# Monolithic → Modular Function Mapping & Parity Check

## 1. Frame Ingestion

Monolithic: cv2.VideoCapture() directly reads RTSP frames in main loop.

Modular: rtsp\_stream/rtsp\_worker.py handles camera connection, currently still using OpenCV. Planned upgrade to GStreamer in Phase 1.

Parity Status: FUNCTIONAL MATCH, but modular should replace OpenCV ingestion with GStreamer for stability/performance.

## 2. Frame Preprocessing

Monolithic: Frames resized and converted to grayscale in main loop before buffer append.

Modular: preprocessing/frame\_normalizer.py handles resizing and grayscale conversion.

Parity Status: MATCH, but confirm target resolution and interpolation method match monolithic settings.

## 3. Rolling Grayscale Buffer

Monolithic: Maintains list of last 11 grayscale frames as video\_array.

Modular: processing/grayscale\_buffer.py and grayscale\_buffer\_optimized.py maintain rolling frame storage.

Parity Status: MATCH, must enforce exact length=11 for smoke detection consistency.

## 4. Motion Detection

Monolithic: Uses time\_difference() + check\_max\_pix() to detect motion, skips smoke detection if motion present.

Modular: Motion logic partially present in smoke/patch\_utils.py but sometimes replaced by simplified is\_valid\_motion().

Parity Status: PARTIAL MISMATCH — restore full original motion gating logic from monolithic sd\_utils\_23.py to ensure accuracy.

## 5. Smoke Detection

Monolithic: check\_video\_for\_smoke3b(video\_array, settings) performs patch-based Wasserstein distance analysis with thresholds, followed by validation.

Modular: Implemented in smoke/smoke\_detector.py and smoke\_detector\_optimized.py with Numba acceleration.

Parity Status: VERIFY — ensure parameters and threshold values match monolithic defaults in sd\_utils\_23.py.

## 6. Alerts

Monolithic: Triggers HTML email with snapshot attachment upon confirmed smoke event.

Modular: Should trigger notification module (push/call) instead of email, but must preserve identical trigger conditions from smoke detection.

Parity Status: FUNCTIONAL CHANGE — alert mechanism updated, but detection condition must match monolithic.

## 7. Logging

Monolithic: Console logs in main loop for each detection stage.

Modular: logger/log\_manager.py handles structured logging, integrated across modules.

Parity Status: MATCH, but log content/verbosity may differ. Consider matching log detail from monolithic for debugging parity tests.

## Recommendations Before Phase 1 Optimization

1. Enforce exact motion detection logic from monolithic (time\_difference + check\_max\_pix).

2. Verify smoke detection thresholds in modular match monolithic defaults.

3. Ensure rolling buffer length=11 in all cases.

4. Run regression test: same input videos through monolithic and modular, compare detection events and logs.

5. Patch mismatches before introducing GStreamer ingestion to ensure accuracy baseline.