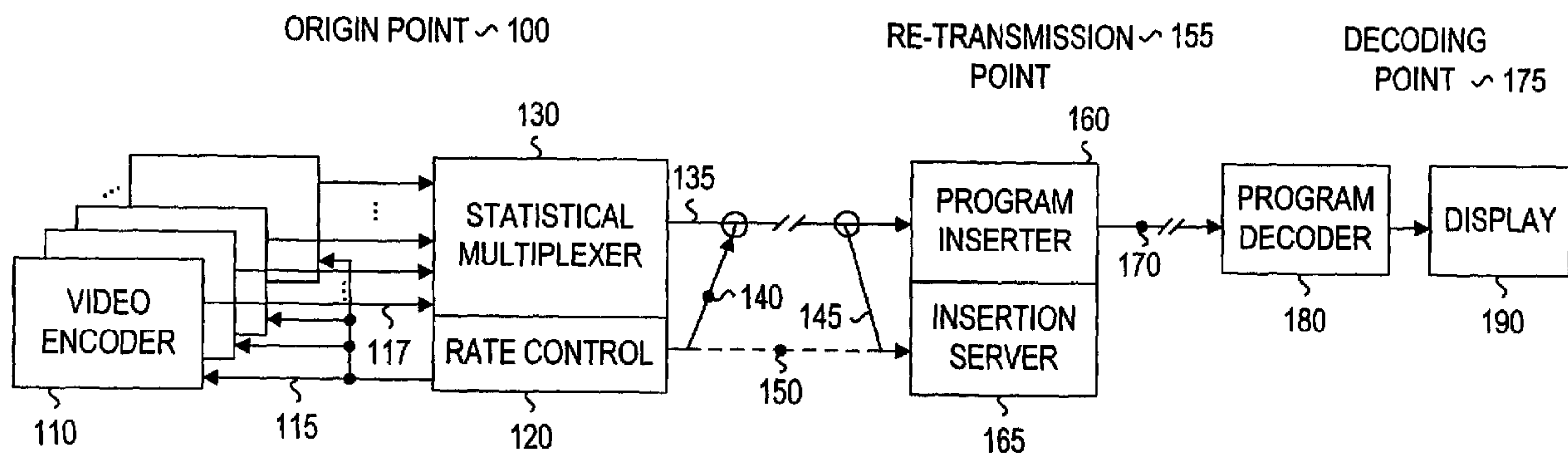




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(54) Titre : METHODE ET DISPOSITIF PERMETTANT D'INSERER DES PUBLICITES MEDIAS NUMERIQUES DANS
DES CHAINES A MULTIPLEXAGE ASYNCHRONE
(54) Title: METHOD AND APPARATUS FOR INSERTING DIGITAL MEDIA ADVERTISEMENTS INTO STATISTICAL
MULTIPLEXED STREAMS



(57) Abrégé/Abstract:

A method and system for the insertion of local signals (165), including digital media advertisements, into statistically multiplexed streams (135) is presented. The rate control (120) and timing information is computed and is used to specify the insertion time and rate parameters for digital advertisements. In one embodiment, a maximum bit rate over the advertisement duration is specified. The maximum bit rate may be constant or may vary in time, such that high bit rate portions of the advertisement are supported. High bit rate portions of the advertisements in different program streams may be staggered, such that the total bandwidth required does not exceed a maximum, but allowing for high bit rate portions of advertisements. Custom bit rate profiles for advertisements may also be defined, with the profiles being defined at a high granularity or a low granularity.

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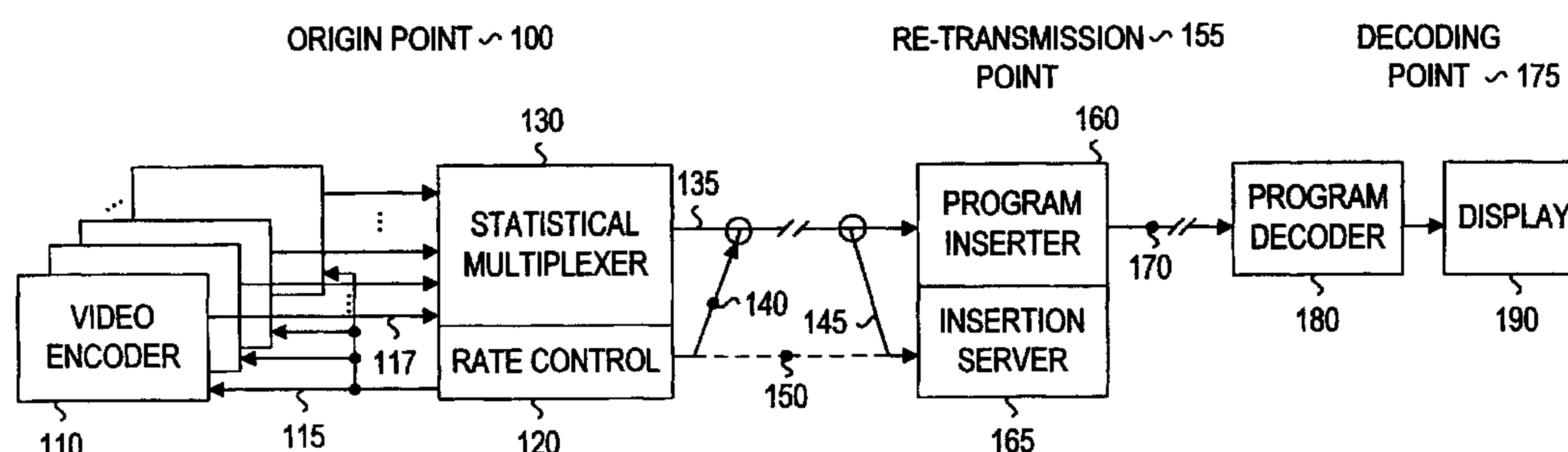
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(54) Title: METHOD AND APPARATUS FOR INSERTING DIGITAL MEDIA ADVERTISEMENTS INTO STATISTICAL MULTIPLEXED STREAMS



(57) Abstract: A method and system for the insertion of local signals (165), including digital media advertisements, into statistically multiplexed streams (135) is presented. The rate control (120) and timing information is computed and is used to specify the insertion time and rate parameters for digital advertisements. In one embodiment, a maximum bit rate over the advertisement duration is specified. The maximum bit rate may be constant or may vary in time, such that high bit rate portions of the advertisement are supported. High bit rate portions of the advertisements in different program streams may be staggered, such that the total bandwidth required does not exceed a maximum, but allowing for high bit rate portions of advertisements. Custom bit rate profiles for advertisements may also be defined, with the profiles being defined at a high granularity or a low granularity.

WO 01/30086 A1

WO 01/30086

PCT/US00/29034

TITLE

*Method and Apparatus for
Inserting Digital Media Advertisements into Statistical
Multiplexed Streams*

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Background of the Invention.

The transition to digital video allows video programming to be transmitted in a digital format through satellite systems, cable systems, and over the air broadcast systems. Digital compression, and in particular, the Motion Pictures Expert Group (MPEG) Standard allows for multiple digital programs to be carried in a section of spectrum which previously could only carry one analog program. Typically, the 6 MHz wide channel which carried one analog program can carry six to ten digitally encoded and compressed programs.

As part of the digital transmission process, multiple programs are statistically multiplexed such that the bit rate requirements for each program are met and when programs do not have a high bit rate requirement, other programs can use the available bandwidth. As an example, when a football game is statistically multiplexed with a talk show, the football game will be allocated sufficient bandwidth to permit accurate representation of the play on the field and the motion of the players. The talk show program will be allocated a minimum amount of bandwidth such that the people appearing on the program can be seen clearly. However, in an instance when there is motion in the talk show program as may be the case when the participants on the talk show begin to hurl chairs at one another, the multiplexing process will allocate additional bandwidth to the talk show and in the event that there is a minimum bandwidth requirement in the football game, that bandwidth will be allocated from the football game to the talk show. Clearly, when there are multiple programs, bandwidth can be allocated among all the programs such that the motion can be

WO 01/30086

PCT/US00/29034

accurately represented in each program and the overall statistically multiplexed stream optimized.

Several problems arise in statistically multiplexed programs including the difficulty in separating programs and substituting provisional programming. As an example, at a re-transmission point such as a cable television local head end it becomes difficult to remove one program from the statistically multiplexed stream and insert another program. This difficulty arises from the fact that the bandwidth of the program is varying constantly according to the bandwidth tradeoffs achieved by the statistical multiplexing equipment at the origin point.

Another difficulty is the insertion of advertisements into the statistically multiplexed streams. Because the bandwidth of each program is varying, an original advertisement inserted into the program stream at the origin point will have a time varying bandwidth. Inserting another advertisement at the re-transmission point is not readily facilitated in existing systems and equipment because the bandwidth is varying and in some cases not easily discernible by the equipment at the re-transmission point. Because local advertisement insertion is an important part of many broadcast services and generates significant revenue, it is necessary to be able to remove the initial advertisements, which are part of the program stream and substitute new advertisements.

Patent Number 5,715,018 entitled "Digital Advertisement Insertion system" issued on February 3, 1998, provides means for digitizing, compressing and storing analog/audio video source information; and decompressing the information to regenerate an analog signal. A method based on this patent includes receiving motion video information from an analog source; digitizing, compressing and storing the received motion video information in a computer data file such that upon decompression, broadcast quality motion video information is

WO 01/30086

PCT/US00/29034

obtained; selecting and editing at least a portion of the stored motion video information; decompressing the selected and edited portion of the stored motion video information to obtain broadcast quality motion; and regenerating an analog signal
5 from the selected and edited portion of the stored motion video information; inserting the regenerated analog signal in place of a broadcast signal on a channel at a predetermined time; and providing synchronization of the regenerated analog signal to the broadcast signal.

10 An apparatus based on this patent includes means for inserting a signal representing motion video information in place of a broadcast signal on a broadcast channel at a predetermined time, and wherein the broadcast channel transmits the motion video information at a field per second rate; means
15 for providing synchronization of the signal representing motion video information to the broadcast signal; a randomly-accessible computer-readable medium for digitally storing in a data file compressed image data for a sequence of digital still images, including an image corresponding to each field of the
20 motion video information to be transmitted in the broadcast channel, such that upon decompression, broadcast quality motion video information is obtained; and a computer including means for editing the sequence of digital still images, means for accessing the sequence at the predetermined time, for
25 decompressing the sequence to obtain broadcast quality motion video information and for generating the signal to be inserted into the broadcast channel from the accessed sequence.

U.S. Patent Number 5,600,366 entitled "Methods and Apparatus for Digital Advertisement Insertion in Video
30 Programming", issued on February 4, 1997 permits timely and correct switchovers from network programming to local advertising in ways which occur smoothly without disruption in perception to the viewer. Switchovers occur at packet or frame boundaries and are designed to occur upon detection of idle

WO 01/30086

PCT/US00/29034

information from a network source. An apparatus based on this patent includes means for receiving externally supplied programming comprising analog video information and embedded tone cues including a pre-roll cue and a roll cue, detecting
5 said tone cues and converting the analog video information to digital video information; means for activating digital video storage in response to one of said tone cues preparatory to initiating playback; and means for initiating playback from
10 said storage in response to detecting an idle condition from said digital video information.

Another apparatus based on this patent includes means for receiving externally supplied programming from a plurality of sources, each source providing programming comprising analog video information and embedded tone cues, and for converting
15 the analog video information to digital video information; storage means for storing a plurality of local programs; common means for monitoring all of said sources to detect one or more tone cues from a source and for preparing said storage means
20 for playback of respective one or more of said local programs to be substituted for said externally supplied programming from a source sending at least one of said one or more tone cues; and means for initiating playback from said storage means of
25 respective one or more of said local programs to be substituted for said externally supplied programming from a source in response to detecting an idle condition from said digital video information of said source.

A method based on this patent includes receiving externally supplied programming comprising analog video information and embedded tone cues including a pre-roll cue and
30 a roll cue, detecting said tone cues and converting the analog video information to digital video information; activating video storage in response to one of said tone cues preparatory to initiating playback; and initiating playback from said

WO 01/30086

PCT/US00/29034

recorder in response to detecting an idle condition from said digital video information.

Another method based on this patent includes receiving local digital video programming and providing it to a user; receiving externally supplied analog video programming and embedded tone cues including a return to network cue, detecting said return to network cue; converting said analog video programming to digital video information upon receipt of said return to network cue; and terminating operation of video storage in response to detection of an idle condition in said local digital video programming.

U.S. Patent Number 5,956,088 entitled "Method and Apparatus for Modifying Encoded Digital Video for Improved Channel Utilization" issued on September 21, 1999 and U.S. Patent Number 5,862,140 entitled "Method and Apparatus for multiplexing Video Programs for Improved Channel Utilization" issued on January 19, 1999 both provide a method (and apparatus) for increasing channel utilization for a data channel transmitting a multiplex of a set of one or more encoded program streams. Each program stream in said set being decodable by a corresponding decoder. Each corresponding decoder including a corresponding decoder buffer, the decoder buffers having a maximum allowable size. The method comprising selecting encoded pictures to be modified, said selecting according to a criterion, which includes preventing any underflow of any decoder buffer, modifying each said selected encoded picture to form a corresponding modified encoded picture, said modified encoded picture having less data than said selected encoded picture, and transmitting the corresponding modified encoded pictures through the channel in place of the selected encoded pictures. In one embodiment of these patents, modifying deletes each selected encoded picture. In another embodiment of the patents, where the encoded program streams include predictively encoded pictures, selecting

WO 01/30086

PCT/US00/29034

selects predictively encoded pictures that are not anchor pictures, and modifying deletes the prediction error data from each said selected encoded picture.

5 In a further embodiment of these patents, one or more additional data channels are used to send augmentation information. The augmentation information can be used by specially equipped receivers to correct the impairments that would normally occur when decoding the modified signal received from the data channel. In yet another embodiment of the
10 patent, augmentation information is sent using the same data channel that is used to transmit the modified pictures. In this case, the information that is removed by modifying is transmitted before it is needed for decoding and at a time when the data channel is not fully utilized. Certain receivers
15 equipped with sufficient storage can receive and store the augmentation information until it is needed. Alternatively, if the additional storage is used to insert additional delay between the time that data is received and the time that data is decoded, then the augmentation information can be sent after
20 it would be needed by a conventional receiver.

A system of these patents comprise primary and overflow demodulators configured to demodulate data from the primary and overflow channels, respectively; a first demultiplexer, coupled to the primary demodulator, configured to extract a primary
25 packet stream from an output of the primary demodulator; a second demultiplexer, coupled to the overflow demodulator, configured to extract an overflow packet stream from an output of the overflow demodulator; a buffer coupled to the second demultiplexer; a time stamp comparator, coupled to the first
30 demultiplexer and the buffer, configured to compare a time stamp associated with a next packet from the primary packet stream with a time stamp associated with a next packet from the overflow packet stream; and a packet multiplexer, coupled to the first demultiplexer, the buffer and the time stamp

WO 01/30086

PCT/US00/29034

comparator, configured to select one of the next packets from the primary packet stream and the overflow packet stream in response to a comparison made by the time stamp comparator.

U.S. Patent Number 5,029,014 entitled "Ad Insertion System and Method for Broadcasting Spot Messages Out of Recorded Sequence", issued on July 2, 1991, provides an advertisement insertion system and method transmit spot messages during intervals in a broadcast transmission and provide immediate access to stored spot messages, in any sequential order, with a single video source. Custom spot messages can be created by superimposing graphics over selected video signals and simultaneously transmitting those signals with appropriate audio signals.

A system of this patent comprises a first playing means for playing spot messages stored in a recorded sequence on a video source, and control means for switching a broadcast system from program signals of a scheduled broadcast, selecting and causing said first playing means to play into said broadcast system in immediate succession a plurality of spot messages out of said recorded sequence without intervening material from another playing means, and switching said broadcast system back to program signals of a scheduled broadcast.

A method of this patent comprises selecting video, audio and/or graphic signals to form custom spot messages; accessing the selected video signals on a laser disk; accessing selected audio signals which are to be simultaneously broadcast with said accessed video signals; and switching from broadcast transmission to spot message transmission to co-broadcast said accessed video and audio signals as said spot messages with an audio component according to a programmed time schedule and out of a pre-recorded sequence of spot messages on said laser disk.

U.S. Patent Number 5,966,120, entitled "Method and Apparatus for Combining and Distributing Data with Pre-

WO 01/30086

PCT/US00/29034

formatted Real-time Video", issued on October 12, 1999, relates to providing constant bit rate distribution of variable bit rate-encoded video programs, along with Auxiliary Data of a general character, to one or more receivers. At a particular receiver, a customized augmented video program is created by inserting selected portions of the Auxiliary Data into a selected encoded video program. The encoded video portion of the augmented video program can be transmitted, decoded and displayed in real time, while the Auxiliary Data need not be transmitted in real time but can be stored locally at the receiver for real-time presentation at a later time. Real time presentation might include insertion into the video program while non real-time presentation might include insertion into non-video applications separate from the video program.

15 A method of this patent comprises the steps of receiving the primary data stream; detecting fill data in the primary data stream; inserting an auxiliary data stream in place of the fill data; and adding location data for the programs and for the auxiliary data; to form a modified data stream for distribution to a plurality of receivers configured for individually extracting selected portions of the modified data stream in accordance with the location data.

Another method of this patent comprises the steps of statistically multiplexing a plurality of encoded video programs; monitoring the statistically multiplexed encoded video programs for the occurrence of a fill packet; maintaining a buffer of auxiliary data segments; replacing the fill packet with at least one segment of the auxiliary data stream from the buffer if the segment is smaller than the size of the fill packet; adding location data for the encoded video programs and for the auxiliary data; to form a modified data stream for distribution to a plurality of receivers configured for individually extracting selected portions of the modified data stream in accordance with the location data.

WO 01/30086

PCT/US00/29034

A system of this patent comprises a program multiplexer for statistically multiplexing a plurality of encoded video programs to the modified data stream; a data insertion controller coupled to receive a multiplexed program stream from the program multiplexer and for inserting auxiliary data therein to yield a modified data stream; and a program map insertion controller coupled to receive the modified data stream for adding location data for the encoded video programs and for the auxiliary data to the modified data stream.

Another system comprises a multiplexer for statistically multiplexing a plurality of encoded video programs; a first controller for adding auxiliary data to the output of the multiplexer; a second controller for adding location data for the encoded video programs and for the auxiliary data to the output of the first controller, thereby forming a modified data stream; a distribution channel for distributing the modified data stream to at least one receiver; a processor for determining location data from the distributed modified data stream; a first demultiplexer for selecting an encoded video program from the modified data stream in accordance with a first predetermined characteristic of the processor and the location data; a second demultiplexer for selecting local auxiliary data from the modified data stream in accordance with a second predetermined characteristic of the processor and the location data; a storage device for storing the local auxiliary data from the second demultiplexer; and an augmentation unit for associating the encoded video program and the stored local auxiliary data to form a receiver-specific augmented video program for decoding and display.

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Summary of the Invention

The present invention provides a system and method for computing rate profiles associated with the multiplexed program streams. The rate profiles may be used for inserting local advertisements and allowing substitution of original

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WO 01/30086

PCT/US00/29034

advertisements or other programming with inserted advertisements. In one embodiment, a predetermined bit rate profile is specified for the compression of an advertisement with the specification extending from the start point of the advertisement to the end point. The digital media advertisement is compressed according to the specified profile and inserted into the advertising opportunity.

The predetermined bit profile may comprise a maximum bit rate, a maximum bit rate and a minimum bit rate, a minimum or maximum number of bits over the avail or a subset or portion of the avail, or a time varying profile defined from the start point to the end point. The profile may be modeled as a piece-wise linear model, allowing bandwidth to change at specified moments during the advertisement.

The specified predetermined bit rate profile may comprise only a minimum bit rate and null packets may be inserted to make up the difference between the minimum bit rate and the actual bit rate which occurs in the statistically multiplexed stream.

In a statistically multiplexed stream where there are multiple programs with varying bit rates for each program, multiple bit rate profiles may be defined such that each advertising opportunity has a specific bit rate profile defined for it. The individual rate profiles may be defined such that the sum of all the profiles is equal to the maximum allowed bit rate in the statistically multiplexed stream during the advertisement. The predetermined bit rate profile for the stream may specify the instantaneous sum of the first bit rate profile and the second bit rate profile or may simply define the total number of bits from the start point to the end point of the first bit rate profile summed with the second bit rate profile.

In inserting advertisements in various multiplexed program streams, it is possible to create the bit rate profiles for the

79348-7

individual advertisements such that they are complementary. That is, the high bandwidth portions of the first bit rate profile correspond to the low bandwidth portions of the second bit rate profile. This method can be extended across
5 multiple profiles such that high bandwidth portions of an advertisement correspond with at least one low bandwidth portion in another program stream, thus allowing for multiple simultaneous high bandwidth portions of advertisements. Alternatively, high bandwidth portions of
10 advertisements may be staggered in a predetermined manner such that ads are allowed to have sections of high motion or other high bandwidth requirements but that these portions do not occur simultaneously.

According to one aspect the invention provides a
15 method for inserting a digital media advertisement in a digital multiplexed stream, the method comprising: computing a rate profile associated with a program stream; compressing the digital media advertisement according to the computed rate profile; and inserting the compressed digital media
20 advertisement in the digital multiplexed stream at an advertising opportunity in the program stream.

According to another aspect the invention provides a method of compressing digital media advertisements for insertion into a statistically multiplexed digital
25 transmission stream containing a plurality of digital program streams with a plurality of advertising opportunities, the method comprising: determining a first bit rate profile for a first advertising opportunity; determining a second bit rate profile for a second
30 advertising opportunity; and specifying a predetermined bit rate profile for compression of a first advertisement and a second advertisement, wherein the predetermined bit rate

79348-7

profile provides a limit to the sum of the first bit rate profile and the second bit rate profile.

According to another aspect the invention provides a system for inserting a digital media advertisement in a digital multiplexed stream, the system comprising: a rate profile monitor for monitoring a rate profile associated with a program stream; a video compressor for compressing the digital media advertisement according to the rate profile associated with the program stream to create a compressed digital media advertisement; and a digital video inserter for inserting the compressed digital media advertisement into the program stream.

According to another aspect the invention provides a system for compressing digital media advertisements and inserting the digital media advertisements into a statistically multiplexed digital transmission stream containing a plurality of digital program streams with a plurality of advertising opportunities, the system comprising: a statistical multiplexor capable of determining a first bit rate profile for a first advertising opportunity and a second bit rate profile for a second advertising opportunity; and an ad encoder/compressor capable of encoding and compressing a first advertisement and a second advertisement at a predetermined aggregate bit rate profile which is less than or equal to the sum of the first bit rate profile and the second bit rate profile.

According to another aspect the invention provides a method for inserting digital advertisements into digital program streams that are part of a statistically multiplexed digital stream, the method comprising: defining an advertisement bit rate for an advertising opportunity in a

79348-7

digital program stream, wherein the digital program stream forms part of the statistically multiplexed digital stream; compressing an advertisement to the advertisement bit rate to form a compressed advertisement; and inserting the
5 compressed advertisement into the digital program stream.

According to another aspect the invention provides a system for inserting compressed digital video advertisements in a statistically multiplexed digital video stream, the system comprising: a statistical multiplexor
10 capable of determining an available bandwidth of an advertising opportunity in a digital video program stream; and an advertisement insertion server capable of serving an advertisement at a forced minimum bit rate.

According to another aspect the invention provides
15 in a statistically multiplexed digital video environment having multiple statistically multiplexed program streams with one or more advertisement opportunities, an advertisement insertion unit for serving advertisements to a statistical multiplexing program insertion unit wherein the
20 advertisement insertion unit is capable of forcing an advertisement to run at a minimum bit rate therefore insuring that a minimum bit rate will be maintained for the advertisement in the statistically multiplexed program stream.

25 According to another aspect the invention provides a system for inserting compressed digital video advertisements in a statistically multiplexed digital video stream, the system comprising: a statistical multiplex unit capable of determining an available bandwidth of an
30 advertising opportunity in a digital video program stream; and an advertisement insertion server capable of limiting

79348-7

the bandwidth of a served advertisement therefore insuring that the advertisement does not exceed a maximum bit rate.

According to another aspect the invention provides in a statistically multiplexed digital video environment having multiple statistically multiplexed programs streams with one or more advertisement opportunities an advertisement insertion unit for serving advertisements to a statistical multiplexing program insertion unit wherein the advertisement insertion unit is capable of limiting the bit rate of a served digital video advertisement to insure that a maximum bit rate is not exceeded.

According to another aspect the invention provides in a statistically multiplexed digital video environment having multiple statistically multiplexed programs streams with one or more advertisement opportunities, a statistical multiplexing unit comprising: a bandwidth monitoring utility for determining an available bandwidth for an advertisement in an advertising opportunity, wherein the bandwidth monitoring utility communicates with one or more external devices to report the available bandwidth for the advertisement; and a program insertion subsystem for inserting the advertisement in the advertising opportunity at the available bandwidth.

According to another aspect the invention provides in a statistically multiplexed digital video environment having one or more statistically multiplexed program streams with one or more advertisement opportunities, an advertisement insertion server comprising: a storage medium for storing one or more digital advertisements; a rate control interface for receiving one or more rate control instructions; and an insertion rate control signal

79348-7

generation mechanism for generating one or more insertion rate control signals from the one or more rate control instructions, wherein the rate control signals are used for controlling advertisement insertion into the one or more advertisement opportunities in the one or more statistically multiplexed program streams.

According to another aspect, the invention provides a method for inserting an advertisement into a statistically multiplexed stream, the method comprising:

10 computing a program stream rate profile for a program stream within a statistically multiplexed stream; generating an avail rate profile for an avail within the program stream, wherein the avail rate profile is based on the program stream rate profile; compressing an advertisement in

15 accordance with the avail rate profile; and inserting the compressed advertisement in the avail within program stream.

According to another aspect, the invention provides a system for inserting an advertisement in a statistically multiplexed stream, the system comprising:

20 rate profiler to determine a program stream rate profile associated with a program stream within a statistically multiplexed stream and an avail rate profile for an avail within the program stream; a video compressor to compress an advertisement according to the avail rate profile; and a

25 video inserter to insert the compressed advertisement into the program stream.

According to another aspect, the invention provides a method for inserting advertisements into a statistically multiplexed transmission stream containing a plurality of program streams with a plurality of advertising opportunities, the method comprising: determining a first

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79348-7

avail rate profile for a first avail within a first program stream, wherein the first avail rate profile is based at least in part on a first program stream rate profile for the first program stream; determining a second avail rate
5 profile for a second avail within a second program stream, wherein the second avail rate profile is based at least in part on a second program stream rate profile for the second program stream; generating a composite avail rate profile based on the first avail rate profile and the second avail
10 rate profile; assigning a first advertisement rate profile to the first avail and a second advertisement rate profile to the second avail, wherein the first advertisement rate profile is not limited by the first avail rate profile and the second advertisement rate profile is not limited by the
15 second avail rate profile, and wherein a combined first advertisement and second advertisement rate profile is limited by the composite avail rate profile; compressing the first advertisement according to the first advertisement rate profile and the second advertisement according to the
20 second advertisement rate profile; and inserting the compressed first advertisement in the first avail and the second advertisement in the second avail.

According to another aspect, the invention provides a system for inserting advertisements into a
25 statistically multiplexed transmission stream containing a plurality of program streams with a plurality of advertising opportunities, the system comprising: a statistical multiplexer capable of determining a first avail rate profile for a first avail within a first program stream and
30 a second avail rate profile for a second avail within a second program stream; a video compressor capable of compressing a first advertisement and a second advertisement at an aggregate rate profile which is less than or equal to

79348-7

sum of the first avail rate profile and the second avail rate profile; and a video inserter capable of inserting the compressed first advertisement in the first avail and the second compressed advertisement in the second avail.

5 These and other features and objects of the invention will be more fully understood from the following detailed description of the preferred embodiments, which should be read in light of the accompanying drawings.

Brief Description of the Drawings

10 The accompanying drawings, which are incorporated in and form a part of the specification, illustrate the embodiments of the present invention and, together with the description serve to explain the principles of the invention.

15 In the drawings:

FIG. 1 is a block diagram illustrating an exemplary processing associated with the generation of statistically multiplexed streams;

20 FIGS. 2A and 2B illustrate the time varying bit rates for an incoming program stream and an outgoing stream with inserts respectively;

FIGS. 3A and 3B illustrate the time varying bit rates for two statistically multiplexed streams having complementary advertisement avails;

WO 01/30086

PCT/US00/29034

FIGS. 4A-4C illustrate staggered avail profiles for three simultaneous multiplexed streams;

FIG. 5 illustrates two profiles having coarse granularity and fine granularity respectively; and

5 FIG. 6 illustrates monitoring of the total number of bits during the avails.

Detailed Description of the Preferred Embodiment

10 In describing a preferred embodiment of the invention illustrated in the drawings, specific terminology will be used for the sake of clarity. However, the invention is not intended to be limited to the specific terms so selected, and it is to be understood that each specific term includes all
15 technical equivalents which operate in a similar manner to accomplish a similar purpose.

With reference to the drawings, in general, and FIGS. 1 through 6 in particular, the system and method of the present invention is disclosed.

20 FIG. 1 illustrates an exemplary processing associated with the generation of statistically multiplexed program streams. As illustrated, each video encoder 110 produces a video programming stream 117 which is received by the statmux 130. The statmux 130 includes a rate control unit 120, which
25 provides a rate control signal 115 to each video encoder 110. This rate control signal 115 is used by the video encoder 110 to compress the programming according to the requirements of the statmux 130. The statmux 130 acts to control the total bandwidth utilized by the multiple video encoders 110. The
30 actual number of video encoders will be determined by the amount of bandwidth available to the statistical multiplexer 130.

WO 01/30086

PCT/US00/29034

The origin point 100 for the video may be a studio location, a satellite uplink location, a cable centralized transmission point, in-home server, or other video origin point.

5 Once the statmux 130 creates a statistical multiplexed stream 135, it is transmitted to the re-transmission point 155. Rate control information may be transmitted as part of the statistically multiplexed stream 135 through use of an inserted rate control signal 140 which is combined with the programming.
10 Alternatively, the rate control information may be transmitted as a separate rate control signal 150 that may be reinserted through use of a rate control reinsertion signal 145. In another embodiment, rate control information may be transmitted only as MPEG video rate parameters.

15 The re-transmission point 155 may comprise a cable television head end, a satellite downlink receiver, or can even be home equipment such as a television set top, personal computer, or other equipment, which receives the statistically multiplexed stream 135.

20 At the re-transmission point 155, a program inserter 160 works in conjunction with an insertion server 165 to reform the program streams with substituted advertisements. This new program stream comprises the outgoing program stream multiplex 170. The outgoing program stream multiplex 170 is received by
25 a decoding point 175 that includes a program decoder 180, which decodes the digital video stream and presents it to a display unit 190. In one embodiment, the program decoder comprises an MPEG decoder and is coupled to a television which acts as display 190. In another embodiment, the program decoder 180
30 comprises another type of digital video decompression system and is coupled to a personal computer or other display device.

From a business perspective, the fact that advertisements have been inserted into what are termed "ad avails" creates difficulty at the re-transmission point 155 because the

WO 01/30086

PCT/US00/29034

advertisement may not be suitable for the viewers in that geographic area, the service provider may be able to receive more revenue by substituting the original advertisement with a new advertisement. As an example, it may be desirable for a cable operator to replace a nationally broadcast advertisement with a local advertisement for a restaurant, car dealership, or other locally provided service. If the cable operator had permission to substitute the ads, they will want to remove the original advertisement from the programming stream and substitute the local advertisement. The term "ad avail" refers to any available spot for advertising which may be filled with an original advertisement or a blank spot in the programming. Alternatively, it may be possible to interrupt the program stream and insert an advertisement where there was no original advertisement. In this case, the "ad avail" becomes created although it did not originally exist.

The rate control signal 115 may contain rate control information as well as insertion timing information to enable program and advertisement insertion at re-transmission points 155. The information which may be included consists of the minimum or actual rate during the avails as determined by predefined rate profiles, or the actual rate profile of the upcoming avail in predefined or specified time units. The rate control signal 115 may indicate a fixed minimum rate which may be different during each ad avail and/or the total number of bits, bites, packets, or other measurable units in the ad avail.

The separate rate control signal 150 as illustrated in FIG. 1 serves as a means of delivery for rate information and can include prearrangement by any means including e-mail, written or verbal specifications, or templates designated by a standards body, or an actual out-of-band or out-of-multiplex transmission which represents the specific rate control information.

WO 01/30086

PCT/US00/29034

FIG. 2A illustrates time varying bits associated with an incoming program stream. Incoming program rate 205 is drawn on Y axis and time 207 is drawn on X axis. The illustration of the incoming program rate 205 as compared to function of the time 207, illustrates that a defined minimum 230 over a pre-determined period of time may be determined. The predetermined time period may have an associated avail start 210, avail end 220, and an example rate 240. Thus, the incoming program stream has a bit rate which varies and exceeds the defined minimum 230 for the avail having avail start 210 and avail end 220. Thus, the underlined program may actually utilize more bandwidth than the avail, but the avail will be assigned the minimum defined bandwidth 230.

FIG. 2B illustrates the time varying bit rates for an outgoing stream. FIG. 2B further illustrates an avail committed information rate (CIR) 260 which is the minimum bit rate that will be guaranteed for use for the insertion of the advertisement in the avail. As shown in FIG. 2B, one or more null packets 250 can be inserted to make up the difference between the CIR 260 and the actual bit rate as defined by the example stream 240.

For exemplary purposes, FIGS. 3A and 3B illustrate exemplary statistically multiplexed streams having predefined avail rate profiles. FIG. 3A represents a first stream in a multiplex, and FIG. 3B represents a second and simultaneous stream in the same multiplex. As illustrated in FIGS. 3A and 3B, a number of avail profiles are specified including avail profile #1 (310); avail profile #2 (320); avail profile #3 (330); avail profile #4 (340); avail profile #5 (350); avail profile #6 (360); avail profile #7 (370); and avail profile #8 (380). As illustrated, avail profile #1 (310) may be complementary to avail profile #5 (350) in that these avail profiles occur simultaneously in the multiplexed stream. This may be the case when the advertisements are synchronous such

WO 01/30086

PCT/US00/29034

that the start times are equal or nearly equal and the end times are equal or nearly equal. In such a case it is possible to define the avail profiles such that they complement each other to allow for a defined rate for multiple simultaneous
5 profiles in a single multiplex wherein high bandwidth requirements are permitted at a time in avail profile #1 (310) which is complementary to the high bandwidth requirement time in avail profile #5 (350).

FIGS. 4A-4C represent avails in three program streams in a
10 multiplexed signal. As shown, several avails are defined including avail 1A 410, avail 2A 420, avail 1B 430, avail 2B 440, avail 1C 450 and avail 2C 460. The profiles for these avails are defined such that the high bandwidth times are staggered.

15 FIG. 5 illustrates custom profiles including avail 1A 510 and avail 2A 520 with profiles defined such that avail 1A has a coarse custom profile with the bit rate varying over time substantially. Avail 2A 520 has a fine time granularity for definition of the rate such that the defined bit rate may vary
20 dramatically over a period as short as a second or several milliseconds. This method allows for the bandwidth in the statistically multiplexed stream to be utilized optimally such that when the initial advertisement is removed the inserted advertisement has a bit rate which matches that of the original
25 advertisement closely.

FIG. 6 illustrates monitoring of avail 1A 610 and avail 2A 620 such that the total number of bits, packets, or other digital measurement is calculated. This can be visualized as the area under the rate curve. By specifying the total number
30 of bits, short avails can be defined and streams can be defined for decoders with large buffers.

It is to be noted that a typical MPEG buffer has a latency of less than 1 second. Thus, the sections of video must be delivered and used within that time. However, the decoders

WO 01/30086

PCT/US00/29034

with larger buffers, as may be included in equipment with large amounts of memory, such as set top devices, may define a 30 second latency and allow bits to be delivered at any time in the 30 second window. Such large buffers can provide
5 additional flexibility in advertisement insertion. One way in which a large buffer can be used is by using the memory to buffer the video stream of the avail, allowing low bit rate delivery of high bit rate ads, and inserting the ads at the appropriate moment. Thus, although the statistically
10 multiplexed video stream may not be capable of transporting a high bit rate advertisement for real time display, the system may receive the advertisement over a period of several seconds and subsequently display the high bit rate advertisement.

The extensions of the techniques disclosed herein can be
15 utilized and include concepts such as profiling of avails which includes profiling of portions of the pre-advertisement and post-advertisement content. For example, by profiling the start/end of television shows it becomes possible to allow higher bit rate and/or higher quality advertisements, based on
20 the occurrence of low bit rate segments of television programming in adjacent channels. When the start/end of programming in an adjacent channel results in a low bit rate and the avail overlaps this start/end segment, the bandwidth from the programming can be used for the avail. For example,
25 ads on channel 2 can benefit from rolling credits on channel 3 at the end of the show on channel 3 when the end time of the programs on channels 2 and 3 are staggered, as frequently occurs.

Another technique which can be utilized as part of the
30 present invention is blind profiling, in which no external rate information other than the MPEG rate values in the video stream is transmitted to the insertion point, which in one embodiment, is the statistical multiplexer 130. At the insertion point, the insertion device optimizes use of the avail bits, and

WO 01/30086

PCT/US00/29034

profiles are created based on the ads which originate from off-line encoders, with the statistical multiplexing process allowing optimal use of bits for the highest quality and full control over the images. The resulting profiles can be
5 transmitted in the inserted rate control signal 140 or through use of the separate rate control signal 150.

In the blind profiling technique, the secondary insertion point 155, which in one embodiment is the retransmission point, utilizes the profiles of the original ads as the basis for
10 compressing or re-compressing replacement ads, which will be forced to match the profiles of the original ads. One advantage of this technique is that it allows for the coexistence of both profiled and unconstrained ads in which the statistical multiplexer 130 accommodates the advertisement in
15 its original form, using traditional statistical multiplexing techniques for compression. The profiles created by the first instance of compression can be piecewise linear profiles with the linear segments extending periods of one second or longer, minimum or maximum bit rate profiles, high granularity profiles
20 which track the bandwidth allocated to the avail in increments ranging from a few milliseconds to one second or more, or total bit rate profiles.

Another advantage of blind profiling is that at the initial insertion point, the profile of the avail is only
25 constrained by the statistical multiplexing process and not by a predetermined profile. Using this technique, it is possible for content providers to sell avails and insert the advertiser's material while insuring a high quality advertisement. The local broadcaster, using the profile
30 generated by the initial insertion, can substitute the original advertisement with another advertisement which matches the profile. The substituted advertisement may have a profile which approximates that of the original advertisement, or may

WO 01/30086**PCT/US00/29034**

be compressed or re-compressed to match or approximate the profile of the original advertisement.

Although this invention has been illustrated by reference to specific embodiments, it will be apparent to those skilled
5 in the art that various changes and modifications may be made which clearly fall within the scope of the invention. The invention is intended to be protected broadly within the spirit and scope of the appended claims.

WO 01/30086

PCT/US00/29034

Claims

What is claimed is:

1. A method for inserting a digital media advertisement in a digital multiplexed stream, the method comprising:

5 computing a rate profile associated with a program stream;

compressing the digital media advertisement according to the computed rate profile; and

inserting the compressed digital media advertisement in the digital multiplexed stream at an advertising opportunity in
10 the program stream.

2. The method of claim 1, wherein the rate profile is based on a predetermined bit rate.

15 3. The method of claim 2, wherein the predetermined bit rate profile comprises a maximum bit rate.

4. The method of claim 2, wherein the predetermined bit rate profile comprises a minimum bit rate.

20

5. The method of claim 2, wherein the predetermined bit rate profile comprises a start point and an end point.

WO 01/30086

PCT/US00/29034

6. The method of claim 2, wherein the predetermined bit rate profile comprises insertion instructions.

7. The method of claim 2, wherein the predetermined bit rate profile comprises a time varying profile from the start point to the end point.

8. The method of claim 7, wherein the time varying profile can be modeled as a piecewise linear model.

9. The method of claim 4, wherein one or more null packets are inserted such that the sum of the minimum bit rate and the one or more null packets is equal to the predetermined bit rate.

10. A method of compressing digital media advertisements for insertion into a statistically multiplexed digital transmission stream containing a plurality of digital program streams with a plurality of advertising opportunities, the method comprising:

determining a first bit rate profile for a first advertising opportunity;

determining a second bit rate profile for a second advertising opportunity; and

WO 01/30086

PCT/US00/29034

specifying a predetermined bit rate profile for
compression of a first advertisement and a second
advertisement, wherein the predetermined bit rate profile
provides a limit to the sum of the first bit rate profile and
5 the second bit rate profile.

11. The method of claim 10, further comprising:

compressing the digital media advertisements according to
the predetermined profile; and

10 inserting the compressed digital media advertisements into
the statistically multiplexed digital transmission stream
within the first and the second advertising opportunities.

12. The method of claim 10, wherein the predetermined bit
15 rate profile specifies the instantaneous sum of the first bit
rate profile and the second bit rate profile.

13. The method of claim 11, wherein the predetermined bit
rate profile is the total bits from the start point to the end
20 point of both the first bit rate profile and the second bit
rate profile.

14. The method of claim 11, wherein the first bit rate
profile is complementary with the second bit rate profile.

WO 01/30086

PCT/US00/29034

15. The method of claim 11, wherein the first bit rate profile has a first high bit rate portion, the second bit rate profile has a second high bit rate portion, and the first high
5 bit rate portion and the second high bit rate portion are staggered.

T712-10PCT (PCT/US00/29034)

PCT/US 00/29034
TPEA/US 14 MAY 2001

16. A system for inserting a digital media advertisement

in a digital multiplexed stream, the system comprising:

a rate profile monitor for monitoring a rate profile
associated with a program stream;

5 a video compressor for compressing the digital media
advertisement according to the rate profile associated with the
program stream to create a compressed digital media
advertisement; and

10 a digital video inserter for inserting the compressed
digital media advertisement into the program stream.

17. The system of claim 16, wherein the video compressor
is capable of compressing the digital media advertisement at a
predetermined bit rate.

15

18. The system of claim 17, wherein the predetermined bit
rate is associated with an available bit rate for an
advertisement opportunity where the compressed digital media
advertisement will be inserted into the program stream.

20

19. The system of claim 16, wherein the video compressor
is capable of compressing the digital media advertisement at a
predetermined maximum bit rate.

T712-10PCT (PCT/US00/29034)

PCT/US 114/424
TPEA/US 114 MAY 2001

20. The system of claim 16, wherein the video compressor is capable of compressing the digital media advertisement at a predetermined minimum bit rate.

5 21. The system of claim 16, wherein the video compressor is capable of compressing the digital media advertisement at a predetermined bit rate profile having a start point and an end point.

10 22. The system of claim 16, wherein the video compressor is capable of compressing the digital media advertisement using a predetermined bit rate profile having a time varying profile from a start point to an end point.

15 23. The system of claim 16, wherein the video compressor is capable of compressing the digital media advertisement using a predetermined bit rate profile having a piecewise linear time varying profile.

20 24. The system of 16, wherein the video compressor is capable of inserting one or more null packets such that the sum of a minimum bit rate and the one or more null packets is equal to a predetermined bit rate.

T712-10PCT (PCT/US00/29034)

10/03 UU / 29034
IPEA/US 14 MAY 2001

25. A system for compressing digital media advertisements
and inserting the digital media advertisements into a
statistically multiplexed digital transmission stream
containing a plurality of digital program streams with a
5 plurality of advertising opportunities, the system comprising:

a statistical multiplexor capable of determining a first
bit rate profile for a first advertising opportunity and a
second bit rate profile for a second advertising opportunity;
and

10 an ad encoder/compressor capable of encoding and
compressing a first advertisement and a second advertisement at
a predetermined aggregate bit rate profile which is less than
or equal to the sum of the first bit rate profile and the
second bit rate profile.

15

26. The system of claim 25, further comprising an ad
inserter capable of inserting the first and the second encoded
and compressed advertisements into the statistically
multiplexed digital transmission stream within the first and
20 the second advertising opportunities.

27. The system of claim 25, wherein the ad
encoder/compressor encodes and compresses the first
advertisement and the second advertisement at a predetermined

T712-10PCT (PCT/US00/29034)

PCI/US 00/29034
IPEA/US 14 MAY 2001

aggregate bit rate profile which is the instantaneous sum of
the first bit rate profile and the second bit rate profile.

28. The system of claim 25, wherein the ad
5 encoder/compressor encodes and compresses the first
advertisement and the second advertisement at a predetermined
aggregate bit rate profile which is based on the total bits
from the start point to the end point of both the first bit
rate profile and the second bit rate profile.

10

29. The system of claim 25, wherein the ad
encoder/compressor encodes and compresses the first
advertisement at the first bit rate profile and the second
advertisement at the second bit rate profile that is
15 complementary with the first bit rate profile.

30. The system of claim 25, wherein the ad
encoder/compressor encodes and compresses the first
advertisement at the first bit rate profile and the second
20 advertisement at the second bit rate profile, the first bit
rate profile having a first high bit rate portion and the
second bit rate profile having a second high bit rate portion
that is staggered with the first high bit rate portion.

T712-10PC1 (PCT/US00/29034)

RUI/US 11/14/29034
IPEA/US 14 MAY 2001

31. A method for inserting digital advertisements into digital program streams that are part of a statistically multiplexed digital stream, the method comprising:

5 defining an advertisement bit rate for an advertising opportunity in a digital program stream, wherein the digital program stream forms part of the statistically multiplexed digital stream;

compressing an advertisement to the advertisement bit rate to form a compressed advertisement; and

10 inserting the compressed advertisement into the digital program stream.

32. The method of claim 31, wherein the advertisement bit rate specifies a maximum bit rate.

15

33. The method of claim 31, wherein the advertisement bit rate specifies a minimum bit rate.

34. The method of claim 31, wherein the advertisement bit rate includes a start point and an end point.

20

35. The method of claim 31, wherein the advertisement bit rate has a time varying profile.

79348-7

36. The method of claim 31, wherein the advertisement bit rate has a piecewise linear model.

5 37. The method of claim 31, wherein the advertisement bit rate specifies a minimum bit rate and null cells are used to insure that the minimum bit rate is achieved.

38. A system for inserting compressed digital video
10 advertisements in a statistically multiplexed digital video stream, the system comprising:

a statistical multiplexor capable of determining an available bandwidth of an advertising opportunity in a digital video program stream; and

15 an advertisement insertion server capable of serving an advertisement at a forced minimum bit rate.

39. The system of claim 38, wherein the forced minimum bit rate corresponds to the available bandwidth of the
20 advertising opportunity.

40. In a statistically multiplexed digital video environment having multiple statistically multiplexed program

79348-7

streams with one or more advertisement opportunities, an advertisement insertion unit for serving advertisements to a statistical multiplexing program insertion unit wherein the advertisement insertion unit is capable of forcing an
5 advertisement to run at a minimum bit rate therefore insuring that a minimum bit rate will be maintained for the advertisement in the statistically multiplexed program stream.

41. A system for inserting compressed digital video
10 advertisements in a statistically multiplexed digital video stream, the system comprising:

a statistical multiplex unit capable of determining an available bandwidth of an advertising opportunity in a digital video program stream; and

15 an advertisement insertion server capable of limiting the bandwidth of a served advertisement therefore insuring that the advertisement does not exceed a maximum bit rate.

42. In a statistically multiplexed digital video
20 environment having multiple statistically multiplexed programs streams with one or more advertisement opportunities an advertisement insertion unit for serving advertisements to a statistical multiplexing program insertion unit wherein the advertisement insertion unit is capable of limiting the bit

79348-7

rate of a served digital video advertisement to insure that a maximum bit rate is not exceeded.

43. In a statistically multiplexed digital video
5 environment having multiple statistically multiplexed program streams with one or more advertisement opportunities, a statistical multiplexing unit comprising:

a bandwidth monitoring utility for determining an available bandwidth for an advertisement in an advertising
10 opportunity, wherein the bandwidth monitoring utility communicates with one or more external devices to report the available bandwidth for the advertisement; and

a program insertion subsystem for inserting the advertisement in the advertising opportunity at the available
15 bandwidth.

44. In a statistically multiplexed digital video environment having one or more statistically multiplexed program streams with one or more advertisement opportunities,
20 an advertisement insertion server comprising:

a storage medium for storing one or more digital advertisements;

a rate control interface for receiving one or more rate control instructions; and

79348-7

an insertion rate control signal generation mechanism for generating one or more insertion rate control signals from the one or more rate control instructions, wherein the rate control signals are used for controlling advertisement insertion into the one or more advertisement opportunities in the one or more statistically multiplexed program streams.

45. A method for inserting an advertisement into a statistically multiplexed stream, the method comprising:

10 computing a program stream rate profile for a program stream within a statistically multiplexed stream;

generating an avail rate profile for an avail within the program stream, wherein the avail rate profile is based on the program stream rate profile;

15 compressing an advertisement in accordance with the avail rate profile; and

inserting the compressed advertisement in the avail within program stream.

46. The method of claim 45, wherein the avail rate profile includes a start point and an end point.

47. The method of claim 45, wherein the avail rate profile includes at least some subset of a maximum bit rate and a minimum bit rate.

48. The method of claim 45, wherein the avail rate profile is a time varying profile.

49. The method of claim 45, wherein the avail rate profile is limited by the program stream rate profile.

79348-7

50. The method of claim 45, wherein the avail rate profile equals the program stream rate profile.

51. The method of claim 45, wherein said inserting includes inserting the compressed advertisement and null
5 packets in the avail within program stream such that combined rate profile of the compressed advertisement and the null packets equals the program stream rate profile if the avail rate profile is less than program stream rate profile.

10 52. The method of claim 45, wherein said computing includes computing a first program stream rate profile for a first program stream within a statistically multiplexed stream and computing a second program stream rate profile for a second program stream within the
15 statistically multiplexed stream;

generating includes generating a first avail rate profile for a first avail within the first program stream and a second avail rate profile for a second avail within the second program stream, wherein a combined first and second
20 avail rate profile is based on a combined first and second program stream rate profile;

compressing a first advertisement and a second advertisement in accordance with the combined first and second avail rate profile; and

25 inserting the compressed first advertisement in the first avail and the second compressed advertisement in the second avail.

79348-7

53. The method of claim 52, wherein the combined first and second avail rate profile does not exceed the combined first and second program stream rate profile.

54. The method of claim 53, wherein the first
5 compressed advertisement may have a bit rate that exceeds bit rate of the first program stream.

55. The method of claim 52, wherein said compressing includes compressing the first advertisement to a first advertisement rate profile and the second advertisement to a
10 second advertisement rate profile, wherein the first advertisement rate profile is not limited by the first avail rate profile and the second advertisement rate profile is not limited by the second avail rate profile, and wherein a combined first advertisement and second advertisement rate
15 profile is limited by the combined first and second avail rate profile.

56. The method of claim 55, wherein the first advertisement rate profile has a lower bit rate portion when the second advertisement bit rate profile has a higher bit
20 rate portion.

57. The method of claim 55, wherein the first advertisement rate profile and the second advertisement bit rate profile stagger higher bit rate portions.

58. A system for inserting an advertisement in a
25 statistically multiplexed stream, the system comprising:

a rate profiler to determine a program stream rate profile associated with a program stream within a statistically multiplexed stream and an avail rate profile for an avail within the program stream;

79348-7

a video compressor to compress an advertisement according to the avail rate profile; and

a video inserter to insert the compressed advertisement into the program stream.

5 59. The system of claim 58, wherein the avail rate profile includes a start point and an end point.

60. The system of claim 58, wherein the avail rate profile includes at least some subset of a maximum bit rate and a minimum bit rate.

10 61. The system of claim 58, wherein the avail rate profile is a time varying profile.

62. The system of claim 58, wherein said video inserter inserts the compressed advertisement and null packets in the avail within the program stream such that a
15 combined rate profile of the compressed advertisement and the null packets equals the program stream rate profile if the avail rate profile is less than program stream rate profile.

63. The system of claim 58, wherein said
20 rate profiler determines a first program stream rate profile for a first program stream within the statistically multiplexed stream, a second program stream rate profile for a second program stream within the statistically multiplexed stream, a first avail rate profile for a first avail within
25 the first program stream and a second avail rate profile for a second avail within the second program stream;

video compressor compresses a first advertisement and a second advertisement so that a rate profile associated with

79348-7

both the first advertisement and the second advertisement is in accordance with a combined first and second avail rate profile; and

video inserter inserts the compressed first advertisement in
5 the first avail and the second compressed advertisement in the second avail.

64. The system of claim 63, wherein the rate profile associated with both the first advertisement and the second advertisement does not exceed the combined first and second
10 avail rate profile.

65. The system of claim 63, wherein the first compressed advertisement may have a bit rate that exceeds the first avail rate profile.

66. A method for inserting advertisements into a
15 statistically multiplexed transmission stream containing a plurality of program streams with a plurality of advertising opportunities, the method comprising:

determining a first avail rate profile for a first avail within a first program stream, wherein the first avail rate
20 profile is based at least in part on a first program stream rate profile for the first program stream;

determining a second avail rate profile for a second avail within a second program stream, wherein the second avail rate profile is based at least in part on a second program
25 stream rate profile for the second program stream;

generating a composite avail rate profile based on the first avail rate profile and the second avail rate profile;

79348-7

assigning a first advertisement rate profile to the first
avail and a second advertisement rate profile to the second
avail, wherein the first advertisement rate profile is not
limited by the first avail rate profile and the second
5 advertisement rate profile is not limited by the second
avail rate profile, and wherein a combined first
advertisement and second advertisement rate profile is
limited by the composite avail rate profile;

compressing the first advertisement according to the first
10 advertisement rate profile and the second advertisement
according to the second advertisement rate profile; and

inserting the compressed first advertisement in the first
avail and the second advertisement in the second avail.

67. The method of claim 66, wherein the composite
15 avail rate profile specifies the instantaneous sum of the
first avail rate profile and the second avail rate profile.

68. The method of claim 66, wherein the first
advertisement rate profile is complementary with the second
advertisement rate profile.

20 69. The method of claim 66, wherein the first
advertisement rate profile has a first high advertisement
rate portion, the second bit rate profile has a second high
bit rate portion, and the first high bit rate portion and
the second high bit rate portion are staggered.

25 70. A system for inserting advertisements into a
statistically multiplexed transmission stream containing a
plurality of program streams with a plurality of advertising
opportunities, the system comprising:

79348-7

a statistical multiplexer capable of determining a first avail rate profile for a first avail within a first program stream and a second avail rate profile for a second avail within a second program stream;

- 5 a video compressor capable of compressing a first advertisement and a second advertisement at an aggregate rate profile which is less than or equal to sum of the first avail rate profile and the second avail rate profile; and

10 a video inserter capable of inserting the compressed first advertisement in the first avail and the second compressed advertisement in the second avail.

71. The system of claim 70, wherein said video compressor compresses the first advertisement at the first avail rate profile and the second advertisement at the
15 second avail rate profile that is complementary with the first avail rate profile.

SMART & BIGGAR

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PATENT AGENTS

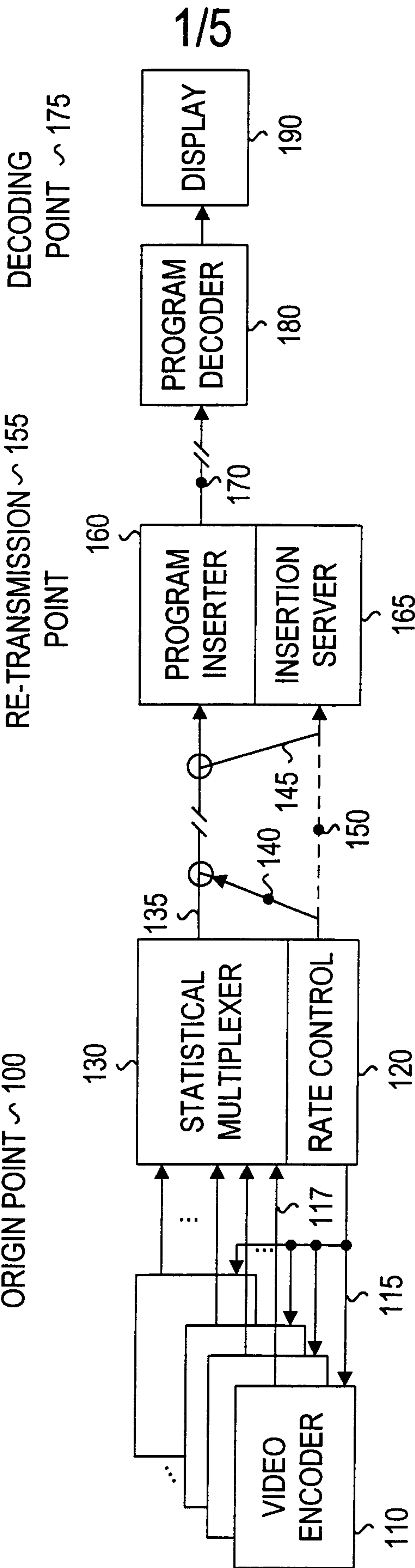


FIG. 1

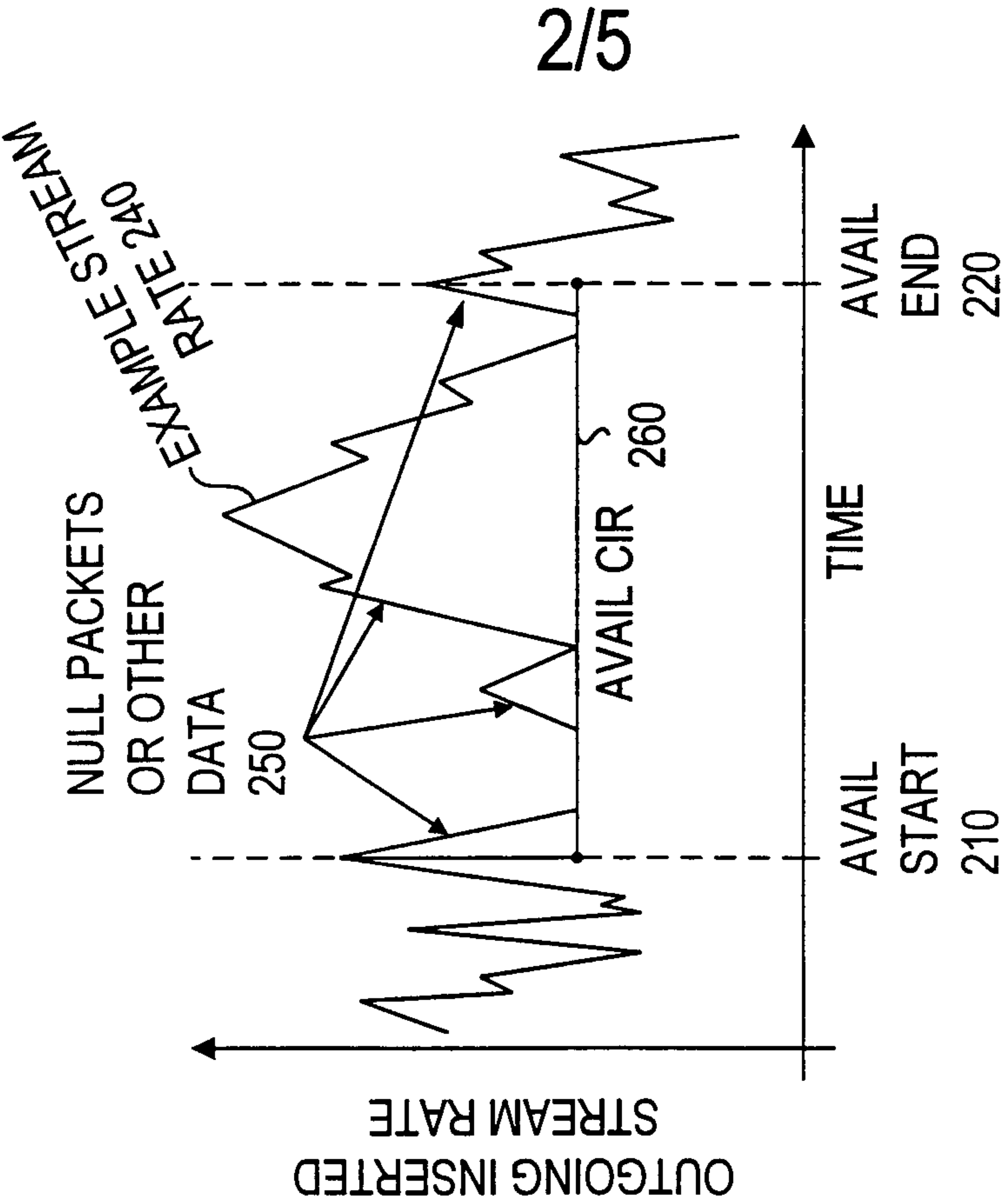


FIG. 2B

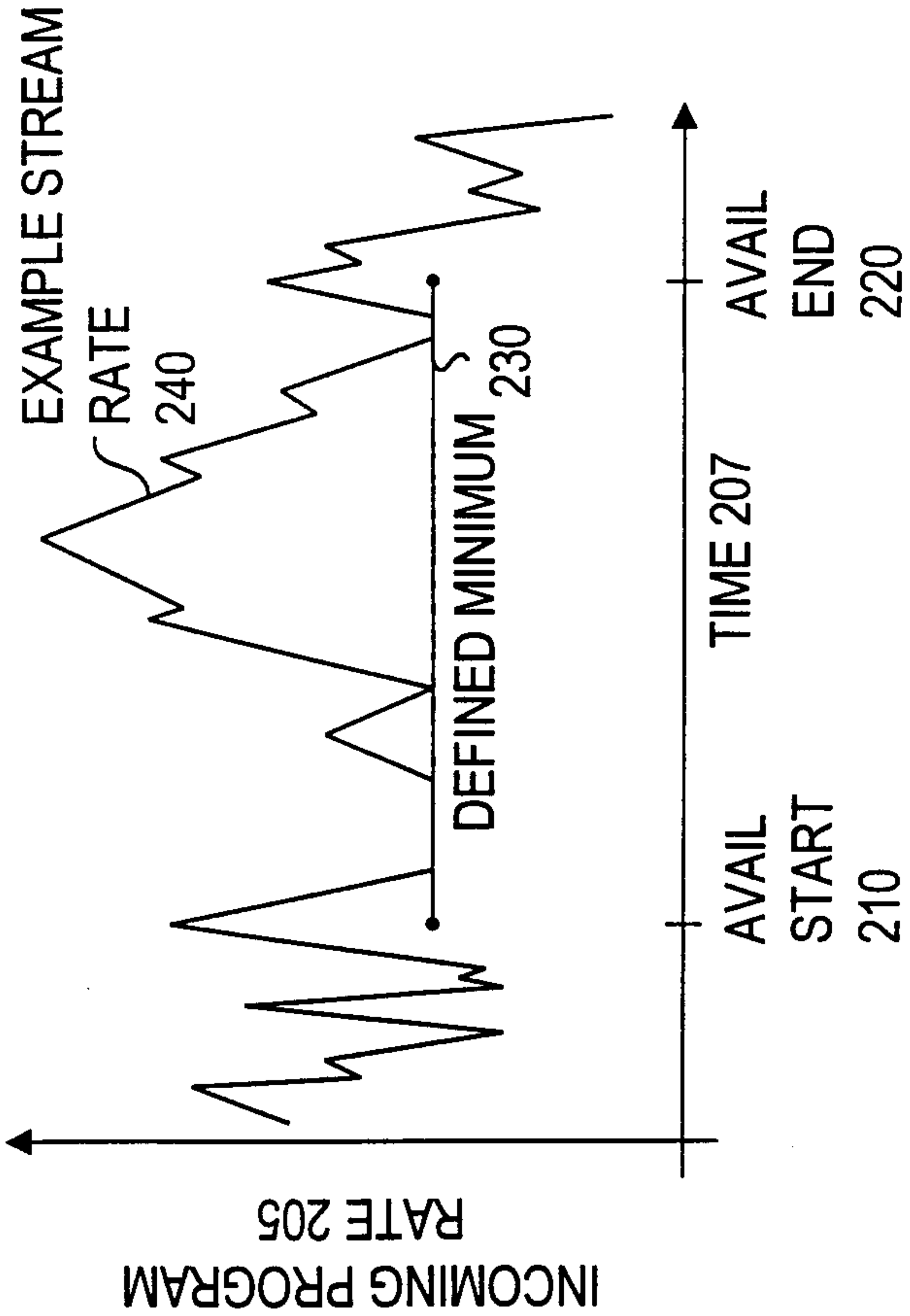


FIG. 2A

3/5

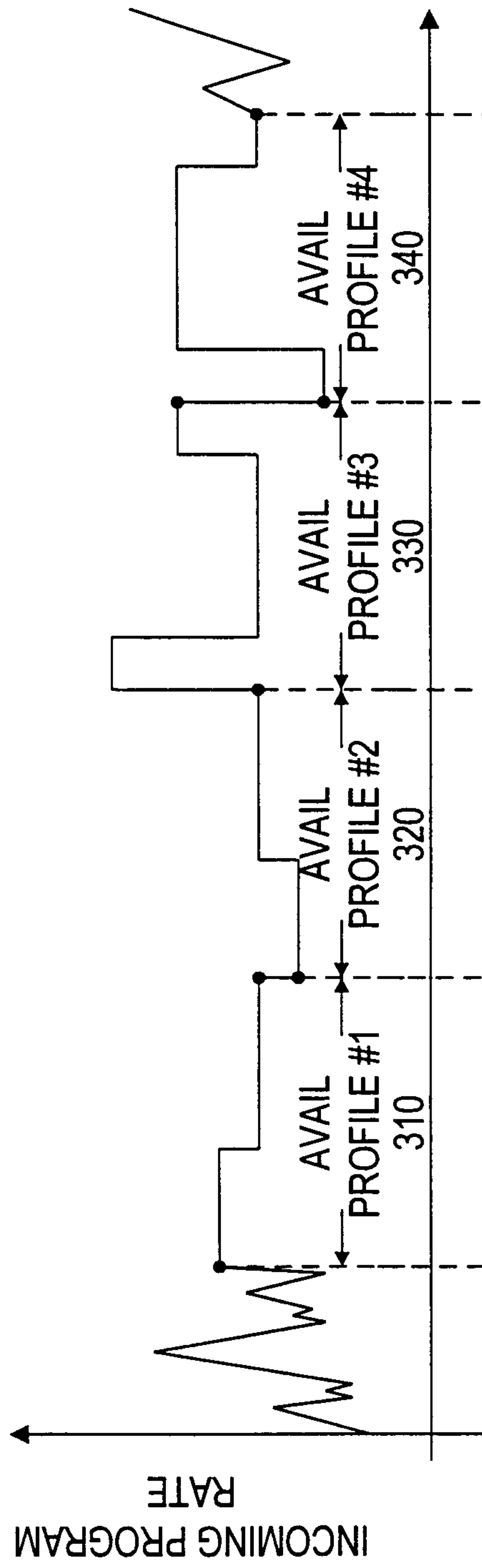


FIG. 3A

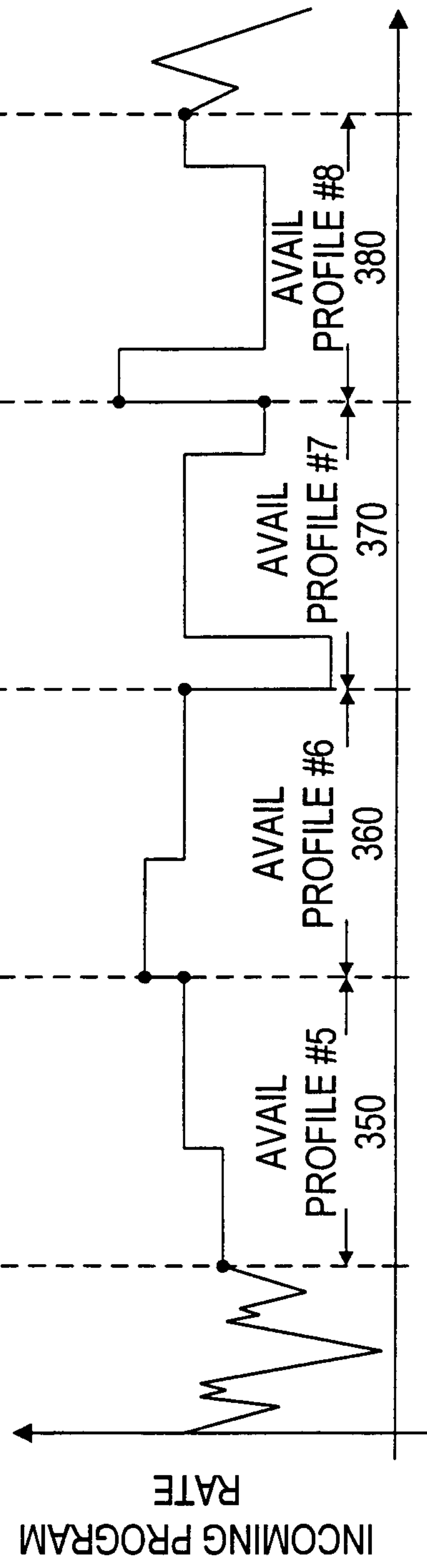
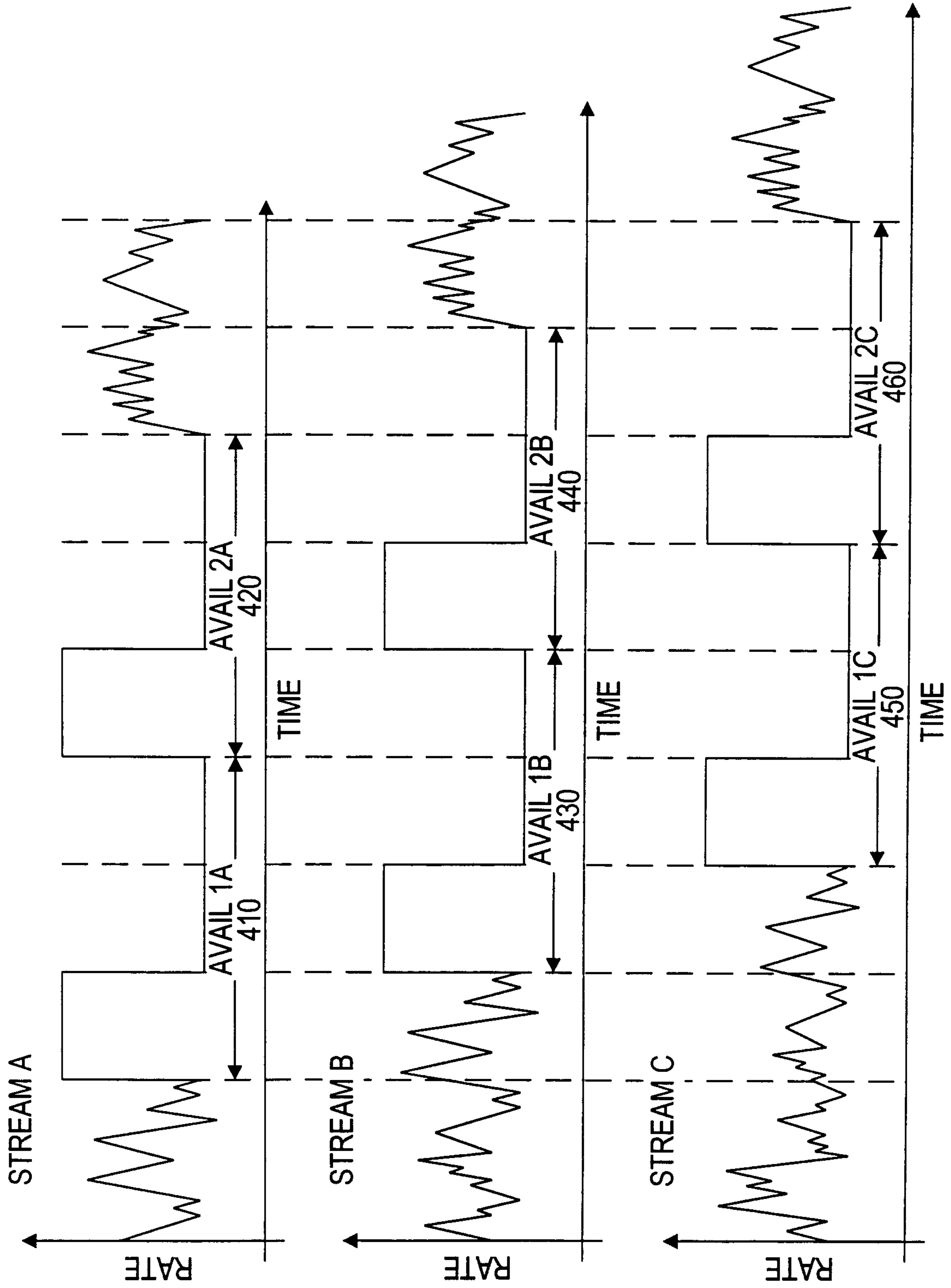


FIG. 3B

4/5



5/5

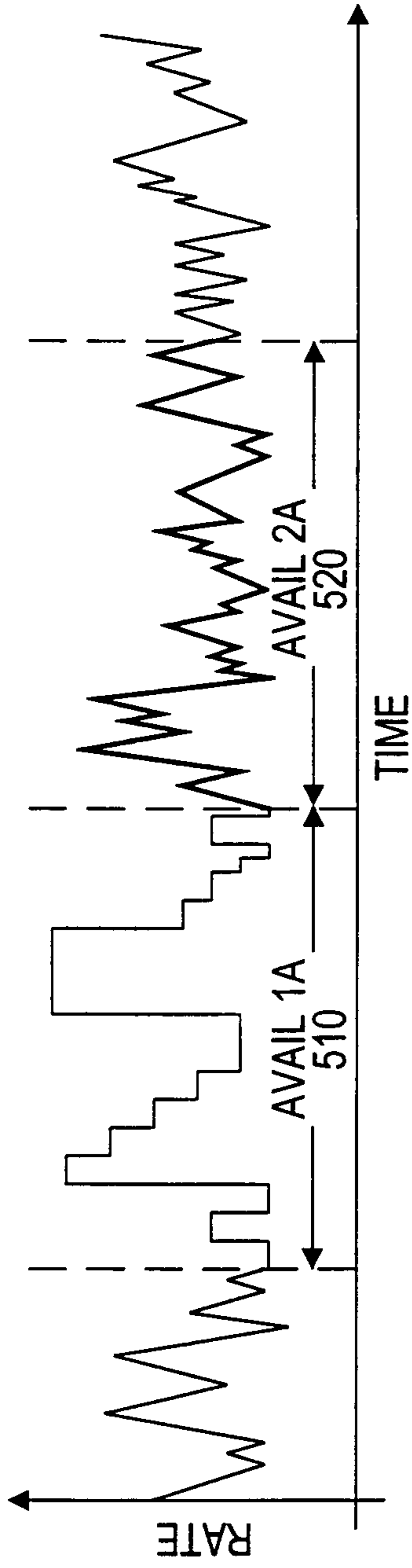


FIG. 5

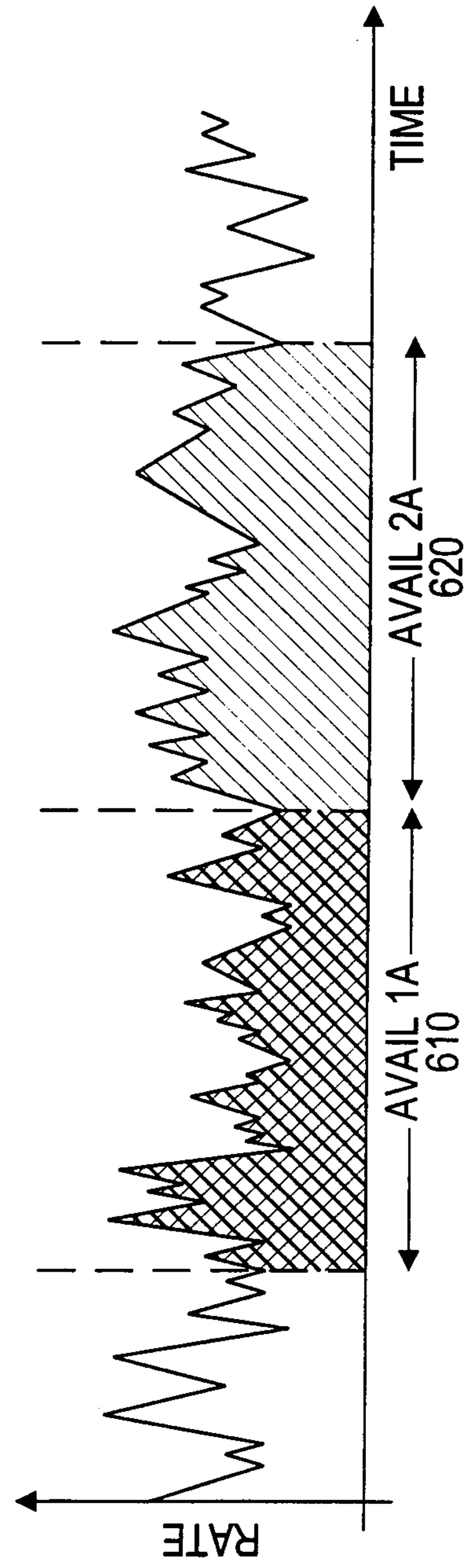


FIG. 6

ORIGIN POINT ~ 100

RE-TRANSMISSION ~ 155
POINT

DECODING
POINT ~ 175

