a control unit incorporated in the synchronization system of
control there is arranged a measuring receiver having
provided with a control unit for the radio data

1.0

1.1

1.25

1.4

1.6

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1961-A
Convention Application for a Patent

SIEMENS AKTIENGESELLSCHAFT

of Wittelsbacherplatz 2, D-8000 Munchen 2, Germany

hereby apply for the grant of a Patent for an invention entitled

"A MOBILE RADIO NETWORK AND CONCENTRATOR FOR SAME"

which is described in the accompanying complete specification.

This application is a Convention Application and is based on the application numbered P 30 12 484.6

for a patent or similar protection made in Germany

on 31st March, 1980

Our address for service is:

Care: SPRUSON & FERGUSON
PATENT ATTORNEYS
4555 HOUSE 117 KENT STREET 60 MARGARET STREET,
SYDNEY. NEW SOUTH WALES.
AUSTRALIA.

Dated this 28th day of January, 1981.

The Common Seal of
SIEMENS AKTIENGESELLSCHAFT
was hereunto affixed in
the presence of:

To:
The Commissioner of Patents

COMMONWEALTH OF AUSTRALIA
PATENTS ACT 1945-72
Form 10

COMPLETE SPECIFICATION
(ORIGINAL) 543725
COMMONWEALTH OF AUSTRALIA

DECLARATION IN SUPPORT OF A CONVENTION APPLICATION FOR A PATENT OR PATENT OF ADDITION

In support of the Convention Application made for a patent for an invention entitled 6 8 8 9 8 / 8 1

"A MOBILE RADIO NETWORK AND CONCENTRATOR FOR SAME"

Full name and address of Declarant.

I, Peter Drost
Procurist
of 8 Munich 80, Franziskanerstrasse 14, Germany

do solemnly and sincerely declare as follows:

1. I am the applicant for the patent
   (or, in the case of an application by a body corporate)
   1. I am authorised by SIEMENS AKTIENGESELLSCHAFT, Berlin und München
      the applicant for the patent
      to make this declaration on its behalf.

2. The basic application as defined by Section 141 of the Act was made in Germany
   on the 31st day of March 1980 by
   SIEMENS AKTIENGESELLSCHAFT

3. I am the actual inventor of the invention referred to in the basic application.
   (or where a person other than the inventor is the applicant)
   3. KARL KAMMERLANDER, HANS-JÜRGEN von der NEYEN
      and GERHARD POOCH
      of Wiesenstrasse 10, D-8190 Wolfratshausen, Germany
      Damaschkestrasse 63, D-8000 München 82, Germany and
      Nordendstrasse 119, D-8080 Emmering, Germany
      respectively

are/is the actual inventor(s) of the invention and the facts upon which the applicant
is/are entitled to make the application are as follows:

The said applicant is the assignee of the actual inventors.

4. The basic application referred to in paragraph 2 of this Declaration was the first
   application made in a Convention country in respect of the invention the subject
   of the application.
   Declared at Munich this 28th day of January 1981.

Signature of Declarant

To:
The Commissioner of Patents.
A mobile radio network having a number of stationary radio concentrators mutually spaced in accordance with a cellular system with overlapping radio regions, wherein a firmly determined number of mutually adjacent radio regions respectively forms a radio region group, in which the frequency channels available in all regions repeat themselves, wherein furthermore the frequency distribution plan for the radio concentrators is so determined that common channel interference in each respective radio region inclusive of an edge zone which overlaps adjacent radio regions, is largely eliminated, and wherein at least the signalling is effected in digital form between the stationary radio concentrators and mobile subscriber stations by means of organisation channels which are designed for duplex operation and in each of the radio concentrators.
provided with a central control unit for the radio data control there is arranged a measuring receiver having a control unit incorporated in the synchronous system of the radio concentrators and by means of which monitoring of the radio channels of adjacent radio regions and change-over of mobile subscribers into another radio region is effected via field strength measurement and storing of the field strength values, characterized in that for a possibly required change-over the measurement of the field strength is determined in the measuring receiver by means of a plurality of measurements and is initiated therefrom by means of a central analysis, and measurement of the distance of the respective mobile subscriber station effected by determining the time difference between a predetermined reference timing signal and a timing signal of received channel data from the subscriber station.
Name of Applicant: SIEMENS AKTIENGESELLSCHAFT

Address of Applicant: Wittelsbacherplatz 2, D-8000 Munchen 2, Germany

Actual Inventors: KARL KAMMERLANDER, HANS-JÜRGEN von der NEYEN and GERHARD POOCH

Address for Service: Spruson & Ferguson, Patent Attorneys, CBA Centre 80 Margaret Street, Sydney, New South Wales, 2000 Australia

Complete Specification for the invention entitled:

"A MOBILE RADIO NETWORK AND CONCENTRATOR FOR SAME"

The following statement is a full description of this invention, including the best method of performing it known to me/us:
ABSTRACT

"MOBILE RADIO NETWORK AND CONCENTRATOR FOR SAME"

Summary

To enable switching of a connected subscriber moving between radio ranges, in a cellular network with overlapping ranges, the concentrators monitor (via a measuring receiver) field strength to determine increase in particular channels and also determine subscriber distance. The field strength values may be stored to provide a trend indication and even a gradient value for the trend. The subscriber distance value is obtained using a comparison of a reference timing signal with a timing signal in the data received from the subscriber. If appropriate the subscriber is switched to another radio range by means of a central control unit.
The invention relates to a mobile radio network having a number of stationary radio concentrators in a mutual spatial arrangement, in the form of a cellular arrangement, with overlapping adjacent radio ranges, each cell comprising a predetermined number of neighbouring radio ranges forming a group of radio ranges, each group employing the total number of frequency channels available in the network, the frequency distribution plan for each of the radio concentrators being contrived to be such that same-channel interference in the radio range in question, including any extendible boundary zone, is substantially avoided and at least for the signalling in digital form between the stationary radio concentrators and mobile subscriber stations there is provided an organisation channel designed for duplex operation.

A mobile radio network of this type is known for example from German specification AS26 59 635 and U.K. patent specification No. 1,562,964. In this known radio network each radio concentrator has at its disposal an organisation channel in which the items of data of the various organisation functions, such as coding, application, re-application, check for presence, seizure and call are transmitted in time staggered fashion. The digital form of this data provides a maximum degree of resistance to interference and allows a direct gauge of the connection quality and the signal to noise ratio to be obtained via measurement of the phase jitter. In order to maintain undisturbed operation,
in the known system the subscriber stations must monitor not only the organisation channel of the radio concentrator to which they have applied, but must also constantly monitor the organisation channels of adjacent radio ranges in order that if necessary they may apply to a different radio concentrator if, in the event that the traffic-load exceeds the relevant radio range capacity, the connection to the first-selected radio concentrator becomes unserviceable. This means a not inconsiderable outlay in respect of control and switching means in the mobile subscriber stations.

In a previous proposal for such a mobile radio network, the radio concentrators of a plurality of radio range groups are assigned at least one common organisation channel which, employing network-wide synchronisation is in the form of a multiple access channel with a periodic frame. Fig. 1 schematically illustrates a radio range group FBG comprising seven radio ranges 1, 2 to 7 which have slightly overlapping border zones and in the centre of each radio range is arranged a radio concentrator which determines the spatial location of the radio range in question. In Fig. 1, r designates the radio range radius in which overlap necessarily occurs. The range shown shaded and having the inner radio range radius r' is free of overlap. Within the inner ranges which are free of overlap the subscribers can only use channels which are allocated to this range.
in order to avoid disruption of the frequency planning.
If the radius \( r \) of the radio ranges amounts for example to 30 km, as a result of the need for mutual overlap inner ranges of about 20 to 25 km radius are formed which are free of overlap.

It is an aim of the invention to provide, in a mobile radio network of this kind, reliable transfer of a connection from a radio range where the relevant subscriber already has a connection quality which is fully adequate, but as a result of likely same-frequency interference is unable to use the radio channel in the neighbouring radio range.

According to one aspect of the present invention there is provided a mobile radio network having a number of stationary radio concentrators mutually spaced in accordance with a cellular system with overlapping radio regions, wherein a firmly determined number of mutually adjacent radio regions respectively forms a radio region group, in which the frequency channels available in all regions repeat themselves, wherein furthermore the frequency distribution plan for the radio concentrators is so determined that common channel interference in each respective radio region inclusive of an edge zone which overlaps adjacent radio regions, is largely eliminated, and wherein at least the signalling is effected in digital form between the stationary radio concentrators and mobile subscriber stations by means of organisation channels which are designed for duplex operation and in each of the radio concentrators provided with a central control
unit for the radio data control there is arranged a measuring receiver having a control unit incorporated in the synchronous system of the radio concentrators and by means of which monitoring of the radio channels of adjacent radio regions and change-over of mobile subscribers into another radio region if effected via field strength measurement and storing of the field strength values, characterised in that for a possibly required change-over the measurement of the field strength is determined in the measuring receiver by means of a plurality of measurements and is initiated therefrom by means of a central analysis, and a measurement of the distance of the respective mobile subscriber station effected by determining the time difference between a predetermined reference timing signal and a timing signal of received channel data from the subscriber station.

An embodiment of the invention will now be described, by way of example, with reference to the accompanying drawing in which:

Fig. 1 is a schematic diagram of the known
arrangement of a radio range group of a mobile radio network embodying this invention; and

Fig. 2 is a block circuit diagram of a radio concentrator embodying this invention and for use in a mobile radio network in which radio ranges overlap as shown in Fig. 1.

Fig. 2 illustrates a radio concentrator FUKO which possesses a radio data control unit FDS which co-operates with a radio channel control unit FKS. The radio channel control unit supplies the transmitter SR, in the timing of the consecutive frames of the organisation channel, with the data block which is to be transmitted in an assigned time slot. The receiver of the radio concentrator is referenced ER. The radio data control unit FDS is also connected to a central transfer device ÜLE.

A measuring receiver ME, in the radio concentrator FUKO, is provided with a control unit which is connected to the synchronisation system of the radio concentrators via the radio data control unit FDS. As a result this control unit has at its disposal all the timing data of the radio organisation, such as e.g. the beginning of the frame, the block number etc.

As a result of this synchronism the measuring receiver is on the one hand able to read not only the reception level prevailing in a channel but also the connection identification and is thus able to store...
provisionally the connection data. If, on the basis of an increasing number of measurements, the control unit establishes an increasing trend in the field strength which means that the mobile subscriber employing the channel in question is moving towards the measuring receiver or radio concentrator, the gradient of the increase is also determined. If the field strength exhibits an increasing tendency in one channel, the connection is identified. At the time of the identification the radio range number and the subscriber number which have been transmitted in the frame of the conversation monitoring data are read out. As soon as the field strength in one of the channels being monitored exceeds a predetermined limit value, the measuring receiver reports this fact together with the other data specific to the connection for the purpose of switch-over to a central analysis unit (not shown), and in the transfer device ÜLE the switch-over of the connection is initiated. If the connection quality drops below a predetermined limit value in a subscriber device, the switch-over of the connection is initiated via the radio concentrator FUKO and the transfer device ÜLE. The transfer device conveys the channel data in the adjacent radio ranges and the measuring receivers of the adjacent radio concentrators FUKO forward their channel data to the transfer device which makes a decision regarding switch-over and implements the switch-over.

On the other hand as a result of the synchron-
isation system the measuring receiver is able to measure the time difference between a predetermined reference timing signal and a timing signal of the received channel data and thus to measure the range (distance) of the subscriber in question. This range (distance) measurement provides a much more definite indication of the assignment between the subscribers and the individual radio ranges than would be the case solely on the basis of the field strength.

The measures provided by the invention which comprise identification of a connection which is to be switched over into another radio range during a conversation and an establishment trend of the mean change in field strength of an identified connection serve to avoid the switch-over of subscribers who are operating in adjacent radio ranges at points of the country which are particularly favourable in respect of radio geography and which therefore result in a high field strength in their surrounding areas. This serves to eliminate transfer errors which can cause temporary confusion as a result of multipath propagation (Rayleigh fading in mobile operation). The range (distance) measurement and the determination of the gradient of the change of the field strength enables the avoidance of disruption of the frequency planning.
CLAIRS
The claims defining the invention are as follows:

1. A mobile radio network having a number of stationary radio concentrators mutually spaced in accordance with a cellular system with overlapping radio regions, wherein a firmly determined number of mutually adjacent radio regions respectively forms a radio region group, in which the frequency channels available in all regions repeat themselves, wherein furthermore the frequency distribution plan for the radio concentrators is so determined that common channel interference in each respective radio region inclusive of an edge zone which overlaps adjacent radio regions, is largely eliminated, and wherein at least the signalling is effected in digital form between the stationary radio concentrators and mobile subscriber stations by means of organisation channels which are designed for duplex operation and in each of the radio concentrators provided with a central control unit for the radio data control there is arranged a measuring receiver having a control unit incorporated in the synchronous system of the radio concentrators and by means of which monitoring of the radio channels of adjacent radio regions and change-over of mobile subscribers into another radio region is effected via field strength measurement and storing of the field strength values, characterised in that for a possibly required change-over the measurement of the field strength is determined in the measuring receiver by means of a plurality of measurements and is initiated therefrom by means of a central analysis, and a measurement
of the distance of the respective mobile subscriber station effected by determining the time difference between a predetermined reference timing signal and a timing signal of received channel data from the subscriber station.

2. A mobile radio network substantially as described herein with reference to Fig.2 of the accompanying drawings.

DATED this THIRTEENTH day of FEBRUARY, 1985

SIEMENS AKTIENGESELLSCHAFT

Patent Attorneys for the Applicant
SPRUSON & FERGUSON
END