Merit LILIN Technical Support Document

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Subject: This document explains the potential causes behind video latency when viewing a stream from a network-enabled surveillance camera

How to observe video latency:
To observe video latency, point a camera to yourself and access the video via a computer. Next, wave your hand in front of the camera. Count the number of seconds between waving your hand, and seeing the wave on the screen. This delay is known as **video latency**

Figure 1

What can cause video latency?
There are a number of factors that can contribute to video latency:

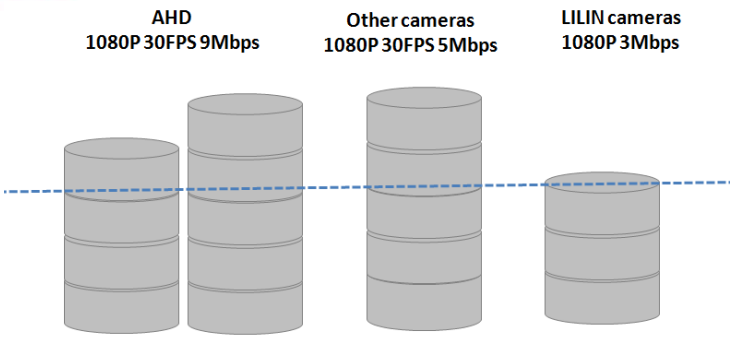
1. When the camera and the video client (such as the user's computer) are within the same network (LAN):
    a. **The number of layers (or "hops") between the camera and the viewing client**
        - Ideally, the cameras and the viewing client would all be connected to the same switch, preferably with the client connected to a Gigabit-capable uplink port
        - Each time the signal needs to transfer from one device to another, that is referred to as a **hop**. Camera -> Switch -> PC = 2 hops. Since each hop has the potential to create more latency, it is not a good idea to have the camera go through more than 2 or 3 hops before reaching the client. More hops will cause the latency to become more pronounced

b. **The quality of the network infrastructure**
   - The ability of the switch to effectively transmit the signal can affect video latency and camera responsiveness
   - The quality, length, and placement of network cables can affect their ability to transmit signal between devices
   - The quality of the termination on the RJ-45 connectors as well as the jack inserts can affect the speed of signal. 8 pins need to be in full contact with copper wire in order for optimal functionality

c. **The configuration on your network equipment**
   - If a managed switch is being used on the network, or if the camera is communicating over a LAN port on a router, the QoS configurations can have an impact on the speed at which data is transmitted
   - Some switches and routers allow certain processes or data transfers can be given preference over another. If there is a process that is higher on the priority list than the camera, you may see latency on the video feed

2. When viewing the camera remotely (viewing client not connected to the same LAN as the camera)
   a. **Network bandwidth**
      - The first thing to consider when troubleshooting latency when viewing video remotely is the **Upload and Download** speeds being offered by the Internet Service Provider (ISP)
      - Slow upload speed at the camera location could cause latency when sending the video
      - Slow download speed at the viewing client location could cause latency when downloading the video
      - Please note, most Internet Service Providers supply slower upload speeds than download speeds. Increasing these speeds can help to reduce latency when viewing remotely

   b. **Video compression**
      - There are two major video compressions still image and dynamic streaming. Still image streaming such as JPEG requires greater bandwidth, while H.264 dynamic streaming requires less bandwidth
      - Choosing the compression method for the video that you are streaming can have an impact on video latency
      - LILIN specializes in high-compression technologies. For example, LILIN Pro series cameras come set to record at 30FPS, 1080P 3Mbps. This is much smaller and more efficient than many cameras currently available, as shown in **Figure 2**



	Other camera	LILIN camera
30 days recording/camera	1581GB	950GB

Figure 2

c. **Video resolution:**
   - If the same compression is used for two video streams, each streaming at different resolutions, the higher resolution normally requires greater bandwidth. It is recommended to use 1080P H.264 when streaming within a LAN environment, whereas it may be best to utilize 720x480 H.264 when accessing your surveillance system remotely

d. **Frame rate:**
   - When using higher frame rate, it is generally to improve the smoothness of the image. If there is not sufficient bandwidth to support transmitting a video at a high frame rate, reducing the FPS can help
   - For example, if there is a 60FPS camera transmitting 60FPS at 6Mbps via a 3Mbps network, this could be a major contributing factor to video latency
   - To improve the latency in this scenario, reduce the frame rate and the bandwidth demand of the camera to match network speed.

Other contributing factors:

- **Too many video clients**
  - A video network product has limited CPU resource for serving many video clients. LILIN IP cameras and NVRs are limited for 7 video clients. If dual streaming is used, this should count as two video clients. You can identify the information from the web interface. To reduce the latency, make sure that the CPU of a network device that is not overloaded.

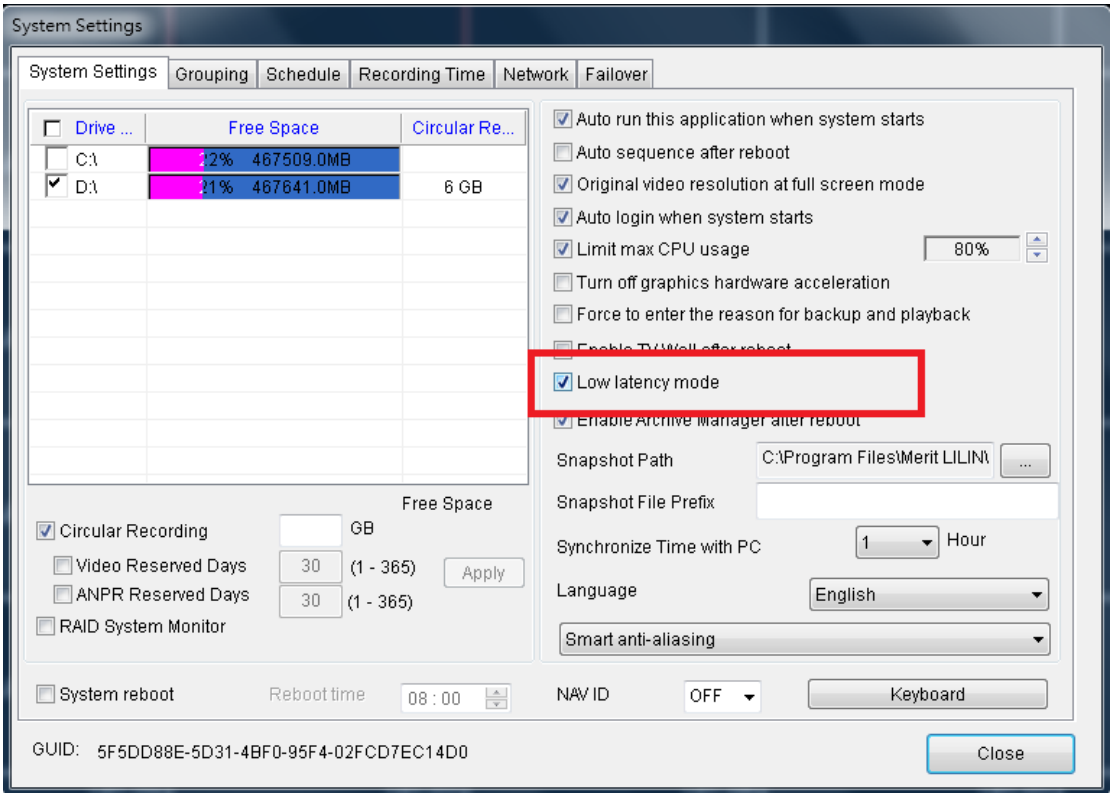
- **CPU speed of a network client**
  - This can greatly affect the speed of decoding the compressed video.
  - To display the video, it requires a CPU to decode the streaming compressed video file. Higher compression rate means less bandwidth required to transmit the video, however, it also means that a higher CPU speed is required in order to decode the streaming
  - For modern compression technologies such as H.265 can compress down to half of the video file size of H.264. However, it requires 4 times the CPU

power to decode the video. If the CPU is not powerful enough, it may take longer to decode a compressed file, which can present itself as video latency

LILIN Navigator Enterprise and NVR utilize dual steaming decoding technology to avoid the CPU load and reduce the latency

1. **Video decoding dependence:**
   - By nature, before the video can show up on the screen, H.264 needs to decode ~3 frames after the **I frame**. This could cause video latency. On a 30FPS camera, the frame interval is 33.3ms (1000ms / 30FPS). For 3 frames decoding dependence, this could cause at least 99.9ms (0.1s). In comparison, for a 60FPS camera, the frame interval is only 16.5ms. It needs only 49.5ms for decoding dependence.

2. **Video buffering:**
   - It is important to find a balance between image smoothness and video latency. To provide smooth video, this means that the system has to provide more memory (buffering) to allow the video to be smoother.
   - In order to reduce latency, LILIN network video products have a feature called **low latency mode**, which turns off video buffering.
   - You can enable this option to reduce latency, which trades video smoothness for lower latency



Conclusion
When experiencing video latency, it is important to troubleshoot the following:

1. Network hardware and infrastructure

2. Network speeds and bandwidth

3. Camera demand on bandwidth

4. CPU ability to provide sufficient processing power to decode the compressed video file

Most systems where high latency issues are being experienced can be improved by addressing the suggestions listed in this document. Improving latency in this way can work to improve the experience and satisfaction of the user

If you still have questions regarding this process, or if you have any questions regarding support for any Lilin products, please feel welcome to reach out to our dedicated support staff by calling (626) 739-1840 or via email at info@lilin.us.