APPARATUS AND METHOD FOR TRANSMISSION RATE MANAGEMENT WITHIN WIRELESS NETWORKS

FIELD OF INVENTION

The present invention relates to wireless networks and, more specifically, to transmission rate management within wireless networks.

BACKGROUND OF THE INVENTION

In current systems, for supporting high rate packet data transmissions, a high rate channel with a constant RF power is shared by multiple active users on the basis of time-division-multiplexing. Rate control, instead of power control is applied. A forward link scheduler schedules packet data to the user who has the most favourable forward link channel condition. In the full-queue case, where all active user's data buffers at the network side are always occupied, significant multi-user diversity gain can be achieved. In non-full-queue cases in which active user's buffers are not always occupied by data (a realistic case), the multi-user diversity gain decreases significantly due to the fact that there is no data in an active user's buffer although the user has the most favourable channel condition.

One solution is to increase the number of active users to increase the multi-user diversity gain in a non-full-queue case. However, the number of active users supported is restricted due to limited system resource.

When a user requests a packet session, the network will respond to this request by transitioning this user to an active state through dedicated or shared resource assignments. Those resources can include forward link

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common power control channel (F-CPCCH), forward shared control channel (F-SCCH), forward shared high rate transmission channel (F-SCH), and reverse link dedicated channel for control signalling required for supporting forward link high rate data transmissions. When a user is in the active state, the user sends the feedback information, such as the forward link channel condition, ACK/NACK indication for the ARQ function, etc. on its dedicated channel. This feedback information is updated at 800Hz (per 1.25ms, full rate).

At the same time the active user detects the power control sub-channel for the purpose of closed-loop reverse link power control on the F-CPCCH at the rate of 800Hz. Due to the resource occupancy by an active user, the number of active users supported cannot be increased infinitely. Actually, due to the burstness of packet applications, for a significant time, an active user's buffer is empty during the active state. When an active user's buffer is empty, it is not necessary to perform reverse link power control at the full rate (800Hz) and for an active user to send feedback information at the full rate. Such an active user can work on a "lower rate mode" and the saving in resources enables more active users to be supported.

Based on this observation, a new method was proposed by which the number of active users could be increased, but without increasing the associated overhead resources for supporting an active user. This method is called "control hold mode". In current cdma2000 systems, an active data user is assigned a forward dedicated control channel/fundamental channel, reverse dedicated control channel/fundamental channel

and supplemental channels on either forward link only or reverse link only or both. Using the control hold mode method, after the data buffer within an active user becomes empty for some period of time, the high rate supplemental channel is released and both forward and reverse dedicated control channels only send pilot and power control sub-channels in both directions with either full rate or a reduced rate. The purpose of this mode is to rate-reduce operations to save battery power.

In more recent wireless systems, there are shared channels, shared control channels and common power control channels. In these systems, there is no technique for performing a control hold operation.

SUMMARY OF THE INVENTION

The present invention is directed to an enhancement to the concept of the control hold mode. The purpose of this enhancement is not only to save battery power but also to dynamically share active users' resources and enable an increase in the number of active users without adding significant additional resource consumption. This could eventually lead to an increase in the system aggregated forward link throughput. In embodiments of the present invention, active users are divided into a plurality of sets of users, each set of users having a different transmission rate assigned for common control channels.

In one embodiment, users are assigned as primary users which receive control information, such as power control information, at a full rate via a common control channel and secondary users which receive control information at a reduced rate via the common control channel. In some embodiments, the secondary

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users could further be subdivided into sets of users with various reduced rates for receiving control information via the common control channel. The grouping of users into these sets that receive control information at different rates, allows for a more efficient use of resources and allow more active users to be supported within the system.

The present invention, according to a first broad aspect, is an apparatus for transmitting control information to a plurality of mobile stations via a common control channel. In this aspect, the apparatus operates to transmit control information to first and second sets of mobile stations at respective first and second rates of transmission via the common control channel, the second rate of transmission being less than the first rate of transmission.

The present invention, according to a second broad aspect, is a method for transmitting control information from a network apparatus to a plurality of mobile stations via a common control channel. The method includes transmitting control information to a first set of mobile stations at a first rate of transmission via the common control channel; and transmitting control information to a second set of mobile stations at a second rate of transmission via the common control channel, the second rate of transmission being less than the first rate of transmission.

The present invention, according to a third broad aspect, is a wireless network including first and second sets of mobile stations; and an apparatus that operates to transmit control information to the first and second sets of mobile stations at respective first

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and second rates of transmission via a common control channel, the second rate of transmission being less than the first rate of transmission.

The present invention, according to a fourth broad aspect, is a method of switching a mobile station from a primary active user to a secondary active user. The method includes determining whether a data buffer for the mobile station at a network apparatus is in an empty condition; if the data buffer is in an empty condition, determining whether a switch condition is detected; and if the switch condition is detected, triggering the mobile station to be switched from a primary active user to a secondary active user. In one case, the determining whether a switch condition is detected comprises determining whether an empty buffer indication from the mobile station has been received. In another case, the determining whether a switch condition is detected comprises determining whether the data buffer is in an empty condition for a predetermined period of time.

In another aspect, the present invention is an apparatus for switching a mobile station from a primary active user to a secondary active user. The apparatus includes means for determining whether a data buffer for the mobile station at a network apparatus is in an empty condition; means for determining whether a switch condition is detected if the data buffer is in an empty condition; and means for triggering the mobile station to be switched from a primary active user to a secondary active user if the switch condition is detected.

Other aspects and advantageous features of the present invention will become apparent to those

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ordinarily skilled in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF THE FIGURES

Preferred embodiments of the present invention will now be described in detail with reference to the following figures:

Figures 1, 2 and 3 are sample configurations for common power control channels according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

For supporting forward link packet data transmission, the following forward link channels are defined:

- Shared channel (F-SCH) for high rate data transmission based on time-division multiplexing.
- Shared control channel (F-SCCH) for conveying the information required for detecting the data on F-SCH.
- Common power control channel (F-CPCCH) for reverse link power control of active users, the F-CPCCH being defined the same as that of current cdma2000 systems in some embodiments of the present invention.

For an active user who has a packet session connected, the following resources are assigned:

- Active user ID.
- Forward shared channel (F-SCH).
- Forward shared control channel (F-SCCH).
- Forward common power control channel (F-CPCCH).
- Reverse dedicated channel for feedback information transmission.

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According to embodiments of the present invention, active users are classified into two types:

- Primary active user (full rate mode): monitors F-SCCH all the time, monitors its power control sub-channel at full rate (800 Hz in one embodiment), sends feedback (e.g., channel condition) at full rate.
- Secondary active user (reduced rate mode): monitors F-SCCH all the time, monitors its power control sub-channel and sends feedback at lower rate than the full rate. In some embodiments, the secondary active users could have various reduced rates such as 1/2 rate (half rate active user), or 1/4 rate (1/4 rate active user) or 1/8 rate (1/8 rate active user).

In some embodiments of the present invention, the coding and modulation scheme of the common power control channel is the same as that of cdma2000 systems (i.e. there are 24 sub-channels transmitted on each slot). In these embodiments, however, the 24 sub-channels are redefined. Some sample embodiments are as follows:

Configuration 1 (refer to Figure 1)

The first 20-bit (sub-channels) field is the "primary power control field" and used for 20 primary active users. The rest of 4-bit (sub-channel) field is the "secondary power control field" and shared by multiple 1/8 rate secondary active users. The 4 sub-channels on the first slot of each 10ms-cycle are for a group of 4 secondary active users. The 4 sub-channels on the second slot of each 10ms-cycle are for another group of

4 secondary active users, and so on. The total active users supported by one common power control channel now are 20+(4X8)=52.

Configuration 2 (refer to Figure 2)

The first 16-bit (sub-channels) field is the "primary power control field" for primary active users. The rest of the 8-bit (sub-channels) field is the "secondary power control field" and used for 1/4 rate secondary active users. The sub-channels on the first slot of each 5ms-cycle are for a group of 8 secondary active users. The sub-channels on the second slot of each 5ms-cycle are for another group of 8 secondary active users, and so on. The total active users supported by one common power control channel now are 16+(8X4)=48.

Configuration 3 (refer to Figure 3)

The first 16-bit (sub-channels) field is the "primary power control field" and used for primary active users. The next 4-bit field is used for 1/4 rate secondary active users and the rest of the 4-bit field is used for 1/8 rate secondary active users. The total active users supported by one common power control channel in this configuration are 16+(4X4)+(4X8)=64.

For each of the above configurations, the percentiles of primary active users and various rate secondary active users supported among active users are fixed, but could be dynamically changing. For instance, the configuration can be dynamically changed

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based on real time traffic load of the active users. The updated configuration information can be sent on F-SCCH.

There are a number of different techniques according to the present invention for switching a mobile station from a primary active user to a secondary active user. In one embodiment, if a primary active user's data buffer at the base station becomes empty after the network sends a packet to the user, the layer 2 frame header of this packet includes a buffer empty indication (1bit) and corresponding information (mode control field) regarding the enhanced control hold mode. After receiving the forward link buffer empty indication, the mobile station of a primary active user replies to this by indicating whether the data buffer at the mobile station side is empty or not. If the mobile station's buffer is empty too, the primary active user is switched to a secondary active user immediately after the response from the mobile is received. Otherwise, the user remains in its full rate mode.

In an alternative embodiment of the present invention, the procedure for switching a mobile station from a primary active user to a secondary active user includes setting a timer with a very small value after the primary active user's buffer at the network-level becomes empty. At the expiration of the timer, the network sends a layer 2 control message to explicitly request the mobile station of the primary active user to switch to the rate-reduced mode of a secondary active user.

Some example embodiments of the mode control field as specified above are as following:

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For configuration 1:

Slot indicator (3 bits): indicates the slot among the 8 slots within a 10ms-cycle, in which, the power control sub-channel of a secondary active user is to be sent.
Sub-channel indicator (2 bits): indicates the secondary active user's power control sub-channel in the 8-bit secondary power control field.

For configuration 2:

Slot indicator (2 bits): indicates the slot among the 4 slots within a 5ms-cycle, in which, the power control sub-channel of a secondary active user is to be sent.
Sub-channel indicator (3 bits): indicates the secondary active user's power control sub-channel in the 8-bit secondary power control field.

For configuration 3:

Reduced rate indicator (1 bit): indicates whether 1/4 rate or 1/8 rate the secondary active user should use.
For a 1/4 rate secondary active user:

Slot indicator (2 bits): indicates the slot among the 4 slots within a 5ms-cycle, in which, the power control sub-channel of the secondary active user is to be sent.
Sub-channel indicator (2 bits): indicates the secondary active user's power control sub-channel in the 4-bit secondary power control field.

For a 1/8 rate secondary active user:

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Slot indicator (3 bits): indicates the slot among the 8 slots within a 10ms-cycle, in which, the power control sub-channel of a secondary active user is to be sent.

Sub-channel indicator (2 bits): indicates the secondary active user's power control sub-channel in the 4-bit secondary power control field.

The configuration information on F-SCCH and the mode control field on F-SCH together provide the operation rule in which a secondary active user follows after it becomes a secondary active user.

There are a number of different techniques according to the present invention for switching a mobile station from a secondary active user to a primary active user. In one embodiment, a secondary active user, after the mobile station's buffer at the network-level becomes non-empty, the network can send data to the secondary active user immediately since the secondary active user monitors F-SCCH all the time. The data rate and modulation scheme of the data packet on the F-SCH for this secondary active user is determined by its latest C/I report. A 5-bit control field indicating which power control sub-channel the user should monitor after being switched into full rate mode is inserted into the header of the layer 2 frame which encapsulates the first data packet. After this, the network will send the power control sub-channel to the user at the full rate and the user will send feedback information on the reverse dedicated channel at the full rate.

There are numerous advantages of the present invention. For instance, the embodiments of the

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present invention improve aggregated forward link throughput by increasing the number of active users without increasing additional resources.

Although, the present invention has been described above with reference to 3G wireless communications and specifically cdma2000, it should be understood that it is not limited to this environment. The present invention could apply to further standards that have similar problems as stated above.

Further, although described above for the case that power control information is being transmitted to the mobile stations, it should be understood that the present invention could apply to other control information (for example, pilot information) and should not be limited to the embodiments described.

Persons skilled in the art will appreciate that there are alternative implementations and modifications of the present invention, and that the above described implementation is only an illustration of specific embodiments of the invention. Therefore, the scope of the invention should only be limited by the claims appended hereto.

An appendix that aids in the understanding of the present invention is further incorporated within the present specification. Appendix 1 is a currently unpublished paper entitled "Enhanced control hold mode for high rate packet data wireless access network" by Zhang et al. that concerns the present invention.

FOR EXAMINER'S USE ONLY

We claim:

1. An apparatus for transmitting control information to a plurality of mobile stations via a common control channel;

wherein the apparatus operates to transmit control information to first and second sets of mobile stations at respective first and second rates of transmission via the common control channel, the second rate of transmission being less than the first rate of transmission.

2. An apparatus according to claim 1, wherein both the first and second sets of mobile stations comprise one or more mobile stations.

3. An apparatus according to claim 1, wherein the apparatus further operates to transmit control information to a third set of mobile stations at a third rate of transmission via the common control channel, the third rate of transmission being less than the second rate of transmission.

4. An apparatus according to claim 1, wherein the control information is power control information.

5. An apparatus according to claim 4, wherein the common control channel is a common power control channel.

6. A method for transmitting control information from a network apparatus to a plurality of mobile stations via a common control channel, the method comprising:

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transmitting control information to a first set of mobile stations at a first rate of transmission via the common control channel; and

transmitting control information to a second set of mobile stations at a second rate of transmission via the common control channel, the second rate of transmission being less than the first rate of transmission.

7. A method according to claim 6, wherein both the first and second sets of mobile stations comprise one or more mobile stations.

8. A method according to claim 6 further comprising transmitting control information to a third set of mobile stations at a third rate of transmission via the common control channel, the third rate of transmission being less than the second rate of transmission.

9. A method according to claim 6, wherein the control information is power control information.

10. A method according to claim 9, wherein the common control channel is a common power control channel.

11. A method according to claim 6, wherein the first set of mobile stations are primary active users that operate to transmit feedback information to the network apparatus at a first rate of feedback transmission; and

wherein the second set of mobile stations are secondary active users that operate to transmit feedback information to the network apparatus at a second rate of feedback transmission, the second rate

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of feedback transmission being less than the first rate of feedback transmission.

12. A method according to claim 11, wherein the first and second rates of feedback transmission are equal to the first and second rates of transmission respectively.

13. An apparatus for transmitting control information to a plurality of mobile stations via a common control channel, the apparatus comprising:

means for transmitting control information to a first set of mobile stations at a first rate of transmission via the common control channel; and

means for transmitting control information to a second set of mobile stations at a second rate of transmission via the common control channel, the second rate of transmission being less than the first rate of transmission.

14. A wireless network comprising:

first and second sets of mobile stations; and

an apparatus that operates to transmit control information to the first and second sets of mobile stations at respective first and second rates of transmission via a common control channel, the second rate of transmission being less than the first rate of transmission.

15. A network according to claim 14, wherein both the first and second sets of mobile stations comprise one or more mobile stations.

16. A network according to claim 14 further comprising a third set of mobile stations;

wherein the apparatus operates to transmit control information to the third set of mobile stations at a third rate of transmission via the common control channel, the third rate of transmission being less than the second rate of transmission.

17. A network according to claim 14, wherein the control information is power control information.

18. A network according to claim 17, wherein the common control channel is a common power control channel.

19. A network according to claim 14, wherein the first set of mobile stations are primary active users that operate to transmit feedback information to the apparatus at a first rate of feedback transmission; and

wherein the second set of mobile stations are secondary active users that operate to transmit feedback information to the apparatus at a second rate of feedback transmission, the second rate of feedback transmission being less than the first rate of feedback transmission.

20. A network according to claim 19, wherein the first and second rates of feedback transmission are equal to the first and second rates of transmission respectively.

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21. A method of switching a mobile station from a primary active user to a secondary active user comprising:

determining whether a data buffer for the mobile station at a network apparatus is in an empty condition;

if the data buffer is in an empty condition, determining whether a switch condition is detected; and

if the switch condition is detected, triggering the mobile station to be switched from a primary active user to a secondary active user.

22. A method according to claim 21, wherein the determining whether a switch condition is detected comprises determining whether an empty buffer indication from the mobile station has been received.

23. A method according to claim 21, wherein the determining whether a switch condition is detected comprises determining whether the data buffer is in an empty condition for a predetermined period of time.

24. An apparatus for switching a mobile station from a primary active user to a secondary active user comprising:

means for determining whether a data buffer for the mobile station at a network apparatus is in an empty condition;

means for determining whether a switch condition is detected if the data buffer is in an empty condition; and

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means for triggering the mobile station to be switched from a primary active user to a secondary active user if the switch condition is detected.

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Enhanced control hold mode for high rate packet data wireless access network

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1. Brief description

In current 1XEV-DO and 1XEV-DV system, for supporting high rate packet data transmission, a high rate channel with a constant RF power is shared by multiple active users on the basis of time-division-multiplexing. The rate control, instead of power control is applied. Forward link scheduler always schedules packet data to the user who has the most favorite forward link channel condition. In the full-queue case, where all active user's data buffers at network side are always occupied, significant multi-user diversity gain can be achieved. In non-full-queue case where active user's buffers are not always occupied by data (a realistic case), the multi-user diversity gain decreases significantly due to the fact that there is no data in an active user's buffer although the user has the most favorite channel condition. One solution is to increase the number of active users to increase the multi-user diversity gain in a non-full-queue case. However, the number of active users supported is restricted due to limited system resource.

When a user requests a packet session, the network will respond to this request by transitioning this user to an active state through dedicated or shared resource assignment. Those resources include forward link common power control channel (F-CPCCH), forward shared control channel (F-SCCH), forward shared high rate transmission channel (F-SCH), and reverse link dedicated channel for control signaling required for supporting forward link high rate data transmission. When a user is in the active state, the user sends the feedback information, such as forward link channel condition, ACK/NACK indication for ARQ function, etc on its dedicated channel. This feedback information is updated at 800Hz (per 1.25ms, full rate). At the same time the active user detects the power control sub-channel for purpose of closed-loop reverse link power control on F-CPCCH at the rate of 800Hz. Due to the resource occupancy by an active user, the number of active users supported cannot be increased infinitely.

Actually, due to the burstness of packet applications, for a significant time, an active user's buffer is empty during the active state. When an active buffer is empty, **it is not necessary to perform reverse link power control at full rate (800Hz) and for an active user to send feedback information at full rate. Such an active user can work on a 'lower rate mode' and the saving in resource enable more active users to be supported.**

Based on this observation, one new method is proposed **by which the number of active users can be increased, but without increasing associated overhead resource for supporting an active user.**

This method is called 'enhanced control hold mode'. In current cdma2000 system, an active data user is assigned a forward dedicated control channel/fundamental channel, reverse dedicated control channel/fundamental channel and supplemental channels on either forward link only or reverse link only or both. After the data buffer becomes empty for some period of time, the high rate supplemental channel is released and both forward and reverse dedicated control channel only send pilot and power control sub-channel on both directions with either full rate or a reduced rate. This mode is called "control hold mode." The purpose of this mode with rate-reduced operation is for battery saving.

In this proposed solution, the concept of the control hold mode is enhanced. However, the purpose here is not only for battery saving. One more important purpose is to dynamically share active users' resource and enable to increase number of active users without additional resource consumption. And eventually to increase system aggregated forward link throughput.

2. Problem solved by this invention

See above.

3. What techniques have tried but didn't work

As mention above, simply to increase number of active users may increase the aggregated throughput in non-full case but at the cost of significant overhead resource for supporting additional active users. In consequence, it is not a practical solution.

4. Working steps of this invention

For supporting forward link packet data transmission, the following forward link channels are defined:
- Shared channel (F-SCH) for high rate data transmission based on time-division multiplexing.
- Shared control channel (F-SCCH) for conveying the information required for detecting the data on F-SCH.
- Common power control channel (F-CPCCH) for reverse link power control of active users. The common power control channel is the same as that of current cdma2000 system.

Active user definition

For an active user who has a packet session connected, the following resources are assigned:
- Active user ID.
- Forward shared channel (F-SCH).
- Forward shared control channel (F-SCCH).
- Forward common power control channel (F-CPCCH).
- Reverse dedicated channel for feedback information transmission.

Active users are classified into two types:

- Primary active user (full rate mode): monitors F-SCCH all the time, monitors its power control sub-channel at 800Hz (full rate), send feedback (e.g., channel condition) at full rate.
- Secondary active user (reduced rate mode): monitors F-SCCH all the time, monitors its power control sub-channel and sends feedback at lower rate, e.g., 1/2 rate (half rate active user), or 1/4 rate (1/4 rate active user) or 1/8 rate (1/8 rate active user).

Common power control channel configuration:

The coding and modulation scheme of the common power control channel are the same as that of CDMA2000 system (there are 24 sub-channels transmitted on each slot). However these 24 sub-channels are redefined. Some example embodiments are as follows:

- configuration 1 (refer to Figure 1)

  The first 20-bit (sub-channels) field is "primary power control field" and used for 20 primary active users.
  The rest of 4-bit (sub-channel) field is "secondary power control field" and shared by multiple 1/8 rate secondary active users. The 4 sub-channels on the first slot of each 10ms-cycle are for a group of 4 secondary active users. The 4 sub-channels on the second slot of each 10ms-cycle are for another group of 4 secondary active users, and so on. The total active users supported by one common power control channel now are 20+4X8=52.

- Configuration 2 (refer to Figure 2)

  The fist 16-bit (sub-channels) field is "primary power control field" for primary active users.
  The rest of 8-bit (sub-channels) field is "secondary power control field" and used for 1/4 rate secondary active users. The sub-channels on the first slot of each 5ms-cycle are for a group of 8 secondary active users. The sub-channels on the second slot of each 5ms-cycle are for another group of 8 secondary active users, and so on. The total active users supported by one common power control channel now are 16+ 8X4 = 48.

- Configuration 3 (refer to Figure 3)

The first 16-bit (sub-channels) field is "primary power control field" and used for primary active users. The next 4-bit field is used for 1/4 rate secondary active users and the rest 4-bit field is used for 1/8 rate secondary active users. The total active users supported by one common power control channel now are 16+4X4+4X8 = 64.

Dynamic configuration adaptation

For each configuration, the percentiles of primary active users and various rate secondary active users supported among active users are fixed. The configuration can be dynamically changed based on real time traffic load of active users. The updated configuration information can be sent on F-SCCH.

Switching a primary active user to a secondary active user

For a primary active user, if the user's data buffer at the base station becomes empty after the network sends a packet to the user, the layer 2 frame header of this packet should include an buffer empty indication (1bit) and corresponding information (mode control field) regarding the enhanced control hold mode. Some example embodiments of the mode control field are as the followings:

For configuration 1:

Slot indicator (3 bits): indicates the slot among the 8 slots within a 10ms-cycle, in which, the power control sub-channel of a secondary active user is to be sent.
Sub-channel indicator (2 bits): indicates the secondary active user's power control sub-channel in the 8-bit secondary power control field.

Configuration 2:

Slot indicator (2 bits): indicates the slot among the 4 slots within a 5ms-cycle, in which, the power control sub-channel of a secondary active user is to be sent.

Sub-channel indicator (3 bits): indicates the secondary active user's power control sub-channel in the 8-bit secondary power control field.

Configuration 3:

Reduced rate indicator (1 bit): indicates whether 1/4 rate or 1/8 rate the secondary active user should use.

For a 1/4 rate secondary active user:

Slot indicator (2 bits): indicates the slot among the 4 slots within a 5ms-cycle, in which, the power control sub-channel of the secondary active user is to be sent.

Sub-channel indicator (2 bits): indicates the secondary active user's power control sub-channel in the 4-bit secondary power control field.

For a 1/8 rate secondary active user:

Slot indicator (3 bits): indicates the slot among the 8 slots within a 10ms-cycle, in which, the power control sub-channel of a secondary active user is to be sent.

Sub-channel indicator (2 bits): indicates the secondary active user's power control sub-channel in the 4-bit secondary power control field.

The configuration information on F-SCCH and the mode control field on F-SCH together explicitly provides the operation rule a secondary active user should follow after it becomes a secondary active user.

After receiving the forward link buffer empty indication, a mobile should reply this by indicating whether the data buffer at mobile side is empty or not. If the mobile's buffer is empty too, the primary active user is switched to secondary active user immediately after the response from the mobile is received. Otherwise, the user remains its full rate mode.

An alternative switching procedure is that a timer with very small value is set upon the primary' active user's buffer at network becomes empty. At the expiration of the timer, the network send a layer 2 control message to explicitly request the active user to switch to the rate-reduced mode.

Switching a secondary active user to a primary active user

For a secondary active user, after the user's buffer at network becomes non-empty, the network can send data to the secondary active user immediately since the secondary active user monitors F-SCCH all the time. The data rate and modulation scheme of the data packet on F-SCH for this secondary active user is determined by its latest C/I report. A 5-bit control field indicating which power control sub-channel the user should monitor after switched into full rate mode, then is inserted into the header of layer 2 frame which encapsulates the first data packet. The network will send the power control sub-channel to the user at full rate and the user will send feedback information on reverse dedicated channel at the full rate.

5. Commercial value of the invention to Nortel and Nortel's major competitors:

Technical benefit

- Improve aggregated forward link throughput by increasing number of active users without increasing additional resources

Commercial benefit

- Added value to Nortels patent profile for current 3G systems and future wireless access systems
- Contribution to current 3G standards evolution (1xEV and UMTS High Speed Downlink Packet Access) and future wireless access network (e.g., mobile or fixed) standards

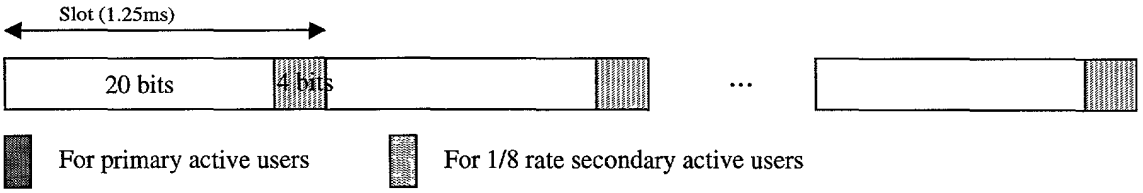


Figure 1. Configuration 1.

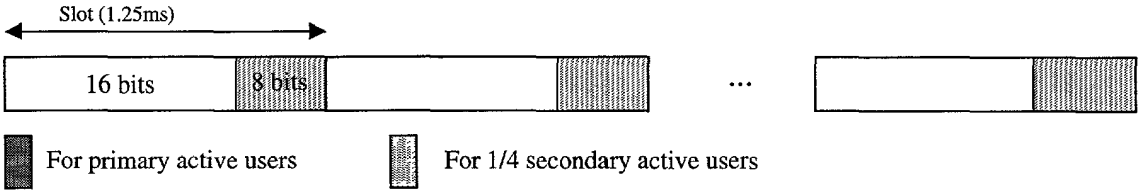


Figure 2. Configuration 2.

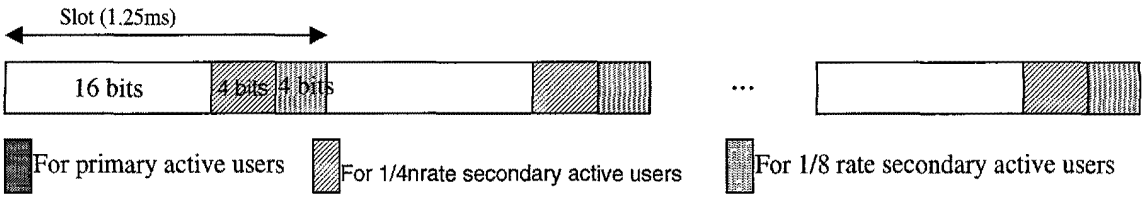


Figure 3. Configuration 3.

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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

Express Mail Label No. EL158462035US

INVENTOR(S)

Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
Hang	Zhang	Nepean, Ontario, Canada

☐ *Additional inventors are being named on the ___ separately numbered sheets attached hereto*

TITLE OF THE INVENTION (280 characters max)

Apparatus and Method for Transmission Rate Management Within Wireless Networks

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ENCLOSED APPLICATION PARTS *(check all that apply)*

☑ Specification *Number of Pages* 23
☐ Drawing(s) *Number of Sheets*
☐ Application Data Sheet. See 37 CFR 1.76
☐ CD(s), Number
☐ Other (specify)

METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT

☐ Applicant claims small entity status. See 37 CFR 1.27.
☐ A check or money order is enclosed to cover the filing fees
☑ The Commissioner is hereby authorized to charge filing fees or credit any overpayment to Deposit Account Number: 50-0210
☐ Payment by credit card. Form PTO-2038 is attached.

FILING FEE AMOUNT ($): 150.00

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☑ No.
☐ Yes, the name of the U.S. Government agency and the Government contract number are: _____

Respectfully submitted,

SIGNATURE John D. Crane

TYPED or PRINTED NAME John D. Crane

TELEPHONE (972) 685-8442

Date 06/27/01

REGISTRATION NO. *(if appropriate)* 25,231

Docket Number: 14727ROUS01P

USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

This collection of information is required by 37 CFR 1.51. The information is used by the public to file (and by the PTO to process) a provisional application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the complete provisional application to the PTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Washington, D.C. 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Box Provisional Application, Assistant Commissioner for Patents, Washington, D.C. 20231.

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Additional Page

PTO/SB/16 (02-01)
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Docket Number	14727ROUS01P	Type a plus sign (+) inside this box →	+

INVENTOR(S)/APPLICANT(S)		
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Number 2 of 2

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Docket #14727ROUS01P