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Kuwabara

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(54) **COMMUNICATION DEVICE, COMMUNICATION METHOD, COMPUTER PROGRAM, AND COMMUNICATION SYSTEM**

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H04W 4/00 (2009.01)

(52) **U.S. Cl.**
CPC ***H04L 63/08*** (2013.01); ***H04W 4/001*** (2013.01)

(58) **Field of Classification Search**
CPC H04L 63/08
USPC 726/3
See application file for complete search history.

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(57) **ABSTRACT**

There is provided a communication device including a communication unit configured to include different communication modes, and an information exchange unit configured to exchange, before the communication unit transmits information to a transmission destination device, an available communication mode and authentication information in advance with the transmission destination device using a communication mode included in the communication unit, the authentication information being used when communication is performed using the communication mode.

13 Claims, 11 Drawing Sheets

FIG.1

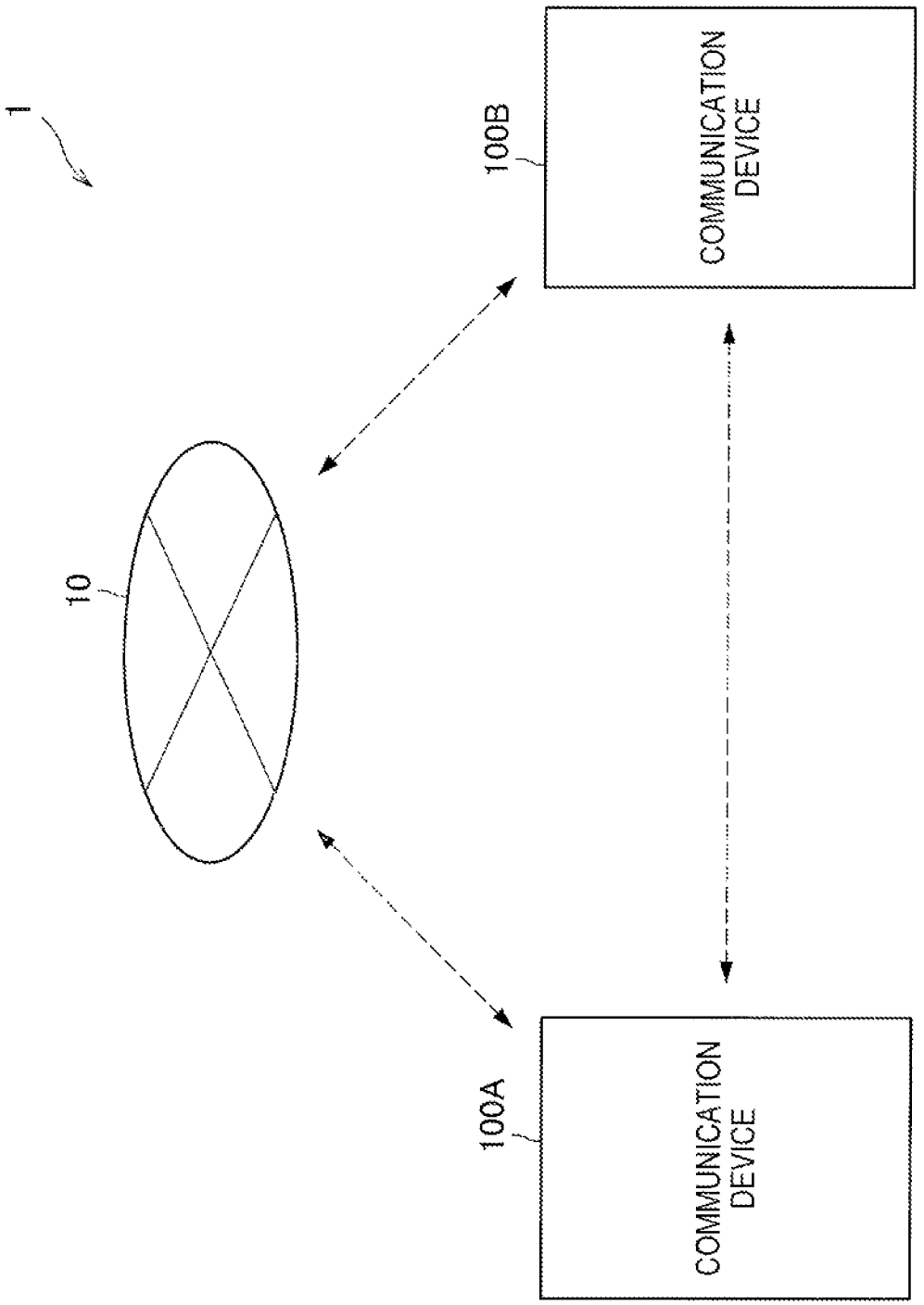


FIG.2

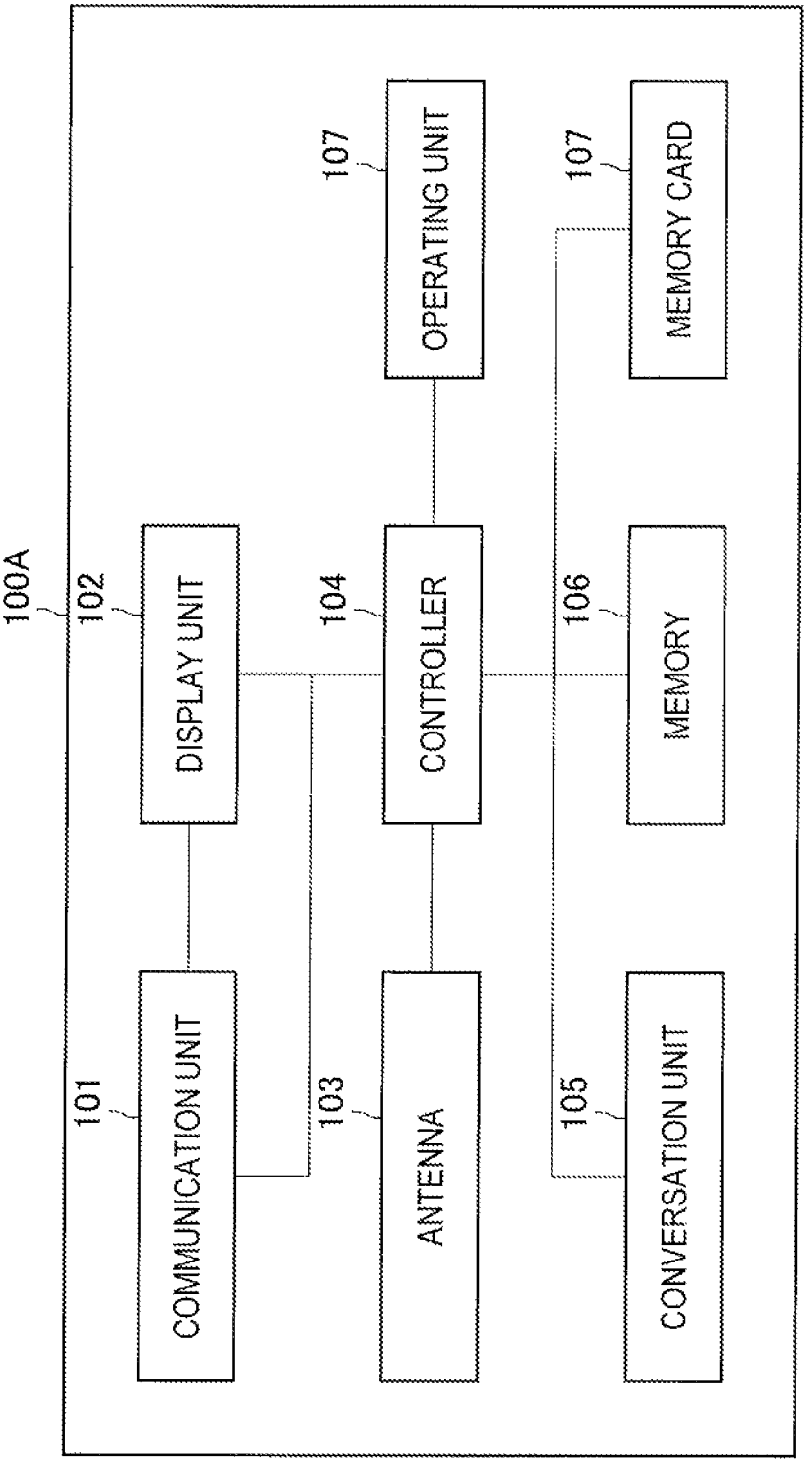

100A
101
COMMUNICATION UNIT
102
DISPLAY UNIT
103
ANTENNA
104
CONTROLLER
105
CONVERSATION UNIT
106
MEMORY
107
OPERATING UNIT
107
MEMORY CARD

FIG.3

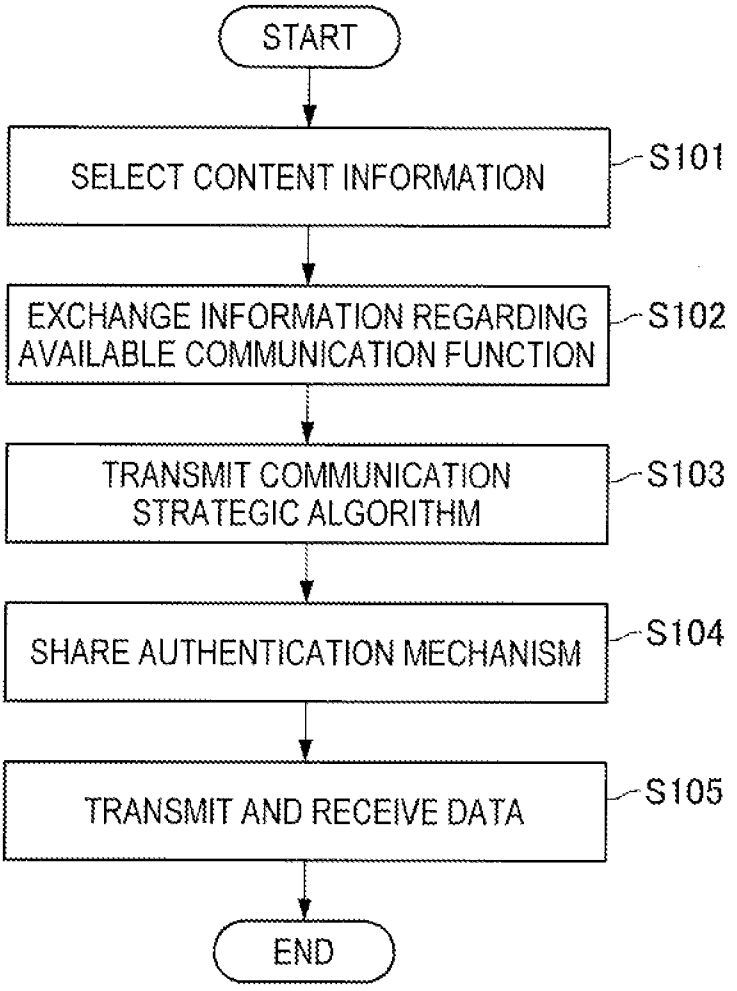

START
SELECT CONTENT INFORMATION
S101
EXCHANGE INFORMATION REGARDING AVAILABLE COMMUNICATION FUNCTION
S102
TRANSMIT COMMUNICATION STRATEGIC ALGORITHM
S103
SHARE AUTHENTICATION MECHANISM
S104
TRANSMIT AND RECEIVE DATA
S105
END

FIG.4

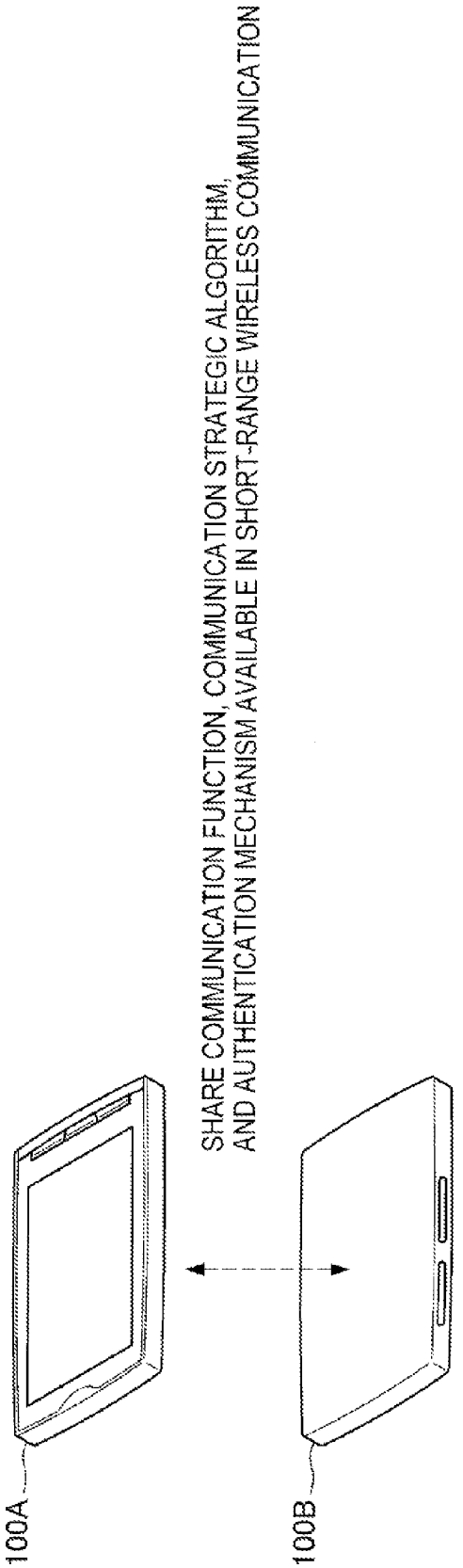

SHARE COMMUNICATION FUNCTION, COMMUNICATION STRATEGIC ALGORITHM,
AND AUTHENTICATION MECHANISM AVAILABLE IN SHORT-RANGE WIRELESS COMMUNICATION
100A
100B

FIG.5

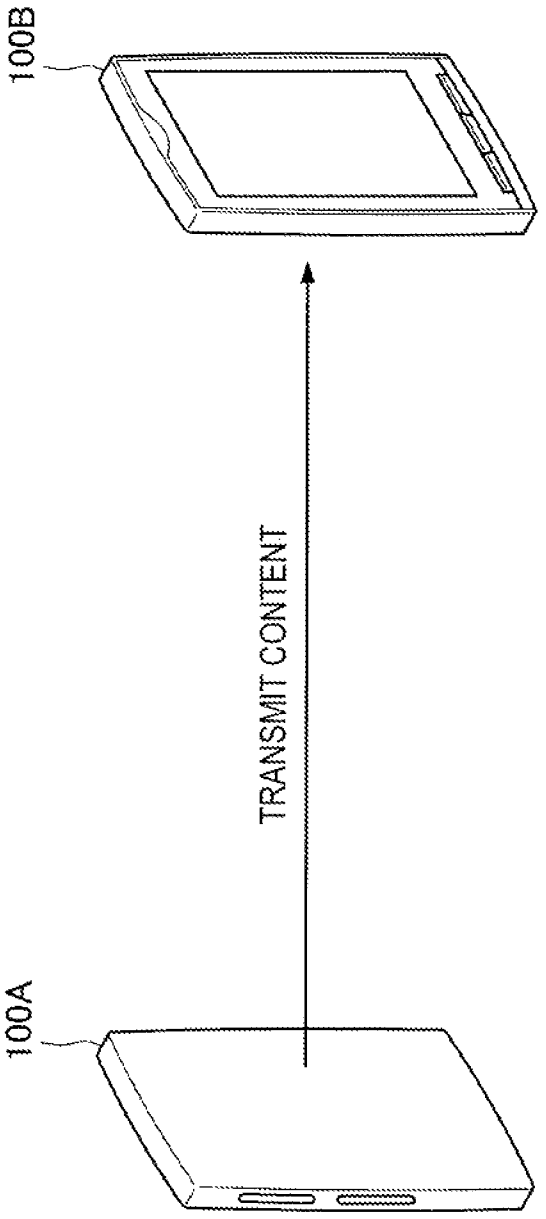


FIG.6

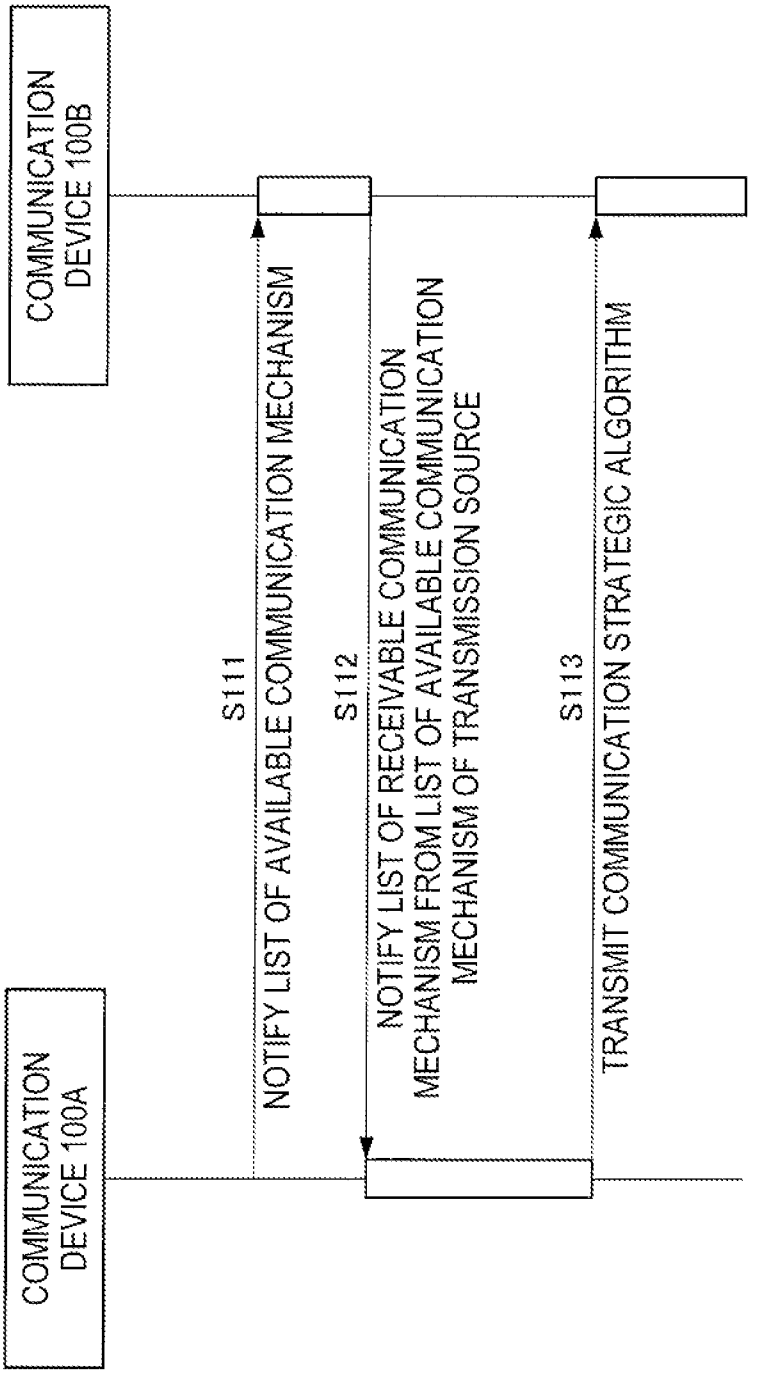

COMMUNICATION DEVICE 100B
COMMUNICATION DEVICE 100A
S111
NOTIFY LIST OF AVAILABLE COMMUNICATION MECHANISM
S112
NOTIFY LIST OF RECEIVABLE COMMUNICATION MECHANISM FROM LIST OF AVAILABLE COMMUNICATION MECHANISM OF TRANSMISSION SOURCE
S113
TRANSMIT COMMUNICATION STRATEGIC ALGORITHM

FIG.7

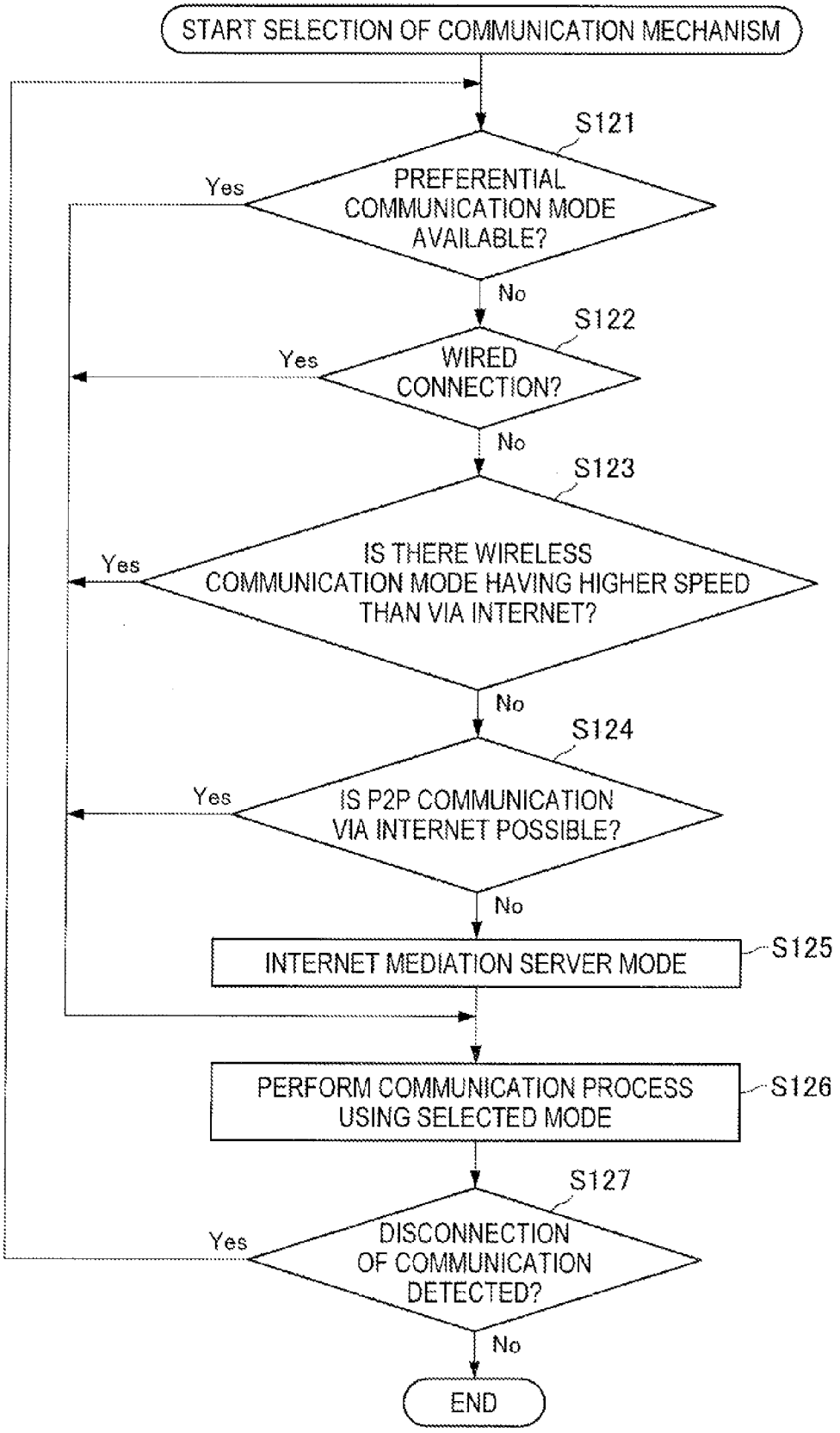

START SELECTION OF COMMUNICATION MECHANISM
S121
PREFERENTIAL COMMUNICATION MODE AVAILABLE?
Yes
No
S122
WIRED CONNECTION?
Yes
No
S123
IS THERE WIRELESS COMMUNICATION MODE HAVING HIGHER SPEED THAN VIA INTERNET?
Yes
No
S124
IS P2P COMMUNICATION VIA INTERNET POSSIBLE?
Yes
No
INTERNET MEDIATION SERVER MODE
S125
PERFORM COMMUNICATION PROCESS USING SELECTED MODE
S126
S127
DISCONNECTION OF COMMUNICATION DETECTED?
Yes
No
END

FIG.8

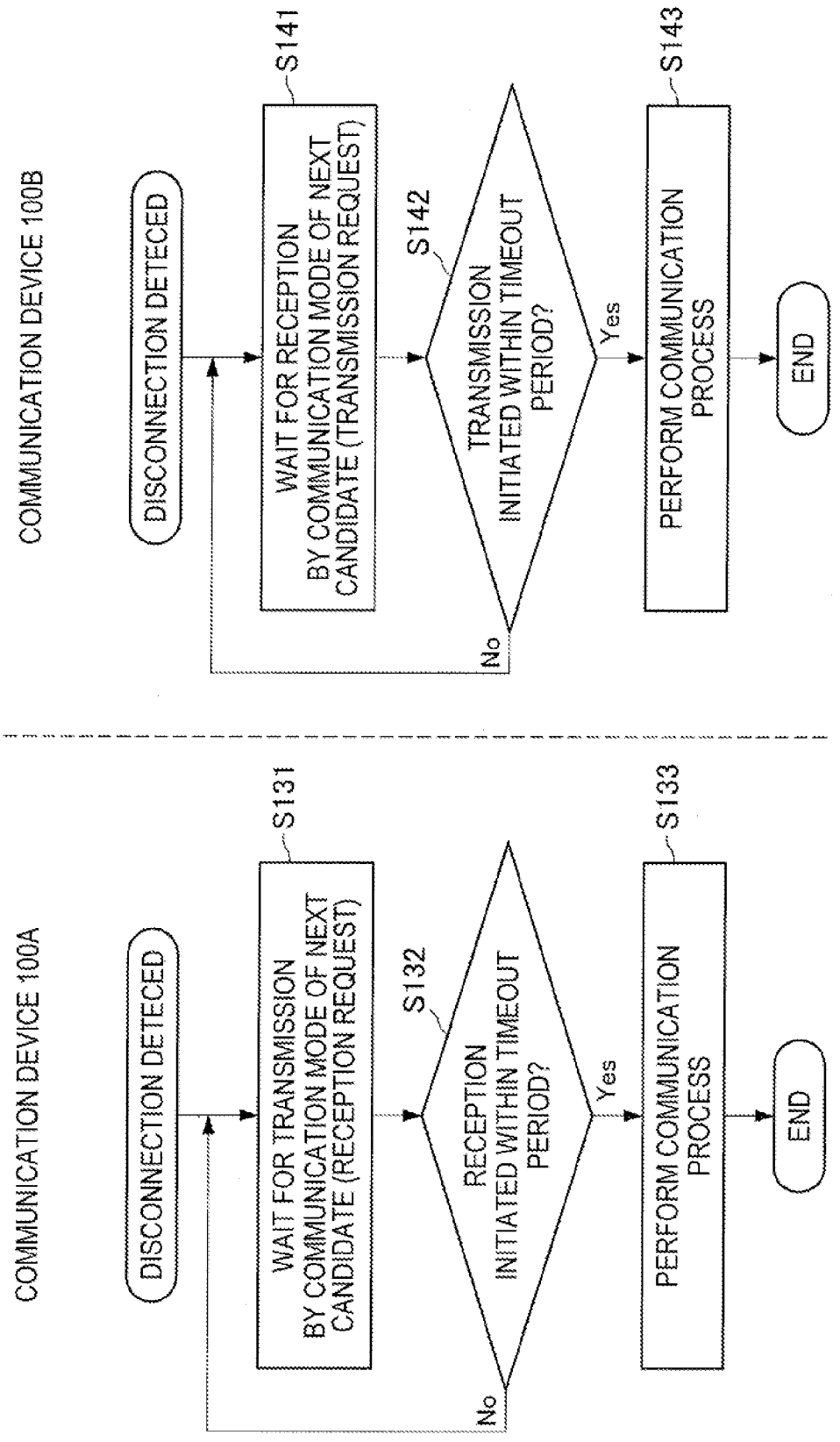

COMMUNICATION DEVICE 100A
DISCONNECTION DETECED
S131
WAIT FOR TRANSMISSION BY COMMUNICATION MODE OF NEXT CANDIDATE (RECEPTION REQUEST)
S132
RECEPTION INITIATED WITHIN TIMEOUT PERIOD?
No
Yes
S133
PERFORM COMMUNICATION PROCESS
END
COMMUNICATION DEVICE 100B
DISCONNECTION DETECED
S141
WAIT FOR RECEPTION BY COMMUNICATION MODE OF NEXT CANDIDATE (TRANSMISSION REQUEST)
S142
TRANSMISSION INITIATED WITHIN TIMEOUT PERIOD?
No
Yes
S143
PERFORM COMMUNICATION PROCESS
END

FIG.9

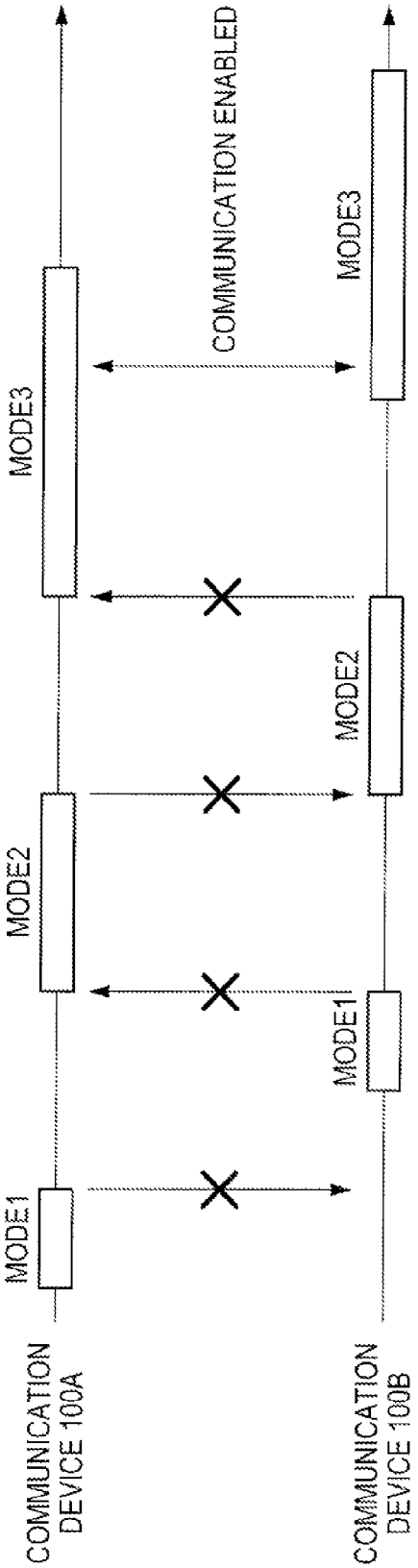

COMMUNICATION ENABLED
MODE3
MODE3
MODE2
MODE2
MODE1
MODE1
COMMUNICATION DEVICE 100A
COMMUNICATION DEVICE 100B

FIG.10

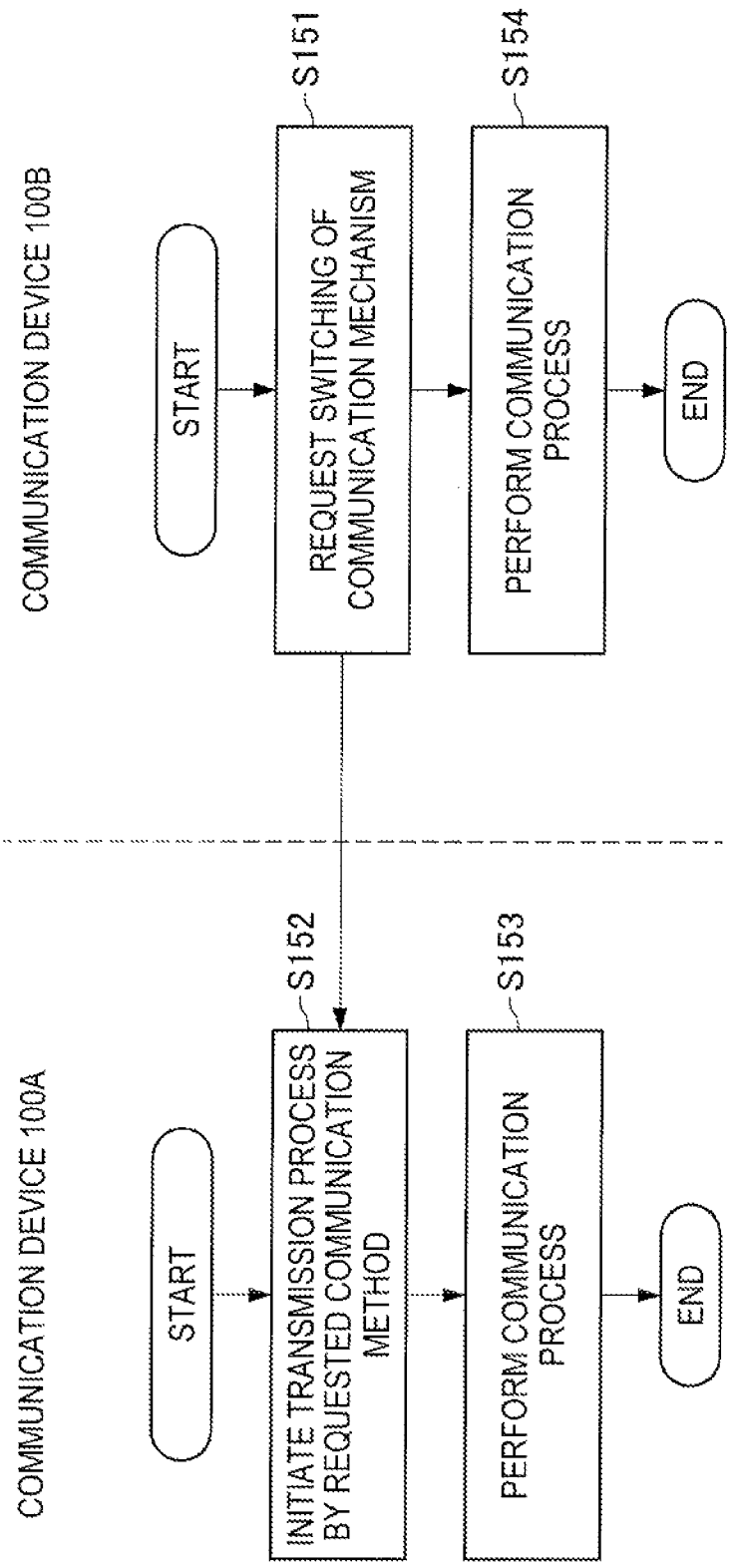
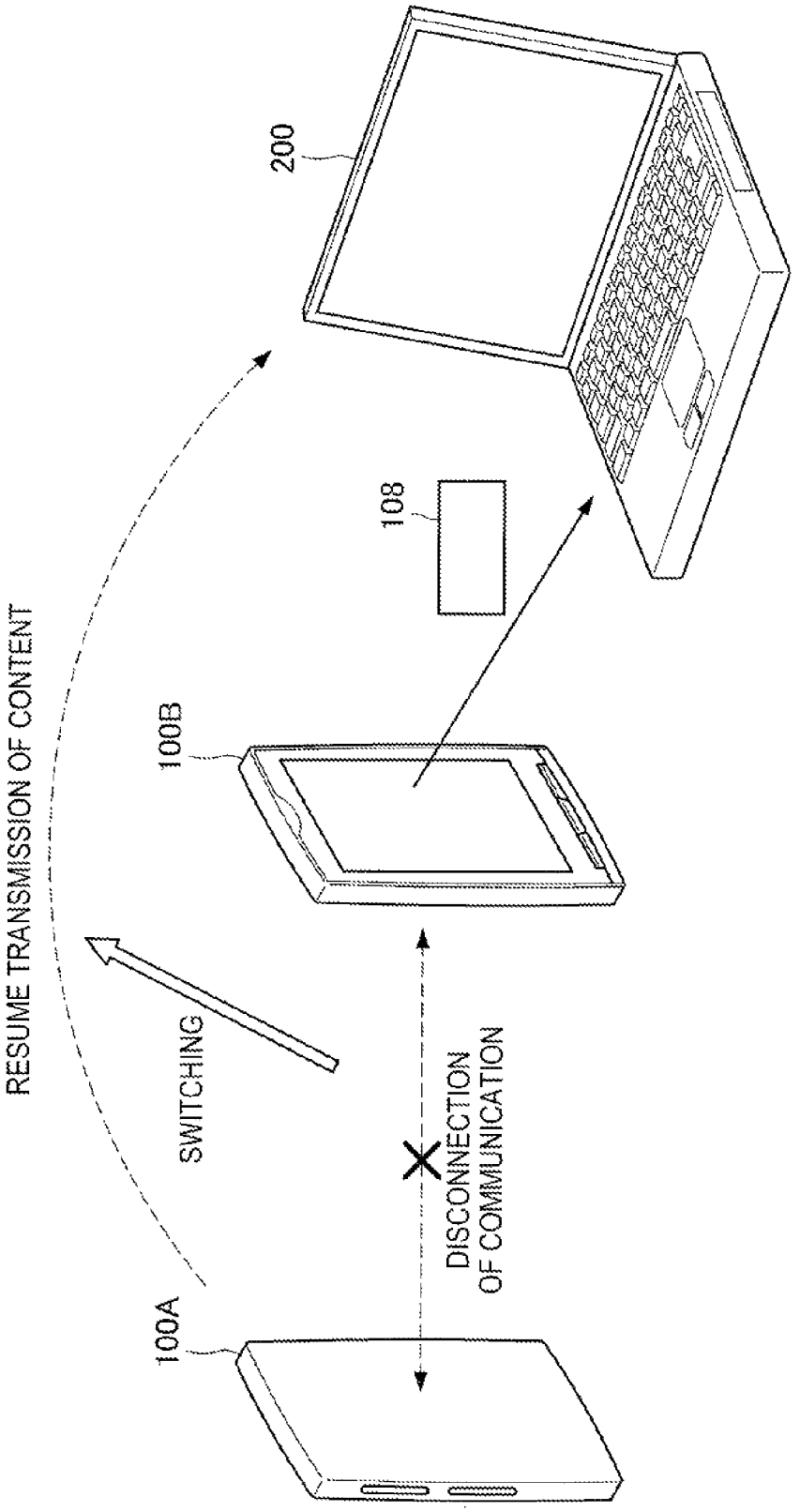

COMMUNICATION DEVICE 100B
START
S151
REQUEST SWITCHING OF COMMUNICATION MECHANISM
S154
PERFORM COMMUNICATION PROCESS
END
COMMUNICATION DEVICE 100A
START
S152
INITIATE TRANSMISSION PROCESS BY REQUESTED COMMUNICATION METHOD
S153
PERFORM COMMUNICATION PROCESS
END

FIG.11


200
108
100B
RESUME TRANSMISSION OF CONTENT
SWITCHING
DISCONNECTION OF COMMUNICATION
100A

COMMUNICATION DEVICE, COMMUNICATION METHOD, COMPUTER PROGRAM, AND COMMUNICATION SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION

The present application claims priority from Japanese Patent Application No. JP 2012-113116 filed in the Japanese Patent Office on May 17, 2012, the entire content of which is incorporated herein by reference.

BACKGROUND

The present disclosure relates to a communication device, a communication method, a computer program, and a communication system.

With the advancement of high-resolution image, the amount of data for content of still or moving images is getting larger and larger. A method of sharing content between terminals may be implemented by directly transmitting content from one terminal to another, but a large amount of content data will increase the amount of time necessary to transmit content.

In order to exchange data between terminals, from the viewpoint of security, it is desirable to perform an authentication process in advance between terminals prior to the exchange of data. A technique for performing an authentication process between terminals prior to the exchange of data is disclosed, for example, in Japanese Patent Application Laid-Open Publication Nos. 2010-011058 and 2009-140275. The technique which is disclosed in Japanese Patent Application Laid-Open Publication Nos. 2010-011058 and 2009-140275 employs a short-range communication to perform an authentication process between terminals, but it actually exchanges data using a communication mechanism that is different from the short-range communication.

SUMMARY

However, since the communications environment is changing rapidly, when data is transferred using certain communication mechanism, the communication via the communication mechanism may be interrupted before the transfer of data is completed. According to the related art, in a case there may be a terminal having a plurality of communication mechanisms, if the communication via a communication mechanism is interrupted during data transmission and reception, there is unfortunately a need for a new authentication process to initiate the communication using another communication mechanism.

Furthermore, according to the related art, in the case where the communication via the communication mechanism is interrupted during data transmission and reception, even if the communication is initiated again using a different communication mechanism through a new authentication process, there is a need to retransmit data all over again. Under these circumstances, it is desired to provide a technology for solving the inconvenience of transferring data between terminals having a plurality of communication mechanisms.

The embodiments of the present disclosure provides a novel and improved communication device, communication method, computer program, and communication system which can continue to maintain communication between a receiver and a transmitter by causing a communication strategy to be shared in advance between them to switch among a plurality of communication mechanisms seamlessly when data is exchanged between the receiver and transmitter using the plurality of communication mechanisms.

According to an embodiment of the present disclosure, there is provided a communication device including a communication unit configured to include different communication modes, and an information exchange unit configured to exchange, before the communication unit transmits information to a transmission destination device, an available communication mode and authentication information in advance with the transmission destination device using a communication mode included in the communication unit, the authentication information being used when communication is performed using the communication mode.

Further, according to an embodiment of the present disclosure, there is provided a communication device including a communication unit configured to include different communication modes, and an information exchange unit configured to exchange, before the communication unit receives information from a transmission source device, an available communication mode and authentication information in advance with the transmission source device using a communication mode included in the communication unit, the authentication information being used when communication is performed using the communication mode.

Further, according to an embodiment of the present disclosure, there is provided a communication method including communicating using one communication mode of different communication modes, and exchanging, before information is transmitted to a transmission destination device in the communicating step, an available communication mode and authentication information in advance with the transmission destination device using a communication mode of the different communication modes, the authentication information being used when communication is performed using the communication mode.

Further, according to an embodiment of the present disclosure, there is provided a computer program for causing a computer to execute communicating using one communication mode of different communication modes, and exchanging, before information is transmitted to a transmission destination device in the communicating step, an available communication mode and authentication information in advance with the transmission destination device using a communication mode of the different communication modes, the authentication information being used when communication is performed using the communication mode.

Further, according to an embodiment of the present disclosure, there is provided a communication system including a transmitting device configured to transmit information, and a receiving device configured to directly or indirectly receive the information transmitted by the transmitting device. The transmitting device includes a communication unit configured to include different communication modes, and an information exchange unit configured to exchange an available communication mode and authentication information in advance with the receiving device using a communication mode included in the communication unit before the communication unit transmits information to the receiving device, the authentication information being used when communication is performed using the communication mode. The receiving device includes a communication unit configured to include different communication modes, and an information exchange unit configured to exchange an available communication mode and authentication information in advance with the transmitting device using a communication mode included in the communication unit before the communica-

tion unit receives information from the transmitting device, the authentication information being used when communication is performed using the communication mode.

In accordance with the embodiments of the present disclosure described above, there is provided a novel and improved communication device, communication method, computer program, and communication system which can continue to maintain communication between a receiver and a transmitter by causing a communication strategy to be shared in advance between them to switch among a plurality of communication mechanisms seamlessly when data is exchanged between the receiver and transmitter using the plurality of communication mechanisms.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram for explaining an exemplary configuration of a communication system **1** according to an embodiment of the present disclosure;

FIG. **2** is a diagram for explaining an exemplary functional configuration of a communication device **100**A that is included in the communication system **1** according to an embodiment of the present disclosure;

FIG. **3** is a flowchart illustrating a schematic operation of each of the communication devices **100**A and **100**B;

FIG. **4** is a diagram for explaining an example of short-range wireless communication;

FIG. **5** is a diagram for explaining an example of transmission of content data;

FIG. **6** is a flowchart illustrating an operation of each of the communication devices **100**A and **100**B;

FIG. **7** is a flowchart illustrating an example of communication strategic algorithm;

FIG. **8** is a flowchart illustrating an operation of each of the communication devices **100**A and **100**B;

FIG. **9** is a diagram for explaining an example of a case where the timeout period that is set at the time of switching of the communication mechanism is changed depending on the priority;

FIG. **10** is a flowchart illustrating an operation of each of the communication devices **100**A and **100**B; and

FIG. **11** is a diagram for explaining an exemplary configuration of the communication system **1** according to an embodiment of the present disclosure.

DETAILED DESCRIPTION OF THE EMBODIMENT(S)

Hereinafter, preferred embodiments of the present disclosure will be described in detail with reference to the appended drawings. Note that, in this specification and the appended drawings, structural elements that have substantially the same function and structure are denoted with the same reference numerals, and repeated explanation of these structural elements is omitted.

The description will be given in the following order.

<1. Embodiment of Present Disclosure>

[Exemplary Configuration of Communication System]

[Exemplary Configuration of Communication Device]

[Exemplary Operation of Each Communication Device]

<2. Summary and Conclusion>

<1. Embodiment of Present Disclosure>

[Exemplary Configuration of Communication System]

An exemplary configuration of a communication device and a communication system having the communication device according to an embodiment of the present disclosure will now be described with reference to accompanying drawings. FIG. **1** is a diagram illustrating an exemplary configuration of a communication system **1** according to the embodiment of the present disclosure. The exemplary configuration of the communication system **1** according to the embodiment of the present disclosure will now be described with reference to FIG. **1**.

As illustrated in FIG. **1**, the communication system according to the embodiment of the present disclosure is configured to include a communication device **100**A and a communication device **100**B. The communication system **1** according to the embodiment of the present disclosure is a system that is configured to exchange still or moving images, music data, or other content between these two communication devices **100**A and **100**B. The following description is based on operations of the case where content held by the communication device **100**A is transmitted to the communication device **100**B, unless otherwise stated.

In this embodiment, the communication devices **100**A and **100**B may be portable devices, and each of them may be any one of mobile phones, smart phones, tablets, and portable music players. Further, in the embodiment, the communication devices **100**A and **100**B may have the respective corresponding plurality of communication mechanisms to directly exchange data with each other using the communication mechanism. Alternatively, in the embodiment, the communication devices **100**A and **100**B can indirectly exchange data with each other through a server provided in a network **10**, such as the Internet, in addition to the direct exchange of data by the communication mechanism.

The communication system **1** according to the embodiment is a system configured to exchange content between the communication device **100**A and the communication device **100**B. Therefore, the communication system **1** according to the embodiment, when exchanging content between the communication device **100**A and the communication device **100**B, exchanges information regarding the communication in advance between the communication device **100**A and the communication device **100**B, and then when actually exchanging content, the communication system **1** uses the exchanged information. Even if the communication mechanism is switched into another communication mechanism for some reasons or other at the time of exchange of content, the communication devices **100**A and **100**B can continue to exchange content with the communication system seamlessly.

The exemplary configuration of the communication system **1** according to the embodiment of the present disclosure has been described with reference to FIG. **1**. An exemplary configuration of the communication devices **100**A and **100**B that are included in the communication system **1** according to the embodiment of the present disclosure will now be described.

[Exemplary Configuration of Communication Device]

FIG. **2** is a diagram illustrating an exemplary functional configuration of the communication device **100**A that is included in the communication system **1** according to the embodiment of the present disclosure. The exemplary functional configuration of the communication device **100**A according to the embodiment of the present disclosure will now be described with reference to FIG. **2**.

As illustrated in FIG. **2**, the communication device **100**A according to the embodiment of the present disclosure is configured to include a wireless communication unit **101**, a display unit **102**, an antenna **103**, a controller **104**, a conversation unit **105**, a memory **106**, an operating unit **107**, and a memory card **108**.

The communication unit **101** communicates with other devices, especially the communication device **100**B, over a wired or wireless network. In this embodiment, the communication unit **101** may have a plurality of communication mechanisms. The communication mechanism of the communication unit **101** may include, for example, wireless communication of IEEE 802.15.1 standards, wireless communication of IEEE 802.11 series standards such as Wi-Fi, wired communication via LAN or USB cable, and so on.

The display unit **102** displays information which is received by the wireless communication unit **101** or information obtained in response to user's operation performed for the operating unit **107**. For example, the display unit **102** may include a flat panel image display such as a liquid crystal display and an organic EL display. A touch panel may be provided on a display surface of the display unit **102**.

The antenna **103** is an antenna for short-range wireless communication which operates at a given frequency (e.g., 13.56 MHz). The controller **104** controls operations of the communication device **100**A. For example, the controller **104** controls operations of the components of the communication device **100**A by executing the program stored in the memory **106**. An operation of the communication device **100**A which is controlled by the controller **104** may include, for example, the display of information on the display unit **102**, the communication performed by the communication unit **101** or the antenna **103**, and so on.

The conversation unit **105** includes, for example, a speaker or a microphone, and performs a voice telephone conversation with other devices or telephone sets. The memory **106** may include, for example, a ROM, a RAM, and so on, and may be used to store the program for controlling the operation of the communication device **100**A. The operating unit **107** includes various types of buttons that are used to operate the communication device **100**A. In response to the operation of the operating unit **107**, the controller **104** controls the operation of the communication device **100**A. In addition, if a touch panel is provided on a display surface of the display unit **102**, then the touch panel functions as the operation unit **107**.

The memory card **108** is a storage medium for storing various types of information, and may be configured to be removable from the communication device **100**A. In addition, the memory card **108** stores still or moving images, music data, or other content data. The content data which is stored in the memory card **108** is transmitted from the communication unit **101** to the communication device **100**B by the controller **104**.

The exemplary functional configuration of the communication device **100**A is illustrated in FIG. **2**. The communication device **100**B has a substantially similar configuration to that of the communication device **100**A. The controller **104** of the communication device **100**A exchanges available communication mode and authentication information in advance with the communication device **100**B. This exchange of the communication mode and authentication information is performed via short-range wireless communication using the antenna **103** before the communication device **100**A transmits information to the communication device **100**B. The authentication information is information necessary when the communication is performed based on the available communication mode. Because the controller **104** performs the exchange of the communication mode and authentication information before transmitting content, even if the communication mechanism being used for transmitting content is switched for some reasons when the communication device **100**A transmits content to the communication device **100**B, the communication device **100**A can continue to transmit content seamlessly.

The exemplary functional configuration of the communication device **100**A according to the embodiment of the present disclosure has been described with reference to FIG. **2**. Next, the operation of the communication devices **100**A and **100**B that are included in the communication system **1** according to the embodiment of the present disclosure will now be described.

[Exemplary Operation of Each Communication Device]

FIG. **3** is a flowchart illustrating a schematic operation of each of the communication devices **100**A and **100**B that are included in the communication system **1** according to the embodiment of the present disclosure. The flowchart illustrated in FIG. **3** shows an overview of the operation performed by each of the communication devices **100**A and **100**B when the communication device **100**A transmits content to the communication device **100**B. An overview of the operation performed by each of the communication devices **100**A and **100**B that are included in the communication system **1** according to the embodiment of the present disclosure will now be given with reference to FIG. **3**.

When transmitting content to the communication device **100**B, the communication device **100**A selects the content to be transmitted to the communication device **100**B (step **S101**). The selection of content which is performed by the communication device **100**A in step **S101** is not limited to any particular method. As an example, in the communication device **100**A, the controller **104** may cause the display unit **102** to display a list of contents and thus cause a user to select content from the list that is to be transmitted to the communication device **100**B.

In the above step **S101**, when the content to be transmitted to the communication device **100**B has been selected by the communication device **100**A, then the communication device **100**A exchanges information regarding available communication functions with the communication device **100**B (step **S102**). This exchange process of information in this step **S102** may be performed, for example, by the controller **104**. In step **S102**, when the communication device **100**A has exchanged information regarding the available communication functions with the communication device **100**B, then the communication device **100**A transmits a communication strategic algorithm to the communication device **100**B (step **S103**). The communication strategic algorithm is used to determine a method for selecting a communication mechanism to be used when the communication device **100**A exchanges content with the communication device **100**B. This transmission process may be performed, for example, by the communication unit **101**. The communication device **100**A then shares an authentication mechanism with the communication device **100**B (step **S104**). The authentication mechanism is used when the communication device **100**A communicates with the communication device **100**B.

When the exchange of information regarding available communication functions, the transmission of a communication strategic algorithm, and the sharing of an authentication mechanism have been performed, the communication device **100**A then transmits content data which is selected in step **S101** to the communication device **100**B (step **S105**). This transmission process of content data may be performed, for example, by the communication unit **101**. At the time of transmission of the content data, the communication device **100**A selects one communication function among the communication functions exchanged in step **S102** based on the communication strategic algorithm transmitted in step **S103**,

and then performs an authentication process with the communication device **100**B by the authentication mechanism shared in step S**104**.

The exchange of information regarding available communication functions, the transmission of a communication strategic algorithm, and the sharing of an authentication mechanism are performed via short-range wireless communication using the antenna **103** in a state in which the communication devices **100**A and **100**B are in close proximity to each other. Because the short-range wireless communication is communication technology which can be implemented only at a close range, the authentication performed via short-range wireless communication between the communication devices **100**A and **100**B may be a simple authentication process which shows just the fact that they are equipments which have initiated the communication with each other at the same time.

FIG. **4** is a diagram for explaining an example of short-range wireless communication performed in a state in which the communication devices **100**A and **100**B are in close proximity to each other. When content data is exchanged between the communication device **100**A and the communication device **100**B, as illustrated in FIG. **4**, the communication devices **100**A and **100**B are to be in close proximity to each other before the communication device **100**A transmits the content data to the communication device **100**B. The short-range wireless communication which is performed between the communication devices **100**A and **100**B then allows the available communication function, communication strategic algorithm, and authentication mechanism to be shared between the communication devices **100**A and **100**B.

FIG. **5** is a diagram for explaining an example of the transmission of content data from the communication device **100**A to the communication device **100**B. After the available communication functions, communication strategic algorithm, and authentication mechanism are shared between the communication devices **100**A and **100**B via short-range wireless communication, the transmission of content data from the communication device **100**A to the communication device **100**B is performed even in a state in which the communication devices **100**A and **100**B are separated from each other, as shown in FIG. **5**. The communication device **100**A, when transmitting content data to the communication device **100**B, uses information of the available communication function, communication strategic algorithm, and authentication mechanism, which have been exchanged with the communication device **100**B.

The overview of the operation performed by each of the communication devices **100**A and **100**B that are included in the communication system **1** according to the embodiment of the present disclosure has been described with reference to FIG. **3**. Next, the operation performed by the communication devices **100**A and **100**B that are included in the communication system **1** according to the embodiment of the present disclosure will now be described in detail.

FIG. **6** is a flowchart illustrating an operation of the communication devices **100**A and **100**B that are included in the communication system **1** according to the embodiment of the present disclosure. The flowchart of FIG. **6** shows in further detail the processes performed in steps S**102** and S**103** shown in FIG. **3**. The operation of the communication devices **100**A and **100**B will now be described with reference to FIG. **6**.

The communication device **100**A, when exchanging information regarding the available communication function with the communication device **100**B, notifies a list of communication mechanisms available on its own device to the communication device **100**B (step S**111**). The list of communication mechanisms available on its own device is notified to the communication device **100**B, for example, via short-range wireless communication using the antenna **103** by the controller **104**.

The list of communication mechanisms available on its own device includes, for example, a desired priority policy that defines the priority level of communication mechanism or a list of communication types. The list of communication types includes, for example, information such as communication types, available communication options, a typical transmission or reception speed, a typical communication coverage, parameters that give the attenuation curve of communication rate according to the distance (in the case of wireless communication), timeout period, and so on. In addition, the communication types include, for example, wired P2P (Peer to Peer) such as USB, short-range wireless P2P such as NFC, wireless P2P such as Wi-Fi ad hoc communication or Bluetooth communication, P2P via a network such as the Internet, and the use of a mediation server on a network such as the Internet.

A communication mode to be used in preference to other modes is specified by the desired priority policy. For example, when wireless P2P such as Wi-Fi ad hoc communication or Bluetooth communication is used preferentially in order for the communication device **100**A to exchange data with the communication device **100**B, the communication device **100**A specifies the wireless P2P to be used preferentially.

In step S**111**, if the list of communication mechanisms available on the communication device **100**A is transmitted via short-range wireless communication from the communication device **100**A to the communication device **100**B, then the communication device **100**B notifies a receivable list of communication mechanisms from among the received list of communication mechanisms to the communication device **100**A (step S**112**). This notification of step S**112** is performed via short-range wireless communication, which is the same as that of step S**111**.

In step S**112**, if the list of communication mechanisms which can be received by the communication device **100**B is transmitted via short-range wireless communication from the communication device **100**B to the communication device **100**A, then the communication device **100**A transmits a communication strategic algorithm to the communication device **100**B (step S**113**). In this case, the communication strategic algorithm is used to determine a method for selecting a communication mechanism to be used when the communication device **100**A communicates with the communication device **100**B. The transmission in step S**113** is performed via short-range wireless communication, which is the same as that of step S**111** or S**112**.

In this way, the exchange of available communication functions or the sharing of communication strategic algorithm is performed in advance between the communication devices **100**A and **100**B, prior to exchanging content data between them. By performing the exchange of available communication functions or the sharing of communication strategic algorithm, and further by performing the sharing of an authentication mechanism between the communication devices **100**A and **100**B, the communication devices **100**A and **100**B can continue to exchange content seamlessly.

An example of a communication strategic algorithm which is shared between the communication devices **100**A and **100**B will now be described. FIG. **7** is a flowchart illustrating an example of the communication strategic algorithm which is shared between the communication devices **100**A and **100**B according to the embodiment of the present disclosure. An example of the communication strategic algorithm that is

shared between the communication devices **100**A and **100**B will now be described with reference to FIG. **7**.

In order to select a communication mechanism to be used between the communication devices **100**A and **100**B from among the available communication mechanisms, it is determined whether a preferential communication mode that is specified to be used preferentially from among the available communication modes is available (step S**121**). The preferential communication mode is specified based on the desired priority policy described above.

In step S**121**, if it is determined that the preferential communication mode that is specified to be used preferentially from among the available communication mechanisms between the communication devices **100**A and **100**B is not available, then it is determined whether the communication devices **100**A and **100**B are connected to each other by a wired connection (step S**122**).

In step S**122**, if it is determined that the communication devices **100**A and **100**B are not connected to each other by a wired connection, then it is determined whether there is a wireless communication mode having a higher speed than via a network, such as the Internet, from among the communication mechanisms available between the communication devices **100**A and **100**B (step S**123**).

In step S**123**, it is determined that there is no wireless communication mode having a higher speed than via a network such as the Internet from among the communication mechanisms available between the communication devices **100**A and **100**B, then it is determined whether P2P communication via a network such as the Internet is available (step S**124**).

In step S**124**, if it is determined that P2P communication via a network such as the Internet is not available, then the content data is determined to be exchanged between the communication devices **100**A and **100**B using a mode in which the exchange is performed via a mediation server provided on the network such as the Internet (step S**125**).

On the other hand, in steps S**121** through S**124**, if any one of the above-described conditions is satisfied, it is determined that the communication devices **100**A and **100**B select a communication mode which satisfies each of the conditions, and then the communication process is performed using the selected communication mode (step S**126**).

Subsequently, it is determined whether a disconnection of communication is detected during the exchange of content data (step S**127**). If it is determined that a disconnection of communication is detected, then the process is returned to step S**121** and the determination processes are repeated. On the other hand, if it is determined that a disconnection of communication is not detected, then the communication strategic algorithm is terminated.

In this way, a communication strategic algorithm is determined and the determined communication strategic algorithm is shared between the communication devices **100**A and **100**B in advance. Therefore, even if the communication is disconnected during the exchange of content data, the communication devices **100**A and **100**B can continue to exchange content seamlessly by switching the communication mechanism into another.

An example of dynamic switching of communication mechanism when content data is exchanged between the communication devices **100**A and **100**B will now be described.

FIG. **8** is a flowchart illustrating an operation of each of the communication devices **100**A and **100**B that are included in the communication system **1** according to the embodiment of the present disclosure. The flowchart of FIG. **8** illustrates the operation of the case where the communication is disconnected when data is exchanged between the communication devices **100**A and **100**B. The operation of the communication devices **100**A and **100**B that are included in the communication system **1** according to the embodiment of the present disclosure will now be described with reference to FIG. **8**.

If the communication devices **100**A and **100**B detect a disconnection of the communication performed using the communication mechanism by which data has been exchanged, then the source communication device **100**A waits for transmission (reception by the communication device **100**B is requested) to be performed using a communication method which is the next candidate to be determined by the communication strategic algorithm (step S**131**). In addition, the destination communication device **100**B waits for reception (transmission by the communication device **100**A is requested) performed using the communication method that is the next candidate to be determined by the communication strategic algorithm (step S**141**).

Subsequently, the communication device **100**A determines whether the communication device **100**B initiates reception within a predetermined timeout period (step S**132**), and the communication device **100**B determines whether the communication device **100**A initiates transmission within a predetermined timeout period (step S**142**). If it is determined that the reception is initiated by the communication device **100**B, then the communication device **100**A performs a corresponding communication process based on the communication mode which is determined in step S**131** (step S**133**). If it is determined that the transmission is initiated by the communication device **100**A, then the communication device **100**B performs a corresponding communication process based on the communication mode which is determined in step S**141** (step S**143**). If it is determined that the reception is not initiated by the communication device **100**B, then the process is returned to step S**131**, and the communication device **100**A waits for transmission to be performed using a communication method that is the next candidate determined by the communication strategic algorithm. If it is determined that the transmission is not initiated by the communication device **100**A, then the process is returned to step S**141**, and the communication device **100**B waits for reception to be performed using the communication method that is the next candidate determined by the communication strategic algorithm.

Furthermore, each process performed by the communication devices **100**A and **100**B illustrated in FIG. **8** is performed independently, not in synchronization with each other. Because a disconnection of communication is detected independently by each of the communication devices **100**A and **100**B, the subsequent processes will be performed independently by each of the communication devices **100**A and **100**B.

The process illustrated in FIG. **8** will be described in detail with reference to the following example. By causing the communication devices **100**A and **100**B to be in close proximity to each other as shown in FIG. **4** and thus by performing short-range wireless communication, the sharing of content is initiated between the communication devices **100**A and **100**B. However, there is not necessary to continue to cause the communication devices **100**A and **100**B to be in close proximity to each other until the sharing of content between the communication devices **100**A and **100**B is completed. The communication devices **100**A and **100**B may be spaced away from each other such that the communication between them is no longer performed.

If a disconnection of short-range wireless communication is detected, each of the communication devices **100**A and **100**B specifies a new communication mechanism based on the communication strategic algorithm which has been shared at the time of initiating the communication, as shown in FIG. **7**. For example, it is assumed that Bluetooth (registered trademark) is specified as a new communication mechanism based on the communication strategic algorithm.

Subsequently, each of the communication devices **100**A and **100**B checks whether the communication performed using the new communication mechanism is available. In this case, because an authentication process of the communication devices **100**A and **100**B is performed by the previously exchanged authentication mechanism, the communication can be initiated automatically with a new communication mechanism without performing a new authentication process.

If the communication using Bluetooth (registered trademark) is disconnected during the exchange of data, then the communication devices **100**A and **100**B specify a new communication mechanism based on the communication strategic algorithm. In this case, when the communication is re-established within a predetermined timeout period, the communication that uses the new communication mechanism is resumed. When the communication using the new communication mechanism is resumed, the communication devices **100**A and **100**B continue to exchange content data without re-transmitting data which has previously exchanged.

In addition, the timeout period that is set at the time of switching of the communication mechanism may be dependent on the priority. For example, the timeout period becomes shorter as the priority becomes higher, and the timeout period becomes longer as the priority becomes lower. By setting the timeout period in this way, the communication devices **100**A and **100**B can reduce the time taken until the establishment of communication that uses a communication mode having a higher priority. In addition, if the time necessary for switching of communication mode is constant, then consequently it is possible to reduce the time taken until the re-establishment of communication that uses a communication mode.

FIG. **9** is a diagram for explaining an example of the case where the timeout period that is set at the time of switching of communication mechanisms is changed depending on the priority. Three communication modes are illustrated in FIG. **9**. In FIG. **9**, the length of timeout period of each communication mode is shown in a rectangular shape. FIG. **9** also illustrates the case where the priority is decreasing in the order of mode**1**, mode**2**, and mode**3**. In this way, by setting the timeout period, the communication devices **100**A and **100**B can reduce the time taken until the communication is re-established using the mode**3**.

A coverage area in which communication can be performed via short-range wireless communication is very narrow, and is highly dependent on the distance between devices. Therefore, in some cases, the switching from the present communication mechanism to another communication mechanism is desired immediately after the sharing process of the authentication mechanism shown in step **S104** of FIG. **3** is terminated. An operation of such a case will be described.

FIG. **10** is a flowchart illustrating an operation of each of the communication devices **100**A and **100**B that are included in the communication system **1** according to the embodiment of the present disclosure. The flowchart of FIG. **10** illustrates an operation of the case where the switching of communication mode is requested from the receiving-side communication device **100**B when data is exchanged between the communication devices **100**A and **100**B. The operation of each of the communication devices **100**A and **100**B that are included in the communication system **1** according to the embodiment of the present disclosure will now be described with reference to FIG. **10**.

When the sharing process of authentication mechanism via shot-range wireless communication between the communication devices **100**A and **100**B is terminated, the communication device **100**B transmits a request for switching of communication mechanism to the communication device **100**A (step **S151**). The communication device **100**A, when receiving the request for switching of communication mechanism from the communication device **100**B, initiates a transmission process using the requested communication mode (step **S152**).

Subsequently, each of the communication devices **100**A and **100**B performs the corresponding communication process according to the flowchart shown in FIG. **3** (steps **S153** and **S154**), and performs the exchange of content data. In addition, the communication device **100**A excludes the short-range wireless communication in advance from among the available communication modes exchanged in step **S102** of the flowchart shown in FIG. **3**.

Since the short-range wireless communication is excluded in advance from among the available communication modes exchanged in step **S102** of the flowchart shown in FIG. **3**, the communication via short-range wireless communication can be excluded from selectable candidates in the subsequent communications. In addition, by performing such a process, the communication devices **100**A and **100**B can dynamically exclude a communication mechanism, which has a high communication priority but is unstable. In addition, even when the case where the communication mechanism, which has been not available at the time of initiating the communication, becomes available depending on the change in the surrounding environments, a new communication mechanism can be incorporated into the communication strategic algorithm by performing the process described above.

Moreover, in the flowchart shown in FIG. **10**, the receiving-side communication device **100**B transmits a request for switching of communication mechanism, or alternatively the transmitting-side communication device **100**A may transmit a request for switching of communication mechanism.

Subsequently, when P2P communication is not enabled between the communication devices **100**A and **100**B, a method of exchanging content data between the communication devices **100**A and **100**B using a mediation server provided on a network will now be described.

In the switching process of communication mechanism shown in FIG. **8**, when the P2P communication has timed-out entirely, the source communication device **100**A changes the destination of content into a cloud or dedicated server on the network **10** according to the communication strategic algorithm which is shared in the flowchart shown in FIG. **3**. At this time, in order to reduce the time necessary to receive and transmit content, the source communication device **100**A may transmit preferentially content that have not yet transmitted.

The destination communication device **100**B may obtain the content that is uploaded by the communication device **100**A using the specified authentication mechanism (an ID or password). The content is uploaded into a cloud or dedicated server on the network **10** specified based on the communication strategic algorithm which is shared in the flowchart shown in FIG. **3**.

In addition, when there are no content in a cloud or dedicated server on the network **10** at the time of checking by the destination communication device **100**B, the communication

device **100**B performs a polling operation on a cloud or dedicated server on the network **10** for a certain period of time or at a certain number of times. The polling operation is performed based on information that is shared in the flowchart shown in FIG. **3**.

In this example, there may be considered the case where a cloud or a server on the network **10** does not take over the middle of transmission of content. In order to use effectively data received at the time of reception and transmission in P2P communication, when data is obtained from a cloud or a server on the network **10**, it is preferable to be able to exchange only data that has not yet transmitted. However, there may be also cases where a cloud or a server on the network **10** performs the uploading or downloading of the same content in parallel, or a cloud or a server on the network **10** has no function that downloads only a portion of data that is uploaded halfway.

When content information is exchanged between the communication devices **100**A and **100**B using the process shown in FIG. **3**, transmission division information and hash information are shared in advance between the communication devices **100**A and **100**B. In addition, the unit of transmission division may be optionally determined in accordance with communication environments. Thus, the exchange of content data between the communication devices **100**A and **100**B is performed in the units defined by the transmission division information.

The communication devices **100**A and **100**B, when exchanging data via a cloud or a server on the network **10**, regard the previously shared hash information as key information and specify a portion of content, thereby performing the reception or transmission. By regarding the previously shared hash information as key information, the communication devices **100**A and **100**B can realize the pseudo parallel execution of the uploading and downloading of content.

The procedure for switching of a communication method in the case where a recording medium which is used to share content between the communication devices **100**A and **100**B can be further connected to other devices will be described. FIG. **11** is a diagram for explaining an exemplary configuration of the communication system **1** according to the embodiment of the present disclosure. FIG. **11** illustrates a personal computer **200** in addition to the communication devices **100**A and **100**B. The personal computer **200** is configured to be connectable with a memory card **108** of the communication device **100**B.

The communication device **100**B stores the communication strategic algorithm and authentication information on the memory card **108**. The communication strategic algorithm and authentication information are obtained in advance from the communication device **100**A in the process shown in FIG. **3**. When the communication between the communication devices **100**A and **100**B is disconnected after the exchange of content data is initiated between the communication devices **100**A and **100**B, the memory card **108** stored with the communication strategic algorithm and authentication information is inserted into the personal computer **200**. Thus, communication between the communication device **100**A and the personal computer **200** can be resumed.

In this time, the communication device **100**B can store content data obtained from the communication device **100**A in the memory card **108**. Thus, the communication device **100**B can store the content data stored in the memory card **108** on the personal computer **200** when the communication between the communication device **100**A and the personal computer **200** into which the memory card **108** is inserted is resumed after the communication between the communication devices **100**A and **100**B is disconnected.

<2. Summary and Conclusion>

As described above, the communication device **100**A and the communication device **100**B that are included in the communication system **1** according to the embodiment of the present disclosure exchange information in advance between the communication device **100**A and the communication device **100**B before the communication device **100**A transmits content data to the communication device **100**B. The previously exchanged information is related to the communication between the communication devices **100**A and **100**B.

The information regarding communication between the communication devices **100**A and **100**B may be exchanged, for example, using short-range wireless communication between the communication devices **100**A and **100**B. The previous exchange of information between the communication device **100**A and the communication device **100**B makes it possible to prevent the authentication mechanism from being exchanged whenever switching is performed even if the communication mechanism is switched one after another, thereby allowing the user to be unaware of switching of communication mechanism and thereby being capable of exchanging data seamlessly.

Since the switching algorithm of communication mechanism is shared between the communication devices **100**A and **100**B at the time of initiating the communication between the communication devices **100**A and **100**B, the communication devices **100**A and **100**B can switch automatically a plurality of communication mechanisms without causing the user to become aware of the switching. In addition, since the switching algorithm of communication mechanism is shared between the communication devices **100**A and **100**B, the communication devices **100**A and **100**B can automatically switch a communication mechanism into a new one even when the communication for performing the switching of communication mechanism has not been performed.

Furthermore, when the communication mechanism between the communication devices **100**A and **100**B is switched, the communication devices **100**A and **100**B continue to receive and transmit data without re-transmitting data which has previously received and transmitted. Thus, it is possible to prevent unwanted traffic from occurring when a communication mechanism is switched, and a receiving-side can obtain the desired data immediately even when the communication is switched.

The process illustrated in the embodiment described above may be performed in hardware or software. When the process illustrated in each of the embodiments described above is performed in software, a controller such as a CPU incorporated in the communication device **100**A or the communication device **100**B may read out sequentially a computer program stored in a recording medium such as ROM, HDD, SSD, or the like, and may execute the program.

It should be understood by those skilled in the art that various modifications, combinations, sub-combinations and alterations may occur depending on design requirements and other factors insofar as they are within the scope of the appended claims or the equivalents thereof.

For example, in the above embodiments, information is exchanged between the communication devices **100**A and **100**B before content data is transferred using short-range wireless communication, but the communication mode which can be used in the exchange of information prior to the transfer of content data is not limited to the above embodiments. For example, information may be exchanged between

the communication devices **100**A and **100**B using the IrDA standard protocol instead of short-range wireless communication. In addition, for example, a two-dimensional barcode may be used in the exchange of information prior to transferring content data. When the communication device **100**A is provided with a camera, a two-dimensional barcode in which available communication modes are embedded is displayed on the display unit **102** of the communication device **100**B and the camera captures the two-dimensional barcode, thereby facilitating the exchange of information between the communication devices **100**A and **100**B.

Furthermore, for example, if the communication device **100**A is disconnected from the communication device **100**B when the communication device **100**A transmits content data to the communication device **100**B, the communication device **100**A may allow the display unit **102** to display available communication modes which are previously exchanged between the communication devices **100**A and **100**B. By allowing the display unit **102** to display available communication modes which are previously exchanged between the communication devices **100**A and **100**B, the user can determine which communication mode is used to transmit content data. Of course, the communication device **100**B that receives content data may cause the display unit **102** to display available communication modes.

Additionally, the present technology may also be configured as below.

(1) A communication device including:

a communication unit configured to include different communication modes; and

an information exchange unit configured to exchange, before the communication unit transmits information to a transmission destination device, an available communication mode and authentication information in advance with the transmission destination device using a communication mode included in the communication unit, the authentication information being used when communication is performed using the communication mode.

(2) The communication device according to (1), wherein, when the communication unit is disconnected from the transmission destination device in transmitting information to the transmission destination device, the communication unit selects a communication mode different from the available communication mode exchanged by the information exchange unit, authenticates the transmission destination device using the authentication information exchanged by the information exchange unit, and resumes transmission of information to the transmission destination device.

(3) The communication device according to (2), wherein the communication unit is configurable to set a timeout period for the available communication mode exchanged by the information exchange unit.

(4) The communication device according to (2) or (3), wherein, when the communication unit resumes transmission of information to the transmission destination device, the communication unit transmits, to the transmission destination device, information following the information that has been already transmitted.

(5) The communication device according to any one of (2) to (4), wherein, when selecting a different communication mode, the communication unit selects a communication mode based on a priority.

(6) The communication device according to (5), wherein, when selecting a different communication mode, the communication unit sets a timeout period to be longer as the priority becomes lower.

(7) The communication device according to any one of (1) to (6), further including:

an information presentation unit configure to present the available communication mode exchanged by the information exchange unit when the communication unit is disconnected from the transmission destination device in transmitting information to the transmission destination device.

(8) The communication device according to any one of (1) to (7), further including:

a storage unit for storing information related to the available communication mode exchanged by the information exchange unit.

(9) The communication device according to (1), wherein the information exchange unit exchanges the available communication mode and the authentication information with the transmission destination device using short-range wireless communication, the authentication information being used when communication is performed using the communication mode.

(10) A communication device including:

a communication unit configured to include different communication modes; and

an information exchange unit configured to exchange, before the communication unit receives information from a transmission source device, an available communication mode and authentication information in advance with the transmission source device using a communication mode included in the communication unit, the authentication information being used when communication is performed using the communication mode.

(11) A communication method including:

communicating using one communication mode of different communication modes; and

exchanging, before information is transmitted to a transmission destination device in the communicating step, an available communication mode and authentication information in advance with the transmission destination device using a communication mode of the different communication modes, the authentication information being used when communication is performed using the communication mode.

(12) A computer program for causing a computer to execute:

communicating using one communication mode of different communication modes; and

exchanging, before information is transmitted to a transmission destination device in the communicating step, an available communication mode and authentication information in advance with the transmission destination device using a communication mode of the different communication modes, the authentication information being used when communication is performed using the communication mode.

(13) A communication system including:

a transmitting device configured to transmit information; and

a receiving device configured to directly or indirectly receive the information transmitted by the transmitting device,

wherein the transmitting device includes

a communication unit configured to include different communication modes, and

an information exchange unit configured to exchange an available communication mode and authentication information in advance with the receiving device using a communication mode included in the communication unit before the communication unit transmits information to the receiving device, the authentication informa-

tion being used when communication is performed using the communication mode, and

wherein the receiving device includes

a communication unit configured to include different communication modes, and

an information exchange unit configured to exchange an available communication mode and authentication information in advance with the transmitting device using a communication mode included in the communication unit before the communication unit receives information from the transmitting device, the authentication information being used when communication is performed using the communication mode.

What is claimed is:

1. A communication between two devices comprising:

a first communication device configured to transmit information; and

a second communication device configured to directly or indirectly receive the information transmitted by the first communication device,

wherein the first communication device includes:

a first central processing unit (CPU) configured to:

control communication, with a second communication device, using a plurality of communication mechanisms available on the first communication device;

transmit, a first list of the plurality of communication mechanisms available on the first communication device and authentication information, which is to be used during the transmission of the information to the second communication device using the communication mechanism of the plurality of communication mechanism before transmitting the information to the second communication device,

receive a second list of another plurality of communication mechanisms from the transmission destination device, wherein the other plurality of communication mechanisms are selected, by the transmission destination device, from the transmitted first list of the plurality of communication mechanisms; and

transmit, the information using a first communication mechanism selected from the received second list of the other plurality of communication mechanisms,

wherein the second communication device includes:

a second central processing unit (CPU) configured to:

control communication, with the first communication device, using a plurality of communication mechanisms available on the second communication device,

receive the first list of the plurality of communication mechanisms, available on the first communication device, and the authentication information, which is to be used during the reception of the information, from the first communication device using a communication mechanism of the plurality of communication mechanism available on the second communication device before receiving the information from the first communication device,

select the other plurality of communication mechanisms from the received first list of the plurality of communication mechanisms,

transmit the second list of the other plurality of communication mechanisms to the first communication device, and

receive the information using the first communication mechanism, selected, by the first communication device, from the transmitted second list of the other plurality of communication mechanisms.

2. The communication devices according to claim 1, wherein,

when the first communication device is disconnected from the second communication device during the transmission of the information to the second communication device using the first communication mechanism, the CPU is configured to:

select a second communication mechanism from the received second list of the other plurality of communication mechanisms, wherein the second communication mechanism is different from the first communication mechanism,

authenticate the second device using the authentication information exchanged in advance, and

resume transmission of the information to the second communication device using the second communication mechanism.

3. The communication devices according to claim 2, wherein the CPU configured to:

set a timeout period for each of the other plurality of communication mechanisms.

4. The communication devices according to claim 2, wherein,

when the transmission of the information to the second communication device is resumed, the CPU is configured to transmit, to the second communication device, information following the information that has been already transmitted.

5. The communication devices according to claim 2, wherein,

the CPU is configured to select the second communication mechanism from the other plurality of communication mechanisms based on a priority.

6. The communication devices according to claim 5, wherein,

when selecting the second communication mechanism the CPU is configured to set a timeout period to be longer as the priority becomes lower.

7. The communication devices according to claim 1, wherein the CPU is configured to:

control display of the received second list of the other plurality of communication mechanisms available on the second communication device, when the first communication device is disconnected from the second communication device during transmission of the information to the second communication device.

8. The communication devices according to claim 1, wherein the CPU is configured to:

store information related to the plurality of communication mechanisms available on the communication devices.

9. The communication devices according to claim 1, wherein the CPU is configured to:

transmit the first list of the plurality of communication mechanisms and the authentication information with the second communication device using short-range wireless communication, the authentication information being used when the transmission of the information is performed using the first communication mechanism.

10. The communication devices according to claim 1, wherein the CPU is configured to:

exchange, before transmitting the information to the second communication device, a communication strategic algorithm with the transmission second communication, wherein the communication strategic algorithm is used to determine a method for selecting, from the second list of the other plurality of communication mechanisms

available on the second communication device, the first communication mechanism to be used for transmitting the information.

11. The communication device according to claim **10**, wherein, when the first communication device is disconnected from the second communication device during the transmission of the information using the first communication mechanism, the CPU is configured to select a second communication mechanism as next candidate for resuming the transmission based on the communication strategic algorithm, wherein the second communication mechanism is different from the first communication mechanism.

12. A non-transitory computer-readable storage medium having stored thereon a set of computer executable instructions which when executed by a computer causes the computer to control a communication between two devices to:

perform steps comprising:

a first communication device configured to transmit information; and

a second communication device configured to directly or indirectly receive the information transmitted by the first communication device,

a first central processing unit (CPU) configured to:

control communication, with a second communication device, using a plurality of communication mechanisms available on the first communication device;

transmitting, a first list of the plurality of communication mechanisms available on the first communication device and authentication information, which is to be used during the transmission of the information to the second communication device using the communication mechanism of the plurality of communication mechanism before transmitting the information to the second communication device,

receiving a second list of another plurality of communication mechanisms from the transmission destination device, wherein the other plurality of communication mechanisms are selected, by the transmission destination device, from the transmitted first list of the plurality of communication mechanisms; and

transmitting, the information using a first communication mechanism selected from the received second list of the other plurality of communication mechanisms,

wherein the second communication device includes:

a second central processing unit (CPU) configured to:

control communication, with the first communication device, using a plurality of communication mechanisms available on the second communication device,

receive the first list of the plurality of communication mechanisms, available on the first communication device, and the authentication information, which is to be used during the reception of the information, from the first communication device using a communication mechanism of the plurality of communication mechanism available on the second communication device before receiving the information from the first communication device,

select the other plurality of communication mechanisms from the received first list of the plurality of communication mechanisms,

transmit the second list of the other plurality of communication mechanisms to the first communication device, and

receive the information using the first communication mechanism, selected, by the first communication device, from the transmitted second list of the other plurality of communication mechanisms.

13. A communication system comprising:

a first communication device configured to transmit information; and

a second communication device configured to directly or indirectly receive the information transmitted by the first communication device,

wherein the first communication device includes:

a first central processing unit (CPU) configured to:

control communication, with the second communication device, using a plurality of communication mechanisms available on the first communication device,

transmit, a first list of the plurality of communication mechanisms available on the first communication device and authentication information, which is to be used during the transmission of information, to the second communication device using a communication mechanism of the plurality of communication mechanisms before transmitting the information to the second communication device,

receive a second list of another plurality of communication mechanisms from the second communication device, wherein the other plurality of communication mechanisms are selected, by the second communication device, from the transmitted first list of the plurality of communication mechanisms; and

transmit, the information using a first communication mechanism selected from the received second list of the other plurality of communication mechanisms,

wherein the second communication device includes:

a second central processing unit (CPU) configured to:

control communication, with the first communication device, using a plurality of communication mechanisms available on the second communication device,

receive the first list of the plurality of communication mechanisms, available on the first communication device, and the authentication information, which is to be used during the reception of the information, from the first communication device using a communication mechanism of the plurality of communication mechanism available on the second communication device before receiving the information from the first communication device,

select the other plurality of communication mechanisms from the received first list of the plurality of communication mechanisms,

transmit the second list of the other plurality of communication mechanisms to the first communication device, and

receive the information using the first communication mechanism, selected, by the first communication device, from the transmitted second list of the other plurality of communication mechanisms.

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