What are the main causes of digital artifact on the Lightbridge 2 image transmission screen?

Main causes are listed below:

1. **Wireless Interference**
   
   The operating frequency of the Lightbridge 2 is 2.4 GHz ISM band. Many devices such as Wi-Fi, Bluetooth and ZigBee also work at 2.4 GHz. When Lightbridge 2 is used close to these devices, its data transmission will be interfered, and data errors and digital artifact occur. Lightbridge 2 adopts H.264 that uses spatial prediction from the edges of neighboring blocks for "intra" coding for video compression. Once there is an error with the image streams, digital artifact will occur in consecutive frames. Frames with errors will be updated until a new keyframe (I-frame) occurs in the H.264 stream and be decoded correctly.

2. **Performance of the decoder of the mobile devices**
   
   H.264 encoding and decoding algorithms are complex. To achieve real-time decoding, a specified encoder with high processing capacity is required. Multiple versions of H.264 have been released in the past decade and decoders supporting these versions are also developed. At present, Android and iOS devices all use System on Chip (SOC) in which a processor for video encoding and decoding is integrated. With considerations of power consumption and cost, manufacturers use processors supporting different H.264 versions. So decoding performance of mobile devices varies. A processor’s performance, especially on error processing, interpolation and filtering, will directly affect the video decoding quality.

   The H.264 decoding processer in the Lightbridge 2 remote controller supports HDMI output and is compatible with the Lightbridge 2 air system’s encoder. So image display through HDMI on the Lightbridge 2 can serve as a reference of the image transmission effect of the Lightbridge 2.

2.1 **Analyses on Mobile Devices’ Decoding Performance**

2.1.1 **Processor’s Performance (CPU Frequency, GPU Frequency and Double Data Rate (DDR) Performance)**
   
   As a powerful application for aerial photography, DJI GO not only receives image transmission data, decodes streams, displays tasks, but also processes various commands and data, analyzes and merges data. The performance of the CPU and GPU will affect the smoothness of image transmission. If data loss occurs in a mobile device of which processor’s performance is poor, image transmission will freeze and digital artifact will occur. It is recommended to turn off other programs when using DJI GO to ensure optimal performance.

2.1.2 **The frequency of Co-processor (HW CODEC) and the capacity with the decoding of H.264**
   
   We barely know much about the Co-processor used by the manufacturers, except a simple description like HD decoding supported. However, there are multiple formats for HD decoding, such as 720p60, 1080p30, 1080p60, 2K30, 2K60, 4K30, and 4K60. Maximum bit rates also differ, such as 20Mbps, 40Mbps, 60Mbps, and 100Mbps. Hence, testing of DJI GO is conducted on the flagship products and leading products of major manufacturers in the industry. At the moment, the maximum real-time bitrate of the Lightbridge 2 air system is 1080p30, which requires high performance of a mobile device.
2.1.3 The frequency conversion and the temperature control strategy
For mobile devices, to save energy, a processor’s frequency is alerted dynamically during system operation. When the CPU’s temperature is too high, the operating frequency will be reduced automatically. With DJI GO which keeps decoding and displaying videos, the mobile device will emit lots of heat, especially in high temperature. That’s why image transmission freezes and digital artifact occurs after the app is running on some earlier mobile devices or mobile devices with poor performance for a while.

2.1.4 Software Decoding and Hardware Decoding
Most of the mobile devices utilize hardware decoding to process videos especially HD videos to ensure high efficiency and low power consumption. But hardware decoding may not be suitable for decoding streams like H.264 or H.265 streams, because it decodes streams by using specified hardware resources and preset mechanisms. This issue will not occur in software decoding, though software decoding needs to be used with processors with high performance. For example, Apple’s processor cannot process Lightbridge 2 streams of low latency properly nor recover automatically when errors occur. What’s more, it crashes when using hardware decoding. So DJI Go adopts software decoding. Though Apple processor’s performance is higher than that of common processors, its earlier products still cannot work normally when decoding 1080p streams, that is, image transmission freezes and digital artifact occurs. This issue has been found in iPad mini series, iPad Air 1, iPhone 6, and iPhone 6 Plus after testing. For iPhone 6S, iPad Pro, and iPhone 7, this issue does not occur. In the future, DJI will keep improving system resource utilization of DJI GO to guarantee optimal performance.

During actual usage, image transmission issues can be troubleshoot by comparing the image transmission screen and HDMI display of Lightbridge 2. If the HDMI screen and image transmission screen in the app freeze at the same time, or digital artifact occurs in these screens simultaneously, image transmission signal may be interfered. Choose another channel free of interference or try to adjust the antennas’ position to ensure optimal signal transmission. Ensure that signal is not blocked by tall buildings. If digital artifact only occurs in the image transmission screen on the mobile device, this issue is caused by the mobile device’s performance. Try to disable other running programs, cool down the device or use hardware decoding.