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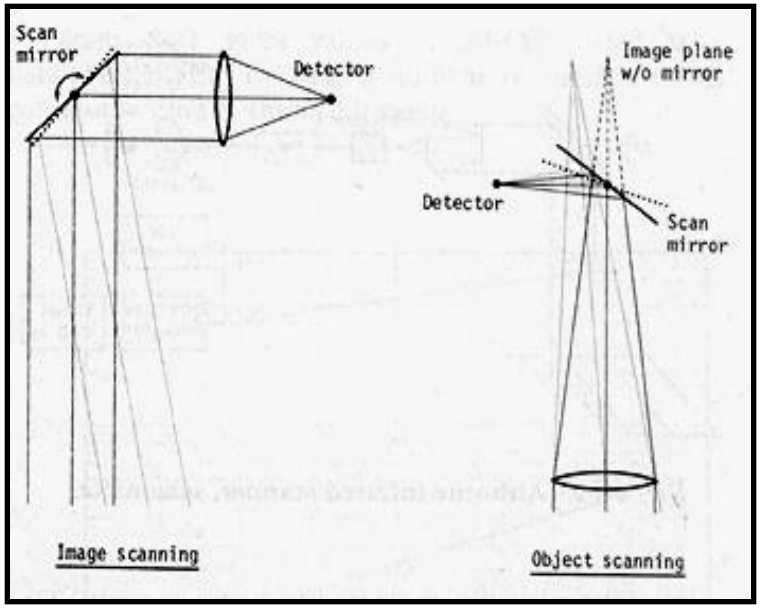
2nd Stage

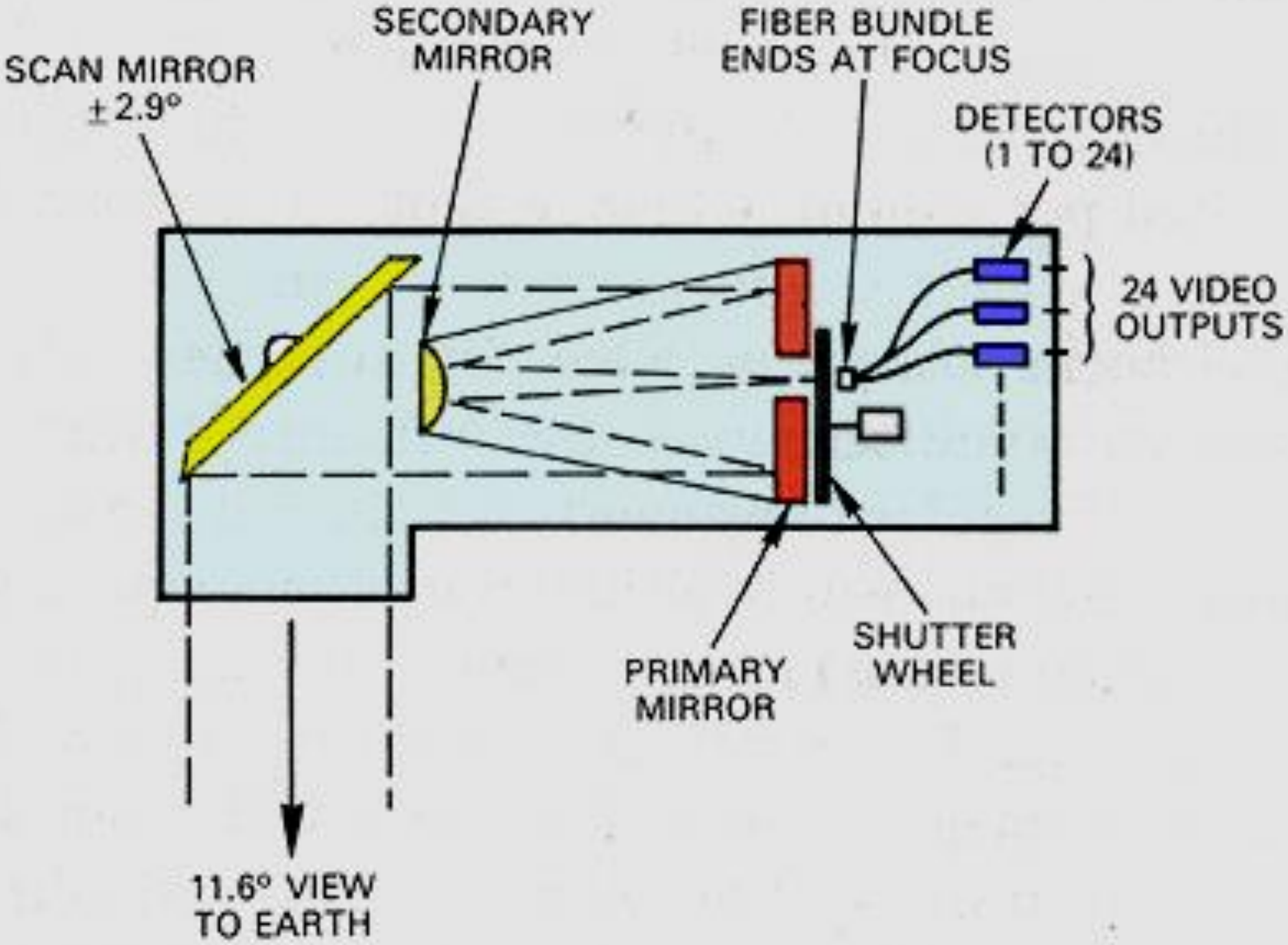
Remote Sensing

Lecture 5 : Satellite operations

The Mechanism of Satellite Recording

The general method of satellite recording to measure the reflected spectrum come from earth surface and the feature above him . This spectrum face the oscillation scan mirror held by satellite sensors . This mirror move oblique toward East – West direction and perpendicular to satellite movement . Each movement period just about some msec. of time , and returned back with same speed .




SCAN MIRROR
±2.9°
SECONDARY
MIRROR
FIBER BUNDLE
ENDS AT FOCUS
DETECTORS
(1 TO 24)
24 VIDEO
OUTPUTS
PRIMARY
MIRROR
SHUTTER
WHEEL
11.6° VIEW
TO EARTH

Each movement of mirror scan ground area about 185 X 185 km.

The reflected spectrum of ground area fall on scan mirror then reflect to satellite primary mirror and to secondary mirror to pass thru shutter wheel which fix the ray of spectral to detectors

The detectors change the ray to digits numbers range between 0 – 255 level depend on the intensity of reflected spectrum .

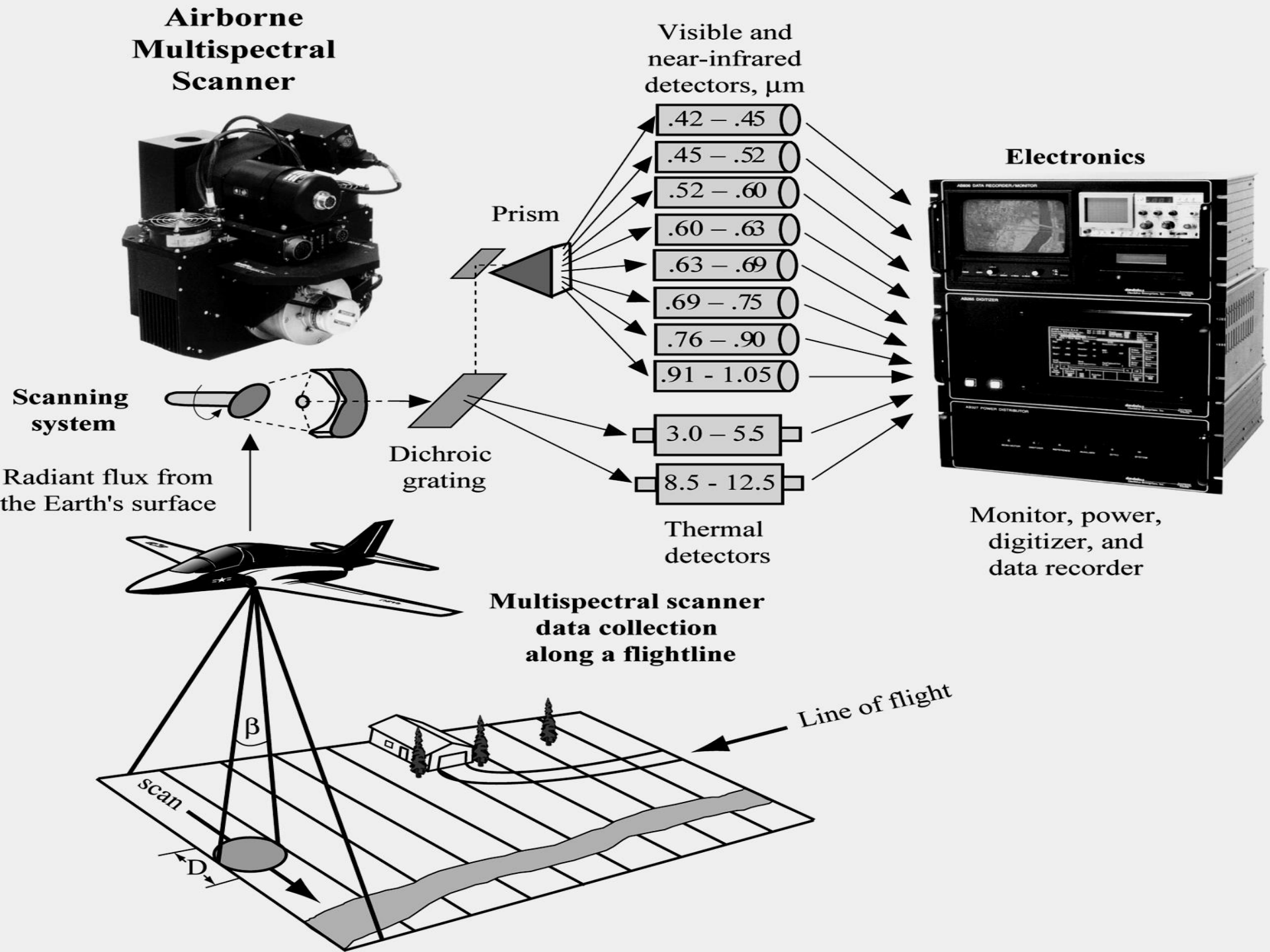
Number of detectors at landsat satellite = 100

6 X 16 = 96 (bands 1,2,3,4,5,7)

1 x 4 = 4 (band 6 Thermal)

After that the prism divide the total ray to bands each with specific wave length depend upon the satellite type .

digits of bands storage at memory units aboard at satellite to send them later to receiving station because of limit memory capacity .


Airborne Multispectral Scanner
Visible and near-infrared detectors, µm
.42 – .45
.45 – .52
.52 – .60
.60 – .63
.63 – .69
.69 – .75
.76 – .90
.91 - 1.05
Prism
Electronics
Scanning system
Dichroic grating
3.0 – 5.5
8.5 - 12.5
Radiant flux from the Earth's surface
Thermal detectors
Monitor, power, digitizer, and data recorder
Multispectral scanner data collection along a flightline
Line of flight
β
scan
D

Transmission of Data from Satellite

Receiving stations capture digital data transmitted by satellite with many types of techniques

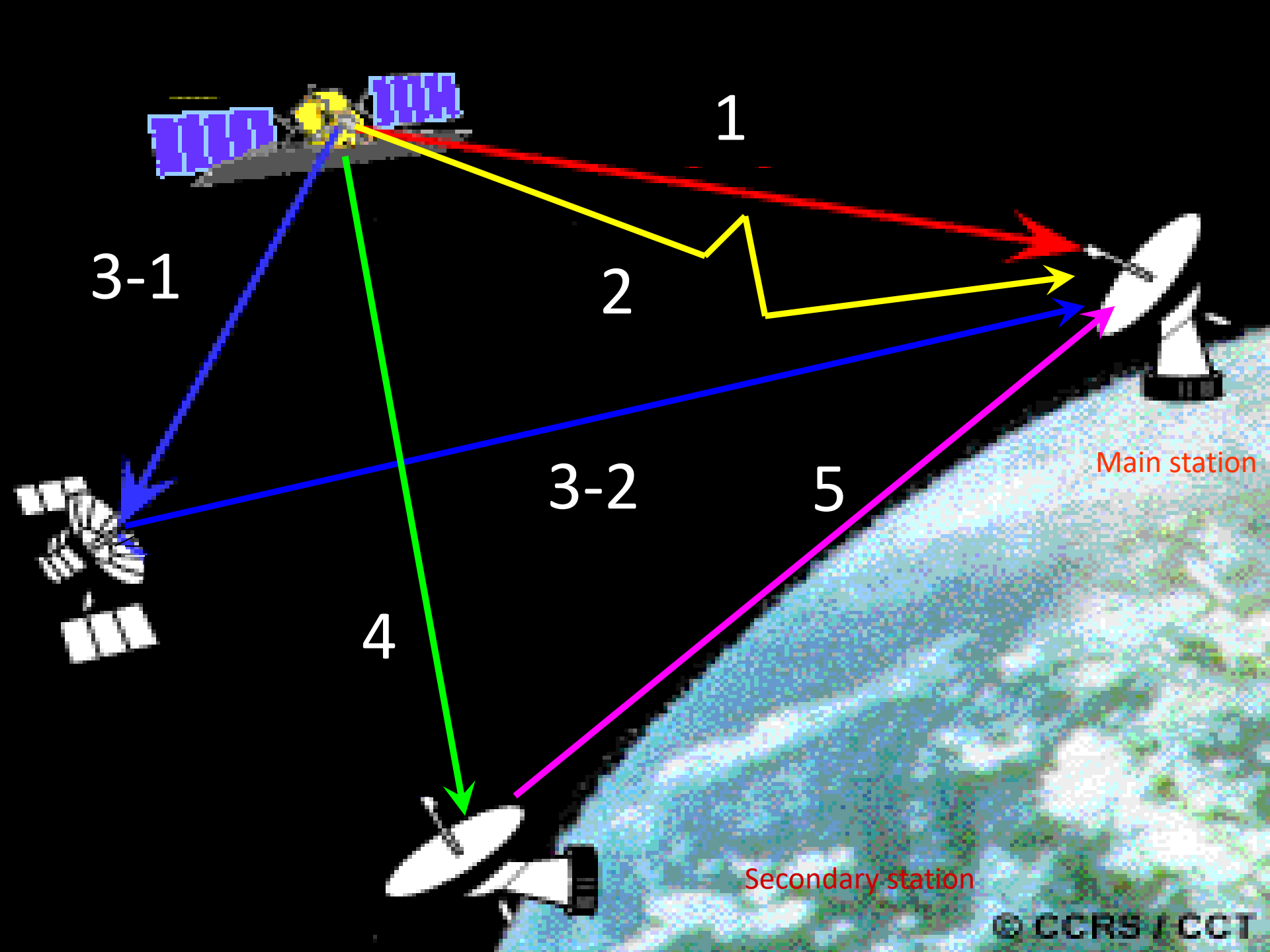
1 - direct if Ground Receiving Station (GRS) visible

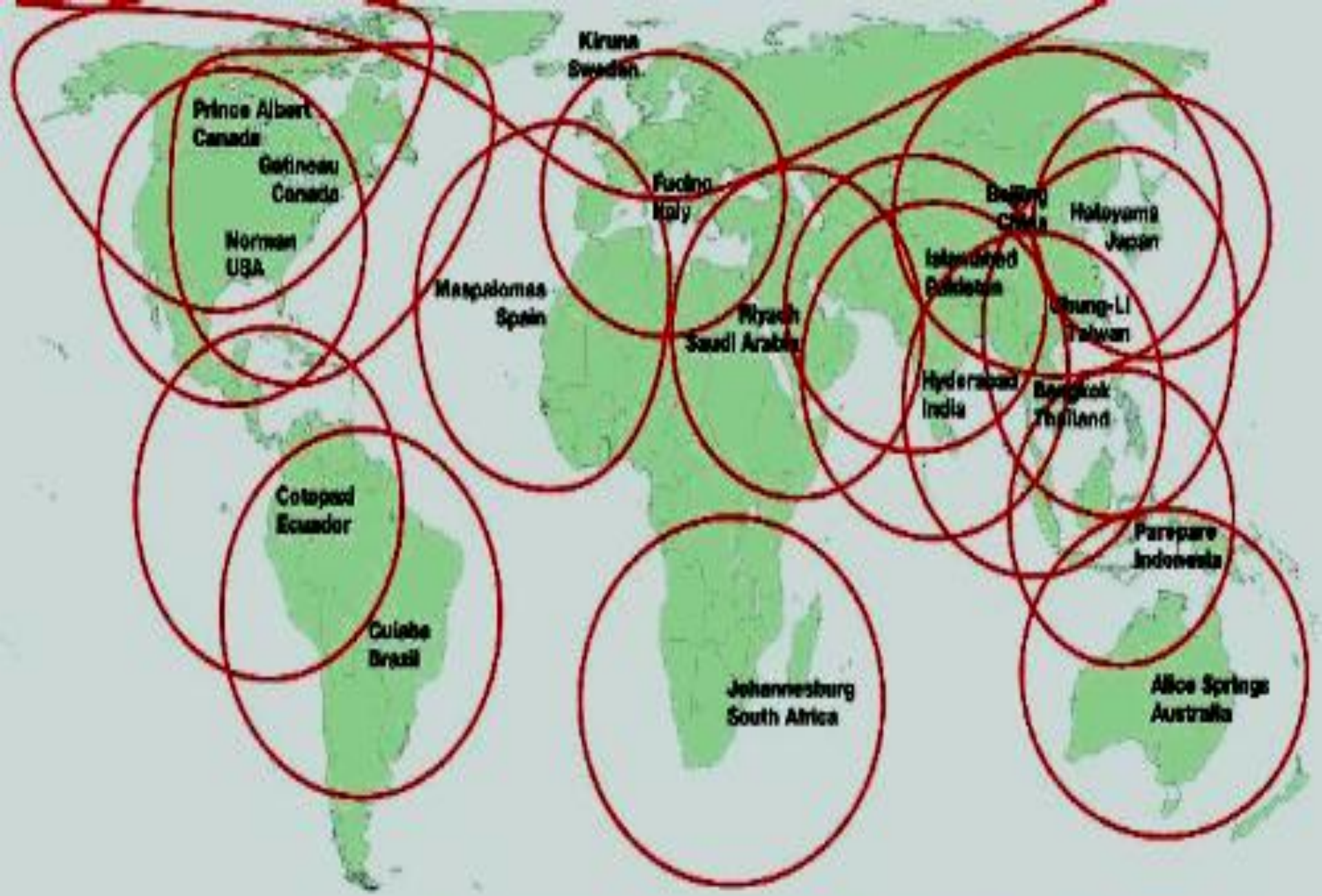
2 – store the data then transmit when become within the range of receiving station

3 – when the satellite out of range of receiving station it will transmit the data to another satellite with location near the receiving station and transmit the data to it

4 – when the satellite out of range of main station it may transmit the data to another secondary station

5 – the secondary station can transmit the data to the main station


1
2
3-1
3-2
4
5
Main station
Secondary station
©CCRS/CCT



Range of receiving station around the world

Landsat satellite

American satellite specialize with natural resources

First generation lunched at 1972 with names Landsat 1 , 2 , 3 .

This series of satellites carried aboard MSS (multispectral scanner) Record 4 bands as below:

spectral bands at MSS 4 = 0.5 - 0.6 μm (green)

MSS 5 = 0.6 - 0.7 μm (red)

MSS 6 = 0.7 - 0.8 μm (photo-IR),

MSS 7 = 0.8 - 1.1 μm (near-IR).

The resolution of that series 79 m or in general 80 m

And each 18 day return back to same path

The full seen cover 185 * 185 km.

Height 705 Km.

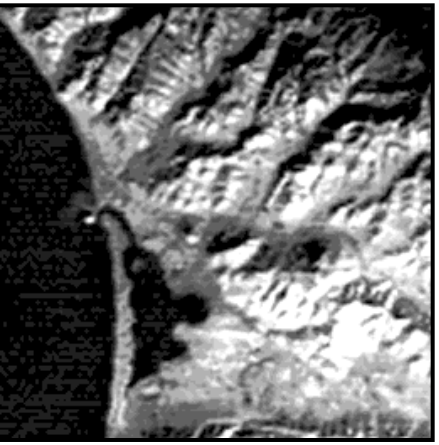
more advanced multispectral imaging sensor, named the Thematic Mapper (TM) has been added to Landsats 4 (1982), 5 (1984), and 6 (this last failed to attain orbit during launch and thus has never returned data) and a modified version to Landsat-7 (1999). These TMs flew on redesigned, more advanced platforms, the first of which, Landsat-4,

Band No.	Wavelength Interval (µm)	Spectral Response	Resolution (m)
1	0.45 - 0.52	Blue-Green	30
2	0.52 - 0.60	Green	30
3	0.63 - 0.69	Red	30
4	0.76 - 0.90	Near IR	30
5	1.55 - 1.75	Mid-IR	30
6	10.40 - 12.50	Thermal IR	120
7	2.08 - 2.35	Mid-IR	30

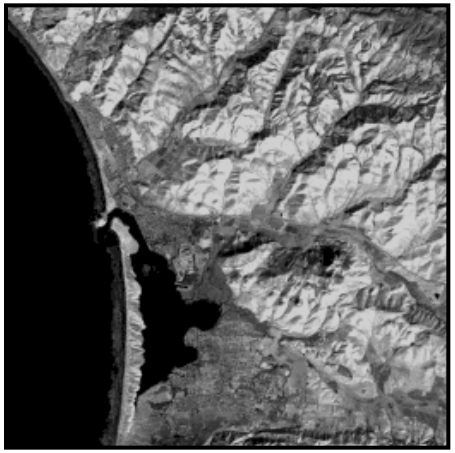
TM 1

TM 2

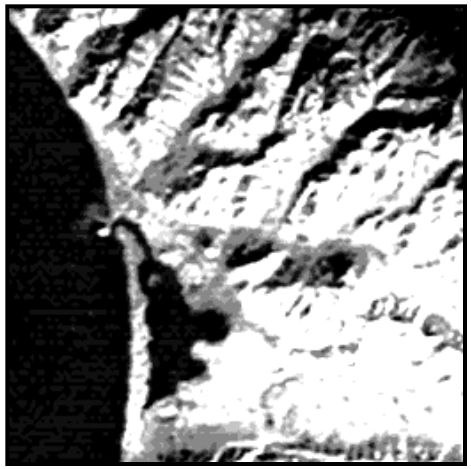
TM 3



TM 4



TM 5



TM 6

The same area with different appearance according to the wavelength

TM 7

The resolution of these series 30 m. for all bands except band 6 that 120m.

Every 16 day come back to same path

Height 705 Km.

The third generation Landsat 6 , 7 Enhancement Thematic Mapper (ETM) have resolution 25 m. and one of bands with 15 m. (Black and white)

With 8 bands

1,2,3 band visible

4, 5 band infrared

6 L , 6 H thermal

7 near infrared

References

IMAGE INTERPRETATION IMAGE INTERPRETATION , Seventh Edition, Lillesand T. M., Kiefer R. W., Chipman J. W., WILEY press , USA , 2015

Earth Science Satellite Remote Sensing Vol. 1: Science and Instruments , Qu J. J., Gao W. , Kafatos M. , Murphy R. E, Salomonson V. V., Tsinghua University Press, Beijing and Springer-Verlag GmbH Berlin Heidelberg . 2006

Internet Remote Sensing Lectures sites