Evolution of Aerial Imaging Technology
From Film to CCD to CMOS

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• **Pre-2000** – Film
• **2000** – Large format CCD
• **2010** - Digital replaces film for virtually all large-area aerial imagery projects
• **2015** – Large format CMOS
• **2022** – All next generation systems = CMOS
How Digital Sensing Works

Larger silicon wafers or smaller pixels?
How CCD Works

Charge-Coupled Device

- Photons gathered in wells converted to electrical charge
- Analog charges moved across the board to A/D converter
- Analog-digital converter located at the corner of the array
- A/D conversion done at aggregated array-level
- Multiple CCD arrays (array of arrays) often calibrated together
How CMOS Works

**Complimentary Metal-Oxide-Semiconductor**

- Photons gathered in wells converted to electrical charge
- Transistors located around each well perform analog-digital conversion
- A/D conversion done at individual pixel-level
- Digital signal moved across the board with standard wiring
CCD Technical Advantages

- High quality & accuracy
- Distortion-free
- Less fixed-pattern noise
- Higher sensitivity
CMOS Technical Advantages

- Less Smearing & Blooming
- Higher Dynamic Range
- Higher IR Wavelength Sensitivity
- Lower Power Consumption
- Faster Capture Rates
- Standardized Chip Manufacturing
3 Perspectives: CCD to CMOS

Camera Manufacturer

Imagery Provider

Consumer or Analyst
Camera Manufacturer Perspective

- CMOS is less expensive
- CCD cost-prohibitive to build-out further
- More CMOS manufacturing facilities
- CMOS more efficient to scale up
- CMOS deficiencies overcome with new technological advances
- Mechanical vs. software-driven motion compensation
Data Provider Perspective

- CMOS requires lower power draw
- CMOS capable of faster capture rates
- CMOS less vulnerable to smearing
- Wider coverage reduces flight time
- Fewer images = more efficient production
- Service contracts with manufacturers
- Client preferences
Imagery Consumer Perspective

- Larger formats = fewer seams
- More efficient flight plans = cost savings
- CMOS sensors = more sensitive to infrared wavelengths
- Clarity, blur, and general fuzziness
- Newest CMOS technology equals CCD accuracies & clarity
- Older proven technology or new & improved?
# General Thoughts / Summary

## Rapidly Evolving Tech
- 1st generation flaws
- Developmental maturity
- Market competition
- Is it just hype?

## Choices
- Do we have a choice?
  - Past - no
  - Present – yes!
  - Future – unlikely
- Camera brands
- Model generation
- Special features

## Cost savings
- Always theoretical
- New features, fidelity, higher resolutions, integrated products cost more
- Expense offset by versatility and efficiency gains
- Trend for higher-resolution imagery
Thank You!

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