US 20050255850A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2005/0255850 A1**

Auterinen (43) **Pub. Date: Nov. 17, 2005**

(54) **COMMUNICATIONS SYSTEM AND METHOD**

(76) Inventor: **Otso Auterinen**, Helsinki (FI)

Correspondence Address:
SQUIRE, SANDERS & DEMPSEY L.L.P.
14TH FLOOR
8000 TOWERS CRESCENT
TYSONS CORNER, VA 22182 (US)

(21) Appl. No.: **10/519,092**

(22) PCT Filed: **Jun. 12, 2003**

(86) PCT No.: **PCT/IB03/02663**

(30) **Foreign Application Priority Data**

Jun. 28, 2002 (GB) 02150134

Publication Classification

(51) **Int. Cl.**[7] **H04Q 7/20**

(52) **U.S. Cl.** **455/452.2**; 455/450; 455/453

(57) **ABSTRACT**

A communications system comprising at least one user equipment at least one resource node arranged to manage resource for communication with said at least one user equipment at least one managing node for managing traffic flow, wherein said at least one resource node and said at least one managing node are arranged so that information is passed between at least one resource node and at least one managing node, said at least one managing node selecting at least one parameter for a new traffic flow based on said information.

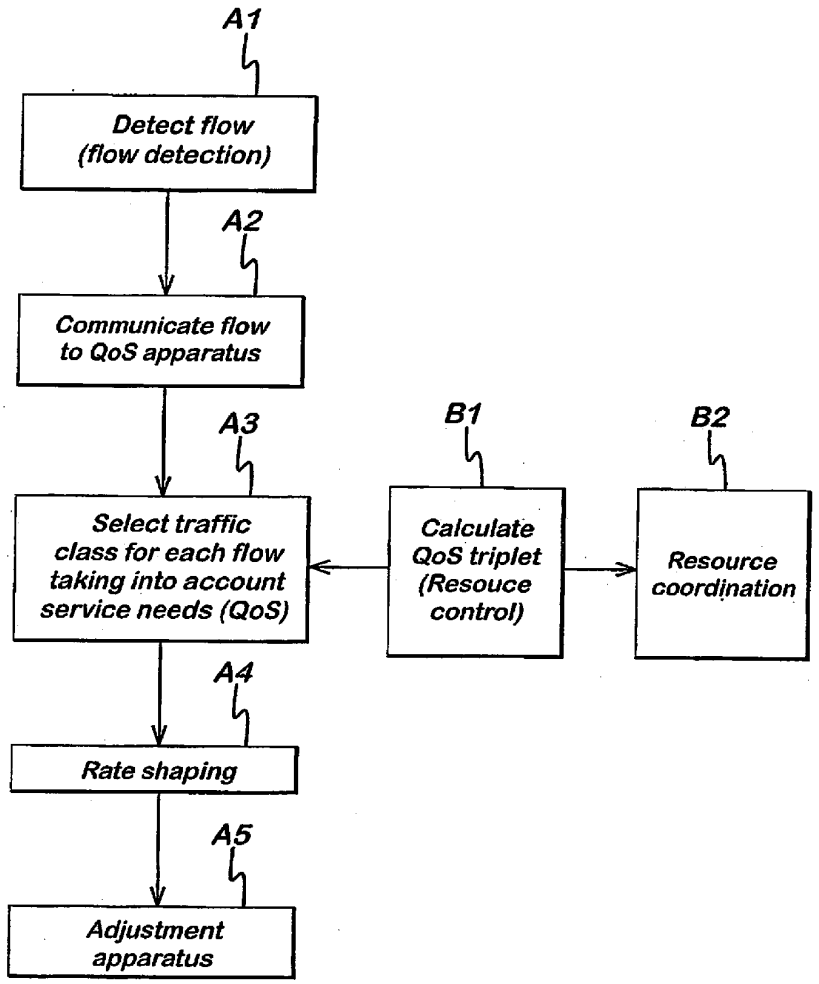
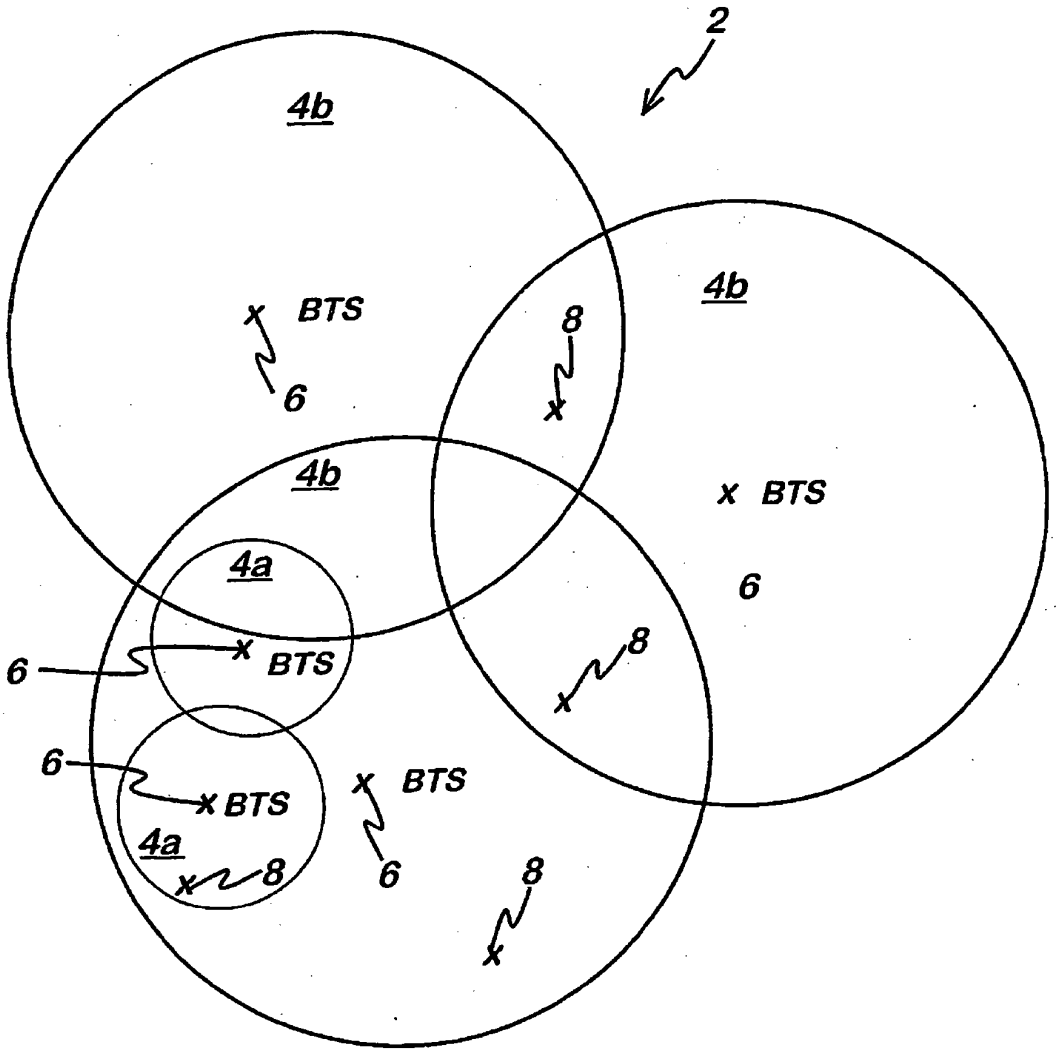


Fig. 1



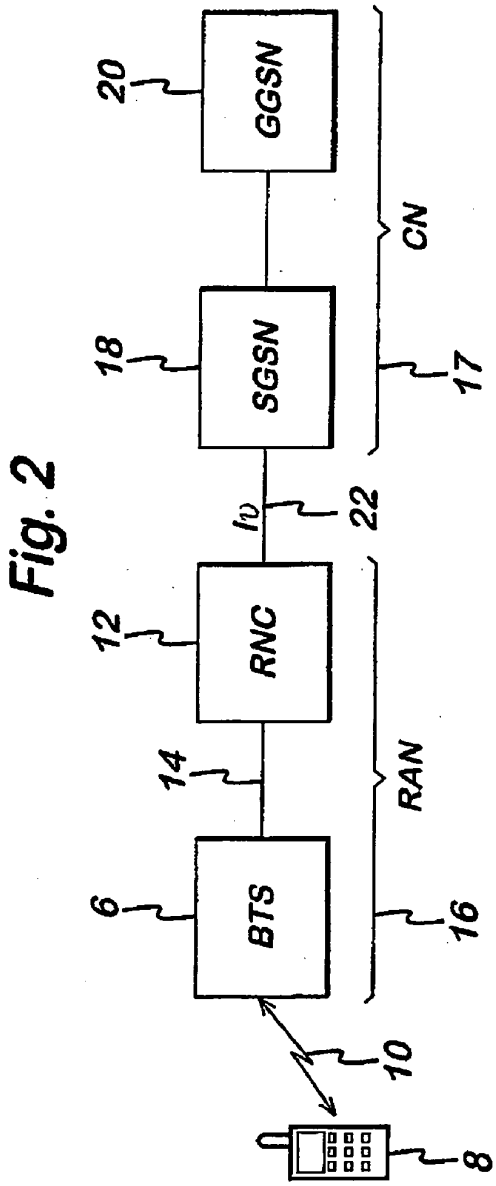

GGSN
20
SGSN
18
CN
17
Iu
22
RNC
12
14
BTS
6
RAN
16
10
8

Fig. 2

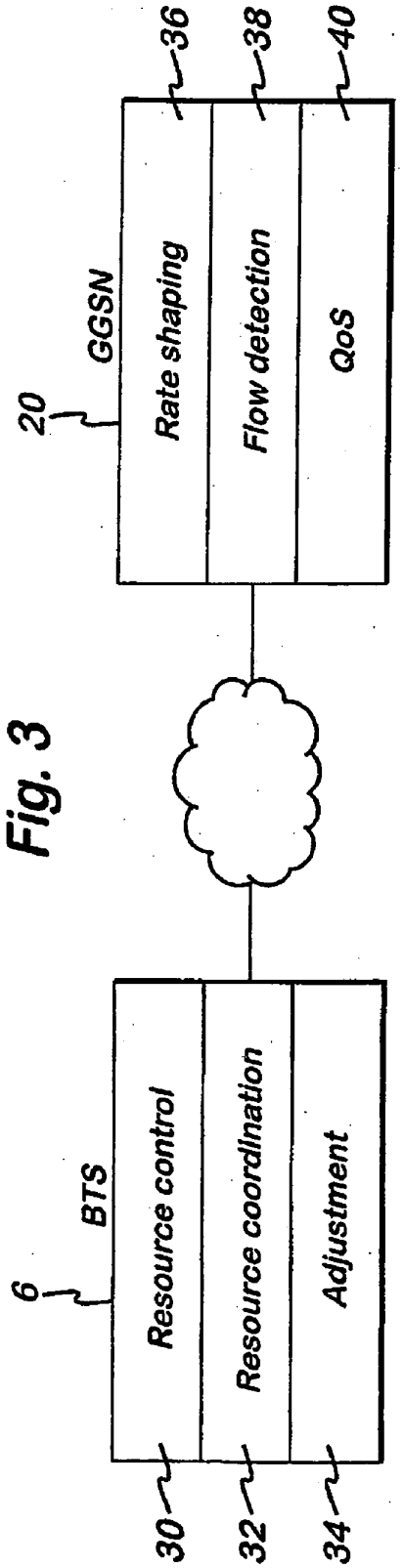
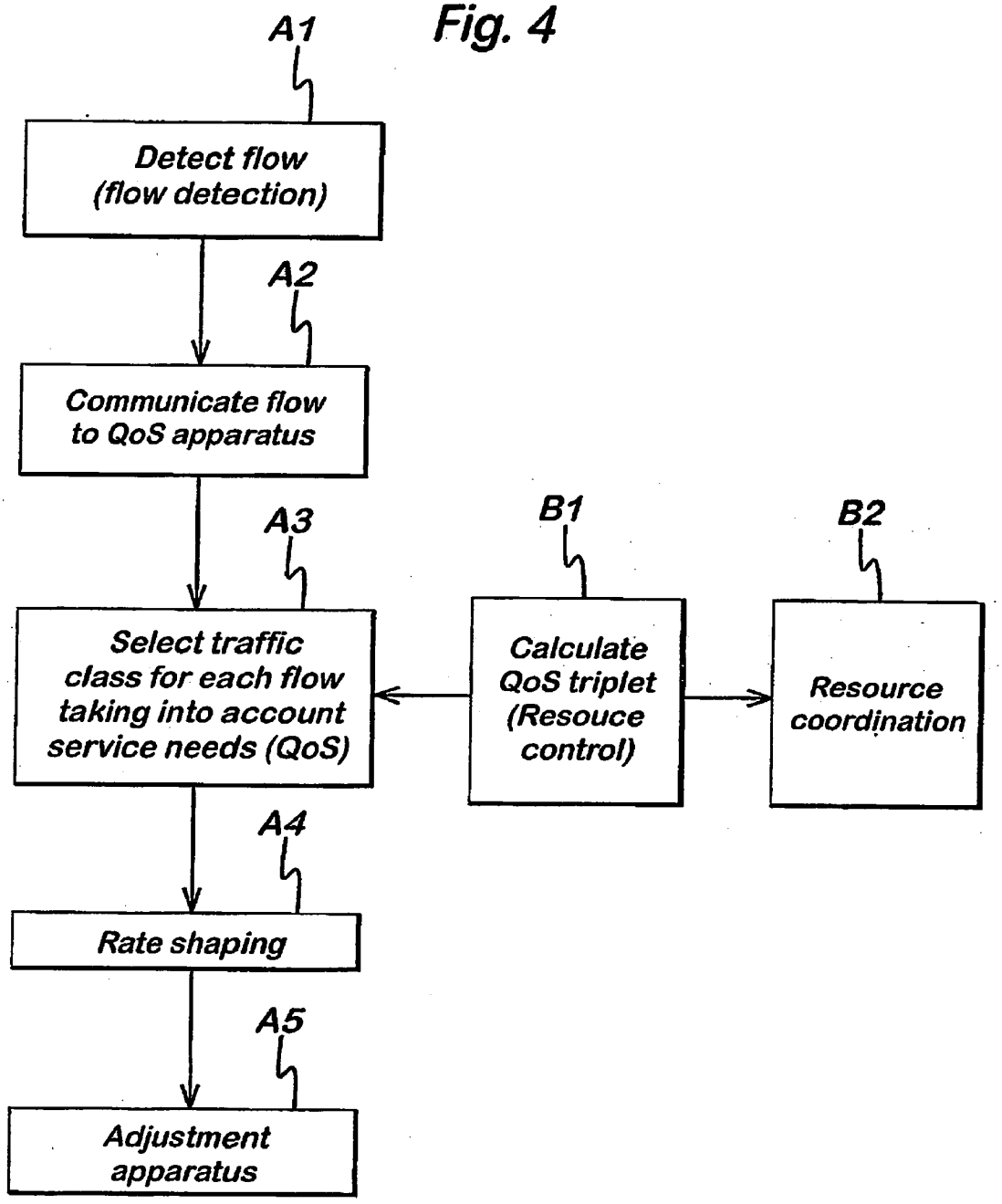

GGSN
20
Rate shaping
Flow detection
QoS
36
38
40
BTS
6
Resource control
Resource coordination
Adjustment
30
32
34

Fig. 3

Fig. 4


A1
Detect flow (flow detection)
A2
Communicate flow to QoS apparatus
A3
Select traffic class for each flow taking into account service needs (QoS)
B1
Calculate QoS triplet (Resouce control)
B2
Resource coordination
A4
Rate shaping
A5
Adjustment apparatus

COMMUNICATIONS SYSTEM AND METHOD

FIELD OF THE INVENTION

[0001] The present invention relates to a communications system and method and in particular and but not exclusively to an internet protocol (IP) based system and method.

BACKGROUND TO THE INVENTION

[0002] Wireless cellular communication networks are known. In these networks, the area covered is divided into a number of cells. Each cell has associated with it a base transceiver station. The base transceiver stations are arranged to communicate with mobile stations located in the cells associated with the base transceiver stations.

[0003] There are a number of different standards which govern the communication between mobile stations and base stations as well as with other network elements. One example of a currently known standard is the GSM standard (Global System for Mobile Communications). At the present time, work is being carried out on the so called third generation standard. One example of these third generation standards is the UMTS (Universal Mobile Telecommunications System) Standard. In general, the third generation standards use code division multiple access in the radio interface between mobile stations and base transceiver stations.

[0004] Currently, it is proposed in at least some third generation standards to use the internet protocol IP in the radio access network (RAN).

[0005] Currently, the access charge for a certain type of access is the same regardless of the location of the user equipment. Thus, if the user is in an area covered by a particular network operator, the cost to the user will be same throughout the network. This has generally been the case in that the-base stations are generally owned by the operator and the subscriber will have a contract with the network operator which is based on fixed charges. The current system thus does not allow the provision of access nodes, such as base transceiver stations, by third parties. Accordingly, the issue of charging is not even addressed where the access node is provided by a third party. Furthermore, the current standards do not provide much flexibility in the charging of a user in dependence of location of the user and local loading conditions.

SUMMARY OF THE INVENTION

[0006] It is an aim of embodiments of the present invention to address one or more of the problems described above.

[0007] According to one aspect of the invention, there is provided a communications system comprising:

[0008] at least one user equipment:

[0009] at least one resource node arranged to manage resource for communication with said at least one user equipment;

[0010] at least one managing node for managing traffic flow, wherein said at least one, resource node and said at least one managing node are arranged so that information is passed between at least one resource node and at least one managing node, said at least one managing node selecting at least one parameter for a new traffic flow based on said information.

[0011] Embodiments of the present invention provide a method, a system and the network elements for executing a traffic class/cost negotiation for a new traffic flow, upon a change in traffic conditions, in an access network.

BRIEF DESCRIPTIONS OF DRAWINGS

[0012] For a better understanding of the present invention and as to how the same may be carried into effect, reference will now be made by way of example only to the accompanying drawings in which:

[0013] **FIG. 1** shows a cellular communications network in which embodiments of the present invention can be incorporated;

[0014] **FIG. 2** shows a schematic view of elements of the communications network in which embodiments of the present invention can be incorporated;

[0015] **FIG. 3** shows circuitry used in embodiments of the present invention; and

[0016] **FIG. 4** shows a flow diagram of a method embodying the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE PRESENT INVENTION

[0017] Reference is first made to **FIG. 1** which shows a cellular communications network **2** in which embodiments of the present invention can be incorporated. The area covered by the network is divided into cells **4**. As can be seen from **FIG. 1** there are two types of cells shown. Cells **4***a* are much smaller than cells **4***b*. The large cells **4***b* generally cover the area of the network and, as shown in **FIG. 1** may at least partially overlap. The smaller cells **4***a* are arranged to overlap the larger cells **4***b*. The smaller cells **4***a* may be provided by the network operator to deal with traffic hotspots. Alternatively, the smaller cells may be part of a wireless LAN (Local Area Network) operated by a third party. Alternatively, the cells **4***a* may be provided by third parties for the purposes which will be discussed in more detail hereinafter.

[0018] Each cell is provided with a base transceiver station **6**. The base transceiver station **6** is arranged to communicate with user equipment **8**. Where the user equipment is in a location served by more than one base station, one or other or even both of the base transceiver stations may service that user equipment. The user equipment may be a mobile telephone, computer, personal digital assistant or any other entity. The user equipment may be fixed or mobile.

[0019] Reference will now be made to **FIG. 2** which shows the hierarchy of the network of **FIG. 1**. The user equipment **8** is arranged to communicate with the base station **6** via an air interface **10**. In other words, the communication between the user equipment **8** and the base transceiver station **6** is via a wireless connection which may for example utilise WLAN, GSM, EDGE, WCDMA, CDMA or some other radio technology. The base station **6** may be an IP base station, that is one which can be used in a IP radio access network structure or may be a non IP base

station, such as some base stations in the so called third generation standards or a base station in a GSM system.

[0020] The base station **6** is connected to a radio network controller **12** via a interface **14**. The interface may be Iub, Iu', It should be appreciated that in practice the radio network controller RNC **12** is arranged to control a number of base stations. Furthermore, a number of radio network controllers **12** are provided. The radio network controller **12** owns and controls the radio resources in its domain. The RNC **12** is a service access point for all services which the UTRAN (UMTS Terrestrial Radio Access Network, ie the base stations and radio network controllers) provide the core network, which will be described in more detail hereinafter. This may for example be the management of connections to the user equipment **8**.

[0021] The core network comprises a SGSN **18** (Serving GPRS (General Packet Radio Service) Support Node) and a GGSN (Gateway GPRS Support Node) **20**.

[0022] The connection between the RNC **12** and the SGSN **18** is via the Packet Switched Iu interface **22**. The SGSN **18** is typically used for packet switched services. Effectively the SGSN **18** is used to switch the packet switched transactions. The GGSN **20** is the switch at the point where the network is connected to external packet switched networks. All incoming and outgoing packet switched connections go through the GGSN **20**.

[0023] It should be appreciated that **FIG. 2** is a schematic view of a network. Variations on this network are possible with embodiments of the present invention. Some of these elements may not be present, and other elements may replace or be provided instead of the element shown.

[0024] Reference is made to **FIG. 3** which shows elements of the embodiments of the present invention. The base transceiver station **6** includes a resource control apparatus **30**, a resource coordination apparatus **32** and an adjustment apparatus **34**. The GGSN **20** comprises rate shaping apparatus **36**, flow detection apparatus **38** and quality of service apparatus **40**. In practice the apparatus of the base transceiver station **6** and the. GGSN **20** will be provided by circuitry and/or be implemented in software.

[0025] The resource control apparatus **30** is arranged to control the radio access resources allocated in a cell to an access network connection such as a PDP context or data flow. A flow is for example data traffic relating to an application or to an individual process within an application or to a combination of flows with common quality of service requirements establishing an aggregate flow. The resource control apparatus **30** includes logic which calculates a target bit rate for each traffic class. The resource control apparatus is also arranged to calculate a cost for each traffic handling class. The cost is calculated on the volume of traffic The cost is calculated for suitable units of traffic volume. A cost is calculated e.g. for packet sizes used at the air interface. The cost is applied to all flows which use the cell and traffic class.

[0026] The traffic handling class may take into account the type of connection for example whether the connection is a -voice connection or a data connection. The traffic handling class can also take into account the volume of data to be transferred and for example the capabilities of the user equipment. The traffic class is used in embodiments of the present invention to indicate a set of quality of service QoS parameters values which include at least (and in some embodiments only) the target bitrate—or target bitrates for uplink UL and DL downlink connections.

[0027] The resource control apparatus **30** uses information about the actual flows to be served. In other words, the calculated target bit rate, cost and traffic class take into account the Radio Access Bearers currently in progress as well as the new radio access bearer to be initiated. The result of the calculations carried out by the resource control apparatus **30** provides the triplet of information which is referred to as the quality of service triplet.

[0028] The quality of service apparatus **40** is arranged to select a suitable traffic class for each flow according to the service needs particularly taking into account the required bit rate. This apparatus only selects a suitable traffic class for the new traffic flows and does not alter existing traffic flows. This selection made by the quality of service apparatus **40** is based on the quality of service triplet provided by the resource control apparatus. In preferred embodiments of the present invention there is a traffic class negotiation between the radio access node and the edge node for each new flow. The negotiation includes a communication of cell level triplets about-traffic class, target bit rate for a flow and cost from the radio access network to the edge node. The edge node allocates a traffic class for each new flow on the basis of the service needs. In other words, the target bit rate and costs are taken into account when determining the traffic class. The traffic class is selected in a preferred embodiment of the invention based on (1) the quality of service QoS properties—including bitrate—available with the traffic class, (2) the needed bitrate to ensure the desired user experience with the application and (3) the cost allowed (e.g access cost tolerable for the application/service provider) for the service.

[0029] The quality of service apparatus **40** is located in at the "intelligent edge" of the access network where the service needs and allowed costs are known. In the embodiment of the present invention shown in **FIG. 3**, this intelligent edge is provided by or at the GGSN **20**. However, it should be appreciated that the quality of service apparatus **40** may be provided at another suitable location.

[0030] The quality of service apparatus **40** is responsible for introducing the flow. In other words, the quality of service apparatus allows a new flow.

[0031] The resource control apparatus **30** and the quality of service apparatus **40** make up an outer control loop. This control loop finds ? the right traffic class for each flow.

[0032] The resource coordination apparatus **32** has the ability to balance the load of cells so that target bit rate per traffic class in adjacent cells is equal or is as similar as possible In one embodiment of the present invention, the target bit rates are set in configuration of the radio access NW network, and in this simple case the coordination is only about the ability to accept the given configuration parameters. More complicated alternatives are of course possible in embodiments of the present invention. In particular the resource coordination apparatus **32** is arranged to adjust the cell size (for example altering the power with which the base transceiver station transmits), alter the cell selection or use any other similar mechanism to provide balanced loads. The resource coordination logic **32** typically aims to provide a

predefined differential of traffic classes and predefined minimum bit rates in upper traffic classes.

[0033] The adjustment apparatus **34** is provided for the flow control of packets to guide the actual bit rate towards the target bit rate of the flow. For example, the apparatus can for example control the TCP (Transport Control Protocol) window size by not allowing a window size which would cause a higher bit rate than the target. In other words, the bit flow is slowed down to meet the target bit rate.

[0034] The rate shaping apparatus **36** is arranged to enforce downlink flow. For uplink packets the rate shaping apparatus may be located in the user equipment.

[0035] The flow detection apparatus **38** operates at the end of the access network. The flow detection apparatus **38** detects new flows and communicates them to the quality of service apparatus **40**. New uplink flows are initially a component of the default flow, that is the PDP context. The flow detection apparatus **38** may make a decision to leave the flow-as a component of the default flow, in which case the quality of service apparatus **40** is not informed.

[0036] As will be appreciated, there is a communication mechanism: to communicate the existence of the flow and associated traffic handling class from the quality of service apparatus **40** to the resource control apparatus **30** and adjustment apparatus **34**. In preferred embodiments of the present invention, this is done via the SGSN **18** and RNC **12**. However, it should be appreciated that any other suitable mechanism can be used for transferring data between the required entities.

[0037] Reference is made to **FIG. 4** which shows a flow chart of an embodiment of the present invention. In step A**1** the flow detection apparatus **38** detects the new flows. In step A**2** the flow detection apparatus **38** communicates the new flows to the quality of service apparatus **40**.

[0038] In step A**3**, the quality of service apparatus **40** selects a suitable traffic class for the flow taking into account the service needs, in particular the required bit rate. It should be appreciated that the selected traffic class takes into account the quality of service triplet which is calculated in step B**1** by the resource control apparatus **30**.

[0039] In step A**4**, any rate shaping required takes place. In other words, any packet dropping which needs to be done, takes place.

[0040] In step A**5**, any adjustment required by the adjustment apparatus **34** takes place. This is for the control of packets to guide the actual bit rate towards the target bit rate. This will typically increase or decrease the bit rate as required.

[0041] In step B**2**, the resource coordination apparatus **32** takes steps to balance the load of cells.

[0042] It should be appreciated that step B**1** occurs prior to step A**3**. Step B**1** may occur before, after or during steps. A**1** and **2**. Step B**2** is shown as taking place after the step B**1**. However, step B**2** may in certain embodiments of the present invention take place at any other suitable time.

[0043] Steps A**4** and A**5** may be omitted or may be carried out so that step A**5** occurs before step A**4**.

[0044] It should be appreciated that the calculated cost using the negotiation need not be the actual cost paid by the subscriber or end user of a service or application. Instead, it can be, for example, partially or totally charged from the core network operator or the application service provider.

[0045] In some embodiments of the present invention,the adjustment apparatus may be omitted. For uplink flow, an adjustment apparatus may be provided in the mobile station. Likewise, as far as the rate shaping apparatus is concerned, for up link packets, this may be located in the user equipment.

[0046] Embodiments of the present invention are particularly applicable when a base station is not operated by the core network operator. For example, the base station may be part of an internal wireless LAN or may be provided as a commercial enterprise. In the case of the base station which is part of the wireless LAN, there may be extra capacity which could then be used by a user, which is not party to the wireless LAN. The base station may be provided by a separate operator which wants to provided particular service.

[0047] Embodiments of the present invention thus allow localised cost, that is, access cost differentiation based on location and services. Alternatively or additionally, the cost may be dependent on time, for example time of day, day of the week or the like.

[0048] Embodiments of the invention also allow bargaining about costs and quality of service between, the access network edge (for example the GGSN) and the radio access node (for example the BTS). Thus, embodiments of the present invention can have a base station which is an investment by third parties to serve a location. This investment can be funded or sponsored by the interest groups of a specific location. For example, service providers are one possible interest group which could fund a base station investment in selected areas.

[0049] Embodiments of the present invention allow the integration of new access technologies such as wireless LAN into mobile access networks. This is because there is the negotiation between the base station and the GGSN.

[0050] During the negotiation between the base station and the GGSN the traffic class can be selected in dependence on cost. This may mean, for example, that a lower bit rate than the optimal bit rate may be used for a particular connection. It should be appreciated that certain types of call may only have a limited range of possibilities as to an acceptable traffic class. For example, some types of call may only be able to have a particular traffic class. The call can proceed or not based on the call cost. The call can proceed or not depending on the available target bit rate for a given class.

[0051] In some embodiments of the present invention the resource control apparatus may offer different quality of service information to different quality of service apparatusa. In other words, depending on the quality of service apparatus, different methods may be used to calculate the triplets. This enables radio access network sharing among virtual access operators and access cost. differentiation between service domains.

[0052] One example of a triplet calculation method based on "high end pays more" is described. A reference setup for

triplets is a linear cost (per volume unit) increase with bitrate. The cost per volume unit in a traffic class is

CostPerUnit=BasicCost+C*(TargetBitrate−BasicBitrate).

[0053] Typically factor C is increased if there is more demand than can be served. In lower traffic classes, Cost per Volume Unit may be kept constant> the cost is decreased proportionally with the target bitrate.

[0054] It should be appreciated that in some embodiments of the present invention the resource control logic may use different methods in determining the cost of a given traffic class. In other words, at least two different traffic classes may use different methods in order to determine the cost.

[0055] In embodiments of the present invention, some of the apparatus are described as being in the base transceiver station whilst other of the apparata are described as being in GGSN. It should be appreciated that any of the apparatus may be located in any other suitable node. For example, the resource coordination apparatus may be provided in a RNC or similar logic element.

[0056] Embodiments of the present invention may be used with a an OWLAN Operator-Wireless LAN. This is a WLAN operated by a mobile operator. This means a known business model of a mobile operator where access cost is paid by the subscriber on a time or volume basis and roaming agreements are used to define how money is shared between visited network NW and the home operator. When used with embodiments of the invention, charging based on location can be implemented.

[0057] It should be appreciated that communication between the edge node and the IPBTS can be based on GTP (GPRS Tunnelling protocol) or MPLS Multiprotocol Label Switching. Label switched tunnels are set across a part of an IP network. The nodes in the network forward packets based on the label set by the ingress node (where the LSP (label switched path) starts) instead of the destination IP address. Per hop behaviour is defined for each label which enables use of LSPs as a QoS mechanism. Traffic classes may be mapped to label switched paths connecting the base station and edge nodes A LSP is chosen to meet the QoS requirements such as delay, and not to exceed the planned maximum load of LSPs. To know the actual limits, Resource control apparatus will communicate with a network NW level MLPS (or IP) traffic coordinator unit. The communication with traffic control would about negotiating the aggregate bitrate for each LSP between IP BTS and GGSN (or IPBTS to RAN GW (radio access network gateway, and RAN GW to GGSN separately. To apply the limits, the cost adjustment per traffic class can be used as for air interface resources.

[0058] It should be appreciated that alternative or additional information may be provided in the negotiation between the radio access node and the edge node. Other quality of service parameters include maximum bit rate, guaranteed bit rate, delivery order, traffic handling priority, allocation/retention priority, maximum SDU (Service Data Unit) size, SDU format information, SDU error ratio, residual bit error ratio, and source statistics descriptors.

[0059] In some embodiments of the present invention, the GGSN would after negotiating with the access node, request the subscribers acceptance for the cost negotiated. Alternatively, if the GGSN has some information about the knowledge of services and user preferences for the user, then the GGSN or some other node can make the decision.

[0060] Embodiments of the present invention are particularly applicable to wireless LAN. In those circumstances, the BTS would instead be a wireless LAN radio access node and GGSN would be the equivalent of wireless LAN node.

[0061] In some embodiments of the present invention, the charging function is provided by the radio network controller. In those embodiments of the present invention, the negotiation may involve RNC. The RNC may replace the base transceiver station in the negotiation or may replace the GGSN or may form part of the negotiation between these entities.

1. A communications system comprising:

at least one user equipment:

at least one resource node arranged to manage resource for communication with said at least one user equipment;

at least one managing node for managing traffic flow, wherein said at least one resource node and said at least one managing node are arranged so that information is passed between at least one resource node and at least one managing node, said at least one managing node selecting at least one parameter for a new traffic flow based on said information.

2. A system as claimed in claim 1, wherein said at least one resource node and at least one managing node are arranged to negotiate in order to select the at least one parameter.

3. A system as claimed in claim 1, wherein said information comprises negotiation information and said negotiation information is determined by at least one resource node.

4. A system as claimed in claim 3, wherein said negotiation information comprises at least one of the following: type of traffic, the bit rate of the traffic and the cost.

5. A system as claimed in claim 3, wherein said negotiation information is determined for a plurality of different traffic handling classes.

6. A system as claimed in claim 1, wherein said parameter is at least one of the following: traffic handling class, cost, and target bit rate

7. A system as claimed in claim 1, wherein an access charge for the user equipment is dependent on the location of the user equipment in said system and/or time.

8. A system as claimed in claim 1, wherein at least one resource node comprises an access node with which said user equipment is arranged to communicate.

9. A system as claimed in claim 8, wherein at least one access node is a base station or radio network controller.

10. A system as claimed in claim 1, wherein said at least one managing node is located at an edge of a network.

11. A system as claimed in claim 1, wherein said at least one managing node comprises an GGSN.

12. A system as claimed in claim 1, wherein said resource node is an access node.

13. A system as claimed in claim 1, wherein in means are provided for guiding an actual flow rate to a target flow rate.

14. A system as claimed in claim 1, wherein means are provided for detecting a new flow.

15. A system as claimed in claim 1, wherein means are provided for balancing load between available resources.

16. A system as claimed in claim 1, wherein communication between the managing node and resource node is via a GPRS tunnelling protocol or a multi-protocol label switching protocol.

17. A communications method for use in a communications system comprising at least one user equipment, at least one resource node arranged to manage resource for communication with said at least one user equipment, at least one managing node for managing traffic flow,

said method comprising the steps of passing information passed between at least one resource node and at least one managing node, and selecting at least one parameter for a new traffic flow based on said information.

18. A resource node for use in a system comprising:

at least one user equipment;

at least one resource node, and at least one at least one managing node for managing traffic flow,

said resource node comprising means for managing resource for communication with said at least one user equipment, and means for passing information to said at least one managing node.

19. A managing node for use in a communications system comprising at least one user equipment, at least one resource node arranged to manage resource for communication with said at least one user equipment, and at least one managing node, said managing node comprising means for managing traffic flow, means for receiving information from at least one resource node, and means for selecting at least one parameter for a new traffic flow based on said information.

* * * * *