



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
26.08.2009 Bulletin 2009/35

(51) Int Cl.:
H04H 20/06 (2008.01)

(21) Application number: **09152785.3**

(22) Date of filing: **13.02.2009**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK TR
Designated Extension States:
AL BA RS

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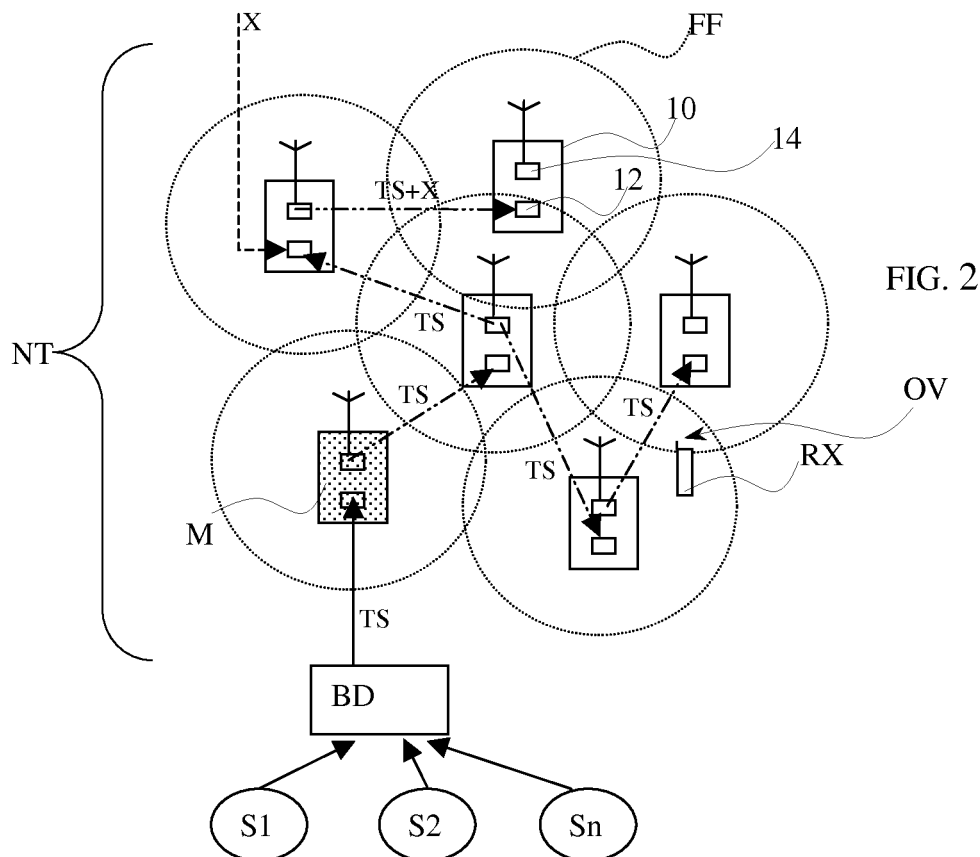
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(30) Priority: **19.02.2008 IT TV20080029**

(54) **Digital radio device**

(57) A digital radio device (10) for emitting a radio signal in digital format comprising a transmitter stage (14) able to emit a radio signal in digital format, a transceiver module (12) for radio access to a wireless data network

(NT) connected to the transmitter stage, means (MP) for extracting a data stream from the wireless network and sending it to the transmitter stage so that it can be radio broadcast locally.



Description

[0001] The invention relates to a digital radio device and a system for the radio broadcasting of content in digital format, formed by a network of such devices.

[0002] Analog signal radio transmission systems are known where the receiving equipment is tuned to the transmitted channels and receive correctly as long as the signal arrives with an appropriate power or other sources transmitting with the same carrier frequency do not disturb the reception thereof.

[0003] In order to increase the signal coverage, transmission/repeater nodes, or bridges, which amplify the signal and then repeat it, sometimes also with different carrier frequencies, are distributed throughout the territory.

[0004] Also known are RDS encoding systems which allow an analog receiver tuned to a particular radio station to be able to recognize other frequencies of the same transmitter, so as to tune automatically to the channel with the best signal. This is particularly useful when a receiver which is in movement is moving away from the radio source and approaches another source which transmits with a different carrier frequency.

[0005] These transmitters/repeaters are, however, installed at considerable distances from one another. To ensure the coverage they emit power levels of the order of a few hundred or thousand Watt. Strong electromagnetic emissions are a source of interference and are known to have negative effects on the health of persons.

[0006] The object of the invention is to alleviate the problem of strong emissions while ensuring good reception of the radio signal broadcast.

[0007] This object is achieved with a digital radio device for emitting a radio signal in digital format comprising

- a transmitter stage able to emit a radio signal in digital format,
- a transceiver module for the radio access to a wireless data network connected to the transmitter stage,
- means for extracting a data stream from the wireless network and sending it to the transmitter stage so that it can be radio broadcast locally.

[0008] With the system according to the invention, through a series of devices deployed in the territory at short distances from each other and networked with each other, signal coverage with a low emission power (about twenty or thirty Watt) is ensured.

[0009] Each device has two cooperating stages. The first stage is a transceiver module which receives, from the wireless network, the radio signal/information to be broadcast to users and which can also send on the network data and/or information of various kinds, including, for example, the configuration of the transmitter itself. The second stage is a radio transmitter stage and receives from the first stage the data and/or the information so as to transmit it over the air using a digitally encoded

radio signal.

[0010] The wireless network is preferably a network of the HiperLAN mesh type or with an architecture which has similar characteristics. In particular, the preference is for a short-range network with broadband radio access, having transmitters capable of covering distances at the most of about ten kilometres and with a maximum irradiated power of about some dozen Watt. These transmitters therefore have limited electromagnetic emission levels.

[0011] The preferred architecture of the radio broadcasting system envisages the presence of at least a base or master station, having the function of introducing in the network the information/signals/content to be broadcast, and a plurality of repeater stations which receive and re-direct said content to other stations, propagating the chain signal. Therefore, any node of the network, i.e. a device according to the invention, acts as a repeater bridge for the information directed to the following nodes, allowing, in theory, limitless expansion of the connectivity.

[0012] Basically the invention relates to a system for radio-broadcasting content in digital format, comprising a plurality of devices as described above located at a certain distance from each other so as to form a wireless network. Preferably most of the devices, except for the master device (M) which introduces into the network the signal to be transmitted, operates so as to receive said signal from an upstream device, transmit it using a dedicated transmitter within a local area and send it via the wireless network to a downstream device. As described later, other signals can also be transmitted and introduced into the network.

[0013] The transmission network is also easy to implement: the low electromagnetic emission levels due to the low transmission power allow the transmitters to be positioned also in the vicinity of locations which are normally frequented by people, without danger for their health.

[0014] Advantageously the devices may be equipped with:

- a solar panel which allows them to be installed in locations which cannot be easily reached by external power sources;
- an input network, e.g. consisting of G-ETH technology, designed to acquire locally at a device one or more audio/video streams in addition to or in place of those received wirelessly from the other network devices;
- a directional antenna for the field emitted by the transceiver module.

[0015] The advantages of the invention will be better clarified by the following description of a preferred embodiment, illustrated in the accompanying drawing, in which:

Fig.1 shows the block diagram of a device according

to the invention;

Fig. 2 shows the diagram of a device network as shown in Fig. 1

[0016] A device 10 is equipped with a first module/ stage 12 and a second module/ stage 14 for transmission/ modulation, operatively connected to each other. With the module 12 the device 10 forms a wireless network node (e.g. for HiperLAN Mesh networks).

[0017] In fact, the module 12 is capable of interconnecting via a field FD, e.g. using a directional MIMO (multiple-input multiple-output) antenna (not shown) with electronic steering, to other modules 12 of the same type present in other devices 10, forming a network NT therewith. The network NT is indicated in Fig. 2 with dot-dash line arrows (Fig. 2 for the sake of simplicity shows only a few reference numbers).

[0018] The module 12 receives and extracts data from the network NT and, under the control of a microprocessor MP which manages the decoding and conversion operations, extracts from it information to be sent to the transmission/modulation stage 14, which transmits it via radio. This information is encoded by the module 12 under the control of the processor MP using the prechosen transmission standard, e.g. T-DMB, DAB, DAB+ or the like.

[0019] The modules 12 may have, associated with them, a cable (but also possibly wireless) network interface, e.g. a network input via a G-ETH card, for the local input of one or more audio/video streams in addition to or in place of those received wirelessly from the network NT. Therefore the module 12 can process and send to the transmitter 14 data received from the network NT and/or data received from the interface E (see broken line arrows in Fig. 1 showing the signal paths).

[0020] The device 10 is provided, for the selection of the signal path, with suitable signal switching means CM and processing means in the module 12 and/or in the processor MP.

[0021] A node BD (Fig. 2) stores in a multiplexer the data/signals/information received from several radio sources or stations S1 ... Sn and encodes them generating, with a suitable frame, a data or transport stream TS containing all the programs/contents to be broadcast. Said stream is introduced via the interface E into a device 10, which acts as the master device M (shown in Fig. 2). The device M sends using its module 12 the signal TS via the mesh network NT to the other devices 10.

[0022] The interface E of a device 10 is therefore multifunctional. For the master M, said interface acts as a collector and input into the network NT for the programs to be transmitted, while for any other device 10 it may be used to introduce an additional channel, in addition to or in place of one of those already contained in the signal TS received wirelessly.

[0023] The advantages of this configuration are numerous and consist mainly in the options of being able to:

- broadcast locally, in an area restricted to the sole coverage area FF of the device 10 into which they introduce/send a new stream, a channel different from or in addition to the range of channels transmitted by the master device M, and/or
- repeat to all the nearby devices 10 the different or additional channel, deviating internally to the device 10 the additional stream 10 taken from the interface E not only to the transmitter 14 but also to the network transmitter in the module 12.

[0024] By way of example, Fig. 2 shows introduction of an additional stream X into a given device 10. The stream X is also sent to the nearby device 10.

[0025] The selection of the signal path of the stream X is performed by the signal switching means CM, which are able to select the signal path of the additional stream X and direct it to the transmitter stage 14 and/or to the wireless data network NT via the transceiver module 12.

[0026] Fig. 2 shows both the uniform coverage with a homogeneous radial field FF determined by the emission of the transmitter 14 and the directionality which is improved (optionally) by directional antennas with a narrow emission range (hence the broken line arrows) for the modules 12. The flexibility with which this architecture allows the devices 10 to be positioned within the territory, ensuring that each device always receives a signal with sufficient power, is obvious.

[0027] In order to create common synchronization of all the devices 10, each of them is equipped with a GPS module 16. Said module obtains from a satellite a reference clock signal which is useful for synchronizing:

- data exchange in the mesh network NT,
- each transmission/modulation stage 14 such that its transmitted signal is in every location consistent with and temporally aligned with the reference signal.

[0028] Advantageously correct and reliable reception of the signal emitted by stages 14 is thus ensured, even if a user-receiver RX is moving.

[0029] The GPS module 16 may provide simultaneously the microprocessor MP with the information relating to the coordinates of the installation location of the device 10, and this data may be sent on the network NT.

[0030] The device 10 may also be equipped with auxiliary connections for connecting external detection sensors or apparatus (not shown), e.g. thermometers, anemometers, tv cameras, seismographs, etc..

[0031] Therefore the data stream travelling in the mesh network NT may consist, not only of the data relating to the audio/video channel to be transmitted, but also information as to the configuration and/or operating state of the individual devices 10, and/or data relating to local recordings, such as seismic events or recordings, weather conditions (temperature, wind, humidity), etc., i.e. of the aforementioned external apparatus.

[0032] A maintenance/installation operator connected

via a computer to the mesh network NT, can thus configure and diagnose from a single remote location each single device 10 connected and also receive data of various kinds depending on the type of sensor equipment installed and connected to the device 10 or installed on it. The signal switching means CM may be controlled remotely so as to program in a centralized manner the territorial areas covered by the signal TS and/or by the local signals X.

[0033] The device 10 may be connected to a rechargeable battery ACCU combined with a solar panel SP, which ensures power in the event of absence or a temporary interruption of the connection to the electricity mains. In sunny areas or with an efficient battery, the device 10 may even be independent.

[0034] A user, provided with a special receiver unit RX within the coverage zone FF of the radio signal, can tune into a channel as desired, receiving the signal from the device 10 with the best (closest) signal. Since the transmission is digital and synchronized for each device 10, a movement of the user through zones OV with different superimposed signals does not affect the reception, since it occurs without the receiver having to disconnect and/or reconnect the signal.

Claims

1. Digital radio device (10) for emitting a radio signal in digital format comprising
 - a transmitter stage (14) able to emit a radio signal in digital format,
 - a transceiver module (12) for radio access to a wireless data network (NT) connected to the transmitter stage,
 - means (MP) for extracting a data stream from the wireless network and sending it to the transmitter stage so that it can be radio broadcast locally.
2. Device (10) according to Claim 1, in which the wireless network is a short-range network with broadband radio access of the HiperLAN mesh type.
3. Device (10) according to Claims 1 or 2, in which the transmitter stage is capable of covering at the most distances of about ten kilometres with a maximum irradiated power of about some dozen Watt.
4. Device (10) according to Claim 3, comprising a directional antenna for the field emitted by the transceiver module.
5. Device (10) according to any one of the preceding claims, comprising an input network (E), e.g. in G-ETH technology, designed to acquire locally, at the device, one or more additional audio/video streams (X).
6. Device (10) according to Claim 5, comprising signal switching means (CM) able to select the signal path of the additional stream (X) so as to direct it to the stage transmitter (14) and/or to the wireless data network (NT) via the transceiver module (12).
7. Device (10) according to any one of the preceding claims, comprising a GPS module (16) for obtaining from a satellite a temporary reference clock signal used to synchronize data exchange in the wireless data network (NT) and/or the transmitter stage (14) so that the signal transmitted by the latter is consistent in every location and temporally aligned with the reference signal.
8. Device (10) according to Claim 7, in which the transceiver module (12) is capable of transmitting in the wireless network (NT) information about the coordinates of the installation location of the device (10).
9. Device (10) according to any one of the preceding claims, comprising a rechargeable battery (ACCU) combined with a solar panel (SP), able to ensure power in the event of absence or a temporary interruption of the connection to the electricity mains.
10. Device (10) according to any one of the preceding claims, comprising auxiliary connections for connecting external detection apparatus or sensors, such as thermometers, anemometers, tv cameras or seismographs.
11. Device (10) according to Claim 10, in which the transceiver module (12) is capable of transmitting in the wireless network data relating to said apparatus or sensors installed externally and/or data relating to its own operation.
12. Device (10) according to any one of the preceding claims and/or Claim 11, in which the transceiver module (12) is able to receive commands from the wireless data network, so that the device (10) can be configured remotely.
13. System for radio broadcasting content in digital format, comprising a plurality of devices as described in the preceding claims, located at certain distance from each other so as to form a wireless network.
14. System according to Claim 13, in which most of the devices (10), except for a master device (M) which introduces into the network the signal to be transmitted, operates so as to receive said signal from an upstream device, transmit it using a dedicated transmitter within a local area and send it via the wireless network to a downstream device.

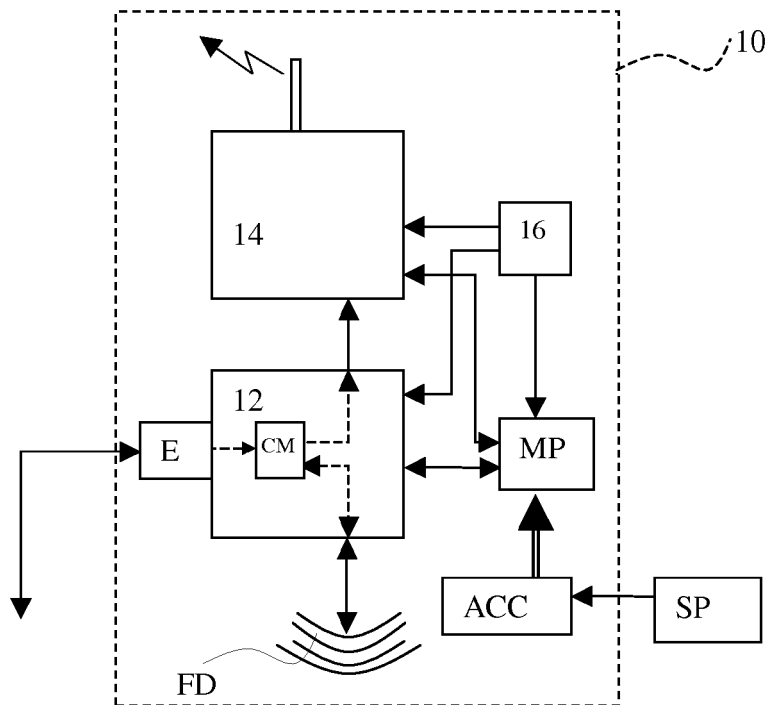


FIG. 1

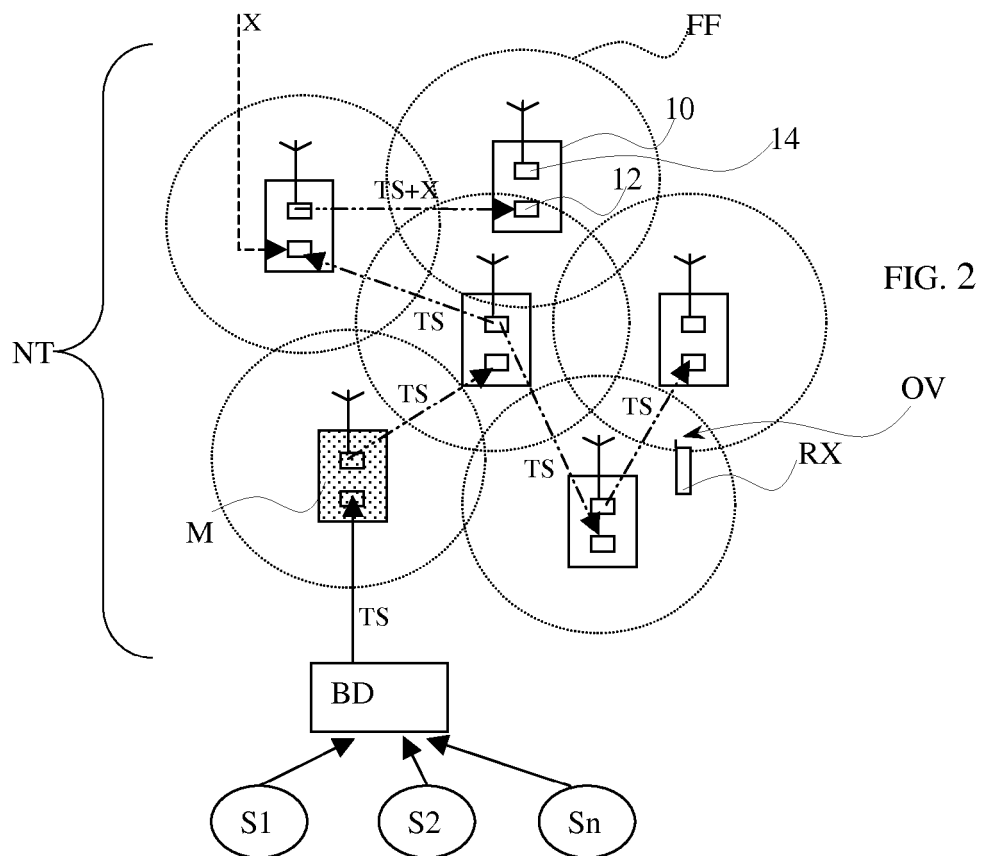


FIG. 2