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(71) Applicant *(for all designated States except US)*: **TELEFONAKTIEBOLAGET L M ERICSSON (PUBL)** [SE/SE]; S-164 83 Stockholm (SE).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **MOE, Johan** [SE/SE]; Ladusäter, S-590 17 Mantorp (SE). **KALLIN, Harald** [SE/SE]; Kruthornsvägen 40, S-192 53 Sollentuna (SE). **FRENGER, Pål** [SE/SE]; Tomatvägen 20, S-582 75 Linköping (SE). **SUNDBLAD, Per** [SE/SE]; Plommongatan 11, S-58249 Linköping (SE).

(74) Agent: **NILSSON, Charlotte**; Ericsson AB, Patent Unit 3G, Torshamnsgatan 21-23, S-164 80 Stockholm (SE).

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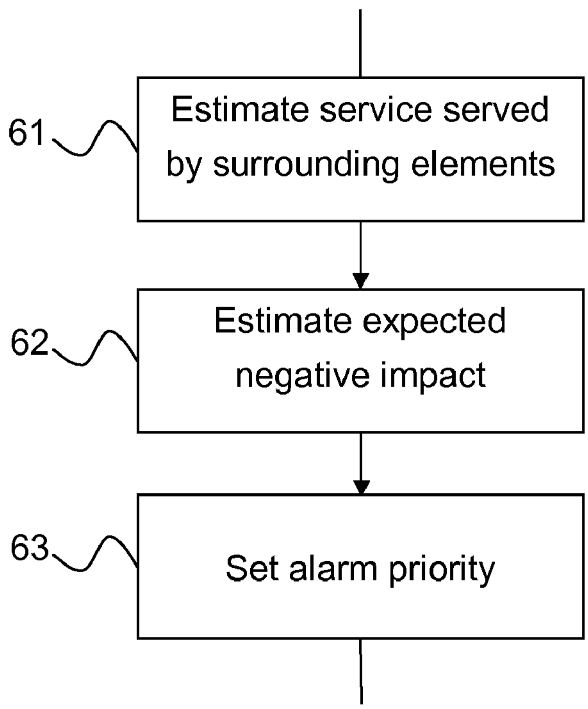
[Continued on next page]

(54) Title: METHOD AND ARRANGEMENT FOR PRIORITISING ALARMS BASED ON ESTIMATED SERVICE IMPACT IN A COMMUNICATION NETWORK.

Fig. 6



(57) Abstract: The present invention relates to a method and an arrangement of managing an alarm priority setting when a communication network element is malfunctioning in a communication network system comprising a multitude of communication network elements. First, an expected negative impact during a pre-determined time period is estimated. Then, the alarm priority is set based on the estimated negative impact.

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Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *of inventorship (Rule 4.17(iv))*

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— *with international search report (Art. 21(3))*

Method and arrangement for prioritising alarms based on estimated service impact in a communication network.

TECHNICAL FIELD

The present invention relates to a method and arrangement in a communication network system and, more particular, to an arrangement allowing for managing alarm priority settings as well as a method for such management.

BACKGROUND

A wireless telecommunication network may contain several ten thousands of network elements. The large number of network elements is due to the number of base stations required to cover a geographical area. As a natural consequence of such large networks, the number of alarms received in a network management centre can be humongous.

In order to support the network management operations, it is desirable to assign priorities to the alarms so that the appropriate attention is assigned to each alarm. Simple recovery actions upon an alarm may take place completely automatically; for example a device reset. If such easy remedies fail, a physical site visit may be required. In that case, the time to repair the malfunctioning unit may take several hours.

Sometimes a cell in a network is not able to provide any, or only limited service, due to hardware (HW) or software (SW) failures. This is called cell outage and is a temporary state that must be handled manually or automatically by the operator. However, other cells in the surroundings may – to some extent – pick up traffic to and from user equipments in the affected cell's area. Therefore, much of the service served by the original cell may be picked up by surrounding cells without any further actions – or from other radio technologies; for example WCDMA user equipments may seek service from the GSM network. The user equipments select the best cell that is picked up.

For some unfortunate users, there is no fallback, so these users will not get any or only marginal service. Problems in the cellular network may hence be seen as a loss of income and/or goodwill and it is important to resolve these problems as quick as possible. The decision of which problem to resolve first is something that is most often referred to as experience, hence it is something that takes a while to gain.

There is, therefore, a need to support the user – an operator or an algorithm – with better information so that it is possible to act according to the impact of a cell outage.

The problem with existing fault management systems is that they are poor at guiding the operator to the most important problem to resolve, i.e. the alarms presented are without context of current and near future impact on the operator income and goodwill.

As an example: assume it is Saturday, 10am, and two identical major alarms have been raised, one in an industrial area with plenty of overlapping coverage from surrounding cells, and one inside a shopping mall with limited coverage from other cells. Just looking at the alarms there is no way to resolve which is the most important. When including the traffic profile of the cell and the possibility that the traffic may be handled by remaining network elements, it becomes clear that the mall has the higher priority, and that it is probably sufficient if the alarm originating in the industrial area needs to be fixed before Monday morning (6am).

Existing solutions also lack an assessment of the net impact. That is, due to the nature of radio networks, when one base station fails, user equipments may be attracted to other base stations within range that provide service. This kind of redundancy is not completely as straight forward to calculate as a hot standby, and will vary from cell to cell, and depend on the kind of outage – is the complete radio site malfunctional, or only one sector (cell), or are there other radio technologies working in the cell?

SUMMARY

Accordingly, one objective of the present invention is to provide an improved method and arrangement for managing an alarm priority setting when a communication network element is malfunctioning in a communication network system comprising a multitude of communication network elements.

According to a first aspect of the present invention this objective is achieved through a method as defined in the characterizing portion of claim 1, which specifies that the alarm priority settings are managed by a method comprising the steps of: estimating an expected negative impact during a pre-determined time period; and, setting said alarm priority according to said expected negative impact.

According to a second aspect of the present invention this objective is achieved through an arrangement as defined in the characterizing portion of claim 6, which specifies that the alarm priority settings are managed by the arrangement comprising a processing unit arranged to: estimate an expected negative impact during a pre-determined time period; and, set said alarm priority according to said expected negative impact.

Further embodiments are listed in the dependent claims.

Thanks to the provision of a method and an arrangement, in which the alarm severity for network elements is classified based on the actual and expected service impact, it is possible to simplify the operation of the managed network and, it supports the operator in the process of prioritizing alarms and allocating resources to rectify the faults. Also, the true service impact is taken into account, that is, the service, e.g. traffic, that may be served by other network elements.

Still other objects and features of the present invention will become apparent from the following detailed description considered in conjunction with the accompanying drawings. It is to be understood, however, that the drawings are designed solely for purposes of illustration and not as a definition of the limits of the invention, for which reference should be made to the appended claims. It should be further understood that the drawings are not necessarily drawn to scale and that, unless otherwise indicated, they are merely intended to conceptually illustrate the structures and procedures described herein.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, wherein like reference characters denote similar elements throughout the several views:

Figure 1 shows an example of a communication network architecture;

Figure 2 is a graph of a possible traffic distribution over a day in a cell;

Figure 3 is a graph of a traffic distribution and traffic loss in the case of an alarm;

Figure 4 illustrates the current traffic levels compared to historical values for the malfunctioning network element;

Figure 5 is a graph showing a forecast of an overload situation;

Figure 6 is a flowchart over embodiments of the present inventive method;

Figure 7 is a simplified block diagram showing embodiments of the present invention.

DETAILED DESCRIPTION

Figure 1 depicts a communication system including a radio access network (RAN), such as the UMTS terrestrial radio access network (UTRAN) architecture, comprising at least one radio base station (RBS) (eNode B or Node B) 15 (two are shown in fig. 1) connected to one or more radio network controllers (RNCs) 10. The RAN is connected to a core network (CN) 12. The RAN and the CN 12 provide communication and control for a plurality of user equipments (UE) 18 that each uses downlink (DL) channels 16 and uplink (UL) channels 17. For the reason of clarity, only one uplink channel is denoted 17 and downlink channel denoted 16. On the downlink channel 16, the RBS 15 transmits data to each user equipment 18 at a respective power level. On the uplink channel 17, the user equipments 18 transmit data to the RBS 15 at respective power levels.

According to a preferred embodiment of the present invention, the communication system is herein described as a WCDMA communication system. The skilled person, however, realizes that the inventive method and arrangement works very well on other communications systems as well, such as GSM and LTE. The user equipments 18 may be mobile stations such as mobile telephones (“cellular” telephones) and laptop computers with mobile termination and thus may be, for example, portable, pocket, hand-held, computer-included, or car-mounted mobile devices which communicate voice and/or data with the RAN.

Embodiments of the present invention comprise in general a method for setting alarm priorities, using historical data to make an estimate of the expected traffic loss when a network element malfunctions. In order to get a better estimate of the traffic loss, the surrounding network elements’ ability to serve the affected traffic is also considered. This knowledge is used when resolving which fault indications (alarm/KPI threshold breach etc) have a higher priority.

The operator is assumed to run at least one, but possibly two or more, radio technologies in parallel; for example WCDMA in combination with LTE.

<u>Calculating traffic impact</u>

Starting with an example, the graph in figure 2 shows a possible traffic distribution over a day for a cell. In this example, traffic may be the number of:

- users
- sessions
- services
- the resource utilization, or
- a combination thereof (α*A + β*B + …)

A good length for the traffic characteristics is to have it for one hour granularity for each day of the week.

The traffic situation is something an experienced operator considers when judging alarms and this is normally based on a long-earned knowledge.

By including severity information in the alarms, inexperienced operators may be more efficient and will be guided to make proper judgments. As said before, the traffic (service) may be picked up by other cells possible belonging to other technologies. This means that although the shopping mall is highly crowded, the traffic may be served to an acceptable level. This is knowledge that is hard to gain for an operator.

According to embodiments of the invention, an arrangement prioritizes – assigns severity levels – alarms by estimating the traffic impact from a faulty network element and is suggested to include:

a) a forecast of the traffic levels in the network element during the coming period of time;
b) what traffic – normally handled by the faulty network element – that will not be handled satisfactory; not at all or by remaining network elements

In its simplest form, it is assumed that no other network element may handle the traffic normally handled by the faulty network element. The traffic loss is close to equivalent to the area between t_{alarm} and Δt shown in figure 3.

In a more elaborate version, a network element in a radio network measures the coverage overlap from surrounding network elements (cells) and estimate what traffic can be supported by other cells.

In yet another version, there may be other network element that to some extent carries some of the traffic, but not necessarily to the same service level. For instance, voice calls may be handled without a problem, but no video calls are possible. Or data traffic is possible but with a lower data rate. The difference in service level may be due to lack of the necessary capabilities in the remaining network elements, or because of overload in the network elements.

The priority, alarm severity, is derived from the time of day and day of week, but not in the way that the severity is directly from the current time; for example $S = f(t)$.

Instead, the severity is computed as the service impact over the coming period of time:

$$S = f(\int_{t}^{t+\Delta t} T(t)dt) \qquad (1)$$

or in other words, a damage estimate is calculated from a given time – t – which may be a) the time of the alarm notification or b) the current time; and some time forward – Δt – for example 6 hours.

By investigating several time durations, e.g. 1, 2, 4, 8, 16, 32, 64 hours, it is possible to also give a severity trend. For example a lot of impact right now, but it will not worsen or the other way around, not a major impact now, but it will get worse after the weekend.

According to one embodiment of the invention, a maximum or average value for a time-to-repair target is set for different cells. In big cities it could be set to 6h, in smaller cities to 8h and on the countryside it could be set to 24h. The time-to-repair target value is then used as Δt when computing the severity level.

When some of the service is handled by the remaining network elements, an estimate of the lost traffic is done by comparing the traffic handled in the region.

The example in figure 4 illustrates a case where a GSM or LTE cell has malfunctioned. The right hand side bars in figure 4 indicate the extra traffic the remaining network elements carry, compared to the normal traffic levels. This analysis indicates a net traffic impact (loss) of only 2 % of the network element's traffic.

The bars in figure 4 indicate the current traffic levels compared to historical values for the faulty network element. As traffic changes over time it is also relevant to forecast if the situation gets worse.

The graph in figure 5 shows a forecasting of the overload situation. At time t_{alarm} the traffic increased significantly in the remaining network elements to levels much above the normal level. During two occasions, the estimate is that the traffic level will exceed the capacity of the remaining network element(s). The traffic impact is calculated and used for setting the severity of the alarm. In this case, it is also possible to use this information to provide a maximum time-to-repair; the traffic may stay at an acceptable level for some time, but the network element should be repaired before the system experience the overload, where the end user impact will be much more evident.

According to one embodiment of the present invention a procedure of managing an alarm priority setting when a communication network element is malfunctioning in a communication network system comprising a multitude of communication network elements, as shown in figure 6, is provided. The procedure comprises the steps of:
- estimating how much service handled by said malfunctioning communication network element that may be served by surrounding communication network elements (step 61);
- estimating an expected negative impact, i.e. traffic outage, during a pre-determined time period based on said estimated service served by surrounding communication network elements (step 62); and,
- setting said alarm priority according to said expected negative impact, i.e. traffic outage (step 63).

According to some embodiments, said step of estimating how much service that may be served by surrounding communication network element comprises the step of measuring a coverage overlap from surrounding communication network elements.

According to some embodiments, said step of estimating said expected negative impact, or traffic outage, comprises the step of comparing said estimated service served by surrounding communication network elements with service normally handled by said malfunctioning communication network element.

According to some embodiments, said pre-determined time period is a time-to-repair target time.

Figure 7 is a block diagram showing a user equipment 18 and a communication network element 15, such as Node B, of managing an alarm priority setting when a communication network element is malfunctioning in a communication network system comprising a multitude of communication network elements. The block diagram further comprises a second communication network element 74 such as a radio network controller (RNC), an operations support system (OSS) or a network management system (NMS).

The Node B 15 comprises a transmitting unit 72 including a radio transmitter. The Node B 15 further comprises a receiving unit 71 including a receiver. The transmitter 72 is transmitting data to a receiver 77 of the user equipment 18 over a radio interface on the downlink channel 16. The receiver 71 is receiving data from the user equipment 18 on the uplink channel 17. Node B 15 optionally further comprises a processing unit 73 arranged to

- estimate how much service handled by said malfunctioning communication network element that may be served by surrounding communication network elements;
- estimate an expected negative impact, i.e. traffic outage, during a pre-determined time period based on said estimated service served by surrounding communication network elements; and,
- set said alarm priority according to said expected negative impact.

The user equipment 18 comprises a transmitting unit 76 including a radio transmitter. The radio transmitter 76 is arranged to transmit data packets to the receiver 71 of the Node B 15 over the radio interface on the uplink channel 17. The UE 18 further comprises a receiving unit 77 including a receiver. The receiver 77 is arranged to receive data packets transmitted from the transmitter 72 of the Node B 15 on the downlink channel 16.

The second communication network element 74 optionally comprises a processing unit 73 arranged to
- estimate how much service handled by said malfunctioning communication network element that may be served by surrounding communication network elements;
- estimate an expected negative impact, i.e. traffic outage, during a pre-determined time period based on said estimated service served by surrounding communication network elements; and,
- set said alarm priority according to said expected negative impact.

According to some embodiments, the processing unit is further arranged to measure a coverage overlap from surrounding communication network elements when estimating how much service that may be served by surrounding communication network element.

According to some embodiments, the processing unit is further arranged to compare said estimated service served by surrounding communication network elements with traffic normally handled by said malfunctioning communication network element when estimating said expected negative impact, or traffic outage.

According to some embodiments, the pre-determined time period is a time-to-repair target time.

Thus, while there have been shown and described and pointed out fundamental novel features of the invention as applied to a preferred embodiment thereof, it will be understood that various omissions and substitutions and changes in the form and details of the devices illustrated, and in their operation, may be made by those skilled in the art without departing from the spirit of the invention. For example, it is expressly intended that all combinations of those elements and/or method steps which perform substantially the same function in substantially the same way to achieve the same results are within the scope of the invention. Moreover, it should be recognized that structures and/or elements and/or method steps shown and/or described in connection with any disclosed form or embodiment of the invention may be incorporated in any other disclosed or described or suggested form or embodiment as a general matter of design choice. It is the intention, therefore, to be limited only as indicated by the scope of the claims appended hereto.

Expressions such as “including”, “comprising”, “incorporating”, “consisting of”, “have”, “is” used to describe and claim the present invention are intended to be construed in a non-exclusive manner, namely allowing for items, components or elements not explicitly described also to be present. Reference to the singular is also to be construed to relate to the plural and vice versa.

Numerals included within parentheses in the accompanying claims are intended to assist understanding of the claims and should not be construed in any way to limit subject matter claimed by these claims.

CLAIMS

1. A method of managing an alarm priority setting when a communication network element is malfunctioning in a communication network system comprising a multitude of communication network elements, **characterized in that** the method comprises the steps of:
- estimating an expected negative impact during a pre-determined time period;
- setting said alarm priority according to said expected negative impact.

2. A method according to claim 1, **characterized in that** the method further comprises the steps of:
- estimating how much service handled by said malfunctioning communication network element that may be served by surrounding communication network elements;
- estimating said expected negative impact based on said estimated service served by surrounding communication network elements.

3. A method according to claim 1, **characterized in that** said step of estimating how much service that may be served by surrounding communication network element comprises the step of measuring a coverage overlap from surrounding communication network elements.

4. A method according to claim 1, **characterized in that** said step of estimating said expected negative impact comprises the step of comparing said estimated service served by surrounding communication network elements with traffic normally handled by said malfunctioning communication network element.

5. A method according to claim 1, **characterized in that** said pre-determined time period is a time-to-repair target time.

6. An arrangement of managing an alarm priority setting when a communication network element is malfunctioning in a communication network system comprising a multitude of communication network elements, **characterized in that** the arrangement comprises a processing unit arranged to:
- estimate an expected negative impact during a pre-determined time period;

- set said alarm priority according to said expected negative impact.

7. An arrangement according to claim 6, **characterized in that** said processing unit further is arranged to:
- estimate how much service handled by said malfunctioning communication network element that may be served by surrounding communication network elements;
- estimate said expected negative impact based on said estimated service served by surrounding communication network elements.

8. An arrangement according to claim 6, **characterized in that** said processing unit further is arranged to measure a coverage overlap from surrounding communication network elements when estimating how much service that may be served by surrounding communication network element.

9. An arrangement according to claim 6, **characterized in that** said processing unit further is arranged to compare said estimated service served by surrounding communication network elements with traffic normally handled by said malfunctioning communication network element when estimating said expected negative impact.

10. An arrangement according to claim 6, **characterized in that** said pre-determined time period is a time-to-repair target time.

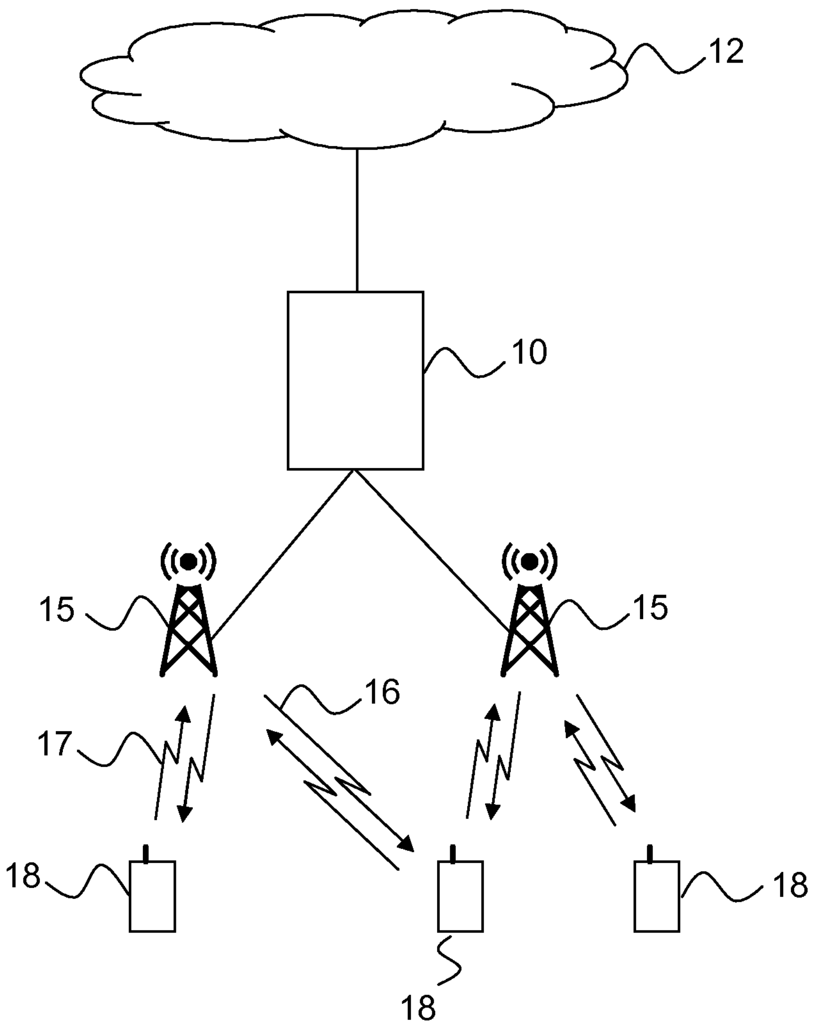

Fig. 1

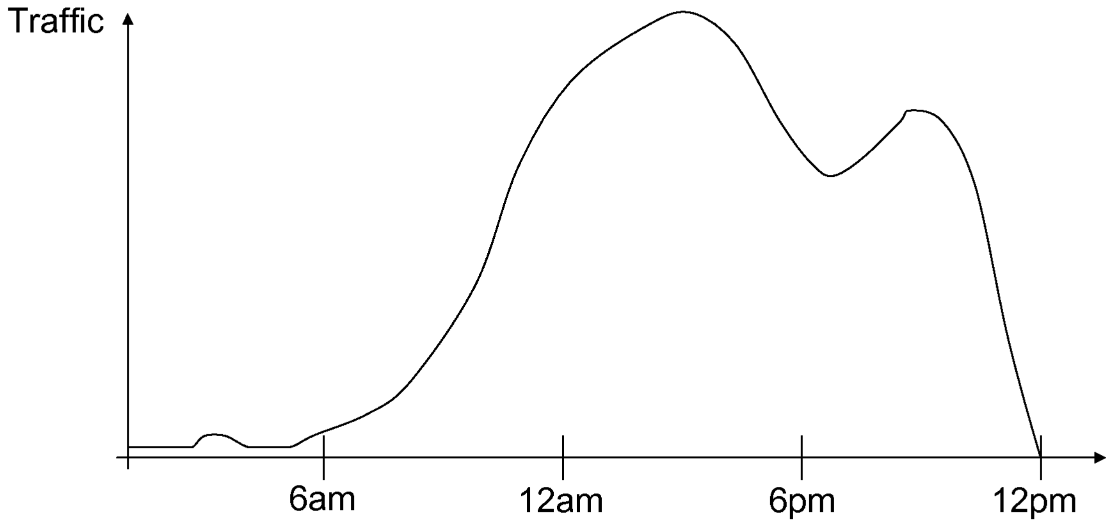
Traffic
6am
12am
6pm
12pm

Fig. 2

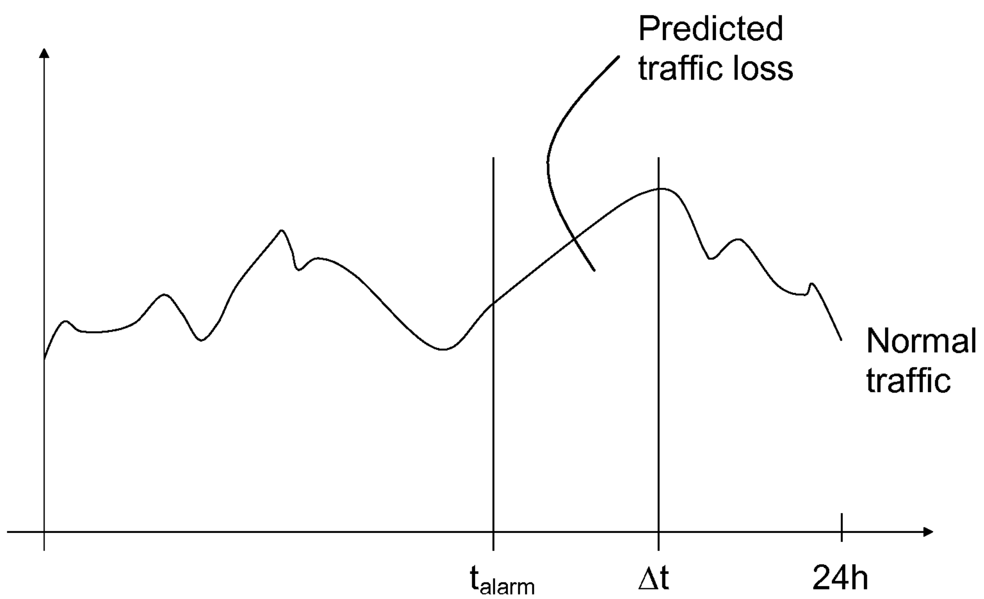
Predicted traffic loss
Normal traffic
t_{alarm}
Δt
24h

Fig. 3

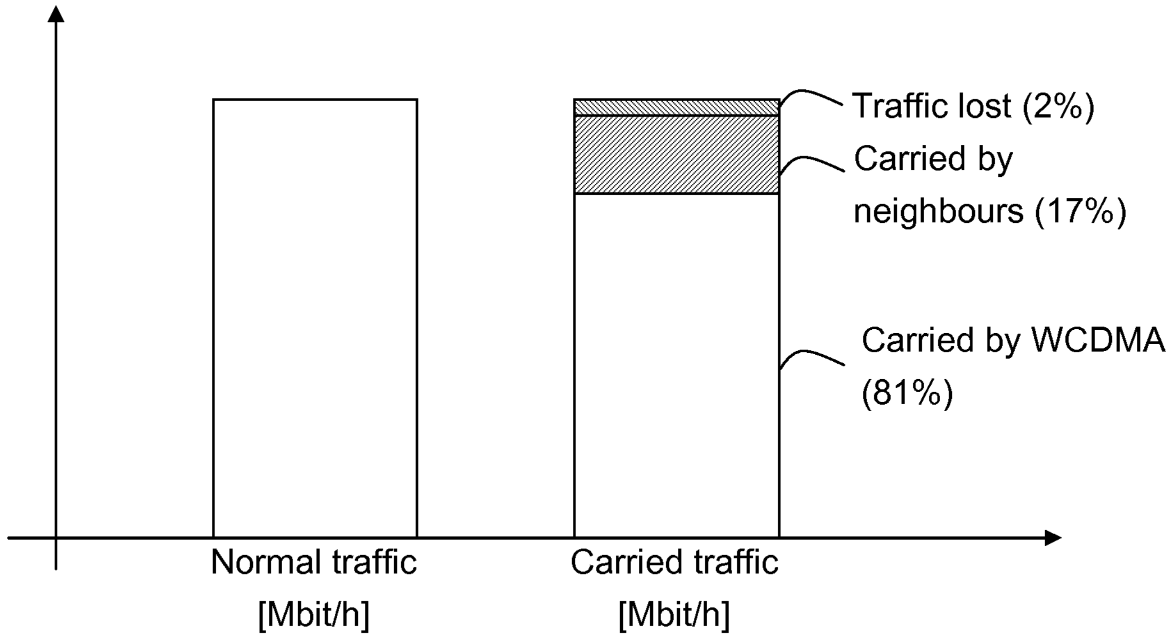
Traffic lost (2%)
Carried by neighbours (17%)
Carried by WCDMA (81%)
Normal traffic [Mbit/h]
Carried traffic [Mbit/h]

Fig. 4

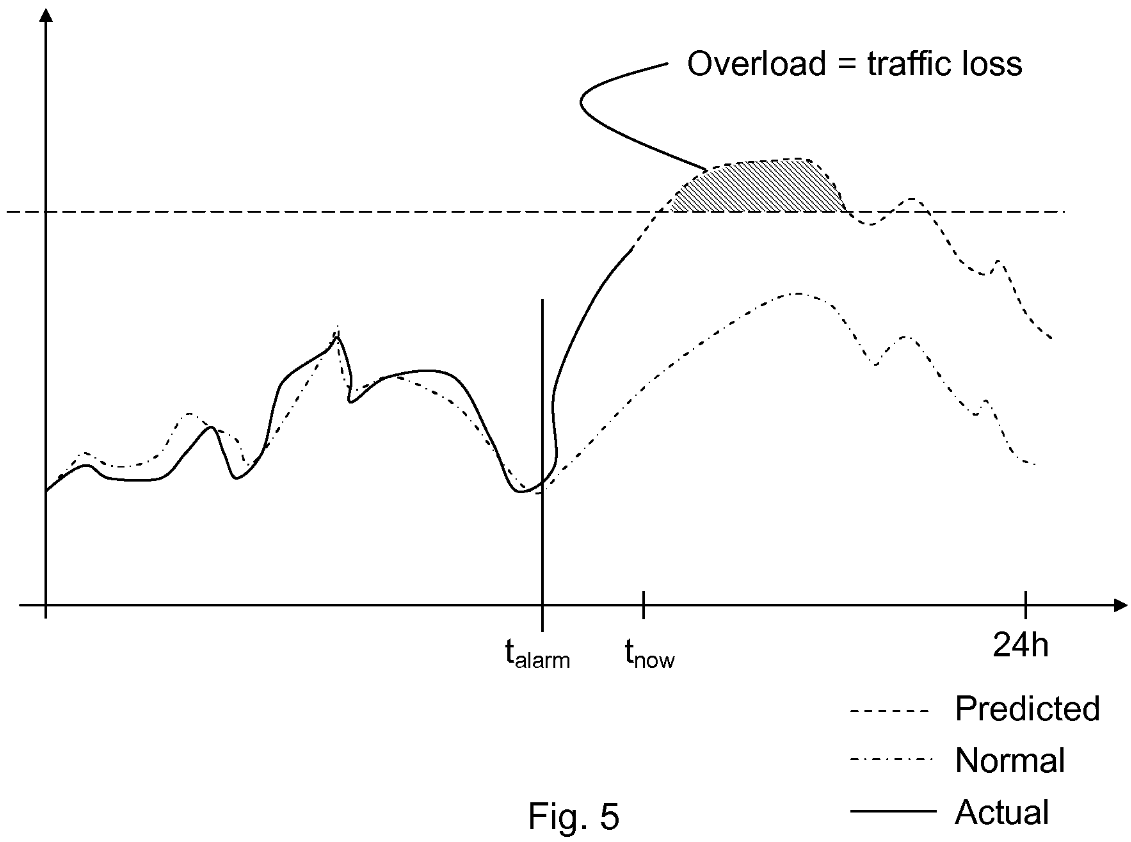
Overload = traffic loss
t_{alarm}
t_{now}
24h
Predicted
Normal
Actual

Fig. 5

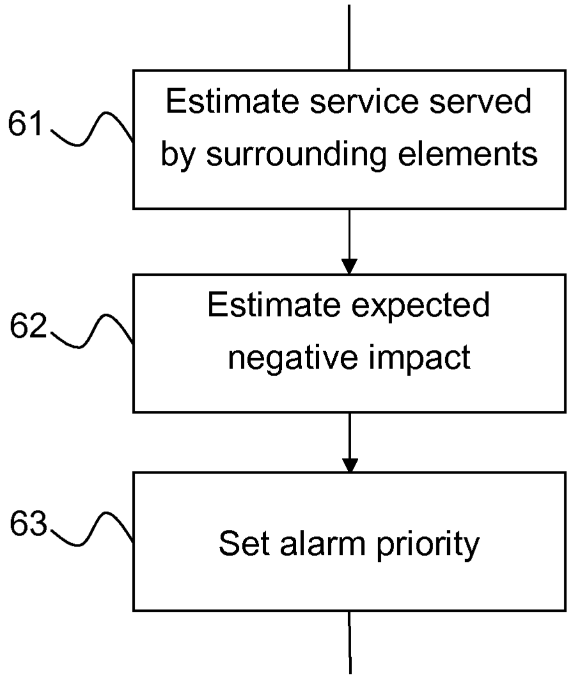
61
Estimate service served by surrounding elements
62
Estimate expected negative impact
63
Set alarm priority

Fig. 6

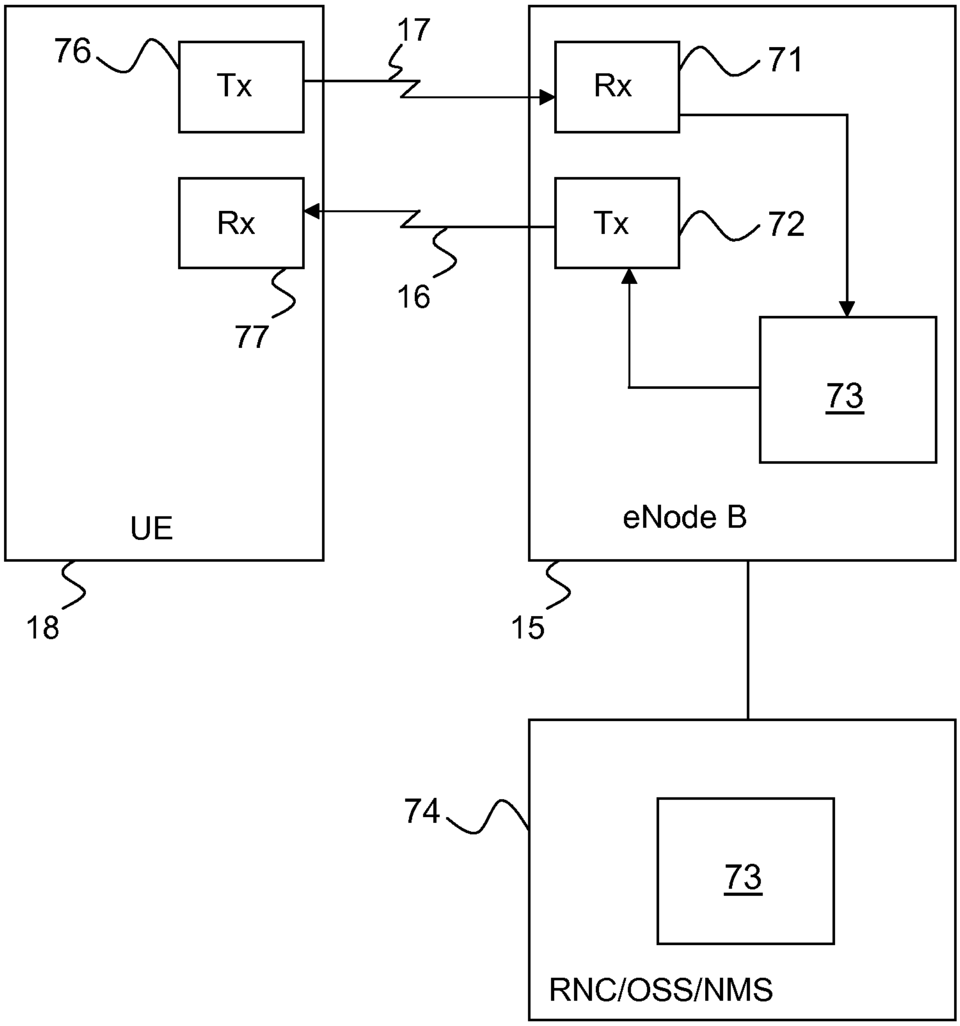

Fig. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2009/051514

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

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:G08B, H04L, H04W

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

SE, DK, FI, NO classes as above

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

EPO-Internal, PAJ, WPI data, COMPENDEX, EMBASE, INSPEC, IBM-TDB

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 20060121906 A1 (STEPHENS PAUL ET AL), 8 June 2006 (2006-06-08); abstract; paragraphs [0001], [0018], [0029]-[0031], [0040]-[0047], [0050]-[0053], [0060], [0064]-[0077]; figures 2-3; claim 7 --	1-10
X	US 20070222576 A1 (MILLER FRANK D ET AL), 27 September 2007 (2007-09-27); abstract; paragraphs [0003]-[0008], [0013], [0021], [0024]-[0025], [0036]-[0037], [0040]-[0041], [0052]-[0054]	1, 5-6, 10
A	 --	2-4, 7-9
A	US 20030142201 A1 (BABKA JAMES J ET AL), 31 July 2003 (2003-07-31); abstract; paragraphs [0010], [0021], [0026]; figure 1; claims 1-2 --	1-10

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

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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
27-09-2010	29-09-2010

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Box 5055
S-102 42 STOCKHOLM
Facsimile No. + 46 8 666 02 86

Authorized officer
Ola Svensson
Telephone No. + 46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2009/051514

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	"A dynamic load balancing strategy for channel assignment using selective borrowing in cellular mobile environment", Sajal K. Das, Sanjoy K. Sen and Rajeev Jayaram, Journal Wireless Networks, Publisher Springer Netherlands, ISSN 1022-0038, (Print) 1572-8196 (Online) Issue Volume 3, Number 5 / October, 1997, DOI 10.1023/A:1019181923135, Pages 333-347 [retrieved from the internet on 2010-09-20, URL: http://www.springerlink.com/content/h637g155782jqm75/fulltext.pdf]; abstract; page 333, right column, 3'rd paragraph - page 334, left column, 2'nd paragraph and section 3.2 on page 336. -- ----------	1-10

International application No.
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Continuation of: second sheet

International Patent Classification (IPC)

G08B 29/00 (2006.01)
H04L 12/24 (2006.01)
H04W 24/08 (2009.01)

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Paper copies can be ordered at a cost of 50 SEK per copy from PRV InterPat (telephone number 08-782 28 85).

Cited literature, if any, will be enclosed in paper form.

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				CN	100421496	C	24/09/2008
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