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TELEVISION BROADCASTING TO MOBILE RECEIVERS10 **Field of the Invention**

This invention relates to television broadcasting to mobile receivers and refers particularly, though not exclusively, to the broadcasting of television to mobile receivers to enable substantially national reception.

15 **Background to the Invention**

The broadcasting of television to a vehicle such as, for example, a car or a bus, moving through a major city and surrounding regions is difficult. If it is required to achieve 99% coverage in the broadcast area, it is quite difficult. Using analog systems, it is impossible to transmit from a single site and have reliable
20 reception in the vehicle when it is moving.

To overcome this problem it has been suggested to use multiple transmission sites, each broadcasting at a different frequency or the same frequency. However, if they use the same frequency they will cause a jam in reception, particularly as the vehicle approaches, crosses, then leaves the boundary area of two adjacent
25 transmitters.

If they use different frequencies it cannot work because the receiver will not be able to select and tune into the correct frequency, particularly at or adjacent the boundary area of two adjacent transmitters. The quality of reception in both instances would generally be relatively poor and unacceptable.

30 When the broadcast signal is for digital television, and must be used for receivers in homes, offices, shops, and elsewhere, the problems are increased.

It is therefore the principal object of the present invention to provide a system for television broadcasting to mobile receivers and which will enable acceptable quality reception over a significant area to be able to be achieved.

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Summary of the Invention

With the above and other objects in mind, the present invention provides a system for television broadcasting including a primary transmitter to provide a

5 primary broadcast signal over a primary region, the primary region including a plurality of zones, there being a secondary transmitter in each of the plurality of zones. Each secondary transmitter is for providing a secondary broadcast signal. The primary transmitter and the secondary transmitter are adapted to, in use, broadcast on a single frequency network such that, in use, a vehicle moving in the primary
10 region and having a television receiver is capable of receiving the primary broadcast signal and, when and as required, at least one of the secondary broadcast signals to enable the television receiver to have an acceptable reception substantially without interference between the broadcast signals and substantially without loss of broadcast signal.

15 Preferably, the primary broadcast signal is prepared in a broadcast centre where it is encoded and multiplexed, and subjected to an input from a Global Positioning System ("GPS") receiver, and the resultant signal is passed to a Single Frequency Network adaptor.

More preferably, the Single Frequency Network adaptor provides a single
20 frequency signal to a Transmit Network Adaptor to enable asynchronous transfer over an asynchronous transfer mode medium to a primary transmitting centre.

The primary transmitting centre may have a Receive Network Adaptor which divides a received signal into at least two divided output signals, the divided output signals including a first signal and a second signal, the first signal being
25 subjected to a first modulation by a first modulator and the second signal being subjected to a second modulation by a second modulator.

The first modulation may provide a first frequency signal, and the second modulation may provide a second frequency signal. Preferably, the second frequency signal is of a frequency different to the frequency of the first frequency
30 signal.

The first modulator may receive an input from a second GPS receiver, and the first frequency signal may be broadcast as the primary broadcast signal using a first transmitter at the primary transmitter. Preferably, the primary broadcast signal is in a frequency range of from 470 to 790 MHz. The second modulator may receive
35 an input from a third GPS receiver.

5 The second frequency signal may be transmitted from the primary transmitter to a plurality of secondary receivers where it is received, modulated to the first frequency, and broadcast as the secondary broadcast signal, the secondary receivers being adjacent the secondary transmitters.

10 The primary region may be the Republic of Singapore, in which case each of the secondary transmitters is located on a roof of an HDB block and/or private property and/or commercial property.

15 The invention also provides a method for television broadcasting including using a primary transmitter to make a primary broadcast signal over a primary region, the primary region including a plurality of zones, there being a secondary transmitter in each of the plurality of zones, each secondary transmitter providing a secondary broadcast signal; the primary transmitter and the secondary transmitter broadcasting on a single frequency network such that a vehicle moving in the primary region and having a television receiver receives the primary broadcast signal and, when and as required, at least one of the secondary broadcast signals to
20 enable the television receiver to have an acceptable reception substantially without interference between the broadcast signals and substantially without loss of broadcast signal.

 The primary broadcast signal may be prepared in a broadcast centre where it is encoded and multiplexed, and subjected to an input from a GPS receiver, and the
25 resultant signal passed to a Single Frequency Network adaptor which provides a signal to a Transmit Network Adaptor which enables asynchronous transfer of the signal to a primary transmitting centre.

 At the primary transmitting centre the received signal is divided into two divided output signals, the divided output signals including a first signal and a
30 second signal, the first signal being modulated by a first modulator and the second signal being modulated by a second modulator.

 Preferably, the first and second frequency modulations give a first frequency signal and a second frequency signal, the second frequency signal being of a frequency different to the frequency of the first frequency signal.

35 The first modulator may also receive an input from a second Global Positioning System receiver.

5 The first frequency signal is broadcast as the primary broadcast signal using a first transmitter and the primary transmitter, the primary broadcast signal preferably being in a frequency range of from 470 to 790 MHz.

 The second frequency signal is also transmitted from the primary transmitter to a plurality of secondary receivers where it is received, modulated to the first
10 frequency, and broadcast as the secondary broadcast signal, the secondary receivers being adjacent the secondary transmitters.

 The primary region may be the Republic of Singapore, in which case each of the secondary transmitters is located on a roof of an HDB block and/or private property and/or commercial property.

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Description of the Drawings

 In order that the present invention may be fully understood and readily put into practical effect, there shall now be described by way of non-limitative example only a preferred form of the present invention, the description being with reference
20 to the accompanying illustrative drawings in which:

 Figure 1 is a schematic view of a system according to the present invention;
and

 Figure 2 is a map of a country showing exemplified broadcast locations.

25 Description of Preferred Embodiment

 As shown in Figure 1, there are generally three physical locations involved in the television broadcast.

 The first is the broadcast center 10, where the primary broadcast signal is prepared. This is done in a normal manner such, for example, by using the normal
30 editing 12 and presentation 14 systems for a digital television ("DTV") broadcast. This gives an output which is encoded and then passed to a multiplexer 16 to allow a number of signals to be sent simultaneously. At this time there is also an input from a first Global Positioning System ("GPS") receiver 18 which is to enable synchronization of all broadcast signals.

35 The output from the multiplexer 16 passes through a Single Frequency Network adapter 20 and then to an Transmit Network Adaptor 22 to enable

5 asynchronous transfer over an Asynchronous Transfer Mode transmission medium
24.

At the second location - a primary transmitting station 26 - the received
signal is processed by a second Receive Network Adaptor 28 which divides the
signal and passes a first output to a first modulator 30 and a second output to a
10 second modulator 32. The first and second outputs are preferably modulated so that
the output from the first modulator is at a different frequency to the output from the
second modulator. This may be done using Quadrature Amplitude Modulation or
Quadrature Phase Shift Keying. The first modulator 30 receives an input from a
second GPS receiver 34 so that the transmission is accurately timed for broadcast
15 synchronization.

The first modulated signal is passed through a first DTV transmitter 38 such
as, for example, a Digital Video Broadcasting Group ("DVB") transmitter. That
passes the first signal to the transmitting tower 36 where it is broadcast at a first
frequency, F1, which is preferably in the range of 470 to 790 MHz. This broadcast is
20 a primary broadcast intended to be received by decoder-receivers in homes, offices,
shops, places of recreation and entertainment, and so forth. It is also intended to be
received by a decoder-receiver in a mobile environment such as, for example, a bus
40.

The second modulator 32 receives an input from a third GPS receiver 33 so
25 that the transmission is accurately time for broadcast synchronization. The second
modulated signal passes through a second DTV transmitter 42 such as, for example,
a DVB transmitter, that also passes the second signal to the transmitting tower 36
where it is transmitted at a second frequency, F2, also in the range 420 to 790 MHz,
but where F2 is different to F1.

30 At a relatively tall location 44, such as on the top of an office block,
apartment block, a tall hill, or the like, the second signal is received by decoder-
receivers 46, modulated to the first frequency F1, and broadcast by transmitter 48.
The building 44 with transmitter 48 therefore each represent a secondary, or filler,
transmitter.

35 The location of the secondary transmitters 48 can be carefully selected so
that for a large area the DTV broadcast will be reliably received by not only fixed

5 decoder-receivers, but also mobile decoder-receivers. In this way up to 99% of the broadcast area can have reliable reception.

This is shown in Figure 2, using the island country and city of Singapore as an example where there is indicated the location of secondary transmitters 48, and also shown is the primary transmitter 36. The secondary transmitters 48 can be
10 located, for example, on a roof of an HDB block, a commercial property and/or a private property.

It is preferred that for the broadcast 16 Quadrature Amplitude Modulation ("QAM"), 2K/8K mode, $\frac{1}{2}$ code rate, $\frac{1}{4}$ guard interval be used, and more preferably a bit rate of 9.95 Mb/second is used.

15 Also, there may also be simultaneous FM (Frequency Modulation) audio broadcast with the DTV broadcast.

Whilst there has been described in the foregoing description a preferred embodiment of the present invention, it will be understood by those skilled in the technology that many variations or modifications in details of design or construction
20 may be made without departing from the present invention.

5 The claims:

1. A system for television broadcasting including a primary transmitter to provide a primary broadcast signal over a primary region, the primary region including a plurality of zones, there being a secondary transmitter in each of the plurality of zones, each secondary transmitter being for providing a secondary broadcast signal; the primary transmitter and the secondary transmitter being adapted to, in use, broadcast on a single frequency network such that, in use, a vehicle moving in the primary region and having a television receiver is capable of receiving the primary broadcast signal and, when and as required, at least one of the secondary broadcast signals to enable the television receiver to have an acceptable reception substantially without interference between the broadcast signals and substantially without loss of broadcast signal.
2. A system as claimed in claim 1, wherein the primary broadcast signal is prepared in a broadcast centre where it is encoded and multiplexed, and subjected to an input from a Global Positioning System receiver, and the resultant signal is passed to a Single Frequency Network adaptor.
3. A system as claimed in claim 2, wherein the Single Frequency Network Adaptor provides a single frequency signal to a Transmit Network Adaptor to enable asynchronous transfer over an asynchronous transfer mode medium to a primary transmitting centre.
4. A system as claimed in claim 3, wherein the primary transmitting centre has a Receive Network Adaptor which divides a received signal into two divided output signals, the two divided output signals including a first signal and a second signal, the first signal being subjected to a first modulation by a first modulator and the second signal being subjected to a second modulation by a second modulator.
5. A system as claimed in claim 4, wherein the first modulation provides a first frequency signal.
6. A system as claimed in claim 5, wherein the second modulation provides a second frequency signal.



- 5 7. A system as claimed in claim 6, wherein the first modulation and the second modulation are performed using quadrature phase shift keying.
8. A system as claimed in claim 6, wherein the first modulation and the second modulation are performed using quadrature amplitude modulation.
9. A system as claimed in any one of claims 6 to 8, wherein the second
10 frequency signal is of a frequency in the range of from 470 to 790 MHz and different to the frequency of the first frequency signal.
10. A system as claimed in any one of claims 5 to 9, wherein the first modulator receives an input from a second Global Positioning System receiver.
11. A system as claimed in any one of claims 5 to 10, wherein the first frequency
15 signal is broadcast as the primary broadcast signal using a first transmitter at the primary transmitter.
12. A system as claimed in any one of claims 1 to 11, wherein the primary broadcast signal is in a frequency range of from 470 to 790 MHz.
13. A system as claimed in any one of claims 6 to 9, wherein the second
20 frequency signal is transmitted from the primary transmitter to a plurality of secondary receivers where it is received, modulated to the first frequency, and broadcast as the secondary broadcast signal.
14. A system as claimed in claim 13, wherein the secondary receivers are adjacent the secondary transmitters.
- 25 15. A system as claimed in any one of claims 1 to 14, wherein the primary region is the Republic of Singapore.
16. A system as claimed in claim 15, wherein each of the secondary transmitters is located on a roof of a location selected from the group consisting of: an HDB block, private property, an office block, apartment block, tall hill and
30 commercial property.
17. A system as claimed in any one of claims 4 to 16, wherein the second modulator receives an input from a third Global Positioning System receiver.
18. A method for television broadcasting including using a primary transmitter to make a primary broadcast signal over a primary region, the primary region
35 including a plurality of zones, there being a secondary transmitter in each of the plurality of zones, each secondary transmitter providing a secondary



5 broadcast signal; the primary transmitter and the secondary transmitter
broadcasting on a single frequency network such that a vehicle moving in the
primary region and having a television receiver receives the primary
broadcast signal and, when and as required, at least one of the secondary
broadcast signals to enable the television receiver to have an acceptable
10 reception substantially without interference between and of the broadcast
signals and substantially without loss of broadcast signal.

19. A method as claimed in claim 18, wherein the primary broadcast signal is
prepared in a broadcast centre where it is encoded and multiplexed, and
subjected to an input from a Global Positioning System receiver, and the
15 resultant signal passed to a Single Frequency Network adaptor.

20. A method as claimed in claim 18, wherein the Single Frequency Network
adaptor provides a single frequency signal to a Transmit Network Adaptor
which asynchronously transfers the single frequency signal to a primary
transmitting centre.

20 21. A method as claimed in claim 20, wherein the primary transmitting centre
has a Receiver Network Adaptor which divides a received signal into two
divided output signals, the two divided output signals including a first signal
and a second signal, the first signal being modulated by a first modulator and
the second signal being modulated by a second modulator.

25 22. A method as claimed in claim 21, wherein the first modulation provides a
first frequency signal.

23. A method as claimed in claim 22, wherein the second modulation provides a
second frequency signal.

24. A method as claimed in claim 23, wherein the first modulation and the
30 second modulation are quadrature amplitude modulation.

25. A method as claimed in claim 23, wherein the first modulation and the
second modulation are performed by quadrature phase shift keying.

26. A method as claimed in any one of claims 23 to 25, wherein the second
frequency signal is of a frequency different to the frequency of the first
35 frequency signal.



- 5 27. A method as claimed in any one of claims 21 to 26, wherein during the first modulation there is received an input from a second Global Positioning System receiver.
28. A method as claimed in any one of claims 22 to 27, wherein the first frequency signal is broadcast as the primary broadcast signal using a first transmitter at the primary transmitter.
- 10 29. A method as claimed in any one of claims 18 to 28, wherein the primary broadcast signal is in a frequency range of from 470 to 790 MHz.
30. A method as claimed in claim 26, wherein the second frequency signal is in a range of from 470 to 790MHz.
- 15 31. A method as claimed in claim 23 or claim 24, wherein the second frequency signal is transmitted from the primary transmitter to a plurality of secondary receivers where it is received, modulated to the first, and broadcast as the secondary broadcast signal.
32. A method as claimed in claim 31, wherein the secondary receivers are adjacent the secondary transmitters.
- 20 33. A method as claimed in any one of claims 18 to 32, wherein the primary region is the Republic of Singapore.
34. A method as claimed in claim 33, wherein each of the secondary transmitters is located on a roof of a location selected from the group consisting of: an HDB block, private property, office block, apartment block, or tall hill and commercial property.
- 25 35. A method as claimed in any one of claims 21 to 34, wherein the second modular receives an input signal from a third Global Positioning System receiver.

