# Ladybug5+ Implementation Assessment

**Introduction**

The following is a description of the requirements identified to successfully implement the Ladybug5+ as part of the Ladbug5 Jackal Integration project. It discusses key factors that can restrict performance, and assesses the overall viability of the Ladybug5+ as the chosen camera system in the project. Content is sorted by function with

**Ladybug API on Linux**

When implemented on a Linux OS, the ladybug API is very vague in how it is meant to be called. I have found how to implement the start up procedure in a custom application, however had no success in running a custom application over the API. The examples have been successfully modified to take multiple images and serve as a video source, but only at a low framerate. By multithreading the image capture process it could be possible to improve this. Current file outputs are set to jpeg.

**Network Requirements**

Due to defence standards DS 00-82 and the AS GVA, a number of constraints are placed on any network transmitting image data on Australian vehicles. To be compliant, the key requirements are:

* Image data must be transmitted using UDP
* File formats to be JPEG or JPEG 2000

The Ladybug5+ can produce extremely high quality images at the cost of large file sizes. By compressing the images into jpeg format, the average file size has been brought down to approximately 700kB. This means that in order to be compliant, each image will need to be packetized into multiple packets and reassembled after transmission. Combined with the relative unreliability of UDP as a transmission protocol (packets are not guaranteed to arrive at the desired address), reduced performance would likely be experienced with this implementation.

**Data Throughput Requirements**

The Ladybug5+ has 6 cameras, each taking an image to produce a single frame of the 360° image. Therefore a single frame of footage taken would be approximately 4.2MB. For 30fps video this then becomes 126MB of footage. In other words, the network would need to be capable of transmitting 126MB/s or around 1Gb/s in order to maintain the image quality at that framerate irrespective of any processing requirements. Because of this alone I would recommend against implementation on a wireless network.

**Processor Limitations**

The hardware on the Jackal UGV is either a Dual Core Celeron processor or a quad core Intel i5. Following Harvey’s report that he was incapable of finding a reliable stitching method to operate on the client, this hardware would likely be required to stitch the images recorded by the Ladybug. Given the system performance is likely to be poor simply when capturing images. Adding the stitching and streaming tasks to this machine would likely put excessive load on the PC. This would result in inferior video performance and reduced operation time due to the PC drawing more power.

**Recommendations**

Given the above restrictions described for the implementation of the Ladybug5+ on the Jackal UGV, I would recommend against proceeding with the project. There are a number of serious software and hardware issues and limitations that prevent it from being a suitable choice for the platform. Thus it would be encouraged to look into alternate camera solutions with lower power and processing requirements to suit to the mobile environment. Preferably this would also use an open source API rather than a proprietary one, as this was one of the major stumbling blocks in this project’s development.

Based on the requirements and limitations described above, an appropriate environment to implement the Ladybug5+ would have the following properties:

* Workstation class PC to operate the camera
* Wired Gigabit (preferably 10 gigabit) networking capability
* Linux based operating system for easy deployment

Given these requirements, a candidate project most capable of utilising the Ladybug5+ would be LOAVES. In this environment, the Ladybug5+ would have access to more powerful workstation class PC’s and a hardwired network, circumventing the major concerns of bandwidth and processor bottleneck. It also meshes well with the project goals of LOAVES being to demonstrate new sensing and vision technologies.