

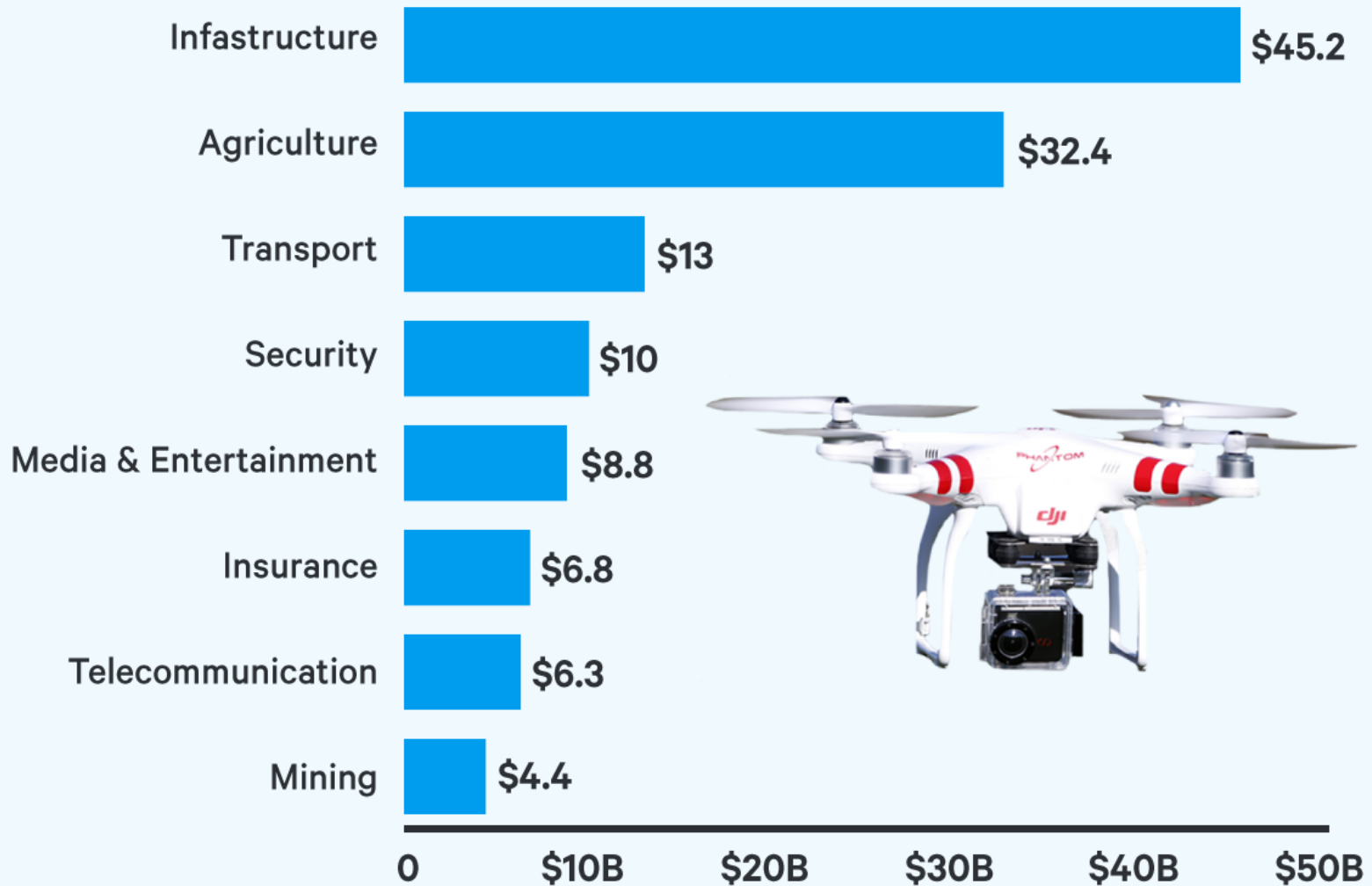


The Potential of UAV Imagery in Research and Decision Making

Dr. Asmala Ahmad & Mr. Yazid Abu Sari

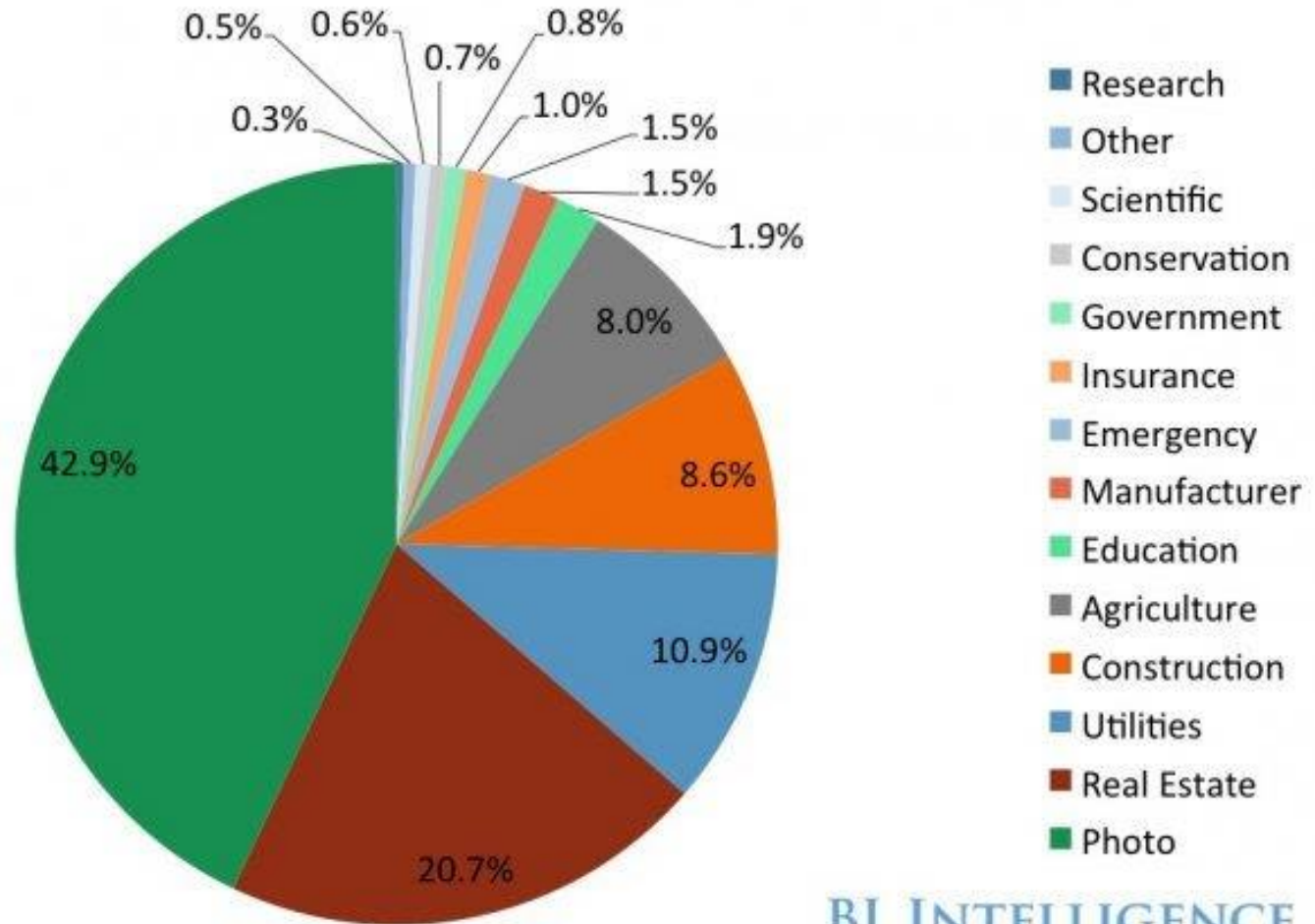
Predicted value of drones by industry

Value of business services and labor in billions



Top Industries Using Drones

% Of Section 333 Exemptions Issued in US



Source: FAA, The Verge Drone Project, 2015

BI INTELLIGENCE

What is UAV?

- An unmanned aerial vehicle: an **aircraft** piloted by **remote control** or **onboard computers**
- Term used since 1980s

(Oxford University Press, 2018)

Difference between UAV and Drone

UAV	Drone
<ul style="list-style-type: none">•An unmanned aerial vehicle: an aircraft piloted by remote control or onboard computers	<ul style="list-style-type: none">•A continuous low humming sound.•A continuous musical note of low pitch.•A male bee in a colony of social bees, which does no work but can fertilize a queen.•A remote-controlled pilotless aircraft or missile.

(Oxford University Press, 2018)

Difference between UAV and Drone

UAV	Drone
<p>•An unmanned aerial vehicle: an aircraft piloted by remote control or onboard computers</p> <p>Google search: 21.1 millions results</p>	<ul style="list-style-type: none">•A continuous low humming sound.•A continuous musical note of low pitch.•A male bee in a colony of social bees, which does no work but can fertilize a queen.•A remote-controlled pilotless aircraft or missile. <p>Google search: 184 millions results</p>

(Oxford University Press, 2018)

Difference between UAV and Drone

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(Oxford University Press, 2018)

UAV Research Opportunities

- Payloads – Maximum weight a UAV can carry?
- Duration – Maximum time a UAV can fly?
- Intelligence – How clever a UAV is?
- Data acquisition – What type of data can be captured?
- Data analytics – What can we do with the **remotely sensed** data captured by a UAV?

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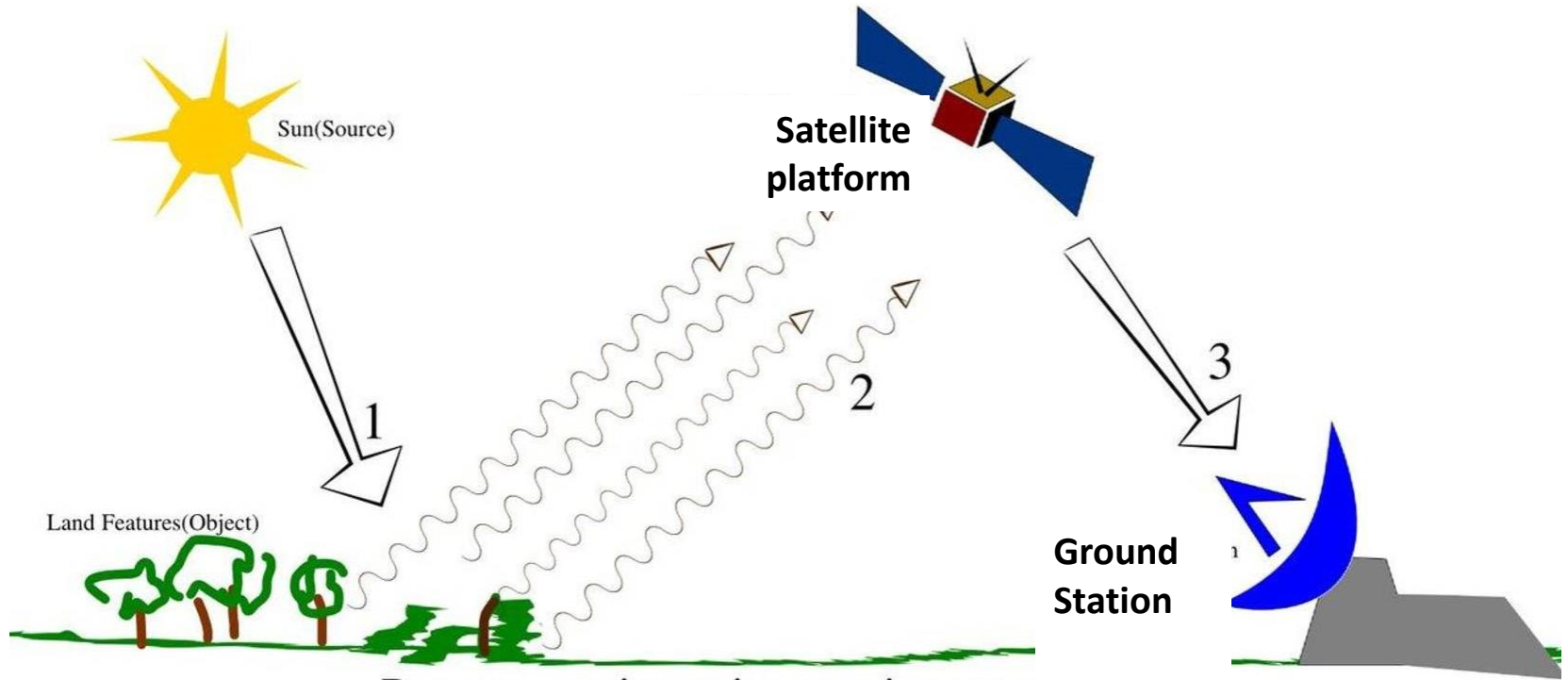
What is Remote Sensing?

- The scanning of the earth by satellite or high-flying aircraft in order to obtain information about it. (Oxford University Press, 2018)
- The science and art of obtaining information about an object, area, or phenomenon through the analysis of data acquired by a device that is not in contact with the object, area or phenomenon under investigation (Lillesand & Kiefer, 2000)

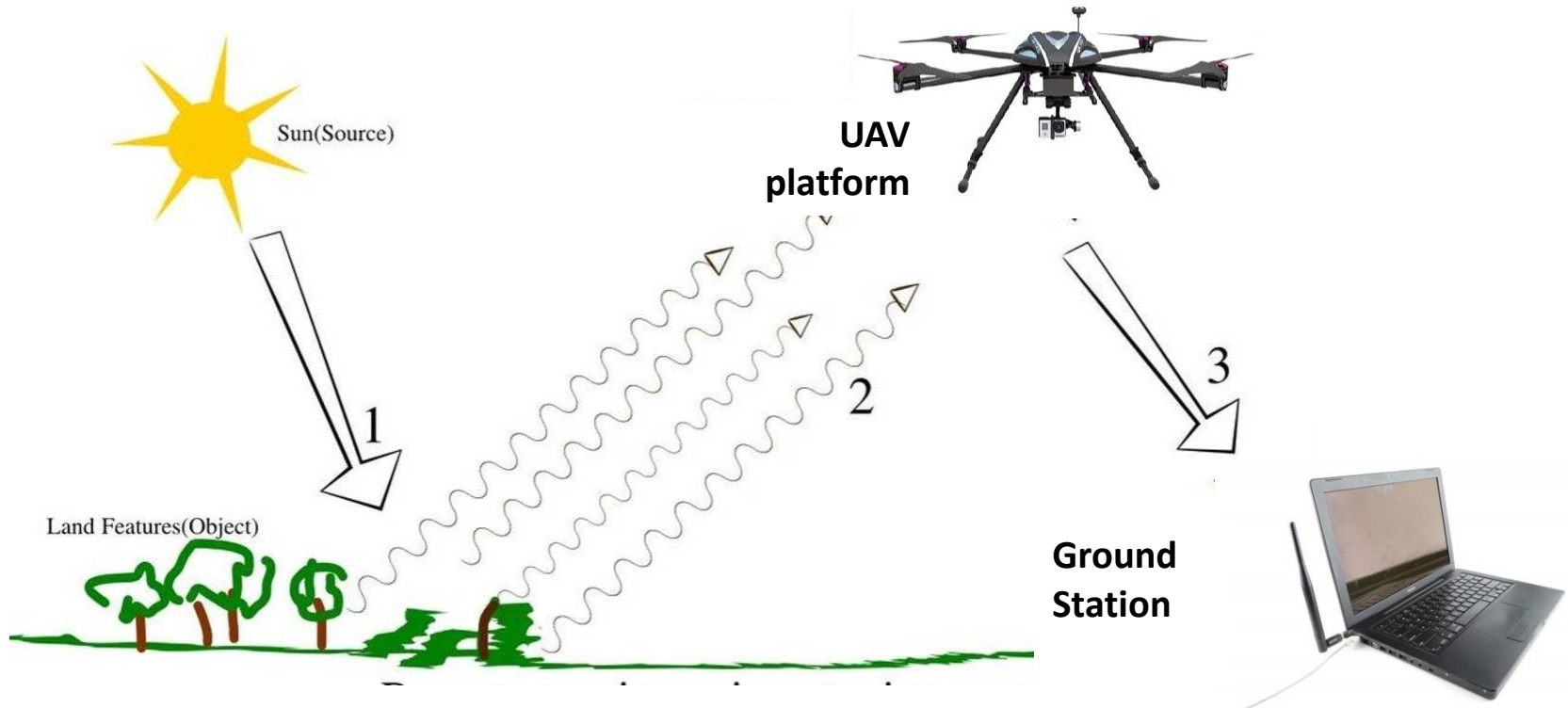
Remote Sensing Components

1. Platform
2. Ground Station
3. Source of Energy

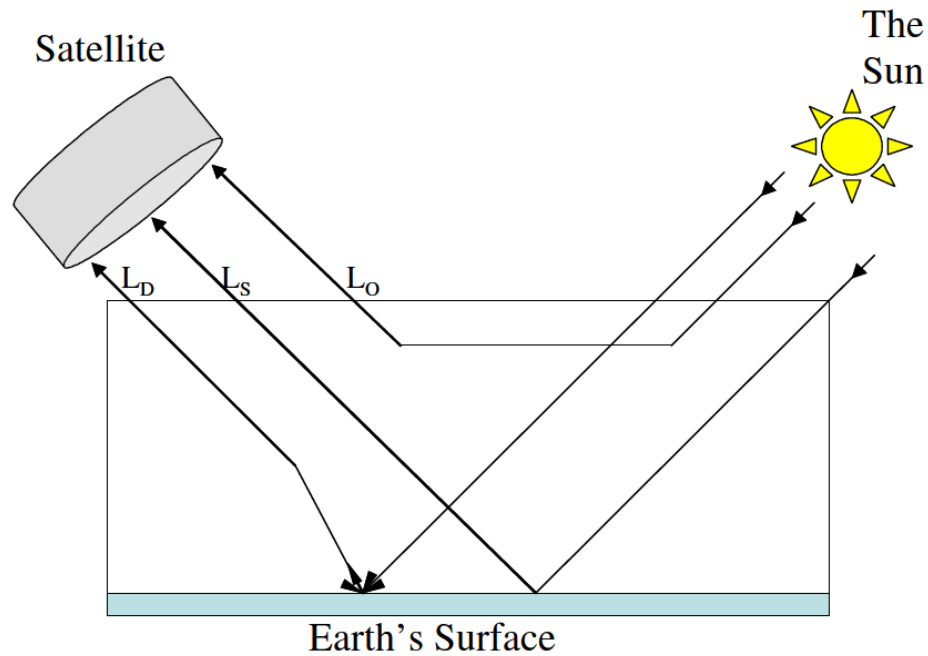
Remote Sensing from Satellite Platform



Remote Sensing from UAV Platform



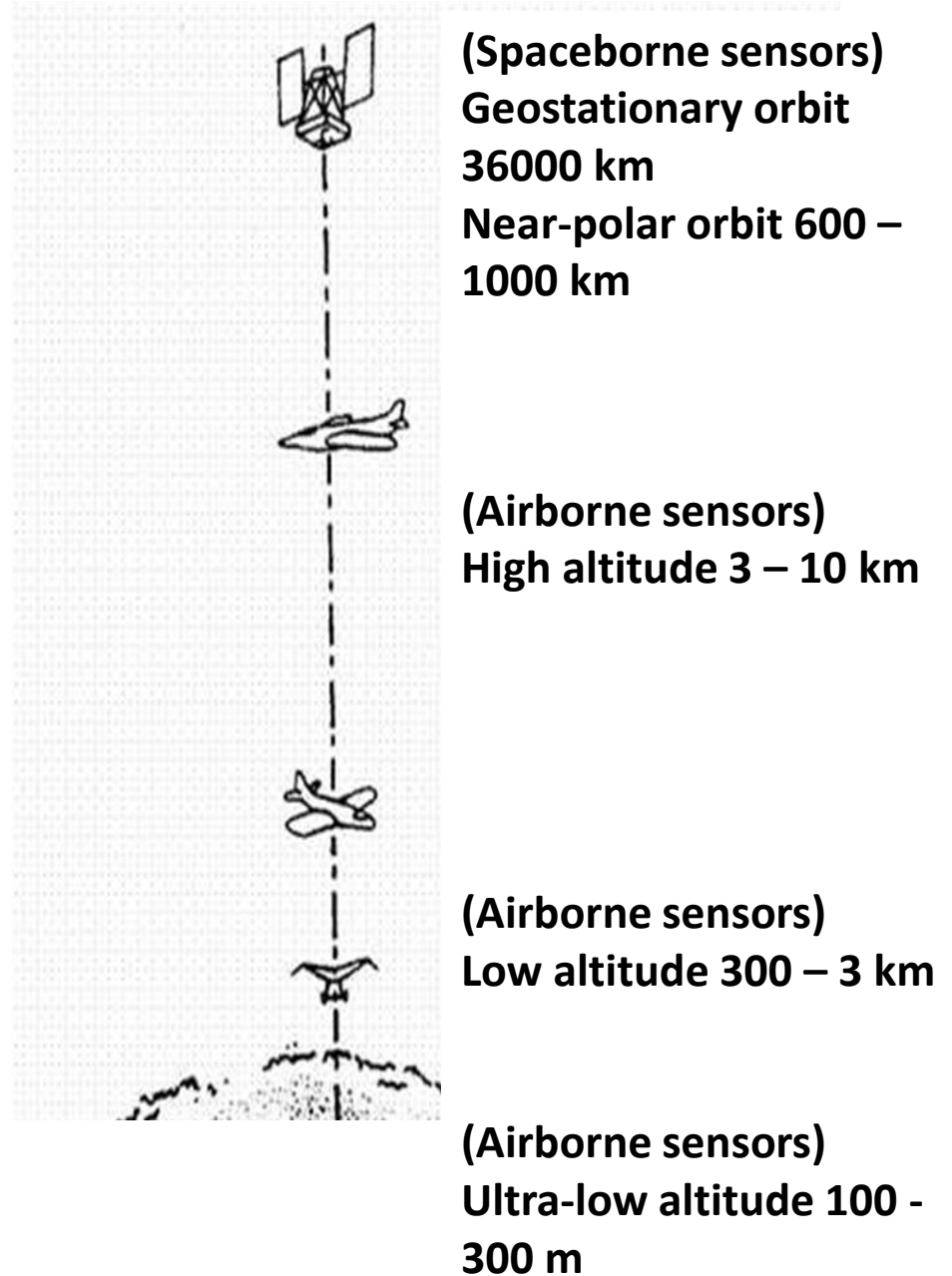
Radiation Paths



*Contribution of paths to the upward radiance for a clear atmosphere
(Kaufman and Sendra 1988).*

$$L = L_S + L_D + L_O$$

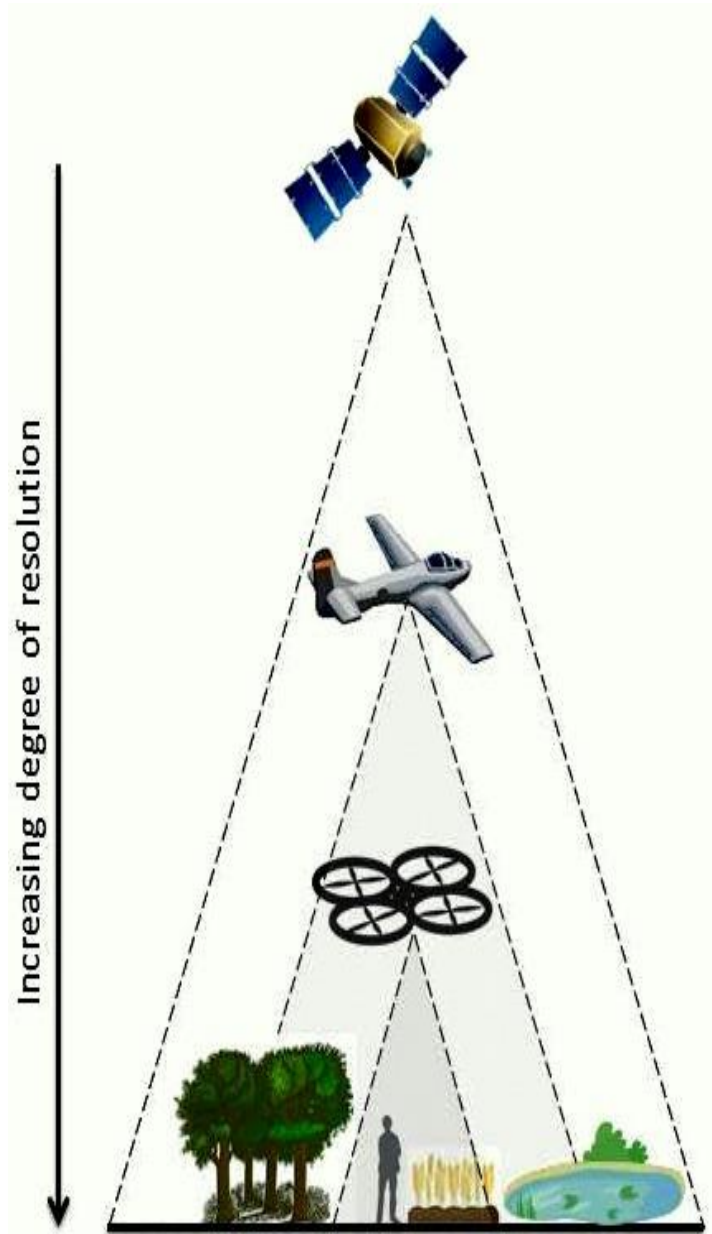
Evolution of Remote Sensing Systems



Important Terms in Remote Sensing

- **Spatial** resolution – The smallest possible feature that can be detected
- **Spectral** Resolution – Bands within Electromagnetic Spectrum used in capturing image
- **Radiometric** Resolution – Grey levels possessed by each pixel of the captured image
- **Temporal** Resolution – The frequency of image capturing for an area of interest

Spatial Resolution



Spatial Resolution



Drone Imagery

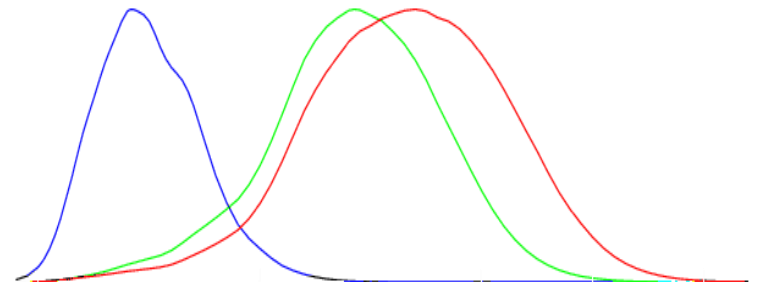
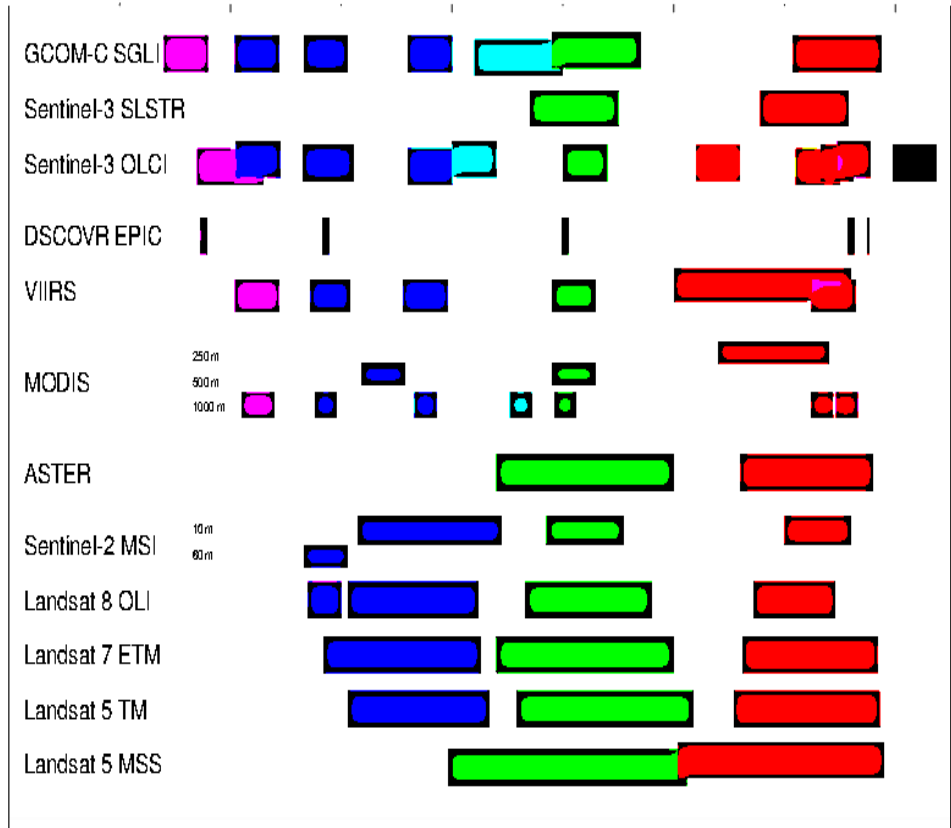
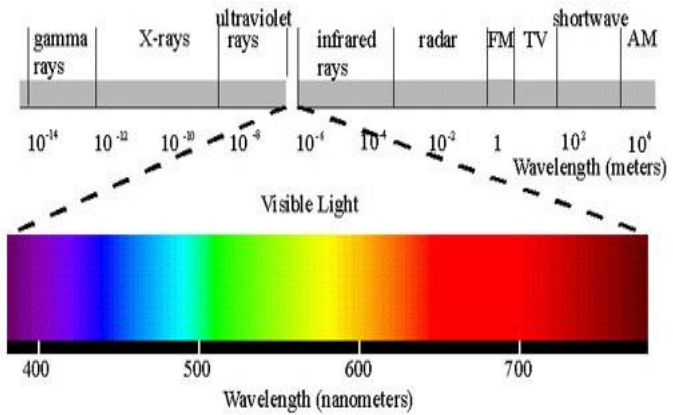
Imagery Data: [Swinglet CAM UAV](#)
Imagery Dates: 10 February 2012
Resolution: 5 cm
Copyright: UNITAR / UNOSAT 2012
Analysis: UNITAR / UNOSAT



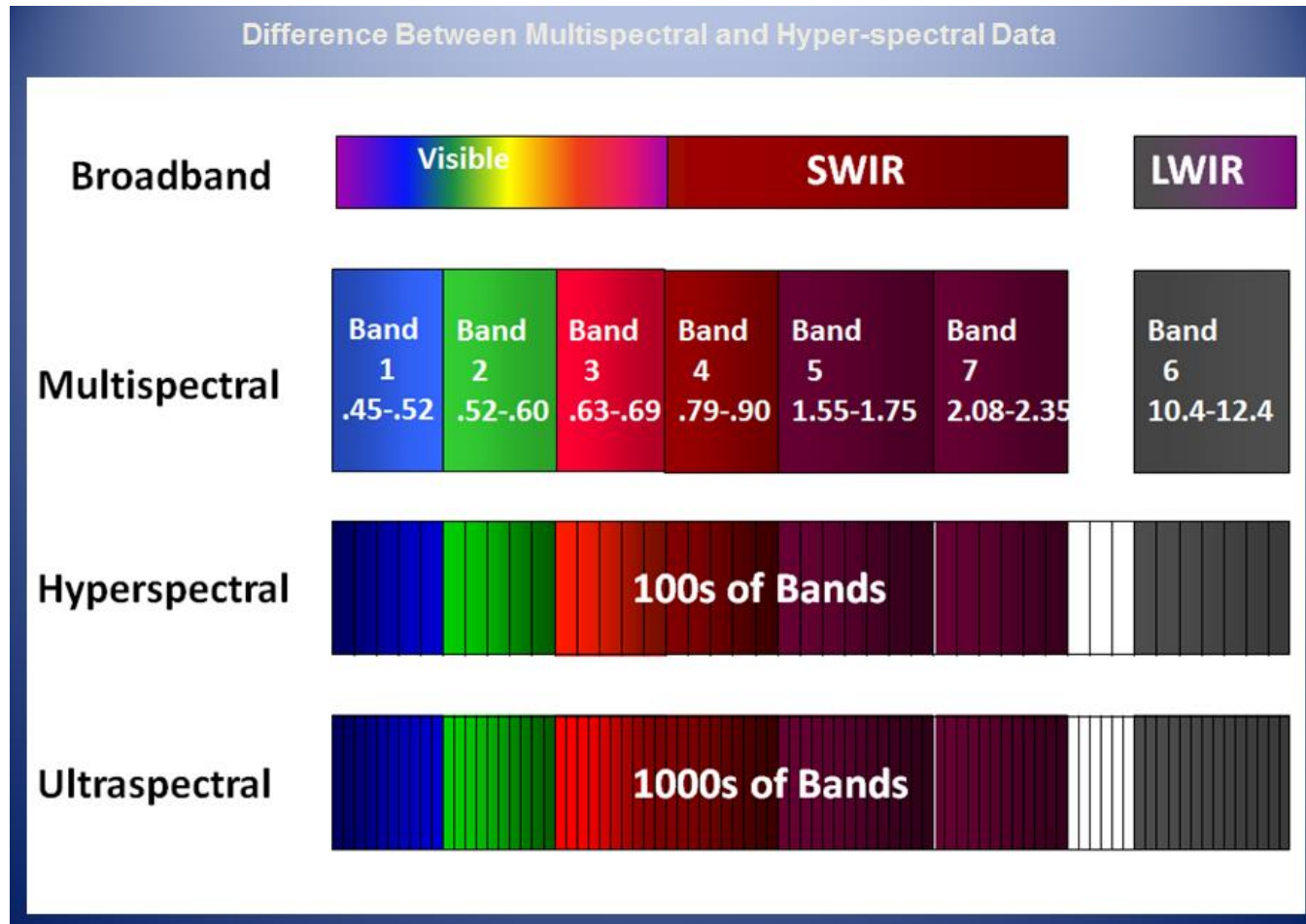
Satellite imagery

Imagery Data: [DigitalGlobe WorldView-02](#)
Imagery Dates: 8 February 2012
Resolution: 50 cm
Copyright: 2012 [DigitalGlobe](#)
Analysis: UNITAR / UNOSAT

Spectral Resolution



Spectral Resolution

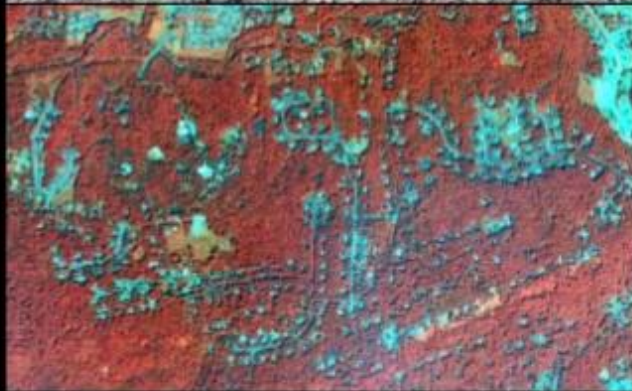


Spectral Resolution

IKONOS Imagery Sample: Bound Brook NJ

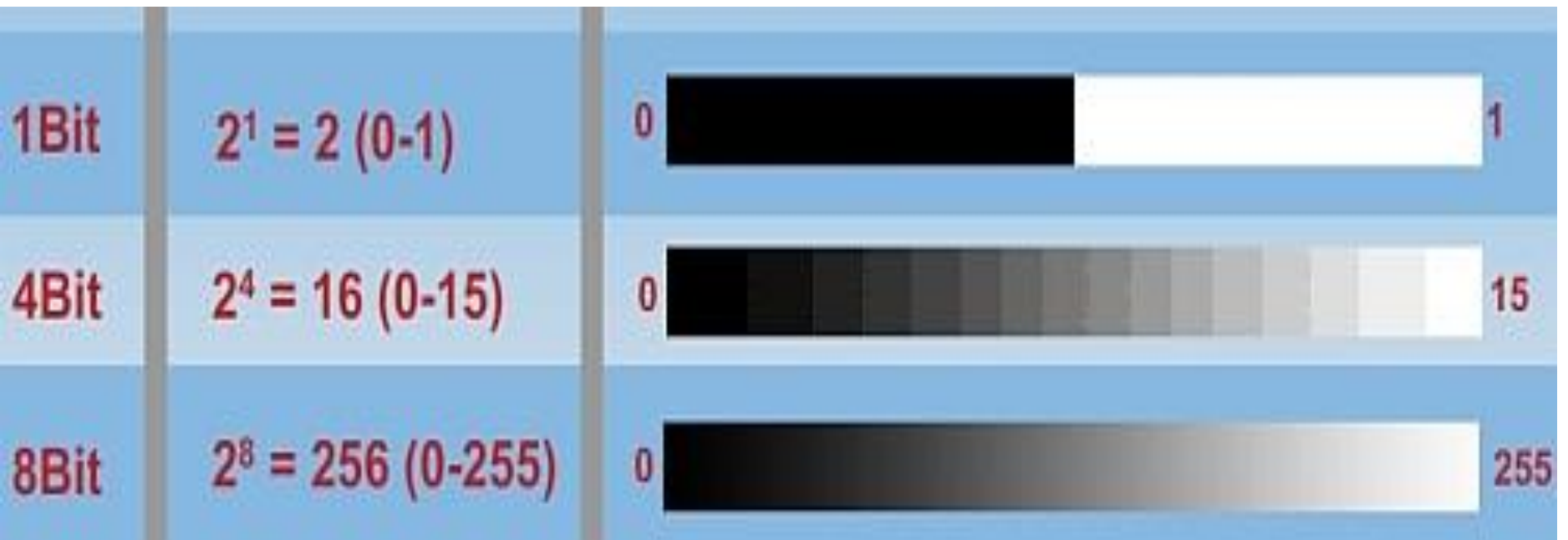


1 m panchromatic



4 m multi-spectral

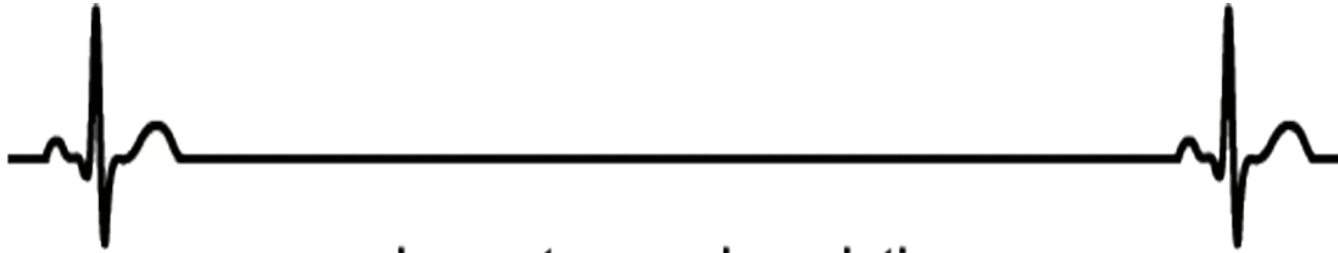
Radiometric Resolution



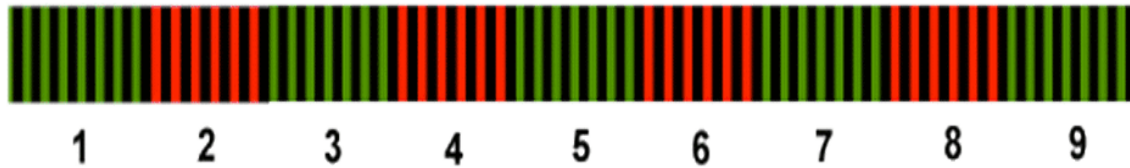
Radiometric Resolution



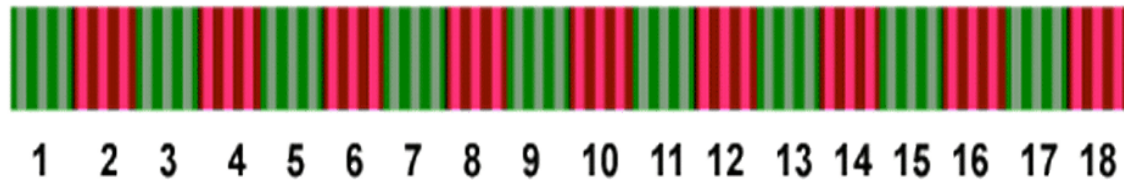
Temporal Resolution



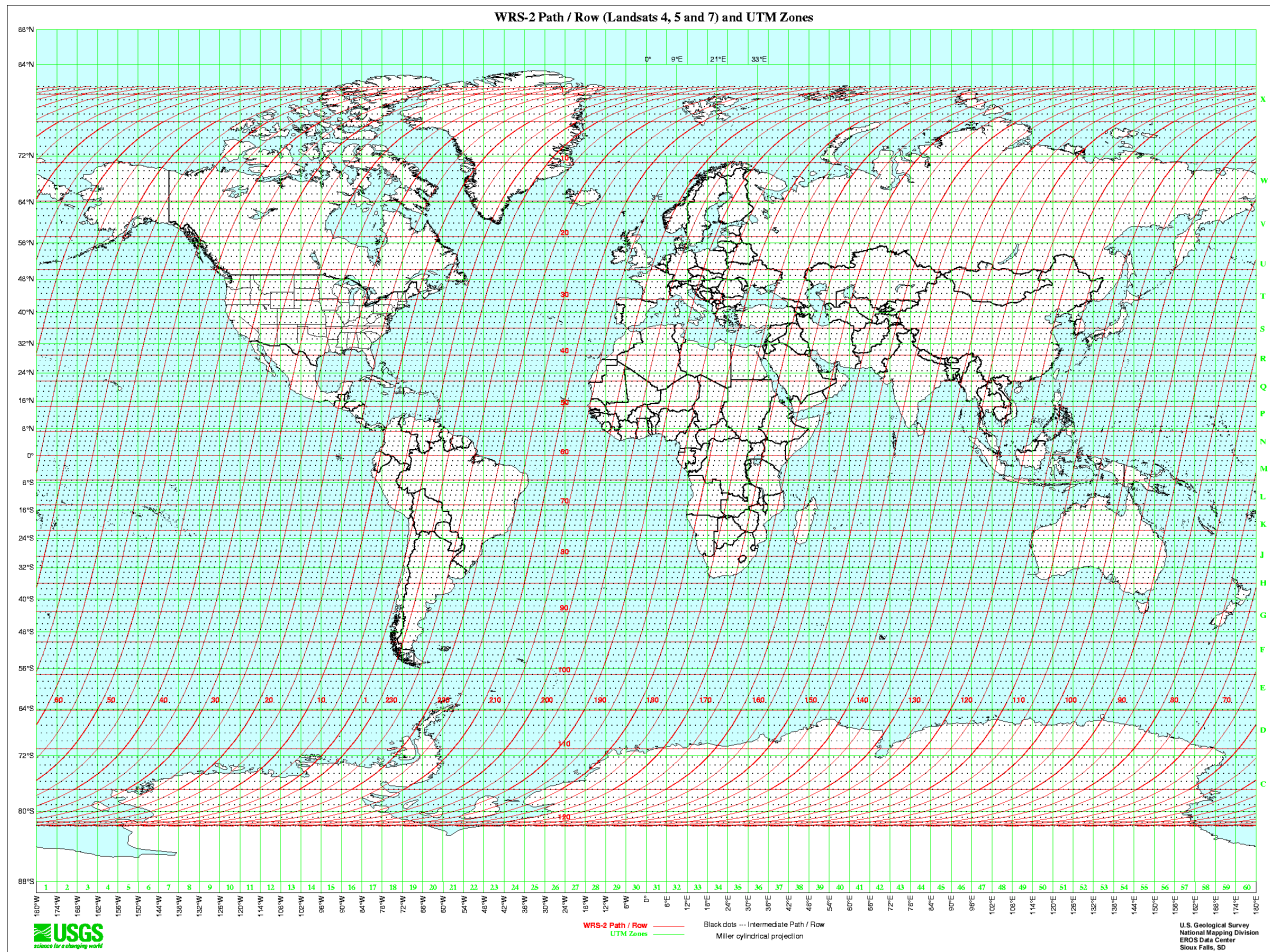
Lower temporal resolution



Higher temporal resolution

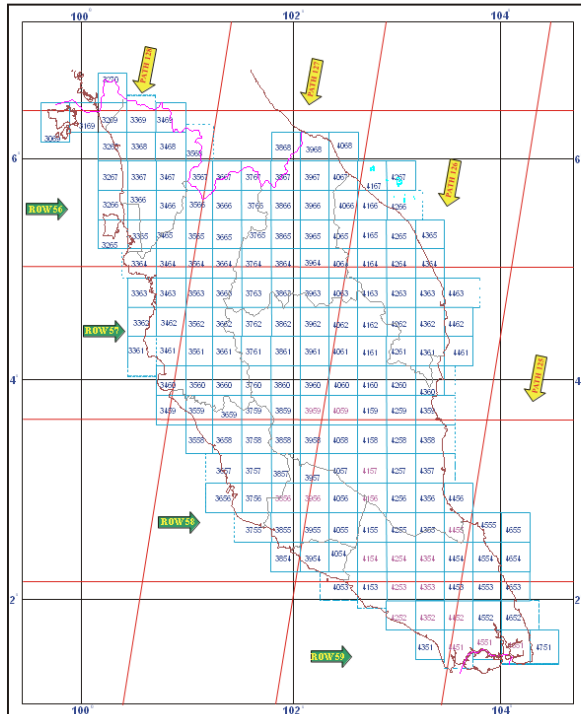


Temporal Resolution



Temporal Resolution

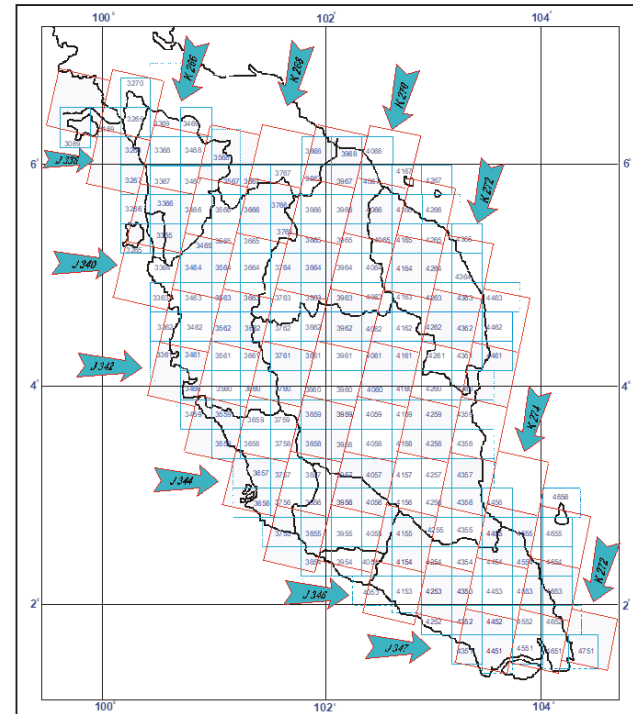
REFERENCE TOPO MAP SERIES 7030 / LANDSAT INDEX (TM)
OF PENINSULAR MALAYSIA



SERIES : L 7030 PENINSULAR MALAYSIA SKILL 1: 50 000	LEGEND [4351] SHEET NUMBER/ PUBLISHED [4351] NOT PUBLISHED — PATH / ROW
LANDSAT INDEX(TM) PENINSULAR MALAYSIA	

Produced by
Cartography Laboratory

REFERENCE TOPO MAP SERIES 7030 / SPOT INDEX
OF PENINSULAR MALAYSIA



SERIES : L 7030 SCALE : 1: 50 000 PENINSULAR MALAYSIA	LEGEND [4351] SHEET NUMBER/ PUBLISHED — PATH / ROW
SPOT PENINSULAR MALAYSIA	

Produced by
Cartography Laboratory

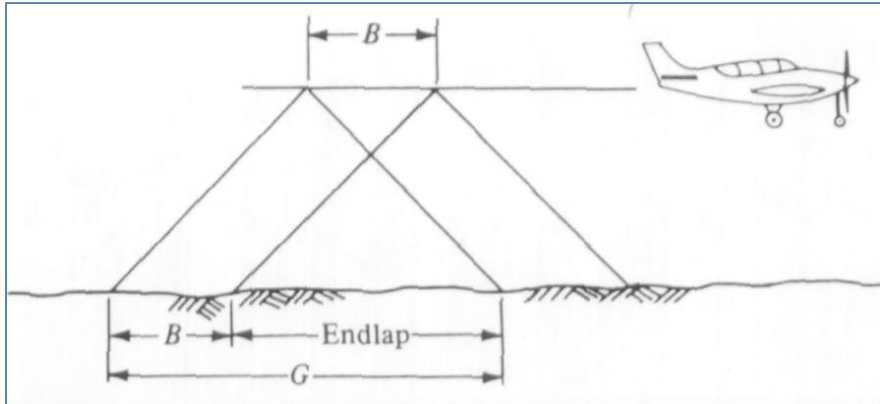
Satellite vs UAV

	Satellite	UAV
Spatial Resolution	30m (Landsat) 10m (SPOT) 1m (Ikonos) 0.6m (Quickbird)	Altitude dependent & Sensor dependent 4cm at 120 m using Canon 12MP
Spectral Resolution	Multispectral Hyperspectral	Multispectral
Radiometric Resolution	16 bit (Landsat) 12 bit (SPOT)	8 bit using Canon 12MP
Temporal Resolution	16 days (Landsat) 2-3 days (SPOT)	User dependent (full autonomy)

Basics of Photogrammetry

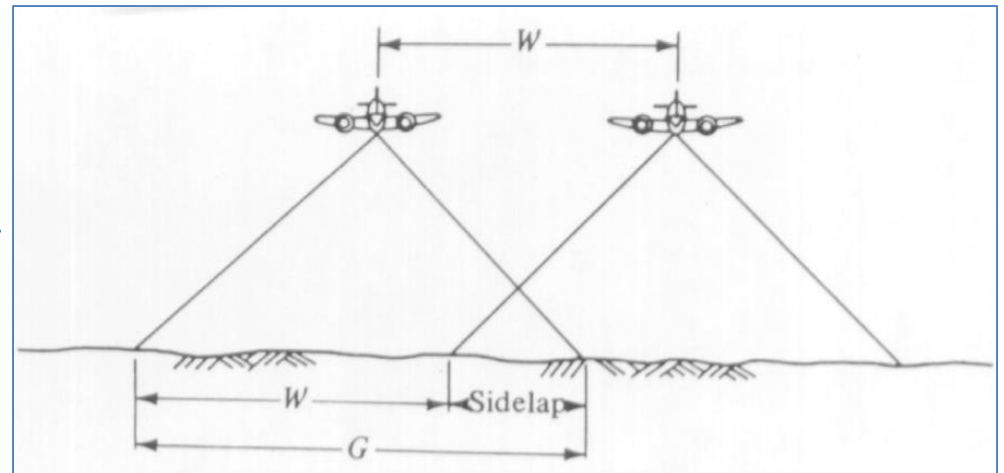


Two Key Conditions for Image Overlapping



← (1) Forward Lap 70%

(2) Side Lap 65% →





8 m/s

Speed merely follows the parameter setting in mission planning



9 m/s

Speed varies according to ground elevation

NORMAL WAYPOINT

Survey (Grid)

Faculty Of Electronics And Computer...
Maia
Pesisiran Imuan
Computer Centre Cim & Icnet

Simple Grid Options Camera Config

Simple Options

Camera CANON S100-Betul

Altitude (m) 110

Angle [deg] 180

Camera top facing forward

Flying Speed (est) (m/s) 15

Use speed for this mission

Add Takeoff and Land WP's

Use RTL

Split into x segments 1

Display

Boundary

Markers

Grid

Internals

Footprints

Advanced Options

Control-S to save to file
Control-O to load from file

Accept

©2017 Google - Map data ©2017 Tele Atlas, Imagery ©2017 TerraMetrics

Stats

Area:	116831 m ²	Pictures:	60	Flight Time (est):	4:01 Minutes
Distance:	2.9 km	No of Strips:	6	Photo every (est):	3.15 Seconds
Distance between images:	47 m	Footprint:	157.4 x 118 m	Turn Dia (at 45d):	66 m
Ground Resolution:	3.93 cm	Dist between lines:	47.22 m	Ground Elevation:	45-105 m

PEAK COMPENSATION

Survey (Grid)

Faculty Of Electronics And Computer...
Computer Centre Grim & Icnnet
Persiaran Ilmuan
Mata

Simple Grid Options Camera Config

Simple Options

Camera CANON S100-Betul

Altitude (m) 80

Angle [deg] 180

Camera top facing forward

Flying Speed (est) (m/s) 15

Use speed for this mission

Add Takeoff and Land WP's

Use RTL

Split into x segments 1

Display

Boundary

Markers

Grid

Internals

Footprints

Advanced Options

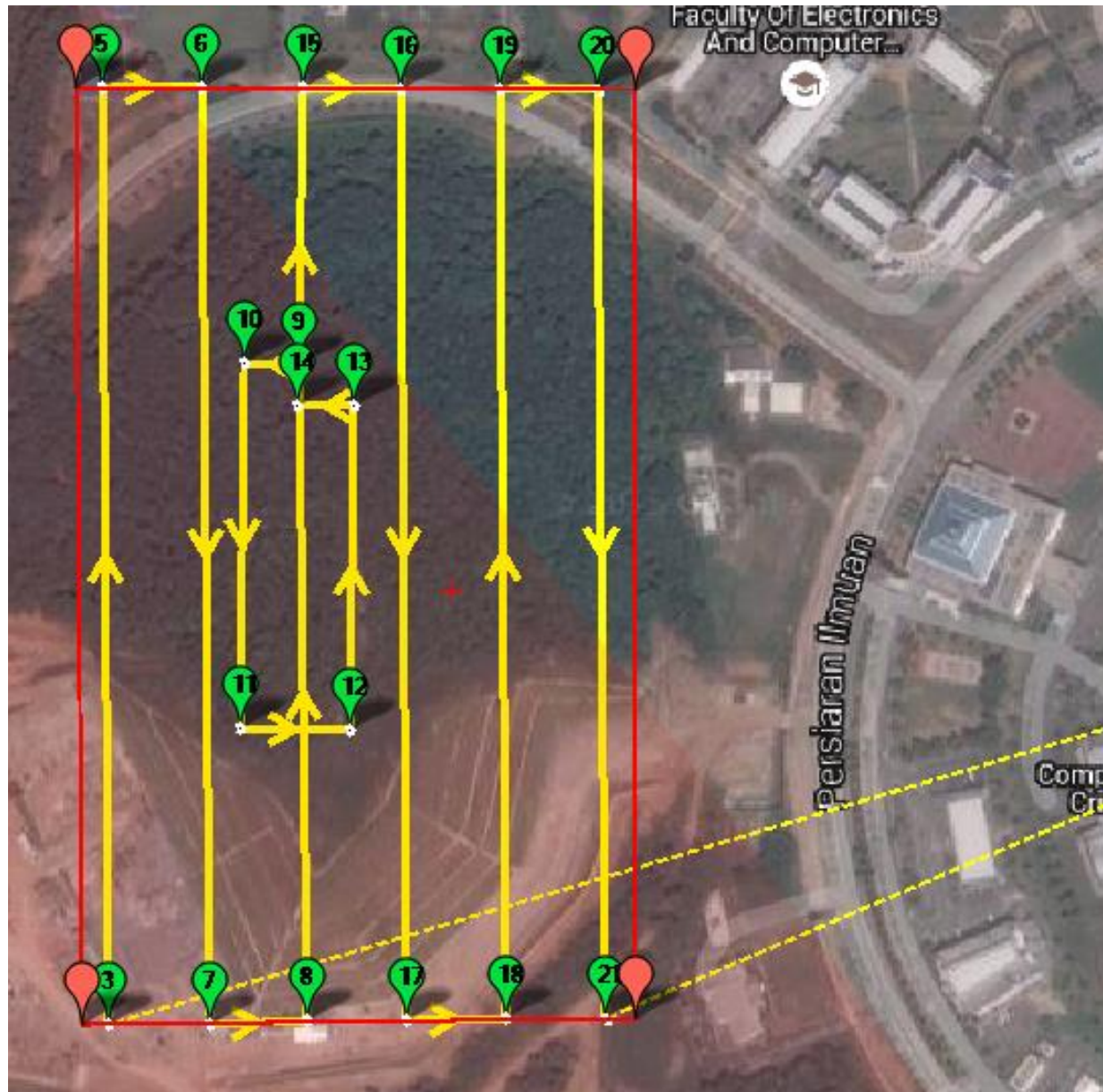
Control-S to save to file
Control-O to load form file

Accept

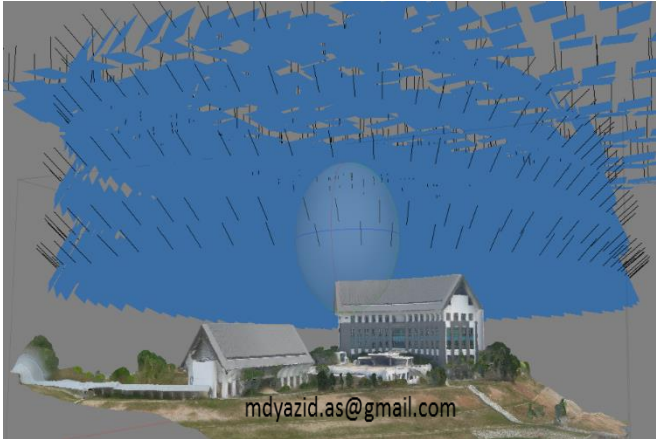
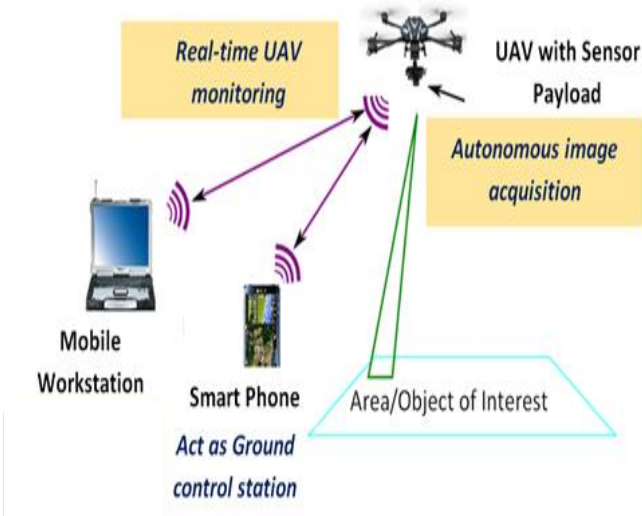
Stats

Area:	116831 m ²	Pictures:	104	Flight Time (est):	5:16 Minutes
Distance:	3.79 km	No of Strips:	8	Photo every (est):	2.29 Seconds
Distance between images:	34 m	Footprint:	114.5 x 85.8 m	Turn Dia (at 45d):	66 m
Ground Resolution:	2.86 cm	Dist between lines:	34.34 m	Ground Elevation:	45-106 m

PEAK PRE-OPTIMIZED WAYPOINT



2D and 3D Mapping Using UAV



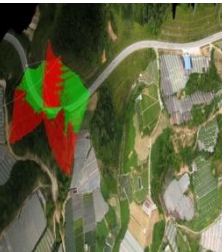
Applications



Kampus INSTUN



Masjid UTeM



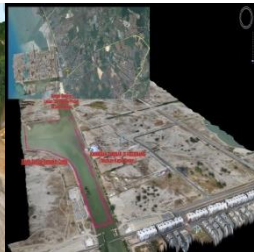
Ringlet



Sg Rambai Airport

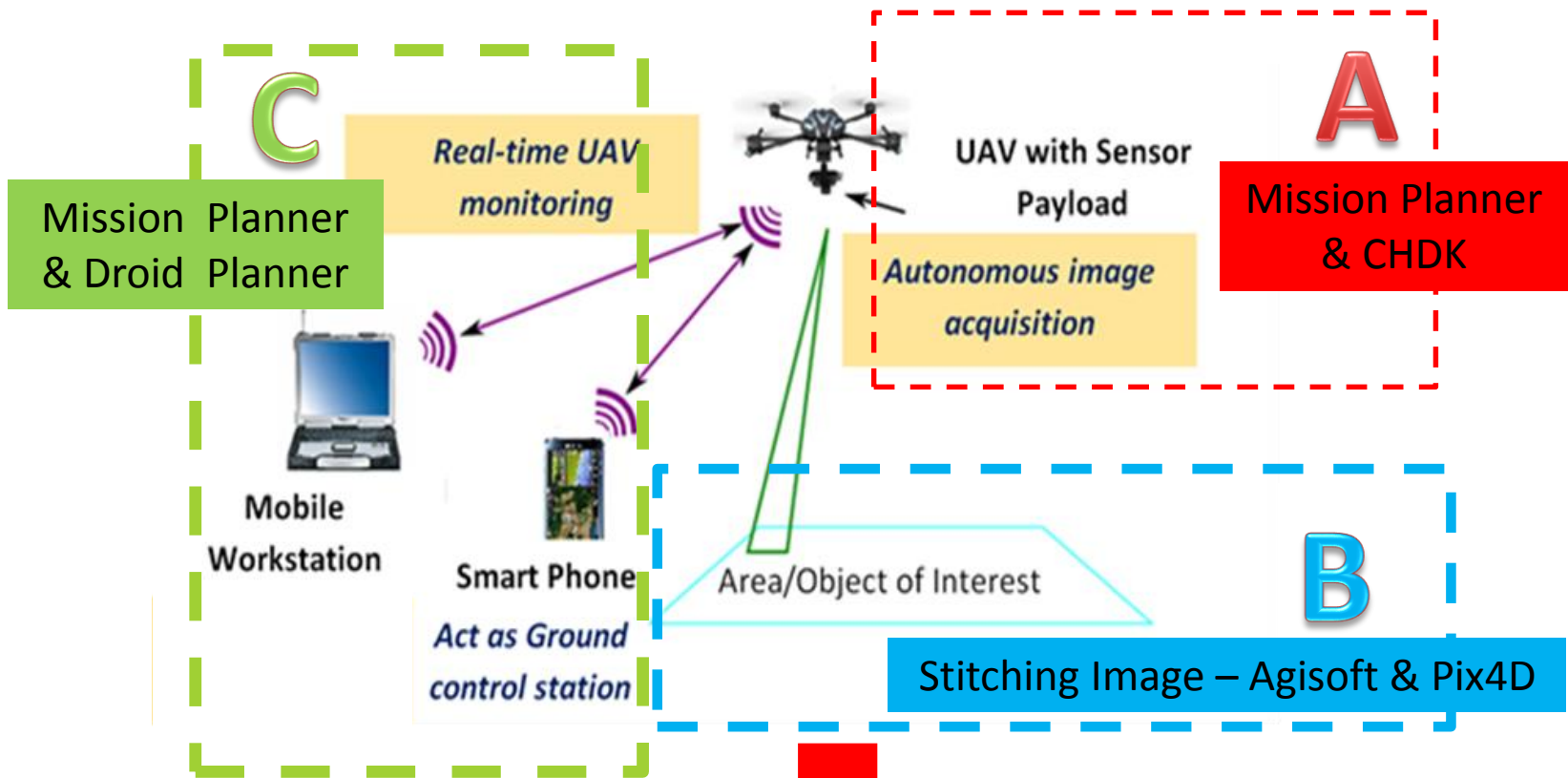


Bukit UTeM



Pantai Klebang

Konsep Operasi Pemetaan 3D UAV-(Drone)



**Risalah Elektronik Geometrik
(Geometric E-Flyers)**

Relationship GSD with Map Scale

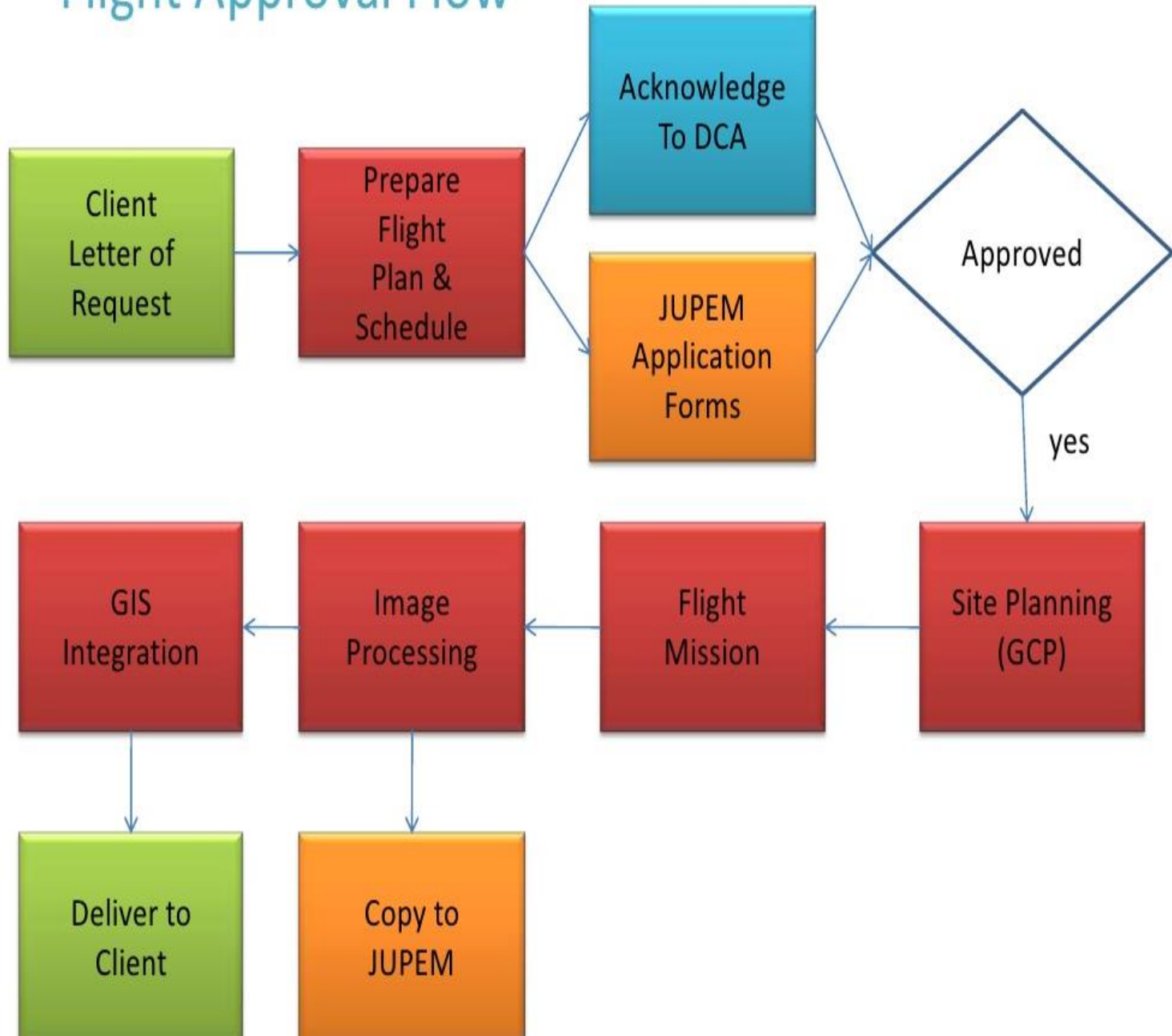
GSD: Ground Spatial Distance

GSD	Mapping scale
5 cm	1:500
10 cm	1:1,000
25 cm	1:2,500
50 cm	1:5,000
1 m	1:10,000
2.5 m	1:25,000
5 m	1:50,000
10 m	1:100,000
50 m	1:500,000

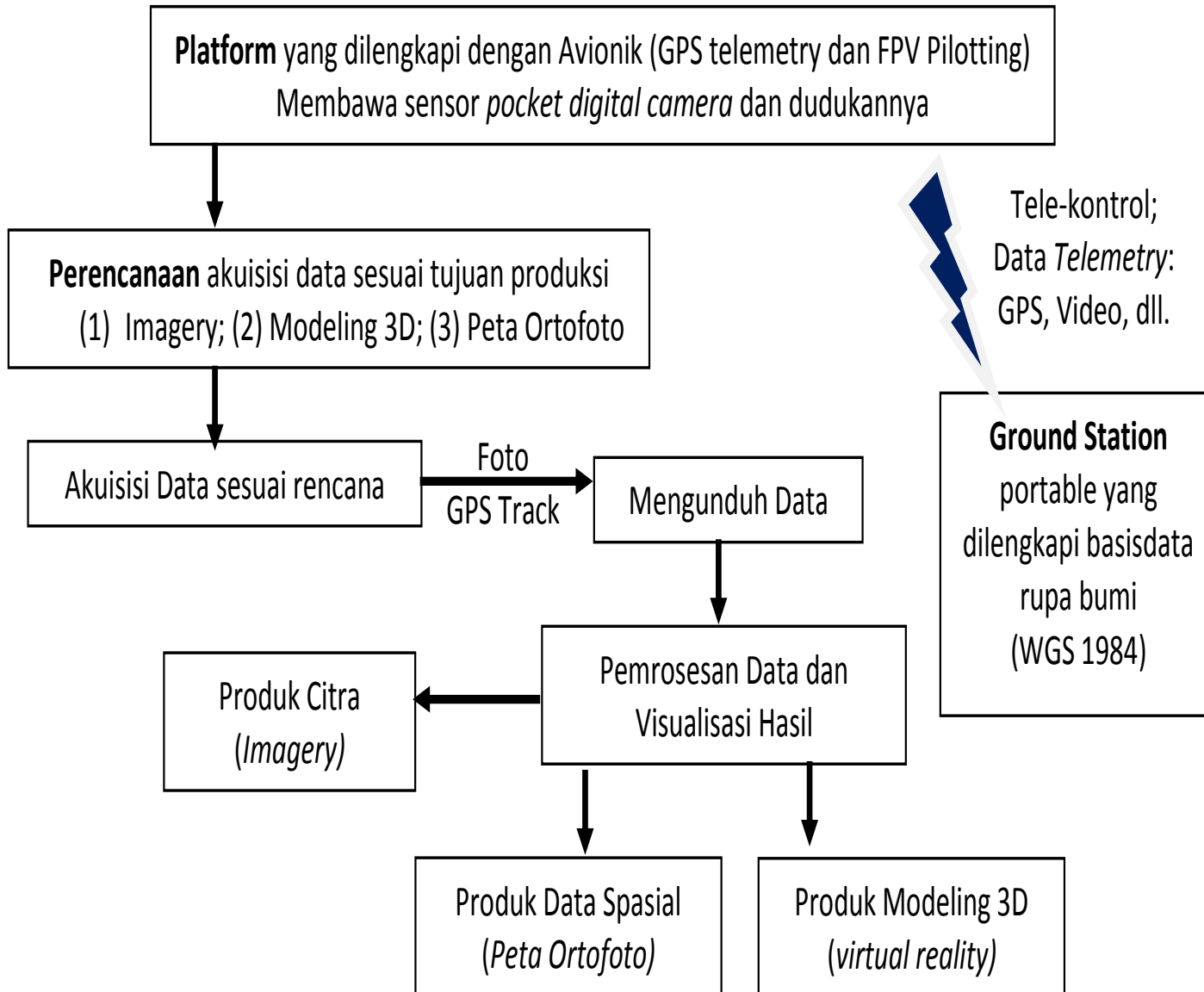
COVERAGE AREA (Ha) – CAMERA 20 MPx

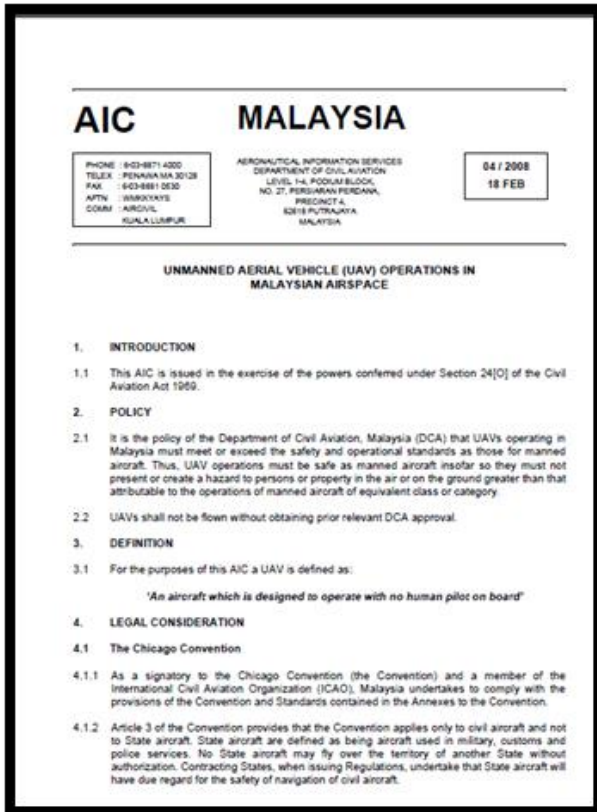
GSD (CM)	ALTITUDE (M)	COVERAGE AREA (Ha) per flight
0.5	30	50 Ha
1	50	100 Ha
1.5	70	150 Ha
5	220	500 Ha
7	310	700 Ha
10	440	1000 Ha

Flight Approval Flow



ALIRAN KERJA UAV





KETUA SETIAUSAHA
KEMENTERIAN SUMBER ASLI DAN ALAM SEKITAR
ARAS 17, WISMA SUMBER ASLI
NO. 25, PERSIARAN PERDANA, PRESINT 4
62574 PUTRAJAYA

Telefon : 03-88861652
Faks : 03-88895449
Tarikh : 10 Julai 2015

Rujukan Kami: NRE.100-1/8/1

Semua Ketua Jabatan di bawah NRE
Semua Sektor Swasta Berkaitan

**SURAT PEKELILING
BILANGAN 1 TAHUN 2015**

**GARIS PANDUAN
URUSAN PENYELARASAN PENGGAMBARAN DAN PENGIMEJAN DARI UDARA
MENGUNAKAN *DRONE* BAGI AGENSI-AGENSI DI BAWAH KEMENTERIAN
SUMBER ASLI DAN ALAM SEKITAR (NRE)**

TUJUAN

Surat pekeliling ini bertujuan untuk makluman dan tindakan agensi-agensi di bawah Kementerian Sumber Asli dan Alam Sekitar (NRE) serta sektor-sektor swasta yang berkaitan berkenaan urusan penyelarasan penggambaran dan pengimejan dari udara menggunakan *drone* bagi agensi-agensi di bawah NRE.

Melalui garis panduan ini, penggunaan *drone* di kalangan agensi-agensi di bawah NRE dapat dipantau sebaik mungkin dengan penggunaan yang optimum dan seterusnya boleh menjimatkan kos serta mengelakkan pertindihan dalam aktiviti penggambaran dan pengimejan dari udara.

UAV DAN UNDANG-UNDANG PENERBANGAN DI MALAYSIA

Penerbangan UAV di Malaysia tertakluk kepada undang-undang penerbangan :

Akta Penerbangan Awam 2016

(Jabatan Penerbangan Awam - DCA)

- Operator perlu ada Private Pilot License (PPL)
- Perlu ada Permit untuk Penerbangan bagi Penggambaran Udara dari JUPEM (BGSP)
- Perlu ada Permit Untuk Penerbangan dari DCA



Ruj. Fall : JKMM.PENT-100-211/13 JLD 4 (73)
 Tarikh : 30 Ogos 2016

KEMENTERIAN	
KUALA LUMPUR	
KETUA UNIT	
a)	PUSAKA
b)	Pembudayaan
c)	BPI
d)	Latihan & Kerjaya
e)	Kawalan Kredit
f)	Teknikal & Senegaraan (Pentadbiran)
KUALA LUMPUR	

Ketua-Ketua Jabatan Negeri Melaka
 Ketua-Ketua Jabatan Persekutuan Negeri Melaka
 Pihak Berkuasa Tempatan Negeri Melaka
 Ketua Agensi Badan Berkanun / Persekutuan Negeri Melaka
 Anak Syarikat/Berkaitan Kerajaan Negeri Melaka



السلامة على منور من الله وبن بركاته

YB. Datuk/YBhg. Datuk/Tuan/Puan,

SYARAT-SYARAT DAN PERATURAN-PERATURAN MENGGUNAKAN 'DRONE'

Dengan hormatnya saya merujuk kepada perkara di atas.

2. Sukacita dimaklumkan bahawa, Majlis Mesyuarat Kerajaan Negeri (MMKN) Bil. 25/2016 bertarikh 11 Ogos 2016 telah bersetuju supaya penggunaan 'drone' dalam majlis-majlis rasmi Kerajaan perlu melalui prosedur undang-undang yang ditetapkan oleh Polis DIRaja Malaysia, Jabatan Penerbangan Awam dan agensi-agensi lain yang berkaitan.

3. Sehubungan itu, bersama-sama ini dikemukakan syarat-syarat dan peraturan-peraturan yang perlu dipatuhi berhubung penggunaan 'drone' di dalam kawasan yang diwartakan sebagai kawasan larangan dan tempat larangan termasuk majlis-majlis rasmi yang dihadiri oleh orang-orang kenamaan seperti berikut:

1.

**Kerajaan Negeri Melaka
 2016**

SYARAT-SYARAT DAN PERATURAN-PERATURAN MENGGUNAKAN 'DRONE'

- a. Menyediakan keperluan dokumen bagi tujuan permohonan penerbangan 'drone' seperti berikut:
 - i. Surat kebenaran daripada Jabatan Ukur dan Pemetaan Malaysia;
 - ii. Surat kebenaran daripada tuan punya kawasan yang diambil fotografi;
 - iii. Tarikh dan tempoh masa penggambaran dijalankan;
 - iv. Radius penerbangan;
 - v. Ketinggian penerbangan;
 - vi. Spesifikasi 'drone';
 - vii. Butir-butir diri pengendali 'drone'; dan
 - viii. Butir-butir syarikat yang terlibat.
- b. Mengemukakan permohonan lengkap dengan disertakan dokumen-dokumen berkaitan seperti di para 3.a. kepada Jabatan Penerbangan Awam (*Air Transport Division*) dalam tempoh 14 hari bekerja sebelum tarikh penerbangan.
- c. Mengikut Akta Penerbangan Awam 1969 – Peraturan-Peraturan Penerbangan Awam 2016, bayaran bagi setiap kelulusan permit adalah sebanyak RM250.00 bagi 'drone' yang berat dibawah 20kg manakala bayaran RM1,000.00 dikenakan jika melebihi 20kg.
- d. 'Drone' yang melebihi berat 20kg diklasifikasikan sebagai boleh mendatangkan bahaya dan pengendali diperlukan lesen Juruterbang.



Jabatan Alam Sekitar
 Department of Environment
Kementerian Sumber Asli & Alam Sekitar
 Ministry of Natural Resources & Environment
 Aras 1 - 4, Podium 2 & 3, Wisma Sumber Asli
 No. 25, Persiaran Perdana, Presint 4
 62574 PUTRAJAYA
 MALAYSIA

Tel: 03-8871 2000
 Faks: 03-8898 1947
 03-8888 8987 (Pentadbiran)
 03-8888 1878 (Pencapaian)
 03-8888 2923 (Integrasi)
 03-8888 4151 (Gitaru)
 03-8888 1042 (Komersial Strategik)
 03-8888 1045 (Pembinaan)
 03-8888 4075 (Air Dan Malar)
 03-8888 0087 (Pengurusan)
 03-8888 3094 (Teknologi Maklumat)
 03-8888 6120 (Bahari Baharu)
 03-8888 1873/1876 (Data Operasi)
 Laman Web : www.jas.gov.my



DITERIMA

28 JAN 2016

PEJABAT KETUA PEGAWAI
 UKUR DAN PEMETAAN

YBhg. Datuk Dr. Ahmad Fauzi bin Nordin
 Ketua Pengarah Ukur dan Pemetaan Malaysia
 Jabatan Ukur dan Pemetaan Malaysia
 Tingkat 11, Wisma JUPEM
 Jalan Sultan Yahya Petra (Jalan Semarak)
 54000 KUALA LUMPUR

Rujukan Kami: AS(U) 91/110/611/036

Jilid 14 ()
 Tarikh: 27 Januari 2016

Tel: 03-26170800
 Faks: 03-26917457

*1898 sila berikan kejasama
 Makluman
 urusan pengurusan
 Perihal*



PEJABAT KETUA PEGAWAI KESELAMATAN KERAJAAN MALAYSIA
 Jabatan Perdana Menteri
 Aras -1, 1 & 2 Blok B7
 Pusat Pentadbiran Kerajaan Persekutuan
 62502 PUTRAJAYA
 MALAYSIA

Telefon : 03 8000 8000
 Fax : 03 8888 3258
 Web : www.cgsa.gov.my

Rujukan Kami: KPKK(S) 800-3/4 Jld. 5 (26)
 Tarikh: 15 April 2016

Ibu Pejabat Jabatan Ukur dan Pemetaan Malaysia
 (Bahagian Geospasial Pertahanan)
 Tingkat 2, Bangunan Ukur
 Jalan Sultan Yahya Petra
 50578 Kuala Lumpur
 (u.p: Lt. Kol. Muhamad Zamri bin Husran)

Tuan,

PERMOHONAN PENGAMBILAN IMEJ UDARA MENGGUNAKAN UNMANNED AERIAL VEHICLE (UAV) DI KAWASAN PUTRAJAYA

Dengan segala hormatnya saya merujuk kepada perkara di atas dan surat tuan bertarikh 4 April 2016 adalah dirujuk dan berkaitan.

2. Sukacita dimaklumkan bahawa pada dasarnya Pejabat Ketua Pegawai Keselamatan Kerajaan Malaysia (KPKK), Jabatan Perdana Menteri **tiada halangan** untuk membenarkan pihak **Bahagian Geospasial Pertahanan** bagi membuat imej udara menggunakan **unmanned aerial vehicle (UAV)** di kawasan **Valau** bagaimanapun, terdapat beberapa perkara yang perlu dipatuhi oleh

Keberanian penerbangan hanya diberikan mulai **11 April 2016 hingga 22 April 2016** dan masa penerbangan dari **jam 8.00 pagi hingga 5.00 petang**.

Dilarang terbang dan pengambilan foto di zon-zon berikut:-

- Kompleks Seri Perdana;
- Bangunan Perdana Putra;
- Kediaman Rasmi Timbalan Perdana Menteri;
- Kompleks Jabatan Perdana Menteri;
- Kompleks Pejabat Kerajaan Parcel C, D dan E;
- Core Island;
- Pusat Persidangan Antarabangsa Putrajaya (PICC);
- Istana Melawati; dan
- Istana Hinggap Selangor.

'RAHSIAKAN RAHSIA KERAJAAN'



IBU PEJABAT JABATAN UKUR DAN PEMETAAN MALAYSIA
 (BAHAGIAN GEOSPASIAL PERTAHANAN)
 TINGKAT 2, BANGUNAN UKUR
 JALAN SULTAN YAHYA PETRA
 50578 KUALA LUMPUR
 MALAYSIA

Tel: 03-26170736
 Faks: 03-26980505



Rujukan Kami: JUPEM.BGSP. 5046
 Tarikh: 19 Apr 16

Cadangan Ti:

Kawasan Per:

Markas Operasi Udara
 Aras 10.13 Wisma Pertahanan
 Kemantah, Jalan Padang Tembak
 50634 KUALA LUMPUR
 (Untuk Perhatian : PS1 Sistem Operasi Darat)

PERMOHONAN KELULUSAN UNTUK MEMBUAT PENGGAMBARAN UDARA MENGGUNAKAN UNMANNED AERIAL VEHICLE (UAV) DI SUNGKAI, PERAK

1. Dengan hormatnya merujuk kepada perkara diatas, Bahagian ini akan melaksanakan penggambaran udara menggunakan UAV di kawasan Sungkai, Perak yang akan dilaksanakan pada 27 Apr hingga 6 Mei 16.

2. Penggambaran udara yang akan dilaksanakan adalah seperti berikut:

- Kawasan Penerbangan - Sungkai, Perak. Lokasi seperti di **Kembaran A**.
- Tarikh - 27 Apr hingga 6 Mei 16
- Masa - 0800H - 1200H dan 1400H - 1700H
- Ketinggian - 300 meter *above ground level*.

3. Kerjasama dan kelulusan pihak tuan amatlah dihargai dan didahului dengan ucapan terima kasih.

MUHAMAD ZAMRI BIN HUSRAN
 Lt Kol
 bp Pengarah Bahagian Geospasial Pertahanan

Kembaran:

- Kawasan Penggambaran Udara UAV Sungkai.

