

JPEG

STILL IMAGE DATA COMPRESSION STANDARD



William B. Pennebaker • Joan L. Mitchell

JPEG

STILL IMAGE DATA COMPRESSION STANDARD

**William B. Pennebaker
Joan L. Mitchell**

*William B. Pennebaker
Joan L. Mitchell*



VAN NOSTRAND REINHOLD
New York

Copyright © 1993 by Van Nostrand Reinhold

Library of Congress Catalog Card Number 92-32860
ISBN 0-442-01272-1

All rights reserved. No part of this work covered by the copyright hereon may be reproduced or used in any form by any means—graphic, electronic, or mechanical, including photocopying, recording, taping, or information storage and retrieval systems—without written permission of the publisher.

Printed in the United States of America

Van Nostrand Reinhold
115 Fifth Avenue
New York, New York 10003

Chapman and Hall
2-6 Boundary Row
London, SE1 8HN, England

Thomas Nelson Australia
102 Dodds Street
South Melbourne 3205
Victoria, Australia

Nelson Canada
1120 Birchmount Road
Scarborough, Ontario M1K 5G4, Canada

16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

Library of Congress Cataloging-in-Publication Data

Pennebaker, William B.

JPEG still image data compression standard / William B.
Pennebaker, Joan L. Mitchell.

p. cm.

Includes bibliographical references and index.

ISBN 0-442-01272-1

1. Image processing—Digital techniques—Standards. 2. Data
compression (Telecommunication)—Standards. 3. Algorithms.

I. Mitchell, Joan L. II. Title.

TA1632.P45 1992

621.36'7—dc20

92-32860
CIP

DHP: The DHP (Define Hierarchical Progression) marker segment is used to signal the parameters identifying the dimensions, components, and relative sampling of the final image of the hierarchical progression. It uses the same syntax as the frame header (see section 7.5) and must precede the first frame in the progression.

DHT: The DHT (Define Huffman Table) marker segment defines one or more Huffman tables.

DNL: The DNL (Define Number of Lines) marker segment provides a mechanism for defining or redefining the number of lines in the image at the end of the first scan. The two-byte length (always 4) is followed by a two-byte value giving the number of lines in the frame. The number of lines specified in the DNL marker segment must be consistent with the number of lines and the sampling factors already specified in the frame header and with the number of lines already decoded. Thus, unless the value specified in the frame header is zero, the number of lines specified in the DNL marker segment must be less than or equal to the frame header value, and in all cases must be a value somewhere within the range of the last row of MCU decoded. Note that if the data are directly written to an image buffer, spurious data may be written to the buffer if rows of samples are padded in this last MCU row.

DQT: The DQT (Define Quantization Table) marker segment defines one or more quantization tables. Quantization tables used in a progression should not be changed between scans of that progression. The DQT marker has meaning only for DCT-based algorithms.

DRI: The DRI (Define Restart Interval) marker segment provides the mechanism for setting and resetting the restart interval. The two-byte length (always 4) is followed by a two-byte value giving the number of MCU in the restart interval. The restart interval is set to zero at the start of an image. When the restart interval is zero, the restart function is disabled.

EOI: The EOI (End Of Image) marker terminates the JPEG compressed data stream.

EXP: The EXP (Expand) marker segment signals the expansion of the spatial resolution of the reference data needed by the hierarchical differential frame that follows. It is followed by a two-byte length (always 3) and an eight-bit integer that has one of the values X'10', X'01' or X'11'. X'10' signals a horizontal expansion by a factor of 2, X'01' signals a vertical expansion by a factor of 2, and X'11' signals both horizontal and vertical expansion by a factor of 2.

JPG; JPG_n: The JPG and JPG_n marker segments are reserved for future JPEG extensions.

RES: The RES markers are reserved for future JPEG extensions.

RST_m: The RST_m (Restart) marker is appended to the compressed data between restart intervals. This provides a unique byte-aligned code that can be located by scanning the compressed data. A three-bit field (*m*) in this marker code provides a modulo-8 restart interval count. The modulo count of the first RST_m code in a scan is zero.

SOF_n: An SOF_n (Start Of Frame) marker begins a frame header. The variable-length SOF_n marker segment gives the frame parameters that apply to all scans within the frame. The particular value of *n* in SOF_n identifies the mode of compression and the entropy coder used within the frame.

SOI: The SOI (Start Of Image) marker begins the compressed data stream. Note that the SOI marker can be used to detect problems with bit order, bit sense, and bit alignment of the data.

SOS: The SOS (Start Of Scan) marker begins a scan header. The scan header is always followed immediately by entropy-coded data for the scan. The two-byte length gives the number of bytes of scan parameters.

TEM: The TEM marker is reserved for temporary private use by arithmetic encoders. It is used to signal temporarily an unresolved carry-over, so that postprocessing can carry out the resolution off-line. It may not occur in JPEG compressed data streams.

The DHT, DAC, DRI, DQT, COM, and APP_n marker segments may be inserted into the compressed data before the frame and scan headers. They may be used in any order and as many times as desired. If the DHT and DQT marker segments follow the start-of-image marker (SOI), they may be followed immediately by the end-of-image (EOI) marker. This is the JPEG abbreviated format for table specification data. COM and APP_n marker segments may also be used in this abbreviated sequence. The DAC and DRI may appear but have no function, because the next SOI will set default values.

7.4.1 Structure of the compressed data stream ①

From the definitions of the segments in the previous section the marker and segment structure of a nonhierarchical encoder output might be as shown in Figure 7-5. Note:

1. The marker terminating the final restart interval of the first scan may be preceded by the DNL marker.
2. The last entropy-coded segment in a scan is not followed by an RST_m marker.
3. If arithmetic coding is used, the DAC marker segment is used instead of the DHT marker segment.