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EXPLODED SHARING TO FACILITATE ANNOTATION

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EXPLODED SHARING TO FACILITATE ANNOTATION

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ABSTRACT

When individuals are collaborating in an online meeting, it is quite common for the presenter to share their application or desktop so that all of the meeting participants may collectively annotate on the presenter's share. However, sometimes such a collective annotation may be difficult. To address such difficulties, techniques are presented herein that support an innovative method for facilitating online meeting annotation. Aspects of the presented techniques support exploding a meeting presenter's share into editable elements. By applying aspects of the presented techniques, a share is no longer a bulk of a single static image but a collection of fine-grained editable elements. Through such editable elements a sharing-based annotation is easier to manipulate and more user-friendly than ever before.

DETAILED DESCRIPTION

When individuals are collaborating in an online meeting, it is quite common for the presenter to share their application or desktop so that all of the meeting participants may collectively annotate on the presenter's share. However, sometimes such a collective annotation may be difficult.

Figures 1A and 1B, below, depict elements of an illustrative example with Figure 1A depicting an original diagram (e.g., as initially shared by a presenter) and Figure 1B depicting a target diagram (e.g., following collective annotation).

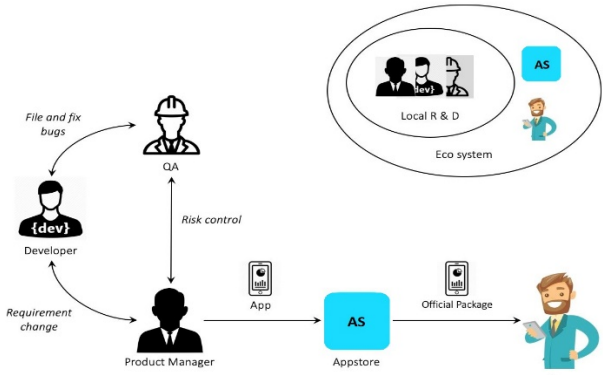


Figure 1A: Original Diagram (Presenter's Sharing)

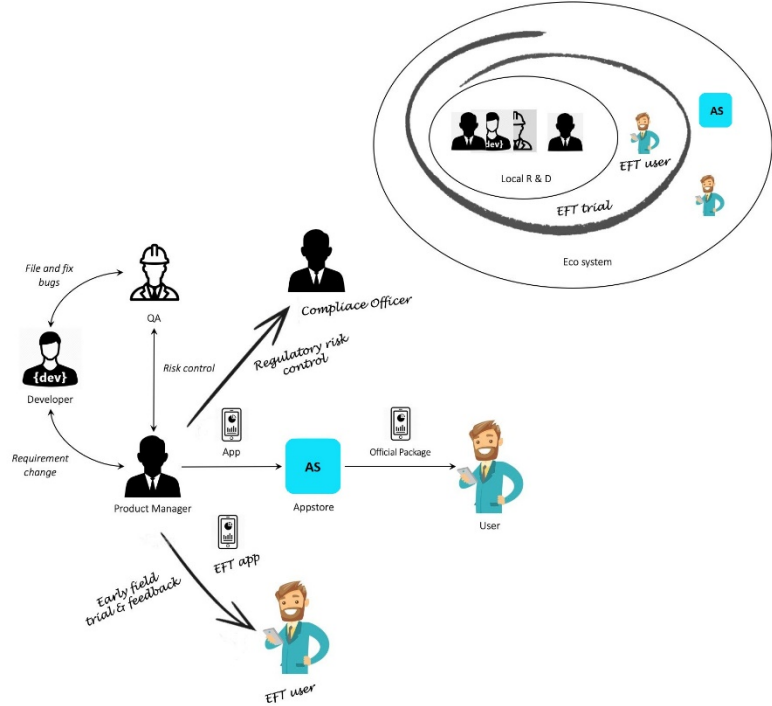


Figure 1B: Target Diagram (Collectively Annotated)

The original diagram that is presented in Figure 1A, above, depicts various elements of the different entities including, for example, icons (for a developer, for a quality assurance (QA) resource, and for a project manager (PM)), an application store (which, for convenience, may be referred to herein as an ‘Appstore’ or an ‘AS’), etc. The diagram also depicts various elements of collections or groupings, such as, for example, arrows and oval groups.

As noted previously, the target diagram (following collective annotation) is presented in Figure 1B, above. The changes between the two figures (i.e., between Figures 1A and 1B) include, for example, in Figure 1B:

1. The new roles of "Compliance Officer" and "EFT user" (Early Field Trial) have been added, along with different arrows and text. The icons for the new roles are intended to be cloned from the existing roles of "Product Manager" and "User," respectively.
2. The existing "Eco system" and "Local R & D" ovals are scaled up and the existing icons for "Appstore" and "User" are moved slightly to make room for additional elements inside the ovals.

3. A new oval for "EFT trial" is added between the "Eco system" and "Local R & D" ovals.
4. A "Compliance Officer" is added to the "Local R & D" oval.
5. An "EFT user" is added to the new "EFT trial" oval.

A number of difficulties may arise during the exemplary collective annotation process that was depicted in Figures 1A and 1B, above. For example:

1. Meeting users expect to be able to move existing elements in the share. For example, the "Appstore" and "User" icons in the "Eco system" oval are moved slightly to make room for new elements.

2. Meeting users expect to be able to scale up or scale down existing elements in the share. For example, the "Eco system" and "Local R & D" ovals are scaled up.

3. Meeting users expect to be able to add new elements by cloning existing ones. For example, an "EFT user" is cloned from the "User" element and a "Compliance Officer" is cloned from the "Product Manager" element.

While the copying and pasting of part of an image is not something new, the copying and pasting of a particular part from a complicated diagram may be difficult during manual operation, especially when the part resides within an irregular shape. Further, while the cutting and pasting of part of an image is not something new, the scaling up or the scaling down of part of an image may be difficult, particularly when the scaling up or down should not impact other elements. For example, when scaling up the "Eco system" oval the "Appstore" and "User" icons and the "Local R & D" group should not be impacted.

In many cases, the artifact that a presenter is sharing is not an editable file (such as, for example, a slide from a slide deck) but rather non-editable materials (such as, for example, an image, a portable document format (PDF) file, or a web page).

To address the types of challenges that were described above, techniques are presented herein that support an innovative method of exploding sharing to editable elements to facilitate collective annotation. Aspects of the presented techniques support various features, including:

1. The ability to explode a presenter's share into editable elements.
2. The ability to explode hierarchically-embedded elements from a share in an iterative manner.

3. The introduction of a new Hierarchical Position Information of Elements (HPIE) artifact.
4. The ability of a meeting user to move, scale, rotate, etc. existing elements that are exploded from a share.
5. The ability of a meeting user to delete existing elements that are exploded from a share.
6. The ability of a meeting user to clone from existing elements that are exploded from a share.
7. The ability to save recently-edited elements in a library and reuse such elements in future annotations.

The capabilities that were identified above will be described and illustrated in the narrative that is presented below.

As a threshold matter, it is important to note that any number of existing techniques may be used to automatically split objects from an image. Such techniques may include, for example:

1. Optical character recognition (OCR) facilities, which are mature and popular, such as OpenCV with Tesseract.
2. BASNet, which is able to split objects of various shapes from images.
3. Grabcut, which can split objects (such as human hands) from images.
4. CAP_augmentation, which is able to split human objects from complicated images.
5. Object-cut, which is able to automatically cut the main object of an image.

Several of these types of techniques may be used in support of the techniques that are presented herein.

Aspects of the explanatory narrative that is presented below will employ the example that was depicted in Figures 1A and 1B, above.

When a meeting presenter, or anyone who is attending a meeting, begins annotation on the presenter's share (as depicted in Figure 2A, below) an initial explosion is launched. Such an initial explosion will yield a range of editable layer 1 elements (as depicted in Figure 2B, below).

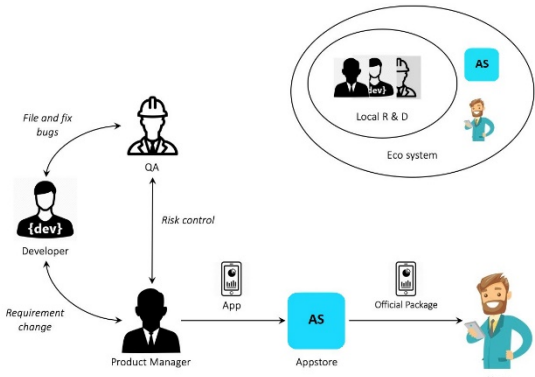


Figure 2A: Original Diagram

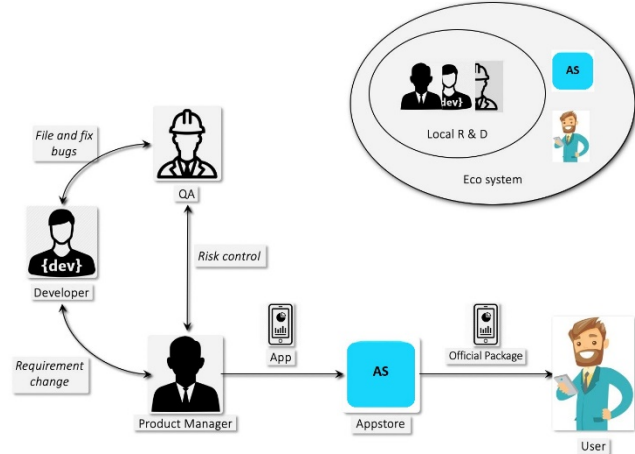


Figure 2B: After Initial Explosion

For example, in Figure 2B, above, the exploded elements include icons (for a "Developer," for a "QA" resource, and for a "Product Manager"), arrows, the oval for "Eco system", etc. All of the elements are rendered as if the original image was the background (i.e., in layer 0) and the exploded elements are 'floating' on top of it (i.e., in layer 1). It is important to note that the exploded elements are editable – that is, meeting participants may move, scale, rotate, or perform any other normal operation on them.

By leveraging several of the "split objects from images" techniques that were previously described, the meeting client or a meeting server can recognize different layer 1 elements. Figure 3, below, depicts various layer 1 elements.

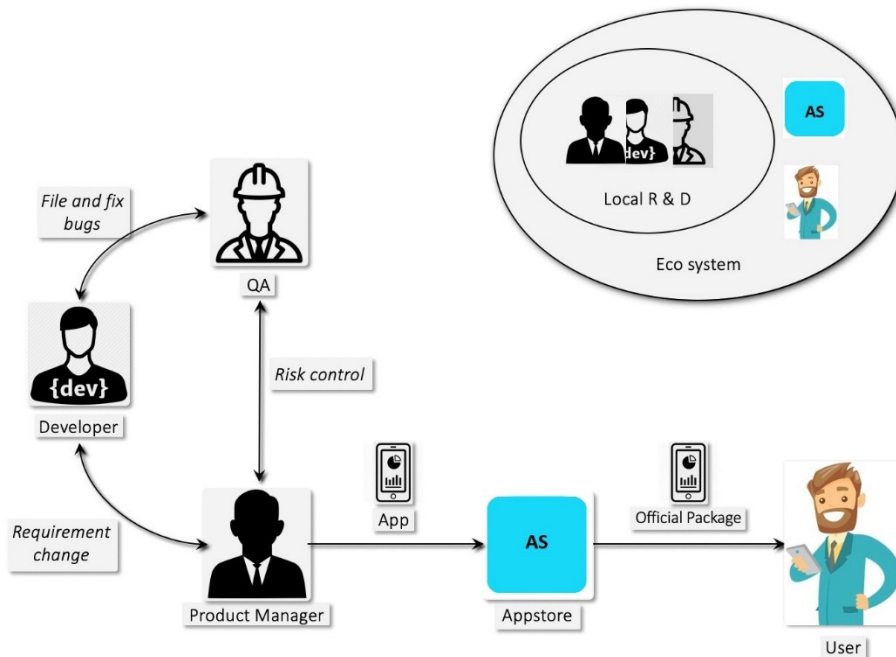


Figure 3: Editable Elements Following Initial Explosion

As depicted in Figure 3, above, icons for various roles (such as "Developer," "QA," and "Product Manager"), arrows, text, etc. are recognized as separate editable elements. Complicated elements such as the "Eco system" oval are recognized as a single element after the initial explosion. Every single element is rendered in a way that indicates it is hovering above the layer beneath. For example, elements may be rendered with shadows.

Figures 4A and 4B, below, present examples of how each separate element may be moved, scaled, or rotated.

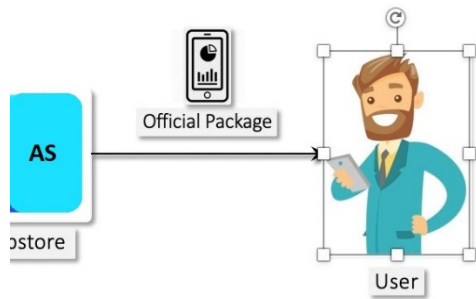


Figure 4A: Editable Graphic Element

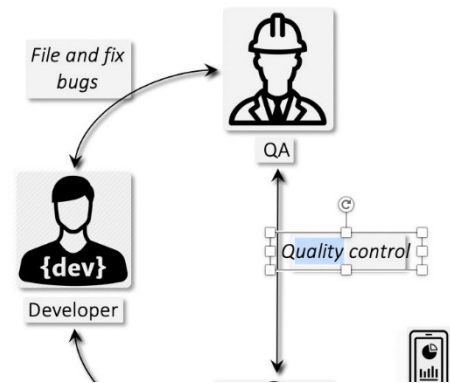


Figure 4B: Editable Text Element

As depicted in Figure 4A, above, when the "User" element is selected a surrounding editor box is rendered. Meeting users can easily apply moving, scaling, or rotation operations to it. Additionally, they may also delete it or clone a new element from it. As depicted in Figure 4B, above, a textual element is a special element whose textual content may be directly edited.

Aspects of the techniques presented herein acknowledge the fact that there may be complicated embedded elements in a share and thus an explosion may be performed in an iterative manner.

As one example, for the grouping ovals that are depicted in the top-right corner of Figure 1A, above, a series of explosions may be possible (as depicted in Figure 5, below).

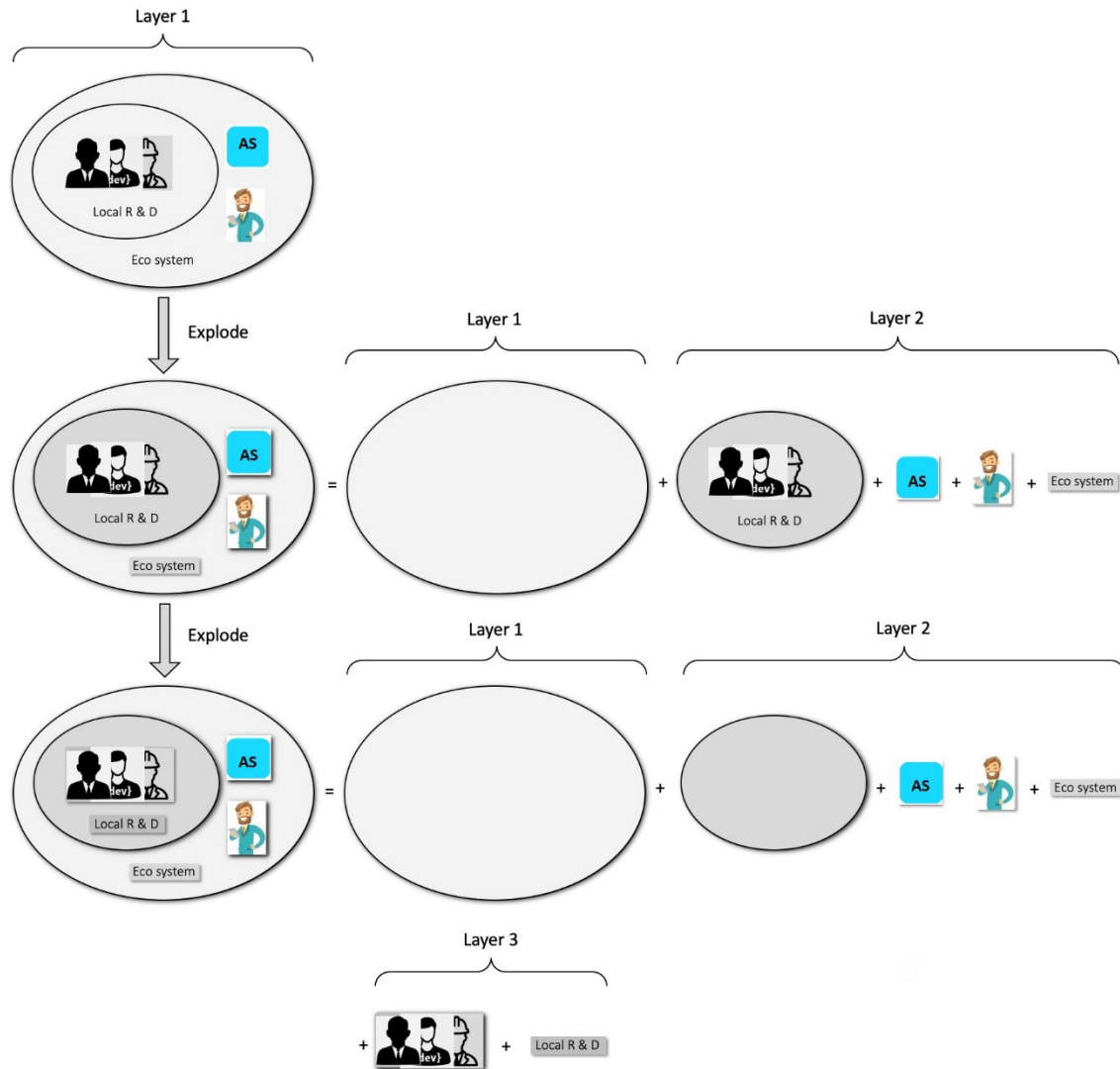


Figure 5: Exemplary Iterative Explosion

As depicted in Figure 5, above, following an initial explosion the "Eco system" oval becomes a single editable element of layer 1. However, the more fine-grained elements inside of that oval are not editable because all of the material that is inside of the "Eco system" oval is a bulk of a single element. If the meeting user wishes to edit inside of the "Eco system" oval he can initiate a further explosion of the "Eco system" oval. For example, if he wants to scale up the "Eco system" oval without impacting any of the other elements inside of it, or edit the "Appstore" group or the "Local R & D" group, a further explosion of the "Eco system" oval is required.

Following a second explosion (as depicted in Figure 5, above), a meeting user has access to a layer 2 with more fine-grained elements such as the icons for "Appstore" and "User". However, the "Local R & D" oval and everything that is inside of it is still a bulk of a single element.

A meeting user may initiate a third explosion on the "Local R & D" oval (as further depicted in Figure 5, above) to obtain access to a layer 3 of elements. Following such a third explosion the meeting user has access to even more fine-grained elements (such as, for example, the "Local R & D" text element).

As indicated in the above description, it is up to a meeting user to decide what should be exploded to which layer. Alternatively, under aspects of the techniques presented herein another option supports exploding to the deepest layer during an initial explosion.

Under aspects of the techniques presented herein, besides exploding for an entire share, a meeting user may select a particular area to explode. Figures 6A and 6B, below, depict aspects of such an approach.

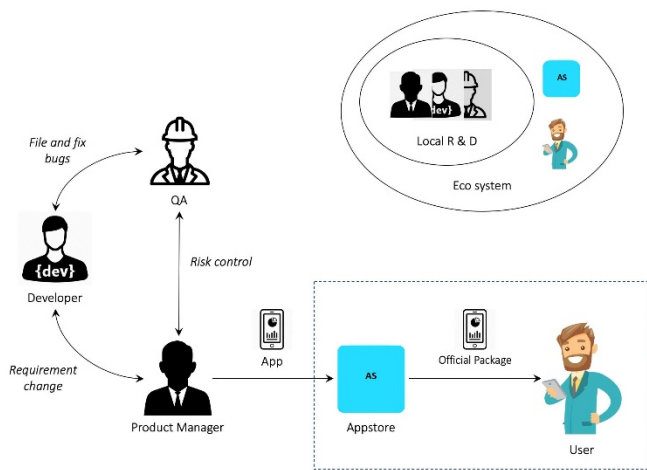


Figure 6A: Explode Selected Area (Before)

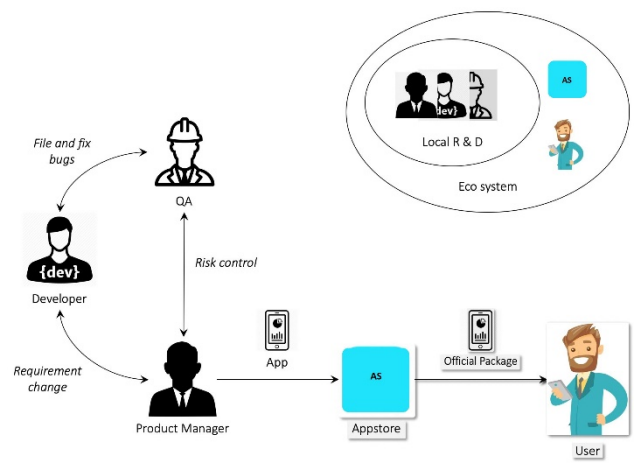


Figure 6B: Explode Selected Area (After)

For example, in Figure 6A, above, a meeting user selects the bottom left portion of a share by dragging a dotted rectangle and then exploding only that area. Figure 6B, above, illustrates that only the elements of "Appstore", "User", etc. become editable while the

other parts of the share remain non-editable. Such an explosion for a selected area is useful because sometimes a meeting user may want to modify a particular part of a share without accidentally impacting the other parts.

Figure 7, below, presents an example of a cross-layer edit that is possible, according to aspects of the techniques presented herein, that is based on the explosion to layer 3 that was depicted in Figure 5, above.

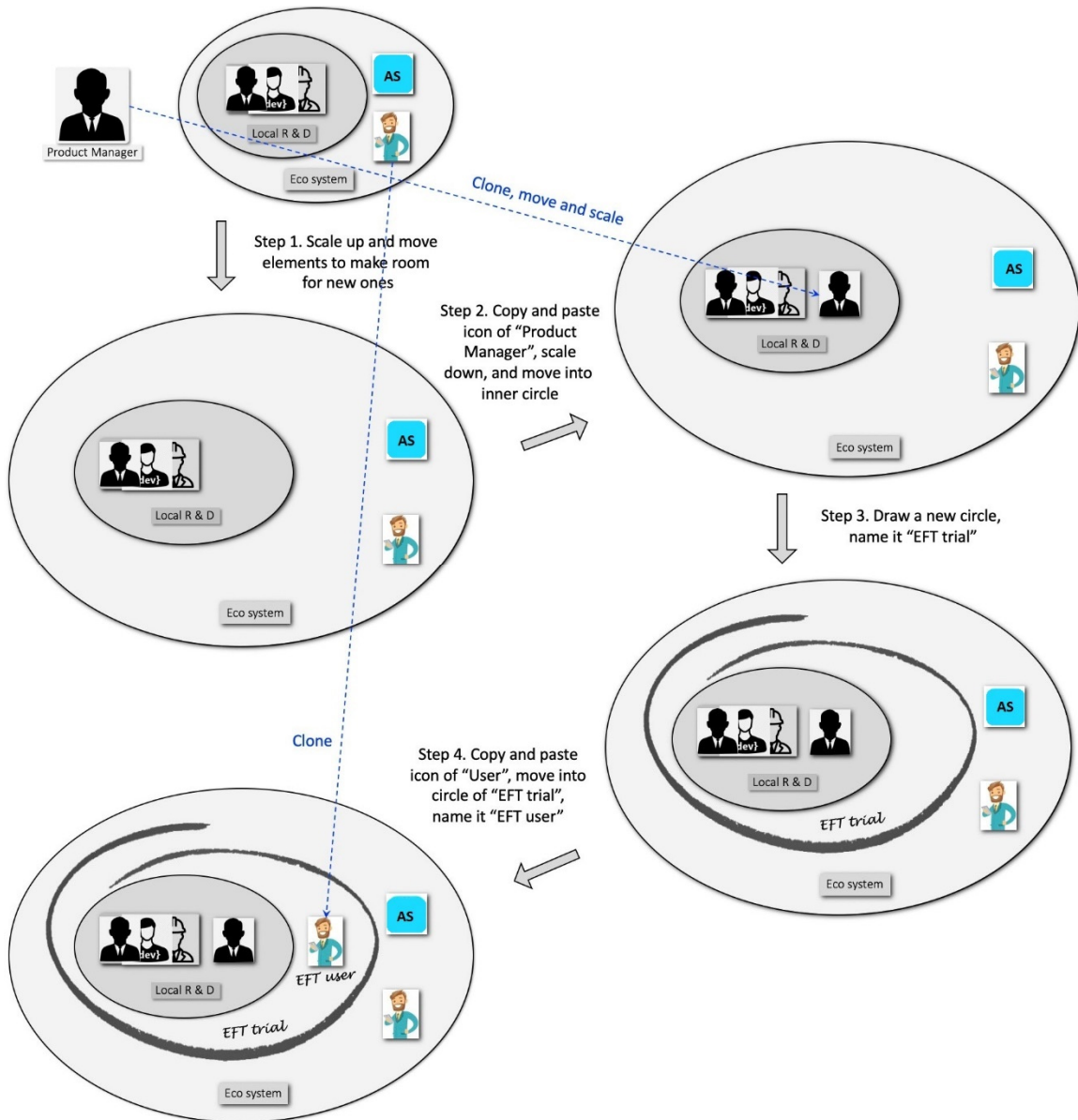


Figure 7: Exemplary Cross-Layer Edit

Figure 7, above, depicts a number of cross-layer edits including, for example:

1. Scaling up the "Eco system" and "Local R & D" ovals to make room for new elements.
2. Moving existing elements in the ovals (such as "Appstore" and "User") without impacting any of the other elements.
3. Drawing a new "EFT trial" circle between the "Eco system" and "Local R & D" ovals.
4. Cloning a new icon for an "EFT user" from the existing "User" icon and placing the new icon inside of the new "EFT trial" circle.
5. Cloning a new icon for a "Compliance Officer" from the existing "Product Manager" icon and placing the new icon inside of the "Local R & D" oval.

Aspects of the techniques presented herein may be used in any of the popular online meeting, collaboration, etc. systems or platforms. Additionally, aspects of the techniques presented herein are suitable for application to the different online collaboration devices which are featured in annotation by pen or finger.

Further, aspects of the techniques presented herein employ a new artifact, a HPIE, which defines the hierarchical position information of elements within an application that is being shared in an online meeting. When an application is being shared, the accessibility information of the elements within such an application may be retrieved. For example, within a Microsoft® Windows® (or "Windows®") environment such information may be retrieved using an accessibility framework. Figures 8A, 8B, and 8C, below, depict snapshots from inspecting accessibility information, retrieved using a commonly-available Windows®-based inspection utility, for the example of Figure 2, above. The inspection tool is based on similar Windows® accessibility application programming interfaces (APIs).

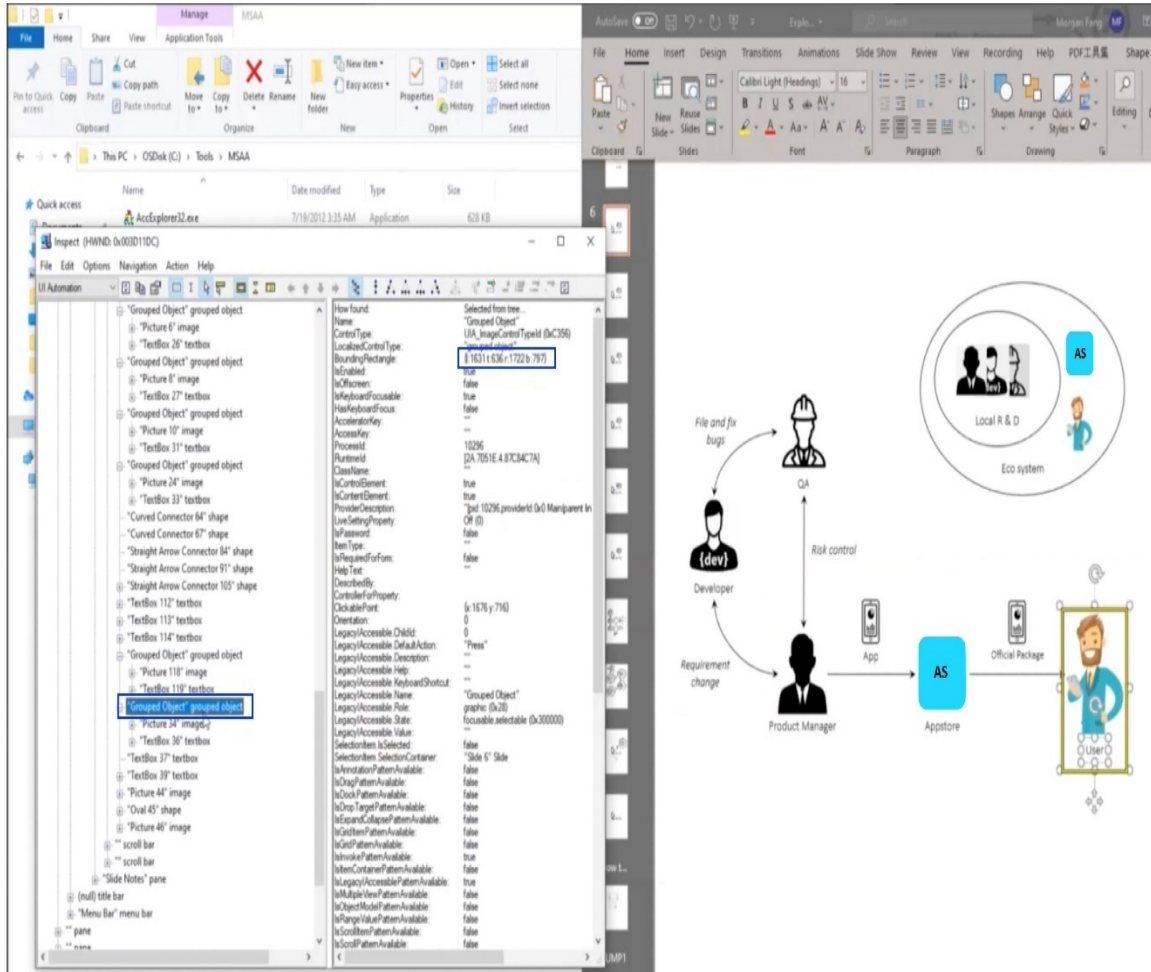


Figure 8A: Inspecting Group of "User" Picture and "User" Text in Figure 2B

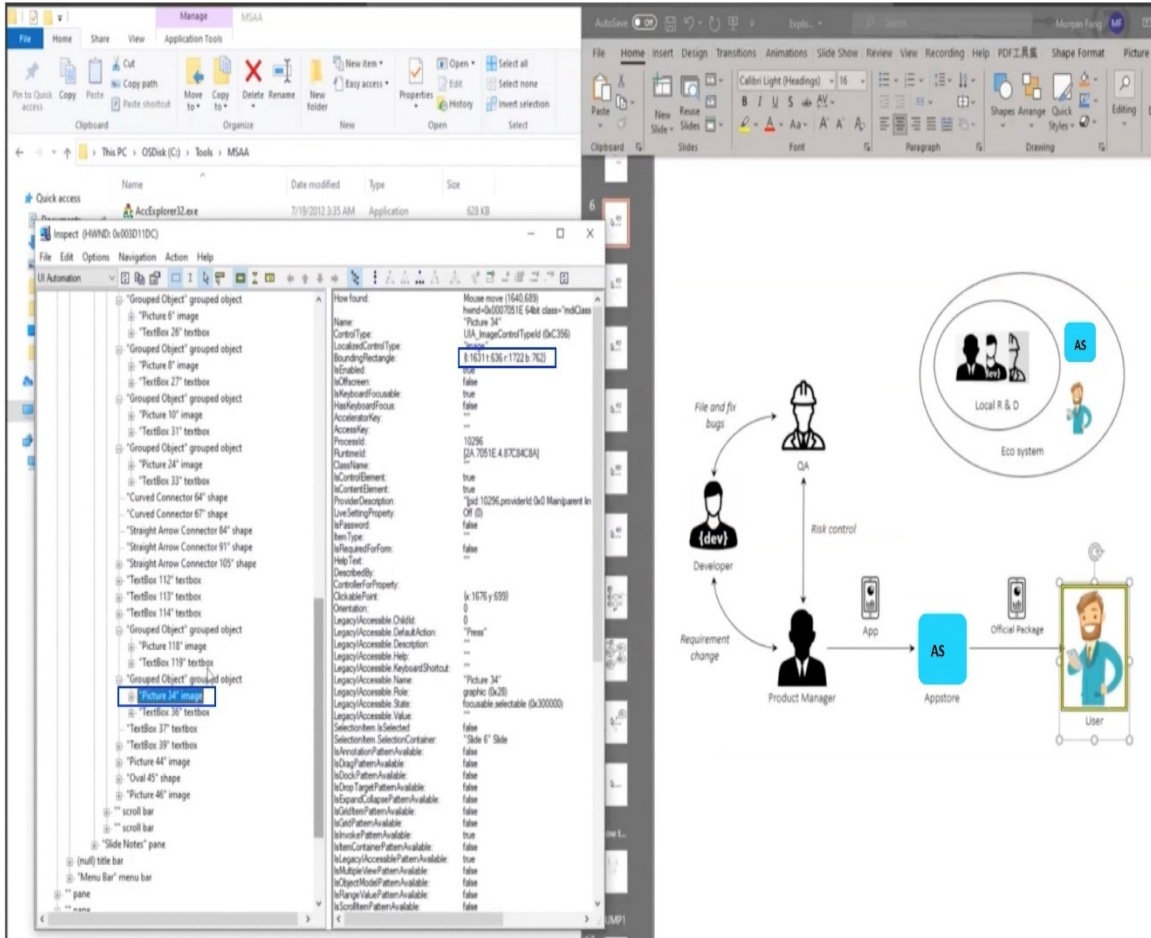


Figure 8B: Inspecting "User" Picture in Figure 2B

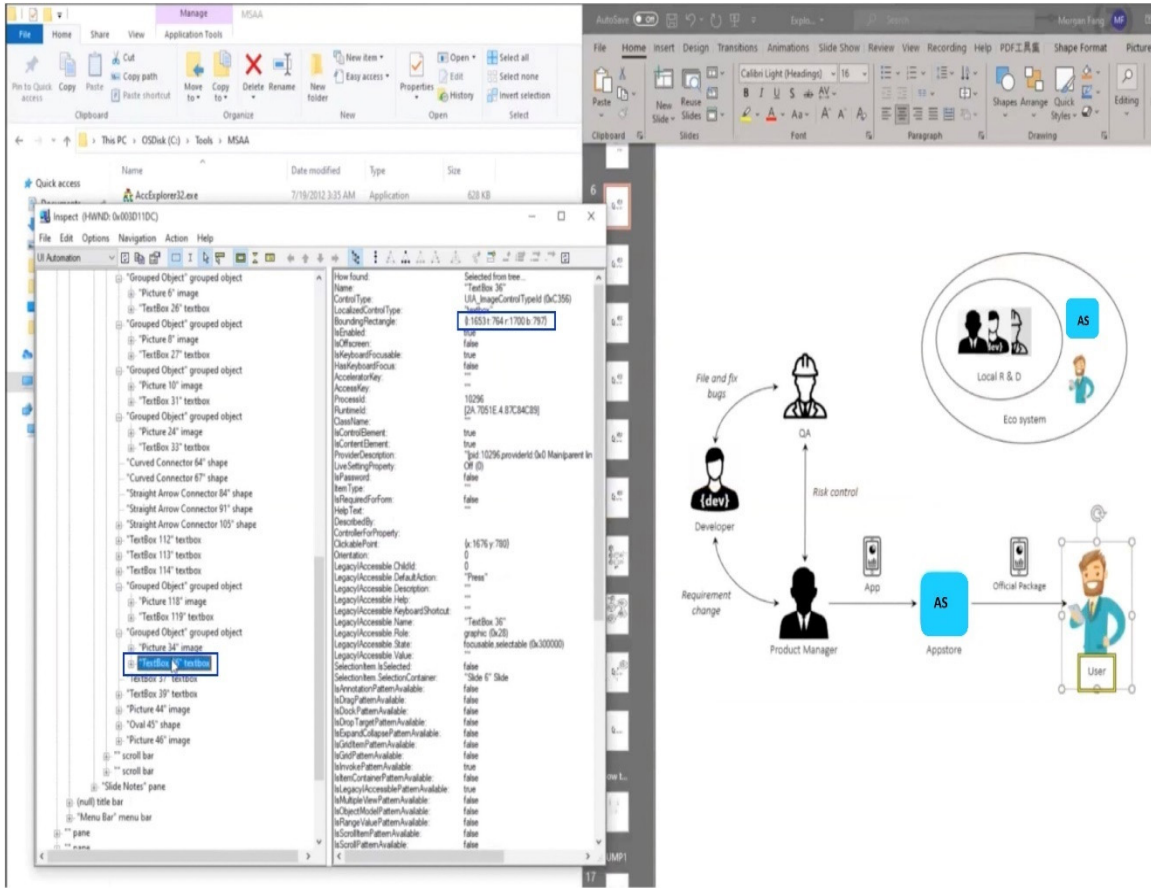


Figure 8C: Inspecting "User" Text in Figure 2B

As Figures 8A through 8C, above, depict, the accessibility information is retrieved in a hierarchical data structure. For example, the "User" picture (Figure 8B, above) and the "User" text (Figure 8C, above) are in a group, and this group is illustrated in Figure 8A, above. In each of the snapshots, the key attributes (such as, for example, "{1:1631 t:636 r:1722 b:797}") are retrieved. Table 1 (to be presented and described below) provides detailed attribute listings. It is important to note that although the text "User" is not found in the attributes, such an absence is not due to some restriction within the accessibility APIs but rather it is a limitation of the instant inspection tool. The text is available through the accessibility APIs.

Table 1, below, depicts exemplary element attributes, with the left-hand column of the table presenting element attributes that are associated with Figure 8B, above, and the right-hand column of the table presenting element attributes that are associated with Figure 8C, above.

Element attributes of Figure 8B	Element attributes of Figure 8C
How found:Selected from tree...	How found:Focus
Name:"Picture 34"	Name:"TextBox 36"
ControlType:UIA_ImageControlTypeId (0xC356)	ControlType:UIA_ImageControlTypeId (0xC356)
LocalizedControlType:"image"	LocalizedControlType:"textbox"
BoundingBox:{l:1631 t:636 r:1722 b:762}	BoundingBox:{l:1653 t:764 r:1700 b:797}
IsEnabled:true	IsEnabled:true
IsOffscreen:false	IsOffscreen:false
IsKeyboardFocusable:true	IsKeyboardFocusable:true
HasKeyboardFocus:false	HasKeyboardFocus:true
AcceleratorKey:""	AcceleratorKey:""
AccessKey:""	AccessKey:""
ProcessId:10296	ProcessId:10296
RuntimeId:[2A.7051E.4.87C84C8A]	RuntimeId:[2A.7051E.4.87C84C89]
ClassName:""	ClassName:""
IsControlElement:true	IsControlElement:true
IsContentElement:true	IsContentElement:true
ProviderDescription: "[pid:10296,providerId:0x0 Main(parent link):Unidentified Provider (unmanaged:mso.dll)]"	ProviderDescription: "[pid:10296,providerId:0x0 Main(parent link):Unidentified Provider (unmanaged:mso.dll)]"
LiveSettingProperty:Off (0)	LiveSettingProperty:Off (0)
IsPassword:false	IsPassword:false
ItemType:""	ItemType:""
IsRequiredForForm:false	IsRequiredForForm:false
HelpText:""	HelpText:""
DescribedBy:	DescribedBy:
ControllerForProperty:	ControllerForProperty:
ClickablePoint:{x:1676 y:699}	ClickablePoint:{x:1676 y:780}
Orientation:0	Orientation:0
LegacyIAccessible.ChildId:0	LegacyIAccessible.ChildId:0
LegacyIAccessible.DefaultAction:"Press"	LegacyIAccessible.DefaultAction:"Press"
LegacyIAccessible.Description:""	LegacyIAccessible.Description:""
LegacyIAccessible.Help:""	LegacyIAccessible.Help:""
LegacyIAccessible.KeyboardShortcut:""	LegacyIAccessible.KeyboardShortcut:""
LegacyIAccessible.Name:"Picture 34"	LegacyIAccessible.Name:"TextBox 36"
LegacyIAccessible.Role:graphic (0x28)	LegacyIAccessible.Role:graphic (0x28)
LegacyIAccessible.State:focusable,selectable (0x300000)	LegacyIAccessible.State:selected,focused,focusable,selectable (0x300006)
LegacyIAccessible.Value:""	LegacyIAccessible.Value:""
SelectedItem.IsSelected:false	SelectedItem.IsSelected:true
SelectedItem.SelectionContainer:"Slide 6" Slide	SelectedItem.SelectionContainer:"Slide 6" Slide
IsAnnotationPatternAvailable:false	IsAnnotationPatternAvailable:false
IsDragPatternAvailable:false	IsDragPatternAvailable:false
IsDockPatternAvailable:false	IsDockPatternAvailable:false
IsDropTargetPatternAvailable:false	IsDropTargetPatternAvailable:false
IsExpandCollapsePatternAvailable:false	IsExpandCollapsePatternAvailable:false
IsGridItemPatternAvailable:false	IsGridItemPatternAvailable:false
IsGridPatternAvailable:false	IsGridPatternAvailable:false
IsInvokePatternAvailable:true	IsInvokePatternAvailable:true
IsItemContainerPatternAvailable:false	IsItemContainerPatternAvailable:false

IsLegacyIAccessiblePatternAvailable:true	IsLegacyIAccessiblePatternAvailable:true
IsMultipleViewPatternAvailable:false	IsMultipleViewPatternAvailable:false
IsObjectModelPatternAvailable:false	IsObjectModelPatternAvailable:false
IsRangeValuePatternAvailable:false	IsRangeValuePatternAvailable:false
IsScrollItemPatternAvailable:false	IsScrollItemPatternAvailable:false
IsScrollPatternAvailable:false	IsScrollPatternAvailable:false
IsSelectedItemPatternAvailable:true	IsSelectedItemPatternAvailable:true
IsSelectionPatternAvailable:false	IsSelectionPatternAvailable:false
IsSpreadsheetItemPatternAvailable:false	IsSpreadsheetItemPatternAvailable:false
IsSpreadsheetPatternAvailable:false	IsSpreadsheetPatternAvailable:false
IsStylesPatternAvailable:false	IsStylesPatternAvailable:false
IsSynchronizedInputPatternAvailable:false	IsSynchronizedInputPatternAvailable:false
IsTableItemPatternAvailable:false	IsTableItemPatternAvailable:false
IsTablePatternAvailable:false	IsTablePatternAvailable:false
IsTextChildPatternAvailable:false	IsTextChildPatternAvailable:false
IsTextEditPatternAvailable:false	IsTextEditPatternAvailable:false
IsTextPatternAvailable:false	IsTextPatternAvailable:true
IsTextPattern2Available:false	IsTextPattern2Available:false
IsTogglePatternAvailable:false	IsTogglePatternAvailable:false
IsTransformPatternAvailable:false	IsTransformPatternAvailable:false
IsTransform2PatternAvailable:false	IsTransform2PatternAvailable:false
IsValuePatternAvailable:false	IsValuePatternAvailable:false
IsVirtualizedItemPatternAvailable:false	IsVirtualizedItemPatternAvailable:false
IsWindowPatternAvailable:false	sWindowPatternAvailable:false
FirstChild:[null]	FirstChild:[null]
LastChild:[null]	LastChild:[null]
Next:"TextBox 36" textbox	Next:[null]
Previous:[null]	Previous:"Picture 34" image
Other Props:Object has no additional properties	Other Props:Object has no additional properties
Children:Container has no children	Children:Container has no children
Ancestors:"Grouped Object" grouped object	Ancestors:"Grouped Object" grouped object
Slide 6 Slide	Slide 6 Slide
Slide pane	Slide pane
pane	pane
Workspace pane	Workspace pane
Explode.pptx - PowerPoint window	Explode.pptx - PowerPoint window
Desktop 1 pane	Desktop 1 pane
[No Parent]	[No Parent]

Table 1: Exemplary Element Attributes

It is important to note that while the previous discussion employed a Windows orientation, similar accessibility tools and frameworks are available for other platforms, operating systems, etc. (such as, for example, the Apple® Macintosh®).

Figure 9, below, presents an example of illustrative HPIE information in a JavaScript Object Notation (JSON) format. It is important to note that only the visible elements and their parents are included in the depicted HPIE.

```

1  {
2    "elements": [
3      {
4        "type": "group",
5        "position": {
6          "left": 1516,
7          "right": 1681,
8          "top": 350,
9          "bottom": 421
10       },
11       "elements": [
12         {
13           "type": "group",
14           "position": {
15             "left": 1519,
16             "right": 1576,
17             "top": 354,
18             "bottom": 411
19           },
20           "elements": [
21             {
22               "type": "image",
23               "position": {
24                 "left": 1522,
25                 "right": 1570,
26                 "top": 364,
27                 "bottom": 390
28               },
29             },
30             {
31               "type": "text",
32               "position": {
33                 "left": 1522,
34                 "right": 1570,
35                 "top": 394,
36                 "bottom": 408
37               },
38               "text": "Hello"
39             }
40           ]
41         },
42         {
43           "type": "image",
44           "position": {
45             "left": 1619,
46             "right": 1676,
47             "top": 354,
48             "bottom": 411
49           }
50         }
51       ]
52     }
53   }
54   {
55     "type": "group",
56     "position": {
57       "left": 1319,
58       "right": 1376,
59       "top": 354,
60       "bottom": 411
61     },
62     "elements": [
63       {
64         "type": "image",
65         "position": {
66           "left": 1322,
67           "right": 1370,
68           "top": 358,
69           "bottom": 398
70         }
71       },
72       {
73         "type": "text",
74         "position": {
75           "left": 1322,
76           "right": 1370,
77           "top": 400,
78           "bottom": 407
79         },
80         "text": "World"
81       }
82     ]
83   },
84   {
85     "type": "image",
86     "position": {
87       "left": 1419,
88       "right": 1476,
89       "top": 354,
90       "bottom": 411
91     }
92   },
93   {
94     "type": "text",
95     "position": {
96       "left": 1219,
97       "right": 1276,
98       "top": 354,
99       "bottom": 411
100    },
101    "text": "Hello"
102  }
103 }

```

Figure 9: Exemplary HPIE in JSON Format

Aspects of the techniques presented herein support converting a share to an editable whiteboard.

Employing the HPIE information, an attendee's meeting client is able to reconstruct the hierarchical structure of the elements in the share. Figures 10A and 10B, below, depict aspects of a presenter's share.

Figure 10A, below, illustrates a presenter (e.g., Alice) sharing a slide from her slide deck.

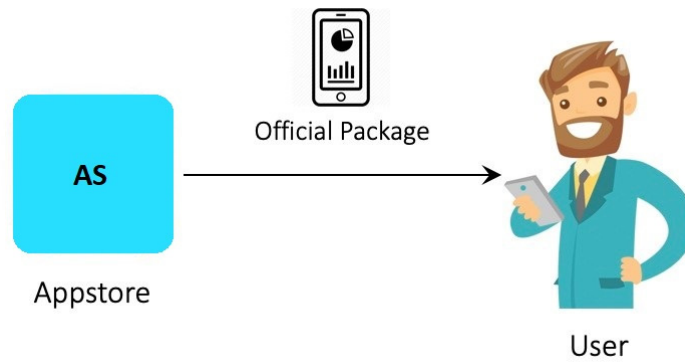


Figure 10A: Presenter's Original Sharing of her Slide

Figure 10B, below, presents the HPIE of the slide that was presented in Figure 10A, above.

```

1  {
2  "elements": [
3  { // group of "Appstore" image and text
4    "type": "group",
5    "position": {
6      "left": 100,
7      "right": 220,
8      "top": 95,
9      "bottom": 242
10   },
11   "elements": [
12     { // "Appstore" image
13       "type": "image",
14       "position": {
15         "left": 110,
16         "right": 210,
17         "top": 105,
18         "bottom": 205
19       }
20     },
21     { // "Appstore" text
22       "type": "text",
23       "position": {
24         "left": 112,
25         "right": 208,
26         "top": 207,
27         "bottom": 237
28       },
29       "text": "Appstore"
30     }
31   ]
32 },
33 { // group of "Official Package" image and text
34   "type": "group",
35   "position": {
36     "left": 225,
37     "right": 345,
38     "top": 65,
39     "bottom": 145
40   },
41   "elements": [
42     { // "Official Package" image
43       "type": "image",
44       "position": {
45         "left": 255,
46         "right": 315,
47         "top": 70,
48         "bottom": 115
49       }
50     },
51     { // "Official Package" text
52       "type": "text",
53       "position": {
54         "left": 230,
55         "right": 340,
56         "top": 115,
57         "bottom": 140
58       },
59       "text": "Official Package"
60     }
61   ]
62 },
63 { // group of "User" image and text
64   "type": "group",
65   "position": {
66     "left": 348,
67     "right": 468,
68     "top": 70,
69     "bottom": 262
70   },
71   "elements": [
72     { // "User" image
73       "type": "image",
74       "position": {
75         "left": 363,
76         "right": 453,
77         "top": 85,
78         "bottom": 212
79       }
80     },
81     { // "User" text
82       "type": "text",
83       "position": {
84         "left": 388,
85         "right": 428,
86         "top": 217,
87         "bottom": 247
88       },
89       "text": "User"
90     }
91   ]
92 },
93 { // Arrow image
94   "type": "image",
95   "position": {
96     "left": 210,
97     "right": 365,
98     "top": 140,
99     "bottom": 150
100  }
101 }
102 ]
103 }

```

Figure 10B: HPIE of Shared Slide from Figure 10A

A meeting attendee (e.g., Bob) may then complete a number of steps. Those steps will be briefly described below.

During a first step, a clone of the current frame of the share is created as a static image (e.g., a whiteboard). The right side of Figure 11A, below, depicts such a cloned static image.

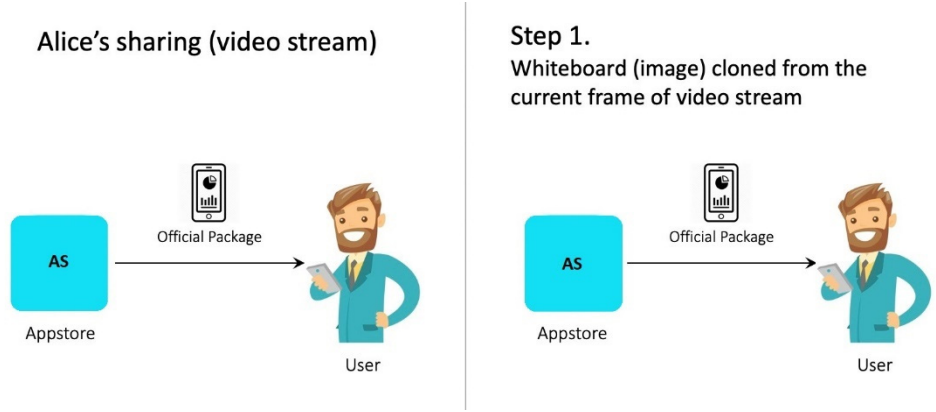


Figure 11A: Step 1 - Cloning

During a second step, the hierarchical structure of the elements in the static image is reconstructed using the HPIE information. Figure 11B, below, illustrates the relationships between each element and its information in the HPIE.



Figure 11B: Step 2 – Reconstructing Hierarchical Structure

During a third step, for each item in the hierarchical structure an editable element is created with the same position and size as described by the HPIE. Figure 11C, below, illustrates aspects of such an approach.

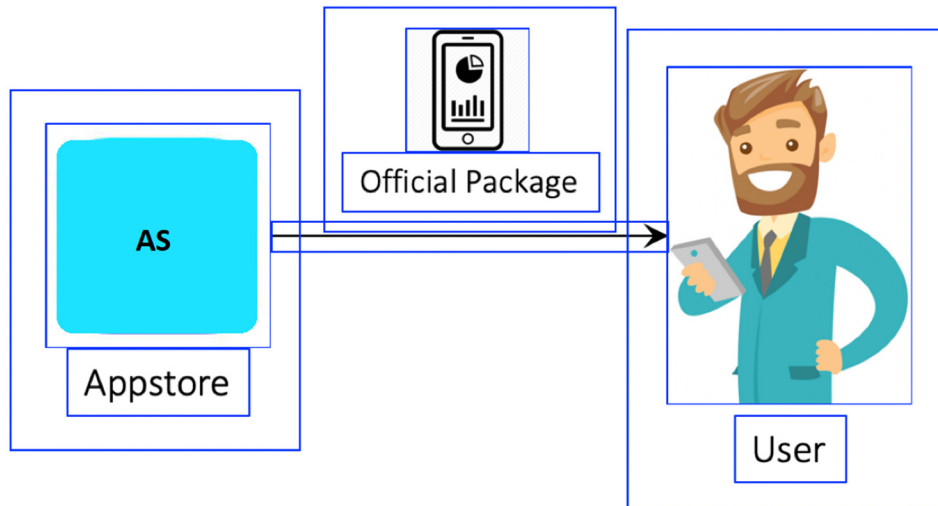


Figure 11C: Step 3 – Editable Element Creation

It is important to note that the blue boundary boxes that are depicted in Figure 11C, above, are for purposes of exposition of this step. In real implementations, the blue boundary boxes are invisible by default. A boundary box becomes visible when it is selected (by, for example, a mouse click).

During the third step, if an element is of type text then the text value will be cloned from the HPIE. If an element is a picture, then cloning will take place against the image of the restricted area of the static image from the first step. Following completion of the third step, the result is still a whiteboard (i.e., a static image) but there will be editable elements on top of it having a hierarchical structure. Those elements may then be moved, scaled, rotated, copied and pasted, deleted, etc.

Aspects of the techniques presented herein encompass, among other things, workflow elements. Figure 12, below, is a typical example of online sharing and collaborative annotation.

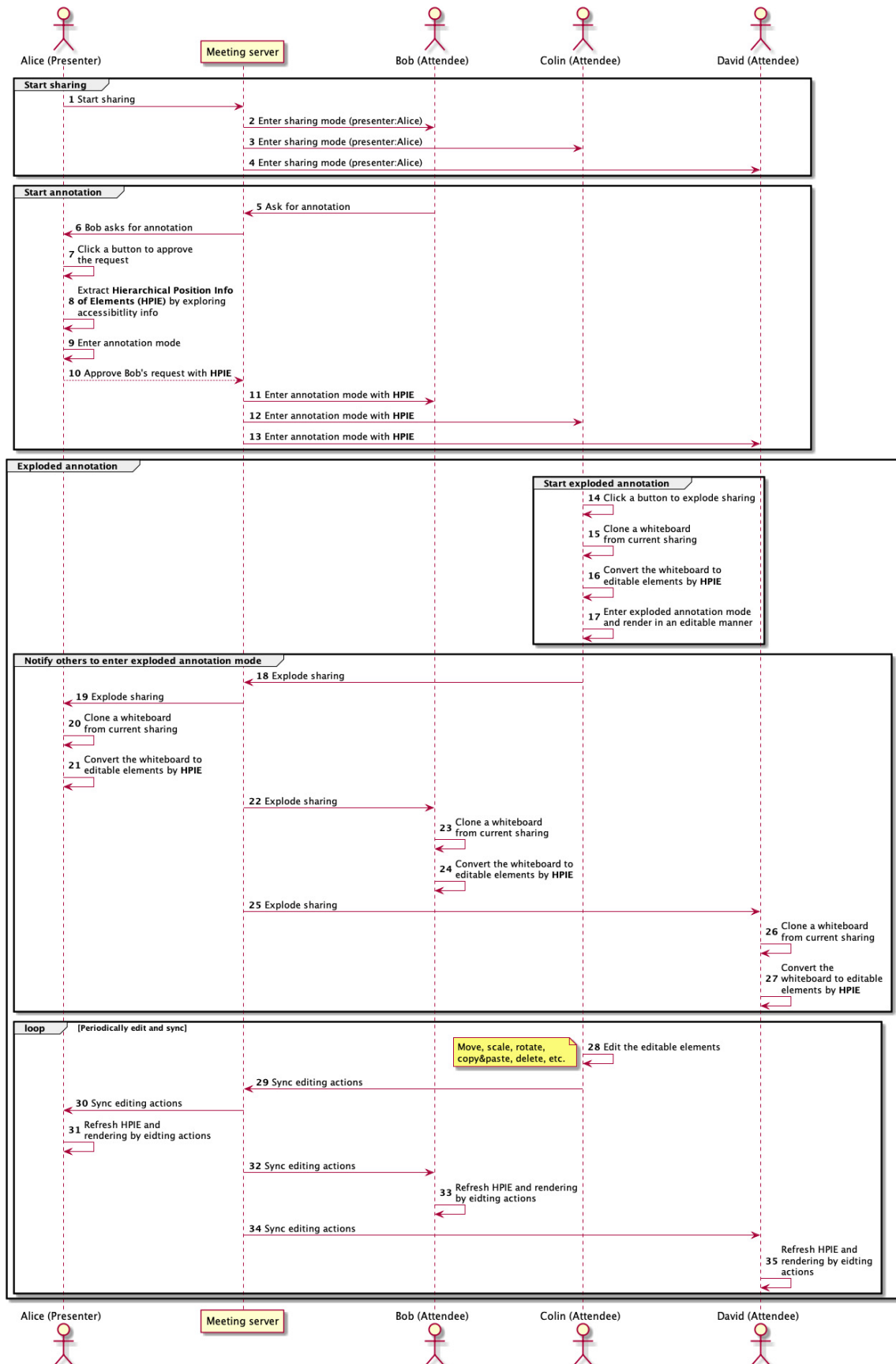


Figure 12: Exemplary Workflow Triggering an Explosion

As depicted in Figure 12, above, when attendee Bob requests annotation in Step 5 and the presenter Alice approves the request in Step 7, Alice's meeting client performs a number of actions, including:

1. At Step 8, extract the HPIE.
2. At Step 10, send the HPIE to the server.
3. During Steps 11 through 23, the server broadcasts the HPEI throughout the meeting.

Then, another attendee (i.e., Colin) starts an exploded annotation in Step 14. Colin's meeting client performs a number of actions, including:

1. At Step 15, clone a static image (i.e., a whiteboard) from the current share.
2. At Step 16, convert the whiteboard into editable elements through the HPIE (which was received in Step 12).
3. At Step 17, enter the exploded annotation mode and render the whiteboard in an editable manner.

During Steps 18 to 27, all of the other participants in the meeting are notified to perform the same conversion and enter the exploded annotation mode.

Based on all of the above preparations, Colin may then edit the editable elements (e.g., move, scale, rotate, copy and paste, delete, etc.) as depicted in Step 28. The editing actions are synchronized in the meeting and the meeting client of each participant in the meeting appropriately updates their own HPIE and whiteboard (as depicted in Steps 29 to 35). Such updates are a continuous action, as illustrated through a "loop" in Figure 12, above.

Figure 13, below, illustrates how online sharing and collaborative annotation may work when multiple attendees annotate collectively.

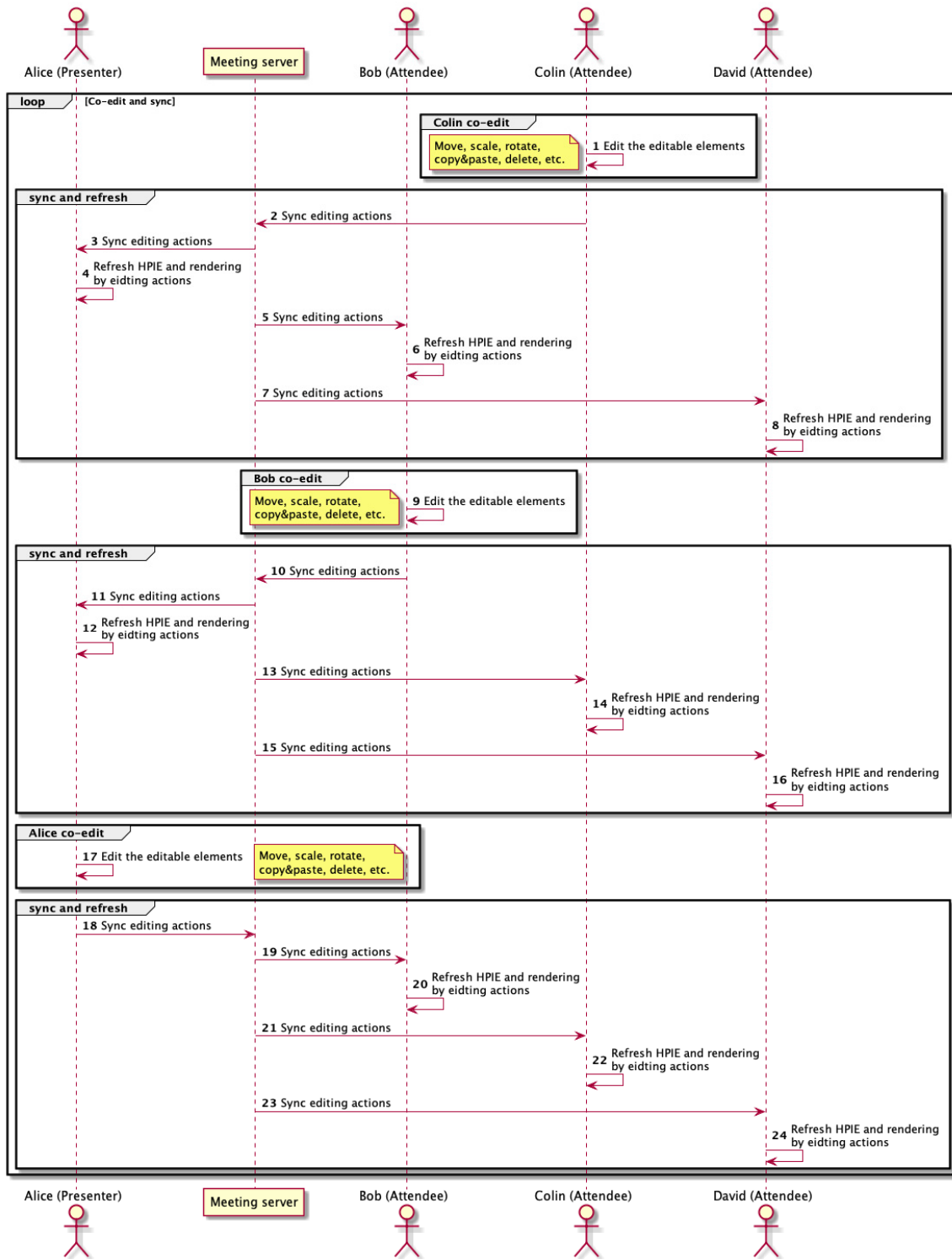


Figure 13: Exemplary Co-Edit Based on Exploded Editable Elements

As depicted in Figure 13, above, each co-edit is an action on an editable element. Accordingly, the action may be an incremental change on the HPIE. By broadcasting and

coordinating the HPIE changes from multiple parties, multiple attendees may co-edit on the same whiteboard. According to aspects of the techniques presented herein, there may be a mechanism, which may be implementation dependent, to handle any concurrency conflict that might arise during such activity.

It is important to note that the HPIE is accessible to meeting clients only. For example, an end user cannot see it. Further, the HPIE resides within computer memory and it lives only for as long as the current annotation. When an annotation is stopped, the HPIE is discarded.

Figure 14, below, illustrates aspects of how a “hole” may be handled when an element is moved.

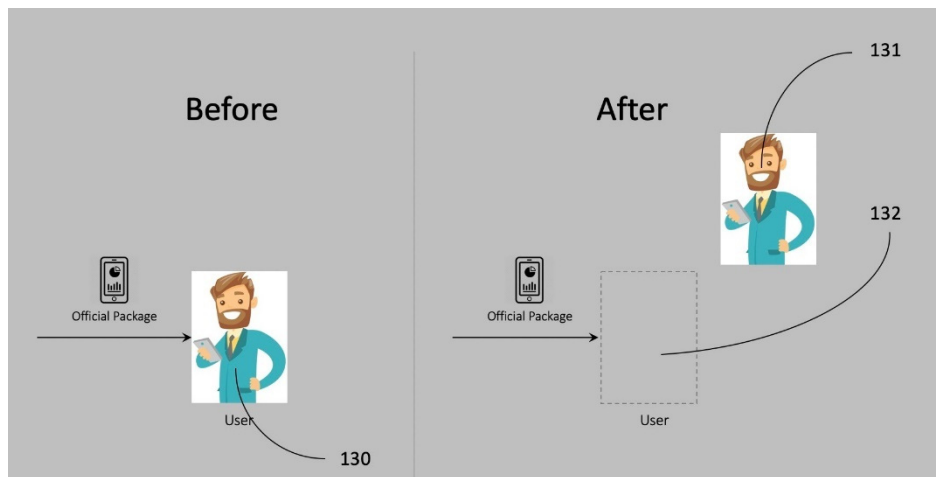


Figure 14: Filling In a "Hole" With Color or Pattern by Referring to Neighboring Areas

As depicted in Figure 14, above, when an editable element (e.g., the "User" picture (130)) is moved somewhere else (e.g., to 131) the rectangle that used to be at the previous position (i.e., 132) may become a "hole" with no color or pattern. Such an occurrence is not user-friendly. Accordingly, under aspects of the techniques presented herein such a “hole” may be filled with a color or a pattern that is obtained by referring to neighboring areas.

In the example that is depicted in Figure 14, above, a color from a neighboring area worked perfectly. For more complicated cases, a reference color or a reference pattern is

preferred. For such a case, aspects of the techniques presented herein leverage several of the commonly-available image processing algorithms.

It is important to note that when an application that is being shared has accessibility information, the meeting client may take advantage of the HPIE-based annotation method, as supported by aspects of the techniques presented herein and as described and illustrated in the preceding narrative, to facilitate annotation productivity. If, however, there is no accessibility information available, then application of the techniques presented herein is limited. Consequently, the techniques presented herein may serve as a complement to the traditional means of online collaborative annotation. In effect, the greater an application supports accessibility the better the techniques presented herein will work.

In summary, techniques have been presented herein that support an innovative method for facilitating online meeting annotation. Aspects of the presented techniques support exploding a meeting presenter's share into editable elements. By applying aspects of the presented techniques, a share is no longer a bulk of a single static image but a collection of fine-grained editable elements. Through such editable elements a sharing-based annotation is easier to manipulate and more user-friendly than ever before.