

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0004]

At present, the value defined as the digital signal transmission speed by the HDMI standard is approximately 10.2 Gbps at the highest. To cope with high-quality 3D (3-dimension) video signals and video signals of the future 4k2k (QFHD) and high-resolution content, the transmission speed in the future is expected to be increased to 15 Gbps or 20 Gbps, which is higher than the highest value defined by the current HDMI standard.

[0005]

There are two possible approaches to the higher-speed HDMI. One is a technique by which the current three data differential line pairs are used as they are, and the clock speed at which data is transmitted is increased so as to increase the transmission rate accordingly. By this technique, however, extending the transmission band only by increasing the clock speed is difficult due to the physical limit on the use of copper cable differential pairs. Even if this technique can be used, it is easy to assume that the transmission distance will become extremely short. That is, limitations will be put on the lengths of HDMI cables connecting devices.

[0006]

The other means to solve the problem relevant to embodiments of the present invention is to increase the number of data differential line pairs, which is currently three, to four or larger. The data rate can be increased by the amount equivalent to the increase in the number of data transmitting lanes. By this technique of increasing the

data differential line pairs, however, the compatibility with the current HDMI becomes an issue. Specifically, if the number of pins in each connector, which is conventionally 19, is simply increased by the number of data differential line pairs, the compatibility with conventional devices will be lost, and misunderstandings and confusion will be caused among users. Therefore, this technique is not preferable.

[0007]

A solution to this is maintaining the compatibility of each connector (plug or receptacle). That is, the wiring needs to be designed so that any functional defects will not be caused in the cables while the conventional 19-pin connectors are used as they are.

[0008]

Embodiments~~An object of this invention is to provide a novel digital interface (new HDMI) that has a high degree of compatibility with the current HDMI, and can transmit signals at a higher data rate than the current HDMI.~~

Embodiments~~Another object of this invention is to provide a transmitting device and a receiving device that have the functions of the current HDMI and the new HDMI, and perform excellent signal transmission.~~

SOLUTIONS TO PROBLEMS

[0009]

According to a first aspect of the present invention,
there is provided~~A concept of this invention lies in a transmitting device that includes: a digital signal transmitting unit that transmits a digital signal to an external device via a transmission path with a differential signal, and has a first operating mode involving a first number of channels~~

for the differential signal and a second operating mode involving a second number of channels for the differential signal, the second number being larger than the first number; an operating mode determining unit that determines whether the external device and the transmission path are compatible with the second operating mode; and an operation control unit that controls the operation of the digital signal transmitting unit, based on the determination performed by the operating mode determining unit.

[0010]

In embodiments of this invention, the digital signal transmitting unit transmits a digital signal to the external device (a receiving device) via the transmission path with a differential signal. The digital signal transmitting unit has the first operating mode and the second operating mode, and selectively uses one of the modes. The number of differential signal channels is the first number in the first operating mode, and is the second number, which is larger than the first number, in the second operating mode. For example, the first operating mode is a current HDMI operating mode, and the first number is three. The second operating mode is a new HDMI operating mode, and the second number is six, which is larger than three.

[0011]

For example, the transmission path is a cable, and a receptacle having pins is provided for connecting a plug of this cable thereto. The digital signal transmitting unit selects a first pin assignment in the first operating mode, and selects a second pin assignment

communication, for example. The operating mode determining unit determines whether the transmission path is compatible with the second operating mode, based on whether the information indicating that the transmission path is compatible with the second operating mode is provided from the transmission path through the near field communication.

[0016]

The operating mode determining unit transmits a differential signal for a predetermined digital signal to the external device, by using a pair of signal lines in the transmission path, for example. The pair of signal lines does not form a differential signal transmission path in the first operating mode, but do form a differential signal transmission path in the second operating mode. Based on a signal sent from the external device, the operating mode determining unit performs the determination. The signal sent from the external device is a signal that indicates whether a received digital signal obtained through the predetermined differential signal received by the external device is correct, for example. Alternatively, the signal sent from the external device is a received digital signal obtained through the predetermined differential signal received by the external device, for example.

[0017]

As described above, in embodiments of this invention, the digital signal transmitting unit has the first operating mode in which the number of differential signal channels is the first number, and the second operating mode in which the number of differential signal channels is the second

number, which is larger than the first number. As the second operating mode (a new HDMI standard) is used, signal transmission can be performed at a high data rate. Also, when the external device, the transmission path, or the like is not compatible with the second operating mode, the first operating mode (the current HDMI standard) is used, to secure backward compatibility.

[0018]

| In embodiments of this invention, the transmission device further includes an information transmitting unit that transmits the result of the determination performed by the operating mode determining unit to the external device via the transmission path, for example. In this case, when the external device includes a digital signal receiving unit that has the first operating mode in which the number of differential signal channels is the first number and the second operating mode in which the number of differential signal channels is the second number, which is larger than the first number, operations of the digital signal receiving unit can be controlled based on the above mentioned determination result, for example.

[0019]

| In embodiments of this invention, the shape of the receptacle may match the shape of a plug of a cable compatible with the second operating mode, and may include the shape of a plug of a cable compatible with the first operating mode. In this case, the plug of the cable compatible with the second operating mode can be connected to the receptacle, and the plug of the cable compatible with the first operating mode can also be connected to the receptacle. In this manner, backward compatibility is secured in

terms of cable connections. In this case, the shape of the receptacle of a transmitting device including a digital signal transmitting unit compatible only with the first operating mode matches the shape of the plug of the cable compatible with the first operating mode. Therefore, the plug of the cable compatible with the second operating mode cannot be connected to this receptacle.

[0020]

| In embodiments of this invention, the transmitting device may further include a display control unit that controls display on a display unit for providing control information about the operation control unit to a user. In this case, the user can easily recognize how the digital signal transmitting unit is being controlled. For example, the user can easily recognize whether the digital signal transmitting unit is in the first operating mode or in the second operating mode.

[0021]

| In embodiments of this invention, when the operating mode determining unit has determined that the external device and the transmission path are compatible with the second operating mode, the display control unit may perform control to display a user interface screen on the display unit. The user interface screen is for allowing a user to select the first operating mode or the second operating mode for the digital signal transmitting unit. In this case, the user can arbitrarily set an operating mode for the digital signal transmitting unit, based on the user interface screen.

[0021a]

According to a second aspect of the present invention, there is provided a transmitting method comprising: a digital signal transmitting step of transmitting a digital signal to an external device via a transmission path with a differential signal in a first operating mode involving a first number of channels for the differential signal or in a second operating mode involving a second number of channels for the differential signal, the second number being larger than the first number; an operating mode determining step of determining whether the external device and the transmission path are compatible with the second operating mode; and an operation controlling step of controlling the operation of the digital signal transmitting step, based on the determination performed in the operating mode determining step.

[0022]

According to a third aspect of the present invention,
there is provided~~Another concept of this invention lies in a~~
receiving device that includes: a digital signal receiving
unit that receives a digital signal from an external device
via a transmission path with a differential signal, and has a
first operating mode involving a first number of channels for
the differential signal and a second operating mode involving
a second number of channels for the differential signal, the
second number being larger than the first number; an
information receiving unit that receives, from the external
device, operating mode information indicating which one of the
first operating mode and the second operating mode is to be
selected; and an operation control unit that controls the
operation of the digital signal receiving unit, based on the
operating mode information received by the information
receiving unit.

[0023]

In embodiments of this invention, the digital signal
receiving unit receives a digital signal from the external
device (the transmitting device) via the transmission path
with a differential signal. The digital signal receiving unit
has the first operating mode and the second operating mode,
and selectively uses one of the modes. The number of
differential signal channels is the first number in the first
operating mode, and is the second number, which is larger than
the first number, in the second operating mode. For example,
the first operating mode is a current HDMI operating mode, and
the first number is three. The second operating mode is a new
HDMI operating mode, and the second number is six, which is
larger than three.

[0024]

The information receiving unit receives, from the external device, the operating mode information indicating which one of the first operating mode and the second operating mode is to be selected. Based on the operating mode information received by the information receiving unit, the operation control unit controls the operation of the digital signal receiving unit. In this case, the operating mode of the digital signal receiving unit can be easily made the same as the operating mode of the digital signal transmitting unit of the external device, and digital signals can be received from the external device in an excellent manner.

[0024a]

According to a fourth aspect of the present invention, there is provided a receiving method comprising: a digital signal receiving step of receiving a digital signal from an external device via a transmission path with a differential signal in a first operating mode involving a first number of channels for the differential signal or in a second operating mode involving a second number of channels for the differential signal, the second number being larger than the first number; an information receiving step of receiving, from the external device, operating mode information indicating which one of the first operating mode and the second operating mode is to be selected; and an operation controlling step of controlling the operation in the digital signal receiving step, based on the operating mode information received in the information receiving step.

[0025]

According to a fifth aspect of the present invention, there is provided ~~Another concept of this invention lies in a~~ transmitting/receiving system formed by connecting a transmitting device and a receiving device via a transmission path. The transmitting device includes: a digital signal transmitting unit that transmits a digital signal to the receiving device via the transmission path with a differential signal, and has a first operating mode involving a first number of channels for the differential signal and a second operating mode involving a second number of channels for the differential signal, the second number being larger than the first number; an operating mode determining unit that determines whether the receiving device and the transmission path are compatible with the second operating mode; a transmitting operation control unit that controls the operation of the digital signal transmitting unit, based on the determination performed by the operating mode determining unit; and an information transmitting unit that transmits

operating mode information about the digital signal transmitting unit to the receiving device via the transmission path. The receiving device includes: a digital signal receiving unit that receives the digital signal from the transmitting device via the transmission path with the differential signal, and has the first operating mode involving the first number of channels for the differential signal and the second operating mode involving the second number of channels for the differential signal; an information receiving unit that receives the operating mode information from the transmitting device via the transmission path; and a receiving operation control unit that controls the operation of the digital signal receiving unit, based on the operating mode information received by the information receiving unit.

[0026]

According to a sixth aspect of the present invention,
there is provided~~Yet another concept of this invention lies in~~
a cable that transmits a digital signal from a transmitting device to a receiving device with a differential signal having a predetermined number of channels, and includes an information providing function unit that provides information indicating the signal transmission capability of the cable to the transmitting device or the receiving device.

[0027]

For example, the information providing function unit provides the information indicating the signal transmission capability of the cable to the receiving device or the transmitting device via the cable, in response to a request from the receiving device or the

transmitting device. Also, the information providing function unit rewrites part of capability information the transmitting device reads from the receiving device via the cable, for example. Also, the information providing function unit provides the information indicating the signal transmission capability of the cable to the transmitting device or the receiving device through near field communication, for example.

EFFECTS OF THE INVENTION

[0028]

According to embodiments of this invention, signal transmission can be performed at a high data rate while backward compatibility is secured.

BRIEF DESCRIPTION OF DRAWINGS

[0029]

Fig. 1 is a block diagram showing an exemplary structure of an AV system as an embodiment of this invention.

Fig. 2 is a diagram showing example combinations of a source device, an HDMI cable, and a sink device.

Fig. 3 is a diagram showing exemplary structures of the data transmitting unit of a source device and the data receiving unit of a sink device (in a current HDMI operating mode).

Fig. 4 is a diagram showing exemplary structures of the data transmitting unit of a source device and the data receiving unit of a sink device (in a new HDMI operating mode).

Fig. 5 is a diagram showing an exemplary structure