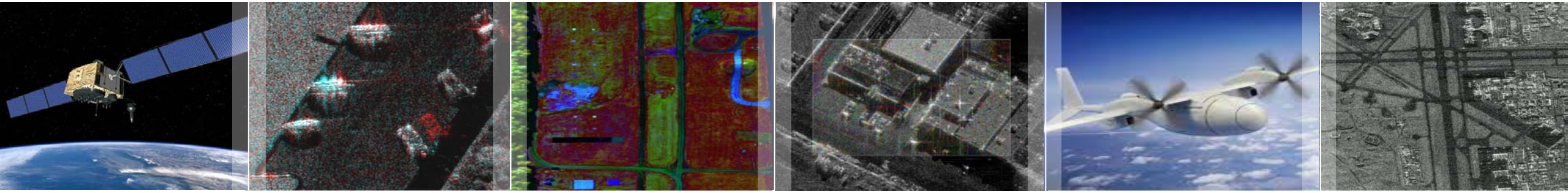
# Interactive Processing and Visualization of Geospatial Data



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# Geospatial Data Processing



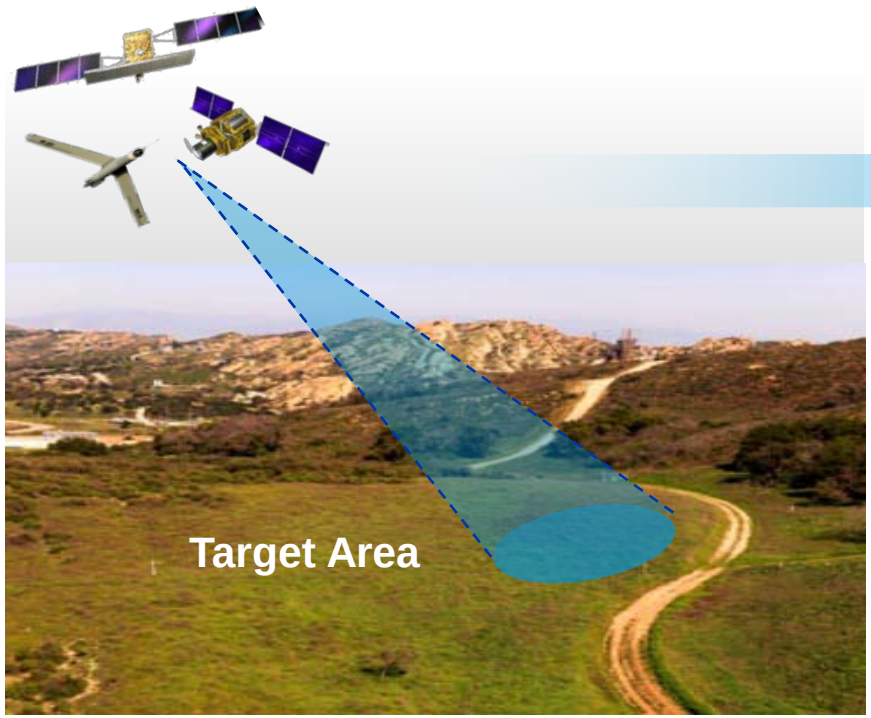
- **Large volumes of data collected from air borne and space borne sensors**
- **Processing extremely computationally intensive**
  - Traditionally minutes to hours timelines
  - User may need to iterate/optimize algorithms to get usable result
  - Results may need to be transferred to/from analyst location

How can GPUs change how we analyze geospatial data?

# Geospatial Sensor Data Processing



## Collection Platforms



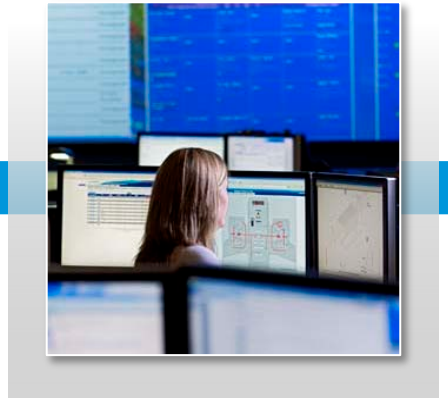

## Raw Data

- Electro-Optic Imagery
- Synthetic Aperture Radar
- Hyper-spectral

## Processing

- Transform data to human viewable format

## Analyst

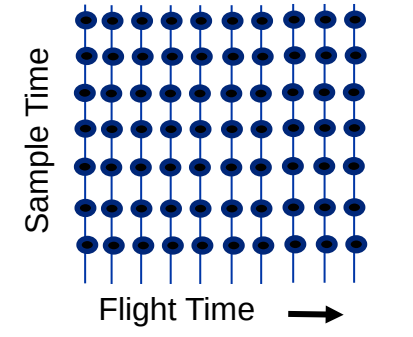


- Engineer
- Scientist
- Domain Expert

# Examples Data Sets



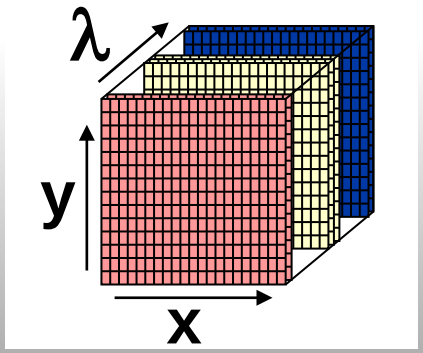
## Synthetic Aperture Radar (SAR)




- Digitized Receive Pulses
- Magnitude/Phase Data
- May include multiple polarizations

- Image Formation (Tomographic-like reconstuctions)
- Polarimetric Analysis
- Interferometric Analysis

## Hyper-Spectral




λ – 250 samples

y – 900 samples

x – 1800 samples

- Band Selections
- Principal Component Analysis
- Material Detection

# Interactive Processing



## Raw Sensor Data

*Unprocessed Data is loaded onto video card*

## Data Processed on GPU

*Results rendered directly to display via OpenGL*

*Operator adjusts algorithm parameter via GUI controls*

*Algorithm parameters updated and data reprocessed at 10-40 frames/second*

**On-Card Feedback Loop Enables Instantaneous Operator Feedback**

# Early Prototype



- Early demonstration based on OpenGL examples in Cuda SDK
- Demonstrated utility of
  + interactive processing

# Agility Framework



## Agility Framework provides interactive processing for geospatial analyst

- Leverage GPU on analyst's workstation
- Near instantaneous feedback to algorithm change
- Flexibility to redefine algorithmic processing chain on-the-fly
- Interoperability with remote batch processing

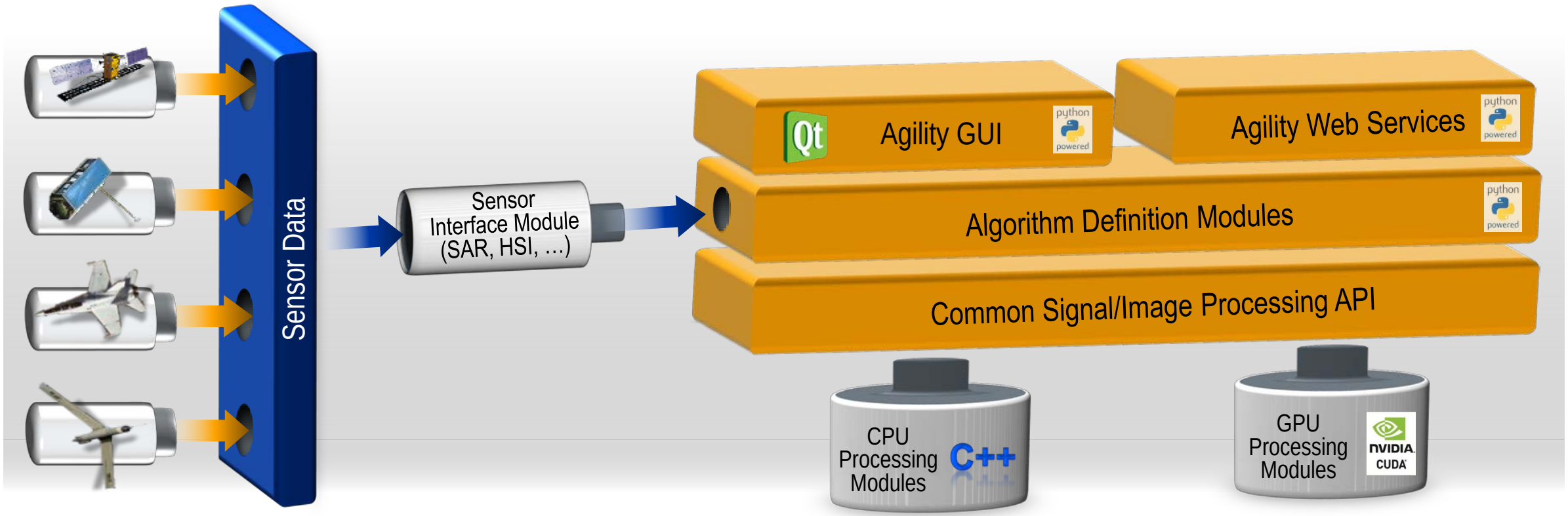
## Agility Framework provides interactive processing for algorithm developers

- Run-time addition of algorithms
- Allows change to algorithm parameters
- Modular support for differing sensor types
- Separate concerns of processing device from signal/image processing logic

# Agility Framework

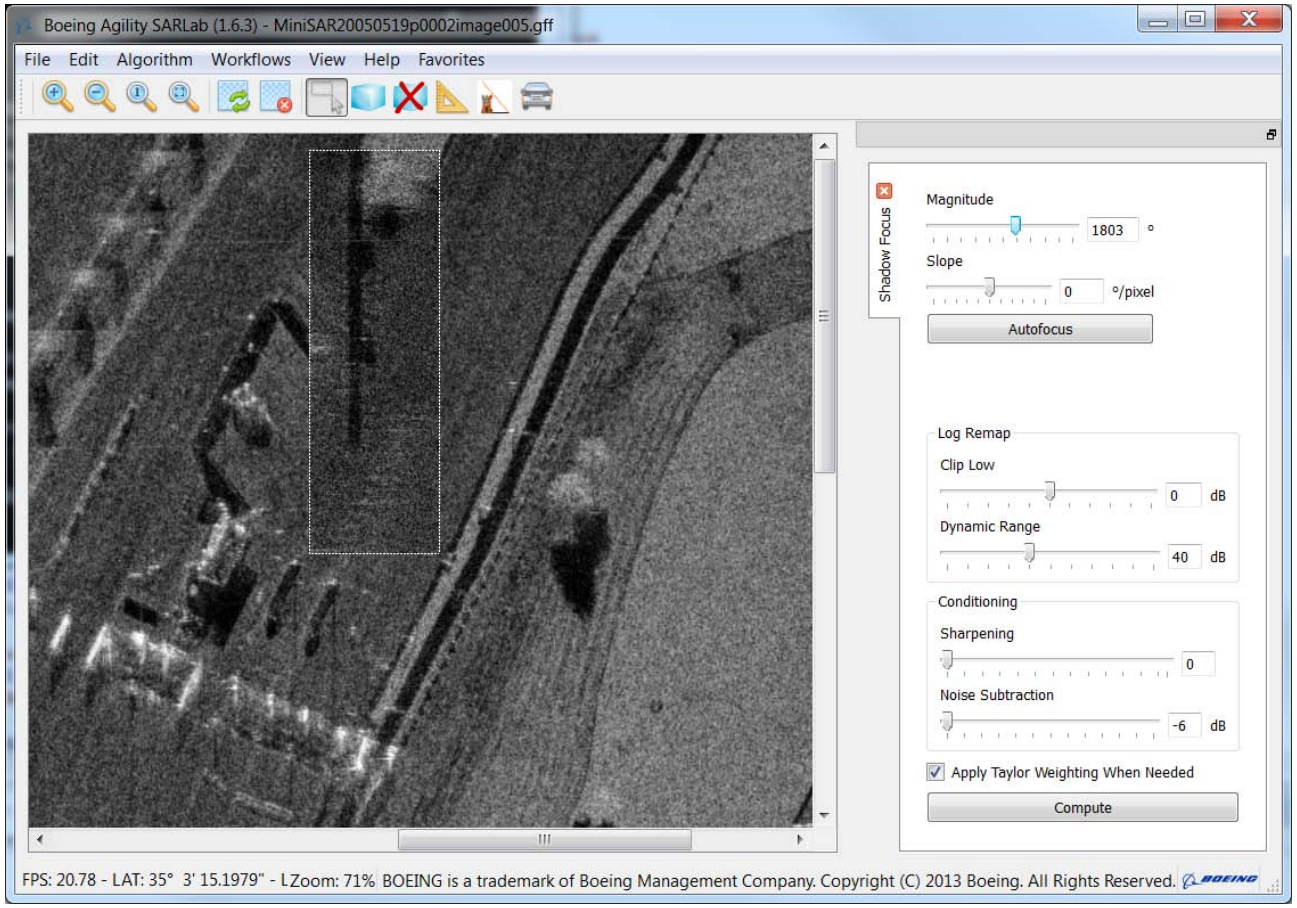


## Processing Modules & Sensor Interfaces Provisioned at Run-time



# Agility Interactive Processing Demonstration

Boeing Advanced Network & Space Systems




MiniSAR Imagery Courtesy of Sandia National Lab

# Agility SARLab



Software suite for SAR analysis built on Agility framework. Commercial licensing available from www.boeing.com/AGISAR

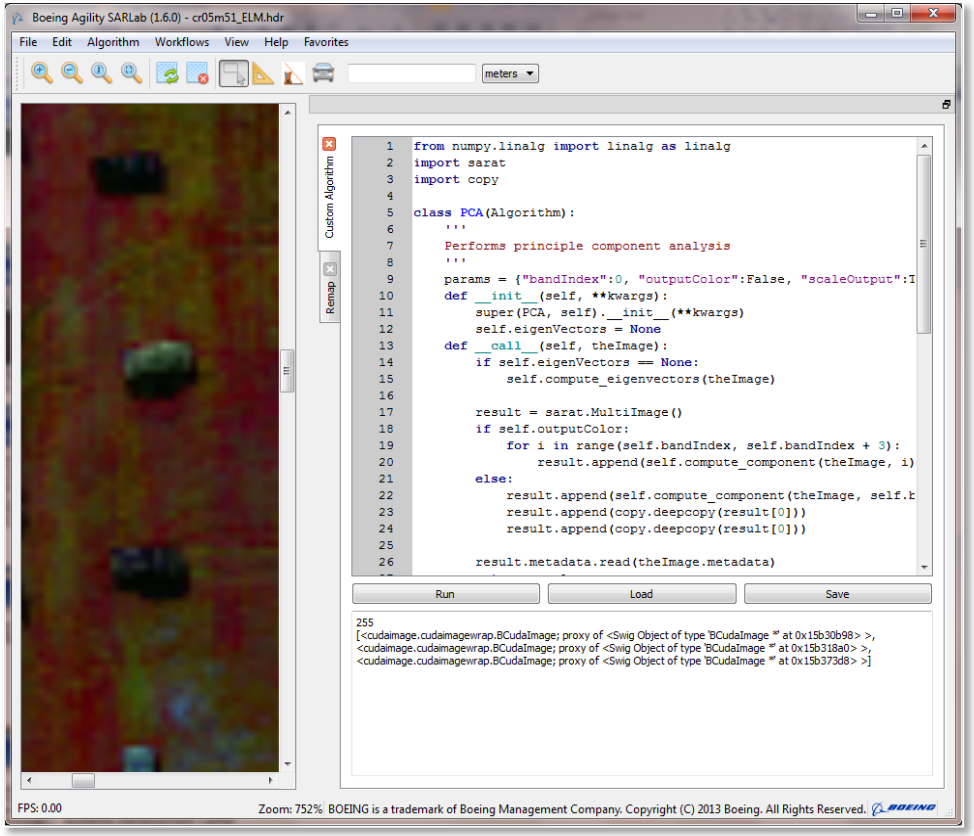
- SAR phase history processing and rendering at 10-20 fps
- Rapid and comprehensive exploitation of SAR phenomena and production of actionable information
- Simple, yet powerful, analysis workflow
- Inexpensive, small footprint supercomputing capability for SAR processing and exploitation
- 10-100x processing speed improvement over traditional SAR processing approaches
- Supporting SAR data formats including TerraSAR-X, Radarsat-2, COSMO-SkyMed, Sensor-Independent SICD, and several other widely used formats

MiniSAR Imagery Courtesy of Sandia National Lab
GOTCHA Imagery Courtesy of Air Force Research Labs

# Interactive Algorithm Editing



- **Integrated algorithm development toolkit**
- **Developers can edit Python scripts to define algorithm modules**
- **Resulting algorithms run immediately on GPU as part of workflow**



# Agility Web Services

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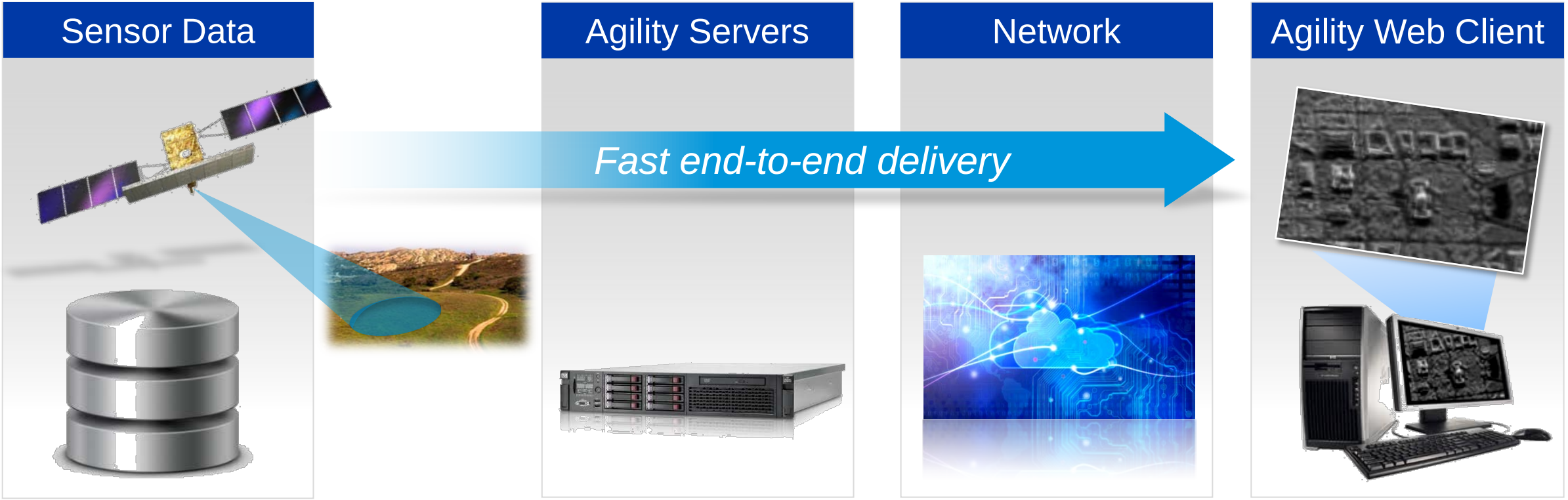
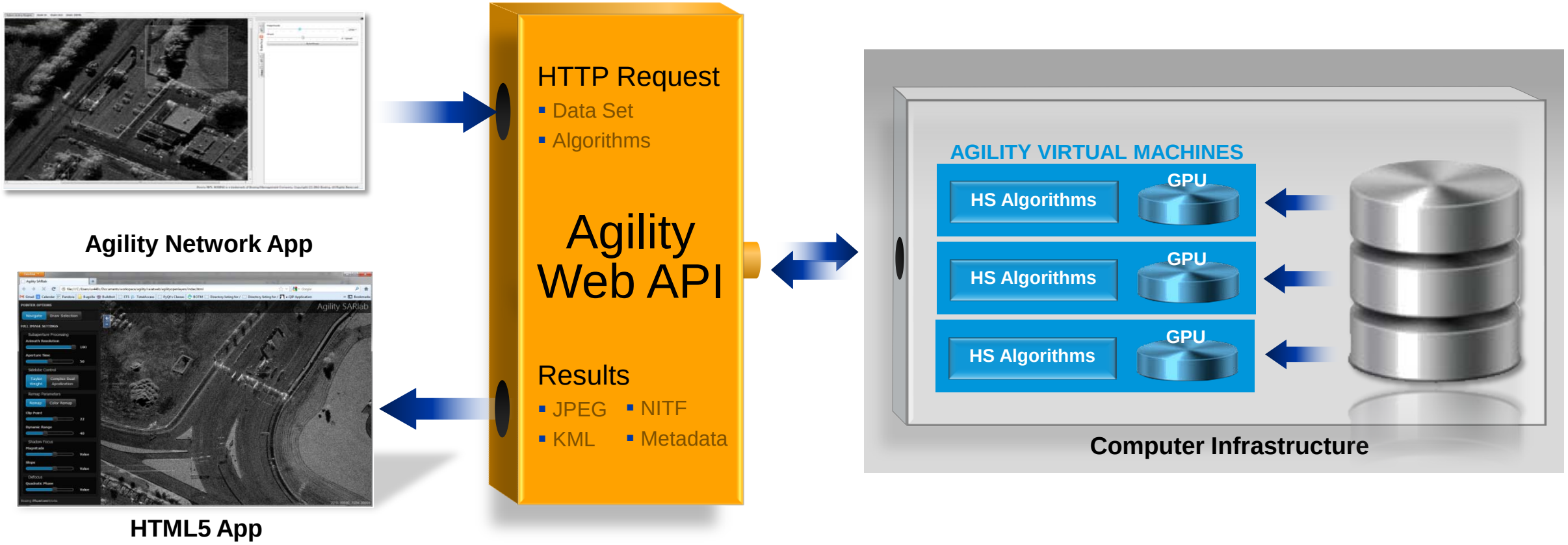


# Agility Web Services

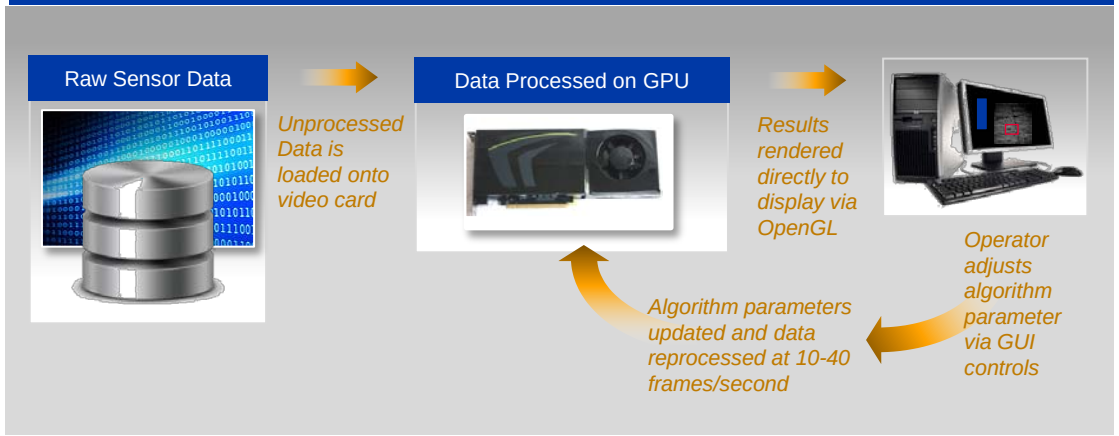




# Summary

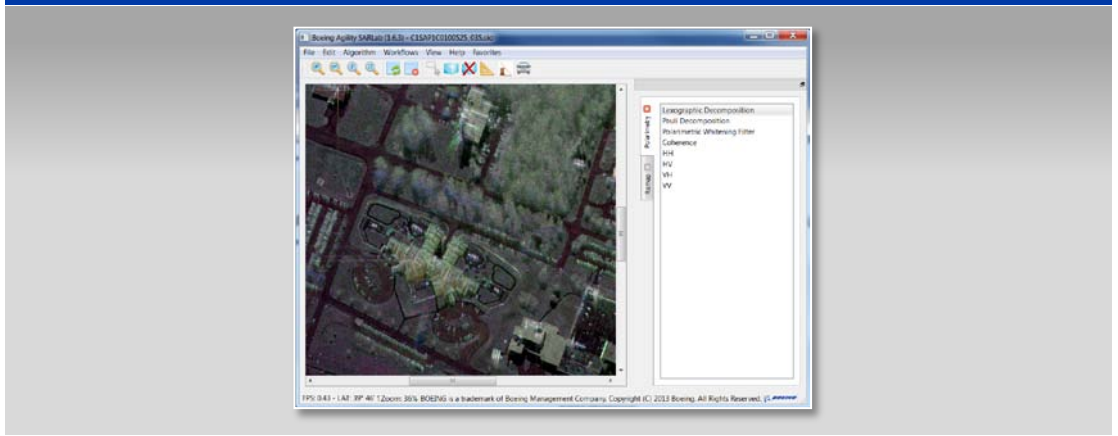


## GPU Enables New Geospatial Analysis Paradigm




- Direct interaction with data

## Leveraging Flexible Framework for Building Visualization Applications



- Dynamic API for sensor format definitions
- Python based dynamic interface for defining GPU processing algorithms

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