TITLE OF THE INVENTION

DATA TELEMETERING SYSTEM AND COMMUNICATION APPARATUS FOR USE IN THE SAME

BACKGROUND OF THE INVENTION

This invention relates to a data telemetering system for telemetering data generated in a plurality of distributed data generating sources in a center unit and a communication unit for use in the same system.

Generally, data telemetering system for telemetering data generated in a plurality of data generating sources distributed in physical region in a center unit includes a system for telemetering data by transmitting the data to a data telemetering unit through a public telephone line as shown in FIG. 1.

Referring to FIG. 1, plural external units 711-71N (N: natural number) disposed as data generating source have data communication units 721-72N for transmitting data. These data communication units 721-72N are connected to a public telephone network 81 which is an external communication network through a public telephone line. This public telephone network 81 connects a data communication unit 92 having a center unit 91 for storing data through the public telephone line.

That is, data generated in the plurality of the external units 711-71N is transmitted from each of the data communication units 721-72N through the public

telephone network 81 to the data communication unit 92 and stored in the center unit 91.

In the aforementioned data telemetering system, a construction for placing the public telephone line must be carried out to telemeter data generated in the external units 711-71N. Further, in data communication between the adjacent external units 711 and 712, communication through the public telephone network 81 is needed. As a result, a procedure for placing the public telephone line is required for executing data telemetering, so that corresponding cost is needed.

For the reason, there has been conventionally proposed a method in which instead of the data communication units 721-72N, 92, a mobile telephone or specific small power radio communication units 731-73N, 93 as shown in FIG. 1 are connected to the external units 711-71N, 94.

However, although a necessity of placing the public telephone line is eliminated if the mobile telephone is used for the data communication unit, communication between the respective data communication units must be carried out through the network 81.

In a case when the specific small power radio communication units 731-73N, 93 are used, direct data communication not through the telephone network is possible. However, if the center unit is connected through the telephone network, placing the public

telephone line from each place to the center unit is required because the specific small power radio communication unit is not capable of making access to the telephone network.

Further because communication between the specific small power radio communication units 731-73N and 93 is carried out by press-to-talk system (hereinafter referred to as half-duplex system) in which transmitting and receiving are changed over alternately, data transmission speed is as low as 4800 bps max. so that data transmission efficiency is very low.

As described above, the conventional data telemetering system has the following problems. That is, upon installation of the data communication units, a new public telephone line must be placed. Further, mutual communication between the data communication units must be carried out through a telephone network and further in a case when radio channel is used, the half-duplex system in which transmitting and receiving are changed over alternately must be used.

BRIEF SUMMARY OF THE INVENTION

Accordingly, an object of the present invention is to provide a data telemetering system capable of telemetering data effectively without placing a new public telephone line and not through a telephone network for carrying out data communication between the communication units and a transmitting and receiving

unit for use in the same system.

Another object of the present invention is to provide a data telemetering system capable of telemetering data effectively from each of the communication units to the center unit without placing a new public telephone line and not through a telephone network for carrying out data communication between the communication units and a transmitting and receiving unit for use in the same system.

Still another object of the present invention is to provide a data telemetering system capable of notifying the data telemetering unit that a trouble occurs in an external unit and a transmitting and receiving unit for use in the same system.

A further object of the present invention is to provide a data telemetering system capable of telemetering data securely from each of the communication units to the data telemetering unit by changing a data transmission route without increasing a number of the communication units when a trouble occurs in the communication unit, a transmitting and receiving unit for use in the same system and a method thereof.

According to an aspect of the present invention, there is provided a data telemetering system comprising: a plurality of data generating sources for generating a predetermined data; and a data accumulating unit for accumulating the predetermined data

generated by this data generating source, for telemetering the predetermined data generated by the data generating source in the data accumulating unit, the data telemetering system further comprising a radio communication unit installed corresponding to the data generating source and the data accumulating unit and having a communication mode for communicating between terminals using a radio channel not through a public telephone network, the radio communication unit having: a radio connecting means for connecting between a radio communication unit and the other radio communication unit by the communication mode; and a data transmission means for connecting between a radio communication unit provided corresponding to the data generating source and a radio communication unit provided corresponding to the data accumulating unit by the connecting means and for transmitting the predetermined data generated in each of the data generating sources to the data accumulating unit.

According to this structure, a known first radio communication unit having the communication mode enabling direct communication between terminals using a radio channel not through a public telephone network is provided at each data generation source and a known second radio communication unit having the communication mode is provided at the data telemetering unit so that they are constructed with a simple

configuration. A radio channel in the communication mode is formed between the first and second radio communication units so that data generated in each data generation source is transferred to the data telemetering unit in bare data communication method through this radio channel.

As a result, disadvantages of construction of a new telephone line and using a public telephone network upon data communication can be eliminated. Further, by carrying out bare data communication at 32 Kbps by full-duplex allowing transmitting and receiving simultaneously in the communication mode enabling direct communication between terminals using a radio channel not through a public telephone network, a rapid effective data communication can be achieved. Further, the bare data communication keeps rapid excellent data transmission quality in voice deemed transmission thereby achieving error free communication.

According to another aspect of the present invention, there is provided a radio communication unit for use in a data telemetering system comprising: a plurality of data generating sources for generating a predetermined data; and a data accumulating unit for accumulating the predetermined data generated by this data generating source, for telemetering the predetermined data generated by the data generating source in the data accumulating unit, the data communication unit

comprising: a radio connecting means for connecting between a radio communication unit and the other radio communication unit by communication mode for communicating between terminals not through a public telephone network; and a data transmission means for connecting between radio communication units provided corresponding to each data generating source by the radio connecting means and for transmitting a predetermined data generated in each of the data generating sources.

According to this structure, a radio channel is established with the first radio communication units in the communication mode enabling direct communication between terminals using a radio channel not through a public telephone network and data generated in each data generation source is accumulated in the data telemetering unit. As a result, effective data communication can be achieved there making it possible to reduce cost.

According to still another aspect of the present invention, there is provided a radio communication unit for use in a data telemetering system comprising: a plurality of data generating sources for generating a predetermined data; and a data accumulating unit for accumulating the predetermined data generated by the data generating source, for telemetering the predetermined data generated by the data generating

source in the data accumulating unit, the data communication unit comprising: a radio connecting means for connecting between a radio communication unit and the other radio communication unit by communication mode for communicating between terminals not through a public telephone network; a data transmission means for connecting between a radio communication unit provided corresponding to a data generating source and a radio communication unit provided corresponding to the data accumulating unit by the radio connecting means and for transmitting a predetermined data generated in each of the data generating sources to the data accumulating unit.

According to a further aspect of the present invention, there is provided a data telemetering system comprising: a plurality of data generating sources for generating a predetermined data; and a data accumulating unit for accumulating the predetermined data generated by this data generating source, for telemetering the predetermined data generated by the data generating source in the data accumulating unit, the data telemetering system further comprising: a first radio communication unit having a first communication mode for communicating not through a public telephone network and provided corresponding to each of the data generating sources; a second radio communication unit having the first communication mode

and a public communication mode for communicating through public telephone network, disposed in a radio zone formed by a base station connected to the public telephone network and installed corresponding to the data accumulating unit; and a center unit connected to the public telephone network through the base station, the second radio communication unit having: a radio connecting means for connecting between the first radio communication unit and the second radio communication unit using the first communication mode and for connecting between the second radio communication unit and the center unit through the base station and the public telephone network using the public communication mode; and a data transmission means for transmitting predetermined data generated in a plurality of data generating sources from the first radio communication unit to the second radio communication unit by this radio connecting means and accumulating the data in the data accumulating unit and then transmitting the data to the center unit through the base station and the public telephone network using the public communication mode.

According to this structure, using the plurality of the first radio communication unit having the first communication mode enabling direct communication between terminals using a radio channel not through a public telephone network and the second radio

communication unit having the first communication mode and public mode, the first radio communication units and the second radio communication unit are connected to each other through the first radio channel using the first communication mode, so that data generated in the data generation sources connected to the first radio communication units is telemetered in the second radio communication unit. After that, the first communication mode is changed to the public mode so that the second radio communication unit is connected to the base station through the second radio channel using the public mode and the telemetry data is transmitted to the center unit connected to the public network.

As a result, the second radio communication unit is capable of telemetering data generated from the data generation source rapidly and effectively with few errors without placing a new public line to the first radio communication unit. Further, by transferring this telemetry data to the center unit, the center unit is capable of managing data generated in the plurality of the data generation sources synthetically.

According to a still further aspect of the present invention, there is provided a radio communication unit for use as a second radio communication unit in a data telemetering system comprising: a plurality of data generating sources for generating a predetermined data; a data accumulating unit for accumulating the

predetermined data generated by the data generating sources; a first radio communication unit provided corresponding to each of the plurality of the data generating sources, having a first communication mode for communicating not through a public telephone network; a second radio communication unit disposed in a radio zone formed by the base station connected to the public telephone network and provided corresponding to the data accumulating unit, having the first communication mode and a public communication mode for communicating through public telephone network; and a center unit connected to the base station through public telephone network, the radio communication unit having: a first radio connecting means for connecting between the first radio communication unit and the second radio communication unit using the first communication mode; a second radio connecting means for connecting between the base station and the second communication unit using the public communication mode; an accumulation control means for connecting between the first radio communication unit and the second radio communication unit in the first communication mode by the first radio connecting means and accumulating predetermined data generated by a plurality of the data generating sources in the data accumulating unit; and a data transmission means for transmitting data accumulated in the data accumulating unit to the center

unit in the second communication mode by the second radio connecting means.

According to this structure, data generated from the plurality of the data generation sources is telemetered and the telemetry data is transmitted to the center unit connected to the external communication network using the public mode. Thus, the center unit is capable of telemetering data effectively through a single access.

According to still further aspect of the present invention, there is provided a data telemetering system comprising: a plurality of radio communication units installed corresponding to the plurality of the distributed data generating units, wherein data telemetering is carried out in a predetermined order between the radio communication units using the communication mode enabling direct communication between terminals using a radio channel not through a public telephone network, and in a region in which at least one of the plurality of the radio communication units is capable of communicating with in the communication mode, at least a first radio communication unit to which the radio communication unit transmits data next and a second radio communication unit to which the first radio communication unit transmits next are allocated.

According to this structure, the plurality of the

radio communication units having the communication mode enabling direct communication between terminals using a radio channel not through a public telephone network are provided on the plurality of the data generating units. In a region in which at least one radio communication unit is capable of communicating in the communication mode, at least the first radio communication unit to which that radio communication unit transmits data next and the second radio communication unit to which this first radio communication unit transmits data next are disposed so that the respective radio communication units are connected to each other through a radio channel using the communication mode. Then, data generated in each corresponding data generating unit is telemetered.

As a result, upon data communication, data can be transmitted without placing a new telephone line. If a trouble occurs in the first radio communication unit during data transmission, data can be transmitted to the second radio communication unit belonging to a predetermined transmitting order in a region allowing communication in the communication mode enabling direct communication between terminals using a radio channel not through a public telephone network without adding the other first radio communication unit than the first radio communication unit belonging to the predetermined transmitting order. As a result, data generated in

each data generation source can be telemetered securely and economically.

According to still further aspect of the present invention, there is provided a communication method for a data telemetering system for telemetry data in a predetermined order using the communication mode enabling direct communication between terminals using a radio channel not through a public telephone network among the radio communication units installed corresponding to a plurality of distributed data generating units, comprising the steps of: in a region which at least one of the plurality of the radio communication units is capable of communicating with in the communication mode, allocating at least a first radio communication unit to which the radio communication unit transmits data next and a second radio communication unit to which the first radio communication unit transmits data next; and executing communication between the allocated radio communication units.

According to still further aspect of the present invention, there is provided a transmitting and receiving unit comprising: a data generating unit for generating a predetermined data; and a radio communication unit installed corresponding to the data generating unit and capable of communicating in the communication mode enabling direct communication

between terminals using a radio channel not through a public telephone network, wherein the data generating unit comprises memory means for storing at least a first transmission route to a first radio communication unit to which the radio communication unit transmits data next and a second transmission route to a second radio communication unit to which the first radio communication unit transmits data next, wherein

the radio communication unit comprises a connecting means for connecting to other radio communication unit to be disposed in a region in which communication is enabled in the communication mode by referring a communication route stored in a memory means of the data generating unit.

According to this structure, the first communication route to the first radio communication unit to which the radio communication unit will transmit data next and the second communication route to the second communication unit to which the first radio communication unit will transmit data next are stored in the memory means of the data generating unit. As a result, the radio communication unit connects itself to the other radio communication unit through a radio channel using the communication mode enabling direct communication between terminals using a radio channel not through a public telephone network by referring to the transmission route stored in the

memory means and transmits data generated in the data generating unit to the other radio communication unit.

As a result, if the second radio communication unit belonging to a transmitting order stored in the memory means exists in a region which allows communication in the communication mode enabling direct communication between terminals using a radio channel not through a public telephone network when a trouble occurs in the first radio communication unit to which data is to be transmitted, the transmission route can be changed to the second radio communication unit so that data can be sent to the data telemetering unit securely.

Additional objects and advantages of the invention will be set forth in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention. The objects and advantages of the invention may be realized and obtained by means of the instrumentalities and combinations particularly pointed out hereinbefore.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate presently preferred embodiments of the invention, and together with the general description given above and the detailed description of the preferred embodiments given below, serve to explain the

principles of the invention.

FIG. 1 is a block diagram showing a conventional data telemetering system;

FIG. 2 is a block diagram showing another conventional data telemetering system;

FIG. 3 is a system block diagram of a data telemetering system and a transmitting and receiving unit for use in the same system according to a first embodiment of the present invention;

FIG. 4 is a block diagram showing a detail of a PHS (personal handy phone system) data communication unit of slave side according to the same embodiment;

FIG. 5 is a block diagram showing a detail of the PHS data communication unit of master side according to the same embodiment;

FIG. 6 is a flow chart for explaining actions of the master side and a slave side first in connecting order according to the same embodiment;

FIG. 7 is a flow chart for explaining actions of the master side and a slave side last in connecting order according to the same embodiment;

FIG. 8 is a flow chart for explaining actions of the master side and a center unit according to the same embodiment;

FIG. 9 is a time chart for explaining an action in the polling method according to the same embodiment;

FIG. 10 is a flow chart for explaining an action

of a data telemetering unit in the polling method according to the same embodiment;

FIG. 11 is a flow chart for explaining an action of an external unit in the polling method according to the same embodiment;

FIG. 12 is a system block diagram for explaining an example of arrangement of external units and data telemetering unit for data communication in the relay method according to a second embodiment of the present invention;

FIG. 13 is a time chart for explaining an action in the relay method according to the same embodiment;

FIG. 14 is a flow chart for explaining an action of an external unit in the relay method according to the same embodiment;

FIG. 15 is a flow chart for explaining an action of a data telemetering unit in the relay method according to the same embodiment;

FIG. 16 is a diagram showing a first arrangement example of the external unit and data telemetering unit using the polling method and relay method mixedly according to a third embodiment of the present invention;

FIG. 17 is a diagram showing a second arrangement example of the external unit and data telemetering unit using the polling method and relay method mixedly according to the same embodiment;

FIG. 18 is a system block diagram showing a data telemetering system and a transmitting and receiving unit for use in the same system according to a fourth embodiment of the present invention;

FIG. 19 is a block diagram showing a detail of a cordless main communication unit according to the same embodiment;

FIG. 20 is a block diagram showing a detail of a cordless sub communication unit according to the same embodiment;

FIG. 21 is a flow chart for explaining actions of a plurality of cordless sub communication units, a cordless main communication unit and center unit according to the same embodiment upon startup;

FIG. 22 is a flow chart for explaining actions of a plurality of cordless sub communication units and a cordless main communication unit according to the same embodiment in an intermediate process;

FIG. 23 is a flow chart for explaining actions of the cordless main communication unit and center unit according to the same embodiment;

FIG. 24 is a block diagram showing a case in which an exchange is used according to a fifth embodiment of the present invention;

FIG. 25 is a flow chart for explaining an action of the external unit upon polling communication according to a sixth embodiment of the present

invention;

FIG. 26 is a flow chart for explaining an action of the external unit located in the most upstream upon relay communication according to the same embodiment;

FIG. 27 is a flow chart for explaining an action of the external unit upon relay communication according to the same embodiment;

FIG. 28 is a system block diagram showing a data telemetering system according to a seventh embodiment of the present invention;

FIG. 29 is a block diagram showing a detail of the external unit according to the same embodiment;

FIG. 30 is a diagram showing an example of arrangement of the PHS data communication units according to the same embodiment;

FIGS. 31A and 31B are diagrams for explaining an example of modification of transmission route when a trouble occurs in the PHS data communication unit according to the same embodiment;

FIG. 32 is a flow chart for explaining an action of the PHS data communication unit when a trouble occurs in the PHS data communication unit according to the same embodiment; and

FIG. 33 is a system block diagram showing a data telemetering system according to a eighth embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Hereinafter, the embodiments of the present invention will be described in detail with reference to the accompanying drawings.

FIG. 3 is a system block diagram showing an embodiment of the present invention.

Referring to FIG. 3, reference numerals 111-11N (N: natural number) denote external units, for example, automatic vending machines which are distributed in physical region.

These external units 111-11N are provided with PHS data communication units 121-12N (hereinafter referred to as slave PHS data communication units 121-12N) which have communication mode (hereinafter referred to as sub-unit direct communication mode) enabling direct communication between terminals using a radio channel not through a public telephone network and have a function for carrying out data transmission to other PHS data communication unit by this sub-unit direct communication mode. The standard of the PHS data communication unit is defined in Personal handy phone system RCR-STSNDARD-28 published by Research & Development Center for Radio Systems in Japan. These external units 111-11N have PHS data communication units 121-12N which function as a slave having a sub-unit direct communication mode. The external units 111-11N are connected to the PHS data communication

units 121-12N through a RS232C cable. The external units 111-11N set communication functioning portions in the PHS data communication units 121-12N to sub-unit direct communication mode regulated under the RCRSTD28 through the external connection functioning portion in the PHS data communication units 121-12N by a serial command. The external units 111-11N executes data communication using LAP-P operating mode or Piafs (PHS internet access forum standard) operating mode through the PHS data communication units 121-12N. The Piafs mentioned herein refers to error correction retransmitting procedure specified by end-to-end of the transmitting/receiving radio terminal in data communication between a transmitting radio terminal and a receiving radio terminal, which are both connected by radio line through a base station. Data communication speed of the Piafs operation mode is about 32 Kbps. The LAP-P is an error correction retransmitting procedure specified between a radio terminal and a base station in data communication between a transmitting radio terminal and a receiving radio terminal, which are both connected by radio line through a base station. Data communication speed at LAP-P operation mode is 14.4 Kbps.

Reference numeral 21 denotes a base station, which forms radio zone for the physical region. In this radio zone, a PHS data communication unit (hereinafter

referred to as master PHS data communication unit 31) is disposed, which has sub-unit direct communication mode and public mode and has a telemetering function to collect data transmitted from the other PHS data communication units in sub-unit communication mode and to transmit telemetry data through the public telephone network. An external unit 32 such as an automatic vending machine and personal computer is connected to this PHS data communication unit 31. The public mode mentioned herein refers to mode for carrying out radio communication through a public network managed by communication enterprise.

The base station 21 is connected to a public network 43 which is an external communication network through a cable line and a center unit 51 is connected to this public network 43. The center unit 51 comprises a modem 511 and a data storage unit 512.

The slave PHS data communication units 121-12N are connected to each other or the master PHS data communication unit 31 through a radio channel using the sub-unit direct communication mode. The PHS data communication unit 31 is connected to the base station 21 through a radio channel using the public mode.

The PHS data communication unit 31 gains access to the plural PHS data communication units 121-12N successively by polling method and connects it through a radio channel according to the sub-unit direct

communication mode so as to execute data communication. The PHS data communication unit 31 temporarily stores data generated in each of the external units 111-11N in a memory.

The PHS data communication unit 31 collects telemetry data generated in each of the external units 111-11N and then changes over to the public mode so as to connect to the base station 21. This telemetry data is transmitted to the center unit 51 together with its own data accumulated in the external unit 32 connected to the PHS data communication unit 31, so that the transmitted data is stored in the data storage unit 512.

FIG. 4 shows the aforementioned slave PHS data communication units 121-12N in detail.

Referring to FIG. 4, each of the PHS data communication units 121-12N comprises a radio portion 12a having an antenna 12a1, a modem portion 12b, a TDMA (time division multiple access) portion 12c, an error correction portion 12d, an external connection interface 12e and a control portion 12f.

An arriving radio frequency signal, which is received by the antenna 12a1, is inputted to a receiving portion 12a3 through a high frequency switch 12a2 of the radio portion 12a. In this receiving portion 12a3, the aforementioned received radio frequency signal is mixed with a receiving local oscillation signal generated from a frequency

synthesizer 12a4 so that the signal is converted to a reception intermediate frequency signal. The local oscillation frequency generated from the aforementioned frequency synthesizer 12a4 is instructed by the control portion 12f depending on the radio channel frequency. Further, the radio portion 12a includes a received signal strength indicator (RSSI) portion 12a5. This RSSI portion 12a5 detects a received signal strength of the radio frequency signal arriving at the antenna 12a1 and notifies the control portion 12f of the detected value.

The reception intermediate frequency signal outputted from the aforementioned receiving portion 12a3 is inputted to a demodulation portion 12b1 of the modem portion 12b. In the demodulation portion 12b1, digital demodulation of the aforementioned reception intermediate frequency signal is carried out and then non-restricted digital data (hereinafter referred to as bare data) is reproduced according to Version 2 prepared by expanding the RCRSTD28 standardized for voice communication, for data communication.

A TDMA decoding portion 12c1 of a TDMA portion 12c extracts bare data from a time slot allocated thereto according to an instruction of the control portion 12f and inputs this extracted bare data into an error correction portion 12d. The error correction portion 12d acts corresponding to the LAP-P operation mode and

Piafs operation mode upon bare data communication. In the LAP-P operation mode, the error detection, correction of an error up to 2 bits and automatic retransmitting request (hereinafter referred to as ARQ) of requesting retransmitting of a frame in which the error is detected are carried out. Under the Piafs operation mode, the error correction and ARQ are carried out.

Data corrected in the error correction portion 12d is accumulated in the external unit 11 (111-11N) through an external connection interface 12e. Data generated in the external unit 11 is supplied to a TDMA encoding portion 12c2 of the TDMA portion 12c through the external connection interface 12e and error correction portion 12d.

The TDMA encoding portion 12c2 inserts digital data to be transmitted into a time slot instructed by the control portion 12f and supplies it to a modulation portion 12b2. In the modulation portion 12b2, carrier signal is digitally modulated according to the aforementioned digital data and this modulated carrier signal is inputted to a transmitting portion 12a6. In the transmitting portion 12a6, the aforementioned modulated carrier signal is mixed with a transmitting local oscillation signal generated from the frequency synthesizer 12a4 so that it is frequency converted to a radio channel frequency instructed by the control

portion 12f and further amplified to a predetermined transmitting power level. Then, a radio frequency signal outputted from this transmitting portion 12a6 is transmitted from the antenna 12a1 through the high frequency switch 12a2.

The control portion 12f contains, for example, a microcomputer as its main control section, so as to synthetically control respective circuits. The control portion 12f contains a sub-unit direct communication control means 12f1 and a data transmitting/receiving control means 12f2. The sub-unit direct communication control means 12f1 is a means for controlling a selective connection of the PHS data communication units 121-12N with each other or with the PHS data communication unit 31 through a radio channel using the sub-unit direct communication mode. The data transmitting/receiving control means 12f2 is a means for controlling data transmitting/receiving between the external units.

The control portion 12f contains a monitoring means 12f5 for monitoring a state of the external units 111-11N corresponding to itself during a waiting period for data transmission. The control portion 12f contains an alarm information transmitting means 12f6 for, if this monitoring means detects an error in the external units 111-11N, transmitting an alarm information to the PHS data communication unit 31

through a radio channel which is set between the PHS data communication units 121-12N and the master PHS data communication unit 31 based on the sub-unit direct communication mode directly or through other slave. Further, the control portion 12f also contains a variable setting means 12f7 for varying data telemetering execution timing depending on a time zone of a day.

Further, the control portion 12f contains a timer 12f8 for counting a waiting time taken until a response is received since a signal is sent to a correspondent, so that if no response is received even if a predetermined time zone elapses, it is determined that the mating PHS data communication unit is in trouble.

FIG. 5 shows a detail of the master side PHS data communication unit 31.

In FIG. 5, the same reference numerals are attached to components having the same functions. Different from FIG. 4, a memory 31a is connected to the control portion 12f. The control portion 12f of the PHS data communication unit 31 contains a data accumulation control means 12f3 and a public mode communication control means 12f4. The PHS data communication unit 31 is connected to an external unit 32 through an external connection interface 12e.

As for the operation, if data generated in a plurality of the external units 111-11N arrives, a data

accumulation control means 12f3 of the control portion 12f stores data in the memory 31a. Further, the data accumulation control means 12f3 also stores data generated in the external unit 32 in the memory 31a.

If data telemetering is completed, the public mode communication control means 12f4 changes its own unit to public mode and connect itself to the base station 21. If the PHS data communication unit 31 is connected to the base station 21, the data accumulation control means 12f3 reads telemetry data and self data generated in the external unit 32 from the memory 31a and transmits them to the center unit 51 through the base station 21 and public network 43.

FIGS. 6-8 are flow charts showing operations of the PHS data communication units 121-12N, PHS data communication unit 31 and center unit 51.

FIG. 6 shows operations of the slave PHS data communication units 121-12N and master PHS data communication unit 31.

Each of the PHS data communication units 121-12N and the PHS data communication unit 31 set sub-unit direct communication mode by the sub-unit direct communication control means 12f1 of each control portion 12f in steps S11, S21, S31 and carry out waiting operation for direct communication between the sub-units. In step S32, the PHS data communication unit 31 dispatches a signal to the PHS data

communication unit 121 by the sub-unit direct communication control means 12f1 of the control portion 12f. When the PHS data communication unit 121 receives a call in step S12, it transmits back a response to the PHS data communication unit 31 and then communication is being done.

Next, in step S13, the PHS data communication unit 121 reads information (data) possessed by the external unit 111 through the external connection interface 12e and transmits it to the PHS data communication unit 31 by the data transmitting/receiving control means 12f2. By using the error correction portion 12d for this transmitting, data communication having an excellent transmission quality can be provided.

If the PHS data communication unit 31 receives data sent from the PHS data communication unit 121 by the data transmitting/receiving control means 12f2 at step S33, the received data is stored in the memory 31a by the data accumulation control means 12f3 at step S34. If data storage is completed, communication path is cut off at steps S14, S35 so that the data communication is terminated.

After that, the master side PHS data communication unit 31 repeats the procedures of steps S36-S39 as shown in FIG. 7 until it receives data sent from all the slave side PHS data communication units 121-12N. Because the procedures of steps S36-S39 are the same as

those of the steps S32-S35, a description thereof is omitted. Further, because the procedures of steps S22-S24 of the PHS data communication unit 12N corresponding to the last access are the same as those of the steps S12-S14, a description thereof is omitted.

The PHS data communication unit 31 receives and stores data generated in all the slaves 1-n (corresponding to PHS data communication units 121-12N) in the memory 31a and stores data generated in the external unit 32 connected to its own unit in the memory 31a, and then in step S40, sets its own unit to the public mode by the public mode communication control means 12f4.

FIG. 8 shows operations of the master side PHS data communication unit 31 and the center unit 51.

The PHS data communication unit 31 set in public mode transmits a call to the center unit 51 through the base station 21 by the public mode communication control means 12f4 at step S41. If the center unit 51 receives the call and responds at step 51, communication is established.

At step S42, the PHS data communication unit 31 reads slave data collected and its own data collected from the external unit 32 from the memory 31a and transmits them to the center unit 51 by the data transmitting/receiving control means 12f2. Because the PHS data communication unit 31 uses the error

correction portion 12d for transmitting data at this time also, data communication having an excellent transmission quality can be provided. After that, at step S52, the center unit 51 receives data generated in the PHS data communication unit 31 and accumulates it in the data storage unit 512, and then the data communication is terminated.

If at the aforementioned step S42, the PHS data communication unit 31 completes data communication, it cuts off at step S43 so as to terminate data communication with the center unit 51.

FIG. 9 shows a time chart of communication in polling method.

In FIG. 9, TP indicates a time for the PHS data communication unit 31 to communicate with the PHS data communication units 121-12N in polling method. TW indicates a waiting time taken until the PHS data communication unit 31 executes next transmission by polling method after it gains access to the PHS data communication units 121-12N. T2-TN indicate a time taken for the PHS data communication unit 31 to get access to the PHS data communication units 121-12N so as to collect data.

FIG. 10 is a flow chart for explaining an operation of the master side PHS data communication unit 31 by the polling method. This operation is controlled by the control portion 12f in the PHS data

communication unit 31.

After startup, the PHS data communication unit 31 sets an initial value (i = 1) for its own unit at step S61 and allocates an order for access to the slave side. First, an access to the PHS data communication unit 121 is made. The PHS data communication unit 31 makes an access to the PHS data communication unit 121 at step S63 so as to transmit a request for data telemetering. At step S64, data sent from the PHS data communication unit 121 is received and at step 65, the received data is transferred to the memory 31a and stored therein. After that, the PHS data communication unit 31 repeats the procedures of steps S62-S65 for the PHS data communication units 121-12N.

In a case when the PHS data communication unit 31 collects data up to the PHS data communication unit 12N at step S66 (YES), idle period (TW) mode (waiting mode) is started at step S67. If the idle period is terminated at step S68 (YES), this processing is returned to the aforementioned step S61.

FIG. 11 is a flow chart for explaining an operation of the PHS data communication units 121-12N of the slave side in the polling method. This operation is controlled by the control portion 12f of the PHS data communication units 121-12N. This procedure will be described about the PHS data communication unit 121 here.

At step S69, the PHS data communication unit 121 goes into wait mode. In a case when the PHS data communication unit 121 receives a call from the PHS data communication unit 31 of the master side (YES), the PHS data communication unit 121 transmits data generated in the external unit 111 to the PHS data communication unit 31 at step S71. Then, if data communication with the PHS data communication unit 31 is terminated (YES) at step S72, the PHS data communication unit 121 goes into the wait mode at step S69.

When the PHS data communication unit 121 executes data communication with the PHS data communication unit 31, if there is information to be stored in the external unit 111, that information is stored in the external unit although this is omitted on the aforementioned flow chart.

Next, a system for data telemetering in relay method will be described.

FIG. 12 shows a second example of arrangement of a plurality of the PHS data communication unit 31, 121-12N and the external units 111-11N.

Referring to FIG. 12, the PHS data communication unit 121 is connected to the PHS data communication unit 122 capable of communicating on sub-unit direct communication mode. After that, relay connection is carried out successively between the respective units

in the order of 2-N in sub-unit direct communication mode. The PHS data communication unit 12N which is last unit of the aforementioned relay connection is connected to the PHS data communication unit 31 of the master side through radio channel of sub-unit direct communication mode.

Data generated in the external unit 111 is brought by the PHS data communication units 121-12N successively and transmitted to the PHS data communication unit 31 by the relay method so that it is accumulated in the memory 31a of the external unit 32. This accumulated data is provided with data generated in the respective external units 111-11N in the relay process. Because the operation of the accumulation in the memory 31a of the external unit 32 is the same as the system based on the polling method shown in FIG. 3, a description thereof is omitted.

FIG. 13 shows a time chart for communication in the relay method.

In FIG. 13, T indicates a data transmitting period of the external units 111-11N and R indicates a data receiving period of the external units 112-11N. After transmitting data to the external unit 112, the external unit 111 goes into waiting period TW. After the waiting period terminates, data is sent to the external unit 112 again. Then, data generated in the external unit 111 passes through the external units

112-11N successively and finally reaches the memory 31a of the external unit 32. This external unit 32 collects accumulative data sent through the external units 111-11N and then goes into waiting mode.

FIG. 14 is a flow chart for explaining an operation of the PHS data communication units 121-12N of the slave side based on the relay method. This operation is controlled by the control portion 12f of the PHS data communication units 121-12N.

After startup, at step S81, the PHS data communication units 121-12N determines whether it is a first external unit of the slave side according to information stored in a memory of the external unit, for example. Here because the PHS data communication unit 121 has a first external unit 111 (YES), it calls the next PHS data communication unit 122 at step S82. At step S83, it executes data communication with the PHS data communication unit 122 and at step S84, transmits its own data to the PHS data communication unit 122.

Then, if the data communication is terminated at step S85, the PHS data communication unit 121 goes into the idle period mode (waiting mode) at step S86 and if the idle period is terminated at step S87 (YES), the processing is returned to the aforementioned step S82.

On the other hand, if the unit at step S81 is, for example, PHS data communication unit 123 (NO), if it is

set to the wait mode at step S88 and there is a call from a preceding number (YES) at step S89, data communication is executed with the PHS data communication unit 122 having the external unit 112 of the preceding number at step 90. Then, at step S91, data generated in the external units 111, 112 is accumulated in the memory of its own external unit 113. If data communication with the preceding number unit is terminated at step S92 (YES), whether or not there is an external unit of a next number is determined according to information stored in the memory of the external unit.

If a PHS data communication unit 124 exists (YES), the PHS data communication unit 123 calls the PHS data communication unit 124 having the next number external unit 114 at step S94 and executes data communication at step S95. At this time, the PHS data communication unit 123 transmits data of the first-preceding numbers and its own data to the PHS data communication unit 124. If data communication is terminated at step S97 (YES), the PHS data communication unit 123 goes into the waiting mode mentioned at step S88. After that, the processing from the step S88 is repeated for the PHS data communication unit of the next number.

If there exists only a final external unit 11N at the above step S93 (NO), the PHS data communication unit 12N calls the PHS data communication unit 31 of

the master side at step 98 and executes data communication at step S99. At step S100, it transmits data of N-2 external units and its own data to the PHS data communication unit 31. If data communication is terminated at step S101 (YES), the PHS data communication unit 12N goes into the waiting mode mentioned at the step S88.

FIG. 15 is a flow chart for explaining an operation of the PHS data communication unit 31 of the master side based on the relay method. This operation is controlled by the control portion 12f of the PHS data communication unit 31.

The PHS data communication unit 31 has been in the waiting mode at step S102 and if it receives a call from the PHS data communication unit 12N having a final external unit 11N in terms of relay connection order (YES), it executes data communication with this PHS data communication unit 12N at step S104. At step S105, data of the external units 111-11N is accumulated in the memory 31a. Then, if data communication with the PHS data communication unit 12N is terminated at step S106 (YES), the PHS data communication unit 31 goes into the waiting mode mentioned at step S102 again.

Next, system for telemetering data using both the polling method and relay method will be described.

FIGS. 16 and 17 show examples of arrangement of the master and slaves.

Referring to FIG. 16, the PHS data communication unit 31 of the external unit 32 makes access to the PHS data communication units 121-123 of the external units 111-113 of the slave side successively by the polling method so that they are connected with each other through a radio channel using the sub-unit direct communication mode. The PHS data communication units 124, 125 of the external units 114, 115 are connected to each other in the relay method and finally connected to the PHS data communication unit 123 of the external unit 113.

That is, in the case of this system, data of the external units 114, 115 is collected in the external unit 113 in the order of the external units 114, 115 and 113. Because the external unit 32 collects data generated in the external units 111-113 by the polling method, all data of the external units 111-115 can be collected.

In an arrangement shown in FIG. 17, data of the external units 114, 115 are collected in the external unit 112 by the polling method. The external unit 32 is capable of collecting all data of the external units 111-115 because it collects data in the relay method in the order of the external units 113, 112, 111.

Therefore, according to the aforementioned embodiment, the known PHS data communication units 121-12N having the sub-unit direct communication mode

are provided on the external units 111-11N and the known PHS data communication unit 31 having the sub-unit direct communication mode is provided on the external unit 32, so that the object of the invention is achieved with this simple structure. These PHS data communication units 31, 121-12N are connected to each other by radio channel based on the sub-unit direct communication mode and data generated in the external units 111-11N is transmitted to the external unit 32 through this radio channel with bare data communication.

As a result, such disadvantages of placing the telephone line and transmitting data through the public network for the data communication can be eliminated and bare data communication of 32 Kbps max. is achieved by full duplex system allowing transmitting and receiving at the same time on sub-unit direct communication mode, so that a quick highly efficient data communication can be attained. Further the bare data communication is capable of keeping a quick excellent data transmission quality in voice deemed communication thereby realizing error free communication.

The master side PHS data communication unit 31 collects data in the polling method from the external units 111-11N with which it is capable of communicating on the sub-unit direct communication mode and collects data mode in the relay method from the external units 111-11N out of such a range in which it is capable of

communicating on the sub-unit direct communication. As a result, highly efficient data communication and data collection corresponding to the arrangement of the external units 111-11N can be achieved.

Therefore, according to the above-described embodiment, using a plurality of the PHS data communication units 121-12N having the sub-unit direct communication mode and the PHS data communication unit 31 having the sub-unit direct communication mode and public mode, the PHS data communication units 121-12N are connected to the PHS data communication unit 31 through a radio channel using the sub-unit direct communication mode. As a result, the PHS data communication unit 31 is capable of communicating with the PHS data communication units 121-12N without placing a public telephone line and not through the public network 43 quickly with few errors and further collecting data generated in the external units 111-11N efficiently.

The PHS data communication unit 31 changes the sub-unit direct communication mode to the public mode when carrying out data communication with the center unit 51, so that it is connected to the base station 21 through a radio channel using the public mode. Data collected from the external units 111-11N is transmitted to the center unit 51 connected to the public network 43. As a result, the center unit 51 is capable

of managing data generated in the external units 111-11N synthetically.

Further, the PHS data communication unit 31 contains the memory 31a for telemetry data generated in the external units 111-11N and the public mode communication control means 12f4 and transmits collected data to the center unit 51 connected to the public network 43 using the public mode. As a result, the center unit 51 is capable of telemetering data through only one access highly efficiently.

As described above, according to the present invention, data communication between the respective communication units can be carried out by the sub-unit direct communication mode. Further data communication from each communication unit to the center unit can be carried out by changing the communication unit from the sub-unit direct communication mode to the public mode so as to execute data communication on the public mode.

Therefore, the present invention is capable of providing a data telemetering system capable of telemetering data generated in each communication unit to the center unit effectively and quickly without an error, without placing a new public telephone line and using the public network in data communication between the respective communication units, and a communication unit for use in this system.

Although in the above embodiment, the PHS data

communication unit 31 accumulates data generated in the external units 111-11N in the memory 31a, it is permissible to use the external unit 32 as a data telemetering unit by accumulating data in the memory of the external unit 32.

Next, a system for telemetry data using private mode of the PHS data communication unit will be described. The private mode mentioned herein refers to a mode for executing radio communication with a private branch exchange.

In FIG. 18, reference numerals 411-41N (N: natural number) herein denote external units of, for example, automatic vending machines distributed in physical region, which are provided with cordless sub communication units 421-42N for use in PHS. These cordless sub communication units 421-42N are connected to a cordless main communication unit 61 through a radio channel using the private mode. A data telemetering unit 62 for collecting data generated in the external units 411-41N is connected to the cordless main communication unit 61.

The cordless main communication unit 61 is connected to the network 43 which is an external communication network through a cable network. The center unit 51 for managing data through the cable network is connected to the network 43. The network 43 may be public switched telephone network (PSTN) or

integrated service digital network (ISDN) or the like.

As for the operation, the cordless sub communication units 421-42N transmit data generated in a corresponding external unit 411-41N to the cordless main communication unit 61 through a radio channel using the private mode. The cordless main communication unit 61 accumulates data arriving from the cordless sub communication units 421-42N in the data telemetering unit 62. After that, the cordless main communication unit 61 transmits data accumulated in the data telemetering unit 62 to the center unit 51 through the public network 43.

FIG. 19 shows a detail of the above mentioned cordless main communication unit 61.

The cordless main communication unit 61 comprises a radio portion 61a having an antenna 61a1, a modem portion 61b, a TDMA portion 61c, an interface portion 61d and a control portion 61e.

A radio frequency signal arriving from the cordless sub communication units 421-42N is received by the antenna 61a1 and inputted to a receiving portion 61a1 through a high frequency switch 61a2 of a radio portion 61a. In this receiving portion 61a3, the aforementioned received radio frequency signal is mixed with a receiving local oscillation signal generated from a frequency synthesizer 61a4 so that the signal is converted to a reception intermediate frequency signal.

The local oscillation frequency generated from the aforementioned frequency synthesizer 61a4 is instructed by the control portion 61e depending on the radio channel frequency. Further, the radio portion 61a includes a received signal strength indicator (RSSI) portion 61a5. This RSSI portion 61a5 detects a received signal strength of the radio frequency signal arriving at the antenna 61a1 and notifies the control portion 61e of the detected value.

The reception intermediate frequency signal outputted from the aforementioned receiving portion 61a3 is inputted to a demodulation portion 61b1. In the demodulation portion 61b1, digital demodulation of the aforementioned reception intermediate frequency signal is carried out so as to reproduce a digital communication signal. A TDMA decoding portion 61c1 of a TDMA portion 61c disassembles the digital communication signal of each time slot according to an instruction of the control portion 61e and this disassembled digital communication signal is inputted to an error correction portion 61d1 of an interface portion 61d.

The error correction portion 61d1 detects and corrects a data error caused during data transmission in bare data communication and supplies corrected data to a subscriber line interface 61d2. The subscriber line interface 61d2 demodulates the digital

communication signal so as to reproduce a corresponding analog communication signal. Then, this analog communication signal is transmitted to the network 43 through a cable line.

On the other hand, the analog communication signal arriving from the network 43 through the cable network is converted to a digital communication signal by the subscriber line interface 61d2. This digital communication signal undergoes error correction at the error correction portion 61d1 and then is inputted to the TDMA encoding portion 61c2. At the TDMA encoding portion 61c2, the digital communication signal is inserted into a desired time slot and multiplexed. This multiplexed digital communication signal is inputted to a demodulation portion 61b2. This demodulation portion 61b2 digital-demodulates a carrier signal by the aforementioned digital communication signal and this demodulated carrier signal is inputted to a transmitting portion 61a6. In the transmitting portion 61a6, the aforementioned modulated carrier signal is mixed with a transmitting local oscillation signal generated from a frequency synthesizer 61a4 and converted to a radio channel frequency instructed by a control portion 61e. Further, it is amplified to a predetermined transmitting power level. A radio frequency signal outputted from this transmitting portion 61a6 is transmitted to each of the cordless sub

communication units 421-42N from the antenna 61a1 through a high frequency switch 61a2.

The control portion 61e contains, for example, a microcomputer as its main portion. Its control function contains a private mode communication control means 61e1, a data transmitting/receiving control means 61e2, a data accumulation control means 61e3, and a subscriber line communication control means 61e4.

The private mode communication control means 61e1 is a means for connecting each of the cordless sub communication units 421-42N through a radio channel using the private communication mode. The data transmitting/receiving control means 61e2 is a means for controlling data transmitting/receiving between the external units 411-41N and the center unit 51, which reads out data accumulated in the data telemetering unit 61 and transmits it to the center unit 51 through the network 43. The data accumulation control means 61e3 accumulates data arriving from each of the cordless sub communication units 421-42N in the data telemetering unit 61 through a radio channel. The subscriber line communication control means 61e4 changes its own unit to subscriber line communication mode so as to connect to the center unit 51 when data collection is completed.

FIG. 20 shows a detail of the aforementioned cordless sub communication units 421-42N.

Referring to FIG. 20, each of the cordless sub communication units 421-42N comprises a radio portion 42a having an antenna 42a1, a modem portion 42b, a TDMA portion 42c, an error correction portion 42d, an external interface 42e and a control portion 42f.

Because the aforementioned radio portion 42a, modem portion 42b and TDMA portion 42c have the same function as the radio portion 61a, modem portion 61b and TDMA portion 61c of the cordless main communication unit 61, a description thereof is omitted.

In the operation the digital communication signal outputted from the TDMA decoding portion 42c1 is inputted to the error correction portion 42d. The error correction portion 42d detects a data error generated during data transmission in bare data communication and requests data retransmitting.

Corrected data by the error correction portion 42d is accumulated in the external unit 41 (411-41N) through the external interface 42e. Further, data generated in the external unit 41 is digitally modulated through the external connection interface 42e, the error correction portion 42d and the modulation portion 42b2 and this modulated carrier signal is inputted to a transmitting portion 42a6. In the transmitting portion 42a6, the aforementioned modulated carrier signal is mixed with a transmitting local oscillation signal generated from the frequency

synthesizer 42a4 so that it is converted to a radio channel frequency instructed by the control portion 42f and further amplified to a predetermined transmitting power level. Then, the radio frequency signal outputted from this transmitting portion 42a6 is transmitted from the antenna 42a1 through the high frequency switch 42a2.

The control portion 42f contains, a microcomputer as its main control portion so as to control the respective circuits synthetically. The control portion 42f comprises a private mode communication control means 42f1, a data transmitting/receiving control means 42f2, and a time counting means 42f5. The time counting means 42f5 is a timer for setting a transmitting timing for data generated in the external unit 41 corresponding to a control channel signal arriving from the cordless main communication unit 61 and has various count values. That is, the control portion 42f controls the respective circuits so as to transmit data generated in the external unit 41 to the cordless main communication unit 61 through a radio channel when the counting action of the time counting means 42f5 is terminated.

FIGS. 21-23 are flow charts for explaining actions of the respective cordless sub communication units 421-42N, the cordless main communication unit 61 and the center unit 51.

In FIG. 21, each of the cordless sub communication units 421-42N gets into waiting action for communication at steps S111, S121. Then, the center unit 51 transmits a data collection request to the cordless main communication unit 61 at step S141 and the cordless main communication unit 61 receives the data collection request at step S131 and then broadcasts information to the respective cordless sub communication units 421-42N by control channel signal at the same time.

When the cordless sub communication units 421-42N receives the broadcast information from the cordless main communication unit 61 at steps S112, S122, each timer is started by the time counting means 42f5 of the respective control units 42f. Here, the timers terminate in order from the cordless sub communication unit 421.

When the timer terminates at step S113, the cordless sub communication unit 421 dispatches a call to the cordless main communication unit 61 at step S114. When a response returns from the cordless main communication unit 61, the cordless sub communication unit 421 transmits data generated in the external unit 411 to the cordless main communication unit 61. At step S132, the cordless main communication unit 61 accumulates data arriving from the cordless sub communication unit 421 in the data telemetering unit 62 by the data

accumulation control means 61e3 of the control portion 61e.

When data is sent to the cordless main communication unit 61, the cordless sub communication unit 421 cuts off a radio channel connected to the cordless main communication unit 61 at step S116 of FIG. 22 and gets into waiting action at step S117.

After that, the cordless main communication unit 61 repeats actions of the above steps S112-S117 for the cordless sub communication units 422 and following units. The last cordless sub communication unit 42N, when the timer terminates at step S123, dispatches a call to the cordless main communication unit 61 at step S124. When a response returns, the cordless sub communication unit 42N transmits data generated in the external unit 41N to the cordless main communication unit 61 at step S125. At step S133, the cordless main communication unit 61 accumulates data arriving from the cordless sub communication unit 42N in the data telemetering unit 62 by the data accumulation control means 61e3 of the control portion 61e.

The cordless sub communication unit 42N, when it transmits data to the cordless main communication unit 61, cuts off a radio channel connected to the cordless main communication unit 61 at step S126 and gets into the waiting action again at step S127 of FIG. 23.

When data accumulation in the data telemetering

unit 62 is completed at step S134, the cordless main communication unit 61 dispatches a call to the center unit 51 at step S135. When a response returns from the center unit 51, the cordless main communication unit 61 reads telemetry data accumulated in the data telemetering unit 62 by the data transmitting/receiving control means 61e2 of the control unit 61e at step S136 and transmits it to the center unit 51 through the network 43. The center unit 51 receives telemetry data sent from the cordless main communication unit 61 at step S142 and manages the telemetry data.

Further, the cordless main communication unit 61, when it transmits the telemetry data to the center unit 51, cuts off the line connected to the center unit 51 at step S137 and the above procedure is terminated.

FIG. 24 shows a case in which an exchange is provided in the above embodiment.

FIG. 24 will be explained by attaching the same reference numerals to the same components as in FIG. 18. What is different from FIG. 18 is that a plurality of cordless main communication units 611-61N are provided and an exchange 63 is interposed between these cordless main communication units 611-61N and network 43. The exchange 63 contains a data telemetering unit 62 for accumulating data generated from the external units 411-41N and accommodates a plurality of the cordless main communication units 611-61N through a cable

network. The exchange 63 accumulates data arriving from the plurality of the cordless main communication units 611-61N in the data telemetering unit 62. If the accumulation is completed, the telemetry data accumulated in the data telemetering unit 62 is transferred to the center unit 51 through the network 43.

Thus, according to the above embodiment, the plurality of the cordless sub communication units 421-42N are connected to the cordless main communication units 61 through a radio channel using the private mode. As a result, the cordless main communication unit 61 is capable of telemetering data generated in the external units 411-41N quickly and efficiently with few errors without placing a new public telephone line and not through the network 43.

Because the cordless main communication units 61 temporarily accumulates data generated in the external units 411-41N in the data telemetering unit 62 before transmitting to the line, it is capable of transmitting data to the center unit 51 with a small traffic intensity. Further because the cordless main communication unit 61 can be occupied specially as a data telemetering system, there never occurs such a case in which radio line busy state occurs due to use by others like public PHS station, thereby reducing a possibility of call loss.

Further because the plurality of the cordless sub

communication units 421-42N are connected to the cordless main communication unit 61 through a radio channel using the private mode, the cordless main communication unit 61 is capable of dispatching a call to a cordless sub communication unit 422 while receiving a call from the other cordless sub communication unit 421 so that flexible system operation is enabled. Further because the cordless sub communication units 421-42N only have to receive a control channel transmitted intermittently from the cordless main communication unit 61, battery saving can be performed during the intermittent receiving so that power consumption can be minimized.

The plurality of the cordless sub communication units 421-42N have time counting means 42f5 having different counting values and the cordless main communication unit 61 broadcasts information to the plurality of the cordless sub communication units 421-42N at the same time so as to actuate the time counting means 42f5. When the counting operation terminates, data transmitting is started. Therefore, it is possible to avoid a concentrated occurrence of calls, so that data can be collected successively from the plurality of the cordless sub communication units 421-42N.

Because the cordless main communication unit 61 transmits telemetry data accumulated in the data

telemetering unit 62 to the center unit 51 through the network 43, the center unit 51 is capable of managing data of the external units 411-41N synthetically and the center unit 51 is capable of receiving telemetry data effectively from the cordless main communication unit 61 only with a single access treatment.

Further in a case when the exchange 63 is provided, because the exchange 63 accommodates the plurality of the cordless main communication units 611-61N and contains the data telemetering unit 62, it is possible to collect data generated in the automatic vending machines or the like from a wide area and further reduce access treatment frequency of the center unit 51 by transmitting this telemetry data to the center unit 51.

Next, a method for notifying the master PHS data communication unit 31 of an occurrence of an error if it occurs in the external units 32, 111-11N in FIG. 3 or FIG. 12 will be described.

FIG. 25 is a flow chart for explaining a countermeasure taken if an emergency occurs in the external units 111-11N of the slave side PHS data communication units 121-12N which are actuated in the polling method (FIG. 3). Here, a case in which an emergency occurs in the external unit 111 of the PHS data communication unit 121 is exemplified.

First, if an alarm indicating an emergency of the

external unit 111 occurs at step S162 when the PHS data communication unit 121 is in waiting mode at step S161 (YES), it calls the master PHS data communication unit 31 at step S163 and executes data communication with the PHS data communication unit 31 at step S164. At step S165, it transmits an alarm information to the PHS data communication unit 31. Then, if the data communication terminates at step S166 (YES), it returns to the waiting mode of step S161.

In a case when no alarm occurs at the above step S162 (NO), the processing goes to step S167. If a call arrives from the PHS data communication unit 31 at step S167 (YES), the processing goes to steps 168, 169. At steps S168, 169, the same processing as steps S71, S72 of FIG. 11 is carried out. Therefore, a description thereof is omitted.

FIG. 26 is a flow chart for explaining actions taken when an emergency occurs in the external unit 111 of the PHS data communication unit 121 which is actuated in the relay method (FIG. 12). At steps S171-S174 and 177 of FIG. 26, the same processing as steps S82-S85 and S87 of FIG. 14 is carried out. Therefore, a description thereof is omitted.

If an alarm occurs at step S176 when idle period mode is on at step S175 (YES), the PHS data communication unit 121 calls a next PHS data communication unit 122 at step S178 and executes data communication

at step S179. At step S180, it transmits an alarm information to the PHS data communication unit 122. Then, if data communication with the PHS data communication unit 122 terminates at step S181 (YES), the processing returns to the idle period mode of the above step S175.

FIG. 27 is a flow chart for explaining actions taken when an emergency occurs in the external units 112-11N of the PHS data communication units 122-12N which are actuated in the relay method (FIG. 12). Here, a case in which a trouble occurs in the external unit 112 of the PHS data communication unit 122 will be described.

If an alarm occurs at step S192 when the PHS data communication unit 122 is in idle period mode at step S191 (YES), it calls a next number PHS data communication unit 123 at step S193 and executes data communication at step S194 and transmits an alarm information to the next number PHS data communication unit 123 at step S195. Then, when data communication with the next number PHS data communication unit 123 terminates at step S196 (YES), the processing is returned to the idle period mode of the above step S191.

At the above step S192, the PHS data communication unit 122 executes processings of step S193 and following steps when no alarm occurs (NO). Because the processing of steps S193-S205 is the same as those of

steps S89-S101 of FIG. 14, a description thereof is omitted. In a case when an emergency occurs in the PHS data communication unit 12N which is last in relay order, the PHS data communication unit 31 is notified of the alarm information.

Therefore, according to the above-described embodiment, the PHS data communication units 121-12N, when a trouble occurs in the respective external units 111-11N, notifies the master side PHS data communication unit 31 of an occurrence of the trouble. Thus, the PHS data communication unit 31 and external unit 32 are capable of grasping the trouble condition of the external units 111-11N and performing a processing for making access to the PHS data communication units 121-12N. Further, a countermeasure for recovering an external unit undergoing that trouble can be executed.

In the case of the relay method, because the external unit 32 has a high possibility of being idle, a probability of success upon dispatching a signal from the external units 111-11N to the external unit 32 when an alarm occurs is high. Therefore, connection to the external unit 32 is always carried out by retransmitting some times. This probability can be expressed in the following expression.

Probability of idle on master side

$$\frac{T_W}{T_W + T_R} \cong 1 \quad (T_W >> T_R)$$

T_R: time for data communication between a data collecting unit and a user apparatus last in relay order ··· (Formula 1)

In the case of the polling method, the probability of the external unit 32's being idle drops as the number of the external units 111-11N increases. As a countermeasure, there is a way of prolonging the polling interval TW as well as a way of increasing the number of retransmitting to the external unit 32. Further, there is also such a method that the external unit 32 and external units 111-11N share common time information and the external units 111-11N calls the external unit 32 when the external unit 32 is in waiting period in accordance with the common time information. Meanwhile, that probability can be expressed in expression 2.

Probability of idle on master side (quantity of user apparatuses = N - 1)

$$\frac{T_W}{T_W + T_P} = \frac{T_W}{T_W + (N-1)T_R'}$$

T_R': time for data communication in polling method between a data collecting unit and a single user apparatus ··· (Formula 2)

The external unit 32 is sometimes capable of executing more effective data communication if the polling cycle and relay cycle can be varied depending on time zone of a day when it collects data generated

in the respective external units 111-11N. The polling cycle and relay cycle can be expressed in expression 3.

polling cycle: $T_W + T_P \cong T_W + (N - 1)T_R'$

relay cycle: $T_W + T_T \cong T_W$

T_T: time for data communication between a user apparatus first in relay order and a user apparatus second in relay order ··· (Formula 3)

Then, in the PHS data communication units 31, 121-12N, their control portions 12f are provided each with a means 12f7 for variably setting an execution timing of collecting data generated in the slave side PHS data communication units 121-12N to the master side PHS data communication unit 31, depending on time zone of a day.

Thus, it is possible to carry out effective data collection corresponding to generation of data in the respective external units 111-11N depending on time zone of a day.

Next, as regards the data telemetering system based on the relay method shown in FIG. 28, a system for telemetry data by changing its transmission route when a trouble occurs in the communication units 121-123 will be described.

Referring to FIG. 28, PHS data communication units 31, 121-123 are distributed such that the PHS data communication units 122, 123 are disposed in a region

in which the PHS data communication unit 121 is capable of communicating on sub-unit direct communication mode. The external unit 32 functions as a data telemetering unit. Because the other part is the same as the data telemetering system of FIG. 12, a description thereof is omitted.

As shown in FIG. 29, each of the external units 111-113 of this system is provided with a transmitting order memory means 11a and a transmitting route rewrite means 11b. The transmitting order memory means 11a is a table for storing the order of the PHS data communication units 121-123, 31 for transmitting data. If the PHS data communication unit 121 detects a trouble in the next PHS data communication unit 122 to which data is to be sent, the transmitting route rewrite means 11b rewrites a content of the transmitting order memory means 11a for the PHS data communication unit 121 so as to change its route to the PHS data communication unit 123 and then transmit data.

Next, a method for changing the transmission route when a trouble occurs in the PHS data communication unit will be described.

As regards the arrangement of the plural PHS data communication units, as shown in FIG. 30, PHS data communication units 122, 123 are disposed in area 1 (indicated by dotted line in the same figure) in which the PHS data communication unit 121 is capable of

communicating in sub-unit direct communication mode. Then, PHS data communication units 123, 124 are disposed in area 2 (indicated by solid line in the same figure) in which the PHS data communication unit 122 is capable of communicating in sub-unit direct communication mode. Further, PHS data communication units 124, 31 are disposed in area 3 (indicated by dot and dash line in the same figure) in which the PHS data communication unit 123 is capable of communicating in sub-unit direct communication mode. These PHS data communication units 121-124 are connected successively through a radio channel using the sub-unit direct communication mode in the order of the PHS data communication unit 121, PHS data communication unit 122, PHS data communication unit 123 and PHS data communication unit 124. The PHS data communication unit 124 which is last of this connection order is connected to the PHS data communication unit 31 of the aforementioned external unit 32.

The plural PHS data communication units 121-124 monitor a status of a next PHS data communication unit with which data communication is to be carried out in the sub-unit direct communication mode. If a trouble is found in the PHS data communication unit 122 as shown in FIG. 31A, the PHS data communication unit 121 changes its transmission route to the PHS data communication unit 123 to which the PHS data

communication unit 122 should transmit data, and transmits data thereto. Before transmitting this data, the transmitting route rewrite means 11b in the external unit 111 of the PHS data communication unit 121 rewrites a content of the transmitting order memory means 11a for the PHS data communication unit 121 to transmit data to the PHS data communication unit 123.

If a trouble is found in the PHS data communication unit 123, as shown in FIG. 31B, the PHS data communication unit 122 changes its transmission route to the PHS data communication unit 124 to which the PHS data communication unit 123 should transmit data and then transmits data thereto.

FIG. 32 is a flow chart indicating actions of the PHS data communication units 121-123 when a trouble occurs in the PHS data communication unit 122.

At steps S211, S221, S231, the respective PHS data communication units 121-123 sets the sub-unit direct communication mode by the sub-unit direct communication control means 12f1 of each control unit 12f and get into waiting mode for the sub-unit direct communication.

At step S212, the PHS data communication unit 121 calls the PHS data communication unit 122 to which it should transmit data by referring to the transmitting order memory means 11a of the external unit 111. At step S213, the PHS data communication unit 121 determines whether or not a response comes from the PHS

data communication unit 122 according to a count value corresponding to a response waiting time of the timer 12f8 of the control portion 12f.

If a response comes within a predetermined response waiting time (YES), the PHS data communication unit 121 executes connecting procedure to the PHS data communication unit 122 at step S214 and carries out data communication with the PHS data communication unit 122 through a normal route. If no response comes from the PHS data communication unit 122 (NO) and a predetermined response waiting time is exceeded at step S215 (YES), the PHS data communication unit 121 rewrites a content of the transmitting order memory means 11a so as to select the PHS data communication unit 123 by the transmitting route rewrite means 11b of the external unit 111 at step S216 and transmits data to the PHS data communication unit 123 by referring to the content of this transmitting route memory means 11a. If the response waiting time is not exceeded at step S215 (NO), the processing of the step 213 is repeated.

If the PHS data communication unit 123 receives a signal from the PHS data communication unit 121 at step S232, it transmits a response to the PHS data communication unit 121 and communication is executed.

Next, the PHS data communication unit 121 reads information (data) possessed by the external unit 111 by the external connection interface 12e at step S217

and transmits data to the PHS data communication unit 123. After the data transmission, the communication line is cut off at step S218.

When the PHS data communication unit 123 receives data arriving from the PHS data communication unit 121 at step S233, it stores the data in the external unit 113. After the data is stored, the line is cut off at step S235 so as to terminate the data communication.

It is permissible to variably set the response waiting time counted by the timer 21f8 of the control portion 21f depending on a place or time zone of a day.

The transmitting order memory means 11a and transmitting route rewrite means 11b may be provided not in the external unit but the control portion 21f.

Therefore, according to the above-described embodiment, because the PHS data communication units 122, 123 having a next number and a next number after the next respectively of a preliminarily set transmission order are disposed in the area in which the PHS data communication unit 121 is capable of communicating in the sub-unit direct communication mode, if a trouble occurs in the PHS data communication unit 122 of the next number, data can be sent to the PHS data communication unit 123 of the next number after the next without placing other PHS data communication unit than the PHS data communication units belonging to the preliminarily set transmitting order. As a result, the

data can be collected in the external unit 32 from the external units 111, 113 of the PHS data communication units 121, 123 having no trouble without waiting for trouble recovery.

FIG. 33 shows a system configuration of other embodiment of the present invention.

In FIG. 33, the same components as FIG. 28 will be described with the same reference numerals. Here, the PHS data communication units 121-123 are referred to as group 1. Additionally, in regions in which the PHS data communication unit 31 is capable of communicating in sub-unit direct communication mode, group 2 containing the PHS data communication units 221-223 and group 3 containing the PHS data communication units 321-323 are disposed.

In the group 1, the PHS data communication units 121-123 have corresponding external units 111-113 and are connected to each other successively in a specified order through a radio channel using the sub-unit direct communication mode. In this case, they are connected in the order of the PHS data communication unit 121, PHS data communication unit 122 and PHS data communication unit 123. Then, data generated in the external unit 111 is brought through the PHS data communication units 121, 122 and 123 in order and temporarily stored in the external unit 113. This data includes data generated in and attached by the external units 111-113.

In the group 2, the PHS data communication units 221-223 have corresponding external units 211-213 and are connected to each other successively in a specified order through a radio channel using the sub-unit direct communication mode. In this case, they are connected in the order of the PHS data communication unit 221, PHS data communication unit 222 and PHS data communication unit 223. Then, data generated in the external unit 211 is brought through the PHS data communication units 221, 222 and 223 in order and temporarily stored in the external unit 213. This data includes data generated in and attached by the external units 211-213.

In the group 3, the PHS data communication units 321-323 have corresponding external units 311-313 and are connected to each other successively in a specified order through a radio channel using the sub-unit direct communication mode. In this case, they are connected in the order of the PHS data communication unit 321, PHS data communication unit 322 and PHS data communication unit 323. Then, data generated in the external unit 311 is brought through the PHS data communication units 321, 322 and 323 in order and temporarily stored in the external unit 313. This data includes data generated in and attached by the external units 111-113.

Then, the PHS data communication unit 31 installed in the data telemetering unit 32 calls the PHS data communication units 123, 223 and 323 successively so

that it is connected thereto through a radio channel using the sub-unit direct communication mode. Then, the PHS data communication unit 31 collects data accumulated in the external units 113, 213 and 313 and stores it in the external unit 32.

If a trouble occurs each in the PHS data communication units 122, 222 and 322 of the respective groups 1-3, the PHS data communication units 121, 221 and 321 change their transmission route to the PHS data communication units 123, 223 and 323 like the above mentioned embodiment and transmit data thereto. If the PHS data communication units 122, 222 and 322 are disposed in a region in which the PHS data communication unit 31 is capable of communicating in the sub-unit direct communication mode, when a trouble occurs each in the PHS data communication units 123, 223 and 323, the PHS data communication unit 31 makes access to the PHS data communication units 122, 222 and 322 and connects itself thereto through a radio channel using the sub-unit direct communication mode. Then, it is capable of telemetering data accumulated in the external units 113, 213 and 313 by the polling method and stores it in the data telemetering unit 32.

Therefore, according to this embodiment, the same advantage as the previously described embodiment can be obtained. Further, the PHS data communication unit 31 gains access to the PHS data communication units 123,

223 and 323 successively which correspond to the last of the connection order of the groups 1-3 and collect data in the polling method. Thus, effective data communication and data collection corresponding to the arrangement of the PHS data communication units 121-123, 221-223, 321-323 can be achieved.

If a trouble occurs in the PHS data communication unit in the respective embodiments, it may be so constructed that the PHS data communication unit of a preceding number transmits such information that the trouble has occurred to a PHS data communication unit to which the route will be changed and notifies the data telemetering unit 32 thereof. As a result, the external unit 32 recognizes the trouble in the PHS data communication unit and can take a countermeasure for the trouble quickly.

Further in each of the above-described embodiments, the plural PHS data communication units disposed in a region in which a single PHS data communication unit is capable of communicating in the sub-unit direct communication mode may be arranged so that they are connected in the order of the field intensity from its largest value.

That is, according to the present invention, if a trouble occurs in the communication unit, a communication unit of a preceding number is capable of changing the transmission route to a communication unit

to which the communication unit undergoing the trouble should transmit data and transmits data thereto.

Therefore, the present invention is capable of providing a data telemetering system capable of telemetering data generated in each of the communication units to the data telemetering unit securely without increasing the number of the communication units when a trouble occurs in the communication unit, and a communication unit for use in the same system and a method therefor.

Meanwhile, the present invention is not restricted to the above described embodiments, but may be carried out in various modifications within a scope not departing from a sprit and gist of the present invention.

Additional advantages and modifications will readily occur to those skilled in the art. Therefore, the invention in its broader aspects is not limited to the specific details and representative embodiments shown and described herein. Accordingly, various modifications may be made without departing from the spirit or scope of the general inventive concept as defined by the appended claims and their equivalents.

CLAIMS

1. A data telemetering system comprising:

a plurality of data generating sources for generating a predetermined data; and

a data accumulating unit for accumulating the predetermined data generated by this data generating source, for collecting the predetermined data generated by the data generating source in said data accumulating unit,

said data telemetering system further comprising a radio communication unit installed corresponding to said data generating source and said data accumulating unit and having a communication mode for communicating between terminals using a radio channel not through a public telephone network,

said radio communication unit having:

a radio connecting means for connecting between a radio communication unit and the other radio communication unit by said communication mode; and

a data transmission means for connecting between a radio communication unit provided corresponding to the data generating source and a radio communication unit provided corresponding to the data accumulating unit by said connecting means and for transmitting the predetermined data generated in each of the data generating sources to said data accumulating unit.

2. A data telemetering system according to

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claim 1, wherein said radio connecting means makes the radio communication unit provided corresponding to the data accumulating unit access the radio communication unit provided on each of the data generating sources successively using said communication mode and connects them.

3. A data telemetering system according to claim 1, wherein said radio connecting means accesses a radio communication unit provided at each of the data generating sources by relay access method using said communication mode and the radio communication unit provided corresponding to the data accumulating unit is connected to a radio communication unit last in connecting order of said relay access.

4. A data telemetering system according to claim 1, wherein said radio communication unit has a means for setting a connection timing by said communication mode variably depending on a time zone.

5. A data telemetering system according to claim 1, wherein said radio communication unit has a monitoring means for monitoring a state of the corresponding data generating source, wherein

said connecting means connects between a radio communication unit and the radio communication unit corresponding to the data accumulating unit or the radio communication unit provided at other data generating source using said communication mode when a

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trouble is detected in the data generating source by said monitoring means.

6. A data telemetering system according to claim 3, wherein said radio communication unit has a monitoring means for monitoring a state of the corresponding data generating source, wherein

said connecting means connects between a radio communication unit and the radio communication unit corresponding to other data generating source capable of communicating with said radio communication unit using said communication mode when a trouble is detected in the data generating source by said monitoring means.

7. A radio communication unit for use in a data telemetering system comprising: a plurality of data generating sources for generating a predetermined data; and a data accumulating unit for accumulating the predetermined data generated by said data generating source, for collecting the predetermined data generated by the data generating source in said data accumulating unit,

said data communication unit comprising:

a radio connecting means for connecting between a radio communication unit and the other radio communication unit by communication mode for communicating between terminals not through a public telephone network;

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a data transmission means for connecting between a radio communication unit provided corresponding to a data generating source and a radio communication unit provided corresponding to the data accumulating unit by said radio connecting means and for transmitting a predetermined data generated in each of the data generating sources to said data accumulating unit.

8. A radio communication unit for use in a data telemetering system comprising:

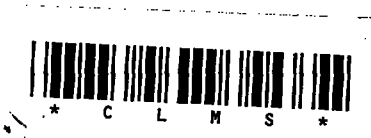
a plurality of data generating sources for generating a predetermined data; and a data accumulating unit for accumulating the predetermined data generated by this data generating source, for collecting the predetermined data generated by the data generating source in said data accumulating unit,

said data communication unit comprising:

a radio connecting means for connecting between a radio communication unit and the other radio communication unit by communication mode for communicating between terminals not through a public telephone network; and

a data transmission means for connecting between radio communication units provided corresponding to each data generating source by said radio connecting means and for transmitting a predetermined data generated in each of the data generating sources.

9. A data telemetering system comprising:



a plurality of data generating sources for generating a predetermined data; and

a data accumulating unit for accumulating the predetermined data generated by this data generating source, for collecting the predetermined data generated by the data generating source in said data accumulating unit,

said data telemetering system further comprising:

a first radio communication unit having a first communication mode for communicating not through a public telephone network and provided corresponding to each of said data generating sources;

a second radio communication unit having said first communication mode and a public communication mode for communicating through public telephone network, disposed in a radio zone formed by a base station connected to the public telephone network and installed corresponding to said data accumulating unit; and

a center unit connected to the public telephone network through said base station,

said second radio communication unit having:

a radio connecting means for connecting between said first radio communication unit and said second radio communication unit using said first communication mode and for connecting between said second radio communication unit and said center unit through said base station and said public telephone network using

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said public communication mode; and

a data transmission means for transmitting predetermined data generated in a plurality of data generating sources from the first radio communication unit to the second radio communication unit by this radio connecting means and accumulating the data in said data accumulating unit and then transmitting the data to said center unit through said base station and said public telephone network using said public communication mode.

10. A data telemetering system according to claim 9, wherein said radio connecting means makes the second radio communication unit access the first radio communication units successively using said first communication mode.

11. A data telemetering system according to claim 9, wherein said radio connecting means accesses each of the first radio communication units by relay access method using said first communication mode and the second radio communication unit is connected to the first radio communication unit last in connecting order of the relay access.

12. A data telemetering system according to claim 9, further comprising a changing means for changing from a state in which said first radio communication unit and said second radio communication unit are connected to each other by said radio

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connecting means in said first communication mode to a state in which said second radio communication unit and said base station are connected to each other by said public communication mode after data generated from all the data generation source are accumulated in the data accumulating means.

13. A radio communication unit for use as a second radio communication unit in a data telemetering system comprising: a plurality of data generating sources for generating a predetermined data; a data accumulating unit for accumulating the predetermined data generated by the data generating sources; a first radio communication unit provided corresponding to each of the plurality of said data generating sources, having a first communication mode for communicating not through a public telephone network; a second radio communication unit disposed in a radio zone formed by the base station connected to the public telephone network and provided corresponding to said data accumulating unit, having said first communication mode and a public communication mode for communicating through public telephone network; and a center unit connected to said base station through public telephone network,

said radio communication unit having:

a first radio connecting means for connecting between said first radio communication unit and said second radio communication unit using said first

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communication mode;

a second radio connecting means for connecting between said base station and said second communication unit using said public communication mode;

an accumulation control means for connecting between said first radio communication unit and said second radio communication unit in said first communication mode by said first radio connecting means and accumulating predetermined data generated by a plurality of the data generating sources in said data accumulating unit; and

a data transmission means for transmitting data accumulated in said data accumulating unit to said center unit in said second communication mode by said second radio connecting means.

14. A radio communication unit according to claim 13, wherein said data transmission means comprising a monitoring means for monitoring data accumulation state in said data accumulating unit, wherein when a monitoring result of said monitoring means indicates that all data generated in the plurality of said data generating sources is collected, the data is transmitted to said center unit in the second communication mode.

15. A data telemetering system comprising:

a plurality of radio communication units installed corresponding to the plurality of the distributed data

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generating units, wherein

data telemetering is carried out in a predetermined order between the radio communication units using a communication mode for communicating between terminals using a radio channel not through a public telephone network, and

in a region in which at least one of the plurality of said radio communication units is capable of communicating with in said communication mode, at least a first radio communication unit to which said radio communication unit transmits data next and a second radio communication unit to which the first radio communication unit transmits next are allocated.

16. A data telemetering system according to claim 15, wherein each of the plurality of said radio communication units includes:

a monitoring means for monitoring a state of said first radio communication units, and

a changing means for changing a transmission route to said second radio communication unit when a trouble is detected in said first radio communication unit by the monitoring means.

17. A communication method for a data telemetering system for telemetry data in a predetermined order using a communication mode for communicating between terminals using a radio channel not through a public telephone network among the radio communication units

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installed corresponding to a plurality of distributed data generating units, comprising the steps of:

in a region which at least one of the plurality of said radio communication units is capable of communicating with in said communication mode, allocating at least a first radio communication unit to which the radio communication unit transmits data next and a second radio communication unit to which the first radio communication unit transmits data next; and

executing communication between the allocated radio communication units.

18. A communication method according to claim 17, wherein each of the plurality of said radio communication units,

monitors a state of said first radio communication units and changes the communication route to said second radio communication unit when a trouble is detected in said first radio communication unit.

19. A transmitting and receiving unit comprising:

a data generating unit for generating a predetermined data; and

a radio communication unit installed corresponding to the data generating unit and capable of communicating in a communication mode for communicating between terminals using a radio channel not through a public telephone network, wherein

said data generating unit comprises,

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memory means for storing at least a first transmission route to a first radio communication unit to which the radio communication unit transmits data next and a second transmission route to a second radio communication unit to which said first radio communication unit transmits data next,

said radio communication unit includes,

a connecting means for connecting to other radio communication unit to be disposed in a region in which communication is enabled in said communication mode by referring a communication route stored in a memory means of said data generating unit.

20. A transmitting and receiving unit according to claim 19, wherein said radio communication unit includes,

a monitoring means for monitoring a state of said first radio communication unit,

a changing means for changing the transmission route to said second transmission route when a trouble is detected in said first radio communication unit by the monitoring means.

21. A data telemetering system and communication apparatus for use in the same, substantially as hereinbefore described with reference to the accompanying drawings.

