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SERIES T: TERMINALS FOR TELEMATIC SERVICES
Data protocols for multimedia conferencing

Multipoint still image and annotation protocol

ITU-T Recommendation T.126



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ITU-T Recommendation T.126

Multipoint still image and annotation protocol

Summary

ITU-T Recommendation T.126 defines a protocol supporting the management of common multi-layer visual spaces and the multipoint exchange of graphical information directed to these spaces including images (hard and soft copy), pointers, and filled and unfilled parametric drawing elements (points, lines, polygons and ellipses). Support for rendering out-of-band video streams within T.126 workspaces is also included. In addition, keyboard and pointing device exchanges are specified to support basic user interaction. Protocol elements for creating and referencing archived visual spaces are defined to allow pre-stored or pre-distributed graphical materials to be referenced. This protocol uses services provided by ITU-T Recommendations T.122 (MCS) and T.124 (GCC) and complies with the guidelines specified in ITU-T Recommendation T.121 (GAT).

This revised version of ITU-T Recommendation T.126 introduces a number of clarifications to the previous version.

Source

ITU-T Recommendation T.126 was approved on 29 August 2007 by ITU-T Study Group 16 (2005-2008) under the ITU-T Recommendation A.8 procedure.

FOREWORD

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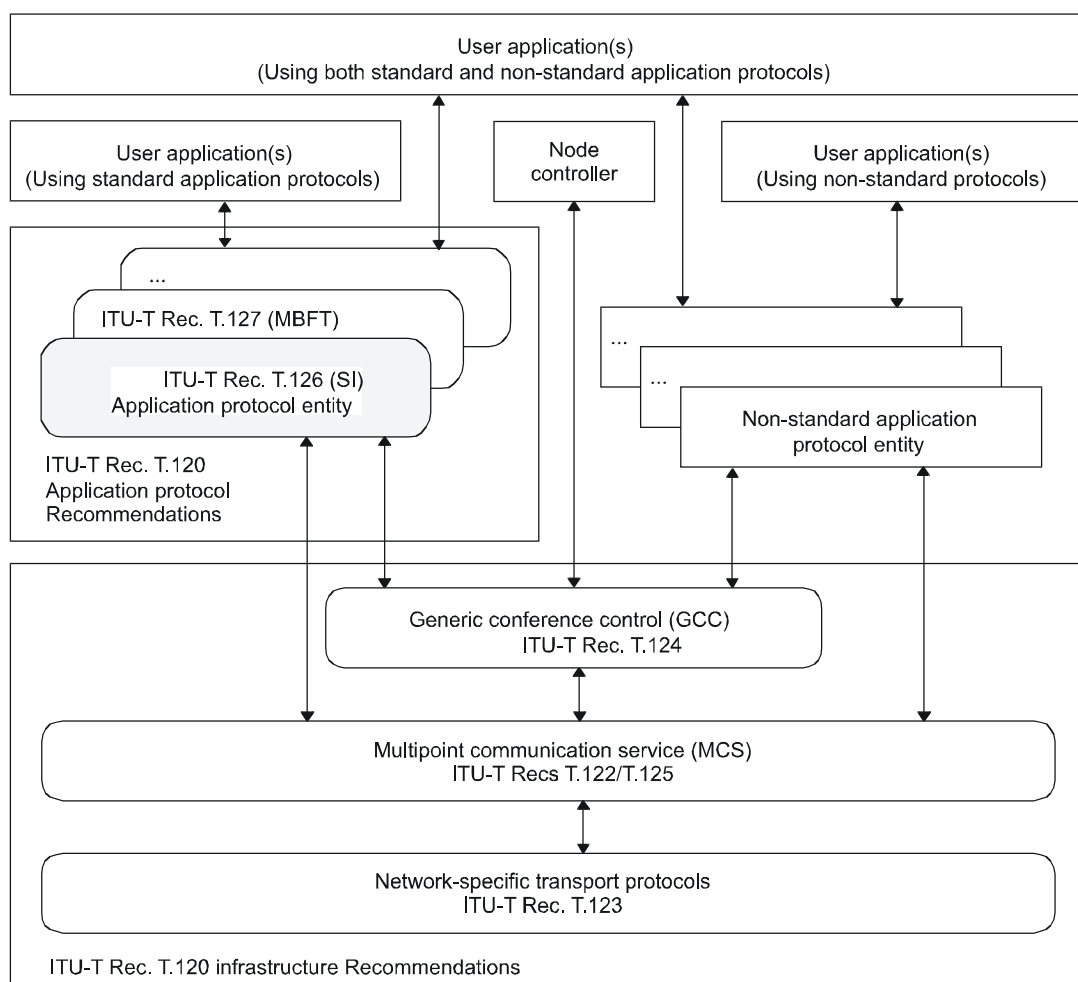
Multipoint still image and annotation protocol

1 Scope

This Recommendation defines a protocol supporting the management of common multi-layer visual spaces and the multipoint exchange of graphical information directed to these spaces including images (hard and soft copy), pointers, and filled and unfilled parametric drawing elements (points, lines, polygons and ellipses). Support for rendering out-of-band video streams within T.126 workspaces is also included. In addition, keyboard and pointing device exchanges are specified to support basic user interaction. Protocol elements for creating and referencing archived visual spaces are defined to allow pre-stored or pre-distributed graphical materials to be referenced. This protocol uses services provided by ITU-T Recommendations T.122 (MCS) and T.124 (GCC) and complies with the guidelines specified in ITU-T Recommendation T.121 (GAT).

The details of communication with the input and output devices and the user interfaces on the host terminal are considered out of the scope of this Recommendation and are left to the discretion of the implementer. Therefore, this Recommendation makes no assumption that these I/O devices are of any specific architecture.

Figure 1-1 presents an overview of the scope of this Recommendation and its relationship to the other elements of the T.120 framework within a single node.



T1604400-07/d01

Figure 1-1 – Scope of T.126

2 Normative references

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- [ITU-T F.702] ITU-T Recommendation F.702 (1996), *Multimedia conference services*.
- [ITU-T H.221] ITU-T Recommendation H.221 (2004), *Frame structure for a 64 to 1920 kbit/s channel in audiovisual teleservices*.
- [ITU-T H.245] ITU-T Recommendation H.245 (2006), *Control protocol for multimedia communication*.
- [ITU-T T.4] ITU-T Recommendation T.4 (2003), *Standardization of Group 3 facsimile terminals for document transmission*.
- [ITU-T T.6] ITU-T Recommendation T.6 (1988), *Facsimile coding schemes and coding control functions for Group 4 facsimile apparatus*.

- [ITU-T T.35] ITU-T Recommendation T.35 (2000), *Procedure for the allocation of ITU-T defined codes for non-standard facilities.*
- [ITU-T T.42] ITU-T Recommendation T.42 (2003), *Continuous-tone colour representation method for facsimile.*
- [ITU-T T.50] ITU-T Recommendation T.50 (1992), *International Reference Alphabet (IRA) (Formerly International Alphabet No. 5 or IA5) – Information technology – 7-bit coded character set for information interchange.*
- [ITU-T T.81] ITU-T Recommendation T.81 (1992) | ISO/IEC 10918-1:1994, *Information technology – Digital compression and coding of continuous-tone still images – Requirements and guidelines.*
- [ITU-T T.82] ITU-T Recommendation T.82 (1993) | ISO/IEC 11544:1993, *Information technology – Coded representation of picture and audio information – Progressive bi-level image compression.*
- [ITU-T T.120] ITU-T Recommendation T.120 (2007), *Data protocols for multimedia conferencing.*
- [ITU-T T.121] ITU-T Recommendation T.121 (1996), *Generic application template.*
- [ITU-T T.122] ITU-T Recommendation T.122 (1998), *Multipoint communication service – Service definition.*
- [ITU-T T.123] ITU-T Recommendation T.123 (2007), *Network-specific data protocol stacks for multimedia conferencing.*
- [ITU-T T.124] ITU-T Recommendation T.124 (2007), *Generic conference control.*
- [ITU-T T.125] ITU-T Recommendation T.125 (1998), *Multipoint communication service protocol specification.*
- [ITU-T X.680] ITU-T Recommendation X.680 (2002) | ISO/IEC 8824-1:2002, *Information technology – Abstract Syntax Notation One (ASN.1) – Specification of basic notation.*
- [ITU-T X.690] ITU-T Recommendation X.690 (2002) | ISO/IEC 8825-1:2002, *Information technology – ASN.1 encoding rules – Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER), and Distinguished Encoding Rules (DER).*
- [ITU-T X.691] ITU-T Recommendation X.691 (2002) | ISO/IEC 8825-2:2002, *Information technology – ASN.1 encoding rules – Specification of Packed Encoding Rules (PER).*
- [ITU-R BT 601-6] ITU-R Recommendation BT 601-6 (2007), *Studio encoding parameters of digital television for standard 4:3 and wide-screen 16:9 aspect ratios.*
- [ITU-R BT 709-5] ITU-R Recommendation BT 709-5 (2002), *Basic values for the HDTV standards for production and programme exchange.*
- [CIE 15.2] CIE 15.2 (1986), *Colorimetry, 2nd Edition.*
- [ISO/IEC 10646] ISO/IEC 10646:2003, *Information technology – Universal Multiple-Octet Coded Character Set (USC).*
- [ISO/IEC 13818-6] ISO/IEC 13818-6:1998, *Information technology – Generic coding of moving pictures and associated audio information – Part 6: Extensions for DSM-CC.*

3 Definitions

This Recommendation defines the following terms:

3.1 4:4:4: A notation that defines the relative horizontal resolution of a three-colour component raster to be equal.

3.2 4:2:2: A notation that defines the relative horizontal resolution of a three-colour component raster to have twice the horizontal resolution on the first channel than the other two.

3.3 4:2:0: A three-colour component raster having twice the horizontal resolution as well as twice the vertical resolution on the first channel.

3.4 annotation: Real-time drawings (freehand drawing, lines, rectangles, ellipses, etc.) and bitmaps (used for text and unsupported graphical elements, for example) shared between peer SICEs.

3.5 bitmap: A rectangular area described by a two-dimensional array of pixels. These pixels can be coded using a variety of encoding methods.

3.6 control points: A set of points defined in terms of the workspace coordinate system that define a drawing shape parametrically.

3.7 drawing: A type of annotation consisting of instructions for creating points, polylines, rectangles, ellipses or non-standard drawing elements.

3.8 handle: A session-wide unique number used to identify an addressable item.

3.9 image: Photographic or document-oriented information which is transmitted in the form of an image bitmap.

3.10 non-standard capability: The capability is outside the scope of this Recommendation but it has been determined through negotiation that it is recognized among all session participants.

3.11 palette: A finite set of colours defined by at least three linearly-independent colour primaries.

3.12 palettized: A term used to describe visible objects (annotation bitmaps, drawing elements) comprised of palettized pixels. The colour of a palettized pixel is specified by the colour value at the location in a colour look-up table referenced by the pixel value.

3.13 plane: A virtual area defined to have the same pixel dimensions as the workspace with which it is associated. A plane provides a canvas for the use of annotation tools such as drawing, erasing and text, as well as for bitmaps.

3.14 pointer plane: A virtual area defined to have the same dimensions as the workspace with which it is associated. This virtual area in front of all other planes houses all the pointers referencing a given workspace.

3.15 pointer: A bitmap that is moveable over the workspace that is used by its creator as an indicator of position.

3.16 standard capability: The capability is defined within the scope of this Recommendation but is not required for all SICE implementation. Note that all standard capabilities must be negotiated before use.

3.17 still image conference entity: An application protocol entity that interacts with a user application above and with the local multipoint communication service (MCS) and local GCC provider below. Data are exchanged between peer SICEs using still image protocol data units (SIPDUs).

3.18 unicode: Multilingual text string format as defined in [ISO/IEC 10646].

3.19 workspace: A workspace is an area comprising N independent but coincident planes of the same pixel dimensions. The assembly of N planes forms the complete display. At a given workspace coordinate, data in any plane hides data present in underlying planes in the stack unless the pixel value at that plane is transparent. If there are no data at a specific pixel location in the middle or front planes, the location is said to be transparent and does not hide the data from underlying planes.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

GCC	Generic Conference Control
GCCSAP	Generic Conference Control Service Access Point
MCS	Multipoint Communication Service
MCSAP	Multipoint Communication Service Access Point
MCU	Multipoint Control Unit
PDU	Protocol Data Unit
SICE	Still Image Conferencing Entity
SIPDU	Still Image Protocol Data Unit

5 Overview

5.1 SI application enrolment

An SI application enrolls via the application enrolment mechanism specified in [ITU-T T.121].

5.2 Capabilities and profiles

The transactions defined by the SI protocol and the ranges on many of the associated parameters are governed by the capabilities set that is in effect at the time of the exchange. Capability profiles exist for terminals wishing to operate as a whiteboard only, operate as a soft copy image exchange terminal, operate as a soft copy image exchange terminal that can annotate and whiteboard, or operate as a hard copy image exchange device. For forward compatibility reasons, these profiles are simply lists of capabilities that must be advertized; therefore, it is possible for a terminal to be capable of one or more of the above functions.

See Annex A for a detailed description of the standard SI profiles. The capabilities exchange mechanism is the method by which additional capabilities that are not assumed by the specific application class are negotiated. The vehicle for this negotiation is the GCC application enrolment facility which has a well-defined protocol for this purpose.

5.3 Workspaces

The workspace data structure and associated operators provides a self-contained, platform-independent method for describing, manipulating and maintaining related annotation, pointer and bitmap data. A workspace is composed of N depth-ordered planes. Higher numbered planes (and all their associated contents) are assumed to be in front of their lower numbered counterparts within the same workspace. Each plane's contents may include images and/or annotations depending on how the plane is tagged at creation time. Depending on negotiated capabilities, a workspace may also include a virtual pointer plane which resides above all other planes. See Figure 5-1.

A created workspace in a session has the same pixel dimensions at all sites within the session. Placement of annotations and images, each in their respective planes, is indicated in workspace coordinates. All workspace coordinates are specified in units of whole pixels. The pixel aspect ratio is 1:1 but there is no absolute size associated with a pixel. Coordinates referenced in this Recommendation are shown as (X,Y) where the workspace origin (0,0) is defined to be at the upper left hand corner of the workspace. The lower right hand corner of the workspace has the coordinate value (workspace horizontal dimension – 1, workspace vertical dimension – 1). Even though workspace pixels are defined to have a square aspect ratio, bitmaps may be exchanged whose native resolutions are non-square. The allowable aspect ratios are dictated by the enforcing profile and capability set.

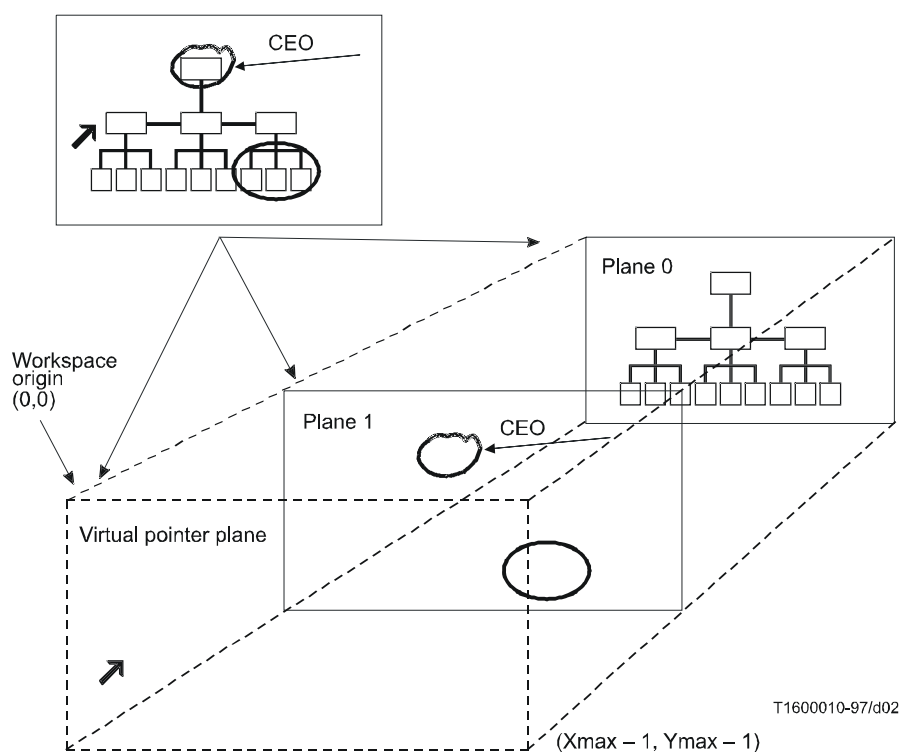


Figure 5-1 – Workspace

To make a workspace visible, one or more workspace views may be defined for a workspace. Each view corresponds to a rectangular region within the workspace to be viewed (which, in the simplest case, is the entire workspace). Within an SI session, only one view among all workspaces is designated as the focus view. This view should be made visible at all nodes.

An SICE implementation may not have a display subsystem that can accommodate the full dimensions of the negotiated maximum size workspace. In this case, the SICE may use any suitable method such as scroll bars or scaling to accommodate a workspace view of a size larger than the local display resolution. Similarly, a workspace view smaller than the local display resolution may, if desired, be scaled appropriately to fill the display. However, regardless of how an SICE chooses to display a workspace view, it must locate its annotations, pointers and bitmaps based on the coordinate system defined for the workspace.

A session can support multiple workspaces given sufficient storage in each SICE. Upon indication by the GCC of new arrivals in the session, all workspaces are deleted upon the creation of the first new one. All SICEs shall create a new workspace whenever they detect that there is a transition from one logical boundary to another. The logical boundary condition is locally determined. An example of one might be the progress from one slide or view graph to the next in a presentation

application using this Recommendation. This Recommendation also defines procedures for refreshing late arrivers with workspace data present in the session before they entered.

5.4 Hard copy devices

An SICE can advertize an optional capability that expresses the ability to receive bitmap exchanges bound for hard copy devices directly. If at least two nodes in the session have this capability, they can exchange these types of bitmaps, which are restricted by a separate capability set from those of the soft copy functions that adapts to facsimile-like devices.

5.5 Bitmaps

The SI protocol supports the exchange of bitmaps. The supported standard formats include:

- uncompressed;
- T.4 (G3);
- T.6 (G4);
- T.81 (JPEG);
- T.82 (JBIG).

Other formats can be negotiated. The governing profile may only allow a subset of the above list in a session. The SI protocol supports bitmap scaling and cropping on a capability negotiated basis. These functions are useful, for example, when attempting to transmit a precompressed image where decompression and recompression would have to be performed if only a subregion of the bitmap is of interest or the bitmap is at an inappropriate resolution.

All submitted bitmaps can be optionally edited and deleted using SI-defined exchanges. These operations are only allowed to workspace planes that will support them and may be disallowed by capabilities negotiation.

5.6 Pointers

Pointers are supported using the bitmap exchange functions. Bitmaps specified as pointers do not belong to any specific workspace plane but instead are managed with respect to the workspace in a virtual plane on top of all other data bearing planes. Pointers are privately held by their creator and are removed if the creator leaves the session in any fashion. Only the creator of a pointer may move it or delete it.

5.7 Video windows

The SI protocol defines exchanges to support the allocation, deletion and management of video window objects that can be placed in SI workspace planes. There is no video information carried via the SI protocol. A referencing mechanism is defined to allow video streams loosely associated with the SI session to be assigned to a video window object. This facility enables conference video streams to be more integrated with the display of graphical information. Features such as interactive video annotation and pointing are examples of functions that are enabled by this service.

5.8 Text

Direct support of text primitives is left for future study. Text can currently be exchanged using the SI protocol by rendering the text locally into a bitmap and then transmitting that bitmap to the session. Alternatively, non-standard text primitives can be negotiated and used within the session. Text bitmaps can use the transparency features of the protocol to support the rendering of only the text information that is drawn into a bitmap.

5.9 Drawn graphical elements

5.9.1 Drawing and erasing basic shapes

The SI protocol defines exchanges for basic drawing shapes. These include:

- open and closed polylines (free hand drawing);
- points;
- rectangles;
- ellipses.

Attributes of the SI basic drawing shapes include:

- line colour;
- fill colour;
- line thickness;
- pen nib shape;
- line style.

Erasing is supported in two ways depending on whether the target workspace plane is of the permanent or editable type. If permanent, erasing is accomplished by drawing over the desired areas with the outline and fill colours set to transparent. Otherwise, erasing is supported by deleting the desired object using the SI drawing delete exchange.

All submitted drawings can be optionally edited and erased using SI-defined exchanges. These operations are only allowable in workspace planes that will support them and may be disallowed from the entire session by capabilities negotiation.

5.9.2 Drawing and erasing custom shapes

Custom shapes that are not supported by the SI protocol or that are disallowed by the specific profile being used or capabilities set negotiated can be supported within the session by rendering them locally into a bitmap which is then submitted to the session using the SI bitmap exchange mechanism. Note that bitmaps can be filled with a transparent colour in all pixel locations that are not affected by the custom shape being rendered.

Custom shapes (and their associated custom attributes) can be supported within a session using non-standard shape and attribute fields within the SI drawing PDUs if they are successfully negotiated.

5.10 Remote events

The SI protocol supports the exchange of keyboard and pointing device events as well as requests for remote workspace printing. These facilities can be optionally supported by terminals if they wish to support basic user interactions with the graphical information presented in SI workspaces (button clicking, basic gesturing, remote printing initiation, etc.). The use of these facilities is not negotiated. These exchanges should be ignored by any terminal that does not support them.

5.11 Archives

This Recommendation supports an archiving function that allows the remote retrieval of information from pre-distributed databases. It also specifies a protocol that can be optionally used to create those databases and add to them remotely.

5.12 Conducted mode behaviour

When a session is in conducted mode, the SICE at the conductor node may grant a set of privileges to perform various actions to one or more nodes in the session. Without such privileges or global conducted-mode permission from the conducting node, an SICE is restricted from performing these actions unless the SICE is the designated refresher for the session.

6 Use of MCS

6.1 Use of MCS service primitives

An SICE uses the following MCS service primitives to attach and detach from a domain, join and leave the SI channel, send and receive SIPDUs, and manage token operations. Table 6-1 describes each of the primitives used by an SICE.

Table 6-1 – MCS primitives needed by an SICE

MCS primitive	Description
MCS-ATTACH-USER	Creates an MCS attachment through an MCS SAP to a domain hosted by the MCS provider. A result is confirmed to the requester. If the request is accepted, a user ID is assigned.
MCS-DETACH-USER	Deletes an MCS attachment that was created previously by invocation of MCS-ATTACH-USER. This primitive may be requested by a user or initiated by a provider. It delivers an indication at every other MCS attachment to the same domain. If provider-initiated, an indication is also delivered at the deleted attachment.
MCS-CHANNEL-JOIN	Used by an application client to join an appropriate channel whose use is defined by the application. This is a prerequisite for receiving data sent to the channel.
MCS-CHANNEL-LEAVE	Used by an application client to leave a previously joined channel and thus stop receiving data sent to that channel. The primitive may be user-initiated (request only) or provider-initiated (indication to affected user only).
MCS-CHANNEL-CONVENE	Used to allocate a new private channel with the requesting user as manager.
MCS-CHANNEL-ADMIT	This primitive enlarges the authorized user group of a private channel at the request of its manager. An indication is delivered to the MCS user added. That user may thereafter send data on the channel or join it as a receiver.
MCS-SEND-DATA	Used to transmit data to other members of a domain. If the sender is a member of the destination channel, it will not receive its own data indications. However, it will receive data indications from other sources addressed to that channel.
MCS-UNIFORM-SEND-DATA	Used to transmit data to other members of a domain in a uniformly sequenced manner, i.e., the data will be received in the same sequence by all members of the destination channel. The different data units from the domain clients will be forwarded to the top MCS provider, which will send them back to all clients in the same sequence. Uniform sequencing of data is guaranteed only for data of the same priority on the same channel.
MCS-TOKEN-GRAB	Used to take exclusive control of a specific token.
MCS-TOKEN-INHIBIT	Used to take non-exclusive control of a specific token.

Table 6-1 – MCS primitives needed by an SICE

MCS primitive	Description
MCS-TOKEN-RELEASE	Used to free up a previously grabbed or inhibited token.
MCS-TOKEN-TEST	Used to check if a token is available.
MCS-TOKEN-PLEASE	Used to request a token held by another node.
MCS-TOKEN-GIVE	Used to pass a token directly from one node to another.

MCS request and response primitives are directed from the SICE to the MCS provider, while indication and confirm primitives are directed from the MCS provider towards the SICE. Additional detail on the MCS primitives described above can be found in [ITU-T T.122].

6.2 Use of MCS tokens and channels

Table 6-2 describes MCS channel and token usage for SICE sessions of the types defined in [ITU-T T.121]. In the case of a session type requiring static channels and tokens, the channel and token IDs shown in Table 6-2 shall be used (symbolic IDs shown). For all other session types, the resource IDs shown in the table shall be used for allocating dynamic tokens and channels. The given resource IDs shall be encoded as two-octet T.50 text strings using the characters shown in quotes in Table 6-2.

Table 6-2 – Description of SI tokens and channels

Mnemonic	Mnemonic for static channel and token IDs	Resource IDs for dynamic channels and tokens	Description
SI-{MCS-USER-ID}-CHANNEL	—	—	Certain SIPDUs are sent directly to individual SICES. To do this, the individual MCS-USER-ID channels of the peer SICES in the MCS domain are used.
SI-CHANNEL	SI-CHANNEL-0	"C0"	This channel bears all SIPDUs to be broadcast to all peer SICES in a domain.
SI-BITMAP-CREATE-TOKEN	SI-TOKEN-0	"T0"	This token is used to restrict bitmap creation to allow only a single bitmap creation at a time. This token shall always be used for bitmaps destined to hard-copy workspaces. For soft-copy workspaces, this token shall only be used if the Soft-Copy-Bitmap-No-Token-Protection capability is not present in the negotiated capability set.

Table 6-2 – Description of SI tokens and channels

Mnemonic	Mnemonic for static channel and token IDs	Resource IDs for dynamic channels and tokens	Description
SI-WORKSPACE-REFRESH-TOKEN	SI-TOKEN-1	"T1"	This token is used to allow a specific SICE to become the designated workspace refresher. The SICE that holds this token is responsible for refreshing workspaces when a new peer SICE enrolls into the session.

6.3 Use of MCS data services

Table 6-3 lists the use of the MCS data services MCS-SEND-DATA and MCS-UNIFORM-SEND-DATA for each SIPDU. This table includes the channel over which the data is sent, which of the two MCS primitives shall be used for the case of synchronized and unsynchronized workspaces, and the data priority at which the data is sent. If more than one channel priority is mandated, the SIPDU must be sent on all.

All PDUs specified in this Recommendation are placed in the data parameter of the MCS-SEND-DATA and MCS-UNIFORM-SEND-DATA primitives. The ASN.1-encoded PDUs are packed into the sequence of octets that form the data parameter such that the leading bit is placed in the most significant bit of each octet and filled toward the least significant bit of the octet.

Table 6-3 – Use of MCS data primitives for SIPDUs

SIPDU	Channel	MCS data primitive		Priority
		Synchronized workspaces	Unsynchronized workspaces (or hard-copy exchanges for valid SIPDUs) or exchanges involving single SICE access-protected workspace planes (Note 1)	
ArchiveAcknowledgePDU	User ID channel of source of ArchiveOpenPDU	MCS-SEND-DATA		Low
ArchiveClosePDU	SI-CHANNEL	MCS-UNIFORM-SEND-DATA		High, Medium, Low
ArchiveErrorPDU	User ID channel of source of archive command	MCS-SEND-DATA		Low
ArchiveOpenPDU	SI-CHANNEL	MCS-UNIFORM-SEND-DATA		Low

Table 6-3 – Use of MCS data primitives for SIPDUs

SIPDU	Channel	MCS data primitive		Priority
		Synchronized workspaces	Unsynchronized workspaces (or hard-copy exchanges for valid SIPDUs) or exchanges involving single SICE access-protected workspace planes (Note 1)	
BitmapAbortPDU	User ID channel of source of BitmapCreatePDU for request or SI-CHANNEL for announcement	MCS-SEND-DATA for request or MCS-UNIFORM-SEND-DATA for announcement	MCS-SEND-DATA or MCS-UNIFORM-SEND-DATA	(Note 3)
BitmapCheckpointPDU	SI-CHANNEL	MCS-UNIFORM-SEND-DATA	MCS-SEND-DATA or MCS-UNIFORM-SEND-DATA	High
BitmapCreatePDU	SI-CHANNEL	MCS-UNIFORM-SEND-DATA	MCS-SEND-DATA or MCS-UNIFORM-SEND-DATA	(Note 3)
BitmapCreateContinuePDU	SI-CHANNEL	MCS-UNIFORM-SEND-DATA	MCS-SEND-DATA or MCS-UNIFORM-SEND-DATA	(Note 3)
BitmapDeletePDU	SI-CHANNEL	MCS-UNIFORM-SEND-DATA	MCS-SEND-DATA or MCS-UNIFORM-SEND-DATA	(Note 3)
BitmapEditPDU	SI-CHANNEL	MCS-UNIFORM-SEND-DATA	MCS-SEND-DATA or MCS-UNIFORM-SEND-DATA	(Note 3)
ConductorPrivilegeGrantPDU	SI-CHANNEL	MCS-UNIFORM-SEND-DATA		High
ConductorPrivilegeRequestPDU	User ID channel of the SICE at the conducting node	MCS-SEND-DATA		High
DrawingCreatePDU	SI-CHANNEL	MCS-UNIFORM-SEND-DATA	MCS-SEND-DATA or MCS-UNIFORM-SD-DATA	Medium
DrawingDeletePDU	SI-CHANNEL	MCS-UNIFORM-SEND-DATA	MCS-SEND-DATA or MCS-UNIFORM-SEND-DATA	Medium
DrawingEditPDU	SI-CHANNEL	MCS-UNIFORM-SEND-DATA	MCS-SEND-DATA or MCS-UNIFORM-SEND-DATA	Medium
FontPDU	FFS	FFS		FFS
RemoteEventPermissionGrantPDU	SI-CHANNEL	MCS-UNIFORM-SEND-DATA		High

Table 6-3 – Use of MCS data primitives for SIPDUs

SIPDU	Channel	MCS data primitive		Priority
		Synchronized workspaces	Unsynchronized workspaces (or hard-copy exchanges for valid SIPDUs) or exchanges involving single SICE access-protected workspace planes (Note 1)	
RemoteEventPermissionRequestPDU	User ID channel of source of WorkspaceCreatePDU	MCS-SEND-DATA		High
RemoteKeyboardEventPDU	User ID channel of source of WorkspaceCreatePDU	MCS-SEND-DATA		High
RemotePointingDeviceEventPDU	User ID channel of source of WorkspaceCreatePDU	MCS-SEND-DATA		High
RemotePrintPDU	SI-CHANNEL	MCS-UNIFORM-SEND-DATA	MCS-SEND-DATA or MCS-UNIFORM-SEND-DATA	High (unsync'ed) High, Medium, Low (sync'ed)
SINonStandardPDU	(Note 2)	(Note 2)	(Note 2)	(Note 2)
TextCreatePDU	FFS	FFS		FFS
TextDeletePDU	FFS	FFS		FFS
TextEditPDU	FFS	FFS		FFS
VideoWindowCreatePDU	SI-CHANNEL	MCS-UNIFORM-SEND-DATA	MCS-SEND-DATA or MCS-UNIFORM-SEND-DATA	(Note 3)
VideoWindowDeletePDU	SI-CHANNEL	MCS-UNIFORM-SEND-DATA	MCS-SEND-DATA or MCS-UNIFORM-SEND-DATA	(Note 3)
VideoWindowEditPDU	SI-CHANNEL	MCS-UNIFORM-SEND-DATA	MCS-SEND-DATA or MCS-UNIFORM-SEND-DATA	(Note 3)
WorkspaceCreatePDU	SI-CHANNEL	MCS-UNIFORM-SEND-DATA		High (unsync'ed) High, Medium, Low (sync'ed)
WorkspaceCreateAcknowledgePDU	User ID channel of source of WorkspaceCreatePDU	–	MCS-SEND-DATA	High
WorkspaceDeletePDU	SI-CHANNEL	MCS-UNIFORM-SEND-DATA	MCS-SEND-DATA or MCS-UNIFORM-SEND-DATA	High (unsync'ed) High, Medium, Low (sync'ed)

Table 6-3 – Use of MCS data primitives for SIPDUs

SIPDU	Channel	MCS data primitive		Priority
		Synchronized workspaces	Unsynchronized workspaces (or hard-copy exchanges for valid SIPDUs) or exchanges involving single SICE access-protected workspace planes (Note 1)	
WorkspaceEditPDU	SI-CHANNEL	MCS-UNIFORM-SEND-DATA	MCS-SEND-DATA or MCS-UNIFORM-SEND-DATA	High (unsync'ed) High, Medium, Low (sync'ed)
WorkspacePlaneCopyPDU	SI-CHANNEL	MCS-UNIFORM-SEND-DATA	MCS-SEND-DATA or MCS-UNIFORM-SEND-DATA	(Note 3)
WorkspaceReadyPDU	SI-CHANNEL	–	MCS-SEND-DATA	High
WorkspaceRefreshStatusPDU	SI-CHANNEL	MCS-UNIFORM-SEND-DATA		High
NOTE 1 – MCS-SEND-DATA shall not be used unless the protectedPlaneAccessList includes only one SICE, the destination plane of the operation is designated protected and the SICE guarantees to never change the plane protection of the plane to unprotected.				
NOTE 2 – The use of the SInonStandardPDU is beyond the scope of this Recommendation.				
NOTE 3 – This indicates that the priority shall be medium if the destination plane has the annotation usage designator set or, in the case of bitmap operations, if the bitmap destination is the pointer plane, and low otherwise.				

7 Use of GCC

7.1 Use of GCC services

An SICE uses the services of GCC [ITU-T T.124] in the manner specified in [ITU-T T.121]. The use of GCC by an SICE shall comply with the procedures outlined in [ITU-T T.121] in addition to the procedures explicitly described in this Recommendation.

7.2 GCC unique handles

All handles used in the SI protocol are acquired from GCC using the GCC-Registry-Allocate-Handle primitive. Handles can be allocated at any time, not just immediately prior to their use. It is suggested that applications allocate blocks of handles to minimize network traffic and perform this operation when idle to avoid associated latencies during periods of protocol activity.

8 Protocol specification

8.1 Session initialization and management

Session initialization and management for this Recommendation shall be performed according to [ITU-T T.121]. The functions of the application resource manager (ARM) described in [ITU-T T.121] shall apply to any T.126 session. For this Recommendation, the following initialization parameters shall be used. For the application protocol key, the value {ITU-T recommendation t126 version(0) 2} shall be used. The required channel and token

resources are defined in Table 6-2. The numeric values of the static channel and token IDs are specified in [ITU-T T.120].

In order to enable SICEs to perform session initialization functions such as (but not limited to) creating an initial whiteboard or displaying an introductory image, it is necessary for session members to be able to identify whether or not they are the first session participant upon entering the session. Identification of the first session participant shall be accomplished by employing a single GCC registry parameter. Upon active enrolment in a session, an SICE shall perform a GCC-Registry-Retrieve-Entry exchange with the resource ID portion of the registry key parameter set to the T.50-encoded octet string "INITIAL". If the result of the exchange reported by the GCC-Registry-Retrieve-Entry confirm is "successful", then the SICE shall deem itself not the initial session participant and not perform any startup operations such as creating an initial workspace. If the result is "entry not found", then the SICE shall attempt to create the same parameter using the GCC-Registry-Set-Parameter exchange using the same resource ID for the registry key and specifying "owner" for the optional modification rights parameter. If the result of this exchange is "successful", then the SICE has identified that it is the initial session participant and can perform its initial actions. If the result is "invalid requester", then the SICE shall not consider itself the first session participant. The scenario that could result in the later condition is one where multiple SICEs are simultaneously enrolling in a session.

8.2 Interpretation of optional parameters

It is mandatory that any PDU parameter or sub-parameter that is specified as optional in the descriptive text or ASN.1 of this Recommendation be appropriately interpreted and acted on by a receiving SICE unless otherwise stated. That is, it is mandatory for an SICE to be able to receive and interpret all optional parameters (unless otherwise stated) but all SICEs have the option of not sourcing optional parameters. If an optional parameter is left unspecified, any implied default value or behaviour defined in this Recommendation must also be adhered to. Some optional parameters may require successful negotiation of one or more SI capabilities before they may be used.

8.3 SI capabilities

Capabilities exchange and negotiation shall be performed according to [ITU-T T.121]. The SI capabilities that can be advertized and negotiated are described in Table 8-1. At least one of the following capabilities shall be included in the advertized application capabilities list: Hard-Copy-Image or Soft-Copy-Workspace. If Soft-Copy-Workspace is included, then at least one of the following shall also be included: Soft-Copy-Image or Soft-Copy-Annotation.

In Table 8-1, certain capabilities are indicated as being dependent on other capabilities. This implies that the capability shall not be included in the application capabilities list unless the capability on which it depends is also included.

SICEs are made aware of the application capabilities that are valid for a given session via GCC-Application-Roster-Report indications. The conditions under which this event is generated are described in [ITU-T T.121]. An SICE may be required to process GCC-Application-Roster-Report indications multiple times during a session and shall adhere to the bounds imposed by the capabilities reported in this fashion. Many components of this Recommendation heavily depend on this mechanism for proper operation, clauses within this Recommendation describing such components include rules governing the interpretation of the applicable parameters conveyed by the GCC-Application-Roster-Report indication.

Table 8-1 – Application capabilities list elements

Capability name (default value if numeric class): Description	ID	Class	SICE count rule	Parameter	Dependency
Hard-Copy-Image: This capability is used to negotiate the use of hard-copy image exchanges. This capability implies a maximum image size of 1728 horizontal by 2300 vertical. It also implies the ability to support unscaled image bitmap creation using either uncompressed or T.4 (G3) formats with a single bitplane and either fax1 or fax2 pixel aspect ratios.	1	L	>1	–	–
Hard-Copy-Image-Bitmap-Max-Width (1728): This capability is used to negotiate the maximum width of an image bitmap for hard-copy image exchanges. This dimension is relative to the pixel aspect ratio of the image.	2	MIN	=D	(1729..21845)	Hard-Copy-Image
Hard-Copy-Image-Bitmap-Max-Height (2300): This capability is used to negotiate the maximum height of an image bitmap for hard-copy image exchanges. This dimension is relative to the pixel aspect ratio of the image.	3	MIN	=D	(2301..21845)	Hard-Copy-Image
Hard-Copy-Image-Bitmap-Any-Aspect-Ratio: This capability is used to negotiate the ability to transmit image bitmaps to a hard-copy workspace with an arbitrary aspect ratio.	4	L	=D	–	Hard-Copy-Image
Hard-Copy-Image-Bitmap-Format-T.6: This capability is used to negotiate the ability to support bitmap creation using T.6 (G4) image compression format with a single bitplane and either fax1 or fax2 pixel aspect ratios.	5	L	=D	–	Hard-Copy-Image
Hard-Copy-Image-Bitmap-Format-T.82: This capability is used to negotiate the ability to support bitmap creation using T.82 (JBIG) image compression format. This capability implies the ability to handle 1 bitplane with 1:1 pixel aspect ratio and the ability to only handle bitmaps encoded without the use of JBIG resolution reduction.	6	L	=D	–	Hard-Copy-Image
Soft-Copy-Workspace: This capability is used to negotiate the ability to support at least one workspace for soft-copy information. This capability implies a maximum workspace size of 384 horizontal by 288 vertical with workspace background colours black and white. Presence of this capability also implies that one of the capabilities Soft-Copy-Annotation or Soft-Copy-Image shall also be included in the application capabilities list.	7	L	>1	–	–
Soft-Copy-Workspace-Max-Width (384): This capability is used to negotiate the maximum workspace width. This dimension is relative to a 1:1 pixel aspect ratio (square pixels).	8	MIN	=D	(385..21845)	Soft-Copy-Workspace

Table 8-1 – Application capabilities list elements

Capability name (default value if numeric class): Description	ID	Class	SICE count rule	Parameter	Dependency
Soft-Copy-Workspace-Max-Height (288): This capability is used to negotiate the maximum workspace height. This dimension is relative to a 1:1 pixel aspect ratio (square pixels).	9	MIN	=D	(289..21845)	Soft-Copy-Workspace
Soft-Copy-Workspace-Max-Planes (1): This capability is used to negotiate the maximum number of planes allowed in any workspace.	10	MIN	=D	(2..256)	Soft-Copy-Workspace
Soft-Copy-Color-16: This capability is used to negotiate the use of the 16-colour palette for use in workspace backgrounds or, if the Soft-Copy-Annotation capability is negotiated, in drawing elements.	11	L	=D	–	Soft-Copy-Workspace
Soft-Copy-Color-202: This capability is used to negotiate the use of the 202-colour palette for use in workspace backgrounds or, if the Soft-Copy-Annotation capability is negotiated, in drawing elements.	12	L	=D	–	Soft-Copy-Workspace
Soft-Copy-Color-True: This capability is used to negotiate the use of the true colour (24-bit RGB) as well as the use of the 202-colour palette for use in workspace backgrounds or, if the Soft-Copy-Annotation capability is negotiated, in drawing elements.	13	L	=D	–	Soft-Copy-Workspace
Soft-Copy-Plane-Editing: This capability is used to negotiate the ability to declare any workspace plane to be editable.	14	L	=D	–	Soft-Copy-Workspace
Soft-Copy-Scaling: This capability is used to negotiate the ability to declare a scaling rectangle during creation of soft-copy bitmaps and video windows. Without this capability, bitmaps and video windows are applied to the destination workspace without scaling (other than that required for non-1:1 pixel aspect ratios).	15	L	=D	–	Soft-Copy-Workspace
Soft-Copy-Bitmap-No-Token-Protection: This capability is used to negotiate the ability to transmit soft-copy bitmaps of any variety without the need to hold the SI-BITMAP-CREATE-TOKEN.	16	L	=D	–	Soft-Copy-Workspace
Soft-Copy-Pointing: This capability is used to negotiate the use of pointer bitmaps on soft-copy workspaces. Successful negotiation of this capability allows the following coding formats and associated parameter constraints for pointer bitmaps: – Uncompressed format of either 8-bit greyscale, RGB 4:4:4 or 1, 4 or 8-bit palettized with a 1:1 pixel aspect ratio. This capability implies the ability to handle pointer bitmaps up to a maximum size of 32 by 32 pixels.	17	L	>1	–	Soft-Copy-Workspace

Table 8-1 – Application capabilities list elements

Capability name (default value if numeric class): Description	ID	Class	SICE count rule	Parameter	Dependency
Soft-Copy-Pointing-Bitmap-Max-Width (32): This capability is used to negotiate the maximum width of a pointer bitmap. This dimension is relative to a 1:1 pixel aspect ratio (square pixels).	18	MIN	=D	(33..21845)	Soft-Copy-Pointing
Soft-Copy-Pointing-Bitmap-Max-Height (32): This capability is used to negotiate the maximum height of a pointer bitmap. This dimension is relative to a 1:1 pixel aspect ratio (square pixels).	19	MIN	=D	(33..21845)	Soft-Copy-Pointing
Soft-Copy-Pointing-Bitmap-Format-T.82: This capability is used to negotiate the ability to use T.82 (JBIG) compression format for encoding pointer bitmaps. This capability implies the ability to handle either 8-bit greyscale, or up to 8 palettized bitplanes with a 1:1 pixel aspect ratio and the ability to only handle bitmaps encoded without the use of JBIG resolution reduction.	20	L	=D	–	Soft-Copy-Pointing
Soft-Copy-Annotation: This capability is used to negotiate the use of annotation on soft-copy workspaces. The presence of this capability in the negotiated capability set implies the ability to create workspaces with annotation specified as the usage-designator of workspace planes. Successful negotiation of this capability also allows the following coding formats and associated parameter constraints for annotation bitmaps: – Uncompressed bitmap format of either 8-bit greyscale, RGB 4:4:4 or 1, 4, or 8-bit palettized raster and colour formats with a 1:1 pixel aspect ratio. This capability also implies the ability to support the creation of drawings using the DrawingCreatePDU with a pen thickness of 3 to 16 pixels, and a round pen nib.	21	L	>1	–	Soft-Copy-Workspace
Soft-Copy-Annotation-Bitmap-Max-Width (384): This capability is used to negotiate the maximum width of an annotation bitmap. This dimension is relative to a 1:1 pixel aspect ratio (square pixels).	22	MIN	=D	(385..65536)	Soft-Copy-Annotation
Soft-Copy-Annotation-Bitmap-Max-Height (288): This capability is used to negotiate the maximum height of an annotation bitmap. This dimension is relative to a 1:1 pixel aspect ratio (square pixels).	23	MIN	=D	(289..65536)	Soft-Copy-Annotation
Soft-Copy-Annotation-Drawing-Pen-Min-Thickness (3): This capability is used to negotiate the minimum thickness in pixels of lines drawn using the DrawingCreatePDU.	24	MAX	=D	(1..2)	Soft-Copy-Annotation

Table 8-1 – Application capabilities list elements

Capability name (default value if numeric class): Description	ID	Class	SICE count rule	Parameter	Dependency
Soft-Copy-Annotation-Drawing-Pen-Max-Thickness (16): The capability is used to negotiate the maximum thickness in pixels of lines drawn using the DrawingCreatePDU.	25	MIN	=D	(17..255)	Soft-Copy-Annotation
Soft-Copy-Annotation-Drawing-Ellipse: This capability is used to negotiate the ability to use the ellipse drawing type when using the DrawingCreatePDU.	26	L	=D	–	Soft-Copy-Annotation
Soft-Copy-Annotation-Drawing-Pen-Square-Nib: This capability is used to negotiate the ability to use a square nib shape in creation of lines drawn using the DrawingCreatePDU.	27	L	=D	–	Soft-Copy-Annotation
Soft-Copy-Annotation-Drawing-Highlight: This capability is used to negotiate the ability to make use of the Highlight line style for drawing.	28	L	=D	–	Soft-Copy-Annotation
Soft-Copy-Annotation-Drawing-Rotation: This capability is used to negotiate the ability to specify the optional rotation parameter that defines a rotation to be applied to annotation drawing elements.	62	L	=D	–	Soft-Copy-Annotation
Soft-Copy-Annotation-Bitmap-Format-T.82: This capability is used to negotiate the ability to use T.82 (JBIG) compression format for encoding annotation bitmaps. This capability implies the ability to handle either 8-bit greyscale, or up to 8 palletized bitplanes with a 1:1 pixel aspect ratio and the ability to only handle bitmaps encoded without the use of JBIG resolution reduction.	29	L	=D	–	Soft-Copy-Annotation

Table 8-1 – Application capabilities list elements

Capability name (default value if numeric class): Description	ID	Class	SICE count rule	Parameter	Dependency
Soft-Copy-Image: This capability is used to negotiate the use of image bitmaps on soft-copy workspaces. The presence of this capability in the negotiated capability set implies the ability to create workspaces with image specified as the usage-designator of workspace planes. Successful negotiation of this capability allows the following coding formats and associated parameter constraints for image bitmaps: 1) JBIG: This capability implies the ability to handle either 8-bit greyscale, RGB 4:4:4, or up to 8 palettized bitplanes and the ability to only handle bitmaps encoded without the use of JBIG resolution reduction. Both 1:1 and CIF pixel aspect ratios shall be supported. 2) JPEG: This capability implies the ability to handle the baseline DCT encoding mode, with baseline sequential transmission and 8 bit/sample data precision in component interleaved format only, using a colour space and colour resolution mode of YCbCr 4:2:2, or greyscale. Both 1:1 and CIF pixel aspect ratios shall be supported. 3) Uncompressed: This capability implies the ability to handle 8-bit greyscale, RGB 4:4:4, YCbCr 4:2:2, or palettized 1, 4, or 8 bits per pixel. Both 1:1 and CIF pixel aspect ratios shall be supported.	30	L	>1	–	Soft-Copy-Workspace
Soft-Copy-Image-Bitmap-Max-Width (384): This capability is used to negotiate the maximum workspace width for soft-copy image bitmap exchanges. This dimension is relative to the pixel aspect ratio of the image bitmap.	31	MIN	=D	(385..65536)	Soft-Copy-Image
Soft-Copy-Image-Bitmap-Max-Height (288): This capability is used to negotiate the maximum workspace height for soft-copy image bitmap exchanges. This dimension is relative to the pixel aspect ratio of the image bitmap.	32	MIN	=D	(289..65536)	Soft-Copy-Image
Soft-Copy-Image-Bitmap-Any-Aspect-Ratio: This capability is used to negotiate the ability to transmit image bitmaps to a soft-copy workspace with an arbitrary aspect ratio.	33	L	=D	–	Soft-Copy-Image
Soft-Copy-Image-Bitmap-Format-T.82-Differential: This capability is used to negotiate the ability to use resolution reduction (differential layers) when encoding a JBIG format image bitmap.	34	L	=D	–	Soft-Copy-Image

Table 8-1 – Application capabilities list elements

Capability name (default value if numeric class): Description	ID	Class	SICE count rule	Parameter	Dependency
Soft-Copy-Image-Bitmap-Format-T.82-Differential-Deterministic-Prediction: This capability is used to negotiate the ability to use deterministic prediction when encoding a JBIG format image bitmap using resolution reduction (differential layers).	35	L	=D	–	Soft-Copy-Image-Bitmap-Format-T.82-Differential
Soft-Copy-Image-Bitmap-Format-T.82-12-Bit-Grey-Scale: This capability is used to negotiate the ability to use 12 bitplanes when encoding a JBIG format image bitmap.	36	L	=D	–	Soft-Copy-Image
Soft-Copy-Image-Bitmap-Format-T.81-Extended-Sequential-DCT: This capability is used to negotiate the ability to use extended sequential DCT mode when encoding a JPEG format image bitmap.	37	L	=D	–	Soft-Copy-Image
Soft-Copy-Image-Bitmap-Format-T.81-Progressive-DCT: This capability is used to negotiate the ability to use progressive DCT mode when encoding a JPEG format image bitmap.	38	L	=D	–	Soft-Copy-Image
Soft-Copy-Image-Bitmap-Format-T.81-Spatial-DPCM: This capability is used to negotiate the ability to use spatial DPCM mode when encoding a JPEG format image bitmap.	39	L	=D	–	Soft-Copy-Image
Soft-Copy-Image-Bitmap-Format-T.81-Differential-Sequential-DCT: This capability is used to negotiate the ability to use differential sequential DCT mode when encoding a JPEG format image bitmap.	40	L	=D	–	Soft-Copy-Image
Soft-Copy-Image-Bitmap-Format-T.81-Differential-Progressive-DCT: This capability is used to negotiate the ability to use differential progressive DCT mode when encoding a JPEG format image bitmap.	41	L	=D	–	Soft-Copy-Image
Soft-Copy-Image-Bitmap-Format-T.81-Differential-Spatial-DPCM: This capability is used to negotiate the ability to use differential spatial DPCM mode when encoding a JPEG format image bitmap.	42	L	=D	–	Soft-Copy-Image
Soft-Copy-Image-Bitmap-Format-T.81-Extended-Sequential-DCT-Arithmetic: This capability is used to negotiate the ability to use extended sequential DCT mode using arithmetic encoding when encoding a JPEG format image bitmap.	43	L	=D	–	Soft-Copy-Image

Table 8-1 – Application capabilities list elements

Capability name (default value if numeric class): Description	ID	Class	SICE count rule	Parameter	Dependency
Soft-Copy-Image-Bitmap-Format-T.81-Progressive-DCT-Arithmetic: This capability is used to negotiate the ability to use progressive DCT mode using arithmetic encoding when encoding a JPEG format image bitmap.	44	L	=D	–	Soft-Copy-Image
Soft-Copy-Image-Bitmap-Format-T.81-Spatial-DPCM-Arithmetic: This capability is used to negotiate the ability to use spatial DPCM mode using arithmetic encoding when encoding a JPEG format image bitmap.	45	L	=D	–	Soft-Copy-Image
Soft-Copy-Image-Bitmap-Format-T.81-Differential-Sequential-DCT-Arithmetic: This capability is used to negotiate the ability to use differential sequential DCT mode using arithmetic encoding when encoding a JPEG format image bitmap.	46	L	=D	–	Soft-Copy-Image
Soft-Copy-Image-Bitmap-Format-T.81-Differential-Progressive-DCT-Arithmetic: This capability is used to negotiate the ability to use differential progressive DCT mode using arithmetic encoding when encoding a JPEG format image bitmap.	47	L	=D	–	Soft-Copy-Image
Soft-Copy-Image-Bitmap-Format-T.81-Differential-Spatial-DPCM-Arithmetic: This capability is used to negotiate the ability to use differential spatial DPCM mode using arithmetic encoding when encoding a JPEG format image bitmap.	48	L	=D	–	Soft-Copy-Image
Soft-Copy-Image-Bitmap-Format-T.81-YCbCr-4:2:0: This capability is used to negotiate the ability to use a chroma format of YCbCr 4:2:0 when encoding a JPEG format image bitmap.	49	L	=D	–	Soft-Copy-Image
Soft-Copy-Image-Bitmap-Format-T.81-YCbCr-4:4:4: This capability is used to negotiate the ability to use a chroma format of YCbCr 4:4:4 when encoding a JPEG format image bitmap.	50	L	=D	–	Soft-Copy-Image
Soft-Copy-Image-Bitmap-Format-T.81-RGB-4:4:4: This capability is used to negotiate the ability to use a chroma format of RGB 4:4:4 when encoding a JPEG format image bitmap.	51	L	=D	–	Soft-Copy-Image
Soft-Copy-Image-Bitmap-Format-T.81-CIELab-4:2:0: This capability is used to negotiate the ability to use a chroma format of CIELab 4:2:0 when encoding a JPEG format image bitmap.	52	L	=D	–	Soft-Copy-Image

Table 8-1 – Application capabilities list elements

Capability name (default value if numeric class): Description	ID	Class	SICE count rule	Parameter	Dependency
Soft-Copy-Image-Bitmap-Format-T.81-CIELab-4:2:2: This capability is used to negotiate the ability to use a chroma format of CIELab 4:2:2 when encoding a JPEG format image bitmap.	53	L	=D	–	Soft-Copy-Image
Soft-Copy-Image-Bitmap-Format-T.81-CIELab-4:4:4: This capability is used to negotiate the ability to use a chroma format of CIELab 4:4:4 when encoding a JPEG format image bitmap.	54	L	=D	–	Soft-Copy-Image
Soft-Copy-Image-Bitmap-Format-T.81-Non-Interleaved: This capability is used to negotiate the ability to use non-interleaved ordering of colour components.	55	L	=D	–	Soft-Copy-Image
Soft-Copy-Image-Bitmap-Format-Uncompressed-YCbCr-4:2:0: This capability is used to negotiate the ability to use a chroma format of YCbCr 4:2:0 when encoding an <i>uncompressed</i> format image bitmap.	56	L	=D	–	Soft-Copy-Image
Soft-Copy-Image-Bitmap-Format-Uncompressed-YCbCr-4:4:4: This capability is used to negotiate the ability to use a chroma format of YCbCr 4:4:4 when encoding an <i>uncompressed</i> format image bitmap.	57	L	=D	–	Soft-Copy-Image
Soft-Copy-Image-Bitmap-Format-Uncompressed-CIELab-4:2:0: This capability is used to negotiate the ability to use a chroma format of CIELab 4:2:0 when encoding an <i>uncompressed</i> format image bitmap.	58	L	=D	–	Soft-Copy-Image
Soft-Copy-Image-Bitmap-Format-Uncompressed-CIELab-4:2:2: This capability is used to negotiate the ability to use a chroma format of CIELab 4:2:2 when encoding an <i>uncompressed</i> format image bitmap.	59	L	=D	–	Soft-Copy-Image
Soft-Copy-Image-Bitmap-Format-Uncompressed-CIELab-4:4:4: This capability is used to negotiate the ability to use a chroma format of CIELab 4:4:4 when encoding an <i>uncompressed</i> format image bitmap.	60	L	=D	–	Soft-Copy-Image
Archive-Support: This capability is used to negotiate the support of archives.	61	L	–	–	–

Table 8-1 – Application capabilities list elements

Capability name (default value if numeric class): Description	ID	Class	SICE count rule	Parameter	Dependency
Soft-Copy-Transparency-Mask: This capability is used to negotiate the ability to use arbitrary transparency masks for applicable graphical elements allowing arbitrary pixels within these objects to be interpreted as transparent. This capability also implies the support of JBIG compression given that a transparency mask can be optionally encoded in this manner.	63	L	>1	–	Soft-Copy-Image
Soft-Copy-Video-Window: This capability is used to negotiate the ability to define video windows that can encapsulate out-of-band video streams in a workspace. Successful negotiation of this capability between two or more session participants enables the use of the VideoWindowCreatePDU, VideoWindowDeletePDU and VideoWindowEditPDU.	64	L	>1	–	Soft-Copy-Image
Non-Standard-Capability: This capability is used to negotiate non-standard functions. Any number of these may appear in the application capabilities list as long as they each have a unique Non-Standard-Identifier. The interpretation of these capabilities is not covered by this Recommendation.	Non-Standard Identifier	–	–	–	–

Table 8-2 – Capability list notation

Class	L	Logical
	MIN	Unsigned minimum
	MAX	Unsigned maximum
SICE count rule	>1	The Number-of-Entities parameter returned by the GCC-Application-Roster-Report indication for this capability must be greater than 1 for it to be considered established for the session.
	=D	In the case of logical capabilities, the Number-of-Nodes parameter returned by the GCC-Application-Roster-Report indication for this capability must be equal to that of the dependent capability for it to be considered established. In the case of numerical capabilities (MIN or MAX), if the Number-of-Nodes parameter is equal to that of the dependent capability, the result of the MIN or MAX operation is established as the session-wide value; otherwise the default value of the capability is established.

8.4 Workspaces

A workspace may be created if the Soft-Copy-Workspace capability is present in the negotiated capability set. Multiple workspaces may coexist if sufficient resources are present at all peer SICEs within a session. This facility can be useful for multi-document applications as well as serving as a

method to cache frequently used graphical information to help avoid the delays that would otherwise be incurred if the information had to be sent at the time it was used in the session.

Workspaces may be created and deleted at any time with different attributes during a session. New arrivals to the session will be able to view information upon receipt of the first workspace create exchange they receive. Workspace attributes within a multi-workspace SI session can be different from one workspace to another. No attributes shall exceed any negotiated limits.

8.4.1 Workspace structure

8.4.1.1 Workspace plane stacking

A workspace consists of a number of stacked planes which aid in determining how overlapping graphical objects occlude each other. The number of planes in a workspace is defined at the time of creation and may range from 1 to the maximum value negotiated for the session using the Soft-Copy-Workspace-Max-Planes capability. An additional virtual plane used exclusively for pointers is present if the Soft-Copy-Pointing capability has been negotiated for the session.

For a workspace with N planes, the planes are ordered from 0 to $N - 1$ with 0 being treated as the farthest back and $N - 1$ being the topmost. If the Soft-Copy-Pointing capability has been successfully negotiated, the pointer plane forms a virtual plane in front of all other planes.

When rendering an image to be displayed, the colour value of each pixel (prior to any format conversion necessary for display) is determined by the following set of rules:

- If a plane X contains a non-transparent graphical element at the topmost Z -order for elements within that plane at that workspace coordinate, and all planes farther forward (including the virtual pointer plane) contain transparent pixel values at that same location, then the resulting pixel shall be set to the colour of the corresponding pixel on plane X .
- If the pixel value for all planes 0 through N (includes virtual pointer plane) are set to transparent, then the resulting pixel shall be set to the background colour specified when the workspace was created.
- If plane X contains a drawing element specified with a line style of highlight, and all planes farther forward (from $X + 1$ through N), if any, contain transparent pixel values, then a locally-defined rule is applied to modify the pixel value that would result if these rules were applied only to planes 0 through $X - 1$ (X is equal to 0, the modification rule is applied to the background colour). The locally-defined modification rule should have the effect of modifying the image formed by rendering the layers below X in such a way that it appears that the resulting pixel value has been highlighted with a semi-transparent coloured value of the colour specified at this pixel in plane X . The specific algorithm for this rule is outside of the scope of this Recommendation.

8.4.1.2 Workspace plane coordinate system

All planes on a workspace are of the same size with the origin of each co-located. Within each plane, pixels are indexed from the origin (0,0), which is defined to be the upper left corner of the workspace, to the size of the workspace ($X - 1$, $Y - 1$) which is defined to be the lower right corner of the workspace, where X and Y are the number of pixels in the workspace, in the horizontal and vertical dimensions, respectively, as specified when the workspace was created. The sizes X and Y shall be greater than or equal to one, and less than or equal to the negotiated maximum values of Soft-Copy-Workspace-Max-Width and Soft-Copy-Workspace-Max-Height, respectively.

Positional references to a workspace plane are designated by specifying a point. A point is an ordered pair of workspace coordinates specifying the horizontal and vertical position in the workspace, respectively. The value of a workspace coordinate is defined to be within the range $(-21845..43690)$. The use of negative values allows objects (e.g., the origin of a bitmap, or a control

point in a drawing element) to be positioned above or to the left of the origin of the workspace plane.

All references to workspace size and plane coordinates assume 1:1 pixel aspect ratio (square pixels) regardless of the aspect ratio of bitmaps that may be transmitted to the workspace.

8.4.1.3 Workspace views

A workspace view defines a rectangular region of a workspace and its associated attributes that may be mapped to the display. For some or all of a workspace to be viewed by participants in a session, at least one workspace view must be defined for that workspace. A workspace view is a region of the workspace to be viewed and associated characteristics to describe how that region should be viewed. A single workspace may be defined to have up to 256 views. Each view may cover distinct or overlapping regions of the workspace, or some views may show common portions of the workspace.

Only active workspaces (non-archive) may be defined to have views – archived workspaces cannot. If views are defined for an archived workspace, they shall be ignored.

Views do not exist separately from the workspace to which they are associated. If a workspace is deleted, all of its associated views are automatically deleted as well.

Figure 8-1 shows the correspondence between a set of workspace views and the workspace to which they are associated.

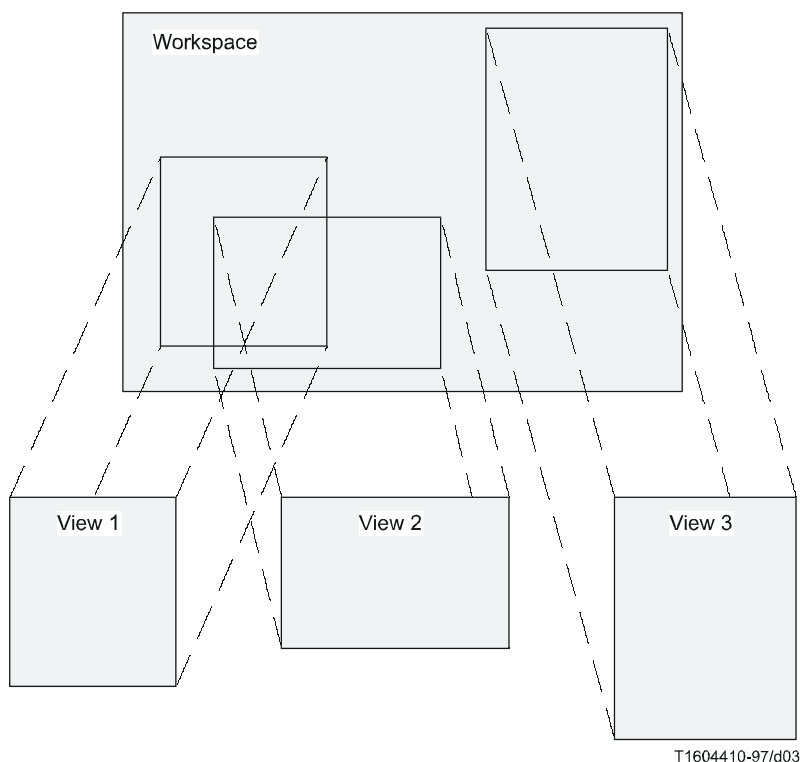


Figure 8-1 – Workspace views

8.4.2 Creating a workspace

To create a workspace, an SICE shall send a WorkspaceCreatePDU to all SICEs in the session in the manner indicated in Table 6-3. The content of the WorkspaceCreatePDU is shown in Table 8-3. If the workspace is synchronized, it shall send this SIPDU three separate times on each of the three priority channels, high, medium and low. This is done to avoid any possibility of data bound for this workspace on any priority channel being received prior to the WorkspaceCreatePDU itself. The first

one received shall be acted on by the receiving SICE. All others shall be ignored. In the case of an unsynchronized workspace, only a single WorkspaceCreatePDU is issued as indicated in Table 6-3.

Table 8-3 – WorkspaceCreatePDU

Parameter	Description
workspaceIdentifier	If this is an active (non-archived) workspace, this is a handle allocated using the GCC-Registry-Allocate-Handle primitive. If this is an archived workspace, this consists of the handle of the opened archive along with the entry name to be used to identify this workspace within the specified archive. Also included in this case is a modificationTime parameter indicating the current time. This shall not be an archived workspace if the Archive-Supported capability is not present in the negotiated capability set.
appRosterInstance	Application roster instance number as returned in the most recently received GCC-Application-Roster-Report indication.
synchronized	Either synchronized or unsynchronized. A synchronized workspace is one that guarantees that the workspace at each node in the session contains the same graphical information at the same Z-order. This is done by requiring synchronized transmission for all SIPDUs using the MCS-UNIFORM-SEND-DATA service for all exchanges that can result in different workspace contents if not received in the same order by all SICEs in a session. For an unsynchronized workspace, no guarantee of visual consistency is made due to potential timing conditions in the communications network. In the unsynchronized case, MCS-SEND-DATA is used for some SIPDUs rather than MCS-UNIFORM-SEND-DATA, resulting in a reduction in network traffic. The valid use of MCS-SEND-DATA versus MCS-UNIFORM-SEND-DATA for all SIPDUs is summarized in Table 6-3.
acceptKeyboardEvents	This flag expresses the ability of the workspace to accept keyboard events via the RemoteKeyboardEventPDU.
acceptPointingDeviceEvents	This flag expresses the ability of the workspace to accept pointing device events via the RemotePointingDeviceEventPDU.
protectedPlaneAccessList (optional)	An optional set of MCS user IDs. If present, the ability to modify any protected plane in this workspace is restricted only to SICEs in this set. The creator of the workspace is not automatically granted access to these planes unless its MCS user ID is specifically on this list (if the list is present). If the parameter is not specified, all SICEs are assumed to have access to the workspace planes.
workspaceSize	This parameter indicates the horizontal and vertical dimension of the workspace. This parameter is expressed in units of pixels. The horizontal component of this parameter may span the range (1..X) where X is the value of the Soft-Copy-Workspace-Max-Width parameter in the negotiated capability set. The vertical component of this parameter may span the range (1..Y) where Y is the value of the Soft-Copy-Workspace-Max-Height parameter in the negotiated capability set. The pixels used to define the workspace size are defined as having a 1:1 pixel aspect ratio (square pixels).
workspaceAttributes (optional)	Workspace attributes are described in Table 8-4. These can be later edited via the WorkspaceEditPDU.
planeParameters	Workspace plane parameters are described in Table 8-5.

Table 8-3 – WorkspaceCreatePDU

Parameter	Description
viewParameters (optional)	Workspace view parameters are described in Table 8-7. When a workspace is created, it may be created along with one or more workspace views.
nonStandardParameters (optional)	An optional list of non-standard parameters allowed only if the corresponding non-standard capabilities are present in the negotiated capability set.
refresh (optional)	A value of TRUE indicates that the WorkspaceCreatePDU is being used to initiate a workspace refresh. The value of FALSE, or the parameter not being present, indicates that the WorkspaceCreatePDU is being used to create a new workspace. See clause 8.4.7 for the rules for interpreting workspace create exchanges used to refresh late arrivers to a session.

Table 8-4 – Workspace attributes

Attribute	Default value	Description
preserve	FALSE	This is an optional parameter which indicates the preference to preserve this workspace (resources permitting). Its value has an impact on the behaviour of an SICE, should it exceed its resource limits. See clause 8.4.9 for details. This flag should only be set to TRUE on rare occasions. It is not intended for use when pre-transmitting SI workspaces for later use. Its primary function is to allow workspaces being used for graphical element caches to be preserved. The preserve flag may be modified by sending a WorkspaceEditPDU specifying a new value.
backgroundColor	White	backgroundColor is used to determine the resulting colour of a pixel if all plane contents (including the virtual pointer plane) are set to a transparent value at that pixel location. In the case of only objects with highlight line styles present above the workspace background, the pixel colour shall be the backgroundColor combined with the colour of the pixels in front using the highlighting rule. The colour space over which the background colour may be chosen is determined by the negotiated palette for the corresponding workspace type (see clause 8.4.6). The baseline palette is the two-colour palette. If a broader colour space was negotiated for use, the corresponding colour spaces may be used to set the background colour. Specifically, if the Soft-Copy-Color-16, Soft-Copy-Color-202 or Soft-Copy-Color-True capabilities are present in the negotiated capability set, then the 16-colour palette, the 202-colour palette or a true-colour specifier may be used, respectively. The background colour may be modified by sending a WorkspaceEditPDU specifying a new value.

Table 8-4 – Workspace attributes

Attribute	Default value	Description
nonStandardAttribute	–	This attribute is specified as a nonStandardIdentifier. To be used, it must have been successfully negotiated by a corresponding non-standard capability. Its interpretation is not specified by this Recommendation.

Table 8-5 – Workspace plane parameters

Parameter	Description
editable	This flag indicates whether the plane shall be permanent or editable. This flag shall be set to permanent unless the Soft-Copy-Workspace-Editing capability is present in the negotiated capability set, in which case it may be designated as either permanent or editable. For a plane designated as permanent, the effect of graphical object creation shall be to modify the image as a single-plane raster image. That is, each pixel in the plane has one and only one value that determines its colour (or transparency) and carries no other state information. Its value shall correspond to the one last written to that plane location as a result of the creation (including copying) of a new graphical element. Bitmaps and drawing elements on a permanent plane cannot be edited or deleted. They can be modified only by overwriting their pixel locations with other bitmaps or drawing elements. As a result, no graphical object edits or deletes can be directed to permanent planes. If an SICE receives any PDU attempting to modify the attributes or position of an object residing in a permanent plane, it shall be ignored. For a plane designated as editable, each SICE shall maintain a database of state information for each graphical element created on that plane. For each object, this shall include the information defining the object, its attributes, its position relative to the origin of the plane, and the position of the object in the object-list for that plane (the Z-order). The object-list determines the order of the objects within the plane, from front to back, used to determine which objects occlude others.

Table 8-5 – Workspace plane parameters

Parameter	Description
usage	This flag indicates the intended usage for the plane: for either image bitmaps, annotation (drawing elements or annotation bitmaps), nonStandardPlaneUsage or a combination of these. This parameter may include annotation only if the Soft-Copy-Annotation capability is present in the negotiated capability set. This parameter may include image only if the Soft-Copy-Image capability is present in the negotiated capability set. This parameter may include a nonStandardPlaneUsage only if a corresponding non-standard capability is present in the negotiated capability set. When a workspace is created, the intended use of each plane in the workspace shall be designated using the usage designator in the WorkspaceCreatePDU. The usage designator is a set of flags. Each member of the set can have three possible values. The first flag indicates whether the plane may be used for annotation. The second indicates whether the plane may be used for image data. The third is used to designate a nonStandardUsage (which requires successful negotiation of a corresponding nonStandardCapability for use). Multiple flags can be asserted for each plane but at least one of these flags must be set. The annotation flag shall not be set unless the Soft-Copy-Annotation capability has been negotiated for the session, and the image flag shall not be set unless the Soft-Copy-Image capability has been successfully negotiated for the session. For a plane designated as allowing annotation, the plane may be used for drawing elements or annotation bitmaps. Drawing elements are those created using the DrawingCreatePDU, while annotation bitmaps are those created using the BitmapCreatePDU with the destinationAddress parameter set to softCopyAnnotationPlane. For a plane designated as allowing image usage, the plane may be used for image bitmaps and video windows. Image bitmaps are those created using BitmapCreatePDU with the destinationAddress parameter set to softCopyImagePlane. The usage designator of each plane determines the data priority used to transmit any SIPDU directed toward that plane as specified in Table 6.3.
planeAttributes (optional)	A set of attributes for a plane (see Table 8-6).

Table 8-6 – Plane attributes

Attribute	Default value	Description
protection	FALSE	This flag indicates access restrictions for a plane. The protected sub-parameter, if set to TRUE, restricts all operations to the plane to be by the SICEs specified in the protectedPlaneAccessList of the workspace only. A value of FALSE imposes no restrictions. If a workspace plane is designated as unprotected, any SICE in a session may direct information toward the plane. Protected workspace planes automatically revert to unprotected when all the SICEs identified by the protectedPlaneAccessList for that workspace leave the session or become inactive as indicated by a GCC-Application-Roster-Report indication. Workspace planes shall not be designated protected for archive workspaces. All parameters associated with plane protection shall be ignored in the case of archive workspaces. If a workspace plane is designated as protected, only the SICEs specified in the workspace's protectedPlaneAccessList may direct information toward the plane. Moreover, if the protectedPlaneAccessList contains only a single SICE, that SICE can choose to use MCS-SEND-DATA instead of MCS-UNIFORM-SEND-DATA for transactions directed to a workspace plane when the destination workspace plane is synchronized, if that SICE never intends to unprotect the target plane. Only SICEs specified in the protectedPlaneAccessList may edit this attribute using the WorkspaceEditPDU. If a WorkspaceEditPDU is received from any node other than the SICEs specified in the protectedPlaneAccessList which indicates a change in the value of this attribute, this change shall be ignored (other attribute changes shall still be processed as normal).
nonStandardAttribute	–	This attribute is specified as a nonStandardIdentifier. To be used, it must have been successfully negotiated by a corresponding non-standard capability. Its interpretation is not specified by this Recommendation.

Table 8-7 – Workspace view parameters

Parameter	Description
viewHandle	Unique handle returned from GCC-Registry-Allocate-Handle exchange. This handle will be used to reference this view in all future SIPDUs.
viewAttributes (optional)	A set of attributes for a view (see Table 8-8).

Table 8-8 – View attributes

Attribute	Default value	Description
viewRegion	fullWorkspace	This attribute defines the portion of the workspace to be associated with this view. This may be set to either fullWorkspace, which indicates that the view corresponds to the complete workspace, or partialWorkspace. In the later case, a rectangular region is specified, in workspace coordinates, indicating the desired portion of the workspace to view. If the viewRegion extends beyond the boundary of the workspace in any dimension, the displayed contents of those portions of the view that extend beyond the workspace boundary are not specified by this Recommendation. Each workspace view is defined to cover a rectangular region of the workspace to which it corresponds. The viewRegion parameter defines the size and location of this region. Its default value is to view the entire workspace. Alternatively, it may be set to view a particular sub-region of the workspace. If the viewRegion extends beyond the boundary of the corresponding workspace in any dimension, the displayed contents of those portions of the view that extend beyond the workspace boundary are not specified by this Recommendation.
viewState	focus	This attribute indicates the initial state of the view, either hidden, background, foreground, focus or nonStandardState. When a workspace view is created, the state of the view may be specified as having one of the following values: • Hidden – Indicates this view should not be shown to the user. • Background – Indicates that the display of this view is optional. • Foreground – Indicates that the display of this view is desirable. • Focus – Indicates that this view is the focus of the current session. The state of the view may be modified by sending a WorkspaceEditPDU specifying a new value of the viewState attribute for this view. Only one view among all views on all workspaces may simultaneously be set to the Focus state. Setting a view to this state forces any other view currently in the focus state into the foreground state.

Table 8-8 – View attributes

Attribute	Default value	Description
		An SICE may choose to send PDUs transmitted to workspaces in whose views are in different states at different throughput rates. For example, an SICE may send PDUs to workspaces whose views are background or hidden at a lower rate than PDUs to workspaces with foreground views or the workspace with a view in the focus state. This would minimize interference on information bound for the more important workspaces from information being sent in the background. The mechanism for controlling the throughput of PDUs intended for different workspaces is a local matter not covered by this Recommendation.
updatesEnabled	TRUE	This attribute specifies whether or not it is recommended that updates to the workspace associated with this view are displayed, or if the content of the view is instead fixed until updates are enabled. This attribute is to be interpreted as a recommendation on how to display the view rather than a requirement. If more than one SICE set this parameter to the disabled state (FALSE), an SICE which makes use of this attribute shall keep track of all such requesting SICES and should only re-enable updates to the view when all of these SICES edit the attribute back to the TRUE state (at which time views are re-enabled). If an SICE leaves the session after setting this attribute to FALSE, all other SICES should interpret this as an implied re-editing of this attribute to TRUE (from that SICE only). It is recommended that updates not be disabled for more than short periods of time (e.g., only during bursts of rapid activity on the workspace).
sourceDisplayIndicator	–	This attribute specifies the size and position of the view relative to the display at the sourcing terminal. This is to be interpreted as a recommendation to the receiving SICE to display the view in a similar manner. However, there is no requirement that the receiving SICE actually display the view in the indicated manner. The creator of a view may specify the size and position of the view relative to the display at the creator's terminal. This is meant as a recommendation to receiving SICES that this view be displayed in a similar manner. However, there is no requirement that the receiving terminal actually display the view in this way. The sourceDisplayIndicator is composed of the set of parameters indicated in Table 8-9.
nonStandardAttribute	–	This attribute is specified as a nonStandardIdentifier. To be used, it must have been successfully negotiated by a corresponding non-standard capability. Its interpretation is not specified by this Recommendation.

Table 8-9 – Source display indicator

Parameter	Description
displayAspectRatio	The aspect ratio of the display device being indicated. This is defined to be the ratio of horizontal to vertical dimensions of the display area.
horizontalSizeRatio	This is the ratio of the horizontal size of the view to the horizontal display size.
horizontalPosition	This is the horizontal offset of the upper left hand corner of the view relative to the upper left hand corner of the display. This is given in normalized units relative to a horizontal display width of 1.0.
verticalPosition	This is the vertical offset of the upper left hand corner of the view relative to the upper left hand corner of the display. This is given in normalized units relative to a vertical display height of 1.0.

Any node that receives a WorkspaceCreatePDU on any of the three priority channels shall first examine the synchronized flag in the SIPDU to determine if the workspace is designated as synchronized or unsynchronized. If the workspace is unsynchronized, the SICE shall send a WorkspaceCreateAcknowledgePDU to the node that issued the WorkspaceCreatePDU. This is done as indicated in Table 6-3. The content of the WorkspaceCreateAcknowledgePDU is shown in Table 8-10. An SICE shall not issue any exchanges that require the use of a priority channel that a WorkspaceCreatePDU has not been received on in the case of synchronized workspaces. Only a single WorkspaceCreatePDU is issued in the case of unsynchronized workspaces.

Table 8-10 – WorkspaceCreateAcknowledgePDU

Parameter	Description
workspaceIdentifier	This specifies the workspace being acknowledged. This may be either an active or archived workspace, although this shall not be an archived workspace if the Archive-Supported capability is not present in the negotiated capability set. In the case of an active workspace, this shall equal the value of the workspaceIdentifier in the WorkspaceCreatePDU of the corresponding workspace. In the case of an archived workspace, this shall equal the value of the workspaceIdentifier in the WorkspaceCreatePDU of the corresponding workspace except the modificationTime parameter shall not be included.
nonStandardParameters (optional)	An optional list of non-standard parameters allowed only if the corresponding non-standard capabilities are present in the negotiated capability set.

Next, the SICE shall determine how it should process the WorkspaceCreatePDU. First, the SICE shall compare the application roster instance number specified in the WorkspaceCreatePDU against the last application roster instance number that was received that signalled new SICEs entering the session. If the new application roster instance is less than this number, the SICE shall ignore the WorkspaceCreatePDU (and all WorkspaceCreatePDUs with the same workspace handle received later on other priority channels). If the application roster instance number specified in the WorkspaceCreatePDU is greater than or equal to the last application roster instance number that was received that signalled new SICEs entering the session and less than or equal to the last application roster instance number received, the WorkspaceCreatePDU is accepted and processed, creating the workspace with the characteristics designated by the parameters in the SIPDU. Because race conditions exist between the receipt of GCC-Application-Roster-Report indications and WorkspaceCreatePDUs, it is possible for the application roster instance number specified in the WorkspaceCreatePDU to be greater than the latest instance number reported by a GCC-Application-Roster-Report indication. In this case, the SICE receiving the

WorkspaceCreatePDU shall process in advance or buffer the workspace create transaction and any other valid transactions directed to the workspace until a GCC-Application-Roster-Report indication is received that identifies an instance number which is equal to the one specified in the workspace create. The SICE shall not source any exchanges to this workspace (except acknowledgements) until this time because the correct capabilities set that binds the new workspace is not known until the referenced GCC-Application-Roster-Report indication is received. If the SICE chooses to process any workspace transactions in advance of the receipt of the proper GCC-Application-Roster-Report indication, it must not assume that the capabilities associated with the new workspace are within the bounds defined by its own capability set given that the roster change prompting the new application roster may have been triggered by the SICE being either forcibly or voluntarily removed from the session.

An SICE that receives a WorkspaceCreatePDU before it receives its first GCC-Application-Roster-Report indication shall process in advance or buffer the workspace create transaction and any other valid transactions directed to the workspace until a GCC-Application-Roster-Report indication is received that identifies an instance number that is equal to the one specified in the workspace create. The same care must be taken with respect to the temporary capability ambiguity as described above. When the application roster does arrive, any workspaces whose application roster instance number is less than the instance number reported by the GCC-Application-Roster-Report indication shall be locally discarded.

As the SICE receives the remaining two WorkspaceCreatePDUs on each of the other two priority channels, it shall check that their workspace handle is the same as that of a WorkspaceCreatePDU previously received on another priority channel, and if so, it shall ignore it.

If more than one workspace is being created at the same time by different SICES, it is possible that the three WorkspaceCreatePDUs from one SICE will be interleaved with the three from other SICES (i.e., the order that they are received on each of the three priority channels may be different). If multiple WorkspaceCreatePDUs specify views with focus set as the viewState, assertion of focus is applied in the order that the WorkspaceCreatePDUs are received on the high priority channel.

If the workspace is designated as unsynchronized, the originating SICE shall wait to receive WorkspaceCreateAcknowledgePDUs from each of the SICES which are present and marked as active in the instance of the application roster to which the workspace was referenced. If a new application roster is received in which some of the nodes in the original instance are no longer present, the SICE shall consider those nodes as having acknowledged and will no longer wait for a response from them. If the SICE receives an acknowledgment from any node which was not in the application roster instance to which the workspace was referenced, these acknowledgements shall be ignored. Once all acknowledgements have been received, the SICE creating the workspace shall issue a WorkspaceReadyPDU with the parameters set according to Table 6-3. This SICE can then perform all allowable exchanges to the new workspace. All other SICES in the session shall wait to receive the WorkspaceReadyPDU before performing any exchanges to the new workspace. However, information from other SICES directed at the workspace can be received prior to reception of the WorkspaceReadyPDU and should be considered valid.

There are additional rules and conditions regarding the processing of multiple WorkspaceCreatePDUs from multiple SICES attempting to refresh the same workspace simultaneously. These can be found in clause 8.4.7.

Table 8-11 – WorkspaceReadyPDU

Parameter	Description
workspaceIdentifier	This specifies the workspace being identified as ready. This may be either an active or archived workspace, although this shall not be an archived workspace if the Archive-Supported capability is not present in the negotiated capability set. In the case of an active workspace, this shall equal the value of the workspaceIdentifier in the WorkspaceCreatePDU of the corresponding workspace. In the case of an archived workspace, this shall equal the value of the workspaceIdentifier in the WorkspaceCreatePDU of the corresponding workspace except the modificationTime parameter shall not be included.
nonStandardParameters (optional)	An optional list of non-standard parameters allowed only if the corresponding non-standard capabilities are present in the negotiated capability set.

8.4.3 Deleting a workspace

To delete a workspace, an SICE shall send a WorkspaceDeletePDU to all SICEs in the session in the manner indicated in Table 6-3. The content of the WorkspaceDeletePDU is shown in Table 8-12. For a synchronized workspace, it shall send this SIPDU three separate times on each of the three priority channels: high, medium and low. This is done to allow a terminal which might wish to save the contents of a deleted workspace locally, to do so without ambiguity ensuring that all data bound for that workspace prior to the deletion has been consistently received at all nodes.

Table 8-12 – WorkspaceDeletePDU

Parameter	Description
workspaceIdentifier	This specifies the workspace being deleted. This may be either an active or archived workspace, although this shall not be an archived workspace if the Archive-Supported capability is not present in the negotiated capability set. In the case of an active workspace, this shall equal the value of the workspaceIdentifier in the WorkspaceCreatePDU of the corresponding workspace. In the case of an archived workspace, this shall equal the value of the workspaceIdentifier in the WorkspaceCreatePDU of the corresponding workspace except the modificationTime parameter shall correspond to the current time rather than the time of creation.
reason	Reason for workspace deletion. May be either userInitiated, insufficientStorage or a nonStandardReason.
nonStandardParameters (optional)	An optional list of non-standard parameters allowed only if the corresponding non-standard capabilities are present in the negotiated capability set.

Any node that receives a WorkspaceDeletePDU on any of the three priority channels shall first check the workspace handle to determine if the receiving SICE has a copy of this workspace. If so, it may either delete the workspace immediately, or, if it wishes to maintain a local copy of the deleted workspace in a form consistent with that which might be maintained on other workspaces, it may continue to apply information bound to this workspace from each of the priority channels up until the time that it receives the WorkspaceDeletePDU on that channel. Once it has received all three WorkspaceDeletePDUs, it has the workspace in its final form and may maintain it for local use. Note that this procedure only ensures consistency of the final form of the workspace if the workspace had been designated as synchronized.

8.4.4 Editing workspace, workspace plane and view attributes

At any time, an SICE may modify the workspace, plane and/or view attributes of a workspace by sending a WorkspaceEditPDU to all nodes in the session in the manner indicated in Table 6-3. The content of the WorkspaceEditPDU is shown in Table 8-13. For a synchronized workspace, it shall send this SIPDU redundantly on all priority channels used for SIPDUs (high, medium and low). In this case, on each priority channel, data received after reception of the WorkspaceEditPDU assumes the constraints of the new attribute set. Based upon the nature of the attribute changes, the application to the workspace of data received after the WorkspaceEditPDU on a given priority channel may need to be delayed until reception of the remaining copies of the WorkspaceEditPDU on all other priority channels.

On receipt of a WorkspaceEditPDU, an SICE shall examine the workspace handle and determine whether it has a copy of this workspace. If so, the SICE shall apply the new workspace, plane and view attributes indicated in the received WorkspaceEditPDU to the local copy of the workspace.

If more than one workspace is being edited or created at the same time by different SICEs, it is possible that the three WorkspaceEditPDUs or workspaceCreatePDUs from one SICE will be interleaved with the three from the other SICEs (i.e., the order that they are received on each of the three priority channels may be different). If multiple WorkspaceEditPDUs or WorkspaceCreatePDUs specify views with focus set as the viewState, assertion of focus is applied in the order that the WorkspaceEditPDUs and WorkspaceCreatePDUs are received on the high priority channel. Similarly, if WorkspaceEditPDUs modifying workspace, plane or view attributes for the same workspace are received interleaved on the three priority channels, attribute changes are applied in the order that the WorkspaceEditPDUs are received on the high priority channel.

If the plane protection attribute is among those in the list of attributes to be modified, the receiving SICE shall check that the user ID of the source of the WorkspaceEditPDU is the same as that of any SICE listed in the protectedPlaneAccessList included in the WorkspaceCreatePDU used to create the workspace. If so, this attribute shall be modified as indicated in the PDU. If not, this attribute shall not be modified.

Table 8-13 – WorkspaceEditPDU

Parameter	Description
workspaceIdentifier	This specifies the workspace being edited. This may be either an active or archived workspace, although this shall not be an archived workspace if the Archive-Supported capability is not present in the negotiated capability set. In the case of an active workspace, this shall equal the value of the workspaceIdentifier in the WorkspaceCreatePDU of the corresponding workspace. In the case of an archived workspace, this shall equal the value of the workspaceIdentifier in the WorkspaceCreatePDU of the corresponding workspace except the modificationTime parameter shall correspond to the current time rather than the time of creation.
attributeEdits (optional)	Sequence of workspace attributes to be modified. Workspace attributes are described in Table 8-4.
planeEdits (optional)	Sequence of planes for which plane attributes are to be modified. For each plane, the plane edit parameters are described in Table 8-14.
viewEdits (optional)	List of views to create, edit or delete. For each view, the view edit parameters are described in Table 8-15.
nonStandardParameters (optional)	An optional list of non-standard parameters allowed only if the corresponding non-standard capabilities are present in the negotiated capability set.

Table 8-14 – Workspace plane edits

Parameter	Description
plane	This parameter is the number of the plane whose attributes are to be edited.
planeAttributes	Set of plane attributes to be modified. Plane attribute parameters are described in Table 8-6.

Table 8-15 – Workspace view edits

Parameter	Description
viewHandle	Unique handle indicating the view to be modified.
action	This parameter indicates the action to be taken on the view. Possible actions are createNewView, editView, deleteView and nonStandardAction. If createNewView is indicated, a new view shall be created and associated with the workspace. An optional list of view attributes may be included to describe the characteristics of the new view. If editView is indicated, the characteristics of an existing view shall be modified. A list of view attributes indicates which attributes are to be changed. If deleteView is indicated, the indicated view shall be deleted. There are no additional parameters in this case. The nonStandardAction is only allowed if a corresponding non-standard capability has been negotiated. View attribute parameters are described in Table 8-8.

8.4.5 Copying workspace contents

If an SICE wishes to copy a rectangular region of one plane of a workspace to another rectangular region of the same plane, a different plane in the same workspace, or a different workspace, it may do so by sending a WorkspacePlaneCopyPDU to all peer SICEs in the manner indicated in Table 6-3. The content of the WorkspacePlaneCopyPDU is shown in Table 8-16.

Table 8-16 – WorkspacePlaneCopyPDU

Parameter	Description
sourceWorkspaceIdentifier	This specifies the source workspace from which a portion of a plane is to be copied. This may be either an active or archived workspace, although this shall not be an archived workspace if the Archive-Supported capability is not present in the negotiated capability set. In the case of an active workspace, this shall equal the value of the workspaceIdentifier in the WorkspaceCreatePDU of the corresponding workspace. In the case of an archived workspace, this shall equal the value of the workspaceIdentifier in the WorkspaceCreatePDU of the corresponding workspace except the modificationTime parameter shall not be included.
sourcePlane	This parameter indicates the plane from which the source rectangle is to be copied. Its value may span the range (0..N – 1) where N is the number of planes in the source workspace.