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(54) **METHOD AND APPARATUS FOR SWITCHING MOBILE STATION BETWEEN AUTONOMOUS AND SCHEDULED TRANSMISSIONS**

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H04J 3/16 (2006.01)

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See application file for complete search history.

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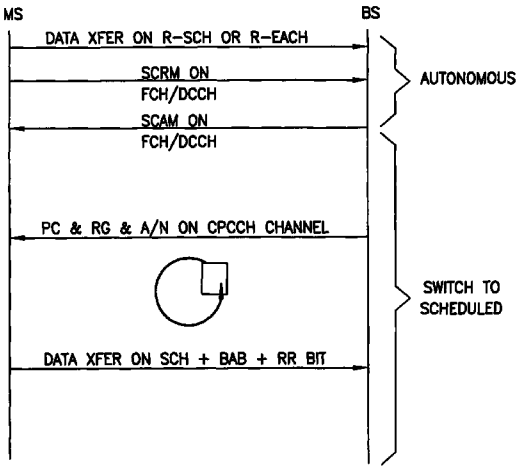
(57) **ABSTRACT**

Disclosed is a method for operating a mobile station with a base station, as well as apparatus for performing this method. The method includes, when the mobile station is in an Autonomous mode of operation, autonomously transmitting from the mobile station to the base station of a reverse access channel or a reverse supplemental channel (Transition 3); in response to receiving an acknowledgement indication from the base station, that comprises a reverse channel assignment message for the mobile station, switching the mobile station to a Scheduled mode of operation (Transition 4) and transmitting data from the mobile station on an assigned reverse channel.

39 Claims, 4 Drawing Sheets



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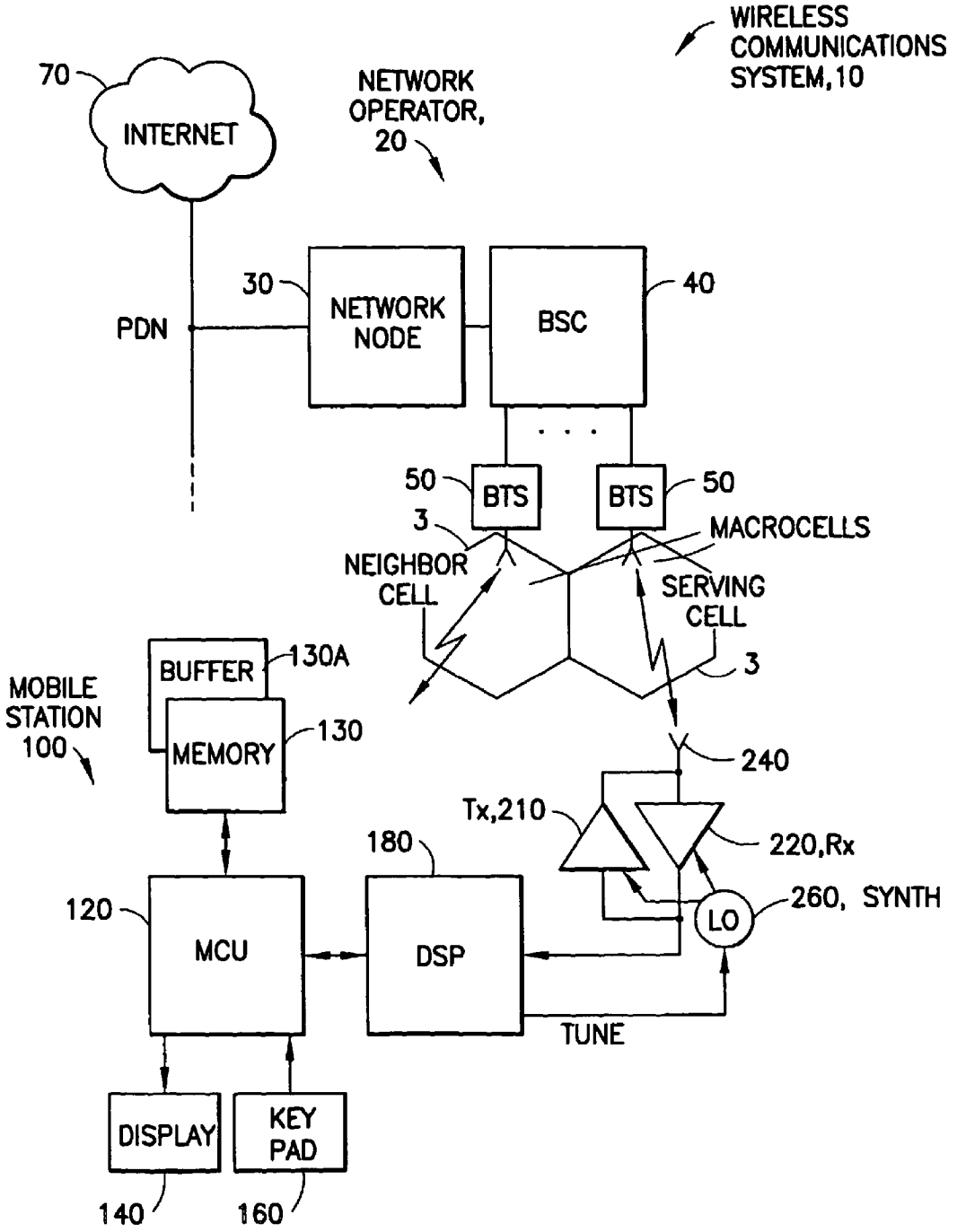
WIRELESS COMMUNICATIONS SYSTEM, 10
70
INTERNET
NETWORK OPERATOR, 20
30
NETWORK NODE
BSC
40
PDN
50
BTS
BTS
50
3
MACROCELLS
NEIGHBOR CELL
SERVING CELL
3
MOBILE STATION 100
BUFFER
130A
MEMORY
130
240
Tx,210
220,Rx
180
260, SYNTH
LO
120
MCU
DSP
TUNE
DISPLAY
KEY PAD
140
160

FIG. 1

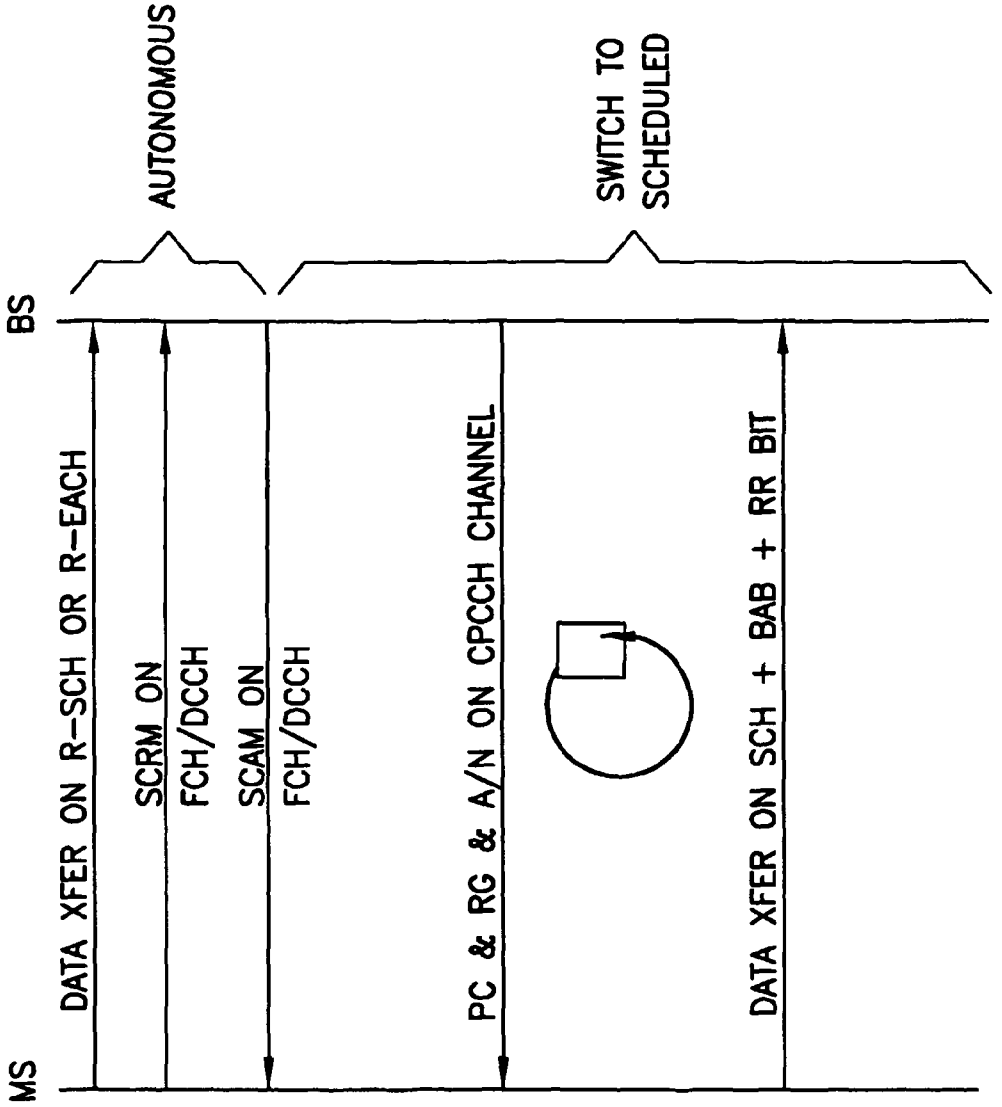
MS
BS
DATA XFER ON R-SCH OR R-EACH
SCRM ON
FCH/DCCH
SCAM ON
FCH/DCCH
PC & RG & A/N ON CPCCH CHANNEL
DATA XFER ON SCH + BAB + RR BIT
AUTONOMOUS
SWITCH TO SCHEDULED

FIG.2

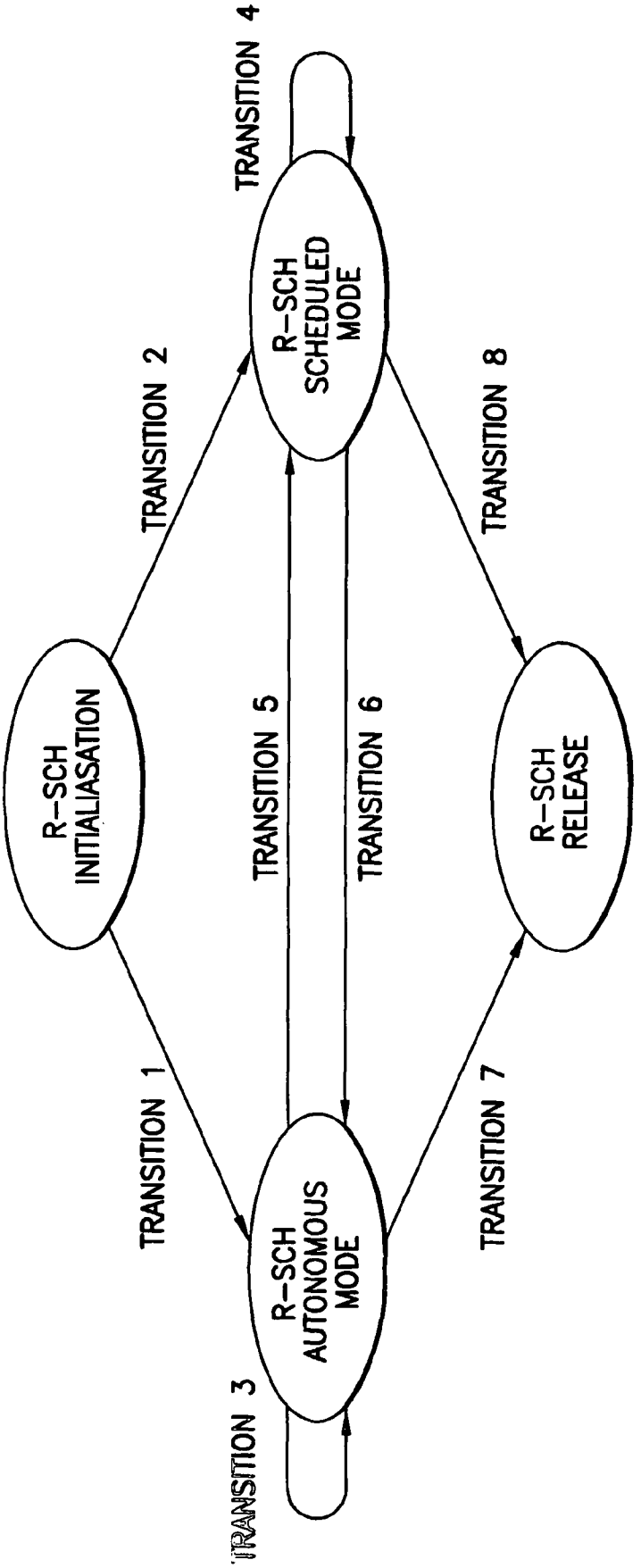
R-SCH INITIALIASATION
TRANSITION 1
TRANSITION 2
R-SCH AUTONOMOUS MODE
R-SCH SCHEDULED MODE
TRANSITION 3
TRANSITION 4
TRANSITION 5
TRANSITION 6
TRANSITION 7
TRANSITION 8
R-SCH RELEASE

FIG.3

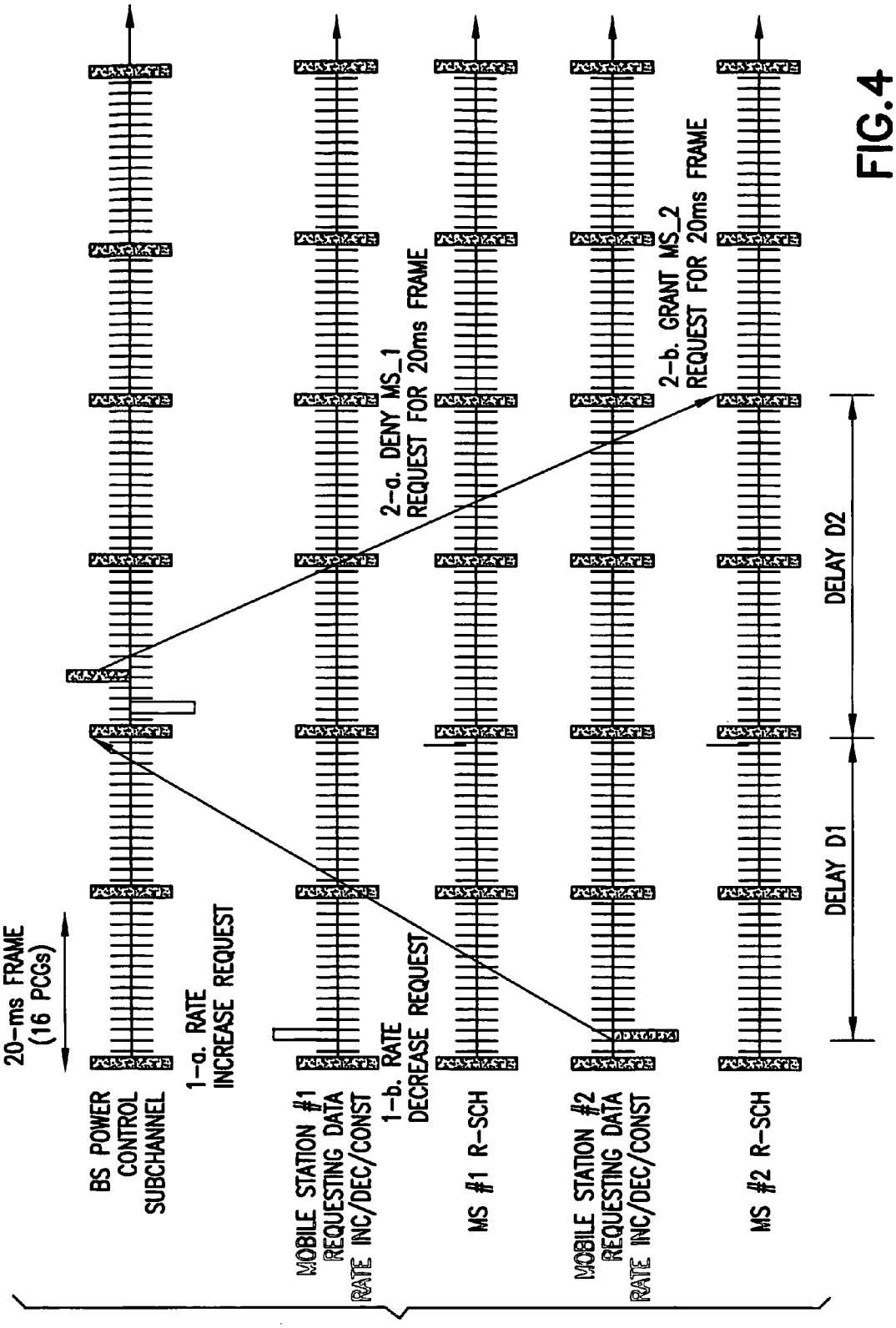
20-ms FRAME
(16 PCGs)
BS POWER CONTROL SUBCHANNEL
1-a. RATE INCREASE REQUEST
MOBILE STATION #1 REQUESTING DATA RATE INC/DEC/CONST
1-b. RATE DECREASE REQUEST
MS #1 R-SCH
2-a. DENY MS_1 REQUEST FOR 20ms FRAME
MOBILE STATION #2 REQUESTING DATA RATE INC/DEC/CONST
2-b. GRANT MS_2 REQUEST FOR 20ms FRAME
MS #2 R-SCH
DELAY D1
DELAY D2

FIG.4

METHOD AND APPARATUS FOR SWITCHING MOBILE STATION BETWEEN AUTONOMOUS AND SCHEDULED TRANSMISSIONS

TECHNICAL FIELD

This invention relates generally to mobile wireless communication systems and, more specifically, relates to methods and apparatus for operating a mobile station, such as a cellular telephone, with a base station when sending data on a reverse channel from the mobile station to the base station in a cdma2000-type system.

BACKGROUND

In a data communications system where a transmission resource is shared by multiple users, or where the transmission quality of a user can be affected by another user, there are generally two modes of channel operation. These may be referred to generally as an autonomous mode and as a scheduled mode. The autonomous mode does not necessarily require a resource request-grant relationship between the transmitters and the receiver prior to a communication, while the scheduled mode requires the presence of an arbiter of some type (e.g., at the receiver) to authorize and/or schedule transmissions for the multiple transmitters.

Each mode of operation has its advantages and its disadvantages. For example, the autonomous mode is well suited for small packet or circuit-like transmissions, while the scheduled mode is well suited for latency-insensitive transmissions.

For the cdma2000 1xEV-DV (or cdma2000, Revision D) reverse link framework, it is desirable to support both the autonomous mode and the scheduled mode of operation for the Reverse Supplemental Channel (R-SCH). However, many technical issues need to be resolved to make the autonomous and scheduled modes mutually compatible. For example, in order to operate these two modes alternatively, one important issue concerns how to best transition between the two modes.

Efforts have begun to standardize a complementary uplink structure, Enhanced Uplink Packet Access (EUPA) in 3GPP, to 1xEV-DV Revision D in 3GPP2. However, at present there is no provision for transitioning a mobile station between the autonomous and the scheduled transmission modes.

As a result, as presently specified the base station may not know, at any given time, when the mobile station needs to transmit data in the packet data system.

SUMMARY OF THE PREFERRED EMBODIMENTS

The foregoing and other problems are overcome, and other advantages are realized, in accordance with the presently preferred embodiments of these teachings.

It is an aspect of this invention to define a procedure to accomplish a scheduled switching mode for transitioning a mobile station between the autonomous transmission mode and the scheduled transmission mode.

Disclosed is a method for operating a mobile station with a base station, as well as apparatus for performing the method. The method includes, when the mobile station is in an Autonomous mode of operation, autonomously transmitting data from the mobile station to the base station on a reverse supplemental channel or a reverse access channel (e.g. R-EACH) from the mobile station to the base station; in

response to receiving an acknowledgment indication from the base station, that comprises a reverse channel assignment message for the mobile station, switching the mobile station to a Scheduled mode of operation and transmitting the data from the mobile station on an assigned reverse channel.

In the preferred embodiment, when initiating the data transmission of scheduled mode, the mobile station transmits a Supplemental Channel Request Message and the reverse access channel is a Reverse Enhanced Access Channel. The acknowledgment indication is sent as part of a Supplemental Channel Assignment Message and further includes power control bits and data rate grant bits, where the power control bits and data rate grant bits are received by the mobile station on a Common Power Control Channel. Transmitting the data from the mobile station on the assigned reverse channel includes also transmitting mobile station buffer activity bits and a data rate request bit, and the method further includes receiving, from the base station, a power control bit, a data rate grant bit and an ACK/NACK indication. The data rate request bit is preferably transmitted as part of a dynamic buffer status report, and requests one of an increase in data rate, a decrease in data rate, or no change in the data rate, and the data rate grant bit is time multiplexed by the base station with the power control bit, and indicates one of a grant of the requested data rate or a denial of the requested data rate.

Also disclosed is a mobile station that includes an RF transceiver for conducting bidirectional wireless communications with a base station and a data processor that operates under the control of a stored program for, when the mobile station is in an Autonomous mode of operation, autonomously transmitting data from the mobile station to the base station on a reverse supplemental channel or a reverse access channel from the mobile station to the base station. The data processor is responsive to a reception of an acknowledgment indication from the base station that comprises a reverse channel assignment message for the mobile station, for switching the mobile station to a Scheduled mode of operation and for transmitting the data from the mobile station on an assigned reverse channel.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other aspects of these teachings are made more evident in the following Detailed Description of the Preferred Embodiments, when read in conjunction with the attached Drawing Figures, wherein:

FIG. **1** is a simplified block diagram of a mobile communications system that is suitable for practicing the teachings of this invention;

FIG. **2** is a diagram for illustrating a state transition from an autonomous transmission mode to a scheduled transmission mode;

FIG. **3** is a state diagram that illustrates 1xEV-DV R-SCH states and transitions; and

FIG. **4** is a timing diagram that illustrates timing relationships between data rate request and grant, where the delays D**1** and D**2** are configurable by the base station.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

By way of introduction, and referring to FIG. **1**, there is shown as a simplified block diagram an embodiment of a wireless communications system **10** that is suitable for practicing this invention. The wireless communications system **10** includes at least one mobile station (MS) **100**. FIG. **1** also shows an exemplary network operator **20** having, for

example, a node **30** for connecting to a telecommunications network, such as a Public Packet Data Network or PDN, at least one base station controller (BSC) **40** or equivalent apparatus, and a plurality of base transceiver stations (BTS) **50**, also referred to as base stations (BSs), that transmit in a forward or downlink direction both physical and logical channels to the mobile station **100** in accordance with a predetermined air interface standard. A reverse or uplink communication path also exists from the mobile station **100** to the network operator, which conveys mobile originated access requests and traffic. A cell **3** is associated with each BTS **50**, where one cell will at any given time be considered to be a serving cell, while an adjacent cell(s) will be considered to be a neighbor cell. Smaller cells (e.g., picocells) may also be available.

The air interface standard can conform to any suitable standard or protocol, and may enable both voice and data traffic, such as data traffic enabling Internet **70** access and web page downloads. In the presently preferred embodiment of this invention the air interface standard is compatible with a code division multiple access (CDMA) air interface standard, such as one known as cdma2000, although this is not a limitation upon the practice of this invention.

The mobile station **100** typically includes a control unit or control logic, such as a microcontrol unit (MCU) **120** having an output coupled to an input of a display **140** and an input coupled to an output of a keyboard or keypad **160**. The mobile station **100** may be a handheld radiotelephone, such as a cellular telephone or a personal communicator. The mobile station **100** could also be contained within a card or module that is connected during use to another device. For example, the mobile station **10** could be contained within a PCMCIA or similar type of card or module that is installed during use within a portable data processor, such as a laptop or notebook computer, or even a computer that is wearable by the user.

The MCU **120** is assumed to include or be coupled to some type of a memory **130**, including a non-volatile memory for storing an operating program and other information, as well as a volatile memory for temporarily storing required data, scratchpad memory, received packet data, packet data to be transmitted, and the like. At least some of this temporary data can be stored in a data buffer **130**A. The operating program is assumed, for the purposes of this invention, to enable the MCU **120** to execute the software routines, layers and protocols required to implement the methods in accordance with this invention, as described in detail below, as well as to provide a suitable user interface (UI), via display **140** and keypad **160**, with a user. Although not shown, a microphone and speaker are typically provided for enabling the user to conduct voice calls in a conventional manner.

The mobile station **100** also contains a wireless section that includes a digital signal processor (DSP) **180**, or equivalent high speed processor or logic, as well as a wireless transceiver that includes a transmitter **200** and a receiver **220**, both of which are coupled to an antenna **240** for communication with the network operator. At least one local oscillator, such as a frequency synthesizer (SYNTH) **260**, is provided for tuning the transceiver. Data, such as digitized voice and packet data, is transmitted and received through the antenna **240**.

The following discussion first describes a plurality of reverse supplemental channel (R-SCH) states and then describes state transitions. However, the teachings of this invention encompass all possible options for state design and state transitions. This invention also accommodates quality of service (QoS) needs for describing mode transitions.

As was stated earlier, an aspect of this invention is to enhance the reverse link (uplink) for IS2000 by the addition of a mode for the MS **100** to transition to scheduling transmissions when operating using autonomous transmissions. FIG. **2** depicts the scenario while the MS **100** is in the active state. The transition proceeds by the following Steps.

1. The MS **100** initiates data transfer on the R-EACH (Reverse Enhanced Access Channel) or Reverse Supplemental Channel. A SCRM (supplemental channel request message) can be transmitted over a reverse fundamental or reverse dedicated channel to request a scheduled mode operation, if the mobile station so desires.

2. If the BS **50** acknowledges the MS **100** transmission it sends an acknowledgment indicator (AI), if the reverse data is sent over the R-EACH in previous step. The base station also can send a SCAM (Supplemental Channel Assignment Message) for informing the MS **100** of its channel assignment over a forward fundamental or dedicated channel. In addition, the BS **50** sends, via the CPCCH (Common Power Control Channel), the PCB (power control bits), RGB (Rate Grant Bits), and the ACK/NAK bits. In response, the MS **100** transmits its data along with BAB (Buffer Activity bits), reflecting utilization of the data buffer **130**A in FIG. **1**, and RRB (Rate Request bits).

If the BS **50** does not acknowledge the MS **100** transmission, i.e., the MS **100** is denied permission to transmit, the MS **100** repeats Step 1.

3. Assuming that the MS **100** has permission to transmit, the MS **100** and BS **50** jointly "close the reverse data transmission loop" by the MS **100** sending its data, plus the BAB and RRB. The BS **50** responds with the PCB, the RGB and the appropriate one of ACK/NAK.

When the MS **100** is in a Control Hold state the MS **100** first transitions out of the Control Hold state prior to initiating the data transfer.

It can be appreciated that the use of this invention solves the previously described problem of the BS **50** not having knowledge of when the MS **100** needs to transmit data. By the use of this invention the MS **100** is permitted to autonomously initiate the data transmission process, followed by BS **50** control of whether the data transmission may continue (entering into scheduled mode). The use of this invention can thus be seen to reduce the delay associated with reverse link transmission (startup). Furthermore, since the BS **50** has control of whether to permit the MS **100** to continue data transmission, the BS **50** can control the ROT (Rise Over Thermal).

A more detailed description of this invention is now provided.

As is shown in FIG. **3**, there are four R-SCH states/modes and eight transitions among these states/modes in cdma2000 1xEV-DV. Note that the terminologies of "state" and "mode" are interchangeable in the ensuing discussion. The four states are the R-SCH initialization state, the R-SCH autonomous state, the R-SCH scheduled state, and R-SCH release state. These are now described in further detail.

A. R-SCH Initialization State

There are various possible (optional) ways to initialize the R-SCH in cdma2000 1xEV-DV.

Option 1:

The MS **100** sends a Supplemental Channel Request Message (SCRM) over the R-DCCH/R-FCH to the BS. The BS **50**

acknowledges with Extended Supplemental Channel Assignment Message (ESCAM) over F-FCH/F-DCCH/F-PDCH. This is same as a conventional cdma2000 1xRTT approach.

Option 2:

The MS **100** sends a Supplemental Channel Request Mini Message (SCRMM) over the R-DCCH/R-FCH to the BS **50**. The BS **50** acknowledges with a Supplemental Channel Assignment Mini Message (SCAMM) over the F-FCH/F-DCCH/F-PDCH/F-CACH. This is also the same as the conventional 1xRTT approach.

Option 3:

The MS **100** sends a modified Supplemental Channel Request Message (SCRM) over the R-DCCH/R-FCH to the BS **50**. The BS **50** acknowledges with a modified Extended Supplemental Channel Assignment Message (ESCAM) over the F-FCH/F-DCCH/F-PDCH/. The modified SCRM includes additional parameters such as the MS **100** buffer status, transmit power, QoS level and the MS **100** preferred mode of R-SCH operation (either Autonomous or Scheduled mode). The modified ESCAM transmitted by the BS **50** includes additional parameters such as the MAC_ID (medium access control ID) to identify the MS **100** for R-SCH access, and the bit positions of control information (e.g. PC, RG, and A/N) in a power control subchannel (i.e., the F-FCH, F-DCCH, or F-CPCCH).

It should be noted that the MAC_ID can be the same as the MAC_ID for the F-PDCH, if the F-PDCH exists for the MS **100**. Also, the MAC_ID in SCAM can be replaced with a mapping identifier serving as a reverse link R-SCH access ID.

Option 4:

The MS **100** sends the Supplemental Channel Request Message (SCRM) over the R-DCCH/R-FCH to the BS **50** (as in Option 1 above). The BS **50** acknowledges with a modified Extended Supplemental Channel Assignment Mini Message (ESCAMM) over the F-FCH/F-DCCH/F-PDCH/F-CACH. The ESCAMM includes parameters as in the modified ESCAM of Option 3.

Option 5:

The MS **100** sends a request over the R-EACH with additional parameters. The additional parameters specify the R-SCH characteristic and its preferred mode of operation.

R-SCH Autonomous Mode

In this mode of operation, the MS **100** can access the R-SCH without prior authorization. The operation in this mode has two options.

Option 1:

For fixed/constant data rate applications, all active MSs **100** can send data over the R-SCH autonomously using a data rate established by any of the following rules:

(1) at a lowest data rate, i.e. 9.6 kbps,

(2) at a low fixed data rate that is configurable by the BS **50**, or

(3) at a minimum rate that is dynamically agreed upon by the MS **100** and the BS **50**. For example, the data rate may be negotiated between the MS **100** and BS **50** by exchanging QoS BLOB according to IS-2000.5 procedures.

It is noted that all active MSs **100** should have been assigned with a MAC_ID in the R-SCH initialization state or in the F-PDCH assignment phase. The MAC_ID is used by the BS **50** to distinguish between multiple autonomous mode MSs **100**. However, the BS **50** also can distinguish multiple autonomous mode MSs **100** by decoding the MS **100** long code, without having knowledge of the MAC_ID.

This option can be used to advantage for short frame transmission or low data rate applications.

Option 2:

Similar to the cdma2000 1xEV-DO (also referred to as HDR), the MS **100**, along with the R-SCH user traffic transmission, can explicitly send Rate Indication information over a reverse channel to indicate the data rate that is being used in the present R-SCH frame. The reverse Rate Indication channel may be a separate dedicated Walsh-coded channel, a common channel, or a channel that is time-multiplexed with other channels.

R-SCH Scheduled Mode

There are two options available for the R-SCH scheduled mode.

Option 1:

Similar to cdma2000 1xRTT, the R-SCH procedures and relevant messages are used. The MS **100** requests R-SCH channel assignment, and the BS **50** schedules and assigns a R-SCH channel with a specific data rate and time duration.

Option 2:

For variable data rate applications, the following mode of operation can also be considered as a "semi-scheduled" mode.

MS **100** Procedures:

The MS **100** begins with the autonomous mode at a low data rate, as defined above. While sending data over the R-SCH, the MS **100** also sends a "Data Rate Request" to the BS **50**. The Data Rate Request has the following characteristics. The Data Rate Request is 1-bit of information with three-state modulation (i.e., −1, 0, and 1), and it may be carried over an uplink overhead dedicated or common channel, or it may be carried over the R-SCH with a special Multiplexing option, where the MS **100** traffic and control information are multiplexed. The Data Rate Request may also be reflected in the MS **100** dynamic buffer status, QoS level and transmit power report to the BS **50**. In other words, the Data Rate Request bit can be referred to as the BAB (buffer activity bit). The definition of the Data Rate Request is as follows:

If BAB=INCREASE=1, the MS **100** is requesting to transmit on the R-SCH at the data rate of (current data rate+incremental rate), where the incremental rate=increased step rate,

If BAB=DECREASE=−1, the MS **100** is requesting to transmits on the R-SCH at the data rate of (current data rate−decremented rate),

If BAB=CONSTANT=0, the MS **100** is requesting to transmit on the R-SCH at the same data rate as the current data rate.

BS **50** Procedures:

Upon receiving the Data Rate Request of one of INCREASE/DECREASE/CONSTANT from the MS **100**, the BS **50** acknowledges (i.e., it either grants or denies) the MS **100** with a 1-bit information (feedback) of GRANT/DENY. This 1-bit information has the following characteristics. It is carried over the power control sub-channels within the F-FCH, F-DCCH, or F-CPCCH, and is time-multiplexed with the power control bit (in F-FCH, F-DCCH, or F-CPCCH) and other control information. For higher transmission reliability of this bit, bit repetition may be used by the BS **50**. A definition of the GRANT/DENY bit is as follows.

If the 1-bit feedback=GRANT=1, the BS **50** allows the MS **100** BAB request.

If the 1-bit feedback=DENY=−1, the BS **50** denies the MS **100** BAB request.

The autonomous data rate request (by the MS **100**) and the grant (by the BS **50**) have a certain timing relationship. FIG. **4** illustrates one non-limiting example of the timing relationship. Special notes for the timing relationship shown in FIG. **4** are as follows.

For Step 1-a (top trace) and 1-b (second to top trace), at any Power Control Group (PCG), where there are 16 PCGs in one 20 ms frame) any MS **100** (e.g. MS **100** #**1** or MS **100** #**2**) can request to increase, decrease, or maintain the data rate. After Delay time D**1**, the BS **50** receives and processes the request. The BS **50** sends the acknowledgment to MS **100** at the designated PCG. After Delay time D**2**, the MS **100** starts transmitting on the R-SCH at the data rate that is agreed upon with the BS **50**. The rate control can be "per PCG" or "per frame", and the value of D**1** and D**2** is controlled or configured by the BS **50**.

R-SCH Release State

This state can be similar to that of cdma2000 1xRTT.

R-SCH State/Mode Transitions

The events (or methods) for the eight transitions shown in the state diagram of FIG. **2** are described as follows.

Transition 1: The preferred mode of operation is embedded in the (modified) R-SCH assignment (mini) message.

Transition 2: The preferred mode of operation is embedded in the (modified) R-SCH assignment (mini) message.

Transition 3: For Option 1, the MS **100** remains in the Autonomous mode when it is continuing transmission at the low (or lowest) data rate. For Option 2, the MS **100** remains in the Autonomous mode when the reverse rate indication indicates a legitimate data rate (instead of a mode switch indication).

Transition 4: The MS **100** remains in the Scheduled Mode so long as there is no new mode switch request in the SCRM, or the MS **100**/BS **50** still operate based on the data rate request-grant "scheduled" procedures defined herein.

Transition 5: For Option 1, the preferred mode of operation is embedded in the (modified) R-SCH assignment (mini) message. For Option 2, the transition trigger may be implemented with the QoS level, with higher QoS needs corresponding to the Scheduled Mode and its transition.

Transition 6: For Option 1, the R-SCH-assigned duration timer is used as the trigger, i.e., after the duration of the scheduled transmission, the MS **100** reverts back to the Autonomous Mode. For Option 2, the preferred mode of operation is embedded in the (modified) R-SCH assignment (mini) message. For Option 3, the transition trigger may be implemented with the QoS level model, with lower QoS needs corresponding to the Autonomous Mode and its transition.

Transition 7: This can be similar to 1xRTT, using R-SCH release messages and procedures.

Transition 8: This can also be similar to 1xRTT, using R-SCH release messages and procedures.

As has been described, for the cdma2000 1xEV-DV reverse link framework it is desirable to support both the Autonomous and the Scheduled Modes of operation for the R-SCH. The foregoing discussion of the invention has described each R-SCH state and state transition in detail, and furthermore applies equally to other possible state designs and state transitions. The QoS parameters can be used to support the presently preferred state transitions.

The foregoing description has provided by way of exemplary and non-limiting examples a full and informative description of the best method and apparatus presently contemplated by the inventors for carrying out the invention. However, various modifications and adaptations may become apparent to those skilled in the relevant arts in view of the foregoing description, when read in conjunction with the accompanying drawings and the appended claims. However, all such modifications of the teachings of this invention will still fall within the scope of this invention. Further, while the method and apparatus described herein are provided with a certain degree of specificity, the present invention could be implemented with either greater or lesser specificity, depending on the needs of the user. Further, some of the features of the present invention could be used to advantage without the corresponding use of other features. As such, the foregoing description should be considered as merely illustrative of the principles of the present invention, and not in limitation thereof, as this invention is defined by the claims which follow.

What is claimed is:

1. A method comprising: when a mobile station is in an autonomous mode of operation, autonomously transmitting data from the mobile station to a base station on a reverse channel; in response to receiving an acknowledgment indication from the base station, that comprises a reverse channel assignment message for the mobile station, switching the mobile station to a scheduled mode of operation, where, while in the scheduled mode, the mobile station provides data transmission power information and data transmission buffer status information as a request to transmit data and a buffer activity bit as a data rate request bit; and transmitting data from the mobile station on an assigned reverse channel.

2. A method as in claim **1**, where transmitting from the mobile station to the base station to initiate the data transmission comprises transmitting a supplemental channel request message.

3. A method as in claim **1**, where the reverse channel comprises one of a reverse enhanced access channel, a reverse fundamental channel, and a reverse dedicated channel.

4. A method as in claim **2**, where the acknowledgment indication comprises a supplemental channel assignment message.

5. A method as in claim **4**, where the acknowledgment indication further comprises power control bits and data rate grant bits.

6. A method as in claim **5**, where the power control bits and data rate grant bits are received by the mobile station on a common power control channel.

7. A method as in claim **1**, further comprising receiving, from the base station, a power control bit, a data rate grant bit and an acknowledgment/non-acknowledgment indication.

8. A method as in claim **7**, where the data rate request bit is transmitted as part of a dynamic buffer status report, and requests one of an increase in data rate, a decrease in data rate, or no change in the data rate.

9. A method as in claim **8**, where the data rate grant bit indicates one of a grant of the requested data rate or a denial of the requested data rate.

10. A method as in claim **1**, wherein the buffer activity bit is a single bit.

11. A method as in claim **1**, wherein the buffer activity bit is arranged to undergo three-state modulation.

12. An apparatus, comprising:

an RF transceiver for conducting bidirectional wireless communications with a base station; and

a data processor operating under the control of a stored program for, when the apparatus is in an autonomous mode of operation, autonomously transmitting from the apparatus to the base station on a reverse channel, said data processor being responsive to a reception of an acknowledgment indication from the base station, that comprises a reverse channel assignment message for the apparatus, for switching the apparatus to a scheduled mode of operation and for transmitting data from the apparatus on an assigned reverse channel, where, while in the scheduled mode, the apparatus provides data transmission power information and data transmission buffer status information as a request to transmit data and a buffer activity bit as a data rate request bit.

13. An apparatus as in claim **12**, where when transmitting from the apparatus to the base station to initiate the data transmission the data processor transmits a supplemental channel request message.

14. An apparatus as in claim **12**, where the reverse channel comprises one of a reverse enhanced access channel, a reverse fundamental channel, and a reverse dedicated channel.

15. An apparatus as in claim **13**, where the acknowledgment indication comprises a supplemental channel assignment message.

16. An apparatus as in claim **15**, where the acknowledgment indication further comprises power control bits and data rate grant bits.

17. An apparatus as in claim **16**, where the power control bits and data rate grant bits are received by the apparatus on a common power control channel.

18. An apparatus as in claim **12**, where said data processor is further responsive for receiving, in response from the base station, a power control bit, a data rate grant bit and an acknowledgment/non-acknowledgment indication.

19. An apparatus as in claim **18**, where the data rate request bit is transmitted as part of a dynamic buffer status report, and requests one of an increase in data rate, a decrease in data rate, or no change in the data rate.

20. An apparatus as in claim **19**, where the data rate grant bit indicates one of a grant of the requested data rate by the base station or a denial of the requested data rate.

21. An apparatus as in claim **12**, where the apparatus and the base station communicate over a reverse synchronous code division, multiple access channel.

22. An apparatus as in claim **12**, wherein the apparatus is a mobile station.

23. An apparatus as in claim **12**, wherein the buffer activity bit is a single bit.

24. An apparatus as in claim **12**, wherein the buffer activity bit is arranged to undergo three-state modulation.

25. A method comprising:

when a mobile station is in an autonomous mode of operation, autonomously transmitting from the mobile station to a base station to initiate a data transmission from the mobile station to the base station, the transmission comprising a supplemental channel request message that is transmitted over a reverse enhanced access channel or a reverse supplemental channel;

receiving an acknowledgment indication from the base station over a common power control channel, the acknowledgment indication comprising a supplemental channel assignment message comprising power control bits and data rate grant bits;

in response to receiving the acknowledgment indication from the base station, switching the mobile station to a scheduled mode of operation;

transmitting data packets from the mobile station over a reverse supplemental channel, further comprising transmitting mobile station buffer activity bits and a data rate request bit, and

receiving, from the base station in response, a power control bit, a data rate grant bit and an acknowledgment/non-acknowledgment indication, wherein there exist at least four reverse supplemental channel states and at least eight transitions between the reverse supplemental channel states, wherein the at least four reverse supplemental channel states include a reverse supplemental channel initialization state, a reverse supplemental channel autonomous state, a reverse supplemental channel scheduled state, and a reverse supplemental channel release state.

26. A method as in claim **25**, where the data rate request bit is transmitted as part of a dynamic buffer status, quality of service level and transmit power report, and requests one of an increase in data rate, a decrease in data rate, or no change in the data rate.

27. A method as in claim **26**, where the data rate grant indicates one of a grant of the requested data rate or a denial of the requested data rate.

28. A method comprising:

executing one of a plurality of techniques to generate a reverse supplemental channel initialization state, comprising one of,

sending a modified supplemental channel request message from a mobile station to a base station, and receiving from the base station an acknowledgement as a modified extended supplemental channel assignment message, where the modified supplemental channel request message comprises at least one of mobile station buffer status, transmit power, quality of service level and a preferred mode of reverse supplemental channel operation, said preferred mode of reverse supplemental channel operation being one of an autonomous mode or a scheduled mode, and where the modified extended supplemental channel assignment message comprises information to identify the mobile station;

sending a supplemental channel request message to the base station, and receiving from the base station an acknowledgement as a modified extended supplemental channel assignment mini message, where the extended supplemental channel assignment mini message comprises the information to identify the mobile station; and

sending a request over a reverse enhanced access channel, where the request comprises parameters that specify at least the preferred mode of reverse supplemental channel operation; and

after executing the reverse channel initialization state and when operating the mobile station with the base station, transmitting data packets from the mobile station on the reverse supplemental channel, where there are at least four reverse supplemental channel states and at least eight transitions between the reverse supplemental channel states, where the at least four reverse supplemental channel states comprise a reverse supplemental channel initialization state, a reverse supplemental channel autonomous state, a reverse supplemental channel scheduled state, and a reverse supplemental channel release state.

29. A method as in claim **28**, where in the reverse supplemental channel autonomous state, the mobile station accesses the reverse supplemental channel without prior authorization, and comprises, for constant data rate applications, one of:

sending data over the reverse supplemental channel autonomously using a data rate established by one of a plurality of rules, where the mobile station is identified using at least one of medium access control identification mobile station information, that is used by the base station to distinguish between multiple autonomous mode mobile stations, and a mobile station long code; and

explicitly sending rate indication information over a reverse channel to indicate the data rate that is being used in a present reverse supplemental channel frame.

30. A method as in claim **29**, where in the reverse supplemental channel autonomous state, and when operating with a variable data rate, the mobile station operates in a semi-scheduled mode by initially starting in the autonomous mode at a current data rate, and while sending data over the reverse supplemental channel, the mobile station sends a data rate request to the base station for indicating one of a request to transmit on the reverse supplemental channel at a data rate of current data rate plus incremental rate, a request to transmit on the reverse supplemental channel at a data rate of current data rate minus decremented rate, or a request to transmit on the reverse supplemental channel at the current data rate.

31. A method as in claim **30**, where the data rate request comprises 1-bit of information with three-state modulation that is sent over one of an uplink overhead dedicated channel, a common channel, the reverse supplemental channel using a multiplexing option, or in a mobile station dynamic buffer status, quality of service level and transmit power report to the base station.

32. A method as in claim **30**, where the base station is responsive to a receipt of the data rate request from the mobile station to either grant or deny the mobile station data rate request using grant/deny feedback information.

33. A method as in claim **32**, where the grant/deny feedback information is sent to the mobile station over power control sub-channels and is time-multiplexed with power control information.

34. A method as in claim **30**, where reverse supplemental channel state/mode transitions between the reverse supplemental channel initialization state, the reverse supplemental channel autonomous state, the reverse supplemental channel scheduled state and the reverse supplemental channel release state occur as follows:

when transitioning from the reverse supplemental channel initialization state to the reverse supplemental channel autonomous state,

the preferred mode of operation is embedded in a modified reverse supplemental channel assignment mini message;

when transitioning from the reverse supplemental channel initialization state to the reverse supplemental channel scheduled state, the preferred mode of operation is embedded in the modified reverse supplemental channel assignment mini message;

for a transition from the reverse supplemental channel autonomous state to remain in the reverse supplemental channel autonomous state, and in accordance with a first operational mode of operation, the mobile station remains in the reverse supplemental channel autonomous state while transmitting at the initial data rate, and in accordance with a second operational mode of operation, the mobile station remains in the autonomous state when a reverse data rate indication indicates a legitimate data rate as opposed to an indication to switch to the reverse supplemental channel scheduled state;

for a transition from the reverse supplemental channel scheduled state to remain in the reverse supplemental channel scheduled state, the mobile station remains in the reverse supplemental channel scheduled state so long as there is at least not a new mode switch request in the supplemental channel request message;

for a transition from the reverse supplemental channel autonomous state to the reverse supplemental channel scheduled state, and in accordance with the first operational mode of operation, the preferred mode of operation is embedded in the modified reverse supplemental channel assignment mini message, and in accordance with the second operational mode of operation, a state transition trigger is implemented with the quality of service level;

for a transition from the reverse supplemental channel scheduled state to the reverse supplemental channel autonomous state, and in accordance with the first operational mode of operation, a reverse supplemental channel assigned duration timer is used as the state transition trigger such that after the duration of the scheduled transmission, the mobile station reverts back to the reverse supplemental channel autonomous state, in accordance with the second operational mode of operation, the preferred mode of reverse supplemental channel operation is embedded in the modified reverse supplemental channel assignment mini message, and in accordance with a third operational mode of operation, the state transition trigger is implemented with the quality of service level; and for transitions to the reverse supplemental channel release state from the reverse supplemental channel autonomous and scheduled states, reverse supplemental channel release messages and procedures are used.

35. A method as in claim **34**, where for the transition from the reverse supplemental channel autonomous state to the reverse supplemental channel scheduled state in accordance with the second operational mode of operation, the state transition trigger is implemented by an increase in a required reverse supplemental channel level, and for the transition from the reverse supplemental channel scheduled state to the reverse supplemental channel autonomous state in accordance with the third operational mode of operation, the state transition trigger is implemented by a decrease in a required quality of service level.

36. A method comprising:

when a mobile station is in an autonomous mode of operation, autonomously transmitting data from the mobile station to a base station on a reverse channel;

the mobile station receiving an assignment message from the base station, the assignment message comprising an acknowledgment/non-acknowledgment indication, power control bits, and data rate grant bits;

in response to receiving an acknowledgment indication from the base station, switching the mobile station to a scheduled mode of operation; and

transmitting data from the mobile station to the base station over a reverse supplemental channel, wherein there exist at least four reverse supplemental channel states and at least eight transitions between the reverse supplemental channel states, wherein the at least four reverse supplemental channel states include a reverse supplemental channel initialization state, a reverse supplemental channel autonomous state, a reverse supplemental channel scheduled state, and a reverse supplemental channel release state.

37. A mobile station, comprising:

an RF transceiver for conducting bidirectional wireless communications with a base station; and

a data processor operating under the control of a stored program for, when the mobile station is in an autonomous mode of operation, autonomously transmitting from the mobile station to the base station on a reverse channel, the mobile station receiving an assignment message from the base station, the assignment message comprising an acknowledgment/non-acknowledgment indication, power control bits, and data rate grant bits, said data processor being responsive to a reception of an acknowledgment indication from the base station for switching the mobile station to a scheduled mode of operation and for transmitting data from the mobile station to the base station over a reverse supplemental channel, wherein there exist at least four reverse supplemental channel states and at least eight transitions between the reverse supplemental channel states, wherein the at least four reverse supplemental channel states include a reverse supplemental channel initialization state, a reverse supplemental channel autonomous state, a reverse supplemental channel scheduled state, and a reverse supplemental channel release state.

38. A method comprising:

when a mobile station is in an autonomous mode of operation, autonomously transmitting from the mobile station to a base station to initiate a data transmission from the mobile station to the base station, the transmission comprising a supplemental channel request message that is transmitted over a reverse channel;

in response to receiving an acknowledgment indication from the base station, switching the mobile station to a scheduled mode of operation;

transmitting data from the mobile station to the base station over a reverse supplemental channel, wherein there exist at least four reverse supplemental channel states and at least eight transitions between the reverse supplemental channel states, further comprising transmitting mobile station buffer activity bits and a data rate request bit, and

receiving, from the base station in response, a power control bit, a data rate grant bit and an acknowledgment/non-acknowledgment indication, wherein the at least four reverse supplemental channel states include a reverse supplemental channel initialization state, a reverse supplemental channel autonomous state, a reverse supplemental channel scheduled state, and a reverse supplemental channel release state.

39. A mobile station, comprising:

a transceiver for receiving and transmitting signals;

a signal processor coupled to the transceiver;

a controller coupled to the signal processor, the controller receiving information from the signal processor derived from the signal processor and providing information to the signal processor to be converted for transmission through the transceiver, wherein the mobile station comprises an autonomous mode and a scheduled mode, wherein, in the autonomous mode, the mobile station is configured to transmit data at a selected data transmission rate to the base station over a reverse supplemental channel, wherein, in the scheduled mode, the mobile station is configured to transmit a request by providing data transmission power information and selected data transmission buffer status information to the base station for granting a data transmission rate to the mobile station, wherein there exist at least four reverse supplemental channel states and at least eight transitions between the reverse supplemental channel states, wherein the at least four reverse supplemental channel states include a reverse supplemental channel initialization state, a reverse supplemental channel autonomous state, a reverse supplemental channel scheduled state, and a reverse supplemental channel release state.

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