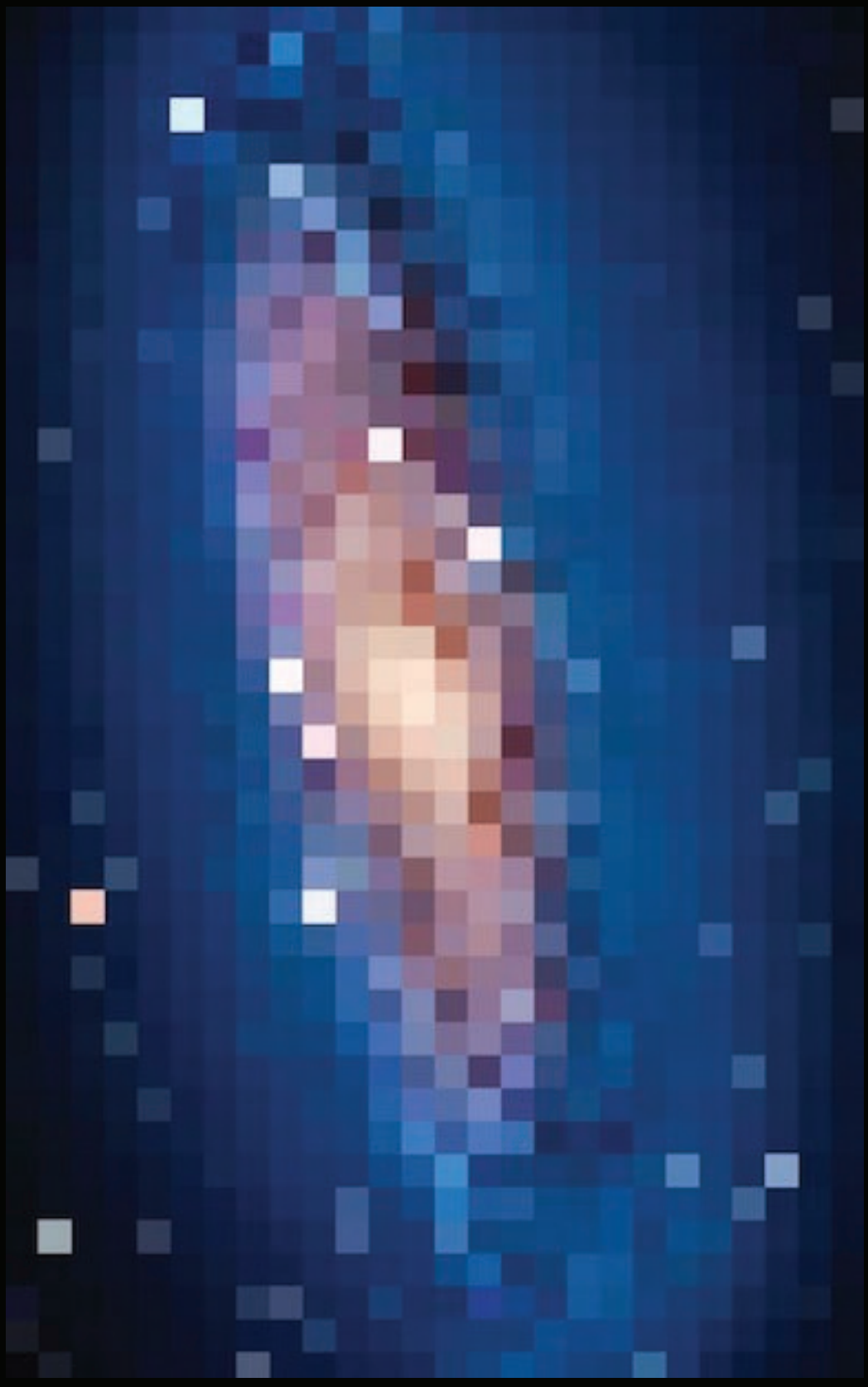
The Transmission of Images from Pluto



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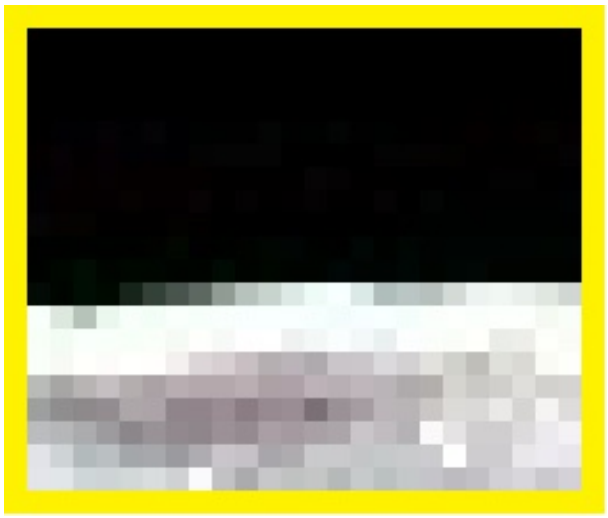
The top image shows a 800x600 pixel digital photo of the full moon in black and white. The small yellow box on the top edge of the moon is a 22x26 pixel piece of this image shown enlarged below.

To send this image to Earth, the brightness of each of the pixels is sent as a string of numbers called data words. The enlarged piece of the larger picture contains 22x26 = 572 pixels, so a string of 572 binary numbers has to be sent to Earth just for this little piece of the image. The full image requires 480,000 numbers to be transmitted.



Each data word is a 12-bit binary number that indicates how bright the pixel is from 000000000000 or '0', which is black to 111111111111 or '8191' which is white. This is often referred to as a 'grey scale level'. For example, the spacecraft might send a string of binary digits for Pixel 234 and Pixel 235 as

….000000000000111111111111….

This will be translated as Pixel 234=0 and Pixel 235=8191, meaning that when you reconstruct the image from the data you assign Pixel 234 as 'black' and Pixel 235 as 'white' on the greyscale. Color images are created from three of these images; one each for the Red, Blue and Green intensity data.

Things to think about: From the distance of Pluto, the New Horizon spacecraft can transmit data at a rate of 1,000 bits per second. Each image contains 1024x1024 pixels, and each pixel is coded with 12-bits of intensity data. How long will it take to transmit to Earth one of these uncompressed images? How long will it take if the image is compressed to 2.5 megabits before sending?