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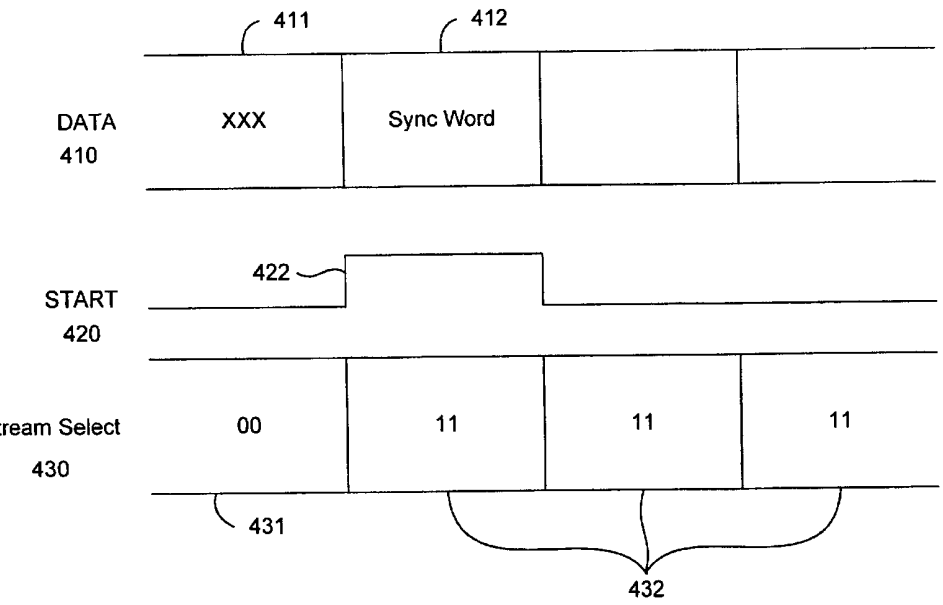
(54) Title: METHOD OF IDENTIFYING MULTIPLE DIGITAL STREAMS WITHIN A MULTIPLEXED SIGNAL



(57) Abstract: In a subscriber television system with a host terminal, the present invention allows the identification of the individual packets from two separate MPEG transport streams that have been multiplexed together for decoding by a single external conditional access or point-of-deployment (POD) module. The decoding of individual packets from two separate MPEG transport streams supports the use of multiple tuner host terminals for such functions as picture-in-picture (PIP) program viewing and the viewing of one program while recording a second program.

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METHOD OF IDENTIFYING MULTIPLE DIGITAL STREAMS WITHIN A MULTIPLEXED SIGNAL

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application claims priority to U.S. Provisional Patent Application Number 60/170,344, Bacon et al., entitled *Method of Supplying Multiple Digital Streams to an External Conditional Access Module*, filed 13 December 1999, which is incorporated herein by reference.

FIELD OF THE INVENTION

This invention relates generally to decrypting multiple digital data streams in a subscriber television system, and more specifically to supplying multiple digital streams to an external conditional access or Point-of-Deployment (POD) module for decryption.

BACKGROUND OF THE INVENTION

Historically, a subscriber television system operator provides a subscriber with a set-top terminal that allows the subscriber to receive and decrypt television programs and services. The set-top provides access to the subscriber television system, including providing conditional access for the specific subscriber television system. The subscriber television system uses conditional access to prevent unauthorized users from pirating or accessing the system services. A system subscriber "rented" the set-top from the subscriber television system by paying a monthly fee. Subscriber's returned the set-top when they moved or changed service providers.

The Telecommunications Act of 1996, which is being implemented by the Federal Communications Commission (FCC), allows subscribers to buy a host terminal, also known as a consumer set-top terminal, from a variety of sources for use in any subscriber television system. The host terminal may be integrated into a videocassette recorder (VCR), television (TV), computer, or other similar device.

The operator of each subscriber television system has the responsibility of providing an interface for this subscriber owned equipment that allows it to function with the individual subscriber television system. To address the concern of the subscriber television system operators about conditional access and piracy, the FCC directed the Society of Cable Television Engineers (SCTE) to establish standards for what is referred to as an external conditional access module or a Point-of-Deployment (POD) module. The POD module provides a removable conditional access element for a host terminal. A POD module is provided by the individual subscriber television

system and upon insertion into a host terminal, and upon receiving proper authorization, allows the decryption of encrypted conditional access services to prevent piracy. A POD module conforms generally to the Personal Computer Memory Card International Association (PCMCIA) standards. The POD module is typically a little larger than a credit card, is inserted into a slot in a host terminal, and communicates with the host terminal via a PCMCIA connector. The POD module would be removed from the host terminal and returned to the subscriber television system when the subscriber moves or changes service providers. The subscriber would get a new POD module from the next subscriber television system to which they elect to subscribe for services.

The subscriber television systems provide a large quantity of programs and services. The programs and services are typically provided to the subscriber via transport streams within a transmission signal. There can be multiple programs or services within a single transport stream and multiple transports streams within the transmission signal. A host terminal that wants to simultaneously display programming from two separate transport streams would use two tuners, one for each transport stream. This creates a problem in that there is the possibility that two transport streams need to be decrypted for conditional access. The SCTE specification limits the number of data streams that can be input at one time into a POD module to one. On a host terminal with Picture-in-Picture (PIP) functionality that requires two inputs, the host terminal would not be able to simultaneously decrypt the two data streams to provide both the main and the secondary picture data. A host terminal with multiple data streams, such as those with two or more tuners, must limit the decryption to one data stream from one tuner. The system subscriber that owns a host terminal with multiple tuners will want to use the functionality that is provided with those elements, such as PIP or the simultaneous taping and viewing of different programs. The operator of a subscriber television system needs to be able to provide a POD module that is capable of receiving multiple data streams for decryption to support the multiple tuner functionality. Thus, what is needed is a method, host terminal, and external conditional access module that allows the decryption of multiple data streams to support a multiple data stream host terminal.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of a subscriber television system.

FIG. 2 is a block diagram of a host terminal.

FIG. 3 is a block diagram view of the functional components of an external conditional access module.

FIG. 4 is an illustration of a packetized data signal with a start of packet signal and a transport stream source indicator signal.

FIG. 5 is a detailed block diagram view of the functional components of an external conditional access module.

DETAILED DESCRIPTION

The present invention is directed to a method, host terminal, and external conditional access module that enable the decryption of portions of multiple packetized data streams associated with a multiple tuner host terminal.

The available functionality can vary widely between different host terminals, based on several factors. The available functionality may vary based on cost and manufacturer of the host terminal or based on the support provided by the local subscriber television system. A less expensive host terminal would typically have less functionality. The host terminal may include the equipment need to perform a function, but if an individual subscriber television system does not allow or support a function the subscriber may not be able to access the function. For example, a host terminal may have multiple tuners to support picture-in-picture (PIP) video display, but if the subscriber television system does not allow or support PIP, a subscriber may not be able to use the functionality available in their host terminal. Conditional access is one method a system operator can use to control the functionality available within an individual subscriber television system. With conditional access, a subscriber needs authorization to access some or all of the programs or services. An external conditional access module or point-of-deployment (POD) module controls the conditional access of the subscriber to the programming and services of the subscriber television system. The system operator provides the external conditional access module that a subscriber inserts into their host terminal. The host terminal would normally transmit data packets for a subscriber-selected program to the external conditional access module for decryption. The host terminal would also typically transmit a data clock or start signal that indicates the start of each of the data packets. The external conditional access module determines if the subscriber is authorized to receive a selected program and, if authorized, decrypts the data packets for that program. The decrypted data packets can then be decoded and displayed to the subscriber.

The advent of picture-in-picture capabilities and the desire to be able to record one program while viewing another requires the ability to perform conditional access on packets from multiple packetized data streams without adding a second external conditional access module. Multiple data streams provide data for two or more programs to be displayed simultaneously. The present invention allows the identification, by a single POD module, of the individual packets from two or more separate MPEG transport streams that have been multiplexed together for decrypting. The POD module, knowing the source of the individual packet, can determine if the packet is authorized to be decrypted for the individual subscriber and the correct decryption parameters to apply to decrypt each packet.

The present invention will be described more fully hereinafter with reference to the accompanying drawings in which like numerals represent like elements throughout the several figures and in which exemplary embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. The present invention is best understood within the context of a subscriber television system. Referring now to the drawings, a subscriber television system and exemplary embodiments of the present invention will be described.

FIG. 1 shows a block diagram view of a subscriber television system **10**, including a Host Terminal **14**. Generally, the subscriber television system **10** is a high quality, reliable and integrated network system that features video, audio, voice, and data services to subscribers. Although FIG. 1 depicts a high level view of a subscriber television system including a regional Hybrid Fiber/Coax (HFC) Access Network **38**, as will be described below, it should be appreciated that a plurality of subscriber television systems can tie together a plurality of regional networks into an integrated global network so that subscribers can receive content provided from anywhere in the world. The subscriber television system **10** shown in FIG. 1 delivers broadcast video signals as digitally formatted signals in addition to delivering traditional broadcast analog video signals. Furthermore, the system can support one way broadcast services as well as both one-way data services and two-way media and data services. The two-way operation of the network allows for subscriber interactivity with services, such as Pay-Per-View programming, View-on-Demand programs, and interactive applications, such as Email, Internet connections, and EPG applications.

The subscriber television system **10** provides the interfaces, network control, transport control, session control, and servers to access content and services, and distributes content and services to subscribers. As shown in FIG. 1, a typical subscriber television system **10** is composed of interfaces to Content Providers **18**, Network Operations Centers (NOC) **22**, core networks **30** of headends **26**, hubs **34**, HFC Access Networks **38**, and subscribers' host terminals **14**. It should be appreciated that although single components (e.g., headend **26**, core network **30**, HFC Access network **38**, etc.) are illustrated in FIG. 1, a subscriber television system **10** can feature a plurality of each of the illustrated components.

The Content Provider **18** represents one or more providers of content, such as video channels, music channels, data channels, video services, audio services, and data services. For example, the Content Provider **18** could comprise an Electronic Program Guide (EPG) data provider that acts as a data service provider. The Content Provider **18** could also represent an Internet Service Provider (ISP) providing data to the system to enable subscribers' web access or web-enhanced

video via the subscriber's television set. The Content Provider **18** transmits the content to a headend **26** for further transmission to subscribers downstream in the network. Also in communication with the headend **26** is a Network Operation Center (NOC) **22**, which is an external management center, interfaced with the subscriber television system **10** to allow for the remote operation of the system.

Content provided by the Content Provider **18** is communicated to one or more headends **26**. From those headends **26** the content is then communicated to the core network **30** of hubs **34** and onto a plurality of HFC Access Networks (only one HFC Access Network **38** is illustrated). The HFC Access Network **38** typically comprises a plurality of HFC nodes **42**, each of which may service a local geographical area. The content provided from the Content Provider **18** is transmitted through the headend **26**, hub **34** and HFC Access Network **38** downstream to one or more taps **46** from each one of the HFC nodes **42** of the HFC Access Network **38**. The hub **34** connects to the HFC node **42** through the fiber portion of the HFC Access Network **38**. Usually, the HFC node **42** connects to a subscriber's host terminal **14** through coaxial cable in a logical tree configuration, which is where the optical-to-electrical and electrical-to-optical conversations of the HFC network take place. From the HFC node **42** a coaxial drop connects the tap **46** to a subscribers' home.

FIG. 2 is a block diagram view of a host terminal **14**. The host terminal **14** receives the incoming radio frequency (RF) signal **210** from the subscriber television system **10**. The signal is available to the multiple tuners **210** and **211** and to the out-of-band (OOB) receiver **215** and transmitter **216**. The OOB signaling provides an alternative communications path within the subscriber television system **10**. Control, signaling, and return communications are typically communicated using the OOB signaling. The host terminal **14** includes a central processing unit (CPU) **230** for controlling the host terminal **14** and the POD interface **225**. The host terminal **14** contains all the normal circuitry required to function as a set-top terminal (STT) or home communications terminal (HCT) including a power supply **270**, an LED display **265**, an infrared (IR) receiver **260**, a keypad **261**, an output modulator **250**, an MPEG decoder **240**, a graphics generator **241**, a DRAM **242**, a Flash **235**, and other support circuitry. This host terminal **14** also includes two independent tuners, tuner **210** and tuner **211**, and is capable of receiving and tuning two separate, encrypted packetized data streams. The present invention assigns a unique designator or address to each tuner to be used in identifying the source of packetized data. Additionally, the host terminal **14** contains the circuitry required to interface to a POD module, which uses the POD interface **225** and a PCMCIA PC Card connector. The typical POD **225** interface specification is described in the Society of Cable Telecommunications Engineers, Inc., Engineering Committee, Digital Video Subcommittee Document SCTE DVS/295, entitled "*Proposed HOST-POD Interface Specification*", dated January 7, 2000, which is incorporated

herein by reference. The POD interface **225** of the present invention includes additional or modified elements to support decrypting packetized data from multiple sources. A multiplexer **226** and a demultiplexer **227** are included. The multiplexer **226** multiplexes together select portions of the separate signals it receives from each tuner and generates a unique designator signal indicating the originating tuner for each portion of the multiplexed signal. The demultiplexer **227** takes the returned signal from a POD module and separates it into demultiplexed signals associated with each tuner.

FIG. 3 is a block diagram view of the functional components of an external conditional access module **310**. The external conditional access module or point-of-deployment (POD) module **310** is inserted into the subscriber's host terminal **14**. The specifications of the POD module **310** are described in the Society of Cable Telecommunications Engineers, Inc., Engineering Committee, Digital Video Subcommittee Document SCTE DVS 131, Rev. 7, entitled "*Draft Point-of-Deployment (POD) Module Interface Proposal*", dated December 3, 1998, which is incorporated herein by reference. The POD module **310** interfaces to the POD interface **225** of FIG. 2, including the multiplexer **226** and the demultiplexer **227**.

In an exemplary embodiment the data stream is a Moving Picture Experts Group (MPEG) transport stream. The present invention is not so limited and can be used to identify multiplexed portions of other types of data streams, including identifying the source of different portions of a multiplexed signal associated with two separate data bit streams or with packetized data streams. The packetized data streams can include formatted data such as Internet Protocol (IP), MPEG-4, and asynchronous transfer mode (ATM) formatted data. In this exemplary embodiment, MPEG refers to the MPEG-1 and MPEG-2 standards. The MPEG-1 standards (ISO/IEC 11172) and the MPEG-2 standards (ISO/IEC 13818) are described in detail in the International Organization for Standardization document ISO/IEC JTC1/SC29/WG11 N (June 1996 for MPEG-1 and July 1996 for MPEG-2), which are hereby incorporated by reference.

The multiplexer **226,** of host terminal **14**, takes MPEG Data 1 and MPEG Data 2 from their respective sources and multiplexes the two data streams together to create the Multiplexed MPEG Data. The multiplexer **226** transmits the multiplex of multiple complete transport streams to the POD module **310**. The MPEG Data 1 and MPEG Data 2 can be a variety of data and data formats, including a bit stream, a packetized data stream, IP data, and individual MPEG transport streams with audio, video, and data packets. The multiplexing can be performed based on a variety of data unit sizes, including data unit sizes of a bit, a byte, or a packet.

An MPEG transport stream can contain data packets for multiple programs. In an alternative embodiment, the multiplexer **226** determines the packet identification (PID) for the packets related to a selected program within the transport streams from each source and then multiplexes

together the desired program associated packets based on the associated PIDs. In this alternative embodiment, only the desired packets are transmitted to the POD module **310**.

Referring to FIG. 4, the Data or Multiplexed MPEG Data stream signal **410** is the multiplex of the MPEG Data 1 and MPEG Data 2 data streams. The Start or MPEG Start signal **420** indicates the start of an MPEG packet with a signal level change **422** and is associated with the synchronization (sync) word **412** in the header of an MPEG packet. In an alternative embodiment, the Start signal **420** indicates a bit or byte of data. The Stream Select or transport stream source indicator signal **430** indicates the source of the associated portion of the signal, portions including bits, bytes, or packets. For example, the packets starting with the packet containing sync word **412** are associated with the MPEG Data 1 source assigned the unique designator "11" **432** and the prior packet **411** would be associated with the MPEG Data 2 source assigned the unique designator "00" **431**. In addition to the Multiplexed MPEG Data stream signal **410**, the multiplexer **226** transmits the MPEG Start signal **420** and the Stream Select signal **430** signal to the POD module **310**. The MPEG Start signal **420** is associated with the MPEG clocks signals of the MPEG Data 1 and MPEG Data 2 data streams.

Referring again to FIG. 3, the POD module **310** receives the Data stream signal **410**, the MPEG Clock signal **420**, and a Stream Select signal **430** in the POD Demultiplexer **330**. The demultiplexer **330** identifies the portions of the Data stream signal **410** as packets from each unique source (MPEG Data 1 or MPEG Data 2) based on the Stream Select signal **430**. The source-associated packets of the Data stream signal **410** are transmitted to a source-associated decryptor, either decryptor **340** or decryptor **345**, for decryption. The Conditional Access Control **360** determines if the subscriber is authorized to have the source-associated data decrypted. If the subscriber is authorized to receive the selected program or service, the Conditional Access Control **360** instructs decryptor **340** or decryptor **345** as to the proper decryption to use for decrypting the selected program associated data. This means that data associated with both, either, or neither source may be decrypted. If the decision is made to authorize decryption, the authorized source associated data will pass through a decryptor, otherwise the decryptor is bypassed. The selected program packets from decryptor **340** and decryptor **345** are transmitted to POD Multiplexer **350** to be recombined into a Multiplexed MPEG Data′ signal. The packets may be decrypted if the subscriber was authorized to receive the packet associated program or service. The data can still be encrypted if the subscriber was not authorized to receive the associated programming or service. The Multiplexed MPEG Data′ signal, with the recombined data of the source associated packets, is transmitted back to the demultiplexer **227** of the host terminal **14**. The demultiplexer **227** uses the Stream Select signal **430** to separate the Multiplexed MPEG Data′ signal back into post-decryption tuner associated signals MPEG Data 1′ and MPEG Data 2′, with associated MPEG Start signals. The MPEG Data 1′ and MPEG Data 2′ signals are related to the

initial MPEG Data 1 and MPEG Data 2 signals. The host terminal **14** uses the decrypted signals to cause the display of programming associated with a first tuner, the MPEG Data 1′ signal, as a primary picture and the programming associated with a second tuner, the MPEG Data 2′ signal, as a secondary picture for a PIP function. Those skilled in the art will appreciate that the order of the PIP pictures can be reversed and that the separately identified signaling can be used for other purposes such as recording one program while continuing to view another program.

FIG. 5 is a detailed functional block diagram of the POD module **310** of the present invention. In another exemplary embodiment, the POD module **310** contains a PCMCIA connection **505** through which MPEG transport streams are received by PCMCIA/POD interface **510**, demultiplexed by MPEG Transport Demultiplexor **512**, decrypted if the conditional access control allows by Core Decryptor **514**, re-encrypted for copy protection by Encryptor **516**, multiplexed back together by MPEG Transport Multiplexor **518**, and transmitted to the host terminal **14** by PCMCIA/POD interface **510**. Additionally, the POD module **310** contains circuitry, OOB Physical **522** and OOB MAC Filters **524**, for receiving of Out-of-Band (OOB) signals in the MPEG transport stream. The OOB signaling is used for transmitting Entitlement Management Messages (EMM) that determine if conditional access to selected programming and services is granted or allowed. The Central Processing Unit (CPU) **530** controls and monitors the functions of the POD module **310** and accesses Flash memory **560** and Dynamic Random Access Memory (DRAM) **570** through the Memory Controller **550**. A Secure Microprocessor **580** is utilized to receive and control the EMM as well as the Entitlement Control Message (ECM). The ECM is used to verify the EMMs. The EMMs and ECM together provide the information required to determine if the subscriber is entitled to access the digital video/audio stream and for the POD module **310** to perform the decryption. A Non-Volatile Memory (NVM) **590** is used to store non-secure system parameters.

The outputs of the two tuners, tuner **210** and tuner **211**, in the host terminal **14** are two separate independent signals. The independent signals are passed through multiplexor **226** in the host terminal **14** that synchronizes them and combines them into a single data stream **410** that is sent through the modified POD interface **510** using the MPEG input stream select signal **430** to indicate the source of the active or current packetized data. The multi-stream capable POD module **310** demultiplexes these signals and uses the conditional access circuitry (internal secure microprocessor **580**) to independently determine if the POD module **310** is authorized to decrypt the packetized data from each stream. This means that packetized data from both, either, or neither stream may be decrypted. If the decision is made to authorize decryption, the authorized packetized data will pass through a decryptor, otherwise the decryptor is bypassed. In one embodiment, if the packetized data was decrypted, that data will be re-encrypted to provide copy protection between the POD module **310** and the host terminal **14**. The two packetized data

streams will then be multiplexed back together and transmitted to the host terminal **14**. The host terminal **14** demultiplexes the streams and performs the desired user function such as picture-in-picture or taping one video/audio stream while viewing another.

One advantage of the present invention is the minimization of the number of connections required between the host terminal **14** and the POD module **310** for processing multiple packetized data streams. Utilizing the same input and output signals prevents the interface from requiring a larger connection. The POD module **310** uses 68-connector pins in the interface. There are 6 unused signals (A13-A10, A3-A2) in a standard POD module configuration. Other methods could require an additional 18 signals and a total of 12 extra connector pins to add a single additional digital video/audio stream. With the present invention, only two extra signals are required for the multiplex selection or Stream Select signal **430**. No extra connector pins are required. In an embodiment using the 6 unused POD module **310** signals (3 for input, 3 for output), portions of up to 8 packetized data streams can be multiplexed together.

An exemplary embodiment of the present invention modifies the standard POD interface to change the A12 signal to the input stream select signal and the A13 signal to the output stream select signal'. The POD module **310** initializes in a PCMCIA mode compatible with the PCMCIA standards. After initialization the POD module **310** functions in an external conditional access mode. The pin assignments of the PCMCIA/POD interface **510** between the host terminal **14** and the POD module **310** of an exemplary embodiment of the present invention are as follows:

Table 1. PCMCIA/POD pin assignments

Pin	PCMCIA Signal Name	I/O	POD Signal Name	I/O	Comments
1	Ground	Power	Ground	Power	Ground
2	Data 3	I/O	Data 3	I/O	Data bit 3
3	Data 4	I/O	Data 4	I/O	Data bit 4
4	Data 5	I/O	Data 5	I/O	Data bit 5
5	Data 6	I/O	Data 6	I/O	Data bit 6
6	Data 7	I/O	Data 7	I/O	Data bit 7
7	CE1#	I	CE1#	I	Card enable 1
8	Address 10	I	Address 10	I	Address bit 10
9	OE#	I	OE#	I	Card output enable
10	Address 11	I	Address 11	I	Address bit 11
11	Address 9	I	DRX	I	Receiver data
12	Address 8	I	CRX	I	Receiver gapped clock
13	Address 13	I	MOSS	I/O	MPEG Output Stream Select

14	Address 14	I	MCLKO	O	MPEG clock output
15	WE#	I	WE#	I	Write enable
16	READY/IREQ#	O	IREQ#	O	Interrupt request
17	Vcc	Power	Vcc	Power	3.3V
18	Vpp1	Power	Vpp1	Power	5V-Switched
19	Address 16	I	MIVAL	I	MPEG input valid
20	Address 15	I	MCLKI	I	MPEG input clock
21	Address 12	I	MISS	I	MPEG Input Stream Select
22	Address 7	I	QTX	O	Transmitter Q channel
23	Address 6	I	ETX	O	Transmitter enable
24	Address 5	I	ITX	O	Transmitter I channel
25	Address 4	I	CTX	I	Transmitter gapped clock
26	Address 3	I	Address 3	I	Address bit 3
27	Address 2	I	Address 2	I	Address bit 2
28	Address 1	I	Address 1	I	Address bit 1
29	Address 0	I	Address 0	I	Address bit 0
30	Data 0	I/O	Data 0	I/O	Data bit 0
31	Data 1	I/O	Data 1	I/O	Data bit 1
32	Data 2	I/O	Data 2	I/O	Data bit 2
33	WP/IOIS16#	O	IOIS16#	O	16 bit I/O (always high)
34	Ground	Power	Ground	Power	Ground
35	Ground	Power	Ground	Power	Ground
36	CD1#	O	CD1#	O	Card detect 1
37	Data 11	I/O	MDO3	O	MPEG data out bit 3
38	Data 12	I/O	MDO4	O	MPEG data out bit 4
39	Data 13	I/O	MDO5	O	MPEG data out bit 5
40	Data 14	I/O	MDO6	O	MPEG data out bit 6
41	Data 15	I/O	MDO7	O	MPEG data out bit 7
42	CE2#	I	CE2#	I	Card enable 2
43	VS1#/Refresh	O	VS1	O	Voltage sense 1
44	IORD#	I	IORD#	I	I/O Read
45	IOWR#	I	IOWR#	I	I/O Write
46	Address 17	I	MISTRT	I	MPEG input start
47	Address 18	I	MDI0	I	MPEG data in bit 0
48	Address 19	I	MDI1	I	MPEG data in bit 1
49	Address 20	I	MDI2	I	MPEG data in bit 2
50	Address 21	I	MDI3	I	MPEG data in bit 3
51	Vcc	Power	Vcc	Power	3.3V
52	Vpp2	Power	Vpp2	Power	5V-Switched

53	Address 22	I	MDI4	I	MPEG data in bit 4
54	Address 23	I	MDI5	I	MPEG data in bit 5
55	Address 24	I	MDI6	I	MPEG data in bit 6
56	Address 25	I	MDI7	I	MPEG data in bit 7
57	VS2#	O	VS2#	O	Voltage Sense 2
58	RESET	I	RESET	I	Card reset
59	WAIT#	O	WAIT#	O	Extend bus cycle
60	INPACK#	O	INPACK#	O	Input port ack
61	REG#	I	REG#	I	Register select
62	BVD2/SPKR#	O	MOVAL	O	MPEG data out valid
63	BVD1/STSCHG#	O	MOSTRT	O	MPEG data out start
64	Data 8	I/O	MDO0	O	MPEG data out bit 0
65	Data 9	I/O	MDO1	O	MPEG data out bit 1
66	Data 10	I/O	MDO2	O	MPEG data out bit 2
67	CD2#	O	CD2#	O	Card detect 2
68	Ground	Power	Ground	Power	Ground

Those skilled in the art will recognize that the pin assignments could be changed, adjusted, expanded, or reduced and that alternate implementations are included within the scope of the present invention.

Although the present invention has been described in one embodiment as allowing the decryption of multiple packetized data streams in a POD module **310**, those skilled in the art will recognize that the unique designator and the Stream Select signal **430** can be used to allow multi-tasking of multiple packetized data streams by other components, such as the MPEG Decoders **240** of host terminal **14**. In one embodiment the host terminal **14** Demultiplexer **227** would not be needed, as a modified MPEG Decoders **240** could interface with the multiplexed data signal **410**.

The unique designator is not to be confused with a packet identifier (PID). The PID is associated with the packet and identifies all packets with the same type of data associated with a particular program or service. For example, the video packets associated with the television program for channel 12 will all have the same PID. The unique identifier of the present invention is associated with the source of the portion of the multiplexed signal for the packetized data.

In addition, those skilled in the art will recognize that to provide PIP or multiple recording options for multiple programs within the same transport stream, two or more of the multiple tuners could be tuned to the same transport stream. The present invention separately identifies the packetized data signals based on the tuner or source providing the input, even if the input signals to the tuners is identical.

Those skilled in the art will recognize that the elements herein described in the POD module **310** and the host terminal **14** can be used for multiple functions and in various combinations within the scope of the present invention. For example, the Encryptor **516** can provide encryption for a variety of reasons including for copy protection and to prevent signal piracy between the POD module **310** and the host terminal **14**.

The terms encryption and decryption are intended to include encryption and decryption and the scrambling and unscrambling of data, including audio and video signals. Scrambling is the disarrangement of the elements of a transmission in order to make it unintelligible to anyone without an authorized receiver.

It should be emphasized that the above-described embodiments of the present invention are merely possible examples of the implementations, set forth for a clear understanding of the principles of the invention. Many variations and modifications may be made to the above-described embodiments of the invention without departing substantially from the spirit of the principles of the invention. All such modifications and variations are intended to be included herein within the scope of the disclosure and the present invention and protected by the following claims.

What is claimed is

1. In a system with a plurality of packetized data streams, a method of designating a source of at least one packetized data stream within a multiplexed signal including at least a portion of the at least one packetized data stream, the method comprising the steps of:

assigning a unique designator to the source of the at least one packetized data stream;

multiplexing at least the portion of the at least one packetized data stream with at least a portion of a second packetized data stream to create the multiplexed signal; and

transmitting the unique designator in conjunction with the multiplexed signal, wherein transmission of the unique designator indicates the source of the portion of the multiplexed signal as the source of the at least one packetized data stream.

2. The method of claim 1, wherein the packetized data stream is in a format compliant with one of Moving Picture Experts Group type 2 (MPEG-2) standard, Moving Picture Experts Group type 4 (MPEG-4) standard, Asynchronous Transfer Modulation (ATM) standard, and Internet Protocol (IP) standard.

3. The method of claim 1, wherein the step of transmitting the unique designator comprises the steps of:

creating a unique designator signal that includes the unique designator; and

transmitting the unique designator signal in conjunction with the multiplexed signal, wherein the unique designator signal provides the unique designator at the start of the at least one packet of the at least one packetized data stream.

4. The method of claim 1, wherein the step of transmitting the unique designator comprises the steps of:

creating a unique designator signal that includes the unique designator; and

transmitting the unique designator signal in conjunction with the multiplexed signal, wherein the unique designator signal provides the unique designator at the start of the at least one byte of the at least one packetized data stream.

5. In a system with a plurality of packetized data streams, a method of designating to an external conditional access module a source of at least one packetized data stream within a multiplexed signal including at least a portion of the at least one packetized data stream, the method comprising the steps of:

assigning a unique designator to the source of the at least one packetized data stream;

multiplexing at least the portion of the at least one packetized data stream with at least a portion of a second packetized data stream to create the multiplexed signal; and

transmitting the unique designator in conjunction with the multiplexed signal to the external conditional access module, wherein transmission of the unique designator indicates the source of the portion of the multiplexed signal as the source of the at least one packetized data stream.

6. The method of claim 5, wherein the packetized data stream is in a format compliant with one of Moving Picture Experts Group type 2 (MPEG-2) standard, Moving Picture Experts Group type 4 (MPEG-4) standard, Asynchronous Transfer Modulation (ATM) standard, and Internet Protocol (IP) standard.

7. The method of claim 5, wherein the step of transmitting the unique designator comprises the steps of:

creating a unique designator signal that includes the unique designator; and

transmitting the unique designator signal in conjunction with the multiplexed signal to the external conditional access module, wherein the unique designator signal provides the unique designator at the start of the at least one packet of the at least one packetized data stream.

8. The method of claim 5, wherein the external conditional access module decrypts the at least one packet of the at least one packetized data stream based on the source of the at least one packetized data stream indicated by the unique designator.

9. In a host terminal, a method of multiplexing together packets from at least two packetized data streams to enable decryption of the packets by an external conditional access module, the method comprising the steps of:

assigning a unique designator to each originating packetized data stream of the at least two packetized data streams;

multiplexing the packets forming portions of the at least two packetized data streams into a signal;

creating an association for each packet in the signal with the unique designator of the originating packetized data stream from which each packet originated;

transmitting the signal and the associations of the packets to the external conditional access module; and

decrypting, in the external conditional access module, the packets in the signal based on the originating packetized data stream as indicated by the associated unique designator.

10. The method of claim 9, wherein the at least two packetized data streams are in a format compliant with one of Moving Picture Experts Group type 2 (MPEG-2) standard, Moving Picture Experts Group type 4 (MPEG-4) standard, Asynchronous Transfer Modulation (ATM) standard, and Internet Protocol (IP) standard.

11. In a system with a plurality of Moving Picture Experts Group type 2 (MPEG-2) standard transport streams and a host terminal, a method of designating to an external conditional access module a source of at least one packet of a first MPEG-2 transport stream within a multiplexed signal including the at least one packet of the first MPEG-2 transport stream, the method comprising the steps of:

assigning a unique designator to the source of the first MPEG-2 transport stream;

creating a transport stream source indicator signal that includes the unique designator associated with the at least one packet of the first MPEG-2 transport stream;

multiplexing the at least one packet of the first MPEG-2 transport stream with packets from at least a portion of a second MPEG-2 transport stream to create the multiplexed signal; and

transmitting to the external conditional access module the transport stream source indicator signal in conjunction with the multiplexed signal, wherein transmission of the transport stream source indicator signal, by the unique designator, indicates the source of the at least one packet as the source of the first MPEG-2 transport stream.

12. The method of claim 11, further including the step of decrypting, in the external conditional access module, the at least one packet based on the source of the first MPEG-2 transport stream.

13. The method of claim 12, further including the step of transmitting the decrypted at least one packet from the external conditional access module to the host terminal.

14. A external conditional access module that can decrypt, based on a unique designator that indicates a source of a data packet, data packets from at least one packetized data stream within an incoming multiplexed signal comprised of data packets from more than one packetized data stream, the external conditional access module comprising:

a host terminal interface for receiving the incoming multiplexed signal from a host terminal, for transmitting an outgoing multiplexed signal to the host terminal, and for communicating the unique designator for each data packet in both the incoming multiplexed signal and the outgoing multiplexed signal;

a de-multiplexer for de-multiplexing the incoming multiplexed signal into data packets associated with the at least one packetized data stream based on the unique designator associated with each data packet;

a controller for determining if decryption is allowed for the data packets associated with the least one packetized data stream and for controlling decryption parameters;

at least one decryptor for decrypting, if decryption is allowed, the data packets associated with the at least one packetized data stream using decryption parameters for the at least one packetized data stream; and

a multiplexer for multiplexing the data packets, including those that were decrypted and those for which decryption was not allowed, into the outgoing multiplexed signal.

15. The method of claim 14, wherein the data packets and the packetized data stream are in a format compliant with one of Moving Picture Experts Group type 2 (MPEG-2) standard, Moving Picture Experts Group type 4 (MPEG-4) standard, Asynchronous Transfer Modulation (ATM) standard, and Internet Protocol (IP) standard.

16. The method of claim 14, further comprising an encryptor for encrypting the data packets associated with the at least one packetized data stream.

17. The method of claim 16, wherein the encryption provides copy protection for the data packets associated with the at least one packetized data stream.

18. A host terminal that provides a multiplexed signal to an external conditional access module, wherein the multiplexed signal includes data packets from at least two packetized data streams, the host terminal comprising:

at least two tuners, each tuner for receiving one of the at least two packetized data streams; and

a multiplexer for combining data packets from the at least two packetized data streams into the multiplexed signal, for assigning a unique indicator that indicates which tuner received the packetized data stream associated with the data packets, for transmitting the multiplexed signal to the external conditional access module, and for communicating the unique designator associated with each data packet to the external conditional access module.

19. The host terminal of claim 18, wherein the data packets and the packetized data stream are in a format compliant with one of Moving Picture Experts Group type 2 (MPEG-2) standard, Moving Picture Experts Group type 4 (MPEG-4) standard, Asynchronous Transfer Modulation (ATM) standard, and Internet Protocol (IP) standard.

20. The host terminal of claim 18, further comprising a demultiplexer for receiving an output signal from the external conditional access module, for de-multiplexing the output signal, and for providing the at least two packetized data streams as separate packetized data streams.

21. In a system with a plurality of packetized data streams, a method of designating a source of a first packetized data stream within a multiplexed signal including at least a portion of the at least one packetized data stream, the method comprising the steps of:

assigning a unique designator to the source of the at least one packetized data stream;

multiplexing at least the portion of the at least one packetized data stream with at least a portion of a second packetized data stream to create the multiplexed signal; and

transmitting the unique designator in conjunction with the multiplexed signal, wherein transmission of the unique designator indicates the source of the portion of the multiplexed signal as the source of the at least one packetized data stream.

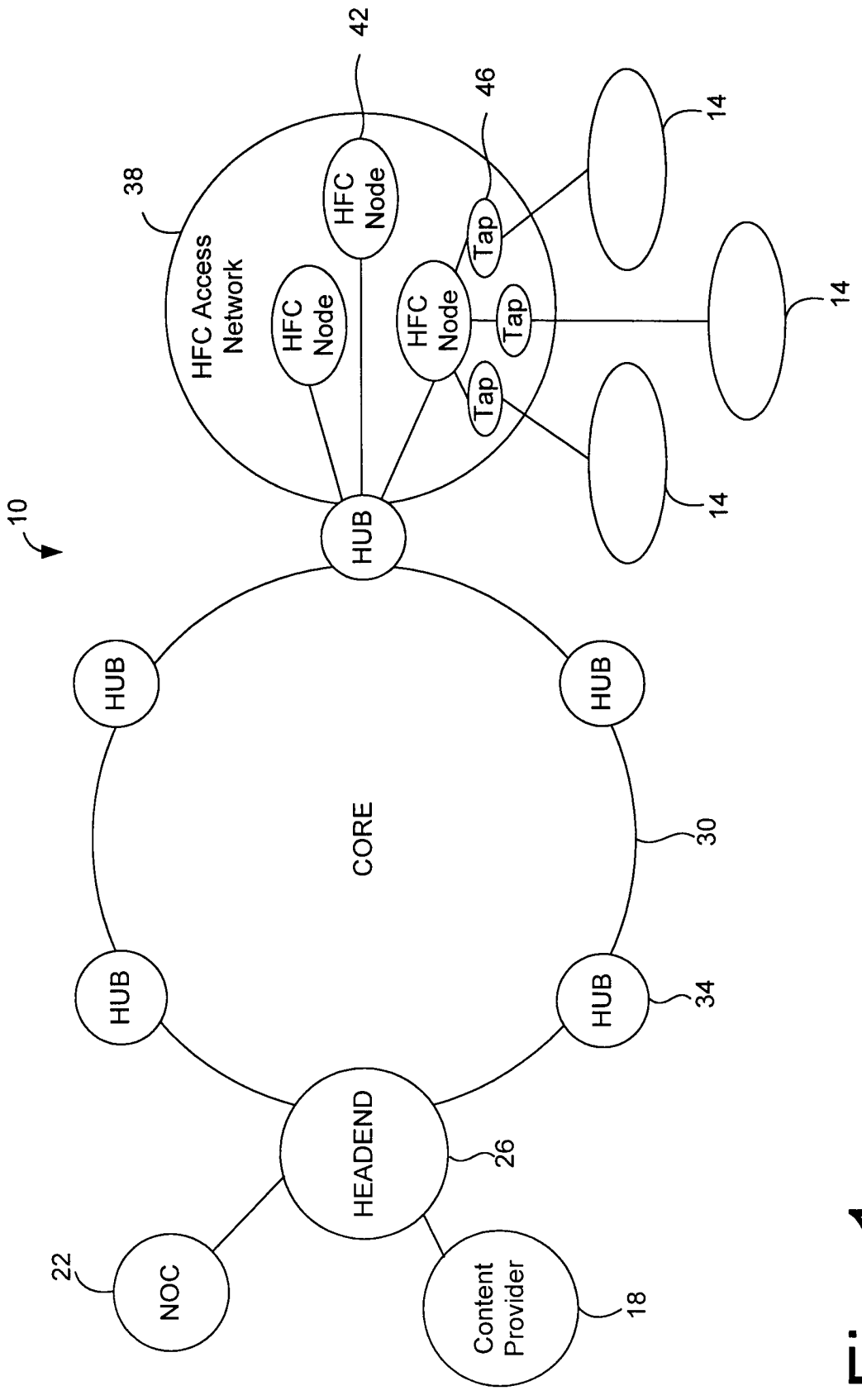
10
HUB
HFC Access Network
38
HFC Node
HFC Node
HFC Node
42
46
Tap
Tap
Tap
14
14
14
HUB
HUB
HUB
HUB
CORE
30
34
HEADEND
26
NOC
22
Content Provider
18

Fig. 1

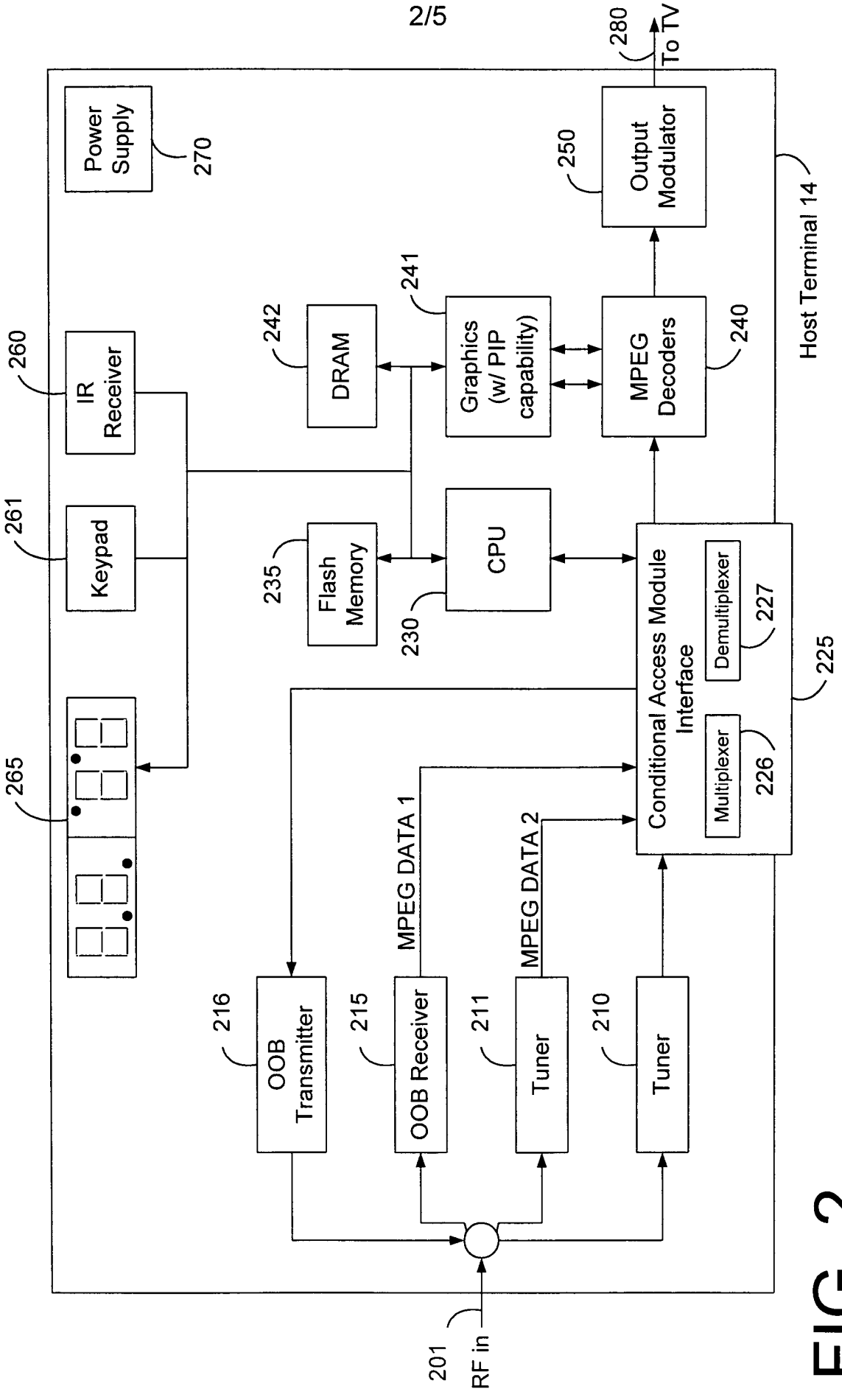
Power Supply
270
280
To TV
250
Output Modulator
241
242
DRAM
Graphics (w/ PIP capability)
MPEG Decoders
240
Host Terminal 14
260
IR Receiver
261
Keypad
265
235
Flash Memory
230
CPU
Conditional Access Module Interface
Demultiplexer
227
Multiplexer
226
225
MPEG DATA 1
MPEG DATA 2
216
OOB Transmitter
215
OOB Receiver
211
Tuner
210
Tuner
201
RF in

FIG. 2

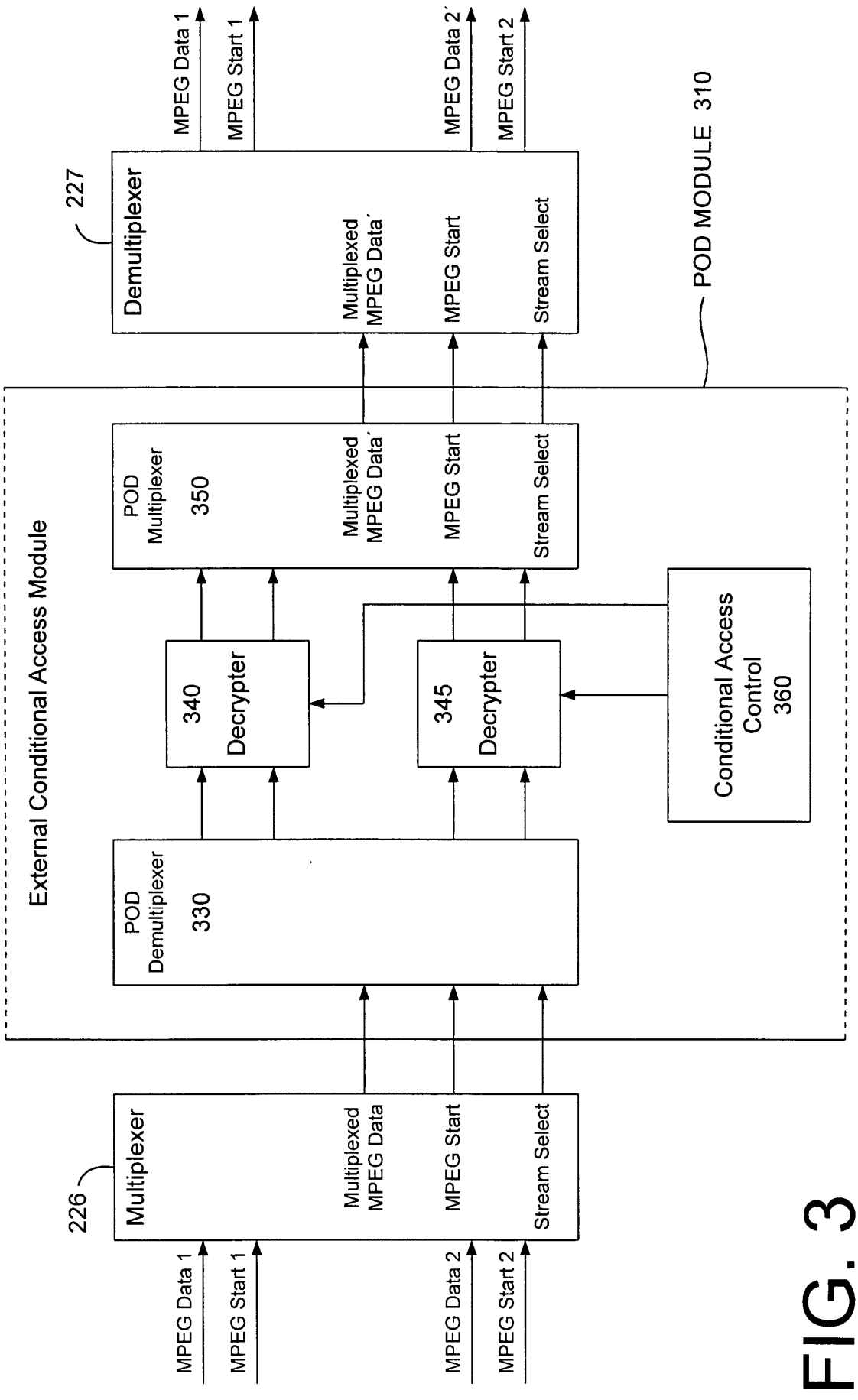
MPEG Data 1
MPEG Start 1
MPEG Data 2´
MPEG Start 2
227
Demultiplexer
Multiplexed MPEG Data´
MPEG Start
Stream Select
POD MODULE 310
External Conditional Access Module
POD Multiplexer 350
Multiplexed MPEG Data´
MPEG Start
Stream Select
340 Decrypter
345 Decrypter
Conditional Access Control 360
POD Demultiplexer 330
226
Multiplexer
Multiplexed MPEG Data
MPEG Start
Stream Select
MPEG Data 1
MPEG Start 1
MPEG Data 2
MPEG Start 2

FIG. 3

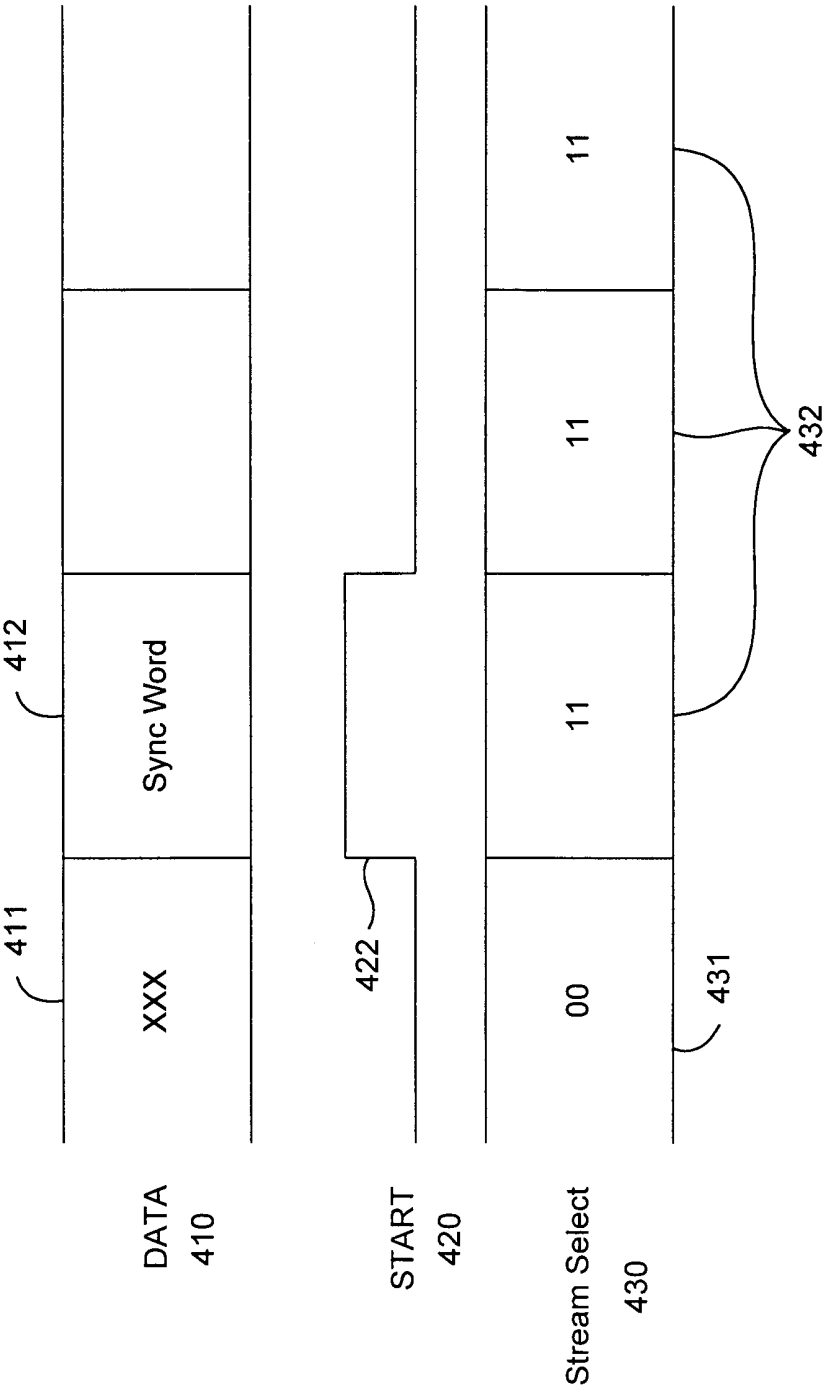
411
412
XXX
Sync Word
DATA
410
422
START
420
00
11
11
11
431
432
Stream Select
430

FIG. 4

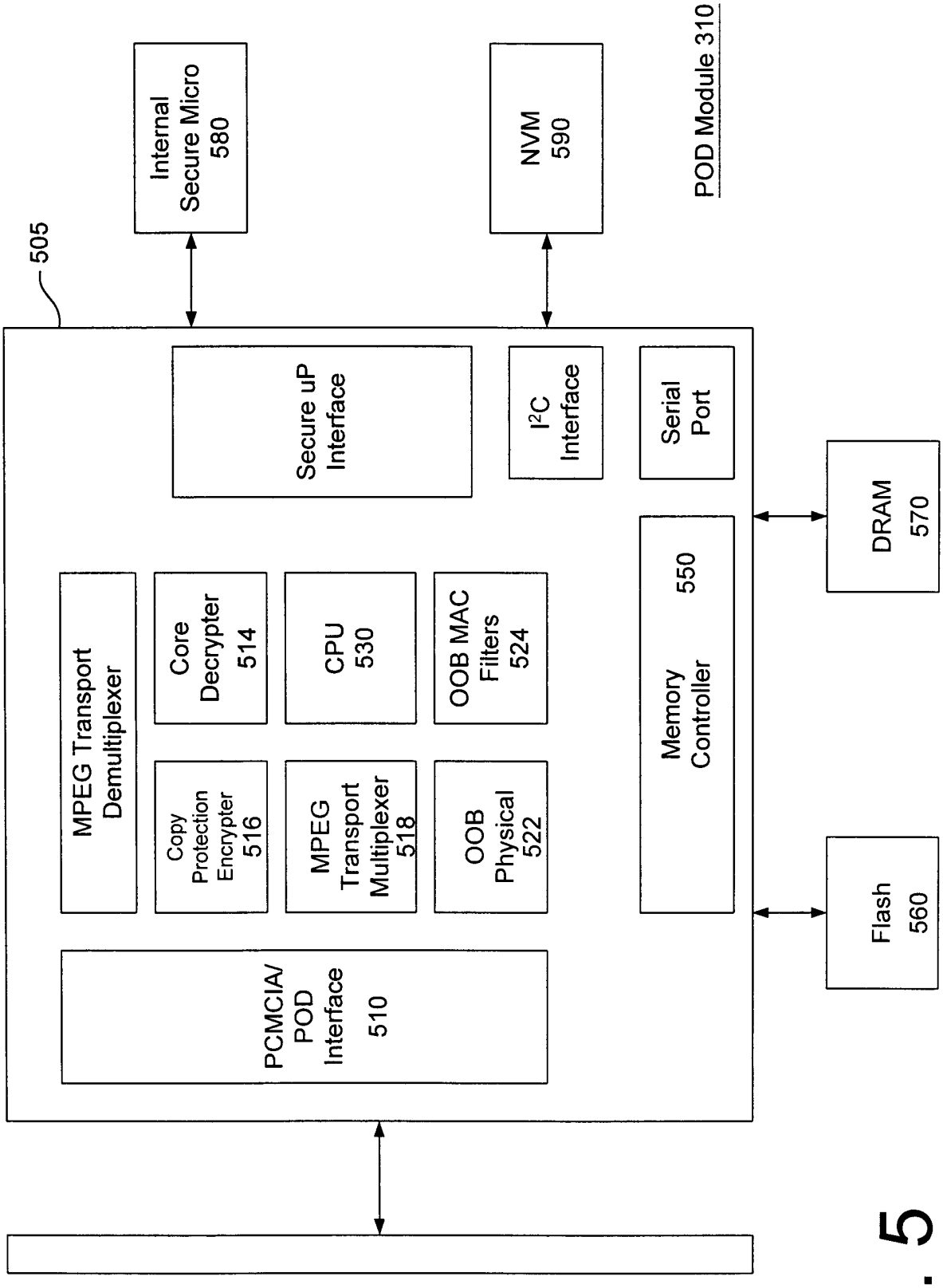
POD Module 310
505
Internal Secure Micro 580
NVM 590
Secure uP Interface
I²C Interface
Serial Port
DRAM 570
MPEG Transport Demultiplexer
Core Decrypter 514
CPU 530
OOB MAC Filters 524
Memory Controller 550
Copy Protection Encrypter 516
MPEG Transport Multiplexer 518
OOB Physical 522
PCMCIA/ POD Interface 510
Flash 560

FIG. 5