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TO: Working Group and
        Accredited Standards Committee X3T9.2

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SUBJ: Changes and Additions to the Automatic Medium Changer
        Proposal by Michael Rudy of FILENET

Attached for your review is a proposal for replacing the Group 0
EXCHANGE MEDIUM" command. The extended version allows all
addresses of an exchange process to be defined in one ten-byte
command.

Also attached is a proposal for adding "SIDE" bits to the
data masks returned in a READ ELEMENT STATUS command. These
optional bits can be used by changers that have the ability to
detect how the media is positioned with regard to Side A or
Side B.

Another proposal is to change the Operation Code of the MOVE
MEDIUM command from a 37h to a 39h to avoid conflicts with
device types.

One issue that requires further attention is that of ADDITIONAL
SENSE CODES.

Group 1 Commands for Automatic Medium Changers

The Group 1 commands for automatic medium changer shall be as shown in Table
12-8.

Group 1 Commands for Automatic Medium Changers

Operation Code	Type	Command Name	Section	Page
20h	V			
21h	V			
22h	V			
23h	V			
24h	V			
25h	V			
26h	V			
27h	V			
28h	V			
29h	V			
2Ah	V			
2Bh	R			
2Ch	R			
2Dh	R			
2Eh	R			
2Fh	R			
30h	R			
31h	R			
32h	R			
33h	R			
34h	R			
35h	R			
36h	R			
37h	R			
38h	O	READ ELEMENT STATUS	n.2.1	
39h	M	MOVE MEDIUM	n.2.2	
3Ah	O	EXCHANGE MEDIUM	n.2.3	
3Bh	R			
3Ch	R			
3Dh	R			
3Eh	R			
3Fh	R			

Key: M = Command implementation is mandatory.
     O = Command implementation is optional.
     R = Operation code is reserved for future standardization.
     V = Operation code is available for vendor unique commands.

EXCHANGE Command

        Peripheral Device Type: Automatic Medium Changer
           Operation Code Type: Optional

                    EXCHANGE MEDIUM Command

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (3Ah)							
1	Logical Unit Number			Reserved				
2	(MSB)							
3				Source Address				(LSB)
4	(MSB)							
5				First Destination Address				(LSB)
6	(MSB)							
7				Second Destination Address				(LSB)
8				Reserved			Inv2	In.1
9	Vendor Unique			Reserved			Flag	Lin.

   The EXCHANGE Command (Table _-_) provides a means for commanding
automatic medium changers that can emulate or have the capability of handling
two units of media at the same time to move a unit of media from a source
element to a full destination element. The unit of media in the full element
is moved to an empty destination element. The target shall return a CHECK
CONDITION status with the sense key set to ILLEGAL REQUEST if this command is
received when the first destination element is empty or when the second
destination element is full.

   The source address specifies the location that the unit of media is taken
from. This address may represent a storage element, an input/output element,
a data transfer element, or a medium transport element. The target shall
return a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST if
the address specified has not been assigned to a specific element fof the
automatic medium changer.

   The first destination address specifies the location that the source unit
of media is moved to. This address may represent a storage element, an
input/output element, a data transfer element or a medium transport element.
The target shall return a CHECK CONDITION status with the sense key set to
ILLEGAL REQUEST if the address specified has not been assigned to a specific
element of the automatic medium changer.

   The second destination address specifies the location that the first
destination media is moved to. This address may represent a storage element,
an input/output element, a data transfer element, or a medium transport
element. The target shall return a CHECK CONDITION status with the sense re-
set to ILLEGAL REQUEST if the address specified has not been assigned to a
specific element of the automatic medium changer.

   The Inv1 bit is used to specify that the transport element is to be placed
in its inverted orientation prior to withdrawing the unit of media from the
first destination element.

   The Inv2 bit is used to specify that the transport element is to be placed
in its inverted orientation prior to depositing the unit of media into the
second destination element.

   If the automatic medium changer does not support medium rotation for
handling double sided media, the Inv1 and Inv2 bits are not implemented.

READ ELEMENT STATUS Command

        Peripheral Device Type: Automatic Medium Changer
        Operation Code Type: Optional

                    READ ELEMENT STATUS Command

```
=====================================================================
 Bit:   7   :   6   :   5   :   4   :   3   :   2   :   1   :   0
 Byte :     :     :     :     :     :     :     :
=====================================================================
 0   :                    Operation Code (38h)
 ------------------------------------------------------------------
 1   : Logical Unit Number   :           Reserved
 ------------------------------------------------------------------
 2   : (MSB)
 ------                                                       ---
 3   :                  Starting Element Address              (LSB)
 ------------------------------------------------------------------
 4   : (MSB)
 ------                                                       ---
 5   :                   Number of Elements                   (LSB)
 ------------------------------------------------------------------
 6   :                        Reserved
 ------------------------------------------------------------------
 7   :                        Reserved
 ------------------------------------------------------------------
 8   :                        Reserved
 ------------------------------------------------------------------
 9   : Vendor Unique  :      Reserved             : Flag : Link
=====================================================================
```

   The READ ELEMENT STATUS Command Table (_-_) provides a means for the target
to report the status of its internal elements to the initiator.

   The starting element address specifies the first element whose status is to
be reported.

   The number of elements specifies the number of elements whose status is to
be reported.

                        ELEMENT STATUS Data

```
=====================================================================
 Bit:   7   :   6   :   5   :   4   :   3   :   2   :   1   :   0
 Byte :     :     :     :     :     :     :     :
=====================================================================
 0   : (MSB)
 ------                      Starting Cell Address            ---
 1   :                                                        (LSB)
 ------------------------------------------------------------------
 2   : (MSB)
 ------                        Number of Cells                ---
 3   :                                                        (LSB)
 ------------------------------------------------------------------
 4   :                        Reserved
 ------------------------------------------------------------------
 5   :                        Reserved
 =====================================================================
       :                    Status Report Data
 =====================================================================
 2n+4 :    Element Type Code           :          Reserved
 ------------------------------------------------------------------
 2n+5 : Vendor Unique  :            Data Mask
 =====================================================================
```

   The starting element address specifies the first element whose status is to
be reported.

   The number of elements specifies the number of elements whose status is to
be reported.

   The Element Type Code defines the type of element whose status is being
reported. This is used in selecting the proper mask for interpreting the
status data being returned.

          Element Type Code

```
==========================================================================
  Code       Description                                   Section
  -----      -----------------------------------------     -------
   0h        No element defined for indicated address
   1h        Storage element
   2h        Input/Output element
   3h        Medium transport element
   4h        Data transfer element
   5h-Fh     Reserved
==========================================================================
```

The data mask varies depending on the element type as defined below.

No Element Defined for Indicated Address

          Data Mask - Element Type Code 0h

```
==========================================================================
  Bit:   5   :   4   :   3   :   2   :   1   :   0   :
  -----:-----------------------------------------------:
       :                   Reserved                    :
==========================================================================
```

Some of the addresses within the range specified by the initiator may not
have been assigned to any element type. This shall not be considered to be a
error. Instead, the target shall respond with the type code bits set to 0h.

Storage Element

          Data Mask - Type Code 1h

```
==========================================================================
  Bit:  5    :   4   :   3    :   2   :   1    :   0   :
  -----:-----------------------------------------------:
       : SdValid: Side B : Access : Error : Resv'd : Full  :
==========================================================================
```

The full bit is set to one to indicate that the storage element contains a
unit of media. The full bit is set to zero to indicate that the storage
element does not contain a unit of media.

The error bit is set to one to indicate that the storage element is in an
abnormal state. This bit is set to zero if the storage element is in its
normal state.

The access bit is set to one if access to the storage element by the medium
transport element is allowed. This bit is set to zero if access to the storage
element by the medium transport element is denied.

The Side B bit is set to zero if side A of the media is in loading position.
This bit is set to one to indicate side B is in loading position. This bit
is only valid when the SdValid bit is set to one.

The SdValid bit is the side valid bit. When this is set to zero the Side B r
is not valid. When this bit is set to one the Side B bit indicates which s
is in loading position.

All other bits in this data mask field are reserved.

Input/Output Element Address

        Data Mask - Type Code 2h

===
      Bit!   5   :   4   :   3   :   2   :   1   :   0   :
      -----|---|
           : SdValid: Side B : Access ! Error ! I/O ! Full !
===

The full bit is set to one to indicate that the Input/Output element contains a unit of media. The full bit is set to zero to indicate that the Input/Output element does not contain a unit of media.

The I/O bit is set to one if the unit of media in the Input/Output element was placed there by an operator. This bit is set to zero if the unit of media in the Input/Output element was placed there by the medium transport element.

The error bit is set to one to indicate that the Input/Output element is in an abnormal state. This bit is set to zero if the Input/Output element is in its normal state. An example of an abnormal state would be if the operator placed the unit of media into the Input/Output element incorrectly.

The access bit is set to one if access to the Input/Output element by the medium transport element is allowed. This bit is set to zero if access to the Input/Output element by the medium transport element is denied. (Implementation note: An example of when access would be denied is when the operator has access to the Input/Output element.)

The Side B bit is set to zero if side A of the media is in loading position. This bit is set to one to indicate side B is in loading position. This bit is only valid when the SdValid bit is set to one.

The SdValid bit is the side valid bit. When this is set to zero the Side B bit is not valid. When this bit is set to one the Side B bit indicates which side is in loading position.

Medium Transport Element Address

        Data Mask - Type Code 3h

===
      Bit!   5   :   4   :   3   :   2   :   1   :   0   :
      -----|---|
           :SdValid :Side B2 :Side B1 : Error : Full2 : Full1 :
===

If the medium transport element is only capable of holding one unit of media at a time, the full1 bit is set to one if it is holding a unit of media and the full1 bit is set to zero if it is not holding a unit of media. If the medium transport element is capable of handling two units of media at once, the full1 bit is set to one if the medium transport is holding a unit of media in the first of its medium gripping devices and the full1 bit is set to zero

if the medium transport is not holding a unit of media in the first of its medium gripping devices.

If the medium transport element is capable of handling two units of media at once, the full2 bit is set to one if the medium transport is holding a unit of media in the second of its medium gripping devices and the full2 bit is set to zero if the medium transport is not holding a unit of media in the second of its medium gripping devices. If the medium transport device is only capable of handling one unit of media at a time, the full2 bit is reserved.

The error bit is set to one to indicate that the medium transport element is in an abnormal state. This bit is set to zero if the medium transport element is in its normal state.

If the medium transport element is only capable of holding one unit of media at a time, the Side B1 bit is set to zero if side A of the media is in loading position. This bit is set to one to indicate side B is in loading position. If the medium transport element is capable of handling two units of media at once, the Side B1 bit is set to zero if side A of the media is in loading position in the first of its gripping devices. This bit is set to one to indicate side B is in loading position in the first of its gripping devices.

If the medium transport element is only capable of holding one unit of media at a time, the Side B2 bit is not implemented. If the medium transport element is capable of handling two units of media at once, the Side B2 bit is set to zero if side A of the media is in loading position in the second of its gripping devices. This bit is set to one to indicate side B is in loading position in the second of its gripping devices. This bit is only valid when the SdValid bit is set to one.

The SdValid bit is the side valid bit. When this is set to zero the Side B1 and Side B2 bits are not valid. When this bit is set to one the Side B1 and Side B2 bits indicates which sides are in loading position.

Data Transfer Element Address

        Data Mask - Type Code 4h

===
      Bit!   5   :   4   :   3   :   2   :   1   :   0   :
      -----|---|
           :SdValid : Side B : Access : Error :Reserved! Full   :
===

The full bit is set to one to indicate that the data transfer element contains a unit of media. The full bit is set to zero to indicate that the data transfer element does not contain a unit of media.

The error bit is set to one to indicate that the data transfer element is in an abnormal state. This bit is set to zero if the data transfer element is in its normal state.

The access bit is set to one if access to the data transfer element by the medium transport element is allowed. This bit is set to zero if access to the

data transfer element by the medium transport element is denied.
(Implementor's note: Access to the data transfer element by the medium
transport element might be denied if a data transfer operation were underw? .

The Side B bit is set to zero if side A of the media is in loading positi?? .
This bit is set to one to indicate side B is in loading position. This bi?
is only valid when the SdValid bit is set to one.

The SdValid bit is the side valid bit. When this is set to zero the Side ? ?
is not valid. When this bit is set to one the Side B bit indicates which ? ?
is in loading position.

All other bits in this data mask are reserved.