

CAMERAS

Consumer digital CCD cameras

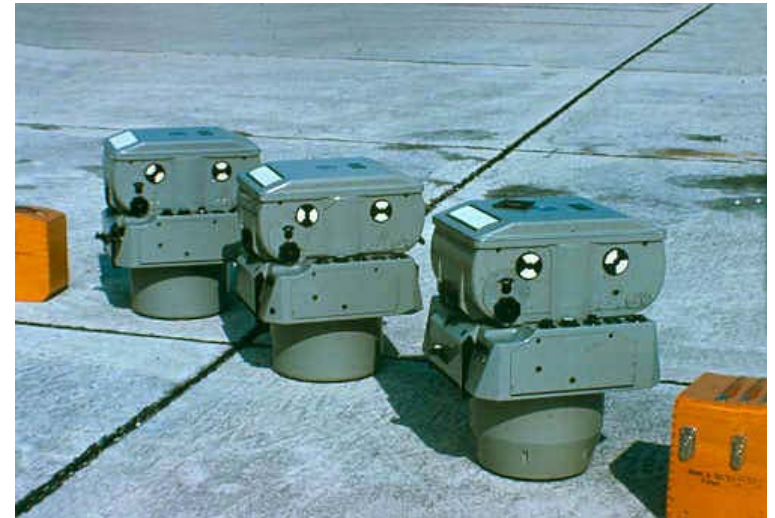


Aerial Cameras

Leica RC-30



Zeiss RMK



Zeiss RMK in aircraft



Vexcel UltraCam Digital (note multiple apertures)



Lenses for Leica RC-30. Many elements needed to minimize distortion and other aberrations

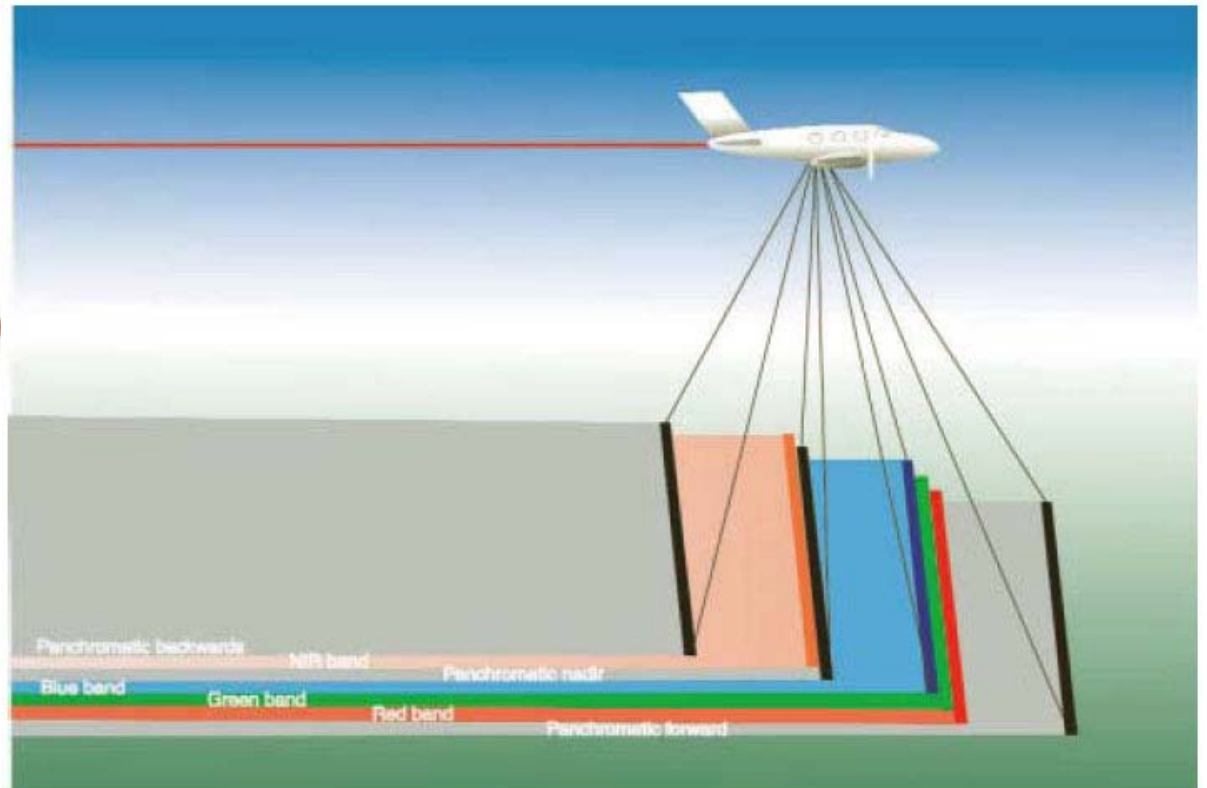
Wide angle lens cone

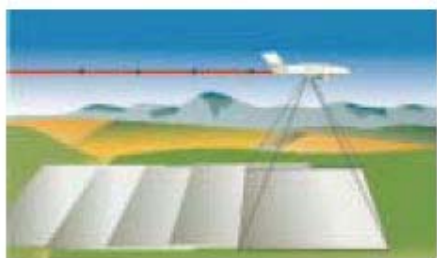


Normal angle lens cone

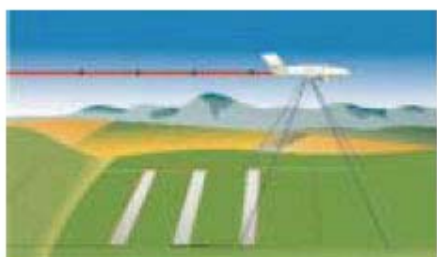


Leica digital aerial camera ADS40, “3-line scanner”





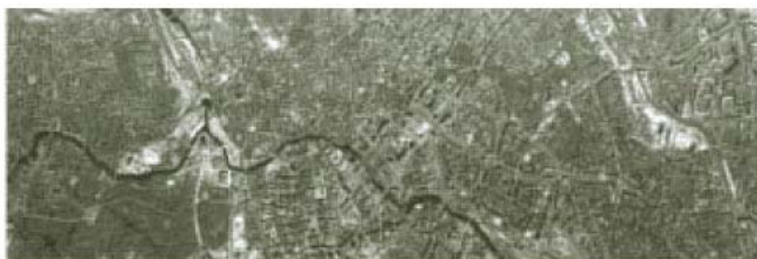
Relief displacement in frame imagery.



Relief of displacement in three-line-scanner imagery.



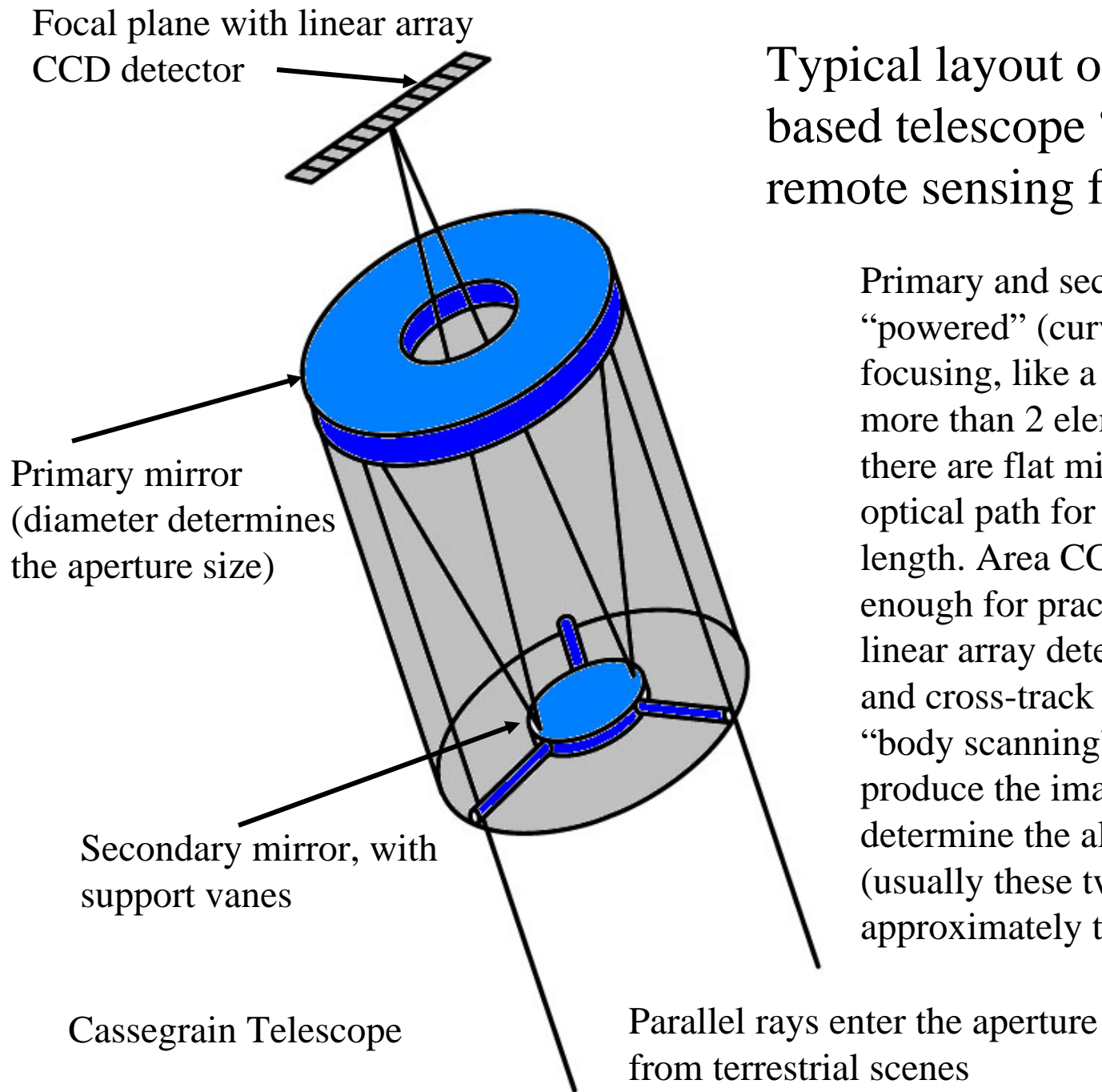
**Original Scene
(without gyro
stabilization)**



Rectified Scene



Linear array
scanning from
aircraft platform
(ADS40)



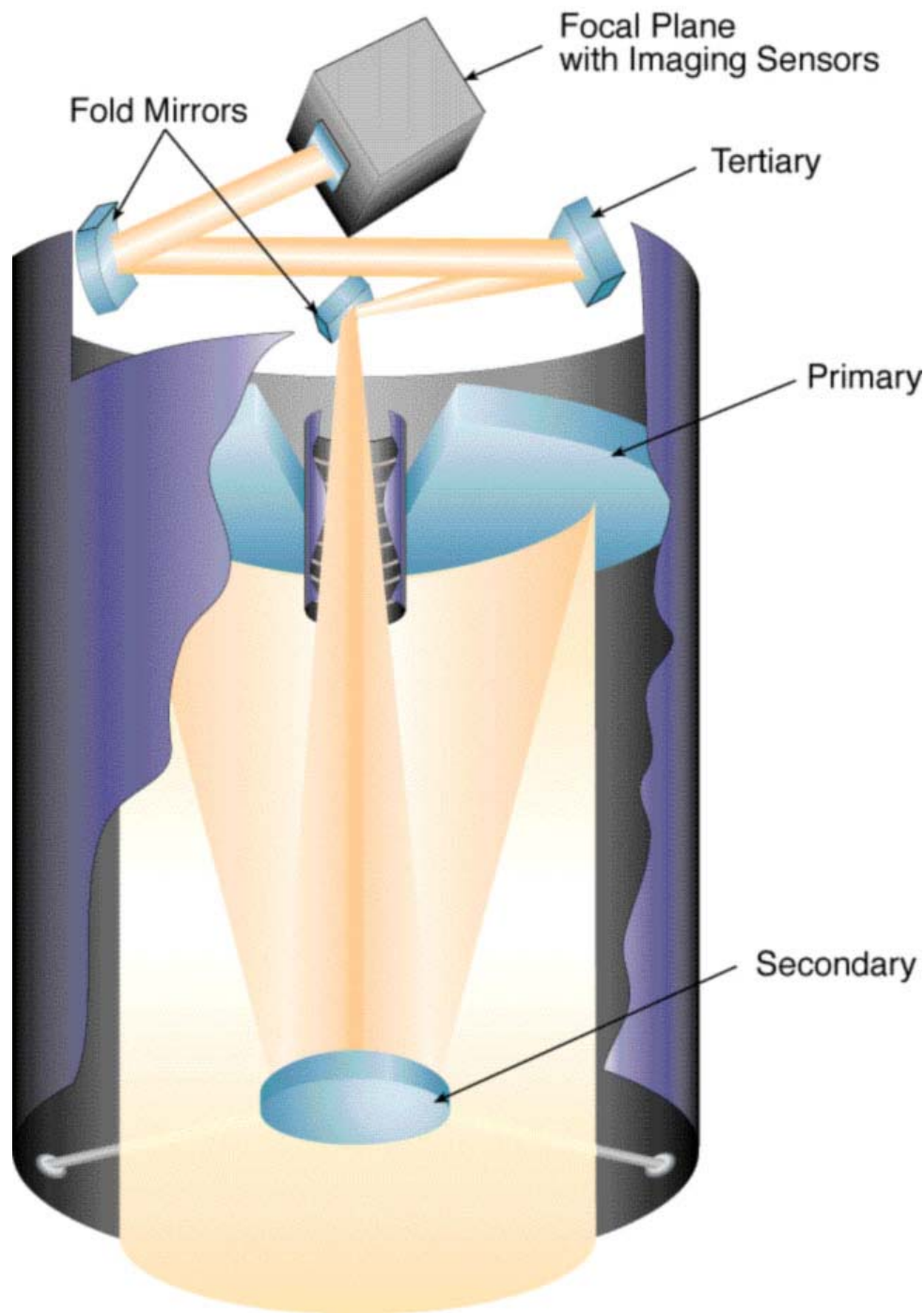
Typical layout of linear sensor based telescope “camera” used for remote sensing from space.

Primary and secondary mirrors are “powered” (curved) and do the focusing, like a lens. There can be more than 2 elements. Sometimes there are flat mirrors to just “fold” the optical path for a needed long focal length. Area CCD arrays are not big enough for practical use. Dimension of linear array determines image “width” and cross-track GSD, orbit motion or “body scanning” plus sampling in time produce the image “length”, and determine the along-track GSD (usually these two GSD’s are approximately the same)

Satellite camera resembles an astronomical telescope more than the conventional notion of a camera



Meade 16" LX200GPS with Permanent Altazimuth Pier. As shown, the telescope fits comfortably inside a 2-meter (7 ft.) dome.



Schematic of IKONOS camera

- Camera made by Kodak
- Cassegrain (Korsch TMA) telescope
- 10 meter focal length
- 12 micrometer detector size
- TDI: 10-32 stages
- 11 bit quantization with APCM compression
- Aperture size 0.7m
- +/- 30 degree pointing
- 13,500 panchromatic pixels (1m), 3375 multispectral pixels (4m)
- 6500 lines / second
- 11-13 km swath width at 680km alt.



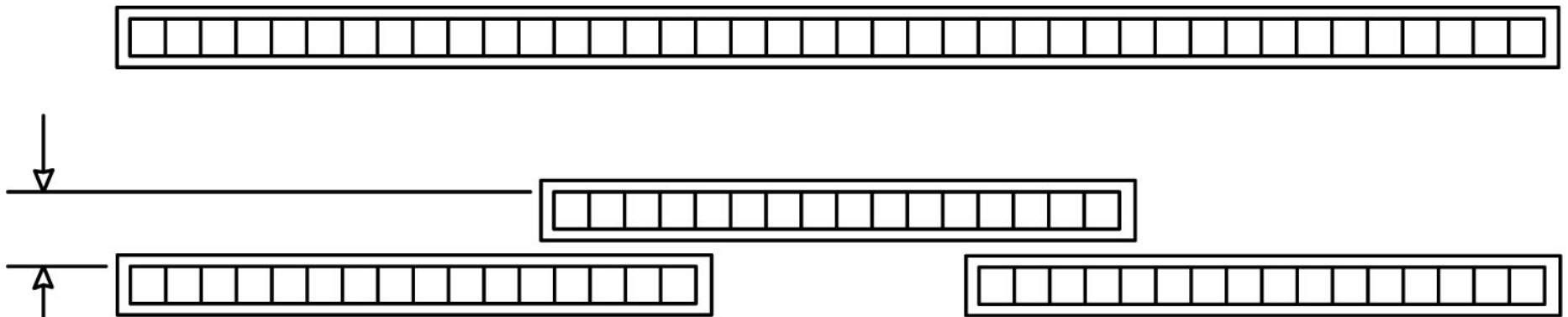
Kodak Model 1000TM commercial version of the IKONOS camera

- Reduced size and mass for fitting into mini-satellites
- ~\$ 1M
- ~ 2 year delivery time

IKONOS focal plane with mechanically displaced linear arrays to simulate 13,500 length, panchromatic, RGB, and near infrared



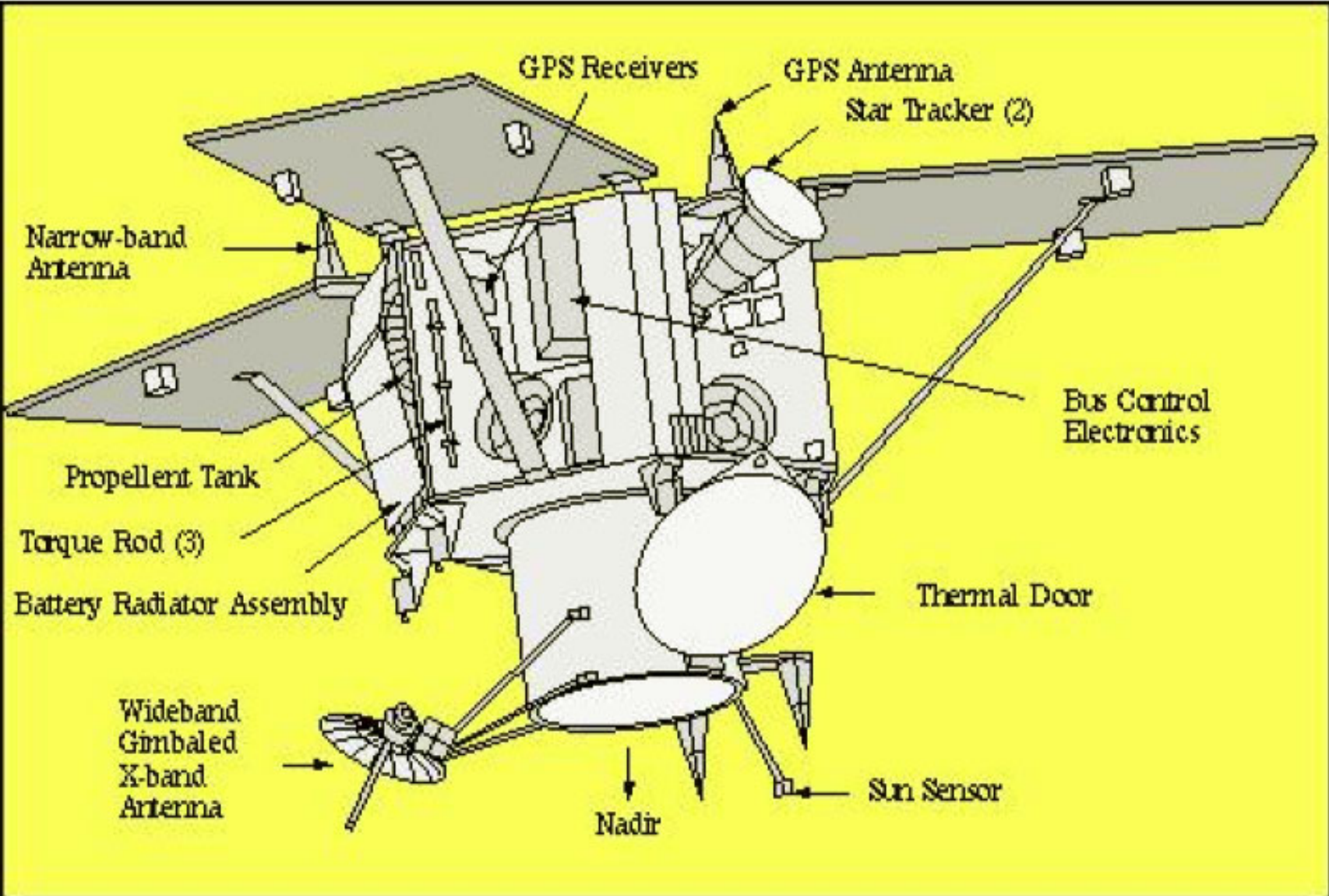
Emulate a continuous 40-pixel linear array with 3 16-pixel arrays, align left-right and displace by integer number of pixel dimensions

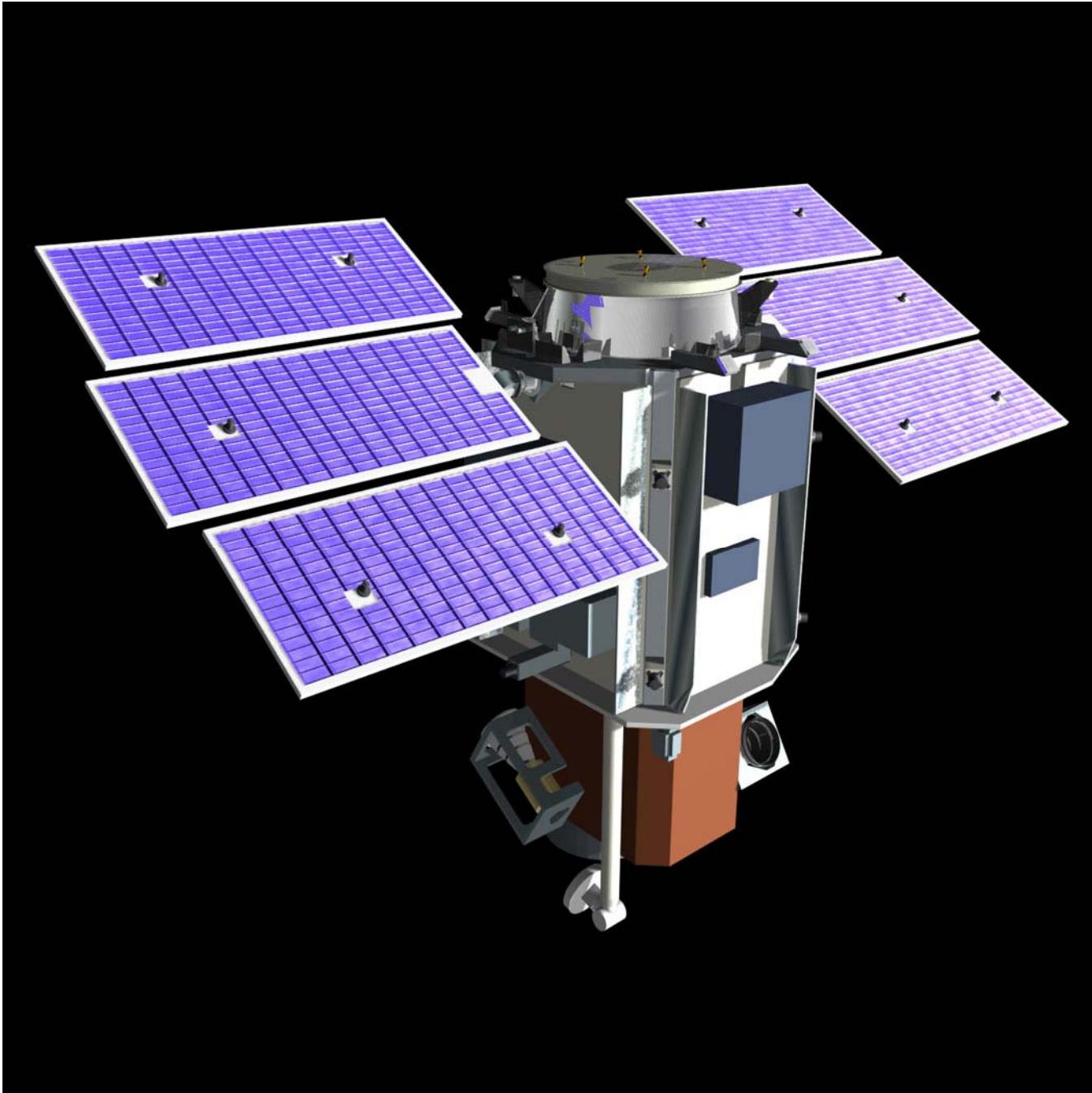


$$n \left(V_{gs} \frac{f}{H} \right) \Delta t$$

Displacement in the focal plane for nadir scanning between linear array segments. V_{gs} is the ground velocity of the viewpoint. n is any integer, for off nadir scanning, may adjust timing.

Schematic of auxiliary components for the IKONOS sensor





Quickbird Spacecraft
and camera yielding
0.6m panchromatic
imagery (operated by
Digital Globe)

Orbview-3, ~1m panchromatic imager, note Orbimage &
Space Imaging merge to form GeoEye (?)



Size Comparison

