PHOTOGRAMMETRY and Cloud Technologies

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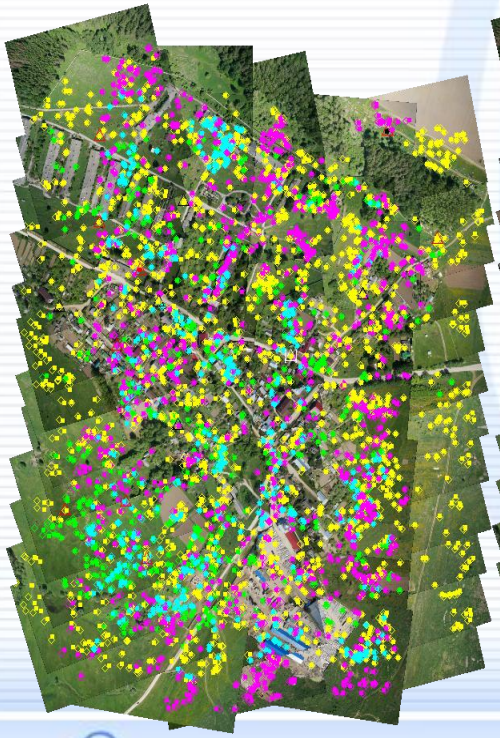
Hadera. Israel. October 2017

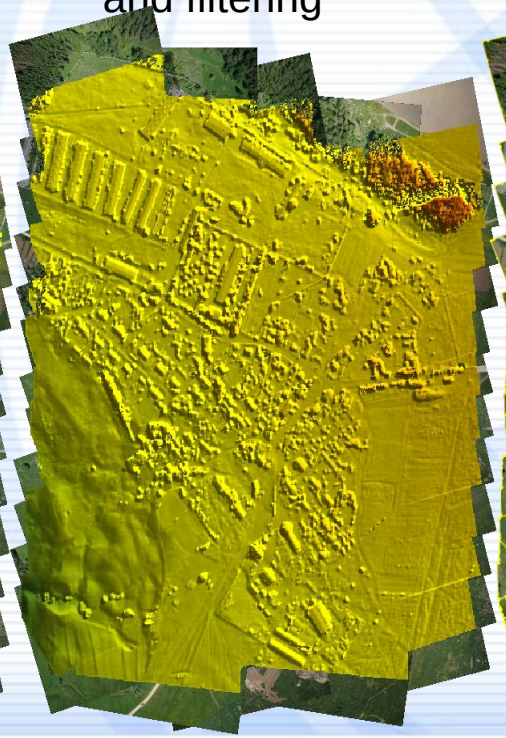
Cloud Technologies

Photogrammetric tasks

aerial triangulation



DEM building and filtering

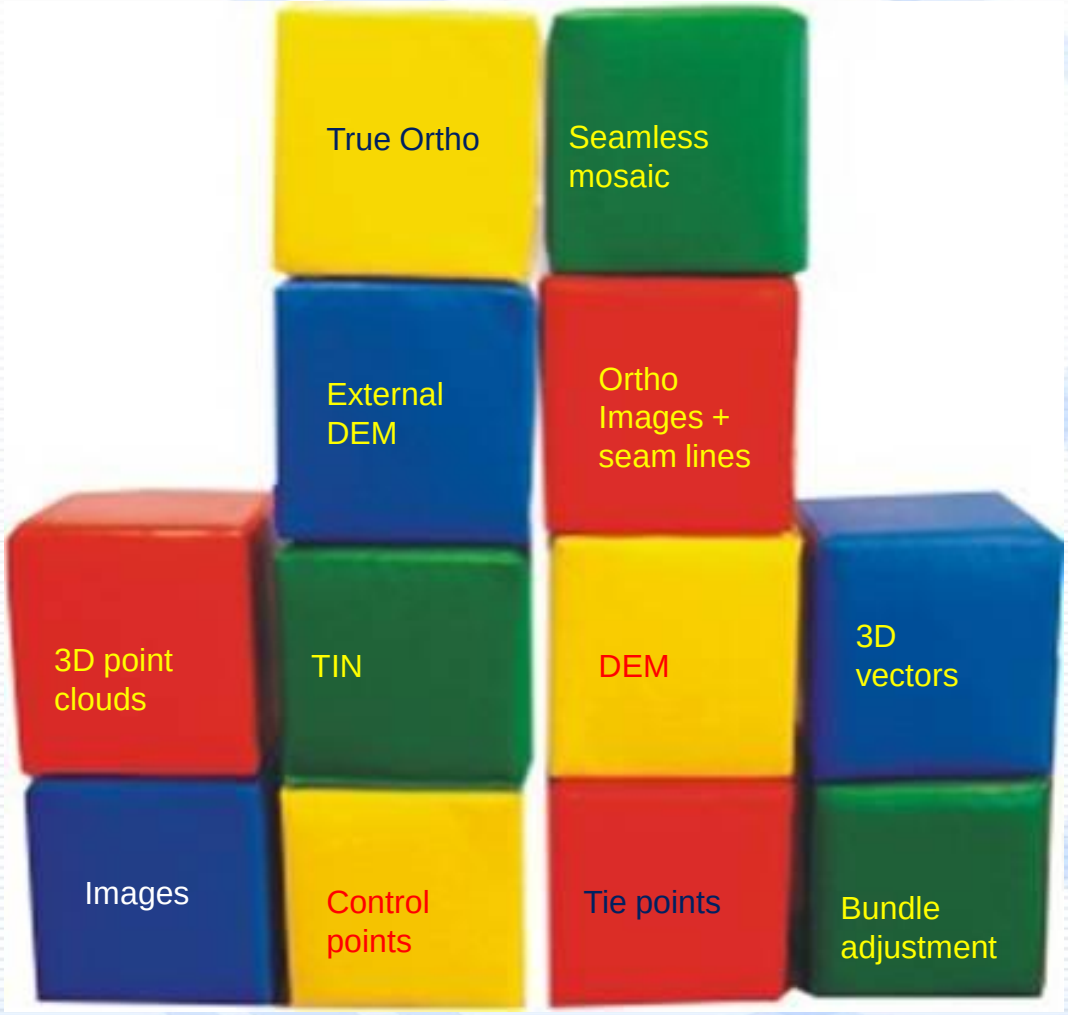


orthomosaic seam lines and color balancing

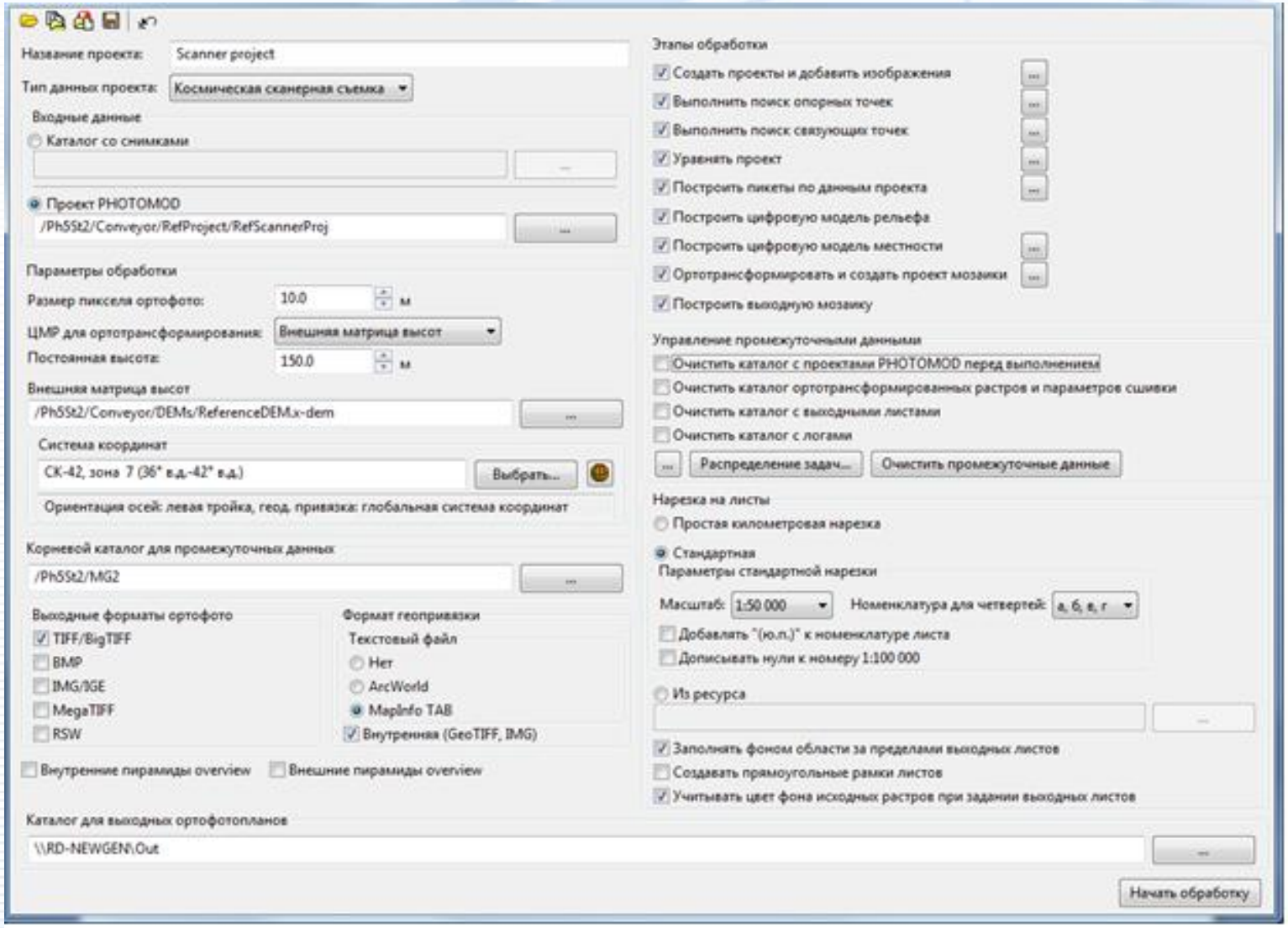
stereo feature extraction

Photogrammetric “blocks”

Blocks can be combined in automatic chains (sequences) of algorithms and data



Automatic sequencies – PHOTOMOD Conveyor SA



Data Volumes Increase

DMC/Ultracam - inflight data storage – thousands of images, terabytes of data

Current aerial block has thousands of images

WorldView IV – 3.2 TB of storage on board

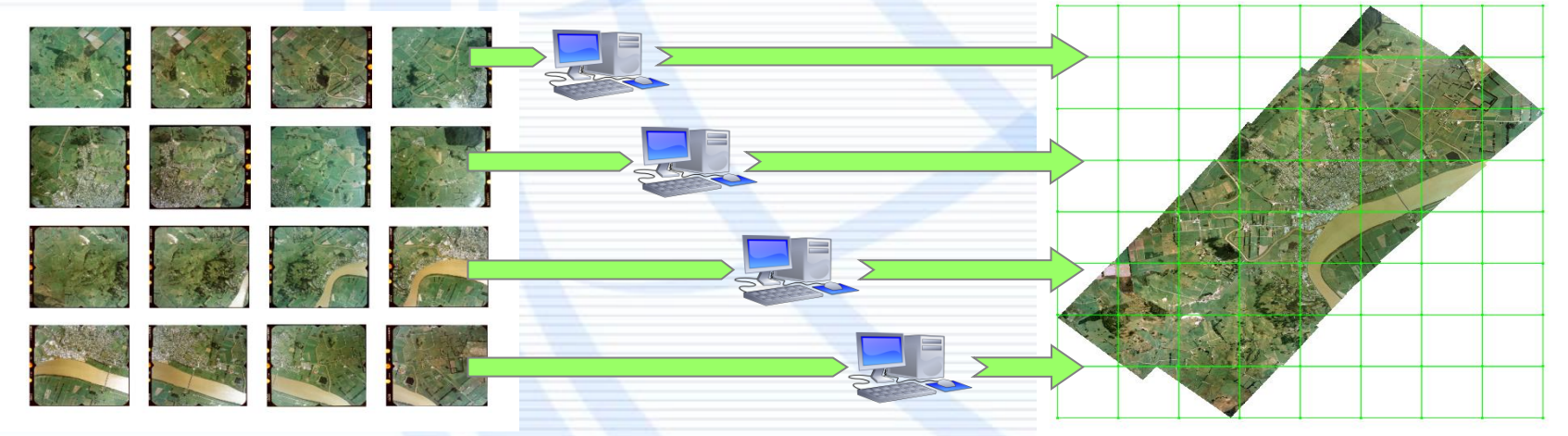
Pleaiades 1A/1B - Daily constellation capacity: 1,000,000 sq.km

New products: DSM, 3D point clouds, True Ortho (DSM based)

Ultracam Ospray

Orthophoto mosaic algorithm (parallelism)

1. Input the images (Compute pyramid levels and stored in tiles);
2. Orthotransform every image;
3. Compute seamlines;
4. Calculate image statistic for brightness adjustment;
5. Build mosaic divided into sheets (separate files);



Computer cluster Performance

Computing block:
Xeon E5-2680 2.40GHz – 10 CPU (140 cores, 280 hyper-threading), RAM 1280GB, 10Gb/s Ethernet

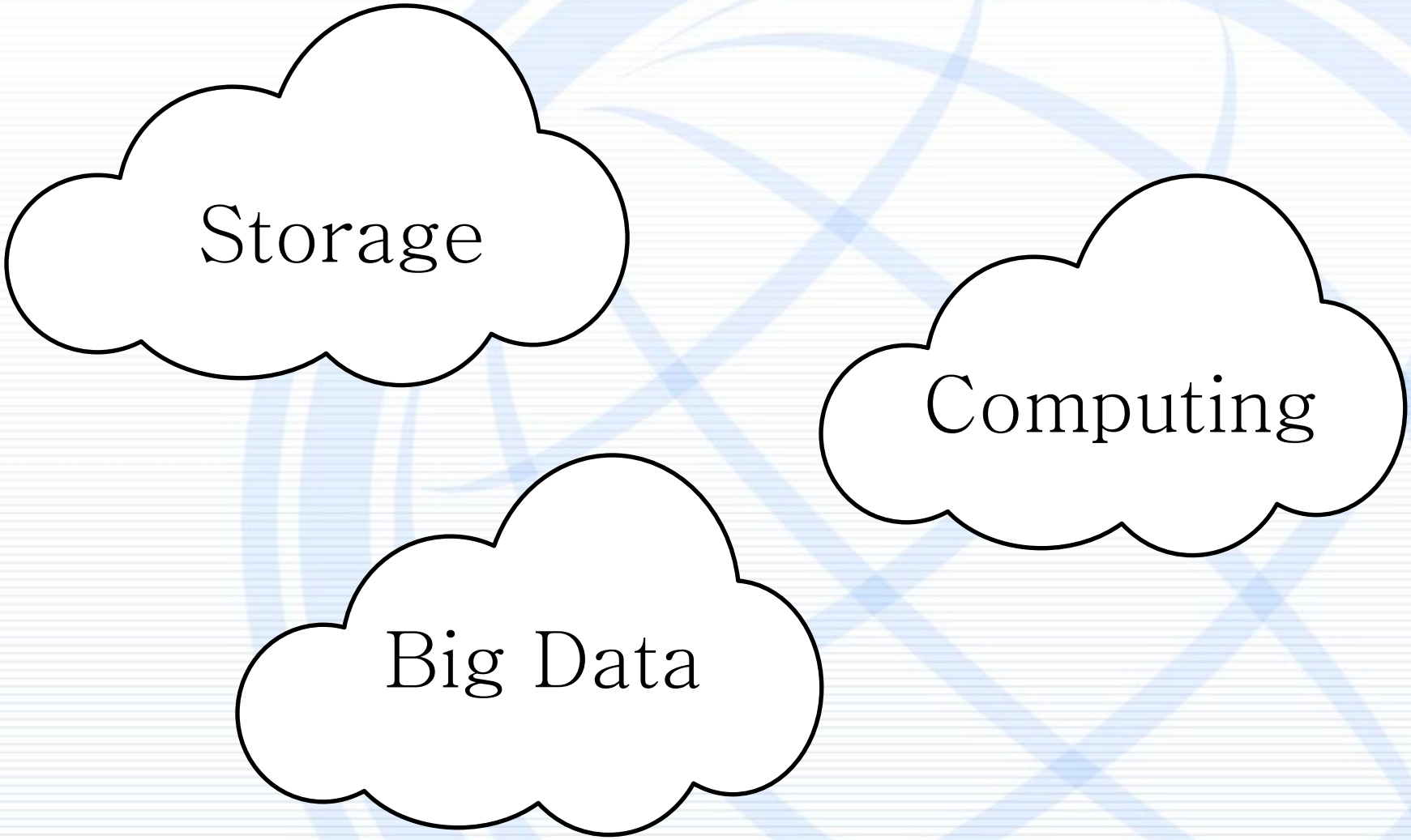
Storage:
Xeon E5-2620 2.10GHz – 4 CPU, 20 TB Raid SSD (striping), RAM 512, 10Gb/s Ethernet

Perfomance
Aerial block (Ultracam): GSD 3-5 см (mountain region), 103 sq. km
Mosaic production– 55 minutes

Pushbroom block Resurs-P: 17000 sq. km
Mosaic production – 43 minutes

Different photogrammetric algorithms have different CPU and storage requirements. 3D point cloud production is 4-10 times more time consuming.

Cloud Computing



Cloud Storage

Dropbox

OneDrive

iCloud

Google Drive

Yandex.Disk

ОБЛАКО@mail.ru

Cloud Storage: Private Clouds

Problem of data security

Large companies can deploy there own private clouds on safe servers

Cloud Storage: Capacity

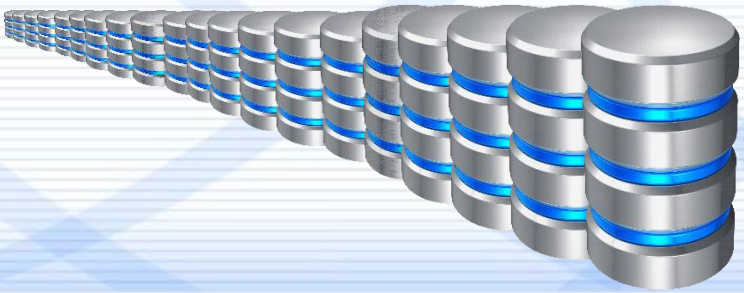
Aerial images project	Space images project
5 cm/10 cm x 4 band x 16 bit x 10 (overlap)	**30 cm**/50cm x 4 band x 16 bit x 3 (overlap)
1 sq.km	
32 GB / 8 GB	260 MB / 93 MB
Moscow, 870 sq.km	
28 TB / 7 TB	226 GB / 81 GB
Belgium, 30 528 sq.km	
1 PB / 250 TB	8 TB / 2.9 TB

Data storage capacity

Racurs 0.5 PB

Data center 100 PB

Amazon ∞



Cloud Storage: Time & Speed

4G up to 100 MB/c
Home Internet up to 100 MB/c
5G up to 10 GB/c
Data transfer services 1-10 GB/c

LAN: 1 – 10 GB/c
SSD – RAM: – 5-10 GB/c

Aerial images, 5 cm
1 km^2 – 32 GB

4G, Home Internet
10 - 100 Mb
10 – 1 hrs

Aerial images, 5 cm
Moscow, 870 km^2 – 28 TB

Fiber
1 - 10 Gb
< 70 - 7 hrs

Space images, 30 cm
Belgium, 30 528 km^2 – 8 TB

Fiber
1 - 10 Gb
< 20 - 2 hrs

Cloud Computing

Virtual computers from 5$/month

Microsoft Azure

DigitalOcean

DigitalGlobe™

amazon web services™ | EC2

CLOUDEO

Cloud Computing: Testing

amazon web services™ | EC2

Virtual Computer:

40 CPU cores
60GB RAM
HDD 250GB + 100GB

Upload Speed:

600KB/s
1.5TB – 1 month to upload,
Several hours to process

Virtual Computer:
Number of CPU cores – 168 (2.6 GHz),
656 GB of RAM
Disk space HDD 7000rpm - 12900GB
Disk space HDD 15000rpm - 8000GB
SSD disk space - 500GB.

Upload Speed:

6MB/s
1.5TB – 7.5 hours to upload,
Several hours to process

No problems with PHOTOMOD

Photomod in Clouds

CLOUDEO

Космическая съемка.
Работает

GEOCLOUD
GEOCLOUD.SHOP

Космическая и аэро съемка.
Скоро запуск

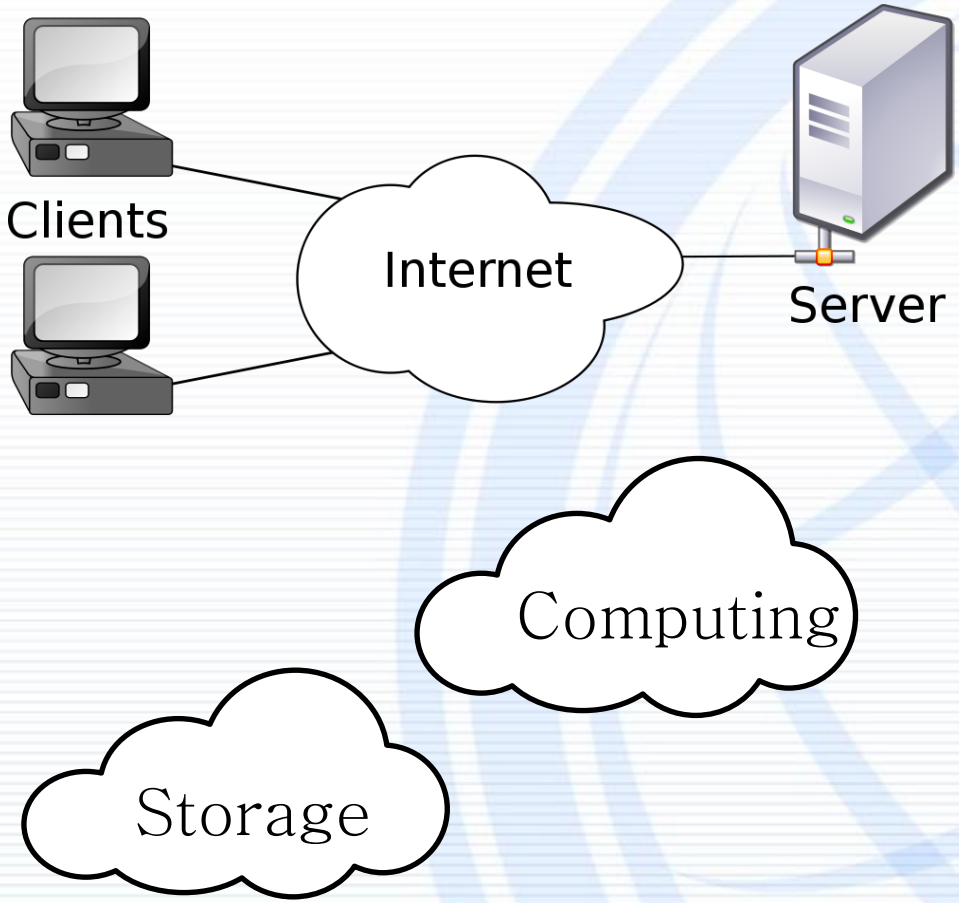
innopolis university

Космическая и аэро съемка.
Прототип 2018. Запуск 2019

РКС
РОССИЙСКИЕ КОСМИЧЕСКИЕ СИСТЕМЫ

Аэро съемка, БПЛА
Тестирование.

Cloud Usage: Problems to be Solved



Stereo control/measurements

Client-Server architecture

Special adaptation for Storage & Computing depends on cloud architecture

Cloud Computing: Facts, Trends & Statistics (2017)

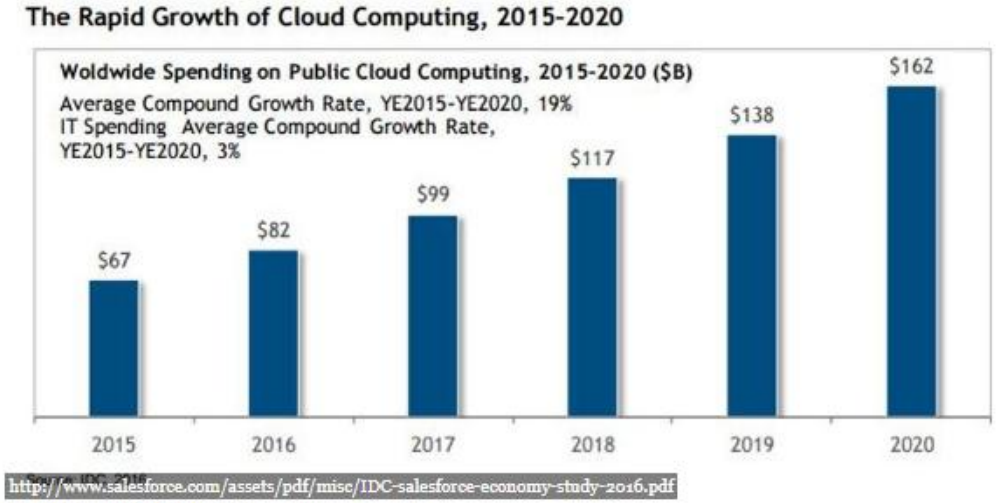
Security no longer the top concern (32%(2016)->24%(2017))

30% of Microsoft revenue to come from Cloud

41% of businesses are planning to increase their investment in Cloud technologies

File storage most popular use of Cloud computing (70% of enterprises use it)

Cloud deployment to become default by 2020 (Cloud deployment of software gradually becoming the default)



Rapid Growth of Cloud Computing, 2015–2020

Conclusions

Cloud technologies can be successfully used for photogrammetric processing

PHOTOMOD can be effectively used in clouds

The financial benefits of using cloud technologies in photogrammetry can be based on:

- absence of requirements to have expensive hardware in the user site but depend on the cloud storage and cloud computing price;
- different price of input images when the user does not download them to his computer and processes them in the cloud of the data owner (e.g.Digital Globe proposal)

Further development of cloud technologies and services will lead to a different business model when DPW is offered as a SaaS (Software as a Service) or IaaS (Infrastructure as a Service)

Thank you for attention