a suitable number of available relay nodes, given a current topology of said available relay nodes, and dynamically select a relay for the UE to be served by, from among said plural potential connections, accordingly.

Certain embodiments of the presently disclosed subject matter seek to provide a IP based cellular communication system utilizing tunnels.

A classical cellular network consists of or comprises a core segment and Radio Access Network (RAN). The RAN typically comprises base stations (BS) and mobile stations (MS). Each of the mobile station is typically connected to one of the base station (Fig. 1).

A hierarchal cellular network (Fig. 2) typically comprises a classical cellular network, however the RAN segment enables direct connection between base stations such that one base station is capable of relaying the traffic of the other base station to the core segment or to other base station in a higher layer that is connected to the core segment, etc.

Multi-layer hierarchical dynamic cellular networks pose difficulties for traffic flow and management since the base LTE protocols and core elements do not support this type of network topology.

Certain embodiments of the present invention seek to provide a method for creating a layered hierarchical cellular network while using standard core elements.

Certain embodiments of the present invention seek to provide a relay station that comprises a standard base station and several mobile handsets that serve as a mobile backhauling link.

Certain embodiments of the present invention seek to provide data forwarding capabilities of such a relay station and how these facilitate transfer of data across multiple relays via standard core elements.

Disclosed herein is an IP based cellular communication system comprising an IP connectivity gateway coupled to a network router and to a mobility management entity; the mobility

management entity (e.g. MME) is configured to store at least (a) IP addresses of a plurality of stationary relays (b) IP addresses of mobile relays and the IP address of a linked relay that each individual mobile relay is anchored to (c), IP addresses of mobile stations and the IP address of a linked relay that each individual mobile station is anchored to; a router for routing from the gateway packets having an IP address of any one of the stationary relays; and re-routing to the gateway packets designated to an IP address of one of the moving relays or mobile stations; the system comprising:

(i) the connectivity gateway communicating with the mobility management entity (MME) for obtaining an IP address of a linked relay of a target mobile station;

(ii) the connectivity gateway transmitting through the router a "tunnel setting packet" having the IP address of the linked relay and in the case that the linked relay having an IP address of any of the stationary relays, the router routing the packet, resulting in setting a tunnel from the gateway to the stationary relay;

(iii) otherwise the linked relay does not match a stationary relay and in response the router re-routing the packet to the gateway and consequently repeatedly performing (i) to (iii) as many times as required for obtaining in each cycle another linked relay of a linked relay obtained in the previous cycle; the linked relays constituting a succession of linked relays, whereby a first tunnel segment is set from the gateway to the matched stationary relay

(iv) the gateway setting a set of tunnels including

(a) the first tunnel segment

(b) a succession of tunnels each commencing from the gateway and ending in a respective linked relay of the succession of linked relays.

In accordance with an embodiment of the presently disclosed subject matter, there is further provided a method, wherein the IP connectivity gateway being a P/S gateway operative in a LTE communication network.

In accordance with an embodiment of the presently disclosed subject matter, there is yet further provided a method, wherein the IP connectivity gateway being a Connectivity Service Network (CSN) module, operative in a Wimax communication network.

In accordance with an embodiment of the presently disclosed subject matter, there is yet further provided a method, wherein the method further comprises downlinking a message through the gateway to the target mobile device utilizing each tunnel in the set of tunnels including

(a) the first tunnel segment

(b) the succession of tunnels each commencing from the gateway and ending at a respective linked relay of the succession of linked relays.

In accordance with an embodiment of the presently disclosed subject matter, there is yet further provided a method, wherein the method further comprises uplinking a message from the target mobile device through the gateway, utilizing each tunnel in the set of tunnels including

(a) the first tunnel segment

(b) the succession of tunnels each commencing from the gateway and ending in a respective linked relay of the succession of linked relays.

The present invention also typically includes at least the following embodiments:

In an embodiment, in an IP based cellular communication network comprising a plurality of stationary relays, a system comprising:

an IP connectivity gateway coupled to a network router and to a mobility management entity;

and a router for routing, from the gateway, packets whose IP address is any one of the plurality of stationary relays to said stationary relays; and routing to said gateway, at least one packet designated to an IP address of at least one of: a moving relay and a mobile station.

In an embodiment, the IP connectivity gateway comprises a P/S-Gateway operative in a LTE communication network.

In an embodiment, the IP connectivity gateway comprises some of: Connectivity Service Network (CSN)

module and Access Service Network (APN), operative in a WiMax communication network.

An embodiment also comprises an MME configured to store at least (i) IP addresses of plurality stationary relays (ii) IP addresses of mobile relays and the IP address of a linked relay that each individual mobile relay is anchored to (iii) IP addresses of mobile stations and the IP address of a linked relay that each individual mobile station is anchored to.

Disclosed herein is a system wherein

(i) the connectivity gateway communicates with said MME for obtaining an IP address of a linked relay of a target mobile station;

(ii) the connectivity gateway transmits through said router a "tunnel setting packet" having the IP address of said linked relay;

(iii) if said linked relay has an IP address of any of said stationary relays, said router routes said packet, resulting in setting a tunnel from said gateway to said stationary relay;

(iv) otherwise said linked relay does not match a stationary relay and in response said router is operative for routing said packet to said gateway and repeatedly performing (i) – (iii) at least one time for obtaining in each cycle another linked relay of a linked relay obtained in the previous cycle; said linked relays constituting a succession of linked relays,

wherein a first tunnel segment is set from said gateway to said matched stationary relay, the gateway setting a set of tunnels including

(a) said first tunnel segment; and

(b) a succession of tunnels each commencing from said gateway and ending at a respective linked relay of said succession of linked relays.

In an embodiment, packets are bounced back to the IP connectivity gateway by the router.

In an embodiment, packets are bounced back to the gateway (e.g. P/S-GW) internally in the IP connectivity gateway by virtue of the IP connectivity gateway recognizing a destination IP address as its own address.

Disclosed herein is a dynamic hierarchical cellular system implementing multi-hop encapsulation, the system comprising:

a core including an mobility management entity and an IP connectivity gateway interfacing therewith,

at least one static base station coupled to the mobility management entity and the IP connectivity gateway in the core,

at least one individual moving relay coupled to at least one individual static base station and including a mobile station functionality and a base station functionality; and

at least one mobile station coupled to at least one of the static base station and the moving relay;

wherein the core comprises an encapsulating router, whose routing operations encapsulate messages to and from said at least one mobile station, wherein the encapsulating router is coupled to the IP connectivity gateway, to the mobility management entity and to the individual static base station via which the individual moving relay connects to the core.

In an embodiment, the router is operative to route IP-packets arriving from a source external to the core.

In an embodiment, the router is operative to route IP-packets arriving from at least one static base station under said core.

In an embodiment, the router is operative to route IP-packets arriving from an IP connectivity gateway within said core.

In an embodiment, if an IP address of a destination in a header of a packet indicates one of a mobile station destination and a relay destination, the router routes said packet to the IP connectivity gateway whereas if an IP address of a destination in a header of a packet indicates a static base station, the router routes the packet to the static base station.

In an embodiment, at least one pair of IP addresses of at least one mobile station functionality and base station functionality have a common portion which is recognized by said router.

In an embodiment, at least one pair of IP addresses of at least one mobile station functionality and its co-located base station functionality have a common portion unique to said pair which is recognized by said router.

In an embodiment, if the router identifies at least a portion of a packet's IP-address which represents both mobile station functionality and base station functionality, the packet is sent to the IP connectivity gateway.

In an embodiment, the core is configured to assign IP addresses such that at least one pair of IP addresses of at least one mobile station functionality and at least one base station functionality have a common portion.

In an embodiment, the core is configured manually.

In an embodiment, the core is configured via an application.

In an embodiment, all mobile station functionalities served by the core have IP addresses with a common portion which is recognized by said router.

In an embodiment, the core is configured to assign identical IP addresses to at least one base station functionality and at least one mobile station functionality but to assign first and second different ports to said at least one base station functionality and at least one mobile station functionality respectively.

In an embodiment, the system operates within a IP-version 4 (IPv4) protocol.

In an embodiment, at least one pair of IP addresses of a base station functionality and mobile station functionality respectively includes a first portion, common to both IP addresses in the pair, common to said base station functionality and mobile station functionality and a second portion, which differs between the IP addresses in the pair and represents uniqueness of each of said base station functionality and mobile station functionality respectively.

In an embodiment, the system operates within a IP-version 6 (IPv6) protocol.

In an embodiment, the system also comprises an additional router in the relay which upon receipt of a message from a co-located base station functionality, sends to the additional encapsulating router in the core said message with a header indicating that the message was sent by said additional router.

In an embodiment, the additional router comprises a separate logical router application residing also on the encapsulating router.

In an embodiment, when said message with a header is received by said encapsulating router, said encapsulating router removes said header to reveal the message as received from the base station functionality co-located with the additional router.

In an embodiment, the router is operative to route information to at least one base station functionality, via at least one mobile station functionality.

In an embodiment, the router cooperates with a logical table in the mobility management entity which indicates which base station serves each mobile station.

In an embodiment, as each individual relay enters a network served by the core, the individual relay's mobile station functionality is assigned an IP address which the router is pre-configured to identify as an IP address of the individual relay's base station functionality.

In an embodiment, the router is pre-configured to identify an individual relay's base station functionality using a predetermined portion of at least one IP address.

In an embodiment, the core having a core network and wherein all mobile station functionalities in relays served by said core form a subnet of the core network.

In an embodiment, all base station functionalities in relays served by said core are also members of said subnet of the core network.

In an embodiment, the core having a core network and wherein all base station functionalities in relays served by said core form a subnet of the core network.

In an embodiment, all base station functionalities in relays served by said core form a first subnet of the core network and all mobile station functionalities in relays served by said core form a second subnet of the core network which differs from said first subnet.

In an embodiment, at least one moving relay has a relay resource manager operative, when the moving relay joins a network served by the core, to instruct the additional router to store an association between the moving relay's base station functionality and the moving relay's co-located mobile station functionality.

In an embodiment, in at least one message destined for an individual base station functionality, the individual base station functionality's header is encapsulated within an individual mobile station functionality's header, so as to allow said message to be routed by said router to the individual base station functionality, via the individual mobile station functionality.

In an embodiment, at least one static base station comprises more than one stationary base station.

In an embodiment, the router at least one of: a physical hardware entity; and a router service application residing on a computer housing the gateway.

In an embodiment, the source comprises at least one of: a video server, a voice calls server, a gaming server, other cellular network; and an external network.

In an embodiment, a message is down-streamed through said gateway to said target mobile device utilizing each tunnel in the set of tunnels including

(a) said first tunnel segment

(b) the succession of tunnels each commencing from said gateway and ending at a respective linked relay of said succession of linked relays.

In an embodiment, a message is up-streamed from said target mobile device through said gateway, utilizing each tunnel in the set of tunnels including

(a) said first tunnel segment

(b) the succession of tunnels each commencing from said gateway and ending at a respective linked relay of said succession of linked relays.

In an embodiment, the IP connectivity gateway comprises some of: GGSN and SGSN, operative in a 3G communication network.

In an embodiment, the IP connectivity gateway interfacing therewith comprises one of: an IP-connectivity GW in LTE; one of a P-Gateway, S-Gateway, P/S-Gateway and Access-Gateway in 3G GGSN, an SGSN in WiMAX, and an ASN-Gateway in CSN.

In an embodiment, the core is static.

In an embodiment, the router is operative to route IP-packets arriving from an mobility management entity within said core.

In an embodiment, all base station functionalities' IP addresses have a common portion which is recognized by said router.

In an embodiment, the router receives information from said table, and is operative to insert new information to said table according to a desired relay network topology.

In an embodiment, the additional router at least one of: a physical hardware entity; and a router service application.

In an embodiment, the encapsulating router at least one of: a physical hardware entity; and a router service application.

In an embodiment, at least one of said plurality of stationary relays resides in a static base station.

In an embodiment, the mobility management entity comprises one of: an LTE MME, a 3G RNC, and a WiMAX ASN.

An embodiment comprises a method corresponding to any of the above system.

Disclosed herein is a computer program comprising computer program code means for performing any of the methods shown and described herein when said program is run on a computer; and a computer program product, comprising a typically non-transitory computer-usable or -readable medium or computer readable storage medium, typically tangible, having a computer readable program code embodied therein, said computer readable program code adapted to be executed to implement any or all of the methods shown and described herein. It is appreciated that any or all of the computational steps shown and described herein may be computer-implemented. The operations in accordance with the teachings herein may be performed by a computer specially constructed for the desired purposes or by a general purpose computer specially configured for the desired purpose by a computer program stored in a typically non-transitory computer readable storage medium.

Any suitable processor, display and input means may be used to process, display e.g. on a computer screen or other computer output device, store, and accept information such as information used by or generated by any of the methods and apparatus shown and described herein; the above processor, display and input means including computer programs, in accordance with some or all of the embodiments of the present invention. Any or all functionalities of the invention shown and described herein, such as but not limited to steps of flowcharts, may be performed by a conventional personal computer processor, workstation or other programmable device or computer or electronic computing device or processor, either general-purpose or specifically constructed, used for processing; a computer display screen and/or printer and/or speaker for displaying; machine-readable memory such as optical disks, CDROMs, magnetic-optical discs or other discs; RAMs, ROMs, EPROMs, EEPROMs, magnetic or optical or other cards, for storing, and keyboard or mouse for accepting. The term "process" as used above is intended to include any type of computation or manipulation or transformation of data represented as physical, e.g. electronic, phenomena which may occur or reside e.g. within registers and /or memories of a computer or processor. The term processor includes a single processing unit or a plurality of distributed or remote such units.

The above devices may communicate via any conventional wired or wireless digital communication means, e.g. via a wired or cellular telephone network or a computer network such as the Internet.

The apparatus of embodiments of the present invention may include, according to certain embodiments of the invention, machine readable memory containing or otherwise storing a program of instructions which, when executed by the machine, implements some or all of the apparatus, methods, features and functionalities of the invention shown and described herein. Alternatively or in addition, the apparatus of embodiments of the present invention may include, according to certain embodiments of the invention, a program as above which may be written in any conventional programming language, and optionally a machine for executing the program such as but not limited to a general purpose computer which may optionally be configured or activated in accordance with the teachings of the present invention. Any of the teachings incorporated herein may whereever suitable operate on signals representative of physical objects or substances.

The embodiments referred to above, and other embodiments, are described in detail in the next section.

Any trademark occurring in the text or drawings is the property of its owner and occurs herein merely to explain or illustrate one example of how an embodiment of the invention may be implemented.

Unless specifically stated otherwise, as apparent from the following discussions, it is appreciated that throughout the specification discussions, utilizing terms such as, "processing", "computing", "estimating", "selecting", "ranking", "grading", "calculating", "determining", "generating", "reassessing", "classifying", "generating", "producing", "stereo-matching", "registering", "detecting", "associating", "superimposing", "obtaining" or the like, refer to the action and/or processes of a computer or computing system, or processor or similar electronic computing device, that manipulate and/or transform data represented as physical, such as electronic, quantities within the computing system's registers and/or memories, into other data similarly represented as physical quantities within the computing system's memories, registers or other such information storage, transmission or display devices. The term "computer" should be broadly construed to cover any kind of electronic device with data processing capabilities, including, by way of non-limiting example, personal computers, servers, computing system, communication devices, processors (e.g. digital signal processor (DSP), microcontrollers, field programmable gate array (FPGA), application specific integrated circuit (ASIC), etc.) and other electronic computing devices.

Embodiments of the present invention may be described, merely for clarity, in terms of terminology specific to particular programming languages, operating systems, browsers, system versions, individual products, and the like. It will be appreciated that this terminology is intended to convey general principles of operation clearly and briefly, by way of example, and is not intended to limit the scope of the invention to any particular programming language, operating system, browser, system version, or individual product.

Elements separately listed herein need not be distinct components and alternatively may be the same structure.

Any suitable input device, such as but not limited to a sensor, may be used to generate or otherwise provide information received by the apparatus and methods

CLAIMS:

1. An Internet Protocol (IP)-based cellular communication system operative in conjunction with a moving relay, the system comprising:

an IP connectivity gateway coupled to a network router and to a mobility management entity; and

a router configured to:

route, to the gateway, at least one packet designated to an IP address of at least one first moving relay, wherein

the router is configured to: (i) use a tunneling protocol other than a multi-protocol label switching (MPLS) tunneling protocol, and (ii) bounce packets back and forth between itself and the gateway, to allow creation of at least one multi-level tunnel that can support multi-level relay deployment on a standard network,

the first moving relay comprises base station functionality, a radio manager and mobile station functionality, all co-located,

the base station functionality is operative to communicate via antennae with at least one mobile station thereby defining a first radio link there between, and

said base station functionality having a physical connection to the co-located radio manager,

the mobile station functionality communicates via antennae with a unit which has base station functionality thereby to define a second radio link,

the radio manager comprises:

a radio resource manager; and functionality for exchanging information with radio managers included in moving relays other than the first moving relay,

the radio manager is configured to use the exchanged information to select, for at least one individual mobile station which seeks to be served by establishing a standard connection, one of: a static base station; and a base station functionality, to which to connect the individual mobile station in order to provide cellular communication services thereto,

the system is configured to support multiple relay scenarios with dynamic topology, in which relay connections vary over time, in that at least one mobile station functionality, UE, with plural potential connections to plural nodes respectively, is provided in at least one relay, with IP

level relayed information regarding various of said plural potential connections via at least one relay that said UE is currently connected to, the plural nodes including at least one of (a) base stations and (b) relay nodes' base station functionalities;

and decision making functionality is provided to:

dynamically derive from said information, a correct IP routing over multiple relays, from among multiple alternative routes available for a one to one entity connection, which will connect said UE to a given final destination via a suitable number of available relay nodes, given a current topology of said available relay nodes, and

dynamically select a relay for the UE to be served by, from among said plural potential connections, accordingly.

2. The system according to claim 1, further comprising a mobile management entity (MME) configured to store at least (i) IP addresses of plurality stationary relays, (ii) IP addresses of mobile relays and the IP address of a linked relay that each individual mobile relay is anchored to, and (iii) IP addresses of mobile stations and the IP address of a linked relay that each individual mobile station is anchored to.

3. The system according to claim1, wherein packets are bounced back to the IP connectivity gateway by the router.

4. The system according to claim 1, wherein packets are bounced back to the gateway, which is a P/S-GW gateway, internally in the IP connectivity gateway by virtue of the IP connectivity gateway recognizing a destination IP address as its own address.

5. A dynamic hierarchical cellular system implementing multi-hop encapsulation, the system comprising:

a core including a mobility management entity (MME) and an IP connectivity gateway interfacing therewith,

at least one static base station coupled to the mobility management entity and the IP connectivity gateway in the core,

at least one individual moving relay coupled to at least one individual static base station

and including a mobile station functionality and a base station functionality; and

at least one mobile station coupled to at least one of the static base station and the moving relay, wherein

the core comprises an encapsulating router, whose routing operations encapsulate messages to and from the at least one mobile station, without resorting to use of a multi-protocol label switching (MPLS) tunneling protocol,

the encapsulating router is coupled to the IP connectivity gateway, to the mobility management entity and to the individual static base station via which the individual moving relay connects to the core, and the router is: (i) operative for re-routing, to the gateway, at least packets designated to an IP address of one of the moving relays, and (ii) configured to bounce packets back and forth between itself and the gateway, to allow creation of at least one multi-level tunnel that can support multi-level relay deployment on a standard network, wherein

the system is configured to:

implement multi-hop encapsulation, such that, for at least one message destined for an individual base station functionality, the individual base station functionality's header is encapsulated within an individual mobile station functionality's header, so as to allow the message to be routed by the router to the individual base station functionality, via the individual mobile station functionality,

support multiple relay scenarios with dynamic topology, in which relay connections vary over time, in that at least one mobile station functionality, UE, with plural potential connections to plural nodes respectively, is provided in at least one relay, with IP level relayed information regarding various of said plural potential connections via at least one relay that said UE is currently connected to, the plural nodes including at least one of (a) base stations and (b) relay nodes' base station functionalities; and provide decision making functionality to:

dynamically derive from said information, a correct IP routing over multiple relays, from among multiple alternative routes available for a one to one entity connection, which will connect said UE to a given final destination via a suitable number of available relay nodes, given a current topology of said available relay nodes, and

dynamically select a relay for the UE to be served by, from among said plural potential connections, accordingly.

6. The system according to claim 5, wherein the router is configured to:

if an IP address of a destination in a header of a packet indicates one of a mobile station destination and a relay destination, route the packet to the IP connectivity gateway, and

if an IP address of a destination in a header of a packet indicates a static base station, route the packet to the static base station.

7. The system according to claim 5, wherein at least one pair of IP addresses of at least one mobile station functionality and base station functionality have a common portion which is recognized by the router.

8. The system according to claim 5, wherein all mobile station functionalities served by the core have IP addresses with a common portion which is recognized by the router.

9. The system according to claim 5, wherein the core is configured to: assign identical IP addresses to at least one base station functionality and at least one mobile station functionality, and assign different first and second ports to the respective at least one base station functionality and at least one mobile station functionality.

10. The system according to claim 5, wherein at least one pair of IP addresses of a base station functionality and a mobile station functionality respectively includes:

a first portion, common to both IP addresses in the pair, common to the base station functionality and the mobile station functionality, and

a second portion, which differs between the IP addresses in the pair and represents uniqueness of each of the base station functionality and the mobile station functionality, respectively.

11. The system according to claim 5, further comprising an additional router in the relay that is configured to, upon receipt of a message from a co-located base station functionality, send to the additional encapsulating router in the core the message with a header indicating that the message was sent by the additional router.

12. The system according to claim 5, wherein the router is operative to route information to at least one base station functionality, via at least one mobile station functionality.

13. The system according to claim 5, wherein the router cooperates with a logical table in the mobility management entity which indicates which base station serves each mobile station.

14. The system according to claim 5, wherein as each individual relay enters a network served by the core, the individual relay's mobile station functionality is assigned an IP address which the router is pre-configured to identify as an IP address of the individual relay's base station functionality.

15. The system according to claim 5, wherein

the core includes a core network, and

all mobile station functionalities in relays served by the core form a subnet of the core network.

16. The system according to claim 5, wherein

the core includes a core network, and

all base station functionalities in relays served by the core form a subnet of the core network.

17. The system according to claim 11, wherein at least one moving relay has a relay resource manager operative, when the moving relay joins a network served by the core, to instruct the additional router to store an association between the moving relay's base station functionality and the moving relay's co-located mobile station functionality.

18. The system according to claim 5, wherein the router is operative to route IP-packets arriving from a mobility management entity within the core.

19. The system according to claim 5, wherein all base station functionalities' IP addresses have a common portion which is recognized by the router.

20. A method for internet protocol (IP) based cellular communication in an IP based cellular communication system comprising a plurality of base stations and a cellular communication system core connected to each of the plurality of base stations and including an IP connectivity gateway operative to receive at least one packet having an IP-address designating a node in the cellular communication system, to add thereto a header of a base station serving the node, and to forward the packet with the header to a router, the method comprising:

providing at least one moving relay having a mobile station functionality and a base station functionality which is addressed by the core using the mobile station functionality's IP address; and

providing a router coupled to the gateway, configured to recognize packets for the individual base station as designated to a mobile station and operative for routing, packets received from the gateway, as follows: packets whose IP address is any one of the plurality of base stations, are routed to the base stations; and at least one packet designated to an IP address of a mobile station is routed back to the gateway, wherein

the router is: (i) operative to receive the packets from an IP connectivity gateway at a cellular communication system core which is connected to each of the plurality of base stations, and (ii) bounce packets back and forth between itself and the gateway, to allow creation of at least one multi-level tunnel that can support multi-level relay deployment on a standard network,

at least one of the packets includes:

an IP-address designating a node in the cellular communication system, and

a header, added by the gateway and recognized by the router, of a base station serving the node,

the method is configured to support multiple relay scenarios with dynamic topology, in which relay connections vary over time, in that at least one mobile station functionality, UE, with plural potential connections to plural nodes respectively, is provided in at least one relay, with IP level relayed information regarding various of said plural potential connections via at least one relay that said UE is currently connected to, the plural nodes including at least one of (a) base stations and (b) relay nodes' base station functionalities, and

decision making functionality is provided to:

dynamically derive from said information, a correct IP routing over multiple relays, from among multiple alternative routes available for a one to one entity connection, which will

connect said UE to a given final destination via a suitable number of available relay nodes, given a current topology of said available relay nodes, and

dynamically select a relay for the UE to be served by, from among said plural potential connections, accordingly.

21. A method according to claim 20, further comprising: when the core receives an individual packet having an IP-address designating a mobile station served by a peripheral base station located at a location which enables communication with a central base station, from among the plurality of base stations connected to the core, performing the following steps:

at the gateway, adding a header of the peripheral base station and forwarding the individual packet with the header of the peripheral base station to the router;

at the router, routing the individual packet, since its outermost IP address is recognized as designated to a mobile station, back to the gateway;

at the gateway, adding a header of the central base station and forwarding the individual packet with the header of the central base station to the router;

at the router, routing the individual packet, since its outermost IP address is one of the plurality of base stations, to the central base station;

at the central base station, routing the individual packet, since its outermost IP address is the peripheral base station, to the peripheral base station; and

at the peripheral base station, routing the individual packet to the mobile station designated in the individual packet's innermost IP address.

22. A method according to claim 20, wherein the using the Mobile station functionality's IP address is effected by using a NAT application.

23. A method according to claim 20, wherein the using the mobile station functionality's IP address is effected by sharing one ipv6 network prefix and using a stateless address auto-configuration in the IP address allocation of the Mobile station functionality.

24. The system according to claim 5, wherein

the first moving relay comprises a radio manager co-located with said base station

functionality and said mobile station functionality,

the base station functionality is operative to communicate via antennae with at least one mobile station thereby to define a first radio link there between,

said base station functionality has a physical connection to its co-located radio manager,

the mobile station functionality communicates via antennae with a unit which has base station functionality thereby to define a second radio link,

the radio manager comprises:

a radio resource manager; and

functionality for exchanging information with radio managers included in moving relays other than said first moving relay, and

the radio resource manager is configured to use the exchanged information to select, for at least one individual mobile station seeking to be served, one of: a static base station; and a base station functionality, to which to connect the individual mobile station in order to provide cellular communication services thereto.

25. The method according to claim 20, wherein

the first moving relay comprises a radio manager co-located with the base station functionality and the mobile station functionality,

the base station functionality is operative to communicate via antennae with at least one mobile station thereby to define a first radio link there between,

said base station functionality has a physical connection to its co-located radio manager,

the mobile station functionality communicates via antennae with a unit which has base station functionality thereby to define a second radio link,

the radio manager comprises:

a radio resource manager; and functionality for exchanging information with radio managers included in moving relays other than said first moving relay, and

the radio resource manager is configured to use the exchanged information to select, for at least one individual mobile station seeking to be served, one of: a static base station; and a base station functionality, to which to connect the individual mobile station in order to provide cellular communication services thereto.

26. The system according to claim 2 wherein said MME comprises a single MME configured to store at least (i) IP addresses of plurality stationary relays, (ii) IP addresses of mobile relays and the IP address of a linked relay that each individual mobile relay is anchored to, and (iii) IP addresses of mobile stations and the IP address of a linked relay that each individual mobile station is anchored to.

27. The system according to claim 1, wherein the gateway is aware of all UEs and rUEs in relays' addresses.

28. The system according to claim 1, wherein

said router is configured to allow for a varying number of layers of encapsulations by the gateway, and

said varying corresponds to a number of relay layers a packet needs to go through to reach said final destination, given the current topology.

29. The system according to claim 1, wherein tire router is aware of whether a given destination address refers to a particular static base station or a UE or a rUE and responsively bounce packets back to the S/P-GW for encapsulation when the destination is found to be a connected UE or rUE.

30. The system according to claim 1, wherein the gateway comprises a standard legacy S/P-GW.