

DETECTION OF FILE LOSS IN A ONE-WAY FILE TRANSFER
SYSTEM

Technical Field

[0001] The present disclosure relates to a one-way file transfer system. More particularly, the present disclosure relates to detection of file loss in the one-way file transfer system.

Background

[0002] One-way file transfer systems are commonly used to mitigate the security risks of connecting two different networks. In one implementation, data diodes are used to enforce the one-way transfer at the physical layer. Allowing transfer of files in only one direction provides network security to the networks by isolating the networks from potential security breaches (for example, undesired and unauthorized data flowing out of the networks) while still allowing them to transfer files in a controlled fashion. Typically, files to be transferred are sent from a data diode sender in a sender network to a data diode receiver in a receiver network. File loss scenarios may occur during the transfer of files. For example, file loss may occur when the data diode receiver is unable to keep up with the files arriving from the data diode sender.

[0003] As there is no feedback loop in the one-way file transfer systems, the data diode sender is unaware of the file loss. Thus, users of the one-way file transfer systems would not be aware of the file loss, if any, unless it is physically verified that all the files have been successfully received at the data diode

receiver. Most of the known solutions addressing the problem of file loss includes a feedback mechanism to inform the data diode sender or some other component in the sender network about the file loss. Further, corrective actions such as initiating retransmission of files that were lost also use the feedback mechanism. An example of a file loss detection and repair using a feedback mechanism is disclosed in U.S. Patent 9,264,470.

[0004] Hence, there is a need for a one-way file transfer system that is designed to perform detection of file loss in a quick and easy manner.

Summary

[0005] In an aspect of the present invention, a system for unidirectional transfer of files between a sender network and a receiver network is provided. The system includes a data diode configured to provide a one-way link between the sender network and the receiver network.

[0006] The data diode includes a data diode sender and a data diode receiver. The data diode receiver is communicably coupled to the data diode sender for unidirectional transfer of files from the data diode sender to the data diode receiver. Each file is identified using a file identifier such as a file name or a file number.

[0007] The data diode sender is further configured to send a file list to the data diode receiver. The file list includes file identifiers of all the files to be sent through the data diode. The data diode receiver is configured to detect a loss of one or more files based on comparing the file identifiers of received files with the file identifiers present in the file list.

[0008] In an aspect of the present invention, the data diode sender is configured to repeatedly send the file list to the data diode receiver. For example, the data diode sender may send the file list a predetermined number of times. Alternatively, the data diode sender may periodically send the file list to the data diode receiver.

[0009] In an aspect of the present invention, upon detecting the loss of the one or more files, the data diode receiver is configured to generate a log containing the file identifiers of the one or more files that are lost.

[0010] In a further aspect of this invention, upon detecting the loss of the one or more files, the data diode receiver is configured to generate an alert message indicating the loss of the one or more files. The alert message includes the file identifiers of the one or more files that are lost during the transfer of files from the data diode sender to the data diode receiver. The alert message is communicated using Simple Mail Transfer Protocol (SMTP) or Syslog to a user device or a monitoring unit communicably coupled to the data diode.

[0011] In another aspect of this invention, the alert message is used to trigger retransmission of the one or more files that are lost during the transfer of files from the data diode sender to the data diode receiver. The retransmission of the one or more files is triggered using the file identifiers of the one or more files.

[0012] Other features and aspects of this invention will be apparent from the following description and the accompanying drawings.

Brief Description of the Drawings

[0013] **FIG. 1** is a schematic view of a one-way file transfer system for unidirectional transfer of data from a sender network to a receiver network, in accordance with embodiments of the present invention;

[0014] **FIG. 2** is a schematic representation of components of the one-way file transfer system, in accordance with an embodiment of the present invention;

[0015] **FIG. 3** is an example of a file list sent from a data diode sender, in accordance with an embodiment of the present invention; and

[0016] **FIG. 4** is an exemplary flowchart of a method for unidirectional transfer of files from the sender network to the receiver network, in accordance with an embodiment of the present invention;

Detailed Description

[0017] Wherever possible, the same reference numbers will be used throughout the drawings to refer to same or like parts. Moreover, references to various elements described herein are made collectively or individually when there may be more than one element of the same type. However, such references are merely exemplary in nature. It may be noted that any reference to elements in the singular may also be construed to relate to the plural and *vice-versa* without limiting the scope of the invention to the exact number or type of such elements unless set forth explicitly in the appended claims.

[0018] **FIG. 1** schematically illustrates an example of a one-way file transfer system **100** including a data diode **102**, according to one embodiment of

the present invention. It provides communications between a sender network **104** and a receiver network **106**, for example, although additional networks are contemplated. The sender network **104** may include one or more network traffic sources **108**. The receiver network **106** may include one or more network traffic destinations **110**. The data diode **102** is configured to allow transfer of files between the sender network **104** and the receiver network **106** in a unidirectional fashion. Specifically, the data diode **102** is configured to allow transfer of files from the sender network **104** to the receiver network **106** and prohibit transfer of files from the receiver network **106** to the sender network **104**. Thus, the data diode **102** acts as a transparent router allowing unidirectional transfer of files without modifying the data passing through it. Although the data diode **102** is shown in **FIG. 1** as external to the sender network **104** and the receiver network **106**, one or more components of the data diode **102** may be disposed in the sender network **104** and/or the receiver network **106**.

[0019] In one embodiment, files may include various types of content, such as documents, images, web pages, graphics, video, sound, programs, and/or other formats. Although the invention has been explained using files, the invention is equally applicable to other types of digital information or digital data known in the art.

[0020] **FIG. 2** schematically illustrates example components of the one-way file transfer system **100** in accordance with one embodiment of the present invention. The data diode **102** includes a data diode sender **202** and a data diode receiver **204**. The data diode sender **202** is connected to the data diode receiver **204** by a one-way optical data link. This configuration physically enforces one-

way data transfer at both ends of the optical fiber connecting the data diode sender **202** to the data diode receiver **204**, thereby creating a truly unidirectional one-way data link from the sender network **104** to the receiver network **106**.

[0021] The data diode sender **202** is configured to send a plurality of files to the data diode receiver **204**. In certain scenarios, there may be a loss of some files during the transfer from the data diode sender **202** to the data diode receiver **204**. For example, the data diode receiver **204** may not be able to keep up with the inflow of files from the data diode sender **202**. To address such scenarios, the data diode sender **202** is configured to send a file list comprising information about all the files to be sent through the data diode **102**. The file list may include one or more file identifiers such as a file name, a file ID, a timestamp, and the like. **FIG. 3** illustrates an example of a file list **302** comprising information of 50 files that are to be transmitted through the data diode **102**. The file list **302** comprises file names and file numbers as the file identifiers.

[0022] In one embodiment, the data diode sender **202** is configured to compile a file list of files upon each file sent from the data diode sender **202**. The compilation of the file list contain history of all the files sent from the data diode sender **202** or a compilation of files sent over a period.

[0023] In some cases, the file list may be lost in transit between the data diode sender **202** and the data diode receiver **204**. To address such concerns, the data diode sender **202** may be configured to repeatedly send the file list to the data diode receiver **204**. In one embodiment, the data diode sender **202** is configured to send the file list a predetermined number of times. In another

embodiment, the data diode sender **202** is configured to periodically send the file list to the data diode receiver **204**.

[0024] The data diode receiver **204** is configured to receive the files sent by the data diode sender **202**. The data diode receiver **204** may be configured to extract file identifiers of the received files. The data diode receiver **204** is also configured to receive the file list comprising file identifiers of all the files that are to be transferred through the data diode **102**. After the transfer of files is complete, the data diode receiver **204** is configured to detect whether there is a loss of one or more files or not. Specifically, the data diode receiver **204** is configured to use the received file list to compare file identifiers of the received files with the file identifiers present in the file list.

[0025] In case some files are lost during the transfer between the data diode sender **202** and the data diode receiver **204**, the data diode receiver **204** would be able to identify the lost files on the basis of comparison of file identifiers. In other words, the lost files may be identified as the files whose file identifiers are present in the file list but are not received at the data diode receiver **204**.

[0026] In one embodiment, the data diode receiver **204** is configured to generate a log containing the information on the loss of the one or more files. The log may include file identifiers of the files which are not received at the data diode receiver **204** but are listed in the file list. Optionally, the log may include time and date information along with the information related to lost files.

[0027] In various embodiments, the data diode receiver **204** is configured to generate an alert message indicating the loss of the one or more files. The alert

message may be an email, a text message, or any other alert message known in the art. The alert message may comprise the file identifiers of the one or more files that are lost during the transfer of files from the data diode sender **202** to the data diode receiver **204**. The alert message may be communicated to a user device or a remote monitoring unit communicably coupled to the data diode **102**. The alert message may be communicated using Simple Mail Transfer Protocol (SMTP) or Syslog, or other alerting protocols known in the art.

[0028] The alert message may be used to trigger retransmission of the one or more files that are lost during the transfer of files from the data diode sender **202** to the data diode receiver **204**. The retransmission of the lost files may be triggered using the file identifiers of the lost files.

[0029] Various embodiments disclosed herein are to be taken in the illustrative and explanatory sense, and should in no way be construed as limiting of the present invention. Additionally, all numerical terms, such as, but not limited to, “primary”, “secondary”, “first”, “second”, “third” or any other ordinary and/or numerical terms, should also be taken only as identifiers, to assist the reader’s understanding of the various elements, embodiments, variations and/or modifications of the present invention, and may not create any limitations, particularly as to the order, or preference, of any element, embodiment, variation and/or modification relative to, or over, another element, embodiment, variation and/or modification.

[0030] It is to be understood that individual features shown or described for one embodiment may be combined with individual features shown or described for another embodiment. The above described implementation does

not in any way limit the scope of the present invention. Therefore, it is to be understood although some features are shown or described to illustrate the use of the present invention in the context of functional components, such features may be omitted from the scope of the present invention without departing from the spirit of the present invention as defined in the appended claims.

Industrial Applicability

[0031] Embodiments of the present invention have applicability for use and implementation in detecting file loss in the one-way file transfer system **100**. The data diode **102** of the present invention is provided with the file list which can be advantageously used to detect loss of files during the transfer of files from the data diode sender **202** to the data diode receiver **204**. Moreover, with use of the embodiments disclosed herein, it would be easy and quick to detect file loss and further identify files for retransmission in comparison to traditional solutions of detecting file loss in one-way file transfer systems.

[0032] **FIG. 4** illustrates a method **400** to detect a loss of one or more files during unidirectional transfer of files from the sender network **104** to the receiver network **106**. At step **402**, the file list is received by the data diode receiver **204**. The file list includes file identifiers of all the files to be sent through the data diode **102**. At step **404**, the files sent by the data diode sender **202** are received by the data diode receiver **204**. The data diode receiver **204** is configured to extract file identifiers of all the files received by the data diode receiver **204**.

[0033] At step 406, the data diode receiver 204 is configured to detect the loss of one or more files during the transfer of files from the data diode sender 202 to the data diode receiver 204. The detection is performed based on comparing the file identifiers of received files with the file identifiers present in the file list. Hence, use of the one-way file transfer system 100 disclosed herein may save time, costs, and effort that were typically incurred with manual detection of file loss or with the use of other file loss detection techniques that are conventionally known in the art.

[0034] While aspects of the present invention have been particularly shown and described with reference to the embodiments above, it will be understood by those skilled in the art that various additional embodiments may be contemplated by the modification of the disclosed machines, systems and methods without departing from the spirit and scope of what is disclosed. Such embodiments should be understood to fall within the scope of the present invention as determined based upon the claims and any equivalents thereof.

Claims

What is claimed is:

1. A unidirectional data network system for unidirectional transfer of files from a sender network to a receiver network, the system comprising:
 - a data diode configured to provide a one-way link between the sender network and the receiver network so as to unidirectionally transfer files from the sender network to the receiver network, the data diode comprising:
 - a data diode sender; and
 - a data diode receiver, wherein the data diode receiver is communicably coupled to the data diode sender for unidirectional transfer of files from the data diode sender to the data diode receiver, wherein each file is identified using a file identifier;
 - wherein the data diode sender is configured to send a file list to the data diode receiver, the file list comprising file identifiers of all the files to be sent through the data diode and the data diode receiver is configured to detect a loss of one or more files based on comparing the file identifiers of received files with the file identifiers present in the file list, the data diode sender is further configured to send the file list a predetermined number of times to the data diode receiver.
2. The system of claim 1, wherein the data diode sender is configured to periodically send the file list to the data diode receiver.

3. The system of claim 1, wherein the file identifier is at least one of a file name and a file number.
4. The system of claim 1, wherein the data diode receiver, upon detecting the loss of the one or more files, is further configured to generate a log containing the file identifiers of the one or more lost files.
5. The system of claim 1, wherein the data diode receiver, upon detecting the loss of the one or more files, is further configured to generate an alert message indicating the loss of the one or more files.
6. The system of claim 5, wherein the alert message comprises the file identifiers of the one or more files that are lost during the transfer of files from the data diode sender to the data diode receiver.
7. The system of claim 5, wherein the alert message is communicated using Simple Mail Transfer Protocol (SMTP) or Syslog to a user device or a monitoring unit communicably coupled to the data diode.
8. The system of claim 5, wherein the alert message is used to trigger retransmission of the one or more files that are lost during the transfer of files from the data diode sender to the data diode receiver.
9. The system of claim 8, wherein the retransmission of the one or more lost files is triggered using the file identifiers of the one or more lost files.

10. A method for unidirectional transfer of files from a sender network to a receiver network using a data diode comprising a data diode sender and a data diode receiver, the method comprising:
 - receiving, by the data diode receiver, a file list comprising file identifiers of all the files to be sent through the data diode;
 - receiving, by the data diode receiver, the files from the data diode sender over a one-way link; and
 - detecting, by the data diode receiver, a loss of one or more files based on comparing the file identifiers of received files with the file identifiers present in the file list,
 - wherein receiving the file list comprises receiving the file list a predetermined number of times.
11. The method of claim 10, wherein receiving the file list comprises periodically receiving the file list.
12. The method of claim 10, wherein the file identifier is at least one of a file name and file number.
13. The method of claim 10 further comprising generating a log containing the file identifiers of the one or more lost files upon detecting the loss of the one or more files.

14. The method of claim 10 further comprising generating an alert message indicating the loss of the one or more files upon detecting the loss of the one or more files.
15. The method of claim 14, wherein the alert message comprises the file identifiers of the one or more files that are lost during the transfer of files from the data diode sender to the data diode receiver.
16. The method of claim 14, wherein the alert message is communicated using Simple Mail Transfer Protocol (SMTP) or Syslog to a user device or a monitoring unit communicably coupled to the data diode.
17. The method of claim 14, wherein the alert message is used to trigger retransmission of the one or more files that are lost during the transfer of files from the data diode sender to the data diode receiver.
18. The method of claim 17, wherein the retransmission of the one or more lost files is triggered using the file identifiers of the one or more lost files.