



# GeoEye-1 New Sensor Mode – 1x2 Multispectral Pixel Aggregation

Preston Mattox

JACIE 2012

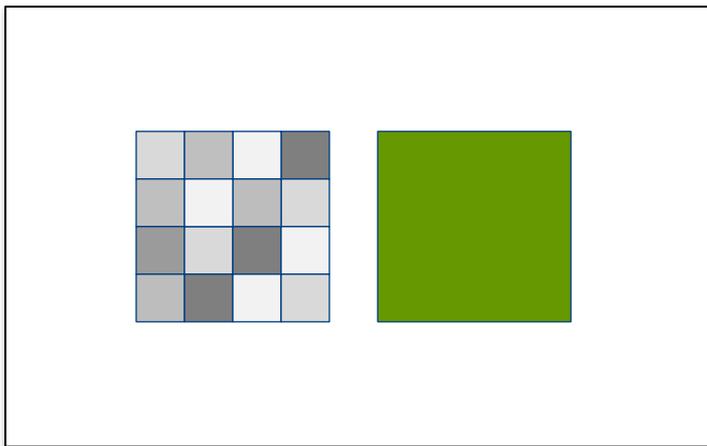
Fairfax, VA

# Overview

- › **What is the GeoEye-1 Enhanced Line Rate (ELR)?**
- › **Advantages of Enhanced Line Rate**
- › **Planning**
- › **Deployment/firmware upload**
- › **On-orbit performance results**
- › **Processing walkthrough**
- › **Pan-sharpened imagery comparison (ELR to SLR)**

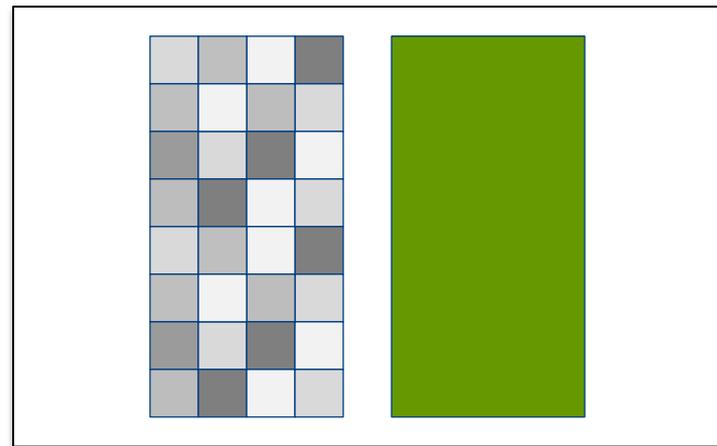
# What is the GeoEye-1 Enhanced Line Rate?

- › **New imaging mode added to GeoEye-1 (in flight)**
- › **Panchromatic 20k lines/sec + Multispectral 2.5k lines/sec**
  - Panchromatic 20k only pre-existing on GE-1
  - Multispectral imaging uses 1x2 pixel aggregation
  - Aggregation occurs in along scan direction (direction of motion)



**Standard Line Rate (SLR)**

16 pan pixels for every multispectral pixel



**Enhanced Line Rate (ELR)**

32 pan pixels for every multispectral pixel

Multispectral pixel aggregated to 1x2

# Advantages of Enhanced Line Rate (ELR)

## › **Increased overall collection capacity vs. Standard Line Rate (SLR)**

- ELR camera slew rate is double that of SLR
- Overhead costs unchanged
- Faster collection of large area targets (25% – 30% increase)
- Point target collection times largely unchanged
- Camera on times decrease up to 40%
- **End-to-end capacity increase: 15% – 20%**

## › **Entirely compatible with SLR imagery**

- Core product formatting is unchanged
  - Mosaic, ORTHO, GEO, STEREO, etc.

# Planning

## › Assessments and discoveries

- Compression table analysis
  - On-board table both sufficient and preferred to newly-developed tables
- MS 1x2 imagery (simulated)
  - Results slightly blurred, some aliasing
- MS 1x2 pan-sharpened imagery (simulated)
  - Pan-sharpened results comparable

## › New payload firmware

- Minor changes to pre-existing firmware
  - Image mode table

# Deployment/Firmware Upload

› **October 3, 2011**

› **24-hour downtime**

- Imaging for regression testing of SLR
- Imaging for requirements verification

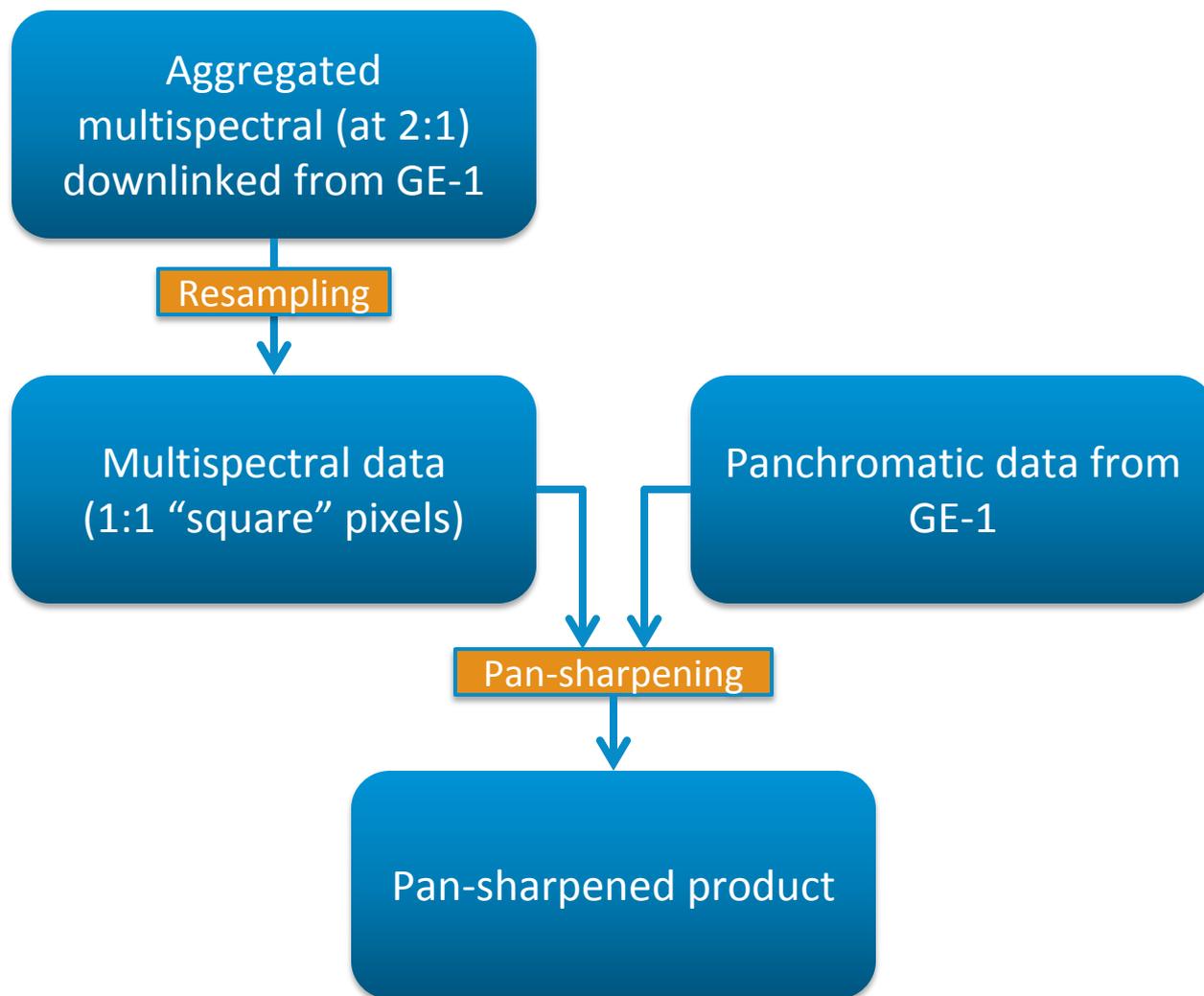
› **Return to normal (SLR) operations within allotted time**

- Regression testing successful – no impact to SLR
  - Streaking & banding
  - Signal-to-noise ratio (SNR)
  - Modulation transfer function (MTF)
  - Geolocation accuracy
  - Qualitative visual assessment

# On-Orbit Performance Results

Requirement	Specification	Performance (BOLD)
Streaking (10% - 20% of DR)	< 1%	<b>33 scenarios tested (band, TDI, etc.); no exceedances</b>
Streaking (20% - 90% of DR)	< 0.5%	
Banding (10% - 20% of DR)	< 0.8%	<b>33 scenarios tested (band, TDI, etc.); no exceedances</b>
Banding (20% - 90% of DR)	< 0.4%	
Signal-to-Noise Ratio (Pan)	> 100	<b>115</b>
Signal-to-Noise Ratio (MS)	> 195	<b>206, 200, 198, 201 (B,G,R,N)</b>
MTF (at Half Nyquist)	> 0.30	<b>0.38 +/- 0.01</b>
MTF (at Nyquist)	> 0.10	<b>0.14 +/- 0.01</b>
Geolocation (Mono CE90)	< 5.0 m	<b>2.5 m</b>

# Processing Walkthrough



# Processing Walkthrough (Continued)



1x2 Aggregated Multispectral (Red Band)



Resampled Multispectral ("Square" Pixels)

# Processing Walkthrough (Continued)



Resampled MS

Panchromatic



Pan-Sharpended Product

# Processing Walkthrough (Continued)



1x2 Aggregated Multispectral (Red Band)



Pan-Sharpened Product

# Pan-Sharpened Imagery Comparison



Standard Line Rate (SLR)



Enhanced Line Rate (ELR)

# Pan-Sharpened Imagery Comparison



Standard Line Rate (SLR)



Enhanced Line Rate (ELR)

# Appendix – Additional Samples

# Multispectral (RGB) Imagery Comparison



Standard Line Rate (SLR) – Multispectral



Enhanced Line Rate (ELR) – Multispectral

# Multispectral (RGB) Imagery Comparison



Standard Line Rate (SLR) – Multispectral

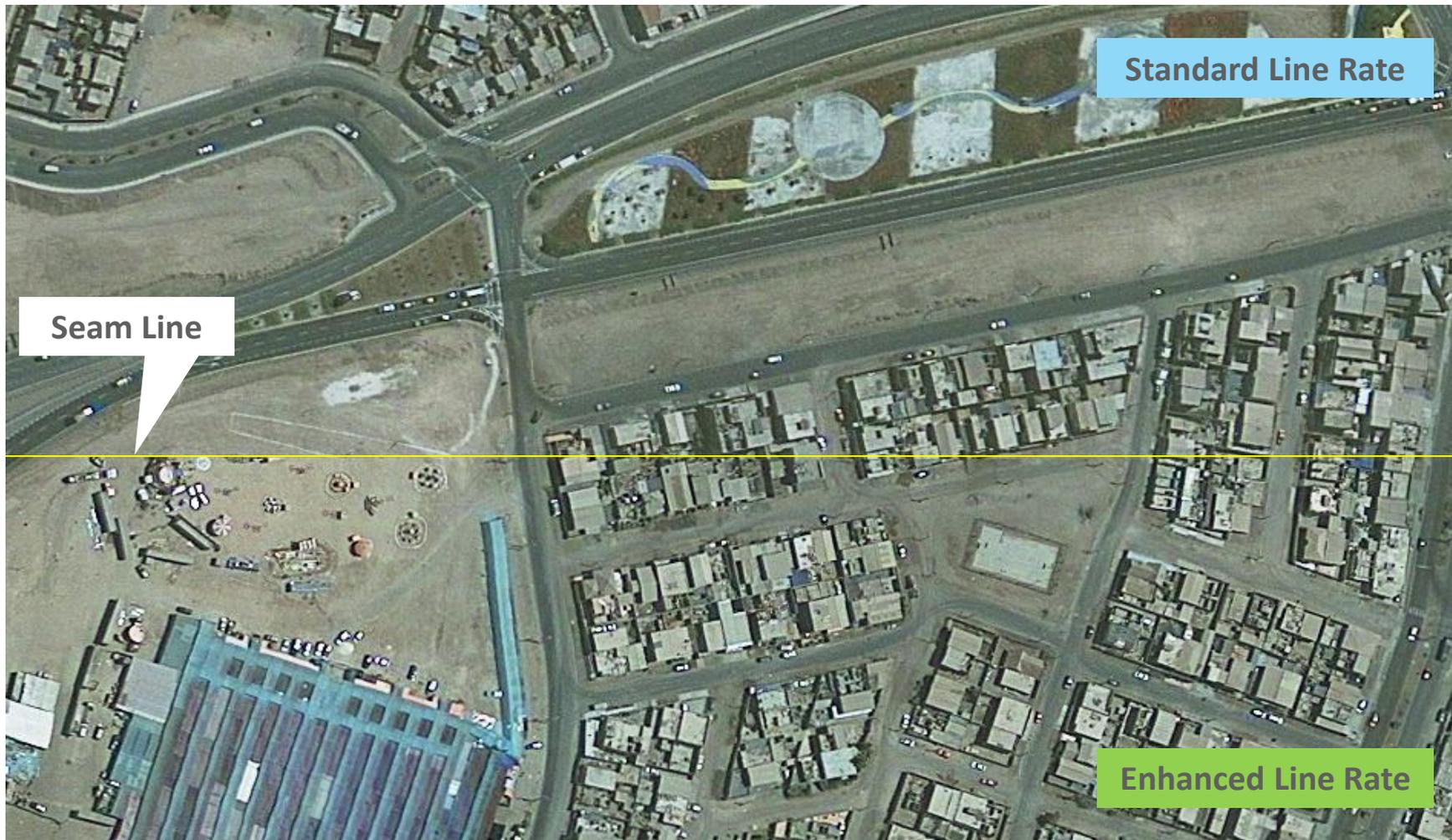


Enhanced Line Rate (ELR) – Multispectral

# Pan-Sharpened Orthomosaic



# Pan-Sharpened Orthomosaic



# Multispectral Orthomosaic



# Multispectral Orthomosaic



# Contact Information

## **Preston Mattox**

Senior Geodetic Engineer

mattox.preston@geoeye.com