128 characters @ 1 byte/character = 128 bytes

1024x768 = 78336 pixels x 24 bits/pixel = 2,359,296 bits x 1 byte/8 bits x 1 kilobyte/1024 bytes x 1 megabyte/1024 kilobytes = 2.25 MB

Assuming png compression of 25%, 2.25MB x .75 = 1.6875 MB

4k Video Raw (4096 x 2160 pixels):

15 minutes x 60 seconds/minute x 30 frames per second x (3840 x 2160) pixels x 8 bits/pixel x 1 byte/8 bits x 1 kilobyte/1024 bytes x 1 megabyte/1024 kilobytes = 213,574.2 MB

1 minutes of 4k video at 30 fps = 175 MB for HEVC x 15 = 2625 MB

HD (1080p) has 25% of the pixels as 4K

HD (1080p) HEVC:  2625/4 = 656.25 MB

HD (1080p) Uncompressed: 213,574.2 /4 = 53,393.5

**Twitter**

500 million tweets per day x 128 bytes per tweet x 3 (HDFS)/ (1024)^3 = 178.8 TB

Each hard drive holds 10 TB, so 18 hard drives are needed

Snappy compression ratio ~1.5, resulting 178.8/1.5 = 119.2 TB, or 12 hard drives

**Instagram**

100 million videos and photos per day

75 million are 1024x768 png photos x 1.7 MB per photo = 127,500,000 MB x 3 (HDFS)/(1024)^2 = 364.8 TB, or 37 hard drives

**YouTube**

500 hours of video per minute x 60 minutes per hour x 24 hours per day = 720,000 hours of video per day

720,000 hours of video per day x (656 MB for 15 minute video x 4 = 2624 MB per hour of video) = 1,889,280,000 MB 3 (HDFS)/(1024)^2 = 5405.3 TB, or 541 hard drives

|  |  |  |
| --- | --- | --- |
|  | Size | #HD (10 TB) |
| Daily Twitter Tweets (uncompressed) | 178.8 TB | 18 |
| Daily Twitter Tweets (snappy compressed) | 119.2 TB | 12 |
| Daily Instagram Photos | 364.8 TB | 37 |
| Daily YouTube videos | 5,405.3 TB | 541 |
| Yearly Twitter Tweets (uncompressed) | 65,262 TB | 6,527 |
| Yearly Twitter Tweets (snappy compressed) | 43,508 TB | 4,351 |
| Yearly Instagram Photos | 133,152 TB | 13,316 |
| Yearly YouTube videos | 1,841,534.5 TB | 184,154 |

|  |  |  |
| --- | --- | --- |
|  | HD | Failures |
| Yearly Twitter Tweets (uncompressed) | 6,527 | 243 |
| Yearly Twitter Tweets (snappy compressed) | 4,351 | 162 |
| Yearly Instagram Photos | 13,316 | 497 |
| Yearly YouTube videos | 184,154 | 6,867 |

Assuming a Seagate 10TB hard drive, the average failure rate is 3.73%

One way latency

LA to Amsterdam: 140.8 ms

<https://wondernetwork.com/pings/los%20angeles/amsterdam>

Low Earth Orbit Satellite: 48 ms

I used Starlink: <https://en.wikipedia.org/wiki/Satellite_Internet_access>

Geostationary Satellite: 120-240ms

<https://en.wikipedia.org/wiki/Satellite_Internet_access>

Earth to Moon: 1250ms

<https://space.stackexchange.com/questions/35590/what-is-the-lowest-latency-achievable-in-reliable-earth-moon-communications>

Earth to Mars:

Earth to moon distance: 238,855 miles

Earth to Mars distance: changes due to orbits of each planet, but the average is 142 million miles (<https://www.space.com/16875-how-far-away-is-mars.html>)

So Mars is 595 times further from Earth than the moon, and thus we’d expect a one way latency of 595 x 1250ms = 743,750 ms, or 743.75 seconds