[0001] NODE-B CAPABLE OF SUPPORTING POINT TO MULTI-POINT SERVICES USING SHARED CHANNELS

[0002] FIELD OF INVENTION

[0003] The invention generally relates to wireless communication systems. In particular, the invention relates to point to multi-point services in such systems.

[0004] BACKGROUND

[0005] There is a growing desire to use point to multi-point services in wireless communication systems. As shown in Figure 1 in point to multi-point (PtM), one service is sent from a single point, such as a base station 10, to multiple points, such as multiple user equipments 12_1-12_3. Examples of point to multi-point services are multimedia broadcasts and multicast services.

[0006] In the third generation partnership program (3GPP) proposed system, one proposed channel that could be used for such services is the forward access channel (FACH). The FACH is a downlink common transport channel (TrCH) that can be received by all users. The FACH TrCH is broadcast by applying it to the secondary common control physical channel (S-CCPCH). The S-CCPCH is transmitted to all the cell users.

[0007] To limit the radio recourses utilized by the S-CCPCH, the S-CCPCH data rate is limited. To illustrate, if a high data rate service was transmitted over the S-CCPCH, it would need to be transmitted using a low data redundancy to achieve that high data rate. Since the S-CCPCH is transmitted to the entire cell, it is transmitted at a power level sufficient for reception by a user at the periphery of the cell at a certain quality of service (QOS). Broadcasting a high data rate service at this power level would increase interference to other users reducing the capacity of system, which is extremely undesirable, due to the inefficient use of cell resources.

[0008] Additionally, due to the broadcast nature of the S-CCPCH and FACH, the radio resources required for the S-CCPCH and FACH are rather static, due to channel allocation and messaging on these channels being provided at a relatively slow rate by layer 3 signaling techniques. The modulation and coding set (MCS) and transmission power level used by the S-CCPCH needs to be sufficient to maintain a certain QOS at the periphery of the cell. The static nature of the S-CCPCH configuration does not allow dynamic adjustment of these parameters to make efficient use of radio resources. Additionally, scheduling of transmissions also occur at this slow rate, which does not allow for efficient use of this radio resource and does not allow for efficient multiplexing of data streams to each user.

[0009] Another channel that can be used for point to point (PtP) services is the downlink shared channels (DSCHs). The DSCHs are shared by multiple users. Transmissions to different users (user equipments) over the DSCH are separated by time. As a result, the DSCHs are time shared channels.

[0010] Each user using the DSCH has an uplink and a downlink dedicated control channel. These control channels allow a more efficient radio resource utilization of the DSCHs. These control channels allow for power control for each user's transmission over the DSCH and also allow for beam forming to better separate user transmissions. The DSCH's use of power control and beam forming allows for better resource utilization than provided by FACH channels.

[0011] To receive information over the DSCH, a user first monitors its dedicated downlink control channel. A burst in the downlink control channel may have both a first portion and a second portion of a transport format combination indicator (TFCI). The first portion indicates the transport format of the downlink dedicated channel.The second portion indicates existence and the transport format of a subsequent DSCH transmission. If a DSCH transmission to the user is going to be sent to the user, the downlink control channel has the second portion of the TFCI set. The transmission will occur in a subsequent transmission time interval (TTI), after a specified time period. The user then monitors the DSCH for its transmission. To verify that the user is the correct recipient of the DSCH transmission, it checks the transmission for its user identifier. If a transmission is not going to be sent, the second portion of the TFCI is not present on the downlink dedicated control channel.

[0012] Although the DSCHs allows for a more efficient utilization of radio resources, only point to point services can be handled. To handle multiple reception points, multiple transmissions are made over the DSCH. Accordingly, transmission to many users requires many transmissions over the DSCH, using valuable radio resources.

[0013] Accordingly, it is desirable to have added flexibility in providing wireless point to multi-point services.

[0014] SUMMARY

[0015] A Node-B comprises a plurality of control channel generators. Each control channel generator produces a control channel for a corresponding user out of a plurality of users and transmits a service identifier over the control channel. A shared channel generator produces a shared channel, transmits a service identifier over the shared channel indicating transmission of a point to multipoint service and transmits a point to multi-point transmission of the point to multi-point service over the shared channel. A multi-point synchronization device synchronizes the transmission of the service identifiers over the control channels and the shared channel. A measurement receiver receives power control commands for users of the point to multi-point service to control a power level of the shared channel.

[0016] BRIEF DESCRIPTION OF THE DRAWING(S)

[0017] Figure 1 is an illustration of a point to multi-point service.

[0018] Figure 2 is an illustration of a preferred shared channel.

[0019] Figure 3 is simplified diagram of a preferred radio network controller/Node-B and user equipment.

[0020] Figure 4 is a simplified diagram of a preferred radio network controller with a scheduling mechanism for the preferred shared channel.

[0021] Figure 5A, 5B, 5C, 5D and 5E are illustrations of preferred scheduling of signals for the shared channel.

[0020] Figure 5A, 5B, 5C, 5D and 5E are illustrations of preferred scheduling of signals for the shared channel.

[0021] Figure 6 is an illustration of preferred signals for establishment and transmission of a point to multi-point service over a downlink shared channel.

[0022] Figure 7 is a simplified diagram of a preferred Node-B and user equipment using transmission power control and beam steering for a shared channel.

[0023] DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

[0024] Although the preferred embodiments are described in conjunction with a preferred 3GPP proposed system, they can be utilized with other wireless systems using point to multi-point transmissions.

[0025] Figure 2 is an illustration of a preferred shared channel 16 and its associated downlink and uplink dedicated control channels 14_1-14_N. Although the preferred embodiment uses downlink and uplink dedicated control channels, the information sent over these channels may, in alternate embodiments, be sent by other means, such as by common physical control channels or layer 2/3 signals. A group of users, UE 1 12_1, ..., UE J 12_J, ..., UE N 12_N, are to receive a shared service 16. A downlink dedicated control channel 14_1-14_N for each user is utilized to establish the shared channel and for other control purposes. The shared channel 16 is sent by a base station 10 and is received by the group of UEs 12_1-12_N. UEs, such as UE X 12_X, do not receive the shared channel allocation indication in their dedicated control channels 14_X and do not receive data of the shared channel 16.

[0026] Figure 3 is a simplified diagram of a RNC 20/Node-B 18 and one of the UEs, UE J 12_J, for use in transferring data over the shared channel. At the RNC 20/Node-B 18, each downlink dedicated control channel (DDCC) generator 24_1-24_N produces a control channel signal for each UE 12_1-12_N. A multi-point synchronization device 25 is used to synchronize DSCH allocations to user groups subscribing to a common PtM service on the users' DDCCs. For a UE J 12_J, after its dedicated control channel is radiated by an antenna 32 or antenna array through the wireless radio interface 22, it is received by an antenna 34 or an antenna array of the UE J 12_J and processed by a control channel receiver 36 to recover control information of the channel.

[0027] A downlink shared channel generator 26 produces the shared channel signal for transfer through the wireless interface 22. The shared channel signal is received by the UE J 12_J using its antenna 34 or antenna array. Information of the shared channel is recovered using the dedicated control channel information by a downlink shared channel receiver 38. A shared channel measuring device 40 takes channel quality measurements/information of the downlink dedicated channel and/or shared channel, for example, received signal code power, relative interference, and block error rate. The measurements/information is sent to the RNC 20/Node-B 18. Typically, this channel quality measurements/information is transmit power commands (TPC), phase shift and amplitude information for use in beam forming, and measured values of received power and interference.

[0028] A measurement receiver 30, at the RNC 20/Node-B 18, recovers the channel measurements from all the users of the shared channel. A power control device 28 uses the channel measurements/information to set the power level for the shared channel. Additionally, a transmit diversity device 29 may use the phase shift and amplitude information to set beam forming for the shared channel. Preferably, the power level and beam forming is updated every transmission time interval (TTI), although a longer time period can be used.

[0029] The dedicated channels are continuously maintained. The received BLER is used to determine a signal to interference ratio (SIR) target. Based on the received estimated SIR, TPC commands are generated. When the DSCH is activated, the power required is derived from the dedicated channel. However, it is typically not exactly the same, since the BLER requirement and physical configuration differ between them. For a PtM transmission, the transmission power level is set to achieve the desired QOS to the user with the worst reception quality for the PtM transmission. It is also possible to omit users within the PtM user group for which their QoS requirements can not be achieved due to physical limitations in this transmission.

[0030] For services having multiple sub-streams of data, the transmission characteristics of the various sub-streams may be handled separately. To illustrate, a multimedia service may have an audio, video and text sub-streams. The QOS of each sub-stream may differ allowing different transmission attributes to be used by each sub-stream. This approach allows for better resource efficiency. Instead of transmitting each sub-stream to meet the highest QOS sub-stream requirements, they can be handled separately on individual DSCH transmissions.

[0031] Figure 4 is a simplified block diagram of a preferred radio network controller (RNC) 42. The preferred RNC 42 has a scheduling mechanism 46. The scheduling mechanism 46 is preferably used to schedule data every TTI, although a longer scheduling period may be used. The scheduling mechanism 46 receives data to be transmitted over shared channel resources. The received data includes data for PtP and PtM services. The scheduling mechanism schedules the data for transmission in the PtP and PtM transmissions. To schedule the information, the scheduling mechanism 46 considers the QOS required by each transmission including its required data latency and throughput, as well as physical propagation requirements including the total power requirements of the cell and each channel and beam steering information. For each TTI, the scheduling mechanism makes a best use of the cell resources in it's decision to schedule the data transmissions. To illustrate, in a particular TTI the total cell power requirement may be almost reached. If the PtM service can be delayed, the PtM service transmission may be delayed one or two TTIs, until the total cell power requirement drops. If this TTI by TTI flexibility is not available, a resource decision is made and can not be changed over a specified time period, such as 100ms. or 1s. In these situations, resources are allocated and not changed in that time period. As a result, certain transmissions that could have been transmitted may not be due to idle allocated resources. The RNC 42 signals to the UEs 12_1-12_N the channels and the timing of the PtP and PtM transmissions. Scheduling on a TTI basis offers a greater ability to achieve the QOS and data latency requirements while maintaining high utilization of DSCH cell resources. Cell physical channel and PtP/PtM data transmission requirements change dynamically, therefore a scheduling mechanism 46 which can react quickly to these changes offers improved ability to achieve QoS requirements while making the most efficient use of the cells physical resources.

[0032] The scheduler 46 may also take into account physical transmission requirements. For example, one user or user group may require a more robust MCS than another. During the next TTI resources may only be available for a less robust MCS. The scheduler 46 may then schedule transmissions for PtP users or PtM user groups that maximize the use of available resources. Since data available for transmission with specific QOS requirements, available physical resources and channel quality measurements change on a TTI basis, the ability to schedule within this interval improves the number of satisfied users and the overall utilization and efficient use of physical resources.

[0033] The preferred scheduling for each TTI reduces resource conflicts between services, by reducing the occurrences of idle radio resources. Additionally, the TTI scheduling granularity allows for the changing of PtM transmissions to PtP transmissions and vice versa on the fly. To illustrate, a multimedia service is sent by a PtM transmission to multiple users. For a particular TTI, only one user requires the transmission and the scheduling mechanism 46 schedules that TTIs service transmission as PtP. In the next TTI, multiple users require the service transmission and a PtM transmission is scheduled. Using the preferred scheduling mechanism 46, the PtP and PtM services can be segmented and reassembled over multiple non-contiguous TTI allocations. This scheduling mechanism 46 further increases flexibility of radio resource assignment and results in greater radio resource efficiency.

[0034] Figures 5A, 5B, 5C, 5D and 5E are illustrations of a potential allocation of the shared channel for a PtM service. In dedicated control channels 14_1-14_N for each user of a PtM user group, user 1 to user N, receiving the service as shown in Figure 5A, control information is sent. As shown in Figure 5B for a

3GPP FDD system, there is a chip offset "DOFF" used to stagger start of user TTIs. For each user within the PtM service user group as shown in Figure 5A and 5B, a service transmission indicator (STI) 50 is sent along with the dedicated control information. The service transmission indicator 50 indicates that service data will be sent over the shared channel 16. The preferred service transmission indicator is the presence of the second portion of the TFCI in the dedicated downlink control channel burst, although different indicators, such as a bit or word, may be used. After a set time period, the service data is transmitted over the shared channel 16. The transmitted service data, preferably, has an ID 52 associated with the service. This service ID (SID) 52 is used to verify that the correct group of recipients is receiving the transmission.

[0035] Figure 5C illustrates the allocation of multiple PtM services. Users 1 and 2 are in group A and receive one PtM service. Users 2 and 3 are in group B and receive another PtM service. A particular user can receive multiple PtM and PtP services. As shown in Figure 5C, user 2 receives both PtM services. In the DDCCs 14_1 to 14_3 for each user,.a service indicator 50_1, 50_2 is sent to indicate that a corresponding service transmission is being sent over its DSCH. The multiple services may be sent over the same DSCH or multiple DSCHs 16_1, 16_2. Each service transmission has its service ID 52_1 and 52_2. In Figure 5D, the STIs 50_1 and 50_2 and the DDCCs are staggered in time. However, the transmission over the different shared channels 16_1, 16_2 may be simultaneous.

[0036] In Figure 5E for a differing signaling approach, multiple user groups 1-G may be receiving a service. Each user has a DDCC 14_{11} to 14_{GN} and receives an STI to indicate the PtM transmission. UE groups 1-G are to receive the service. The data transmitted in the shared channel comprises a group ID (GID) 54_1-54_G for each of the recipient groups.

[0037] Figure 6 is an illustration of preferred signals for establishment and transmissions of a point to multi-point service over DSCHs. The UMTS terrestrial radio access network (UTRAN) 70 signals to each user, user equipment 12, to received the service the transport attributes of the transmission, 74. Data to be sent for the point to multi-point service is received from the core network by the UTRAN 70. Each user of the PtM service may not be activated/configured to receive the service at the same time. Users may register for the service at any time, even when the service is ongoing or the user may register when entering specific PtM service areas. Each user configures itself for reception of the transmission, 72, and monitors it's dedicated control channel for DSCH allocations 82.

[0038] Each user maintains uplink and downlink dedicated channels and sends channel information, such as received interference, received power, calculated pathloss and location information, to the UTRAN 70, 76. The received interference and pathloss can also be indicated by use of TPC and location information can be signaled by phase shift indications. Using the channel information for all the users within each PtM user group, the RAN 70 establishes criteria for allocation of the DSCH transmissions, such as transmission power levels and beam forming requirements, 78. To illustrate, if beam forming is not used, the RAN 70 would typically set the transmission power level at a level for reception by the user having the worst reception quality, such as the user having the largest pathloss. If beam forming is used, the power level for each beam is based on the users within the beam having the worst quality. For beam forming, the location information is used to group the users based on their location to establish the number, size and shape of the beams needed to service the group. To optimize the usage of radio resources, these parameters are preferably updated every time transmission interval (TTI), preferably, on each user's uplink dedicated control channel, although a longer time period between updates may be used by transferring equivalent information with layer 3 signaling procedures.

[0039] The UTRAN 70 sends the service indicator to the user group(s) on each users dedicated control channel in a synchronized manner, 80. Each user in the group(s) configures itself to receive the PtM transmission, 82.

[0040] Since the indication of the shared channel transmission is typically not completely fault tolerant, preferably, an identifier is sent in the DSCH. However, in alternate embodiments, the DSCH identifier may not be used. For PtP services, a specific user identifier is signaled with the DSCH transmission.

For the preferred embodiment, a PtM service identifier common to all users within the PtM user group is signaled with DSCH, 84. Each user verifies that either its PtP user specific identifier or the PtM service identifier is sent with the service transmission. The received service data is forwarded to the common traffic channel at the UE 12_1-12_N, 86.

[0041] Figure 7 is a simplified illustration of a Node-B 18 and UE 12_J utilizing adaptive power control and beam steering for the DSCH. The UE 12_J receives the DSCH over the wireless radio interface 64 using its antenna 72. The DSCH data is recovered by a user DSCH receiver 66. A user feedback transmitter 68 sends channel information, such as TPC and/or phase shift information back to the Node-B 18. The Node-B 18 recovers the channel information from all the users associated with each PtM user group using a user feed back receiver 62.

[0042] Data to be sent over the DSCH for each PtM user group is produced by a DSCH generator 56. A power control device 58 establishes the transmission power level of the DSCH or each DSCH beam using the received feedback information. Beams for the DSCH are determined by a beam steering controller 60, which provides appropriate magnitude and weight values to each antenna 70_1 to 70_N of the Node-B's antenna array.

* * *

CLAIMS

What is claimed is:

1. A Node-B comprising:

a plurality of control channel generators, each for producing a control channel for a corresponding user out of a plurality of users and transmitting a service identifier over the control channel;

a shared channel generator for producing a shared channel and transmitting a service identifier over the shared channel indicating transmission of a point to multi-point service and transmitting a point to multi-point transmission of the point to multi-point service over the shared channel;

a multi-point synchronization device for synchronizing the transmission of the service identifiers over the control channels and the shared channel; and

a measurement receiver for receiving power control commands for users of the point to multi-point service to control a power level of the shared channel.

2. The Node-B of claim 1 further comprising an antenna for radiating the control channels and the shared channel and receiving the power control commands.

3. The Node-B of claim 1 further comprising a plurality of antennas for radiating the control channels and the shared channel and receiving the power control commands and a transmit diversity device for beamforming the point to multi-point transmission over the shared channel.

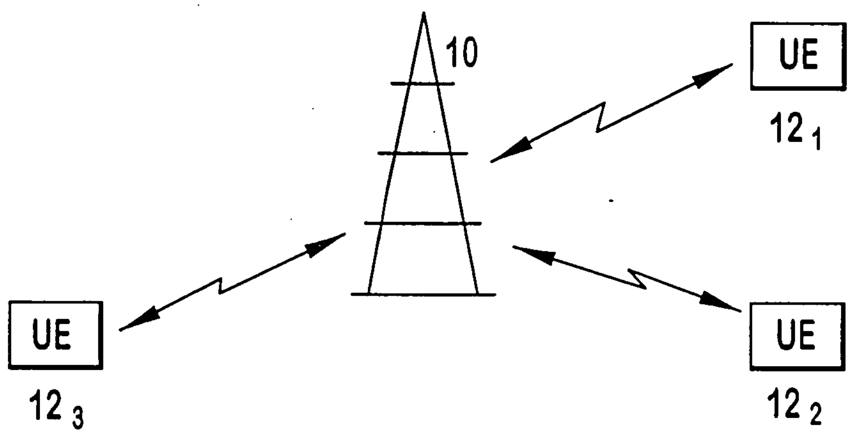
10
UE
12_1
UE
12_3
UE
12_2

FIG. 1

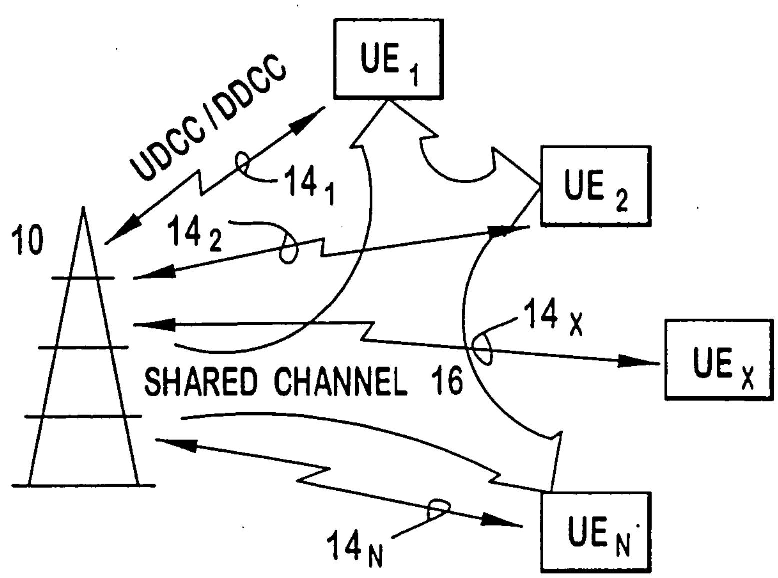
UDCC / DDCC
UE_1
14_1
UE_2
10
14_2
14_X
UE_X
SHARED CHANNEL 16
14_N
UE_N

FIG. 2

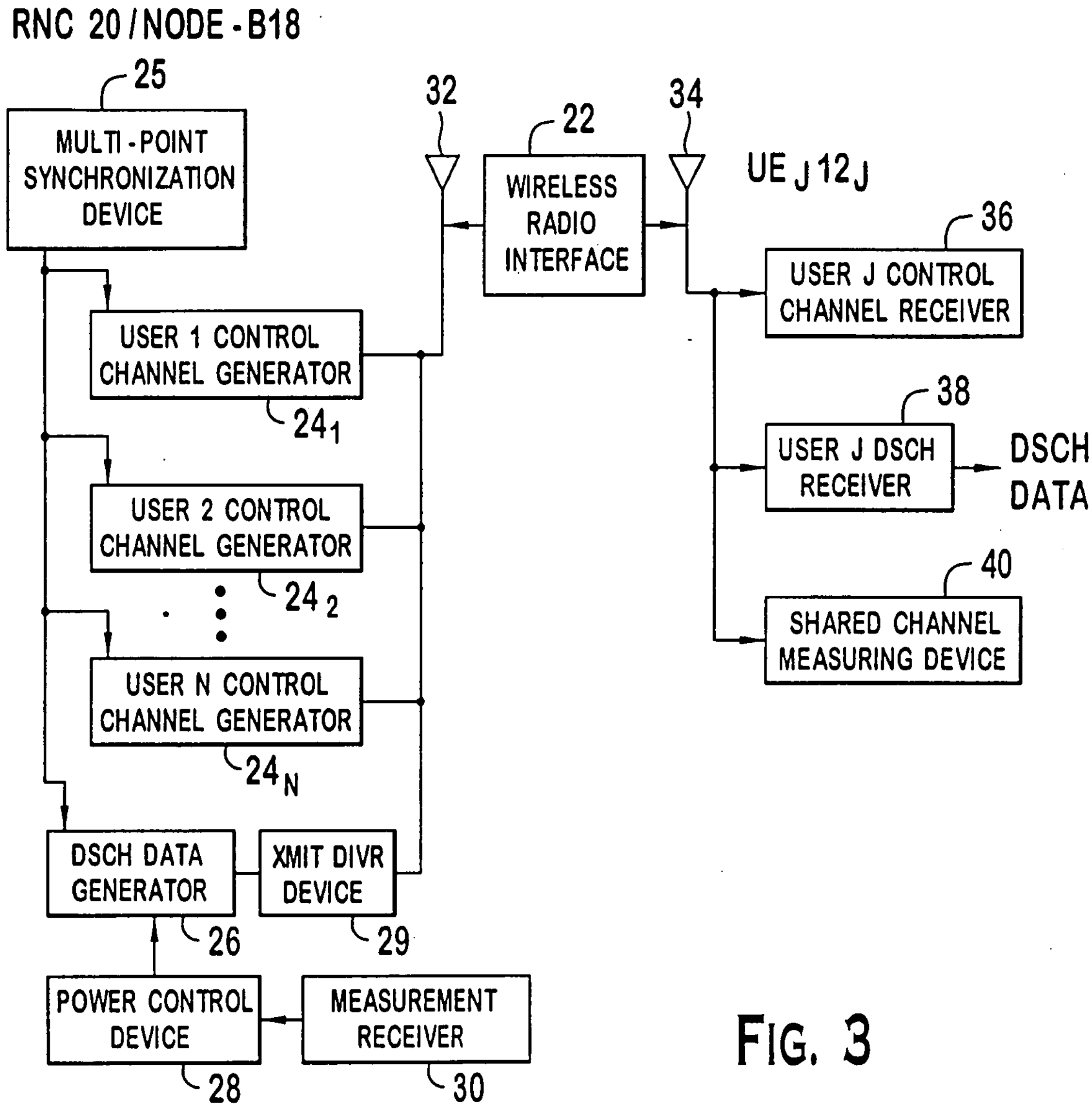
RNC 20/NODE-B18
25
MULTI-POINT SYNCHRONIZATION DEVICE
32
22
WIRELESS RADIO INTERFACE
34
UE J 12J
36
USER J CONTROL CHANNEL RECEIVER
38
USER J DSCH RECEIVER
DSCH DATA
40
SHARED CHANNEL MEASURING DEVICE
USER 1 CONTROL CHANNEL GENERATOR
24 1
USER 2 CONTROL CHANNEL GENERATOR
24 2
USER N CONTROL CHANNEL GENERATOR
24 N
DSCH DATA GENERATOR
26
XMIT DIVR DEVICE
29
POWER CONTROL DEVICE
28
MEASUREMENT RECEIVER
30

FIG. 3

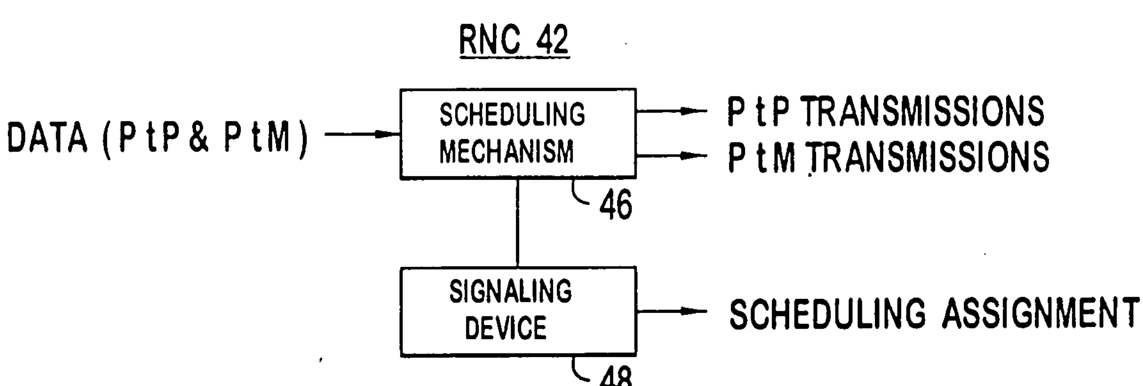
RNC 42
DATA (PtP & PtM)
SCHEDULING MECHANISM
46
PtP TRANSMISSIONS
PtM TRANSMISSIONS
SIGNALING DEVICE
48
SCHEDULING ASSIGNMENT

FIG. 4

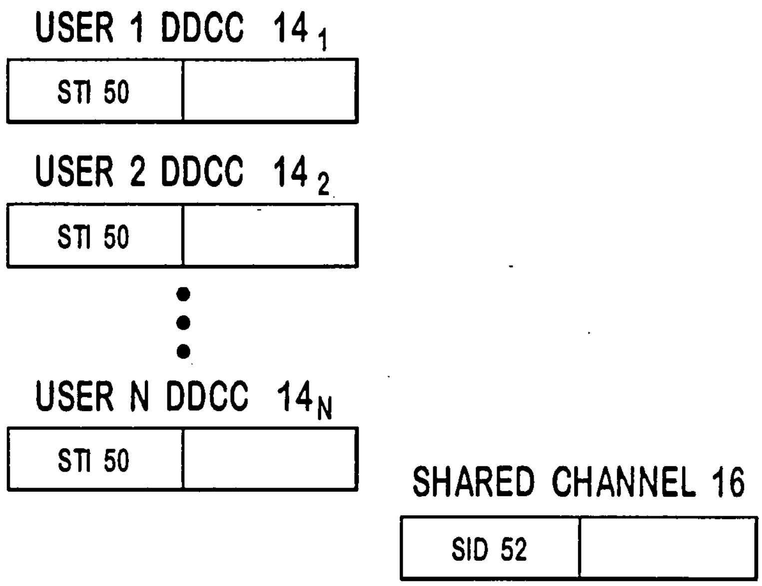
USER 1 DDCC 14 1
STI 50
USER 2 DDCC 14 2
STI 50
USER N DDCC 14N
STI 50
SHARED CHANNEL 16
SID 52

FIG. 5A

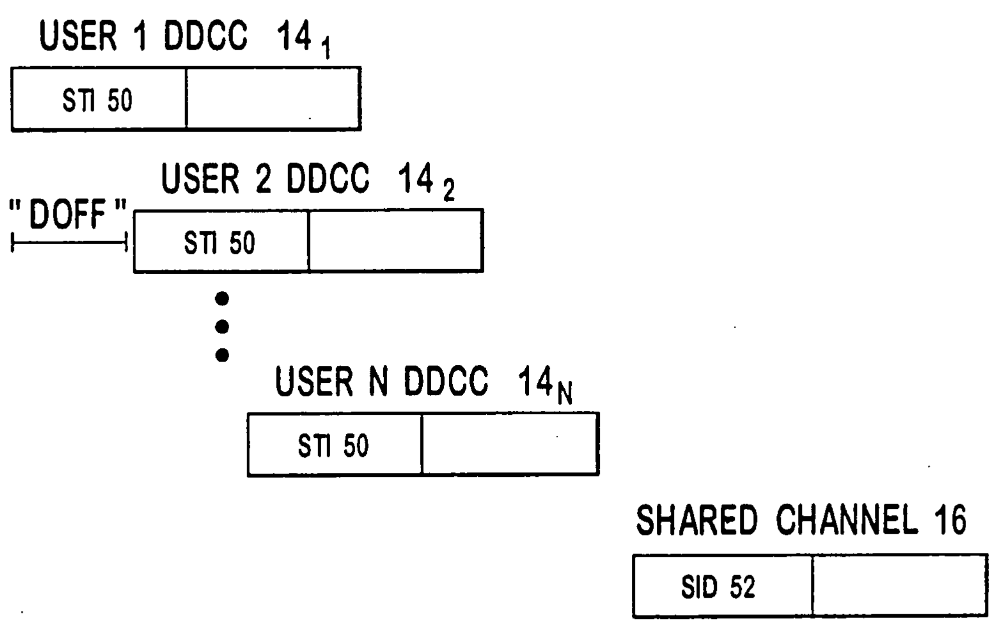
USER 1 DDCC 14 1
STI 50
USER 2 DDCC 14 2
"DOFF"
STI 50
USER N DDCC 14N
STI 50
SHARED CHANNEL 16
SID 52

FIG. 5B

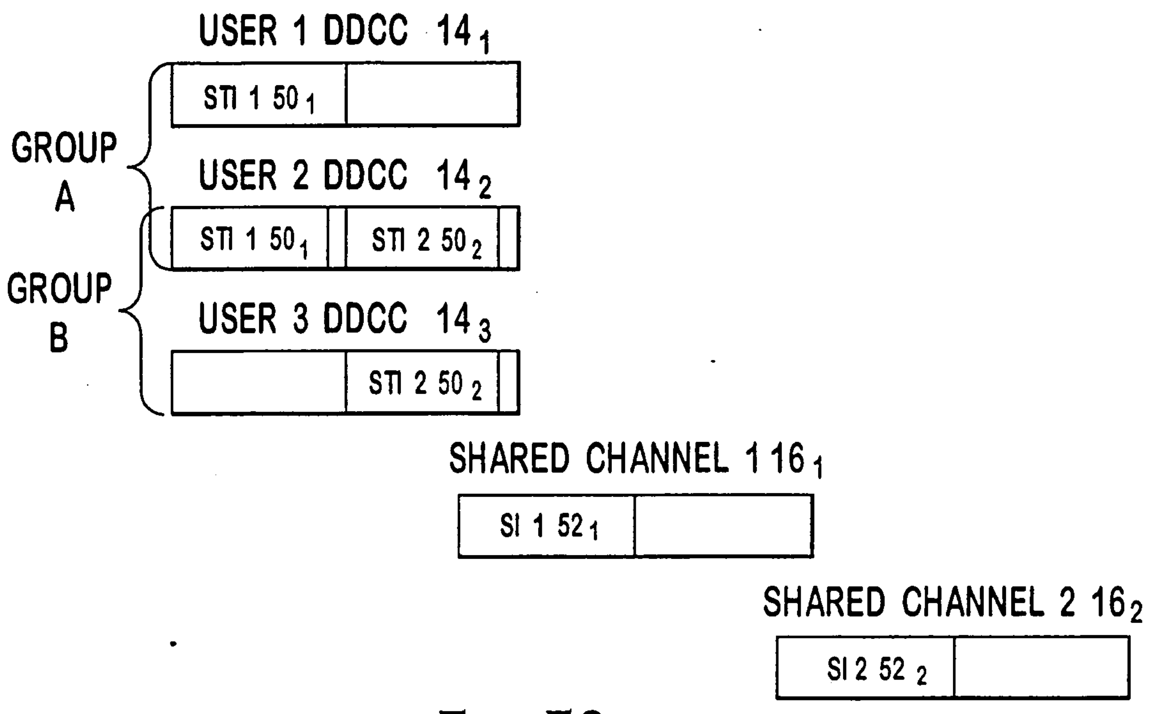
USER 1 DDCC 14 1
STI 1 50 1
GROUP A
USER 2 DDCC 14 2
STI 1 50 1
STI 2 50 2
GROUP B
USER 3 DDCC 14 3
STI 2 50 2
SHARED CHANNEL 1 16 1
SI 1 52 1
SHARED CHANNEL 2 16 2
SI 2 52 2

FIG. 5C

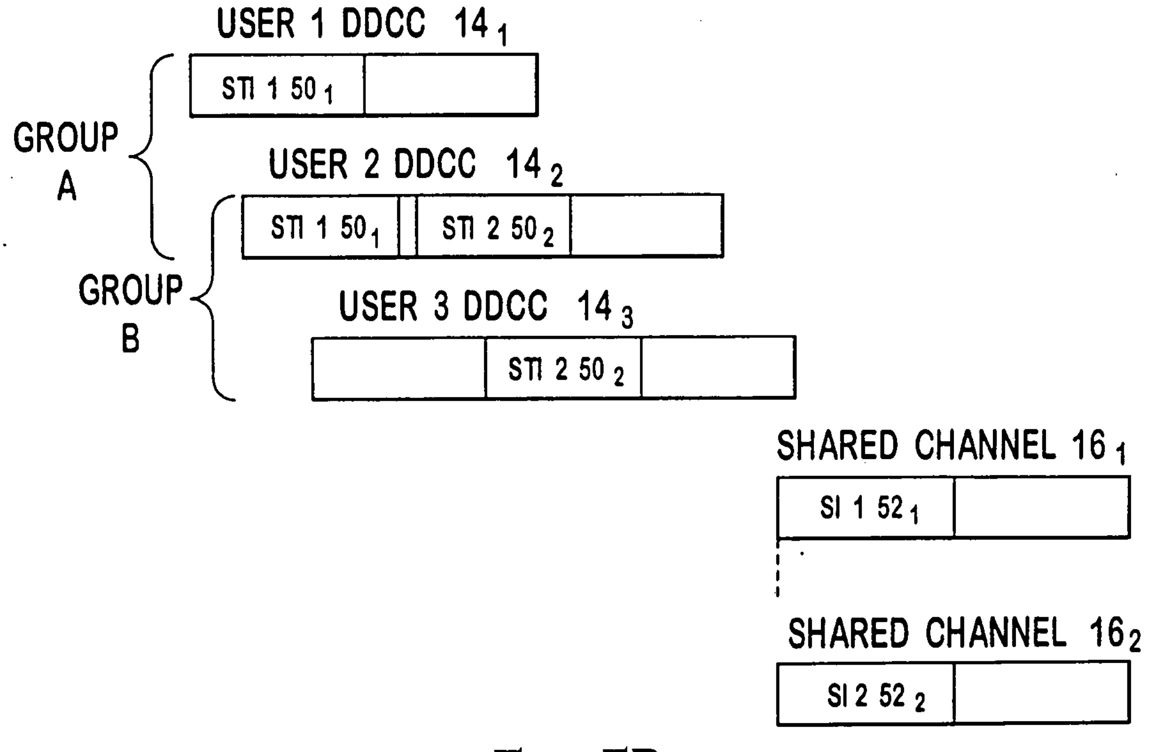
USER 1 DDCC 14 1
STI 1 50 1
GROUP A
USER 2 DDCC 14 2
STI 1 50 1
STI 2 50 2
GROUP B
USER 3 DDCC 14 3
STI 2 50 2
SHARED CHANNEL 16 1
SI 1 52 1
SHARED CHANNEL 16 2
SI 2 52 2

FIG. 5D

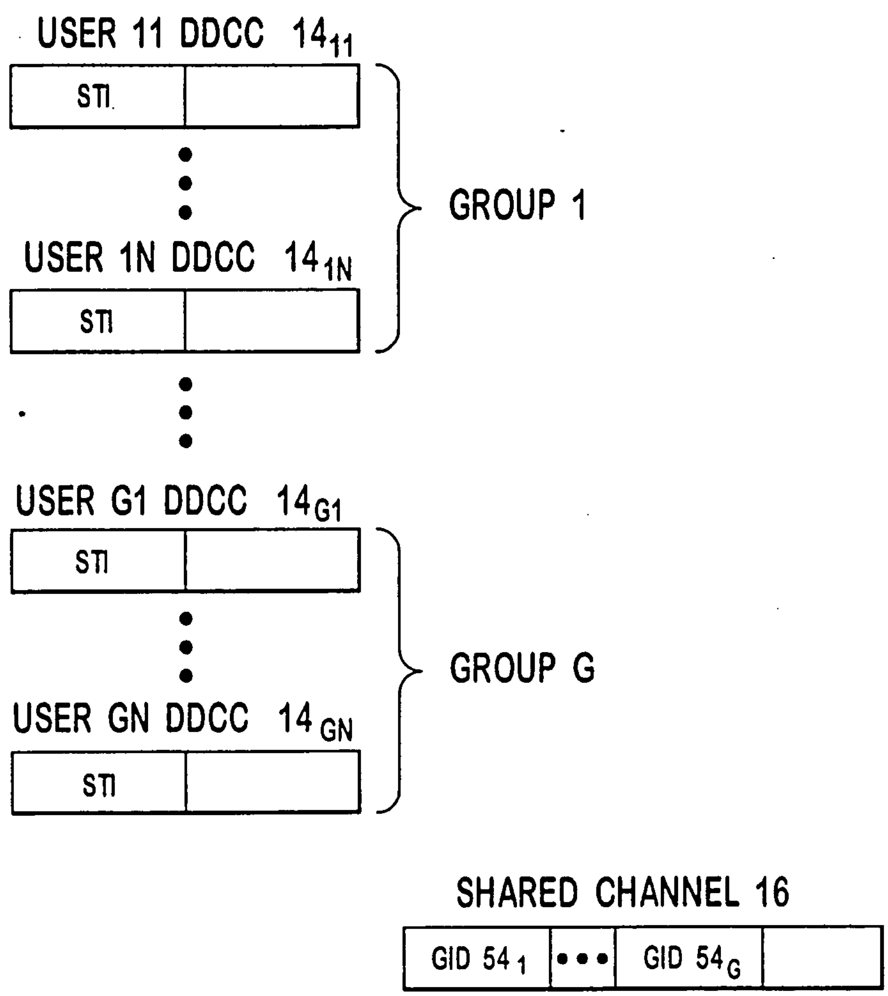
USER 11 DDCC 14_{11}
STI
USER 1N DDCC 14_{1N}
STI
GROUP 1
USER G1 DDCC 14_{G1}
STI
USER GN DDCC 14_{GN}
STI
GROUP G
SHARED CHANNEL 16
GID 54_1
GID 54_G

FIG. 5E

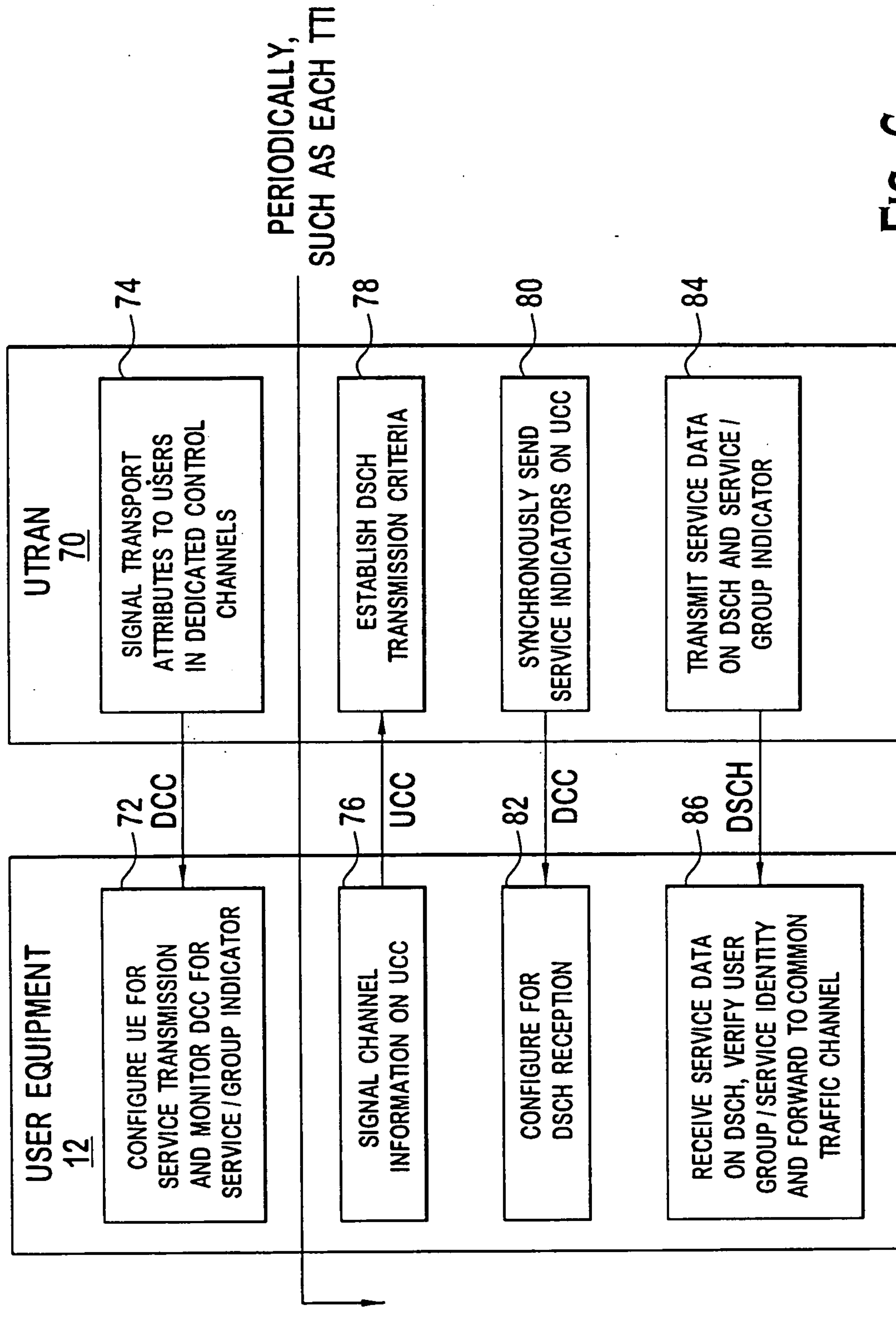
PERIODICALLY, SUCH AS EACH TTI
UTRAN
70
SIGNAL TRANSPORT ATTRIBUTES TO USERS IN DEDICATED CONTROL CHANNELS
74
ESTABLISH DSCH TRANSMISSION CRITERIA
78
SYNCHRONOUSLY SEND SERVICE INDICATORS ON UCC
80
TRANSMIT SERVICE DATA ON DSCH AND SERVICE / GROUP INDICATOR
84
72
DCC
76
UCC
82
DCC
86
DSCH
USER EQUIPMENT
12
CONFIGURE UE FOR SERVICE TRANSMISSION AND MONITOR DCC FOR SERVICE / GROUP INDICATOR
SIGNAL CHANNEL INFORMATION ON UCC
CONFIGURE FOR DSCH RECEPTION
RECEIVE SERVICE DATA ON DSCH, VERIFY USER GROUP / SERVICE IDENTITY AND FORWARD TO COMMON TRAFFIC CHANNEL

FIG. 6

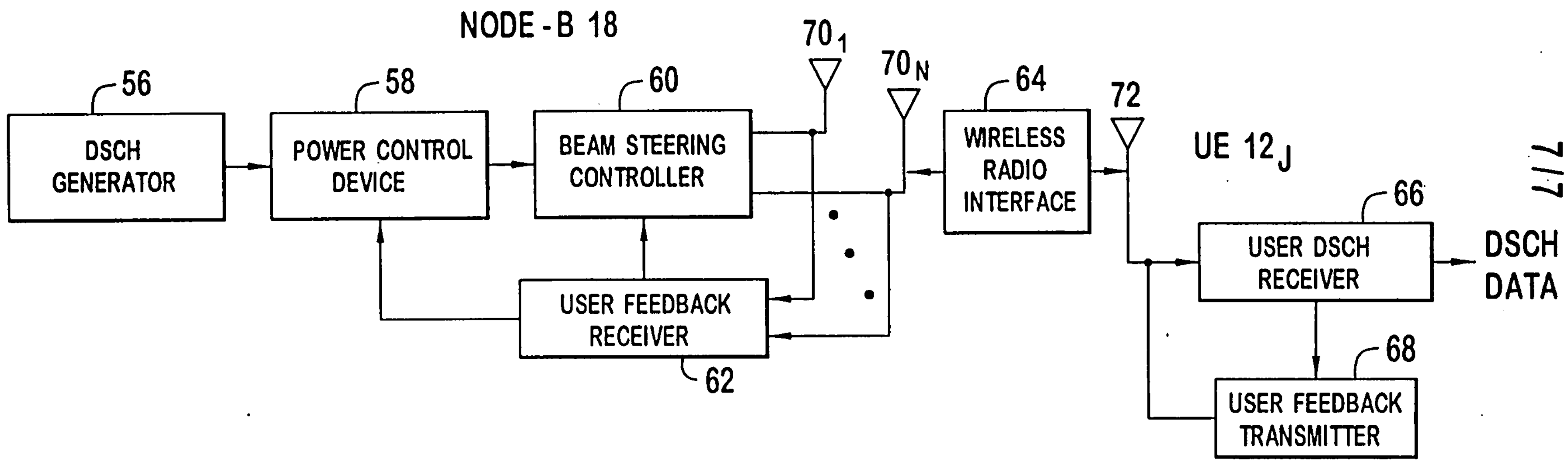
NODE - B 18
56
DSCH GENERATOR
58
POWER CONTROL DEVICE
60
BEAM STEERING CONTROLLER
USER FEEDBACK RECEIVER
62
70_1
70_N
64
WIRELESS RADIO INTERFACE
72
UE 12_J
66
USER DSCH RECEIVER
DSCH DATA
68
USER FEEDBACK TRANSMITTER

FIG. 7