US009489659B1

(12) United States Patent
Liu et al.

(10) Patent No.: US 9,489,659 B1
(45) Date of Patent: Nov. 8, 2016

(54) **PROGRESSIVE SHARING DURING A COLLABORATION SESSION**

(75) Inventors: **Guangbing Liu**, Sunnyvale, CA (US); **Hailei Sheng**, San Jose, CA (US); **Qing Wang**, San Jose, CA (US); **Jianzhong Ding**, San Jose, CA (US)

(73) Assignee: **Cisco Technology, Inc.**, San Jose, CA (US)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 372 days.

(21) Appl. No.: **13/437,068**

(22) Filed: **Apr. 2, 2012**

(51) **Int. Cl.**
***G06Q 10/10*** (2012.01)
*H04L 12/58* (2006.01)

(52) **U.S. Cl.**
CPC ............. ***G06Q 10/10*** (2013.01); *H04L 12/581* (2013.01)

(58) **Field of Classification Search**
CPC .. H04N 19/142; H04N 19/137; H04N 5/147; H04N 19/87; H04N 21/44012
USPC .......................................................... 709/204
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,118,817 A * 9/2000 Wang .................. H04N 19/147 375/240.03
6,816,616 B2 11/2004 Teng
7,031,342 B2 4/2006 Teng
7,933,955 B2 * 4/2011 Khalatian ............... G06F 3/038 709/203
7,945,621 B2 5/2011 Yuan et al.
8,195,009 B2 * 6/2012 Hanamoto et al. ........... 382/298
2002/0176025 A1 * 11/2002 Kim ........................ H03M 7/30 348/699
2005/0089232 A1 * 4/2005 Hsu et al. ..................... 382/236
2007/0036442 A1 * 2/2007 Stoffer et al. ................. 382/232
2010/0104021 A1 * 4/2010 Schmit ..................... 375/240.24
2010/0306413 A1 * 12/2010 Kamay ................ H04N 19/503 709/247
2011/0141133 A1 * 6/2011 Sankuratri ............ G06F 3/1454 345/600
2012/0219052 A1 * 8/2012 Wakuda ............... H04N 19/172 375/240.01
2012/0287987 A1 * 11/2012 Budagavi ............ H04N 19/105 375/240.02
2013/0060886 A1 * 3/2013 Wynn et al. .................. 709/217

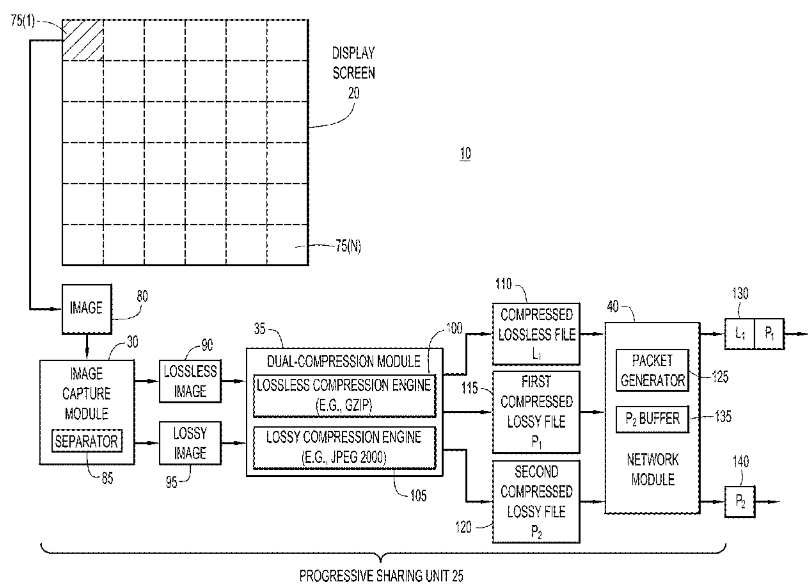
* cited by examiner

*Primary Examiner* — Vivek Srivastava
*Assistant Examiner* — Muhammad Raza
(74) *Attorney, Agent, or Firm* — Edell, Shapiro & Finnan, LLC

(57) **ABSTRACT**

In accordance with one example, a presenter device is configured to participate in a collaboration session with one or more attendee devices. A change in an image displayed at a screen of the presenter device is detected and captured to produce a captured image. The captured image is compressed to form a compressed lossless file and first and second compressed lossy files. The compressed lossless file and the first compressed lossy file are transmitted to the one or more attendee devices, and a determination is made as to whether a further change to the image displayed at the screen occurs within a predetermined period of time. The compressed lossy file is transmitted to the one or more attendee devices when no further change to the image displayed at the screen occurs within the predetermined period of time.

**13 Claims, 5 Drawing Sheets**



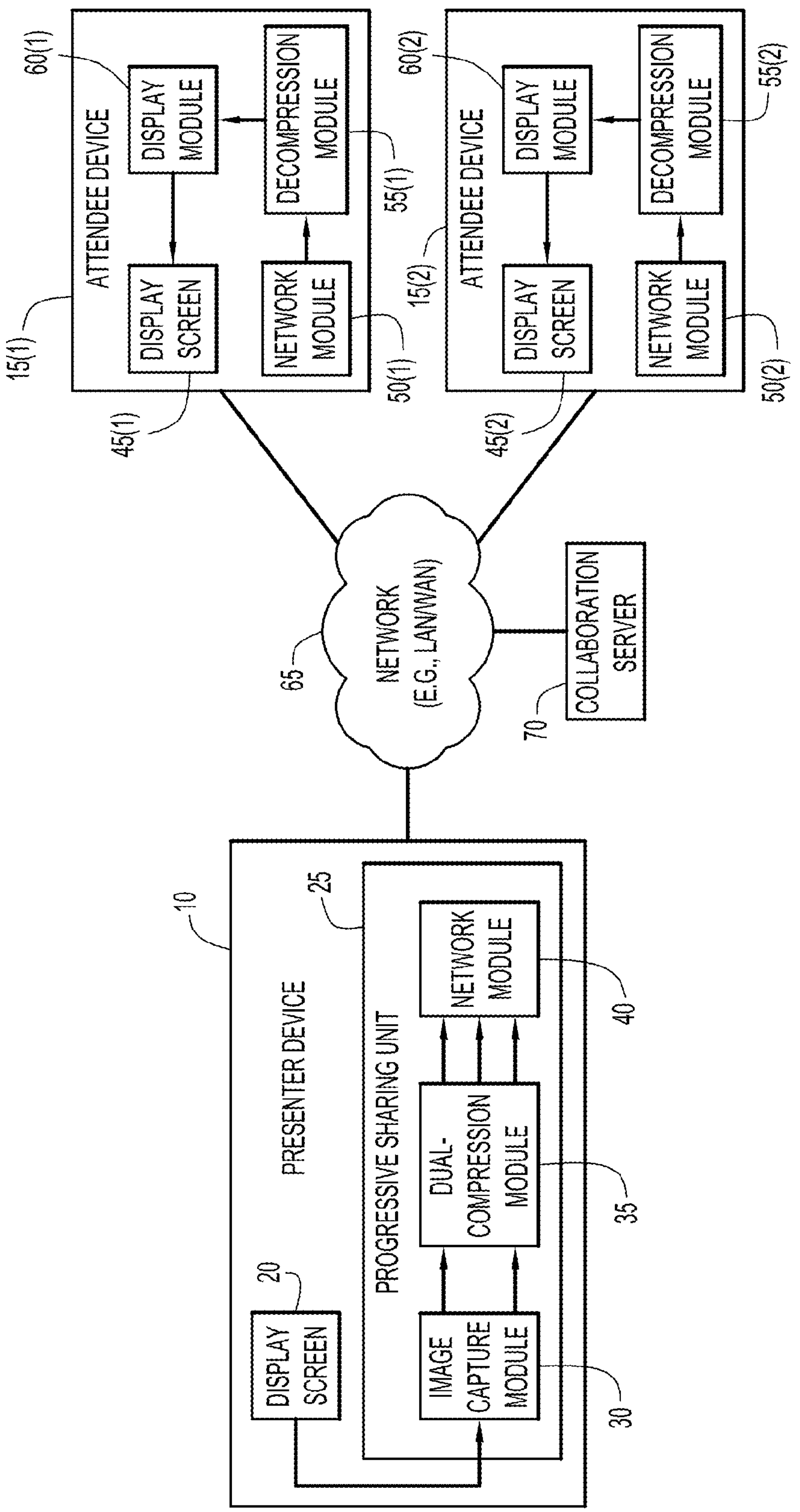

ATTENDEE DEVICE
DISPLAY MODULE
DECOMPRESSION MODULE
DISPLAY SCREEN
NETWORK MODULE
60(1)
55(1)
15(1)
45(1)
50(1)
ATTENDEE DEVICE
DISPLAY MODULE
DECOMPRESSION MODULE
DISPLAY SCREEN
NETWORK MODULE
60(2)
55(2)
15(2)
45(2)
50(2)
NETWORK (E.G., LAN/WAN)
65
COLLABORATION SERVER
70
PRESENTER DEVICE
10
PROGRESSIVE SHARING UNIT
25
DISPLAY SCREEN
20
IMAGE CAPTURE MODULE
30
DUAL-COMPRESSION MODULE
35
NETWORK MODULE
40

FIG.1

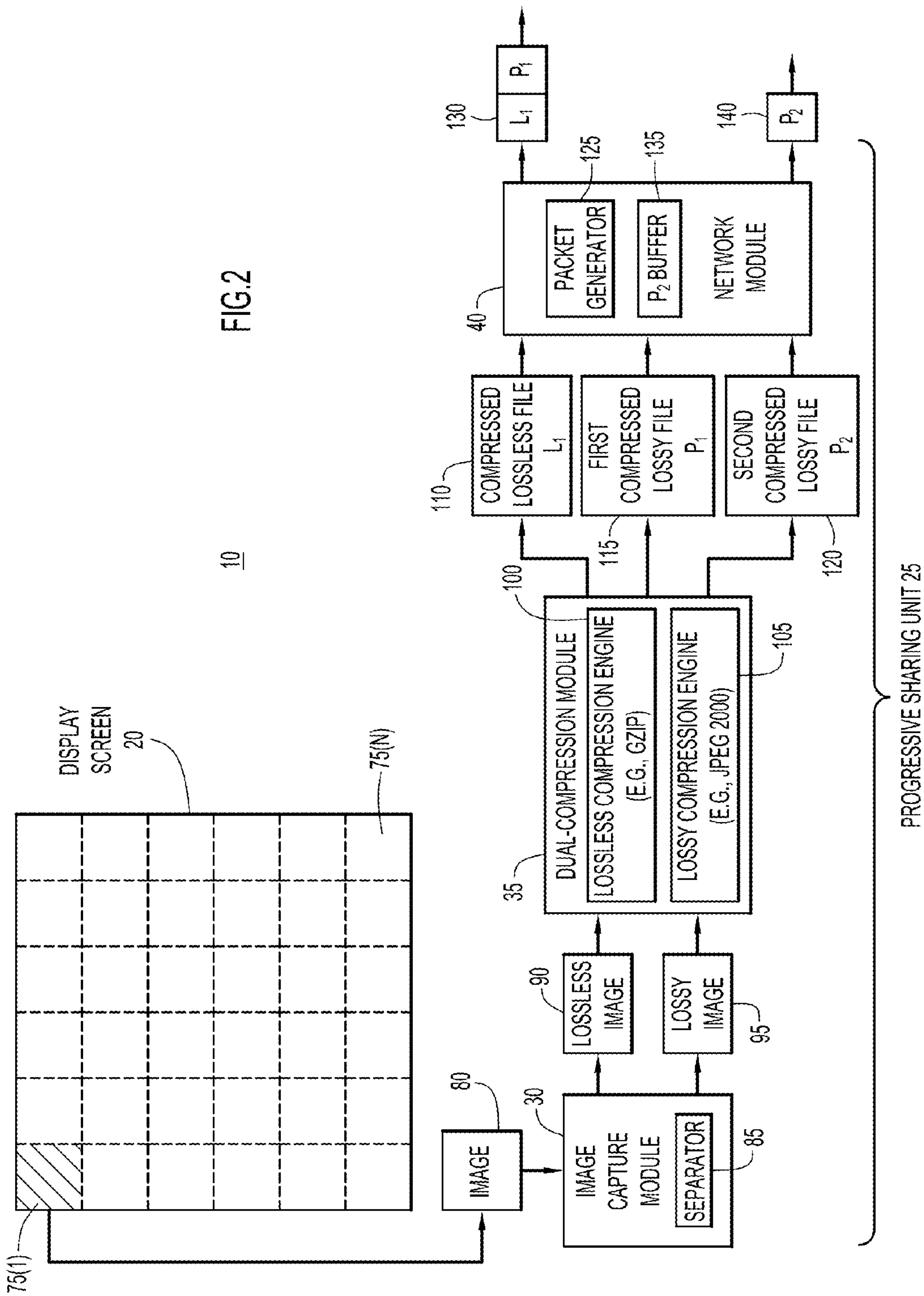

10
DISPLAY SCREEN
20
75(N)
75(1)
IMAGE
80
IMAGE CAPTURE MODULE
30
SEPARATOR
85
LOSSLESS IMAGE
90
LOSSY IMAGE
95
DUAL-COMPRESSION MODULE
35
LOSSLESS COMPRESSION ENGINE (E.G., GZIP)
100
LOSSY COMPRESSION ENGINE (E.G., JPEG 2000)
105
COMPRESSED LOSSLESS FILE L1
110
FIRST COMPRESSED LOSSY FILE P1
115
SECOND COMPRESSED LOSSY FILE P2
120
PACKET GENERATOR
125
P2 BUFFER
135
NETWORK MODULE
40
L1
P1
130
P2
140
PROGRESSIVE SHARING UNIT 25

FIG.2

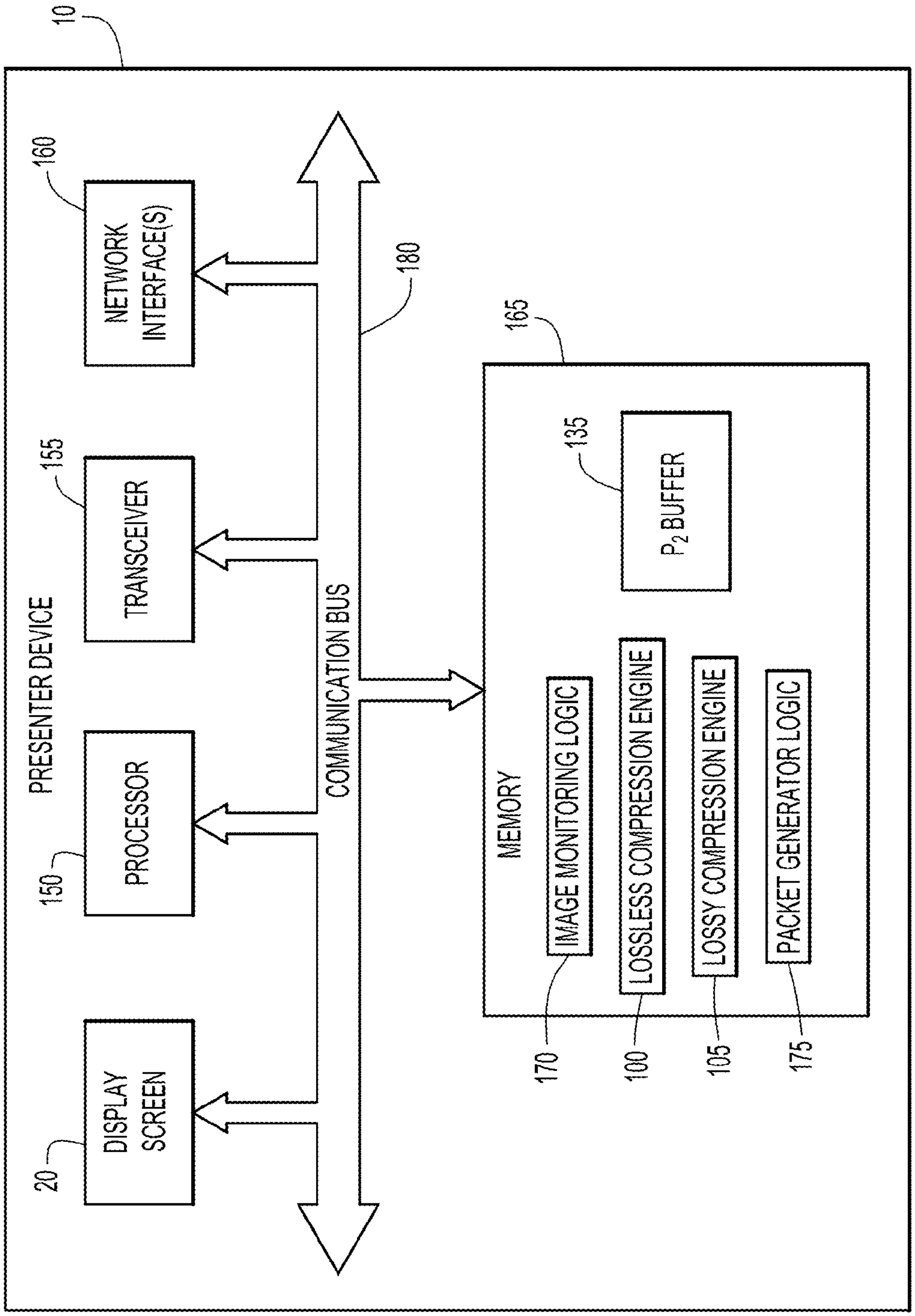

10
PRESENTER DEVICE
NETWORK INTERFACE(S)
160
TRANSCEIVER
155
PROCESSOR
150
DISPLAY SCREEN
20
COMMUNICATION BUS
180
MEMORY
165
$P_2$ BUFFER
135
IMAGE MONITORING LOGIC
170
LOSSLESS COMPRESSION ENGINE
100
LOSSY COMPRESSION ENGINE
105
PACKET GENERATOR LOGIC
175

FIG.3

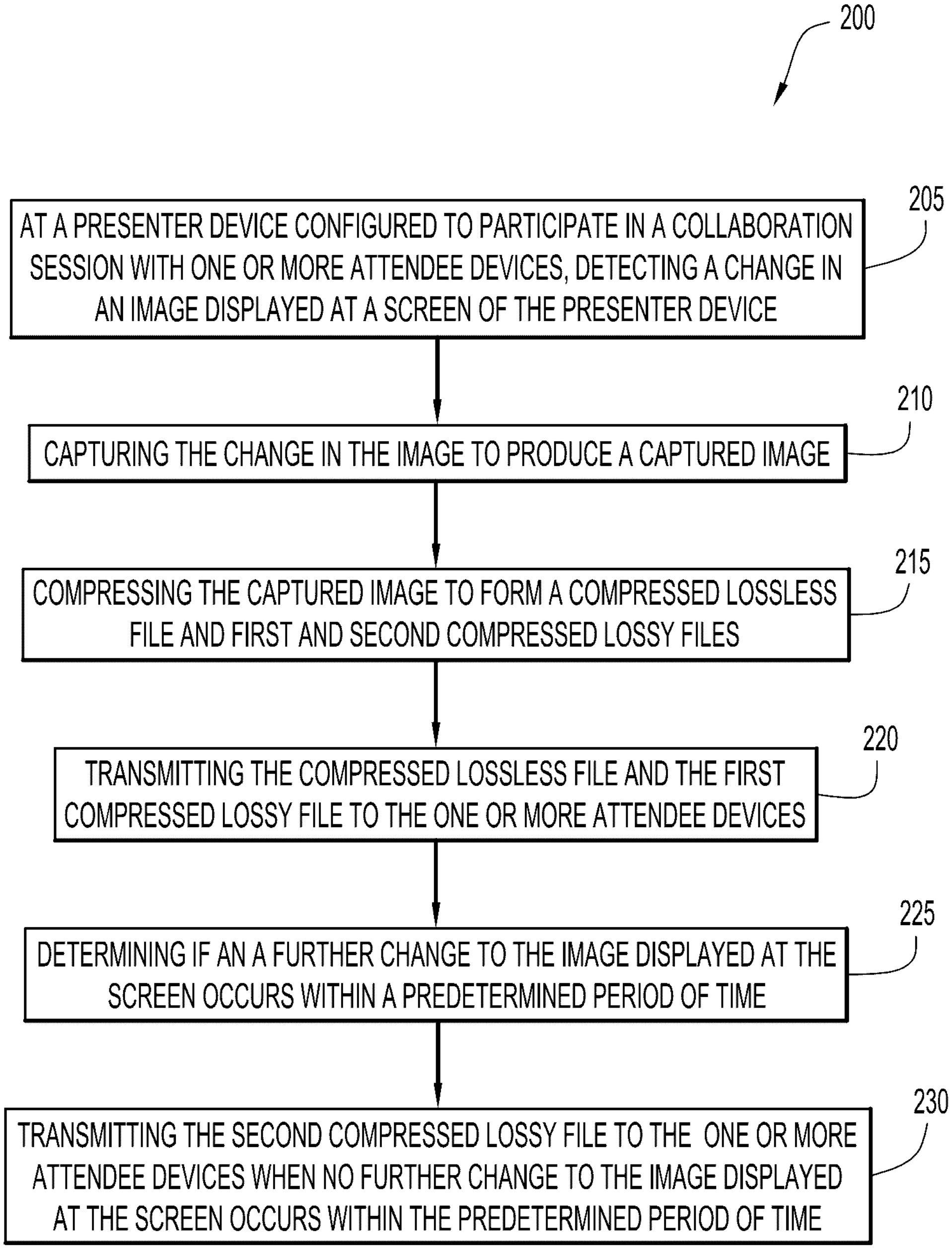

200
AT A PRESENTER DEVICE CONFIGURED TO PARTICIPATE IN A COLLABORATION SESSION WITH ONE OR MORE ATTENDEE DEVICES, DETECTING A CHANGE IN AN IMAGE DISPLAYED AT A SCREEN OF THE PRESENTER DEVICE
205
CAPTURING THE CHANGE IN THE IMAGE TO PRODUCE A CAPTURED IMAGE
210
COMPRESSING THE CAPTURED IMAGE TO FORM A COMPRESSED LOSSLESS FILE AND FIRST AND SECOND COMPRESSED LOSSY FILES
215
TRANSMITTING THE COMPRESSED LOSSLESS FILE AND THE FIRST COMPRESSED LOSSY FILE TO THE ONE OR MORE ATTENDEE DEVICES
220
DETERMINING IF AN A FURTHER CHANGE TO THE IMAGE DISPLAYED AT THE SCREEN OCCURS WITHIN A PREDETERMINED PERIOD OF TIME
225
TRANSMITTING THE SECOND COMPRESSED LOSSY FILE TO THE ONE OR MORE ATTENDEE DEVICES WHEN NO FURTHER CHANGE TO THE IMAGE DISPLAYED AT THE SCREEN OCCURS WITHIN THE PREDETERMINED PERIOD OF TIME
230

FIG.4

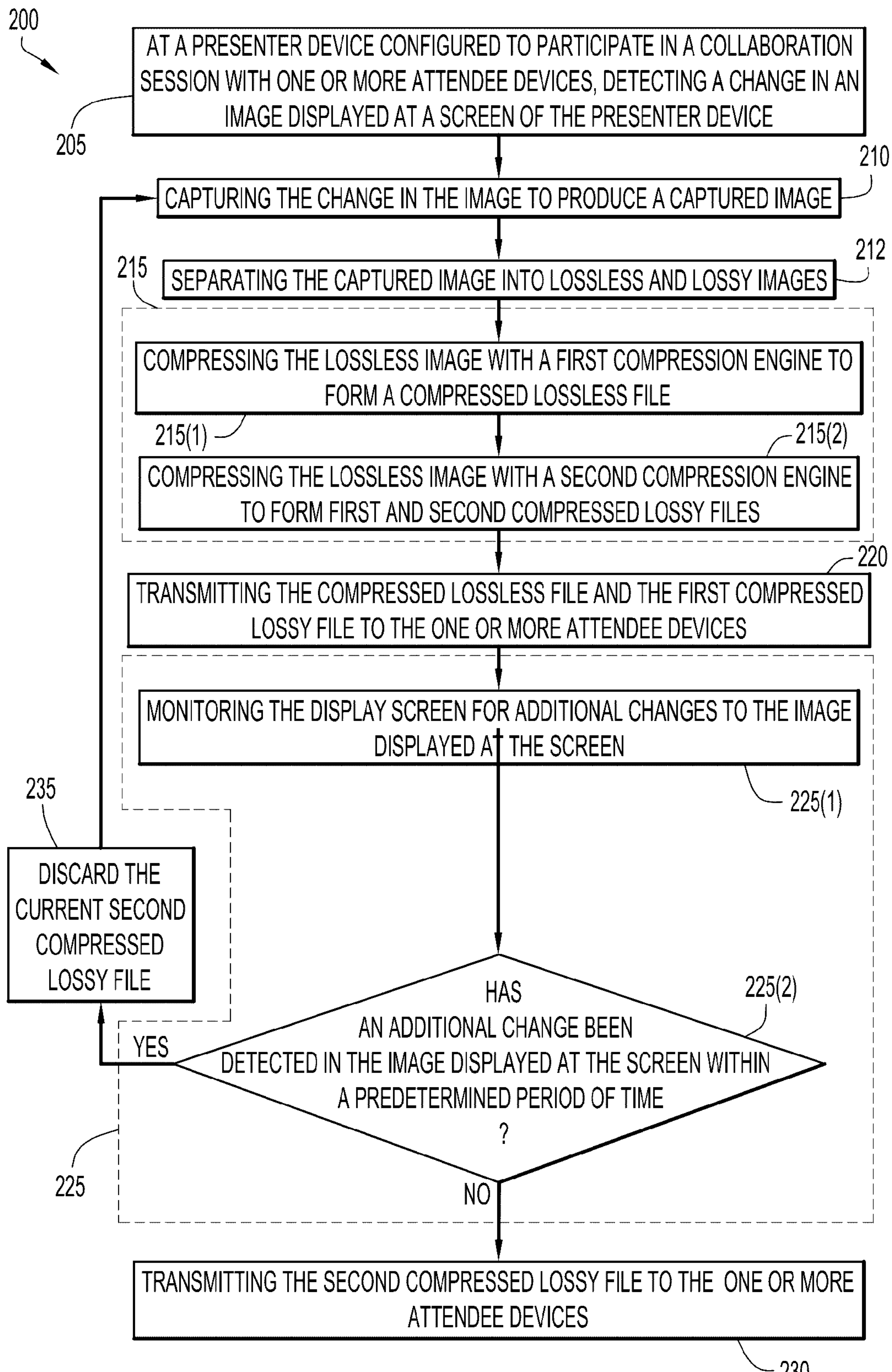

200
AT A PRESENTER DEVICE CONFIGURED TO PARTICIPATE IN A COLLABORATION SESSION WITH ONE OR MORE ATTENDEE DEVICES, DETECTING A CHANGE IN AN IMAGE DISPLAYED AT A SCREEN OF THE PRESENTER DEVICE
205
CAPTURING THE CHANGE IN THE IMAGE TO PRODUCE A CAPTURED IMAGE
210
SEPARATING THE CAPTURED IMAGE INTO LOSSLESS AND LOSSY IMAGES
212
215
COMPRESSING THE LOSSLESS IMAGE WITH A FIRST COMPRESSION ENGINE TO FORM A COMPRESSED LOSSLESS FILE
215(1)
215(2)
COMPRESSING THE LOSSLESS IMAGE WITH A SECOND COMPRESSION ENGINE TO FORM FIRST AND SECOND COMPRESSED LOSSY FILES
220
TRANSMITTING THE COMPRESSED LOSSLESS FILE AND THE FIRST COMPRESSED LOSSY FILE TO THE ONE OR MORE ATTENDEE DEVICES
MONITORING THE DISPLAY SCREEN FOR ADDITIONAL CHANGES TO THE IMAGE DISPLAYED AT THE SCREEN
225(1)
235
DISCARD THE CURRENT SECOND COMPRESSED LOSSY FILE
HAS AN ADDITIONAL CHANGE BEEN DETECTED IN THE IMAGE DISPLAYED AT THE SCREEN WITHIN A PREDETERMINED PERIOD OF TIME ?
225(2)
YES
NO
225
TRANSMITTING THE SECOND COMPRESSED LOSSY FILE TO THE ONE OR MORE ATTENDEE DEVICES
230

FIG.5

# PROGRESSIVE SHARING DURING A COLLABORATION SESSION

## TECHNICAL FIELD

The present disclosure relates generally to sharing content during a collaboration session.

## BACKGROUND

There has been an increase in the use of collaboration sessions that enable real-time sharing of content such as audio, graphical, and/or textual data between multiple participants (e.g., employees, vendors, clients, etc.) located at physically separate locations. These collaboration sessions are generally conducted over a wired or wireless computer network (e.g., local area network (LAN), wide area network (WAN), etc.).

The content shared during a collaboration session is typically sent over the network as discrete packets. These packets will generally include a header (routing information) and a payload (the shared content). To improve transmission efficiency, the shared content may be compressed before it is packetized so that more data may be transmitted within a given network bandwidth. Generally, the shared content is compressed at a source node, transmitted in the compressed state in the packets over the network, and decompressed at a destination node.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is block diagram of a presenter device configured to progressively share images of its display screen with a plurality of attendee devices during a collaboration session.

FIG. **2** is a block diagram of the presenter device configured to execute progressive sharing techniques.

FIG. **3** is a block diagram illustrating one example software configuration of a progressive sharing unit.

FIG. **4** is a high-level flowchart of a progressive sharing method in accordance with examples described herein.

FIG. **5** is a detailed flowchart illustrating further details of the example progressive sharing method of FIG. **4**.

## DESCRIPTION OF EXAMPLE EMBODIMENTS

### Overview

Devices, methods and instructions encoded on computer readable media are provided herein for execution of progressive sharing techniques during a collaboration session. In one example, a presenter device is configured to participate in a collaboration session with one or more attendee devices. A change in an image displayed at a screen of the presenter device is detected and captured at the presenter device to produce a captured image. The captured image is compressed to form a compressed lossless file and first and second compressed lossy files. The compressed lossless file and the first compressed lossy file are transmitted to the one or more attendee devices, and a determination is made as to whether a further change to the image displayed at the screen occurs within a predetermined period of time. The compressed lossy file is transmitted to the one or more attendee devices when no further change to the image displayed at the screen occurs within the predetermined period of time.

### Example Embodiments

FIG. **1** is a block diagram of a presenter device **10** configured to participate in a collaboration session, sometimes referred to as a desktop sharing session, with two attendee devices **15**(**1**) and **15**(**2**). Presenter device **10** comprises a display screen **20** and a progressive sharing unit **25**. Progressive sharing unit **25** comprises an image capture module **30**, a dual-compression module **35**, and a network module **40**. Attendee devices **15**(**1**) and **15**(**2**) each comprise a display screen **45**(**1**) and **45**(**2**), respectively, a network module **50**(**1**) and **50**(**2**), respectively, a decompression module **55**(**1**) and **55**(**2**), respectively, and a display module **60**(**1**), and **60**(**2**), respectively.

The collaboration session between presenter device **10** and attendee devices **15**(**1**) and **15**(**2**) occurs via a network **65**, and is facilitated by a collaboration server **70**. Network **65** may be, for example, a local area network (LAN) or a wide area network (WAN).

As used herein, a presenter device is a device configured to participate in a collaboration session in order to share content (i.e., audio, graphical, textual data, etc.) with other participants in the collaboration session. Attendee devices are devices configured to participate in the collaboration session in order to receive the content shared by the presenter device. Presenter device **10** and attendee devices **15**(**1**) and **15**(**2**) may be the same or different types of computing devices such as desktop computers, laptop computers, tablet computers, mobile phones, personal digital assistants (PDAs), etc.

The collaboration server **70** is configured to perform the set-up of a collaboration session, including access control, and to forward data traffic between the participating devices during the session. That is, collaboration server **70** is configured to "host" the collaboration session by maintaining a website, application, etc., through which content may be shared. In general, the presenter device **10** executes collaboration software that allows the presenter device to connect to collaboration server **70** and to establish the online collaboration session. Similarly, attendee devices **15**(**1**) and **15**(**2**) each execute the same or different collaboration software to connect to collaboration server **70** and join the online collaboration session.

In operation, presenter device **10** executes the collaboration software so that the content displayed on display screen **10** is transmitted to collaboration server **70**. Collaboration server **70** is then configured to forward the content to each of the attendee devices **15**(**1**) and **15**(**2**). Attendee devices **15**(**1**) and **15**(**2**) also execute collaboration software so that the content received from presenter device **10** (via collaboration server **70**) may be displayed on their display screens **45**(**1**) and **45**(**2**), respectively. It would be appreciated that collaboration server **70** is configured to pass the presentation responsibilities between the different participating devices. That is, a selected attendee device **15**(**1**) or **15**(**2**) may become the presenter device (i.e., the selected device begins to share its desktop), while, simultaneously, the presenter device **10** may become an attendee device. The general functionality of collaboration or desktop sharing software is well known in the art and will not be described in detail herein.

The content shared during a collaboration session is provided to the attendee devices **15**(**1**) and **15**(**2**) as quickly as possible so that the display screens **45**(**1**) and **45**(**2**) are updated soon after the display screen **20** is updated. That is, the collaboration software attempts to ensure that display screens **45**(**1**) and **45**(**1**) are updated substantially in "real-time" with the display screen **20**. This real-time updating ensures that users at all participating devices are viewing the same content (after only minimal lag time), so as to improve the user experience.

During a collaboration session, the shared content is packetized and sent over the network **65** as discrete packets that comprise a packet header and/or trailer that includes control information (e.g., source and destination Media Access Control (MAC) addresses), error detection codes, sequencing information, etc.). The packets also comprise a payload that includes the shared content. Generally, limited network bandwidth is available for a collaboration session. As such, the shared content is typically compressed before it is packetized so that more data may be transmitted within the available bandwidth.

Due to the need for real-time updating, coupled with bandwidth limitations, conventional collaboration systems use compression and transmission techniques that limit the amount of data that is compressed and transmitted during given periods of time. This reduction in the amount of data that is compressed/transmitted reduces the quality of the images displayed at the attendee devices. That is, although the attendee devices **15(1)** and **15(2)** can quickly display an image that resembles the image on display screen **20**, the image displayed at the attendee devices is of significantly less quality (e.g., less clear) that the original image. For example, as the result of conventional compression/transmission schemes employed in collaboration sessions, the image quality at the attendee devices **15(1)** and **15(2)** may be less than thirty-five (35) percent the quality of the original image displayed at display screen **20**.

Examples described herein are generally directed to techniques for progressively sharing content displayed at display screen **20** in manner that ensures real-time updates of attendee devices, remains constrained to typical collaboration session bandwidth requirements (i.e., does not consume more bandwidth than conventional techniques), yet significantly improves the quality of the image displayed at the attendee devices **15(1)** and **15(2)**. In the example of FIG. **1**, the progressive sharing techniques are enabled by a collection of software and/or hardware components collectively referred to herein as progressive sharing unit **25**.

Progressive sharing unit **25** first comprises an image capture module **30** that, as described further below, is configured to detect changes in the image displayed at display screen **20**. When a change in the image is detected, image capture module **30** captures the changed portion of the image and separates the captured image into two images, namely a lossless image and a lossy image. As used herein, the lossless image generally comprises portions of the original image that need to be exactly recovered upon decompression. Such portions may include, for example, text data. Furthermore, as used herein, the lossy image generally comprises the portions of the original image other than the text (e.g., graphics, background, color data, etc.) that may not need to be exactly recovered upon decompression.

The lossless and lossy images generated by image capture module are provided to dual-compression module **35**. Dual-compression module **35** is configured to execute two different compression techniques in order to process each of the received lossless and lossy images. More specifically, dual-compression module **35** executes a lossless compression technique to convert the lossless image into a compressed lossless file. A lossless compression technique is a compression technique that results in the recovery of substantially all of the data upon decompression. Similarly, dual-compression module **35** executes a lossy compression technique to generate first and second compressed lossy files. A lossy compression technique is a technique that reduces data by permanently eliminating certain information, especially redundant information, such that only a part of the original information is present and recoverable upon decompression. Further details of the dual-compression module **35** and the compression process are provided below.

The compressed lossless file and the first and second compressed lossy files are then provided to network module **40**. Network module **40** is configured to generate packets that include the compressed files and to transmit the packets to collaboration server **70** for forwarding to attendee devices **15(1)** and **15(2)**. However, as detailed below, network module **40** is configured to generate/transmit packets in a specific manner that ensures real-time updates of the attendee devices **15(1)** and **15(2)**, significantly improves the quality of the image displayed at the attendee devices **15(1)** and **15(2)**, while ensuring transmissions remain constrained to typical collaboration session bandwidth requirements.

The packets transmitted by network module **40** are received by collaboration server **70**. Collaboration server **70** is configured to re-direct and/or duplicate the received packets so that the packets are received by each of network modules **50(1)** and **50(2)** in attendee devices **15(1)** and **15(2)**, respectively. Network modules **50(1)** and **50(2)** are configured to parse the received packets in order to extract the various compressed files. Decompression modules **55(1)** and **55(2)** decompress the received files and provide the recovered data to display modules **60(1)** and **60(2)**, respectively. Display modules **60(1)** and **60(2)** each comprise hardware and/or software components configured to perform video decoding, video rendering, and other operations to display the recovered data as video signals at display screens **45(1)** and **45(2)**, respectively.

FIG. **2** is a block diagram illustrating further details of the execution of progressive sharing techniques by presenter device **10**. As noted above, image capture module **30** is configured to monitor display screen **20** to determine if the image displayed on the screen changes or is otherwise updated. During a typical collaboration session, it is possible that, at a given time, only a portion of the image may change. In such circumstances, it is generally undesirable to compress and transmit the portions of the displayed image that remain unchanged because such operations needlessly consume processing power and bandwidth.

To the enable image capture module **30** to determine which portions of the image have changed, the display screen **20** is functionally separated into a plurality of logical blocks **75(1)**-**75**(N). Each block **75(1)**-**75**(N) comprises, for example, a group of pixels of display screen **20** that are physically positioned in proximity to one another. Each of these blocks **75(1)**-**75**(N) are monitored such that only the specific changed portions of the displayed image are captured and ultimately transmitted to attendee devices **15(1)** and **15(2)**. For purposes of illustration, the example of FIG. **2** will be described with reference to a change detected at block **75(1)**. It is to be appreciated that this is merely an example and that changes in multiple blocks may be simultaneously detected, compressed, and transmitted in accordance with the progressive sharing techniques described herein.

In operation, the image **80** displayed at block **75(1)** is captured by image capture module **30**. Image capture module **30** includes, in this example, a separator **85** that separates image **80** into a lossless image **90** and a lossy image **95**. Lossless image **90** and a lossy image **95** are then provided to dual-compression module **35** that is configured to compress each of the two images using different compression techniques. More specifically, dual-compression module **35** includes a lossless compression engine **100** and a lossy compression engine **105**. Lossless compression engine **100** may be a software application that compresses image **90** in a manner such that substantially all of the data may be recovered upon decompression. In one specific example, lossless compression engine **100** is a GNU zip (Gzip) compression application. Lossy compression engine **105** may be a software application that compresses image **95** by permanently eliminating certain information, particularly redundant data in the image such that only a part of the original data is present and recoverable. In one specific example, lossy compression engine **105** is a Joint Photographic Experts Group 2000 (JPEG2000) compression application.

Lossless compression engine **100** compresses lossless image **90** to form a compressed lossless file ($L_1$) **110**. Lossy compression engine **105** compresses lossy image **95** to generate a first compressed lossy file ($P_1$) **115** and a second compressed lossy file ($P_2$) **120**. The first and second lossy files **115** and **120**, respectively, are compressed versions of the same image **95**, but are of different qualities, and thus are of different compressed sizes. More specifically, second compressed lossy file **120** is of significantly higher quality, and thus has a larger compressed size than the first compressed lossy file **115**. In one example, first compressed lossy file **115** has a JPEG quality of approximately 35% (i.e., 35% the quality of lossy image **95**), while second compressed lossy file **120** has a JPEG quality such that, when combined with first compressed lossy file **115**, the total JPEG quality would be approximately 85% (i.e., 85% the quality of lossy image **95**).

Compressed lossless file **110**, first compressed lossy file **115**, and second compressed lossy file **120** are provided to network module **40**. Network module **40** comprises a packet generator **125** that combines the compressed lossless file **110** and the first compressed lossy file **115** into one or more packets **130** that are immediately sent to each of the attendee devices **15**(**1**) and **15**(**2**) (via collaboration server **70**). This transmission of compressed lossless file **110** and first compressed lossy file **115** allows the attendee devices **15**(**1**) and **15**(**2**) to quickly display the changed image of block **75**(**1**) (i.e., provides real-time updates at the display screens **45**(**1**) and **45**(**2**) of attendee devices **15**(**1**) and **15**(**2**), respectively).

Due, in part, to the bandwidth requirements of the network **65**, the second compressed lossy file **120** (which is larger than each of the compressed lossless file **110** and first compressed lossy file **115**) is not immediately sent to attendee devices **15**(**1**) and **15**(**2**). Rather, the second compressed lossy file **120** may be temporarily stored in a buffer **135** and only sent to attendee devices **15**(**1**) and **15**(**2**) after a predetermined period of time passes. During this period of time, image capture module **30** (or another element of presenter device **10**) monitors block **75**(**1**) for further changes to the displayed image. If no further change in the image is detected during the predetermined period of time, then a notification is sent to network module **40** that the second compressed lossy file **120** should be transmitted to the attendee devices **15**(**1**) and **15**(**2**). Accordingly, packet generator **125** generates one or more packets **140** that include the second compressed lossy file **120** and these packets **140** are transmitted to the collaboration server **70** and ultimately attendee devices **15**(**1**) and **15**(**2**). Upon receipt of these packets **140**, the images at display screens **45**(**1**) and **45**(**2**) of attendee devices **15**(**1**) and **15**(**2**), respectively, are updated with the second compressed lossy file **120** so that the image quality is improved (e.g., improved from approximately 35% quality to approximately 85% quality).

If a further change in the image at block **75**(**1**) is detected during the predetermined period of time, the second compressed lossy file **120** is discarded (e.g., deleted from buffer **135**), and is not transmitted to the attendee devices **15**(**1**) and **15**(**2**). This deletion of lossy file **120** from the buffer **135** occurs because, if a further change is detected, there is no need to transmit the larger second compressed lossy file **120** as it will be immediately replaced by the data in the next received compressed lossless file **100** and the next first compressed lossy file **115**. By discarding the larger second compressed lossy file **120** when a further change is detected, network bandwidth may be conserved.

The above concepts may be better understood with respect to a real-world example in which a user at presenter device **10** scrolls through shared material (e.g., a document, spreadsheet, presentation, etc.) displayed at display screen **20** and shared with users at attendee devices **15**(**1**) and **15**(**2**) during a collaboration session. In such an example, as the user begins to scroll through the material, the image displayed at block **75**(**1**), as well as the other blocks, will change. When the first change is detected, the process described above in FIG. **2** is executed to immediately provide the attendee devices **15**(**1**) and **15**(**2**) with the compressed lossless file **110** and first compressed lossy file **115**. This allows the users at attendee devices **15**(**1**) and **15**(**2**) to see that the user at presenter device **10** has started to scroll through the material.

As the user continues to scroll through the displayed material, the image at block **75**(**1**) continues to change. As such, the second compressed lossy file **120** would be discarded and the above process is repeated so as to provide the attendee devices **15**(**1**) and **15**(**2**) with the compressed lossless files **110** and first compressed lossy files **115** so that the display screens **45**(**1**) and **45**(**2**) reflect the scrolling that is occurring at display screen **20**. When the user at presenter device **10** stops scrolling, and thus the image stays constant for the predetermined period of time, the last captured second compressed lossy file **120** is transmitted to attendee devices **15**(**1**) and **15**(**2**) for improvement of the displayed image quality.

FIG. **3** is a block diagram illustrating one example software configuration of progressive sharing unit **25** in presenter device **10**. Presenter device **10** comprises, in this example, a display screen **20** (FIG. **2**), processor **150**, transceiver **155**, a network interface **160**, and a memory **165**. The memory **165** comprises image monitoring logic **170**, lossless compression engine **100** (FIG. **2**), lossy compression engine **105** (FIG. **2**), packet generator logic **175**, and a buffer **135** (FIG. **2**). As shown, the various components of presenter device **10** are connected by a communication bus **180**.

Memory **165** may comprise read only memory (ROM), random access memory (RAM), magnetic disk storage media devices, optical storage media devices, flash memory devices, electrical, optical, or other physical/tangible memory storage devices. The processor **150** is, for example, a microprocessor or microcontroller that executes instructions for the image monitoring logic **170**, lossless compression engine **100**, lossy compression engine **105**, and packet generator logic **175**. Thus, in general, the memory **165** may comprise one or more tangible (non-transitory) computer readable storage media (e.g., a memory device) encoded with software comprising computer executable instructions and when the software is executed (by the processor **150**) it is operable to perform the operations described herein in connection with image monitoring module **30** (through execution of image monitoring logic **170**), lossless compression engine **100**, lossy compression engine **105**, and packet generator **125** (through execution of packet generator logic **175**).

As noted, presenter device **10** comprises a transceiver **155** and a network interface **160**. These comprise the hardware components that are used to transmit the packets that contain compressed files **110**, **115**, and **120** to the attendee devices **15**(**1**) and **15**(**2**).

FIG. **4** is a high-level flowchart of a progressive sharing method **200** in accordance with examples described herein. Method **200** is performed at a presenter device configured to participate in a collaboration session with one or more attendee devices. At **205**, a change in an image displayed at a screen of the presenter device is detected. At **210**, the changed image is captured to produce a captured image. Next, at **215**, the captured image is compressed to form a compressed lossless file and first and second compressed lossy files. At **220**, the compressed lossless file and the first compressed lossy file are transmitted to the one or more attendee devices. At **225**, a determination is made as to whether a further change to the image displayed at the screen occurs within a predetermined period of time. At **230**, if no further change to the image displayed at the screen occurs within the predetermined period of time, the second compressed lossy file is transmitted to the one or more attendee devices.

FIG. **5** is a detailed flowchart illustrating further details of the example progressive sharing method **200** illustrated in FIG. **4**. As noted, method **200** starts at **205** with the detection of a change in the displayed image and the capture of the image at **210**. At **212**, the captured image is separated into lossless and lossy images.

Next, **215** of FIG. **4** includes two parallel processes at **215**(**1**) and **215**(**2**). More specifically, at **215**(**1**) the lossless image is compressed with a first compression engine (e.g., a lossless compression technique) to form a compressed lossless file. Similarly, at **215**(**2**), the lossy image is compressed with a second compression engine (e.g., a lossy compression technique) to first and second compressed lossy files. At **220**, the compressed lossless file and the first compressed lossy file are transmitted to the one or more attendee devices.

In this example, **225** includes two processes **225**(**1**) and **225**(**2**). At **225**(**1**), the screen of the presenter device is monitored for further changes to the displayed image. At **225**(**2**), a determination is made as whether a further change has been detected within a predetermined period of time. If no additional change to the image displayed at the screen occurs within the predetermined period of time, the method proceeds to **230** where the second compressed lossy file is transmitted to the one or more attendee devices (via a collaboration server). However, if a further change is detected, the second compressed lossy file is discarded at **235** and the method returns to **210**. The above processes of **210**-**235** are repeated until no change is detected for the predetermined period of time and the final second compressed lossy file is transmitted to the attendee devices.

The above description is intended by way of example only.

What is claimed is:

**1**. A method comprising:

at a presenter device configured to participate in a collaboration session and share content with one or more attendee devices, detecting a change in an image displayed at a screen of the presenter device;

capturing a changed portion of the image to produce a captured image, wherein the changed portion of the image is a subset of the image displayed at the screen defined by a group of pixels in a logical block of the image, and the change in the image occurred within at least one pixel of the group of pixels, and wherein the captured image comprises a changed portion and an unchanged portion of the logical block, wherein the screen is functionally separated into a plurality of logical blocks, and wherein detecting the change in the image displayed at the screen comprises separately monitoring each of the plurality of logical blocks to individually detect changes in the plurality of logical blocks;

separating the captured image into a lossless image and a lossy image;

compressing the lossless image using a first compression technique to form a compressed lossless file and compressing the lossy image using a second compression technique to form a first compressed lossy file and a second compressed lossy file, wherein the first compressed lossy file and the second compressed lossy file are both generated from the lossy image, and wherein the first compressed lossy file and the second compressed lossy file are compressed versions of the lossy image each having a different compression quality such that a size of the second compressed lossy file is larger than a size of the first compressed lossy file;

transmitting the compressed lossless file and the first compressed lossy file to the one or more attendee devices such that only a representation of the captured image is transmitted;

determining if a further change to the corresponding changed portion of the image displayed at the screen occurs within a predetermined period of time, wherein if the further change to the corresponding changed portion of the image displayed at the screen occurs within the predetermined period of time, discarding the second compressed lossy file from a buffer of the presenter device to prevent transmission of the second compressed lossy file to the one or more attendee devices; and

transmitting the second compressed lossy file to the one or more attendee devices when no further change to the corresponding changed portion of the image displayed at the screen occurs within the predetermined period of time, wherein the compressed lossless file, the first compressed lossy file, and the second compressed lossy file are generated and transmitted in a manner to ensure real-time updates of the one or more attendee devices.

**2**. The method of claim **1**, wherein compressing the lossless image with the first compression technique comprises:

compressing the lossless image with a zip compression application.

**3**. The method of claim **1**, wherein compressing the lossy image with the second compression technique comprises:

compressing the lossy image with a Joint Photographic Experts Group 2000 compression application.

**4**. The method of claim **1**, wherein after determining the further change to the corresponding changed portion of the image displayed at the screen occurs within the predetermined period of time, further comprising:

capturing the further change to the corresponding changed portion of the image displayed at the screen to produce a second captured image;

separating the second captured image into a second lossless image and a second lossy image;

compressing the second lossless image to form an additional compressed lossless file and compressing the second lossy image to form an additional first compressed lossy file and an additional second compressed lossy file, wherein the additional first compressed lossy file and the additional second compressed lossy file are compressed versions of the second lossy image each having a different compression quality such that a size of the additional second compressed lossy file is larger than a size of the additional first compressed lossy file;

transmitting the additional compressed lossless file and the additional first compressed lossy file to the one or more attendee devices;

transmitting the additional second compressed lossy file to the one or more attendee devices after the predetermined period of time has elapsed from transmitting the additional compressed lossless file and the additional first compressed lossy file.

5. The method of claim 1, wherein the lossless image comprises changed portions of the image that need to be exactly recovered upon decompression, and wherein the lossy image comprises changed portions of the image that do not need to be exactly recovered upon decompression.

6. One or more non-transitory computer readable storage media encoded with software comprising computer executable instructions and when the software is executed, operable to:

at a presenter device configured to participate in a collaboration session and share content with one or more attendee devices, detect a change in an image displayed at a screen of the presenter device;

capture a changed portion of the image to produce a captured image, wherein the changed portion of the image is a subset of the image displayed at the screen defined by a group of pixels in a logical block of the image, and the change in the image occurred within at least one pixel of the group of pixels, and wherein the captured image comprises a changed portion and an unchanged portion of the logical block, wherein the screen is functionally separated into a plurality of logical blocks, and wherein detecting the change in the image displayed at the screen comprises separately monitoring each of the plurality of logical blocks to individually detect changes in the plurality of logical blocks;

separate the captured image into a lossless image and a lossy image;

compress the lossless image using a first compression technique to form a compressed lossless file and compress the lossy image using a second compression technique to form a first compressed lossy file and a second compressed lossy file, wherein the first compressed lossy file and the second compressed lossy file are both generated from the lossy image, and wherein the first compressed lossy file and the second compressed lossy file are compressed versions of the lossy image each having a different compression quality such that a size of the second compressed lossy file is larger than a size of the first compressed lossy file;

transmit the compressed lossless file and the first compressed lossy file to the one or more attendee devices such that only a representation of the captured image is transmitted;

determine if a further change to the corresponding changed portion of the image displayed at the screen occurs within a predetermined period of time, wherein if the further change to the corresponding changed portion of the image displayed at the screen occurs within the predetermined period of time, discard the second compressed lossy file from a buffer of the presenter device to prevent transmission of the second compressed lossy file to the one or more attendee devices; and

transmit the second compressed lossy file to the one or more attendee devices when no further change to the corresponding changed portion of the image displayed at the screen occurs within the predetermined period of time, wherein the compressed lossless file, the first compressed lossy file, and the second compressed lossy file are generated and transmitted in a manner to ensure real-time updates of the one or more attendee devices.

7. The non-transitory computer readable storage media of claim 6, wherein the instructions operable to compress the lossless image with the first compression technique comprise instructions operable to:

compress the lossless image with a zip compression application.

8. The non-transitory computer readable storage media of claim 6, wherein the instructions operable to compress the lossy image with the second compression technique comprise instructions operable to:

compress the lossy image with a Joint Photographic Experts Group 2000 compression application.

9. The non-transitory computer readable storage media of claim 6, wherein after determining the further change to the corresponding changed portion of the image displayed at the screen occurs within the predetermined period of time, the instructions are further operable to:

capture the further change to the corresponding changed portion of the image displayed at the screen to produce a second captured image;

separate the second captured image into a second lossless image and a second lossy image;

compress the second lossless image to form an additional compressed lossless file and compress the second lossy image to form an additional first compressed lossy file and an additional second compressed lossy file, wherein the additional first compressed lossy file and the additional second compressed lossy file are compressed versions of the second lossy image each having a different compression quality such that a size of the additional second compressed lossy file is larger than a size of the additional first compressed lossy file;

transmit the additional compressed lossless file and the additional first compressed lossy file to the one or more attendee devices;

transmit the additional second compressed lossy file to the one or more attendee devices after the predetermined period of time has elapsed from the transmission of the additional compressed lossless file and the additional first compressed lossy file.

10. An apparatus comprising:

a display screen configured to display material shared with one or more attendee devices in a collaboration session;

one or more network interfaces; and

a processor configured to:

detect a change in an image displayed at the screen,

capture a changed portion of the image to produce a captured image, wherein the changed portion of the image is a subset of the image displayed at the screen defined by a group of pixels of a logical block of the image, and the change in the image occurred within at least one pixel of the group of pixels, and wherein the captured image comprises a changed portion and an unchanged portion of the logical block, wherein the screen is functionally separated into a plurality of logical blocks, and wherein detecting the change in the image displayed at the screen comprises separately monitoring each of the plurality of logical blocks to individually detect changes in the plurality of logical blocks,

separate the captured image into a lossless image and a lossy image,

compress the lossless image using a first compression technique to form a compressed lossless file and compress the lossy image using a second compression technique to form a first compressed lossy file and a second compressed lossy file, wherein the first compressed lossy file and the second compressed lossy file are both generated from the lossy image, and wherein the first compressed lossy file and the second compressed lossy file are compressed versions of the lossy image each having a different compression quality such that a size of the second compressed lossy file is larger than a size of the first compressed lossy file,

transmit the compressed lossless file and the first compressed lossy file to the one or more attendee devices via the one or more network interfaces such that only a representation of the captured image is transmitted,

determine if a further change to the corresponding changed portion of the image displayed at the screen occurs within a predetermined period of time, wherein if the further change to the corresponding changed portion of the image displayed at the screen occurs within the predetermined period of time, discard the second compressed lossy file from a buffer to prevent transmission of the second compressed lossy file to the one or more attendee devices, and

transmit the second compressed lossy file to the one or more attendee devices via the one or more network interfaces when no further change to the corresponding changed portion of the image displayed at the screen occurs within the predetermined period of time, wherein the compressed lossless file, the first compressed lossy file, and the second compressed lossy file are generated and transmitted in a manner to ensure real-time updates of the one or more attendee devices.

**11**. The apparatus of claim **10**, wherein to compress the lossless image with the first compression technique, the processor is configured to execute a zip compression application.

**12**. The apparatus of claim **10**, wherein to compress the lossless image with the first compression technique, the processor is configured to execute a Joint Photographic Experts Group 2000 compression application.

**13**. The apparatus of claim **10**, wherein after determining the further change to the corresponding changed portion of the image displayed at the screen occurs within the predetermined period of time, the processor is further configured to:

capture the further change to the corresponding changed portion of the image displayed at the screen to produce a second captured image,

separate the second captured image into a second lossless image and a second lossy image,

compress the second lossless image to form an additional compressed lossless file and compress the second lossy image to form an additional first compressed lossy file and an additional second compressed lossy file, wherein the additional first compressed lossy file and the additional second compressed lossy file are compressed versions of the second lossy image each having a different compression quality such that a size of the additional second compressed lossy file is larger than a size of the additional first compressed lossy file,

transmit the additional compressed lossless file and the additional first compressed lossy file to the one or more attendee devices, and

transmit the additional second compressed lossy file to the one or more attendee devices after the predetermined period of time has elapsed from the transmission of the additional compressed lossless file and the additional first compressed lossy file.

* * * * *