GROUP 47

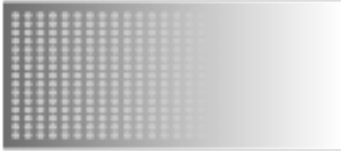# A NON-MAGNETIC, 1000+ YEAR SOLUTION FOR ARCHIVING DIGITAL DATA

Prepared for

Library of Congress
Storage Architectures Meeting

September 20, 2016

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The Digital Dilemma

The Problem: Even if you could have a file in perfect
condition 100 years from now, will your
operating system still support it?

We've solved the problem

GROUP 4 7

DOTS™: Design Principles

- Archival for 1000+ years

- Data can be seen, and recorded in human readable form

- Data is retrieved without sophisticated technology

- Immune to magnetism & can withstand environmental stress

- Same form factor as existing LTO systems

- Compatible with current robotics, commands and LTFS

- One pass read/write of tape & able to support multiple data types

- Hardware devices are backwardly compatible for all previous generations

- DOTS is a Green Technology. Eliminates media & energy waste from forced migration, costly power requirements, and rigid environmental control demands

DOTS and Group 47

(12) **United States Patent**
Rosen

(10) **Patent No.:** US 9,208,813 B2
(45) **Date of Patent:** Dec. 8, 2015

(54) **DIGITAL OPTICAL TAPE STORAGE SYSTEM**

(71) Applicant: **Group 47, Inc.**, Woodland Hills, CA (US)

(72) Inventor: **Daniel Scott Rosen**, Thousand Oaks, CA (US)

USPC 369/124.02, 13.37, 124.03, 13.38,
369/13.28, 13.02, 30.12, 44.25, 44.26,
369/44.37, 53.12, 53.23, 53.27, 53.28,
369/124.01, 275.3, 276, 279, 280, 284
See application file for complete search history.

(19) **United States**
(12) **Patent Application Publication**
Rosen

(10) **Pub. No.:** US 2014/0307961 A1
(43) **Pub. Date:** Oct. 16, 2014

(54) **ARCHIVING IMAGERY ON DIGITAL OPTICAL TAPE**

(71) Applicant: **Group 47, Inc.**, Woodland Hills, CA (US)

(72) Inventor: **Daniel Scott Rosen**, Thousand Oaks, CA (US)

(73) Assignee: **Group 47, Inc.**, Woodland Hills, CA (US)

(21) Appl. No.: **14/249,922**

(22) Filed: **Apr. 10, 2014**

Related U.S. Application Data

(60) Provisional application No. 61/811,025, filed on Apr. 11, 2013.

Publication Classification

(51) **Int. Cl.**
G06T 7/00 (2006.01)
G06T 7/40 (2006.01)
G11B 7/003 (2006.01)
(52) **U.S. Cl.**
CPC *G06T 7/0081* (2013.01); *G11B 7/003* (2013.01); *G06T 7/408* (2013.01); *G06T 2207/20112* (2013.01)
USPC **382/164**; 369/100

(57) **ABSTRACT**

Methods and apparatus for archival storage of an image are disclosed. The image may be separated into a plurality of bit plane images. The plurality of bit plane images may be written separately onto digital optical tape.

PROPRIETARY

4
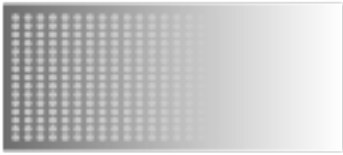
G47 Visual Metal Alloy Storage
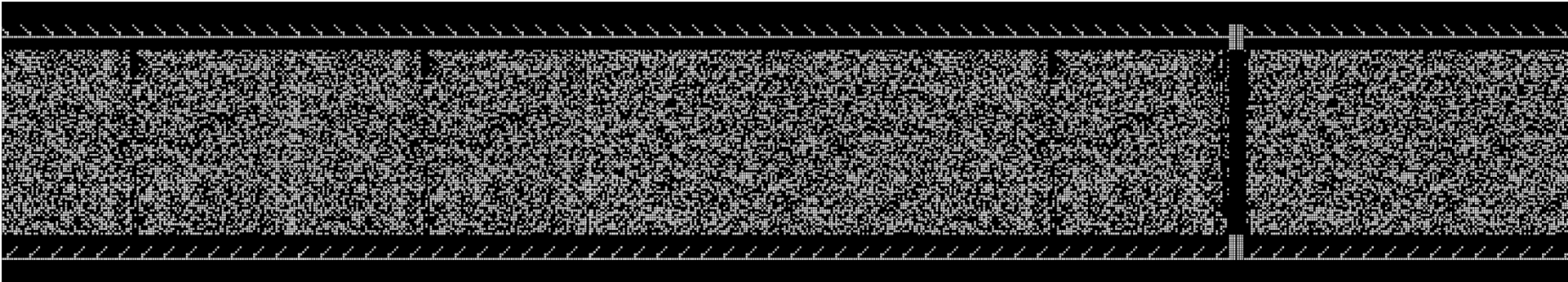
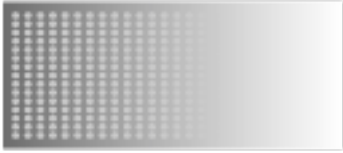Low resolution example of data on ½" tape

A photo of a test write to DOTS media, illustrating the ability to write binary, text, and images. In actual practice, the data would be microscopic in size.
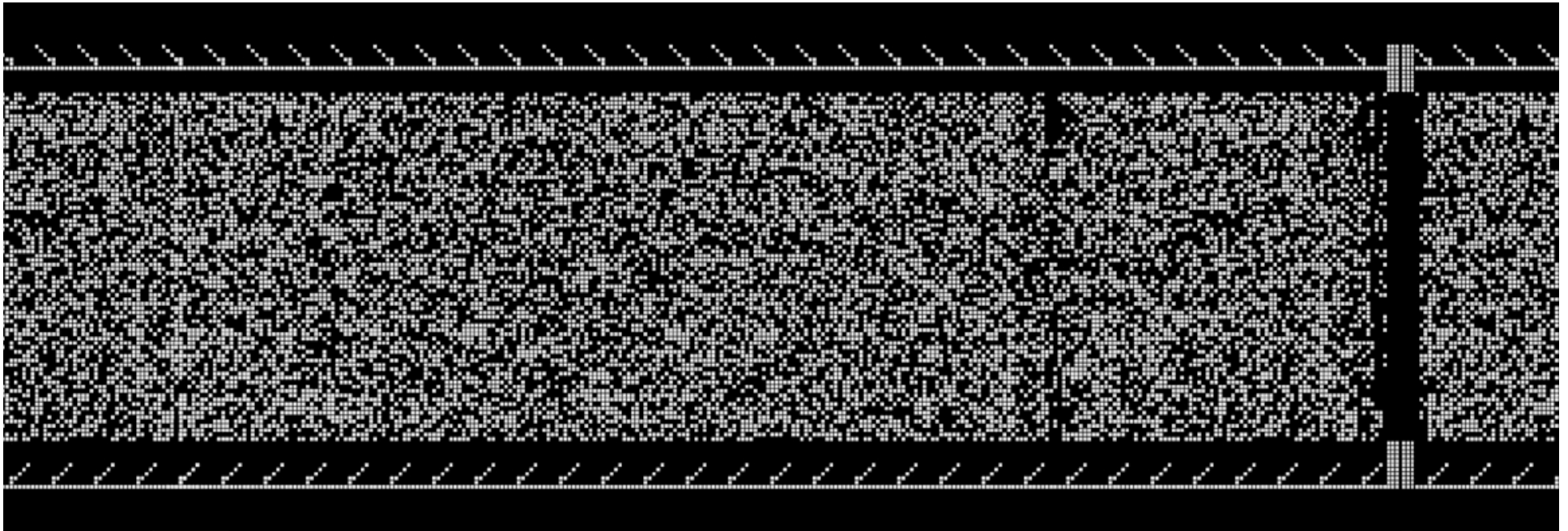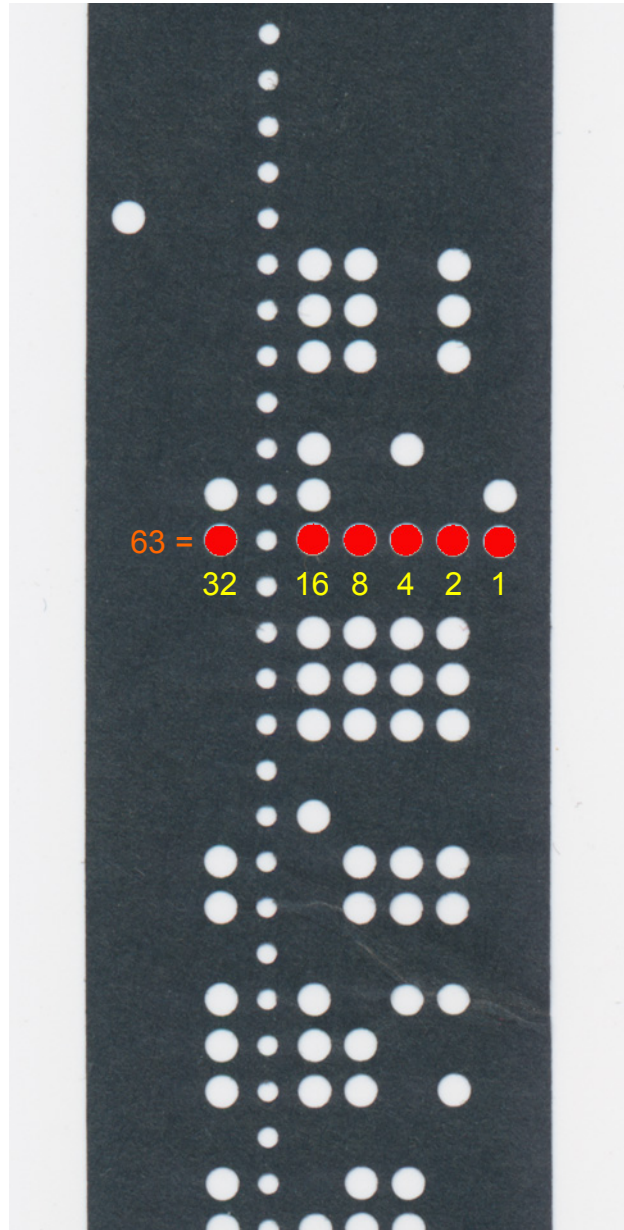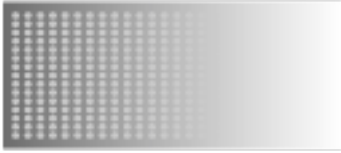

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PROPRIETARY

6
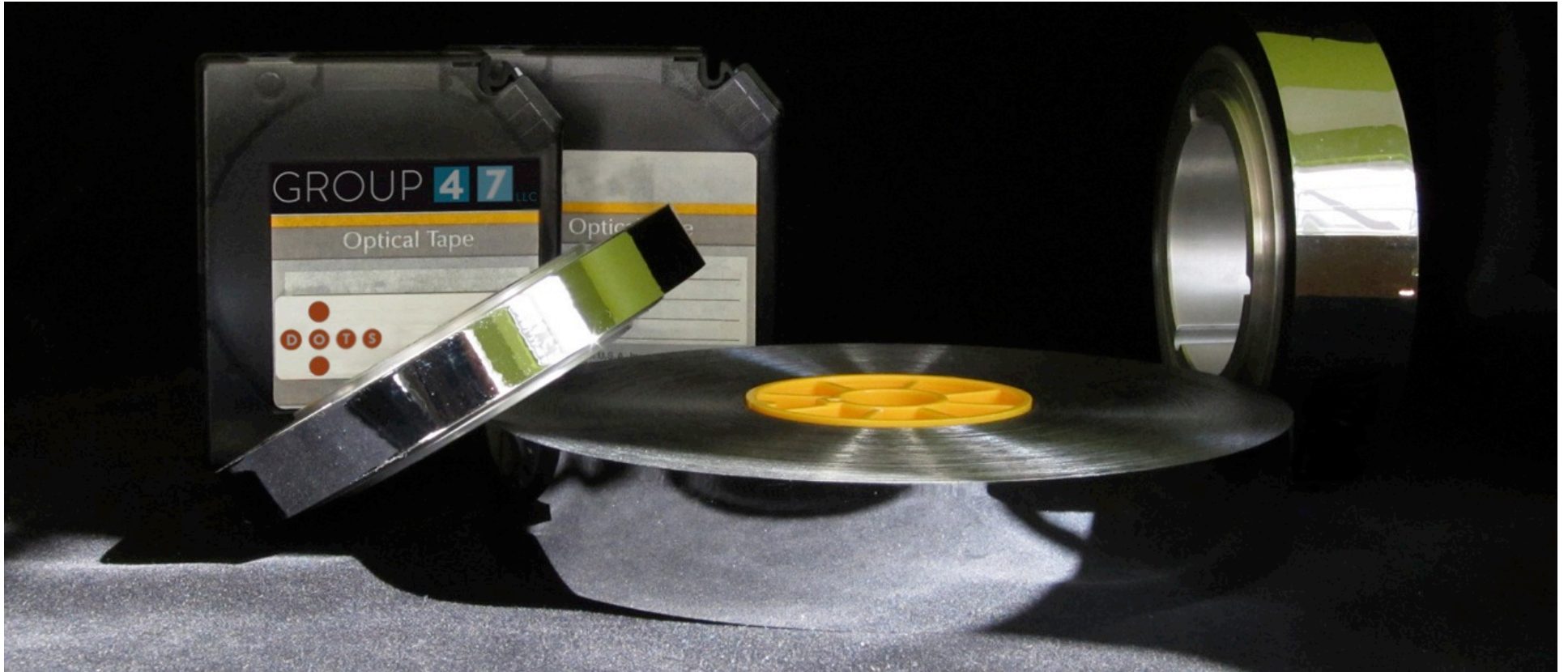
DOTS™

Visual Methods to Store Data

63 = 32 16 8 4 2 1

A Bit More About Bytes

ARCHIVE

A = 65 = 01000001
R = 82 = 01010010
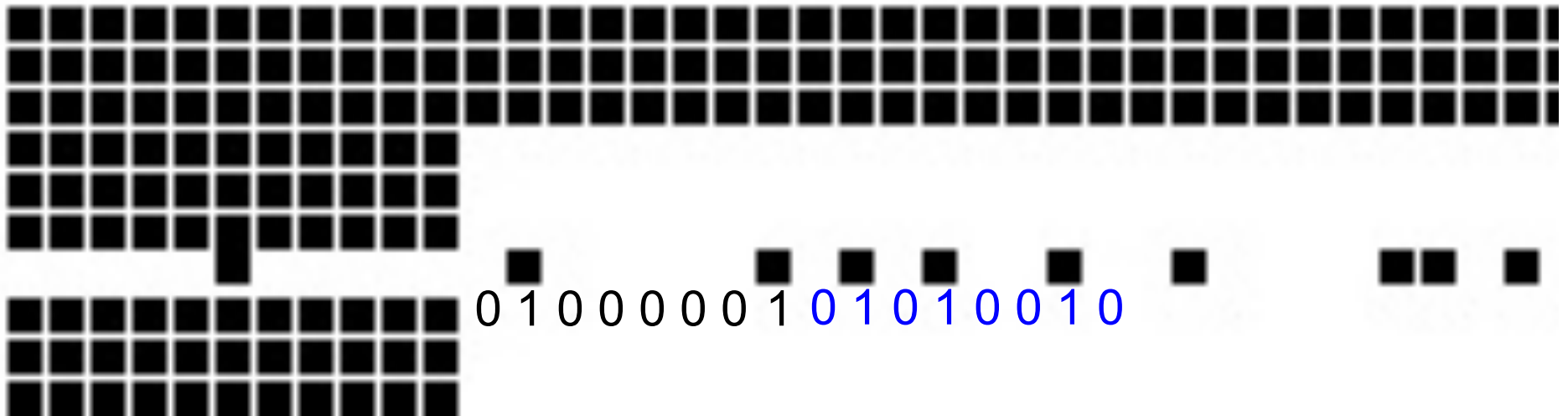C = 67 = 01000011
H = 72 = 01001000
I = 73 = 01001001
V = 86 = 01010110
E = 69 = 01000101

Visual Representation of Data

ARCHIVE

Visual Representation of Data

ARCHIVE

0 1 0 0 0 0 0 1 0 1 0 1 0 0 1 0

A = 65 = 01000001
R = 82 = 01010010

DOTS

DOTS

JPEG data for the previous image… (some of it)
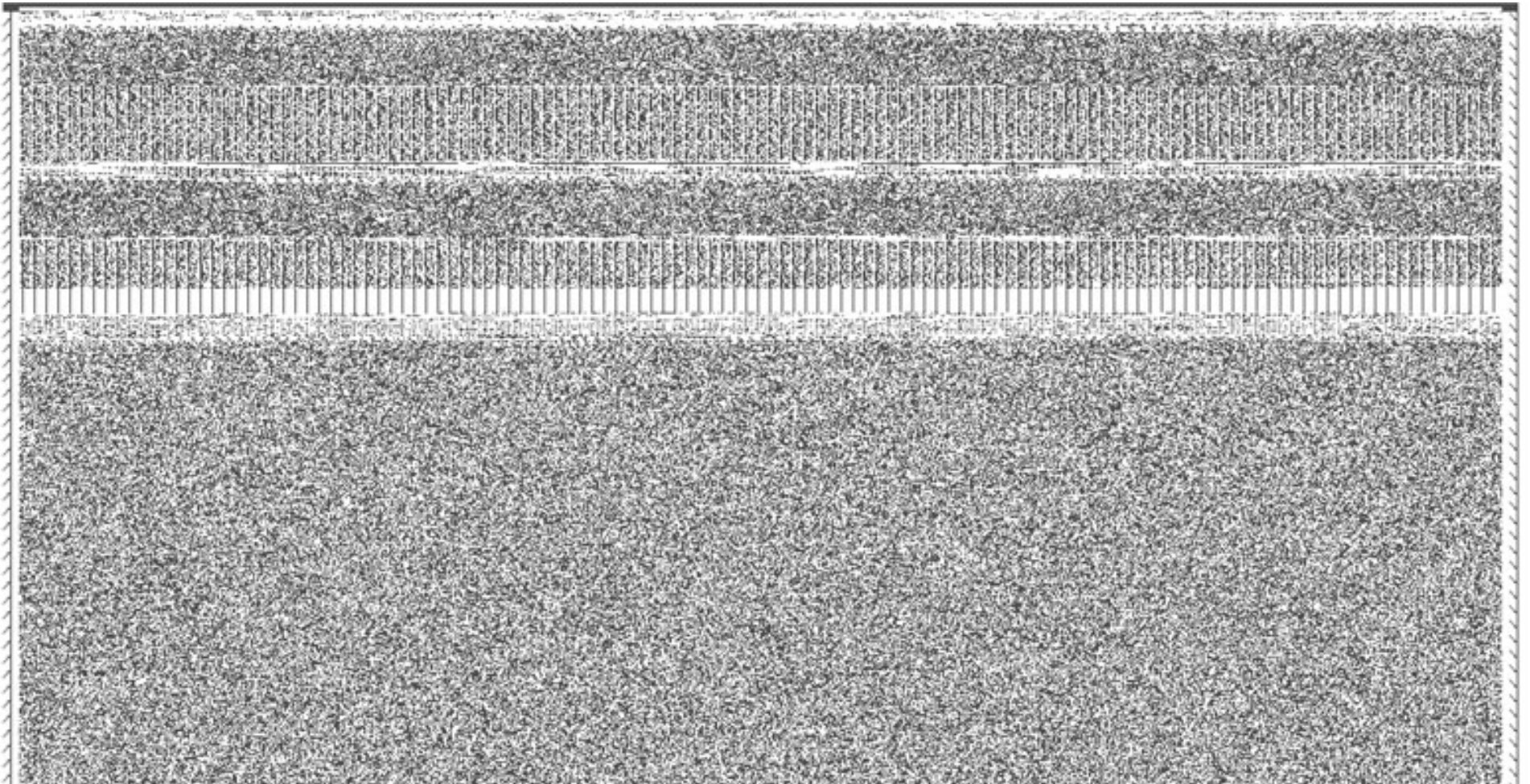
DOTS
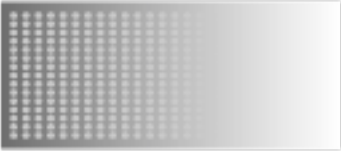
Full Aperture "Super 1.85" frame of film

PROPRIETARY

Area of Detail
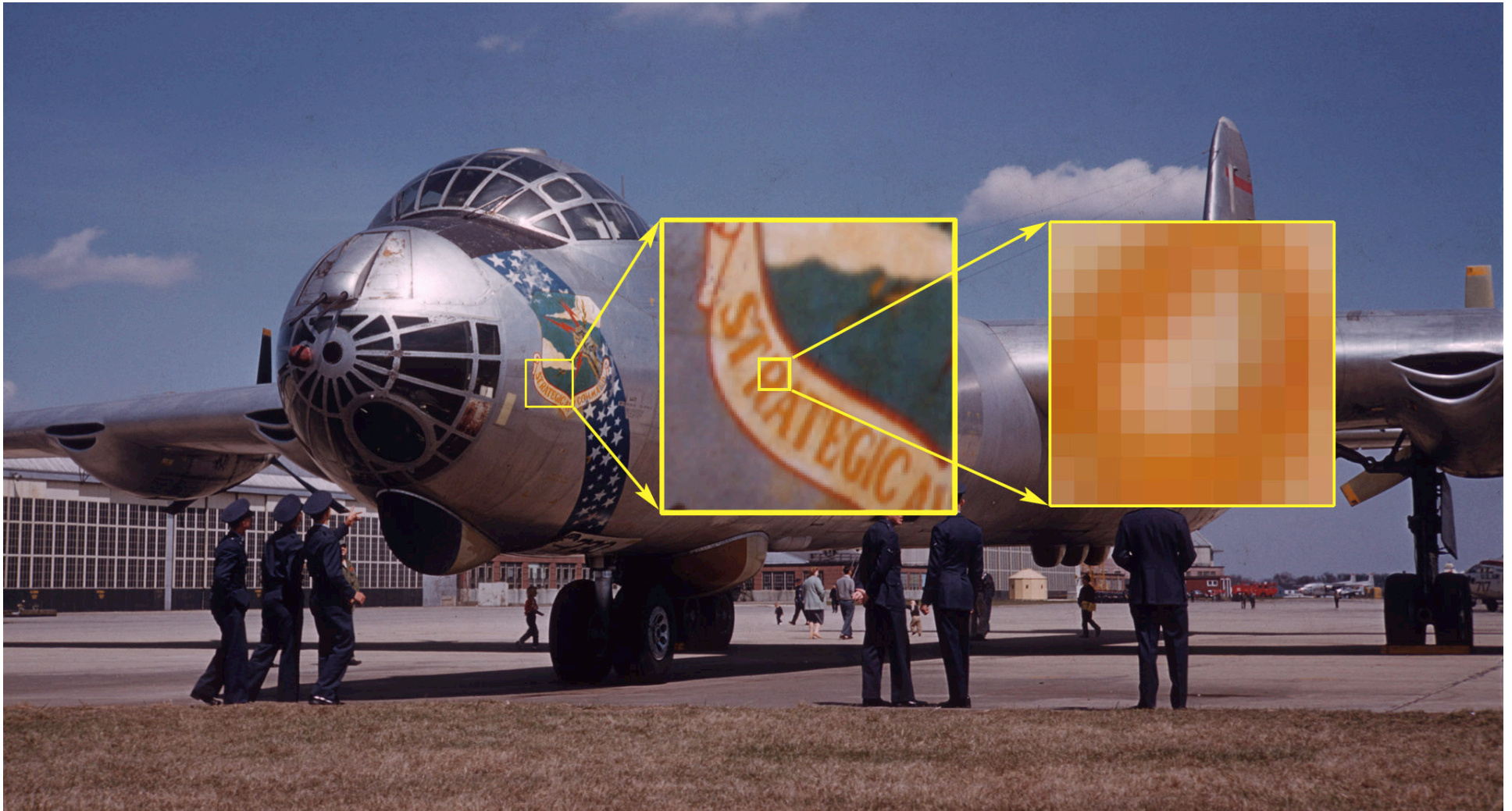
12 X 12 Pixel Area
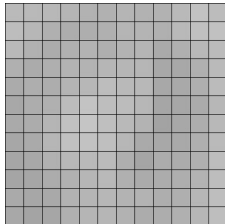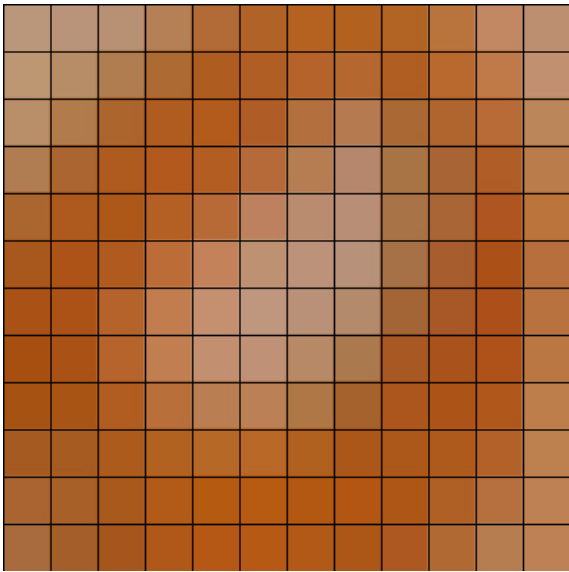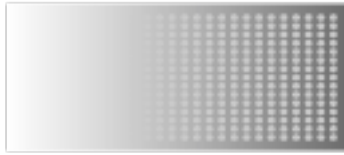
R **G** **B**
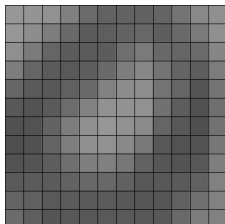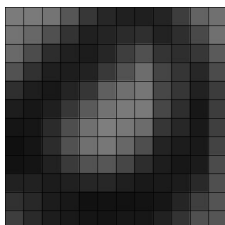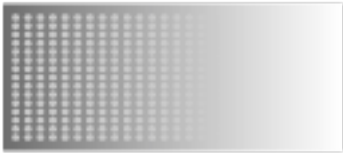
Bit Plane Images

R182 G125 B082	R182 G135 B109
R185 G140 B111	R184 G142 B118

R **G** **B**

GROUP 4 7

Bit Plane Images

R182
G125
B082

R182 G125 B082	R182 G135 B109
R185 G140 B111	R184 G142 B118

R   **G**   **B**

Bit Plane Images

R182
G125
B082

R

182

128	64	32	16	8	4	2	1
1	0	1	1	0	1	1	0

Bit Plane Images

R182
G125
B082

R

182
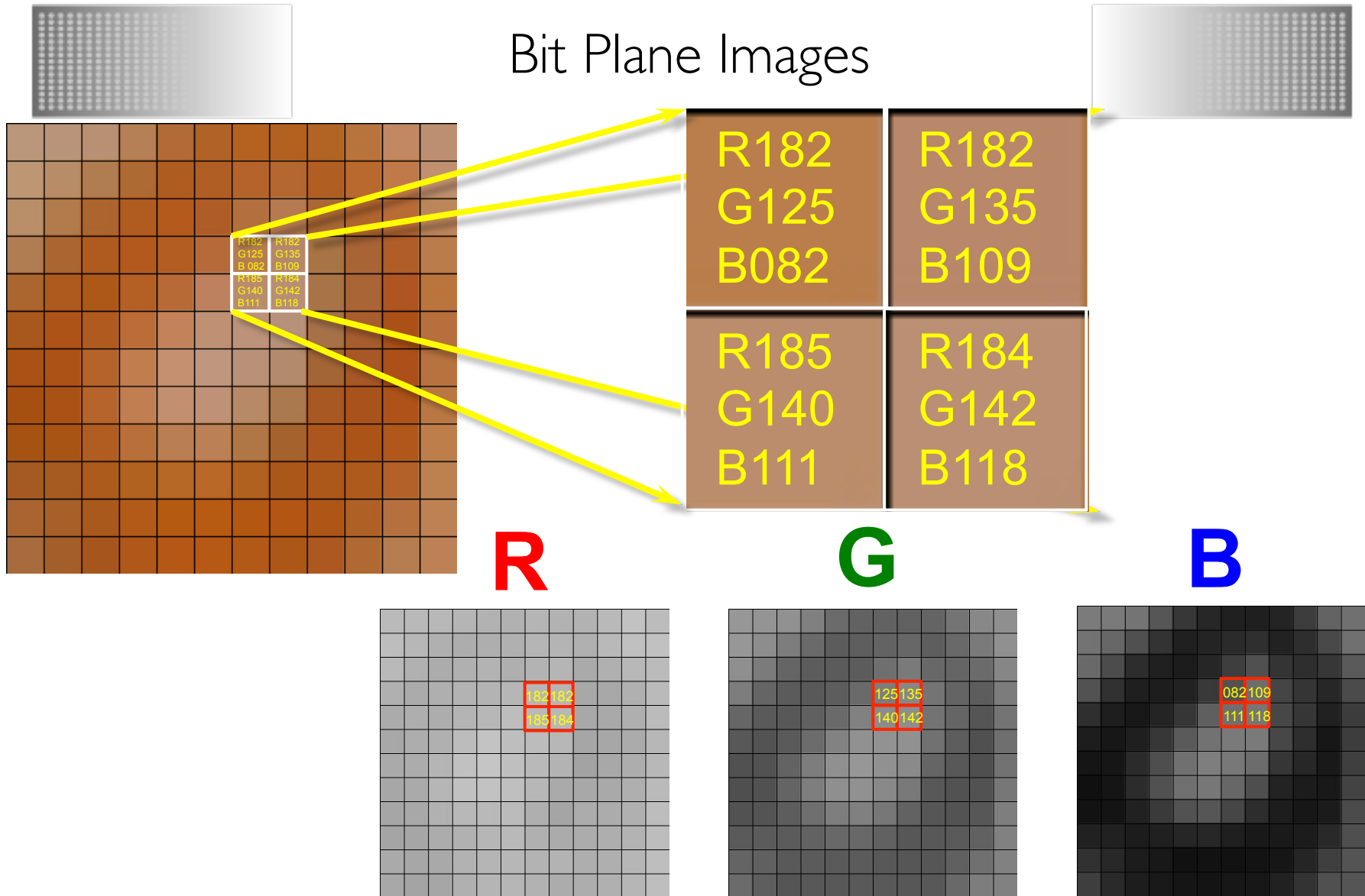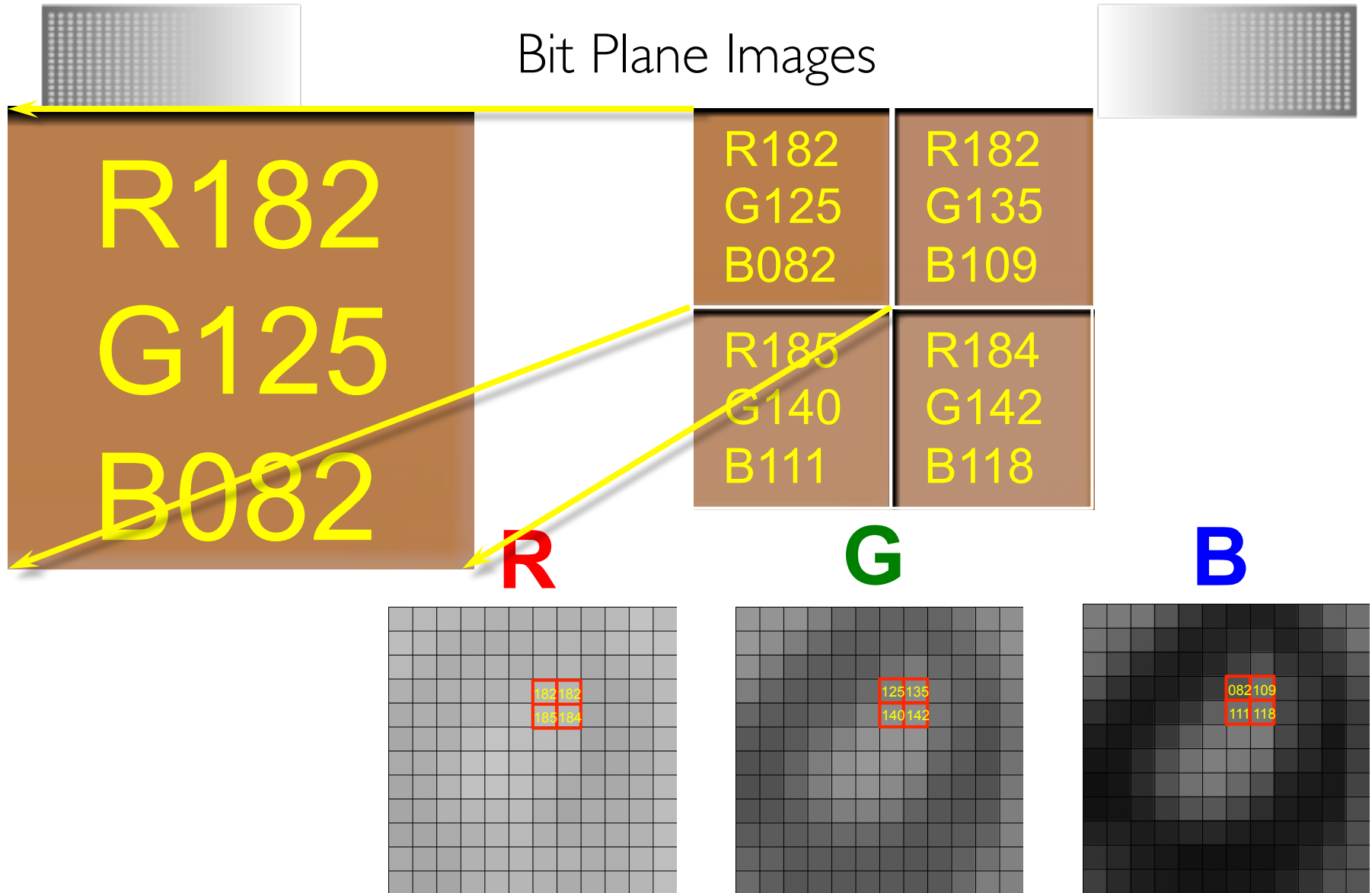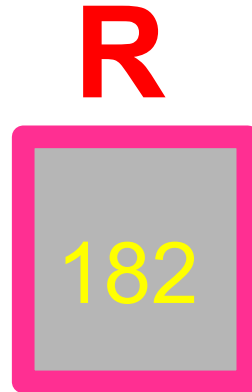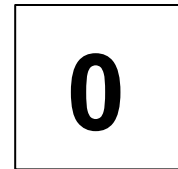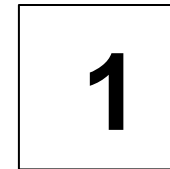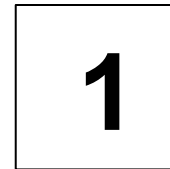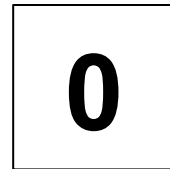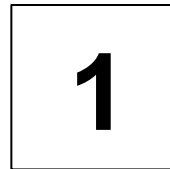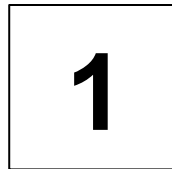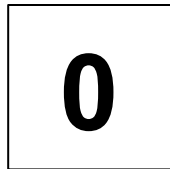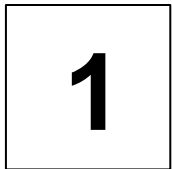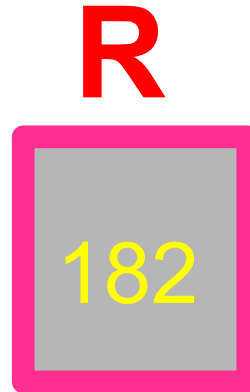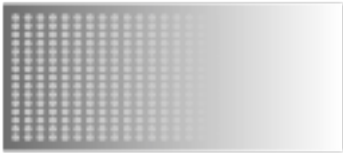
128	64	32	16	8	4	2	1

128 + 0 + 32 + 16 + 0 + 4 + 2 + 0 = 182
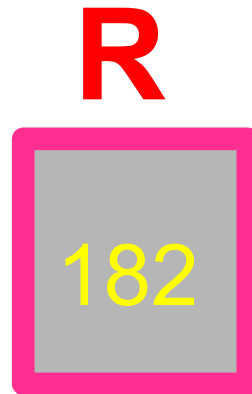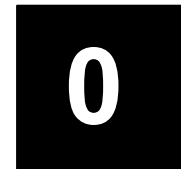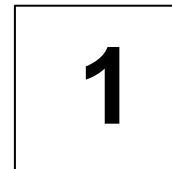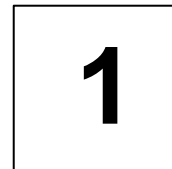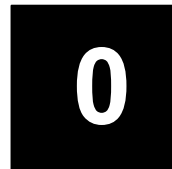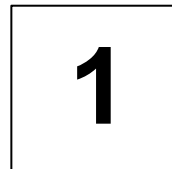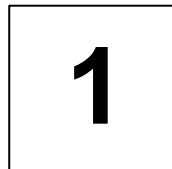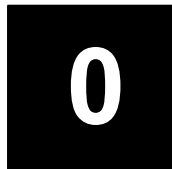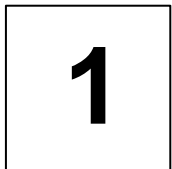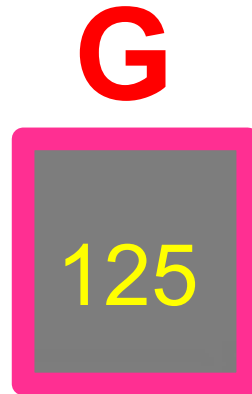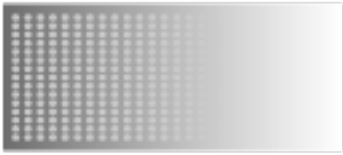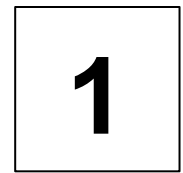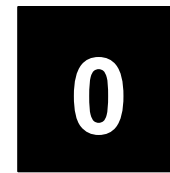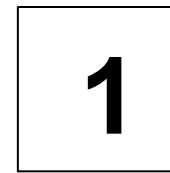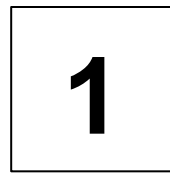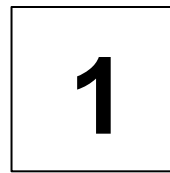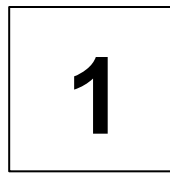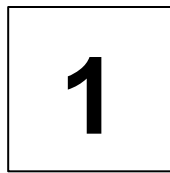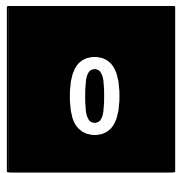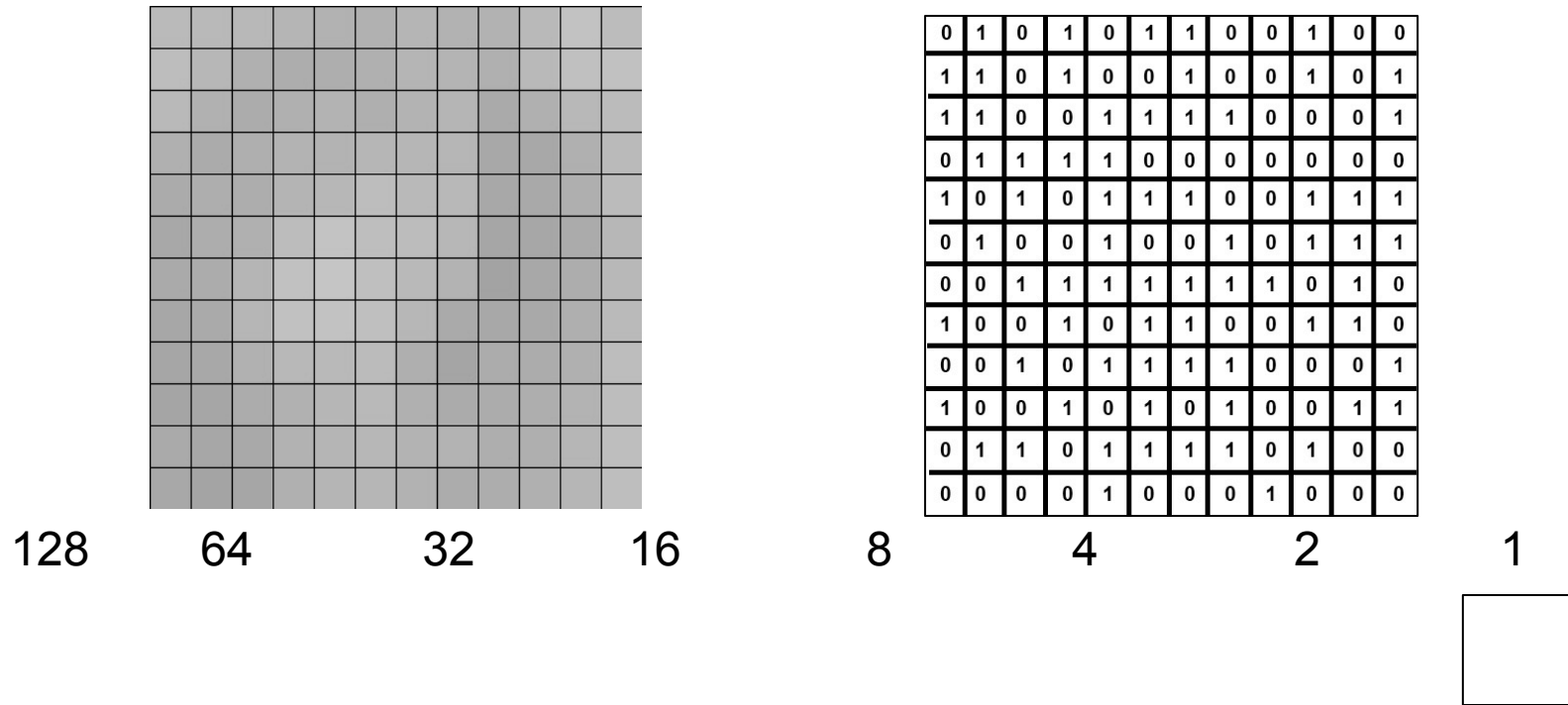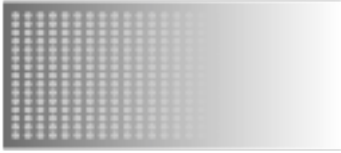
R182
G125
B082

R

182

128		32	16		4	2	
1	**0**	**1**	**1**	**0**	**1**	**1**	**0**

Bit Plane Images

R182
G125
B082

G

125

64	32	16	8	4		1
0	1	1	1	1	1	0	1

PROPRIETARY

Bit Plane Images

R

0	1	0	1	0	1	1	0	0	1	0	0
1	1	0	1	0	0	1	0	0	1	0	1
1	1	0	0	1	1	1	1	0	0	0	1
0	1	1	1	1	0	0	0	0	0	0	0
1	0	1	0	1	1	1	0	0	1	1	1
0	1	0	0	1	0	0	1	0	1	1	1
0	0	1	1	1	1	1	1	1	0	1	0
1	0	0	1	0	1	1	0	0	1	1	0
0	0	1	0	1	1	1	1	0	0	0	1
1	0	0	1	0	1	0	1	0	0	1	1
0	1	1	0	1	1	1	1	0	1	0	0
0	0	0	0	1	0	0	0	1	0	0	0

128   64   32   16   8   4   2   1

Bit Plane Images

R

0	1	0	1	0	1	1	0	0	1	0	0
1	1	0	1	0	0	1	0	0	1	0	1
1	1	0	0	1	1	1	1	0	0	0	1
0	1	1	1	1	0	0	0	0	0	0	0
1	0	1	0	1	1	1	0	0	1	1	1
0	1	0	0	1	0	0	1	0	1	1	1
0	0	1	1	1	1	1	1	1	0	1	0
1	0	0	1	0	1	1	0	0	1	1	0
0	0	1	0	1	1	1	1	0	0	0	1
1	0	0	1	0	1	0	1	0	0	1	1
0	1	1	0	1	1	1	1	0	1	0	0
0	0	0	0	1	0	0	0	1	0	0	0

128   64   32   16   8   4   2   1

Bit Plane Images

R

128   64   32   16   8   4   2   1

Bit Plane Images

R

128	64	32	16

8	4	2	1

Bit Plane Images

R

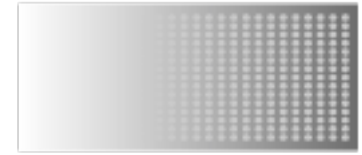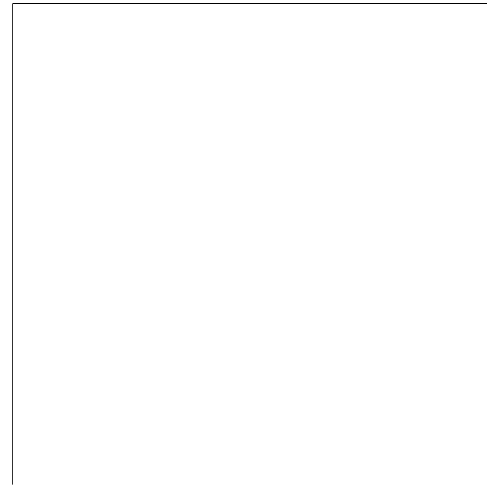| 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |

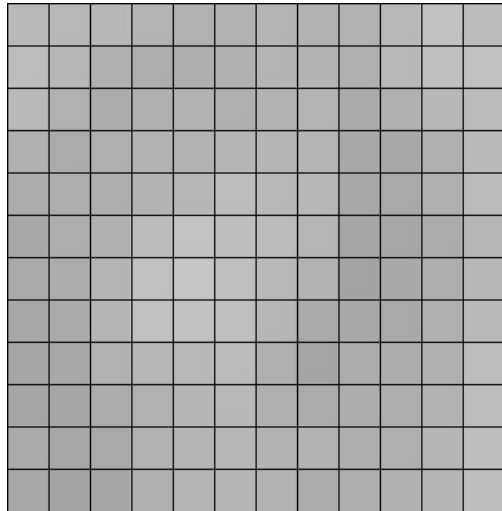GROUP 47

Bit Plane Images

R

| 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |

Bit Plane Images

R

128   64   32   16   8   4   2   1

PROPRIETARY

Bit Plane Images

R

| 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |

GROUP 4 7

Bit Plane Images

R

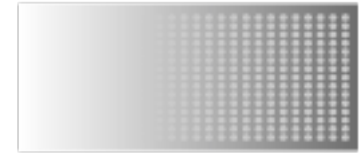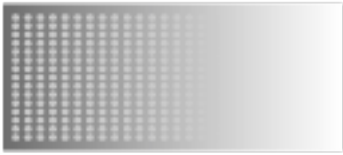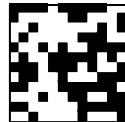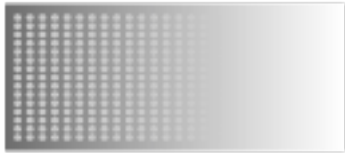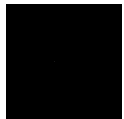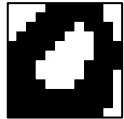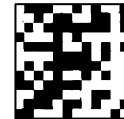| 128	64	32	16	8	4	2	1

Bit Plane Images

R

128 64 32 16 8 4 2 1

Bit Plane Images

R

| 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |

GROUP 4 7

Bit Plane Images

R
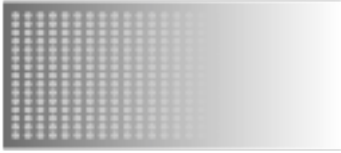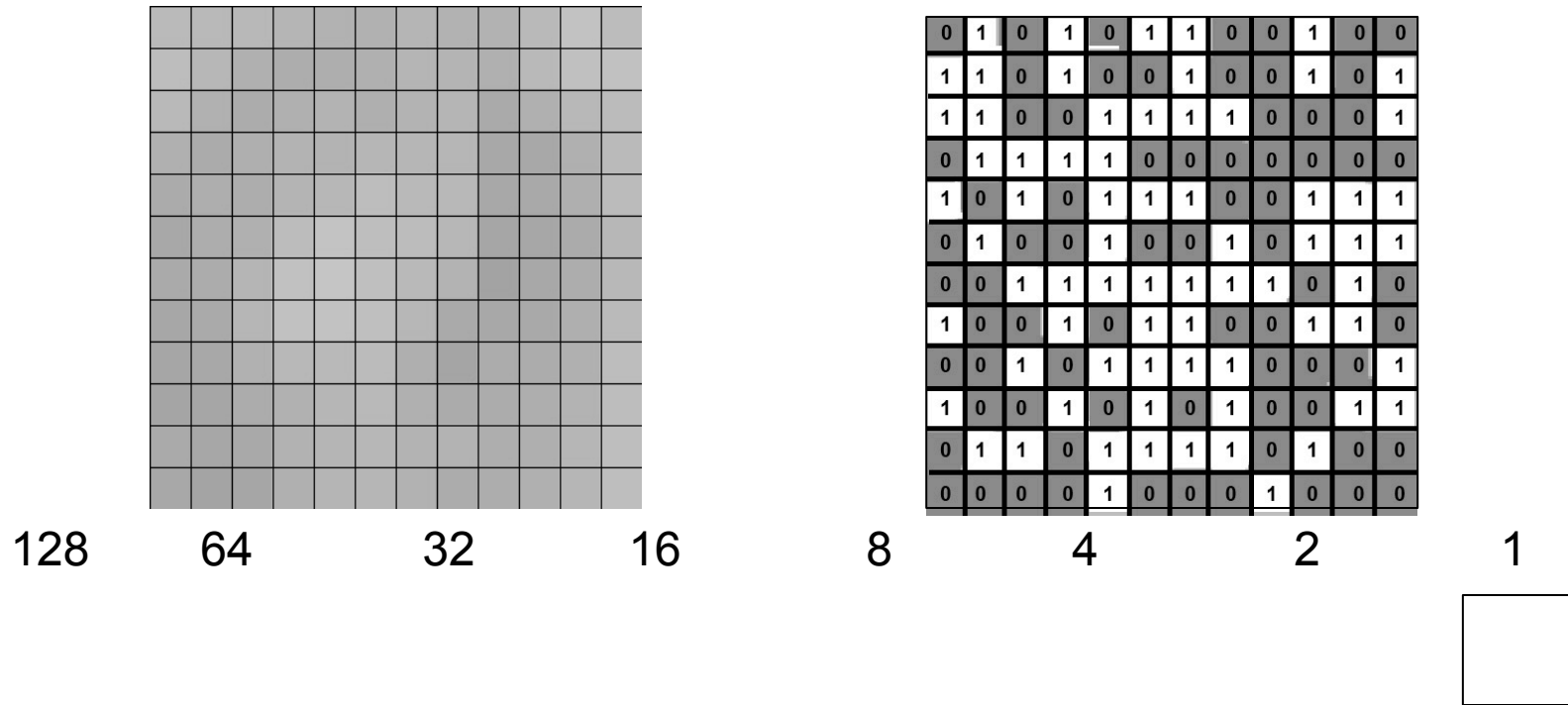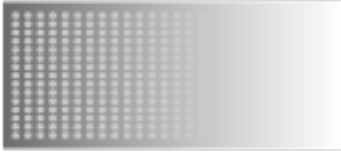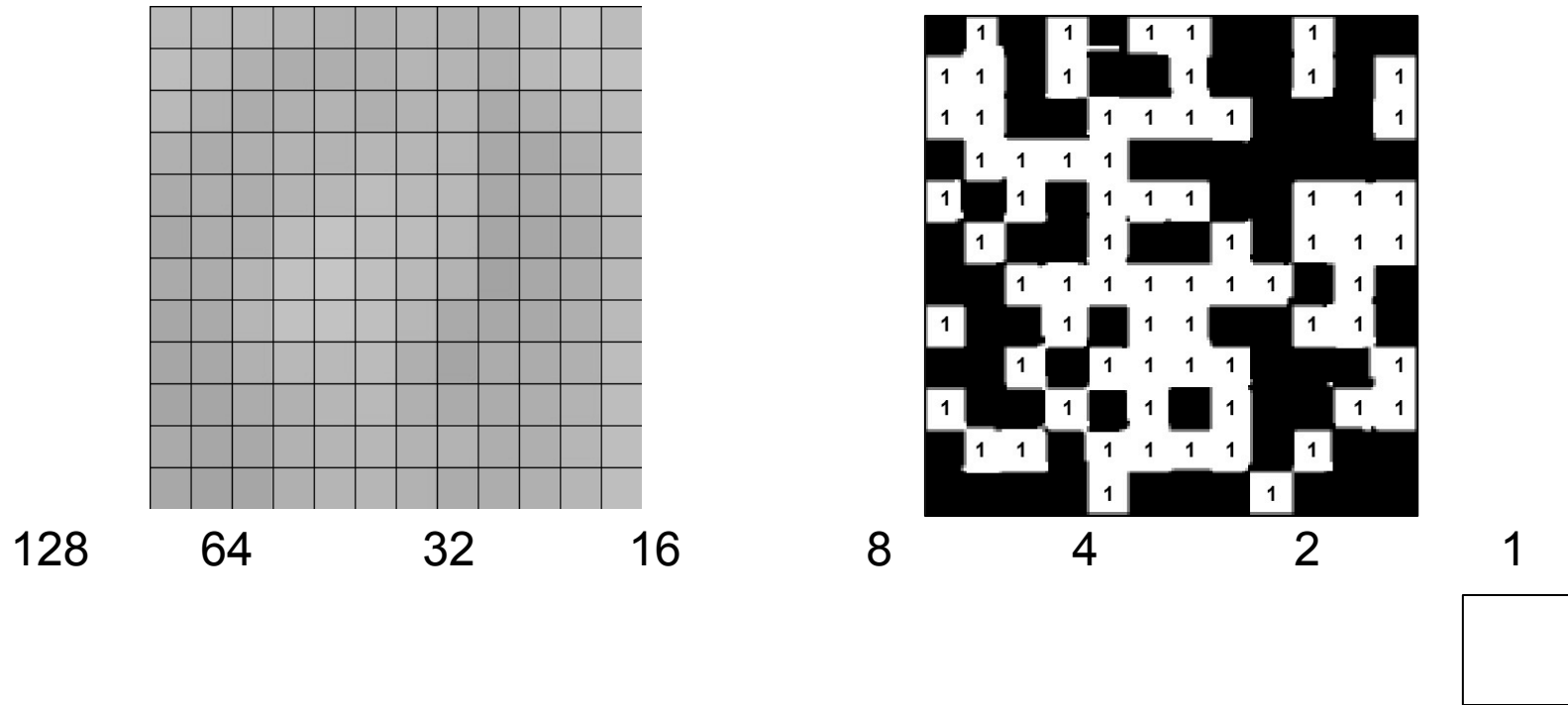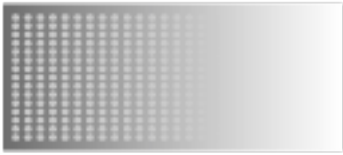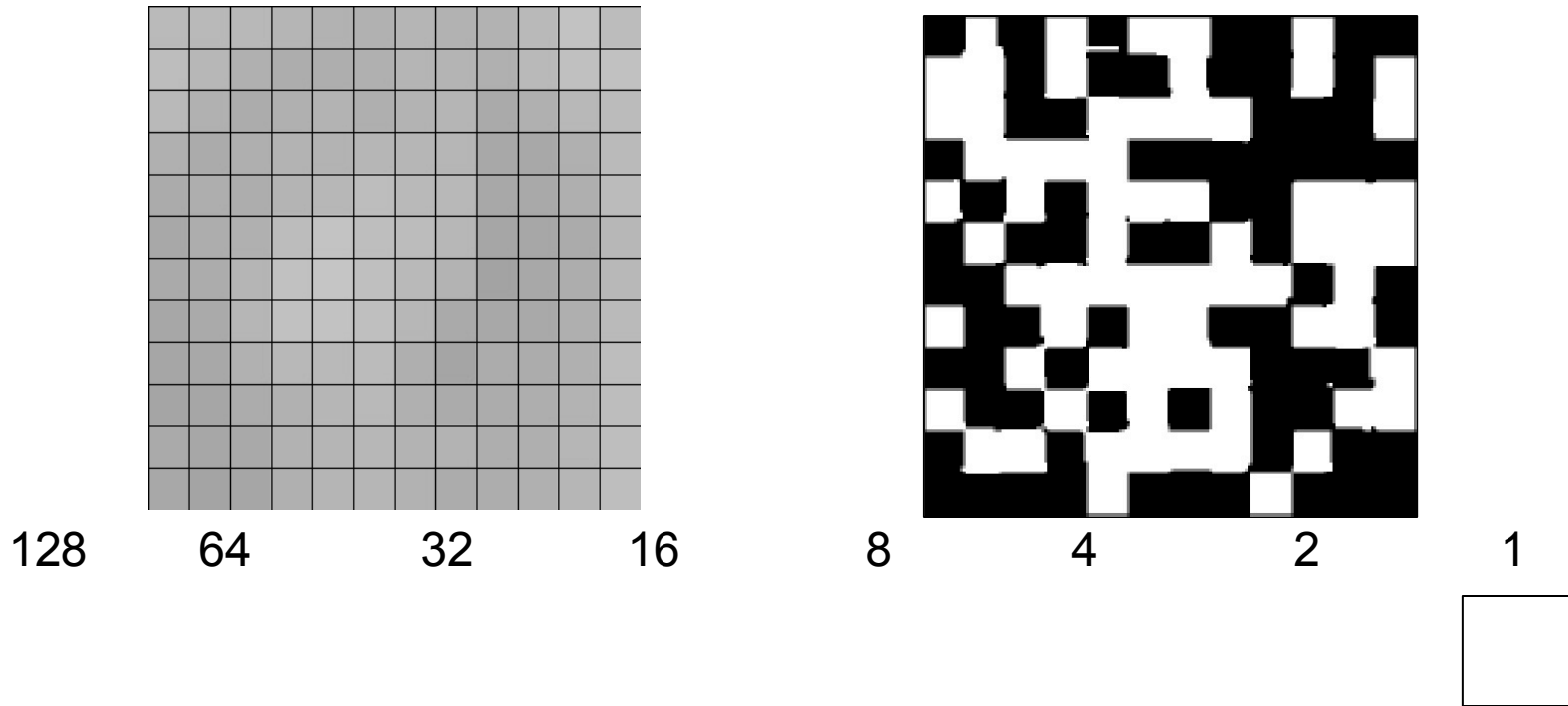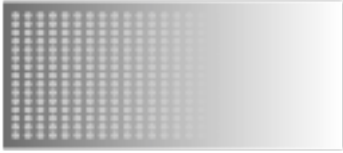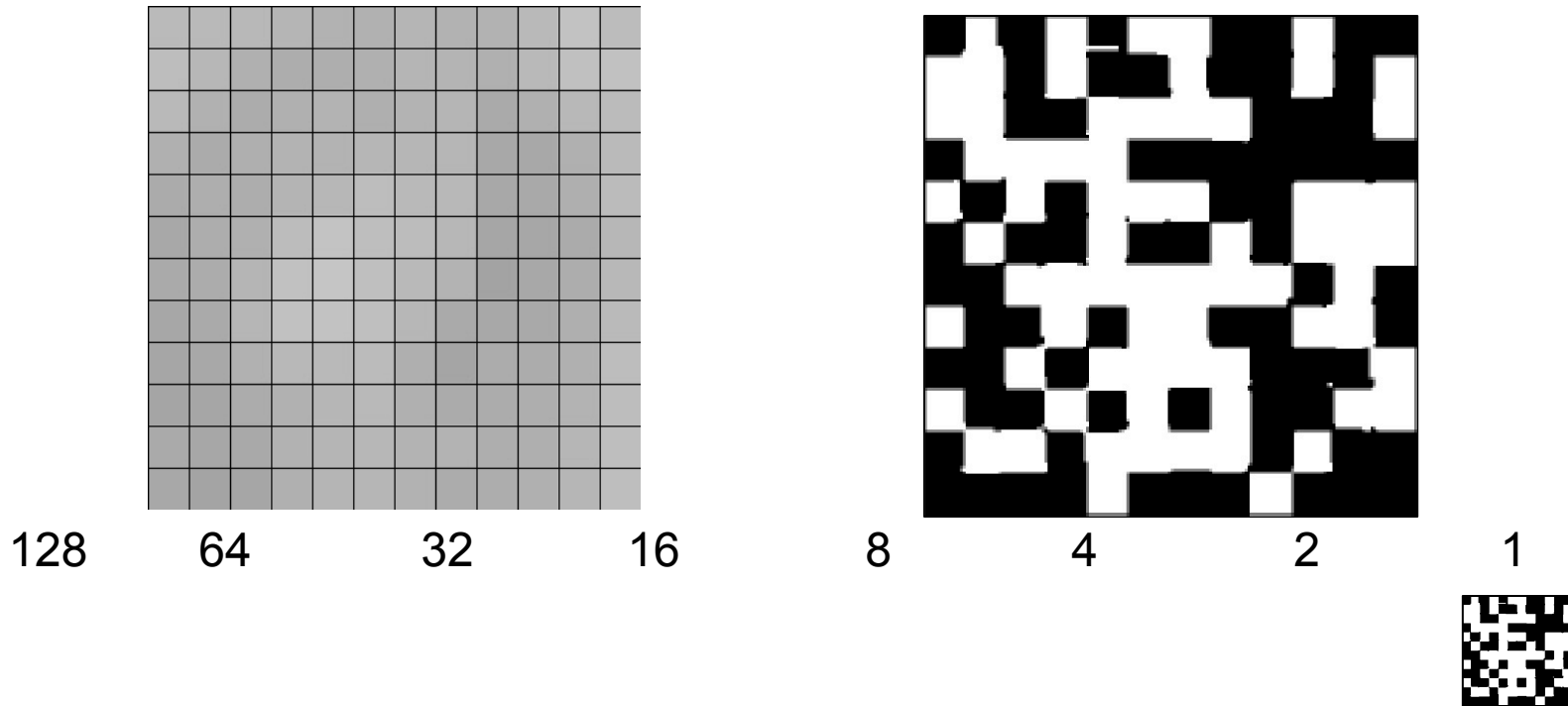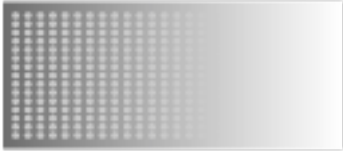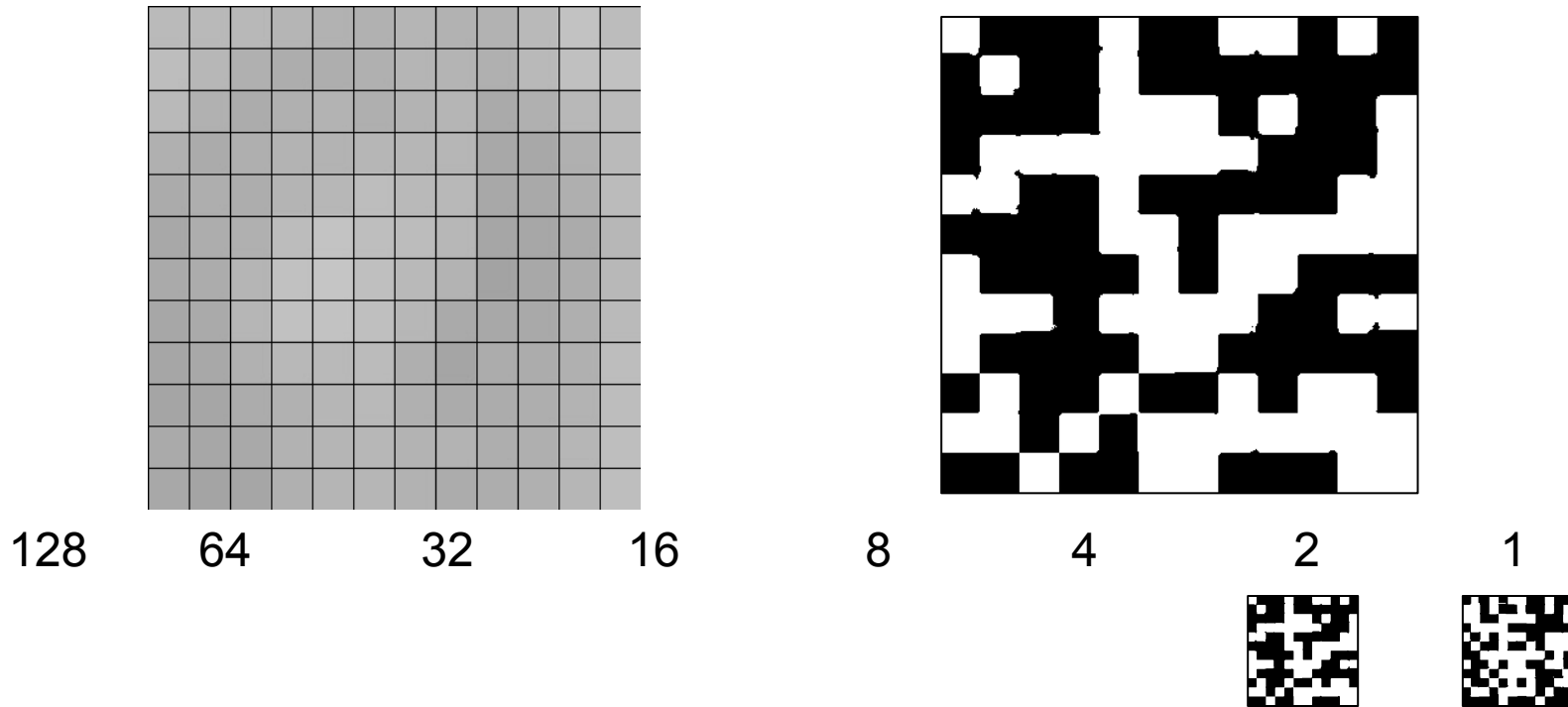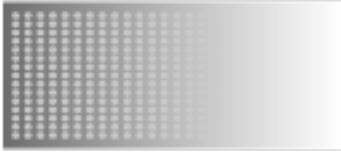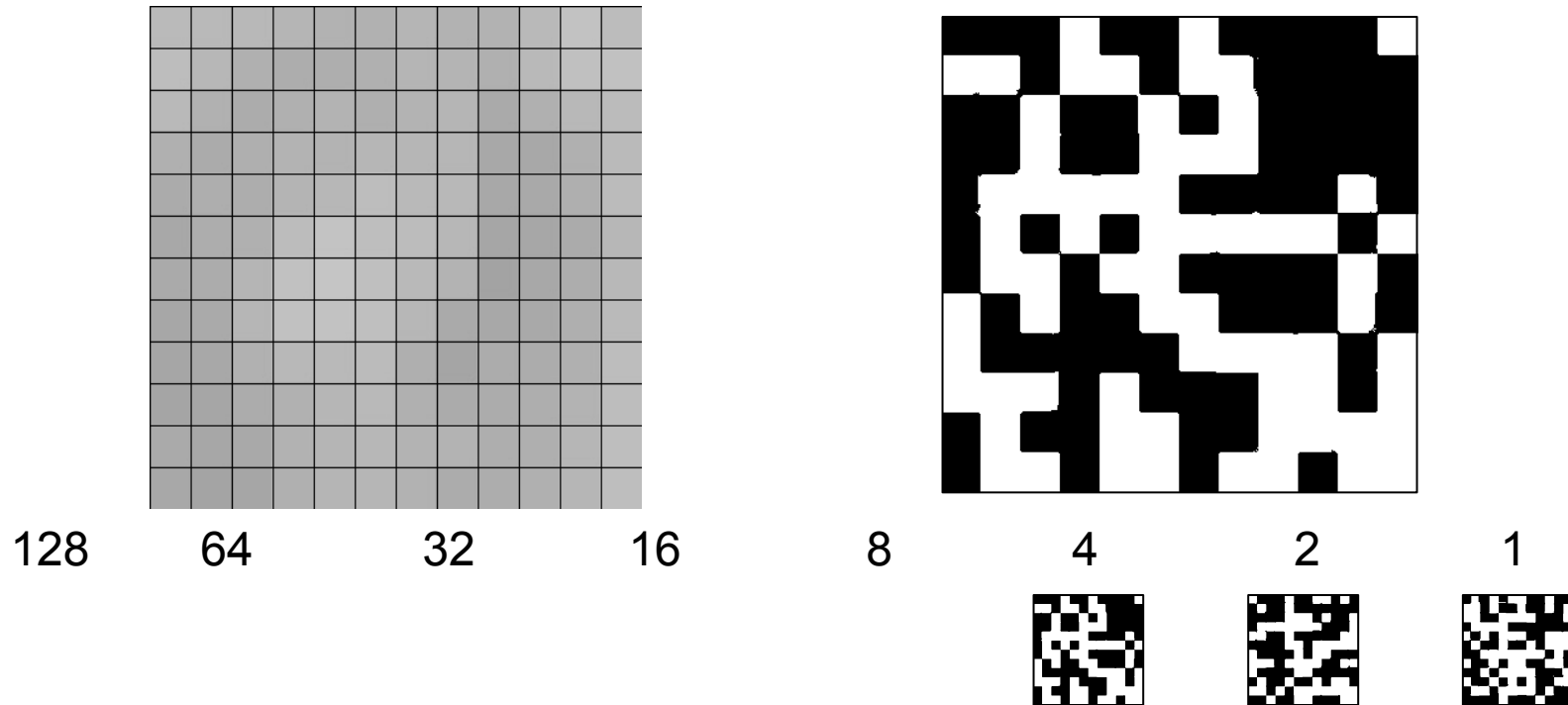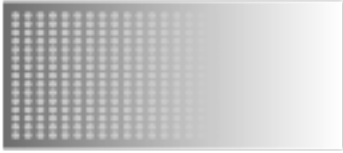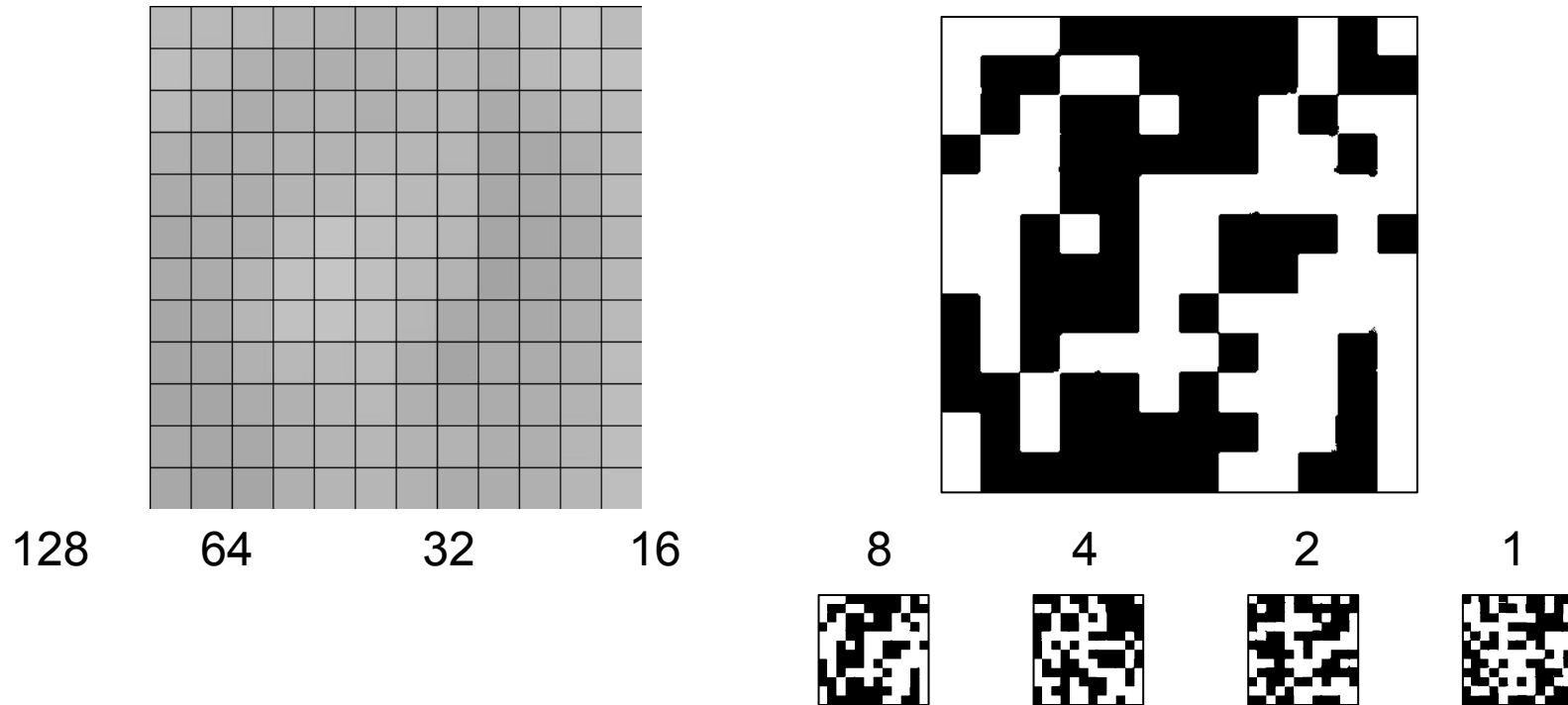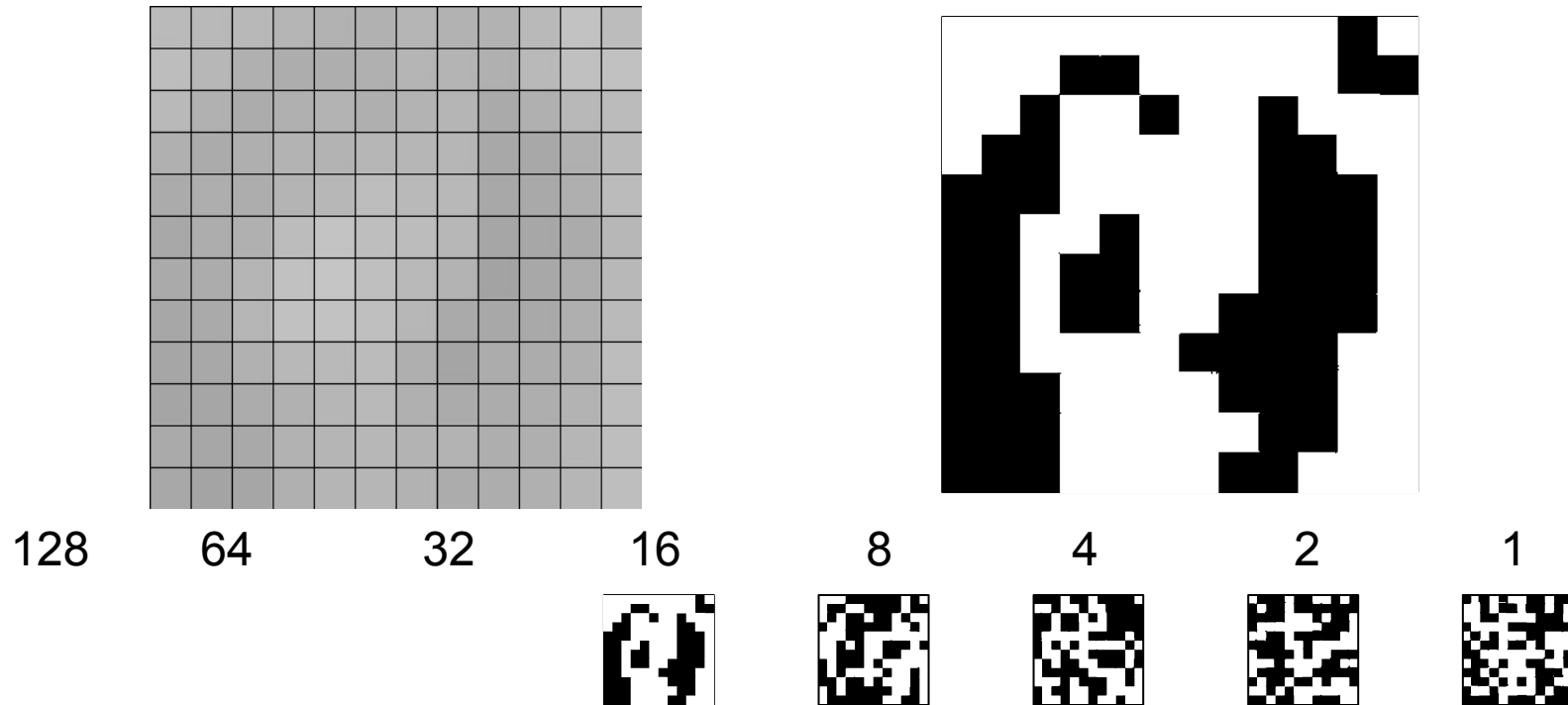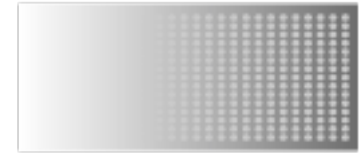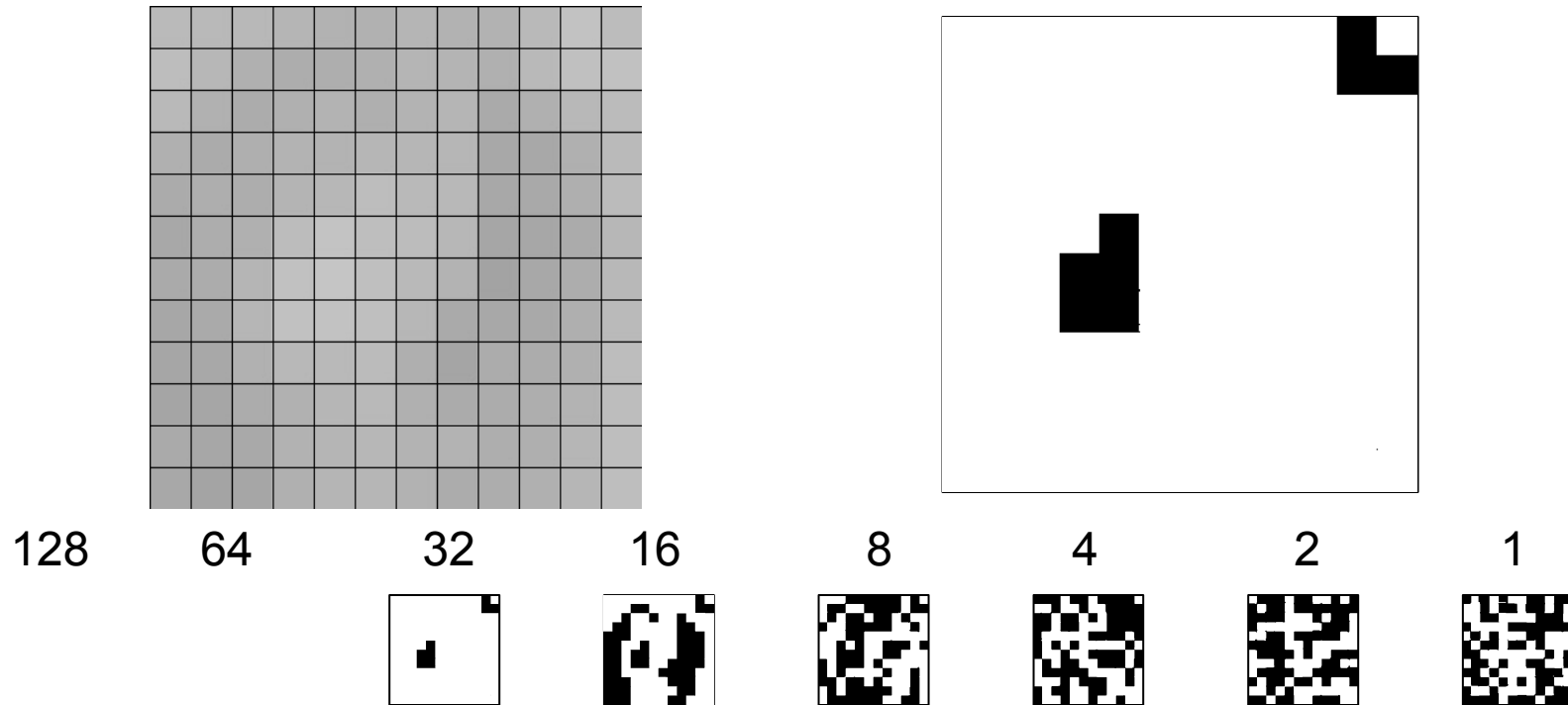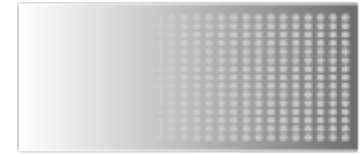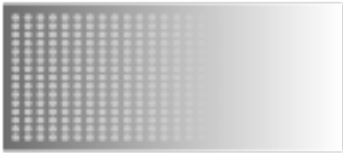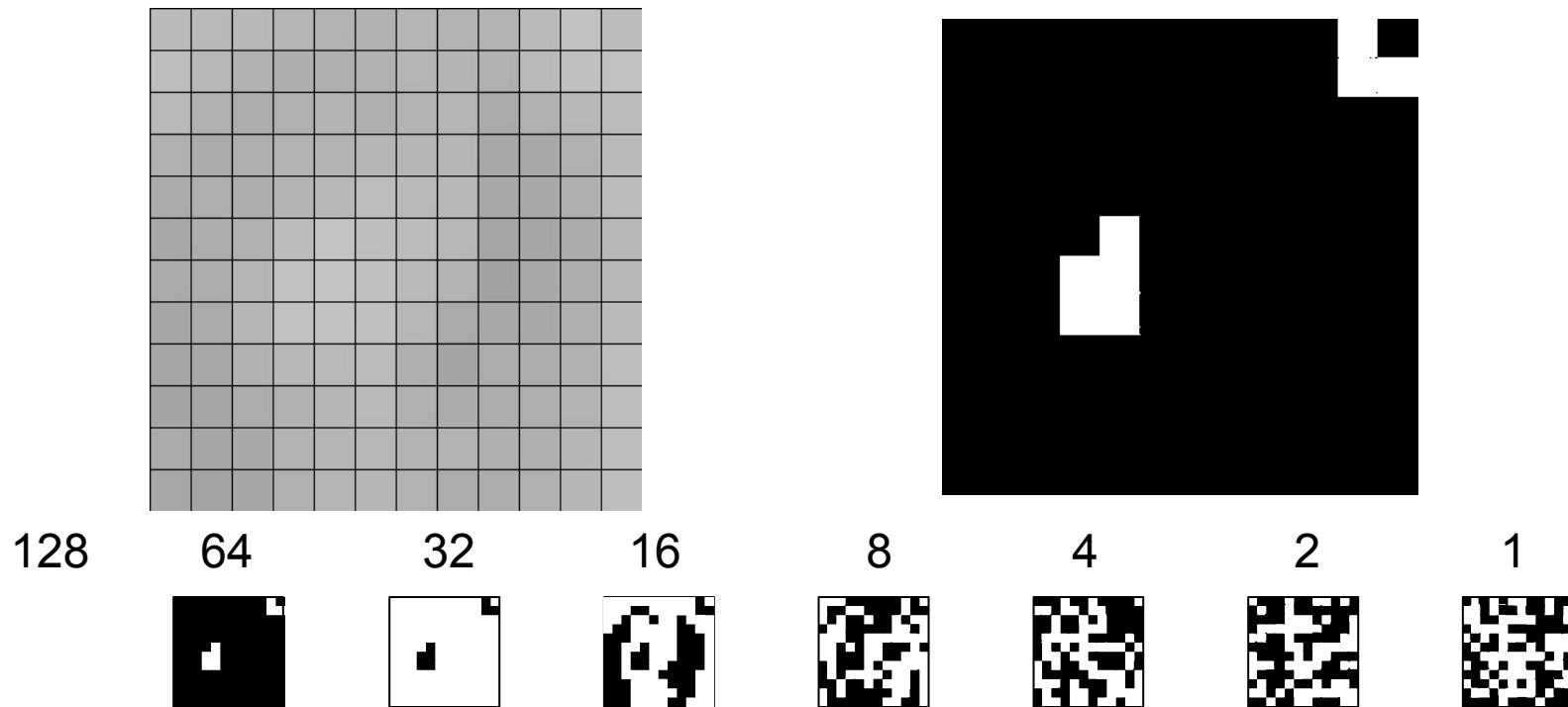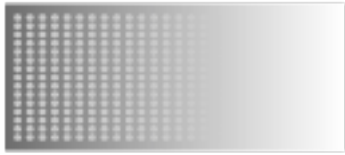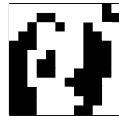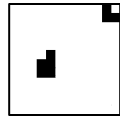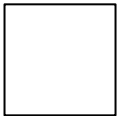
| 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |

Bit Plane Images

G

128	64	32	16	8	4	2	1

GROUP 4 7
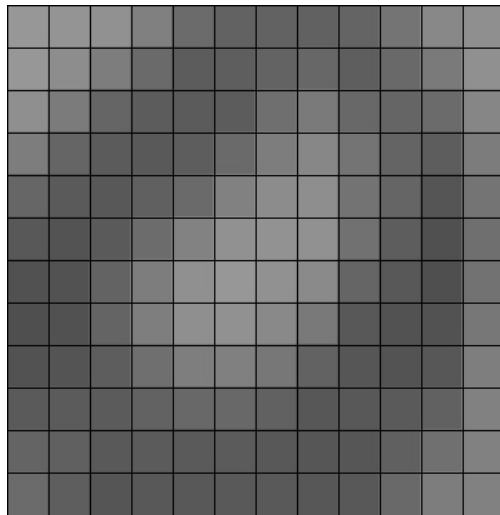
Bit Plane Images

B

128	64	32	16	8	4	2	1

GROUP 4 7

R

G

B

PROPRIETARY
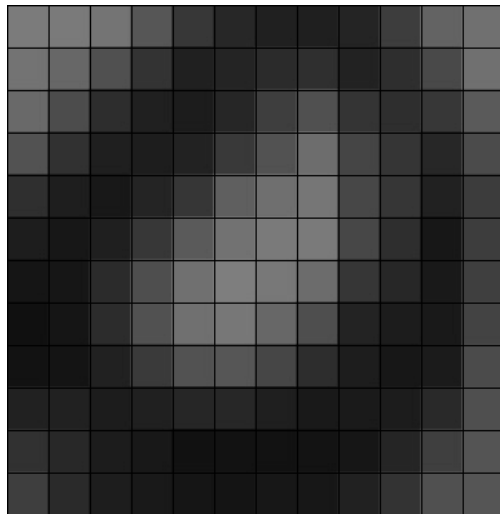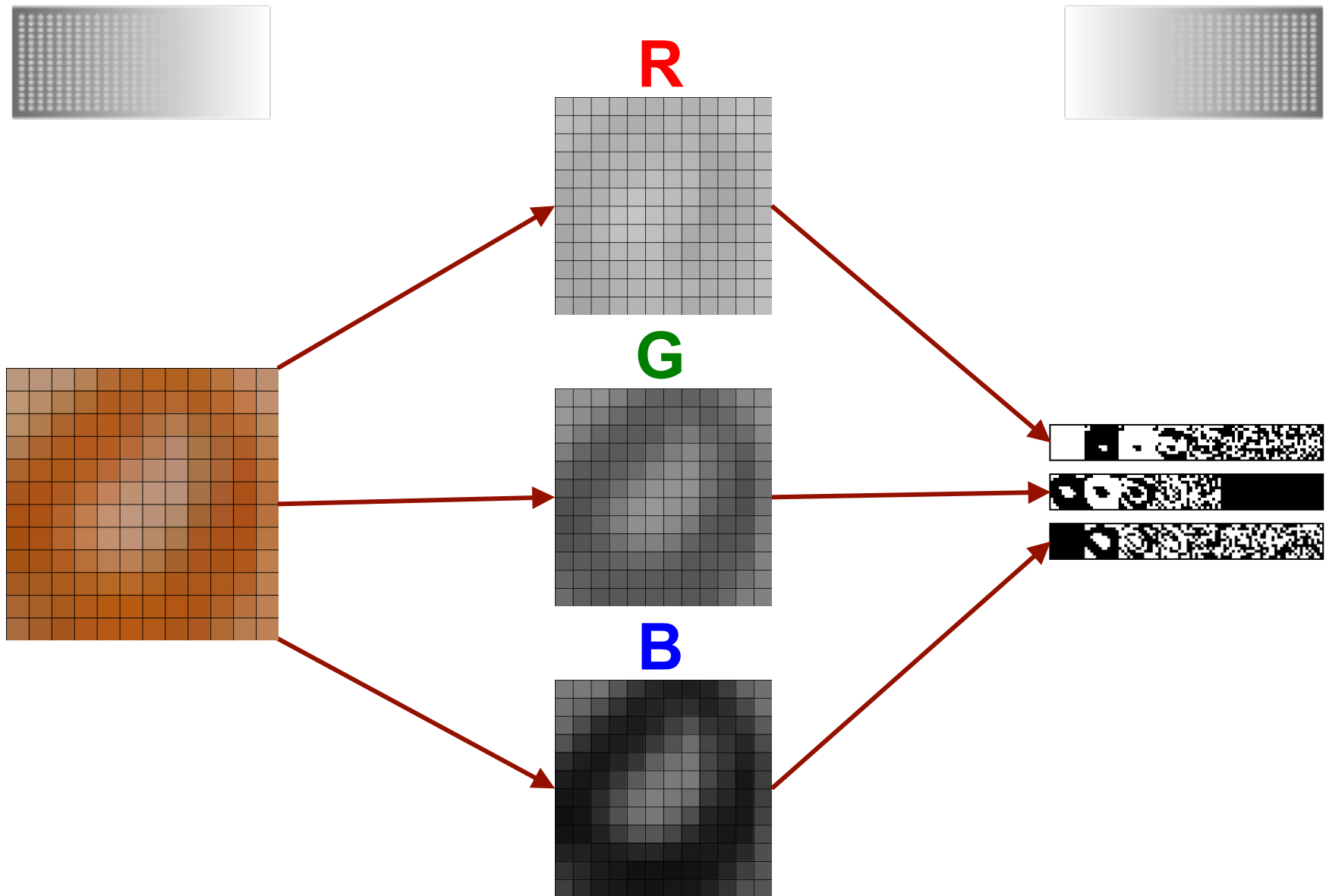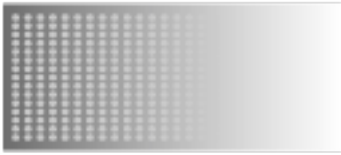
R
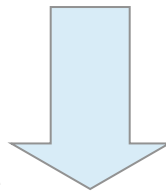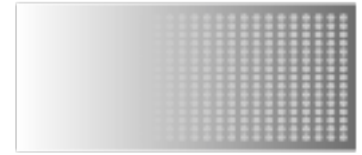
128	64	32	16	8	4	2	1
7	6	5	4	3	2	1	0

Bit Plane

GROUP 4 7

PROPRIETARY
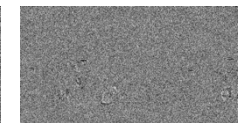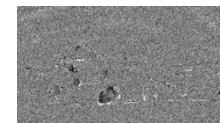
Bit Plane Images

R

G

B

GROUP 4 7
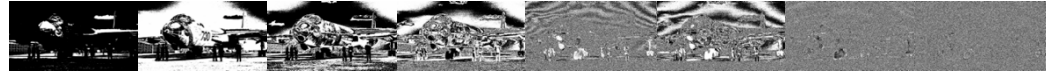
Bit Plane Images on 0.5'' tape

Test of 24 4K DCI compliant JPEG 2000 frames   13 Random Bits Flipped

4K DCI compliant JPEG 2000   **13 Random Bits Flipped**
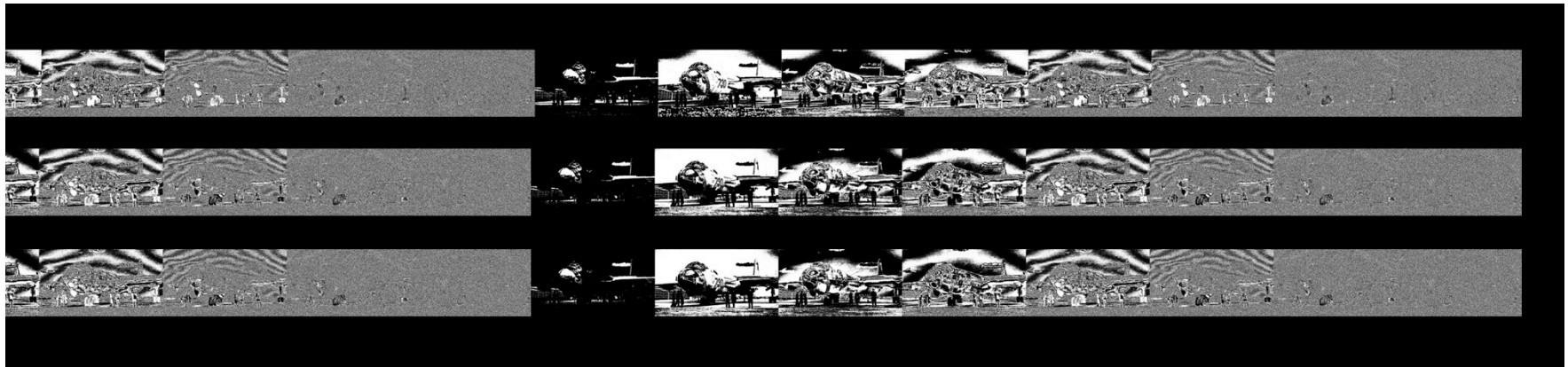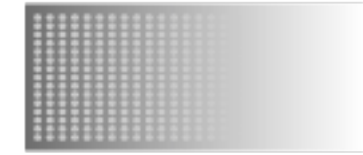
4K DCI compliant JPEG 2000   13 Random Bits Flipped
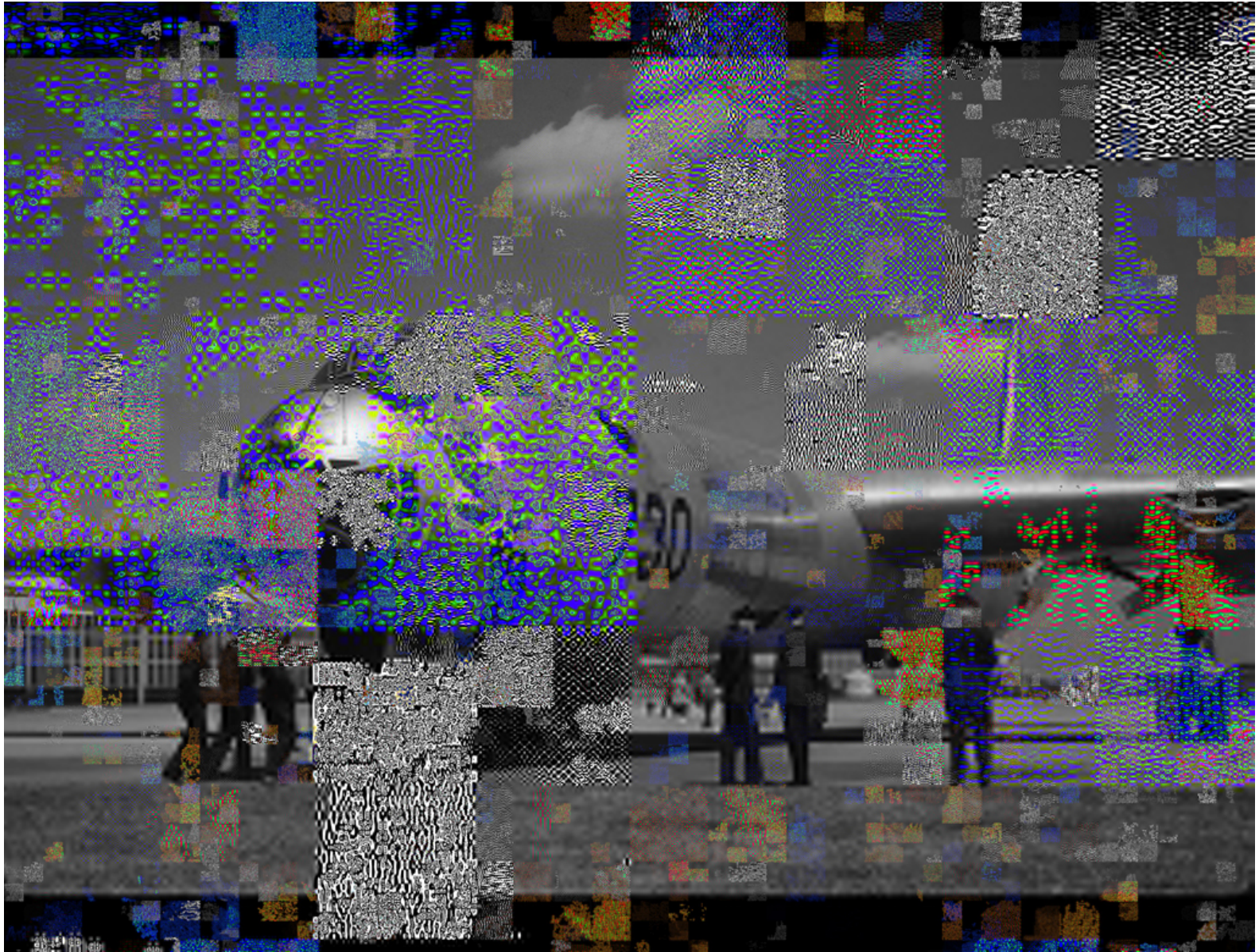
GROUP 47

PROPRIETARY

4K DCI compliant JPEG 2000   13 Random Bits Flipped

4K DCI compliant JPEG 2000   13 Random Bits Flipped

.01% Random Bit Flips
45,548 Corrupt Bits

GROUP 47

DOTS™
Bit Plane Images

382,279 Random Bits
Flipped, or 1% error rate

DOTS™

Bit Plane Images

GROUP 47

382,279 Random Bits
Flipped, or 1% error rate

DOTS™

Bit Plane Images

GROUP 47

DOTS

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