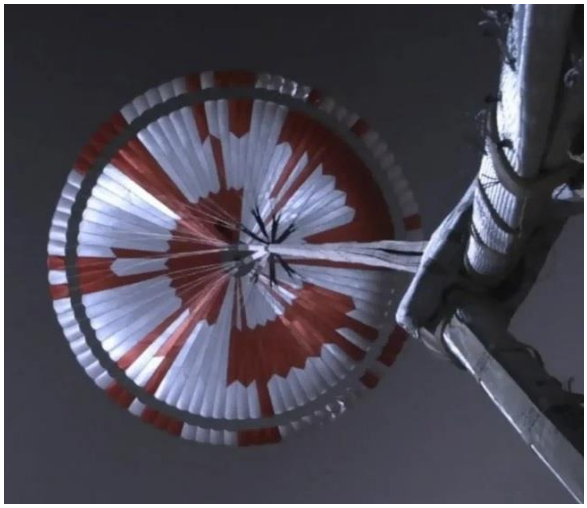
Decoding Perseverance's Parachute

By Miles Hamby, Ph.D., and Jim Gearing

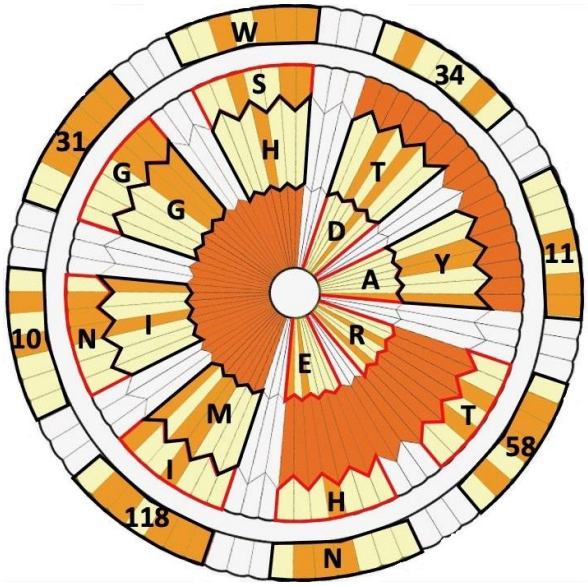
March 4, 2021 (updated 3/6/21)

On February 18, 2021, at 2055 hrs UTC, NASA, once again, survived the "7 minutes of terror" to softly land a vehicle – Perseverance – totally autonomously on the surface of Mars using a combination of parachute, rocket assisted descent, and "sky crane". Heretofore, NASA has landed Viking 1 and 2 (1976), Pathfinder (1997), Spirit and Opportunity (2004), Phoenix (2008), and Curiosity (2012).[1]

Several days following, the first amazing high definition photos and videos of the descent and landing were released by NASA. One has caused quite a stir – the photo looking up at the massive 80 gore parachute (a parachute gore is one set of panels extending from the center to the rim) of white and red panels that opened flawlessly during a supersonic descent (on the right Original Photo of Perseverance Parachute). Circular sport parachutes have long been assembled with multi-color panels in a multitude of combinations (remember James Bond skiing off a cliff in The Spy Who Loved Me?). It was soon learned that the seemingly random pattern of Perseverance's parachute was not random at all – but a code created by the parachute project team led by Dr. Ian Clark that spelled out the Jet Propulsion Laboratory's (JPL) motto and longitude and latitude "DARE MIGHTY THINGS -- 118°10'31"W – 34°11'58"N". [2] The expression comes from a speech by Teddy Roosevelt in 1899, "The Strenuous Life" – "Far better it is to dare mighty things, to win glorious triumphs, even though checkered by failure, than to take rank with those poor spirits who neither enjoy much nor suffer much, because they live in a gray twilight that knows not victory nor defeat."



Original Photo of Perseverance Parachute



Presumed Code Schematic (source unknown)

According to news reports, the team implied a challenge to the public to break the code and shortly after reported that it been broken within a few hours. One article identified a person not affiliated with NASA who had proposed a solution based on assigning each letter in the alphabet a binary 10-bit code beginning with A = 0000000001. However, this code is only coincidental to the ASCII 8-bit binary code for some letters and falls apart with the numbers. Chief Engineer for the Perseverance team Adam Steltzner posted on Twitter a schematic (depicted on left "Presumed Code Schematic – source unknown") implying (with no explanation) that this was the code [3]. The schematic depicts the 80-gore parachute with the original white and red (dark orange) panels, but enhances the colors of white panels with yellow for "0" and the red panels with light orange for "1".

What keeps coming up are the articles with the picture below (Schematic Superimposed on Photo of Parachute). But even this is inaccurate. The actual code, we believe, is that the panels are arranged in ASCII (American Standard Code for Information Interchange) spelling out the aforementioned message in binary as in the schematic. However, the schematic depiction is also incorrect. The schematic depicts 7-bit binary sequences bounded by the black and red lines. Binary code, today, is generally 8-bits of "1" and "0". ASCII originally was 7-bit but soon expanded to 8-bit to be more versatile. However, if you look at each character on the schematic, specifically "D", you will note that some of the characters do not match their 8-bit or even 7-bit sequences (see table Mars Lander Perseverance Parachute Code below). Regards "D", the red line on the left is not an orange panel representing "1", but simply a red border, thus the sequence is incorrect in 7-bit but correct in 6-bit. To be correct, the panel to the right of that red line should be red making the 7-bit code 10001000. We further found that the characters were accurately depicted as 6-bit bytes for the letters but the outer ring of numbers are in 7-bit bytes. Now it works!

Schematic Superimposed on Photo of Parachute

Perseverance Parachute Binary Code Correctly Identified

The picture on the left (Perseverance Parachute Binary Code Correctly Identified) depicts the original photo with no overlaid schematic but with red and yellow lines encompassing the 6-bit and 7-bit bytes of letters and numbers, respectively. (The colors we chose for the borders have no significance except to facilitate seeing the sections). The original parachute had only white and red panels. The panel colors are, in some places, difficult to discern due to shadows, but close inspection readily reveals the contrast and the seam lines of the actual panels. The code for the longitude and latitude numbers is the binary for the ASCII decimal character numbers (see table Mars Lander Perseverance Parachute Code below). To interpret the codes, read the binary code for each depicted character counterclockwise starting with the very right digit of the binary code and moving right to left in sequence. The white "W" and red "R" at the 1- and 3-o'clock positions are to facilitate discerning the white and red colors of the respective panels of the outer ring.

So, until we hear from the person who actually designed it, we think this is it!

01000101 – 01000100 - 01000100

Mars Lander Perseverance Parachute Code

Character [4]	Decimal *(character number)*[4]		8-bit Binary Code*[4]
Inner Ring			
D	068	01	000100
A	065	01	000001
R	082	01	010010
E	069	01	000101
2ND Ring Out			
M	077	01	001101
I	073	01	001001
G	071	01	000111
H	072	01	001000
T	084	01	010100
Y	089	01	011001
3RD Ring Out			
T	084	01	010100
H	072	01	001000
I	073	01	001001
N	078	01	001110
G	071	01	000111
S	083	01	010011
Outer Ring			
(quote mark ")	034	0	0100010
(vertical tab)	011	0	0001011
(colon :)	058	0	0111010
N	078	01	001110
(lower case v)	118	0	1110110
(line feed)	010	0	0001010
(unit separator)	031	0	0011111
W	087	01	010111

**Looking up at the parachute, read the text CW; the binary code is white panels "0", red panels "1"; the binary for all characters should be read from R to L in this guide; the "letters" are 6-bit binary, and the "numbers" are 7-bit as denoted by the column line separating them; the actual numbers in the outer ring are represented by the decimal character number (e.g., actual number "11" is decimal character number 011 representing 7-bit binary code 0001011 (binary codes only cover integers 0-9).*

REFERENCES

[1] Retrieved from https://en.wikipedia.org/wiki/Curiosity_(rover)#:~:text=Curiosity%20was%20launched%20from%20Cape%20Canaveral%20(CCAFS)%20on,6%20km%20(350%20%C3%97%2010%206%20mi)%20journey. Visit site for full and detailed references.

[2] Kenneth Chang (Feb. 24, 2021, updated Feb. 26). 2021NASA Sent a Secret Message to Mars. Meet the People Who Decoded It. New York Times. Retrieved from https://www.nytimes.com/2021/02/24/science/nasa-mars-parachute-code.html

[3] Eric Sorensen (Feb. 26, 2021, updated Feb. 26, 2021). Internet Sleuths Crack Secret Message Hidden on Mars Perseverance's Parachute. Global News. Retrieved from https://globalnews.ca/news/7665906/mars-perseverance-parachute-secret-message/

[4] ASCII source code retrieved March 4, from 2021https://www.rapidtables.com/code/text/ascii-table.html

ABOUT THE AUTHORS

Miles Hamby is a retired college professor who earned a Bachelor of Science degree from the US Air Force Academy and a Ph.D. in Industrial Technology from the University of Maryland. He has taught business and statistics at the doctoral level for several universities and has published a book "Writing Research: a Handbook for Writing Research Articles and Dissertations".

Jim Gearing has developed computer software for 45 years for telecom, internet, financial, and government clients. He has spent more time than he cares to admit looking at binary numbers.