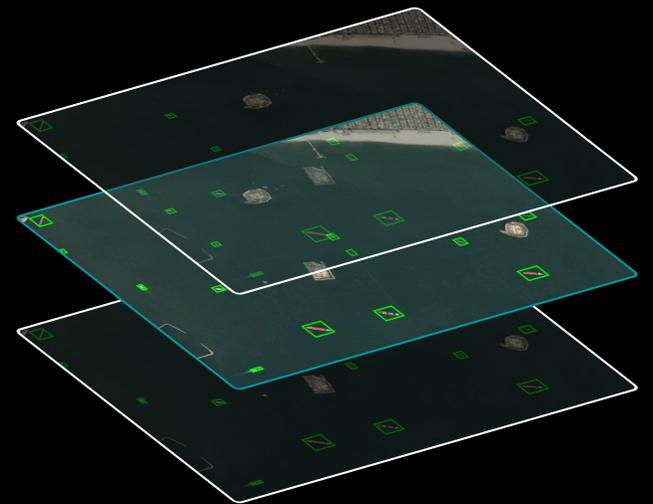# Data Compression

Lossless image compression

Implements differential Huffman encoding in accordance with the ITU-T.81 JPEG standard, offering a simple yet robust solution for lossless image compression in space applications. The architecture is optimized for radiation resilience and can be easily hardened using Triple Modular Redundancy (TMR) with minimal utilization overhead — ensuring reliable, fault-tolerant data handling in orbit.

Key Features

- **Supported color depths:** up to 16 bits
- **Supports planar or interleaved data compression:** up to 4 planes
- **Highly configurable IP core:** Depending on desired use case, IP can be configured to minimize resource utilization on FPGA
- **Not dependent on FPGA vendor**

Technical Specifications

Compression Ratio					
Bit depth (BPP)	8	10	12	14	16
Compression ratio	38%	32%	40%	42%	35%

Resource Utilization						
Data Type	RAW8	RAW10	RAW12	RAW14	RAW16	RGB888
LUT	440	2920	3530	3850	4500	3645
FF	256	380	400	420	480	719

Example

Uncompressed RGB888 9.85 MB

Lossless RGB888 6.79 MB (31.07% Less)

Lossy RGB888 2.46 MB (75.03% Less)

Delivery

IP delivery includes encrypted IP and simulation test bench with description. Evaluation or full license, depending on purchased product. SW includes the Matlab script file used to generate Huffman tables with examples.

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LABS

Object Detection and Segmentation

Downlink more than just data

Protostar Labs' object detection and segmentation IP cores enable onboard analysis directly on supported FPGAs or our Protostar Data Processing Unit (DPU). By detecting, segmenting, and prioritizing targets before transmission, missions can drastically reduce data volume, latency, and bandwidth requirements - ensuring only meaningful insights are downlinked.

Modules

Object Detection
Enable onboard autonomy. Our detection cores identify objects of interest in real time.

Object Segmentation
Gain pixel-level insight. Each frame is classified by region - clouds, terrain, ocean, or spacecraft elements.

Image Enhancement
Enhance key details. Our super-resolution core sharpens low-resolution imagery.

Key Features

- **Flexible Development –** Train models with mission-specific datasets.
- **Radiation-Tolerant Design –** Built with our Triple Modular Redundancy for reliable operation in harsh conditions.
- **Video Fault Supervisor (VFS) –** Continuously monitors data integrity, detecting frame errors or logic faults to ensure dependable performance.
- **Intelligent Payload Switching –** Reuse architectures across applications — e.g. wildfire detection, maritime tracking, or urban monitoring.
- **Seamless Integration –** Fully supported by ProtoSDK, simplifying deployment with optional compression and DMA utilities.
- **Adaptive Efficiency –** Balance accuracy and resource use through configurable quantization.

Video
Fault
Supervisor

Raw Image

Segmented Image

ROI Selection and Object Detection

Image
Compression
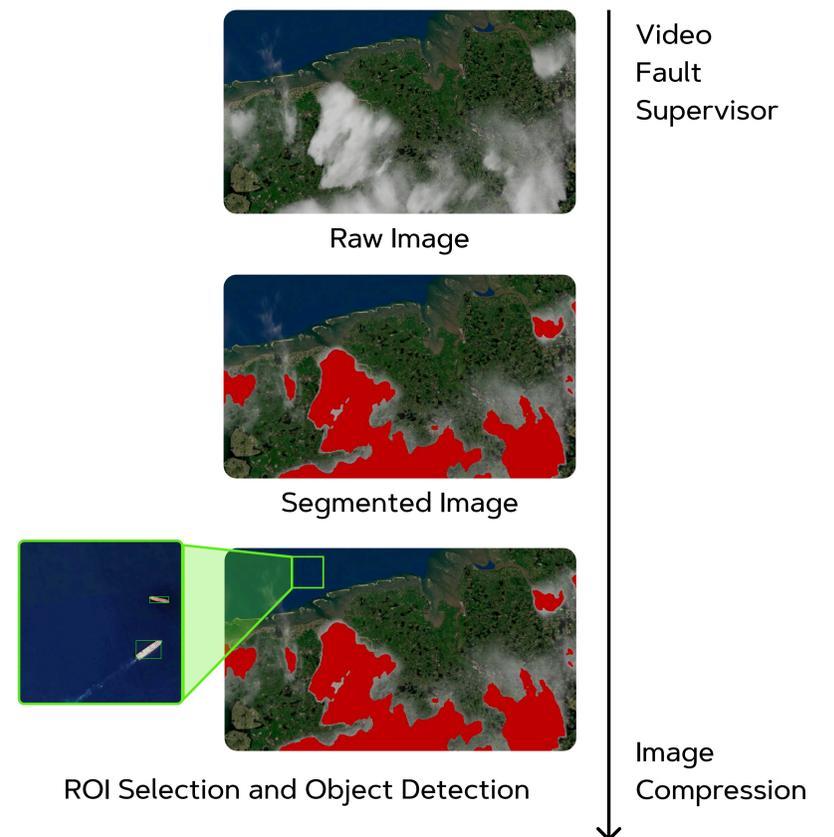
Technical Specifications

Supported Architectures	Supported FPGA Families and Boards	Protostar Labs IP Cores
ResNet, U-Net, FCN, YOLO, SSD	ZYNQ-7000, UltraScale, UltraScale+, Protostar DPU	VFS, Data Compression

Delivery

Pre-verified **Vivado project and IP cores**, followed by a detailed user manual.

Ready for collaboration? Contact us at **sales@protostar.ai**

hello@protostar.ai