

# **Surveying Instruments And their applications for Mining Engineering Systems**

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# Presentation Overview...

- ➔ • Description of some Mining task using Geospatial Information.
- ➔ • Description of surveying technologies used for Geospatial Data Collection.
- ➔ • State of art of the Surveying technologies for Monitoring.
- ➔ • Engineering systems for Surveying Technologies.

# Geospatial Information for Mining...

- Some geospatial information requirements...



The asset data collection, specially the geometry of access roads for mining trucks, is a very important point, specially for the fuel consumption and mineral transportation efficiency.

The earth moving calculation as tones volumes of useful minerals production is a key point for higher production in a Mining Project.



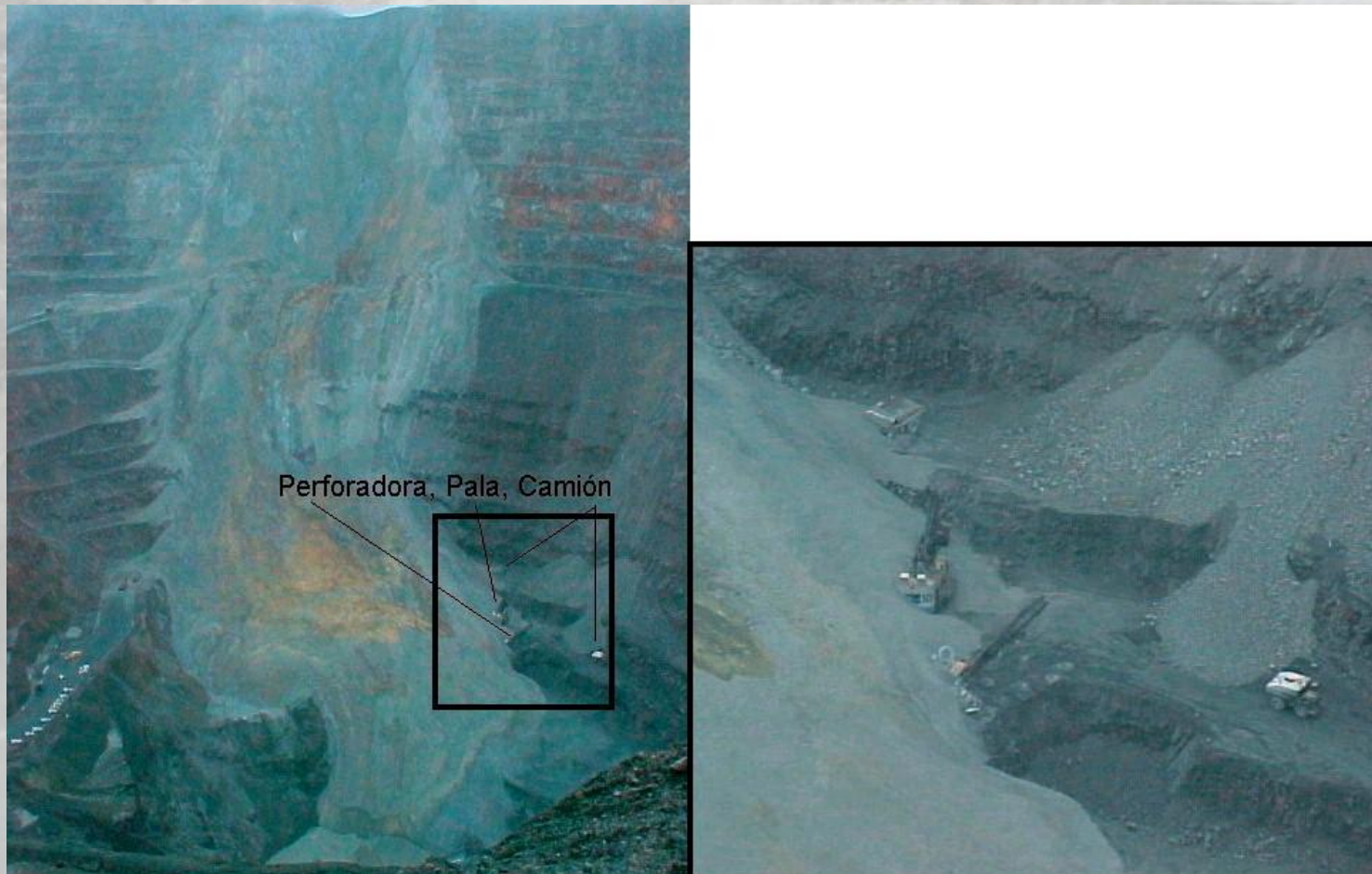
# Geospatial Information for Mining...

- The geospatial data collection in a mining environment is always a risky component to be considered in any mining project. The machinery moving, heavy weather environment, terrain sliding and several other aspects of the mining site, are important challenges to be considered when choosing a geospatial data collection device.



# Geospatial Information for Mining...

- Besides data collection, another important event to be considered in a mining project is the terrain instability condition, mainly in open pit mines. Human lives can be saved and instrument damage can be spared just by a powerful structure monitoring. Geospatial Information is the key also to prevent it...

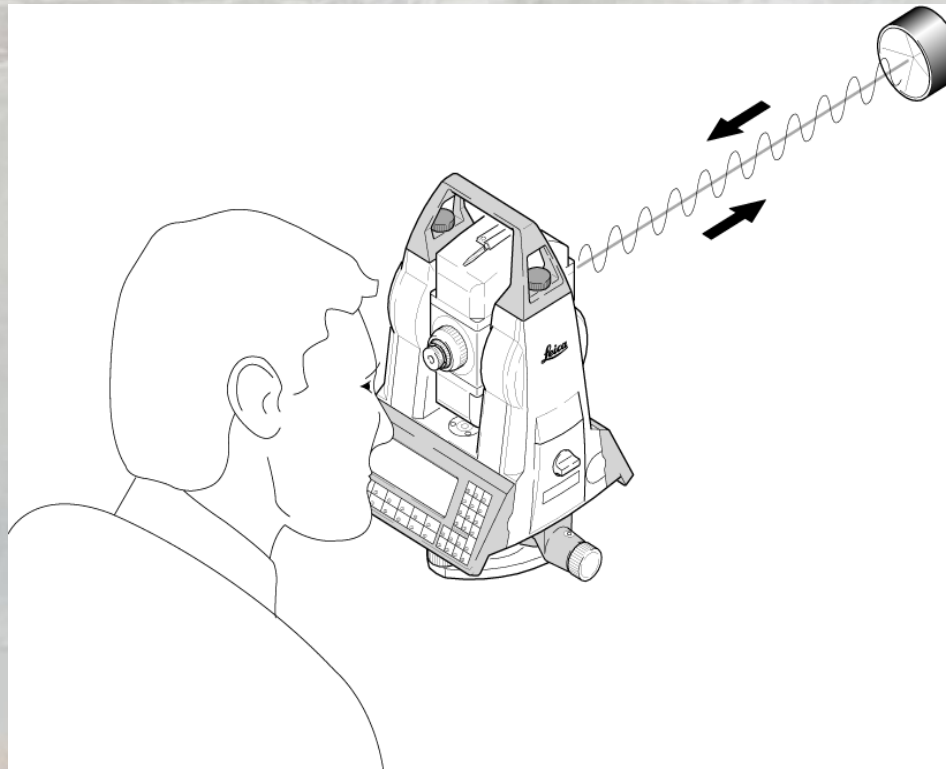


# Which technologies do we have available today to get the Geospatial Information...?



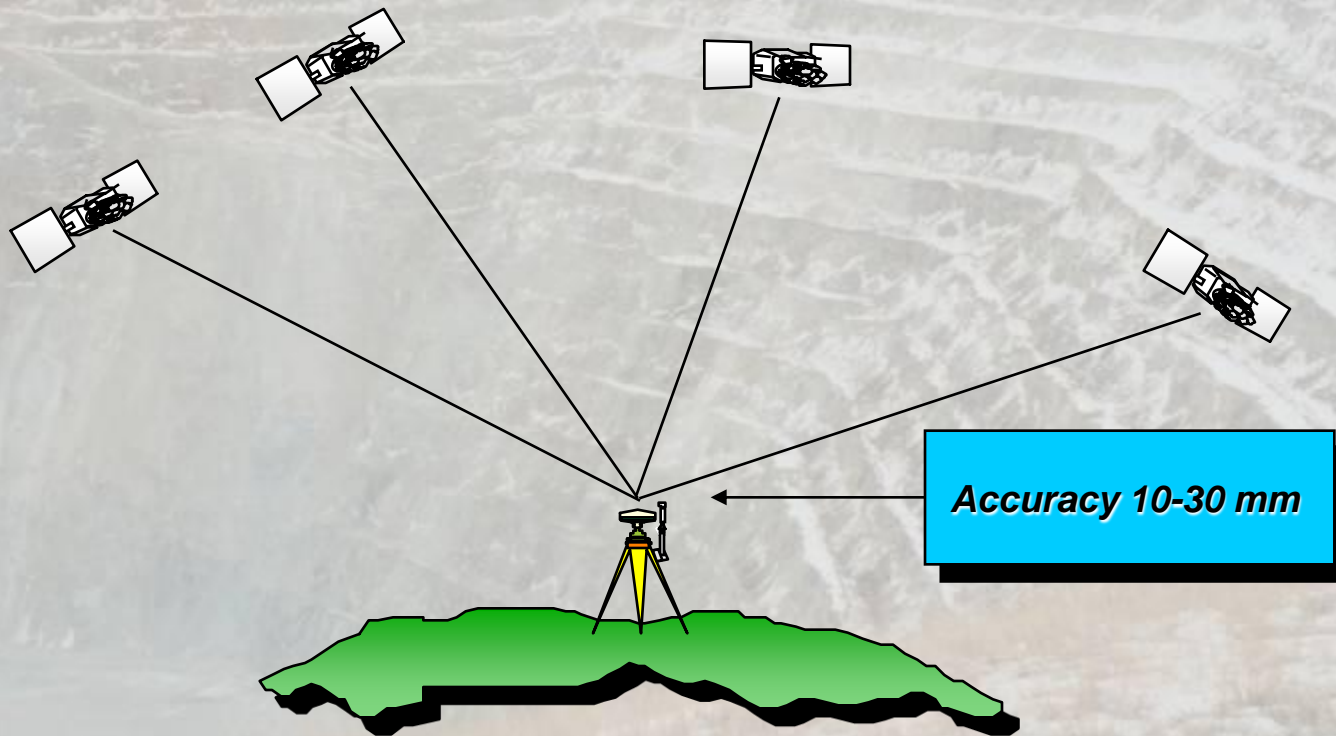
# Polar System Measurements...

- The oldest and easy to use technology available for geospatial data collection is the Total Station... The instrument reads Angles and Distances and an on-board CPU computes the local position... But this system requires the user to be in the site to sample the geo information data.
- Poles and Prisms > Risky Conditions...



# Global Navigation Satellite System - GNSS...

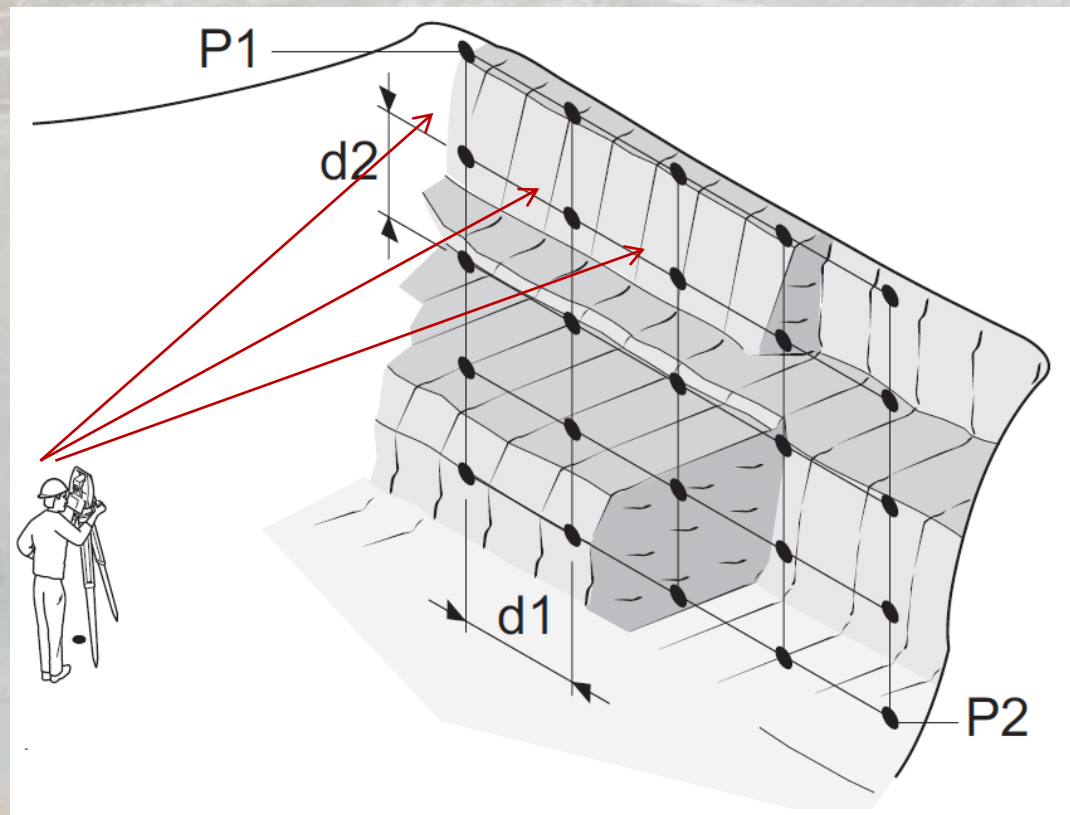
- With the introducing of the GNSS system for positioning tasks, the geospatial data collection, for any surveying application, can be done faster and reliably. But again – the system still requires the user to sample the geoinformation data in site...
- Poles and Antennas > Risky Conditions...





# Polar System Measurements... With Laser Beam

- Another interesting technology available for the mining geospatial data collection is the Total Station with a coaxial laser beam included in the instrument's line of sight for point measurements. Replacing prisms by laser beams, the surveyors can still do a reliable job faster and safer than before.
- Remote measurement > Less risky conditions

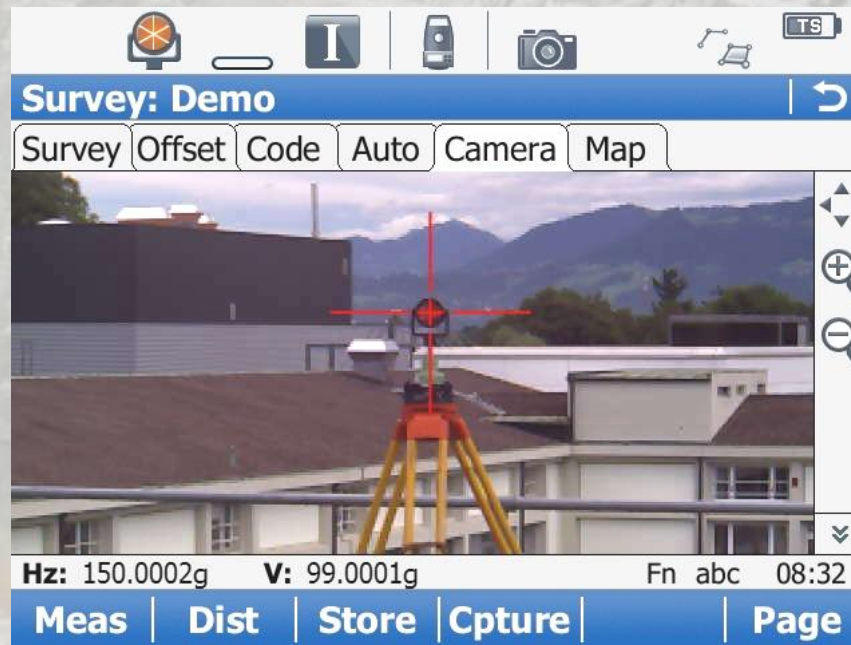


# What is New?... Is there a new technologies to get the Geospatial Information...?



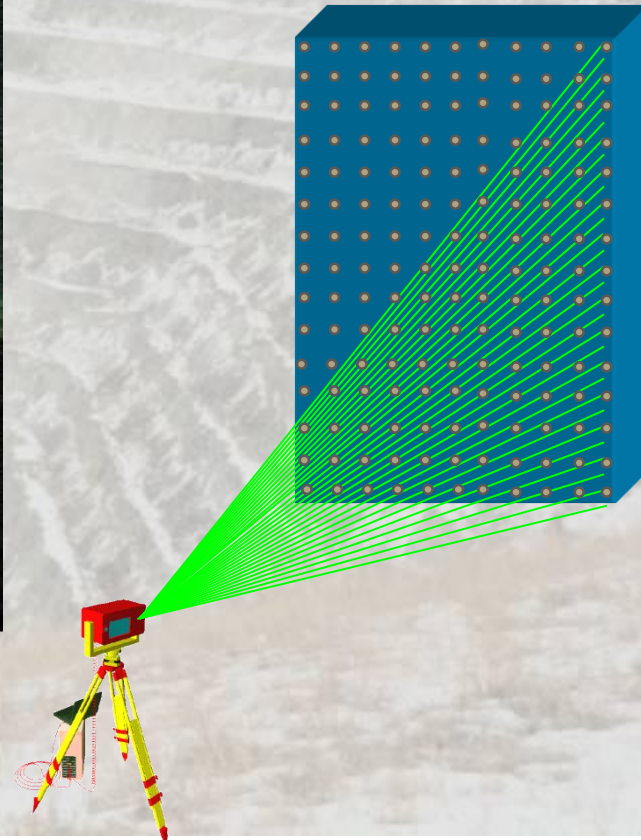
# Polar System Measurements... With Images!

- With the introducing of imaging capabilities in the Total Station the surveyors, besides sampling the data with laser beams, can now easily document the features during his Geospatial Information data collection. With a proper technology, one can even perform basic photogrammetric operations as, for instance, image-retification and others to improve ones post-processing data analysis.
- Remote measurements with automatic features collection> Less risky conditions.



# High Definition Scanning... Cloud Points!

- With the introducing of the High Definition Scanning System a new paradigm was imposed to the mining sector. Surveyors can now perform more than just geospatial data collection. One can now bring the data to the office and decides afterwards what really needs to model.
- Remote measurements and office modeling > Less risky conditions.



# New technologies to get the Geospatial Information!... But Can I integrate all information Collected?



# New technologies to get the Geospatial Information!... But Can I integrate all information Collected?



**Other Brands**



**Existing Viva GNSS System**



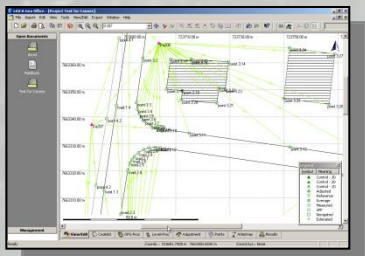
**Existing Viva TS15 Total Station**



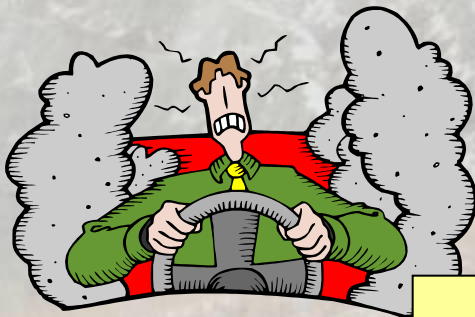
**User**

**Existing TPS and GNSS System-1200**  
Support Project data

**Existing TPS1100**  
Support Project Data



**Flow Project Data**



**Convert Tools**



# The integration of all Geospatial Sensors in one Platform!... **SmartWorx Concept!**



Powerful TPS Sensor Integration

+



Powerful data Collection

+

## GS12



Powerful GNSS Sensor Integration

## Geospatial Data Collection Integration



# And Then...!

# The integration of all Geospatial Sensors in one Platform!... **SmartWorx Concept!**



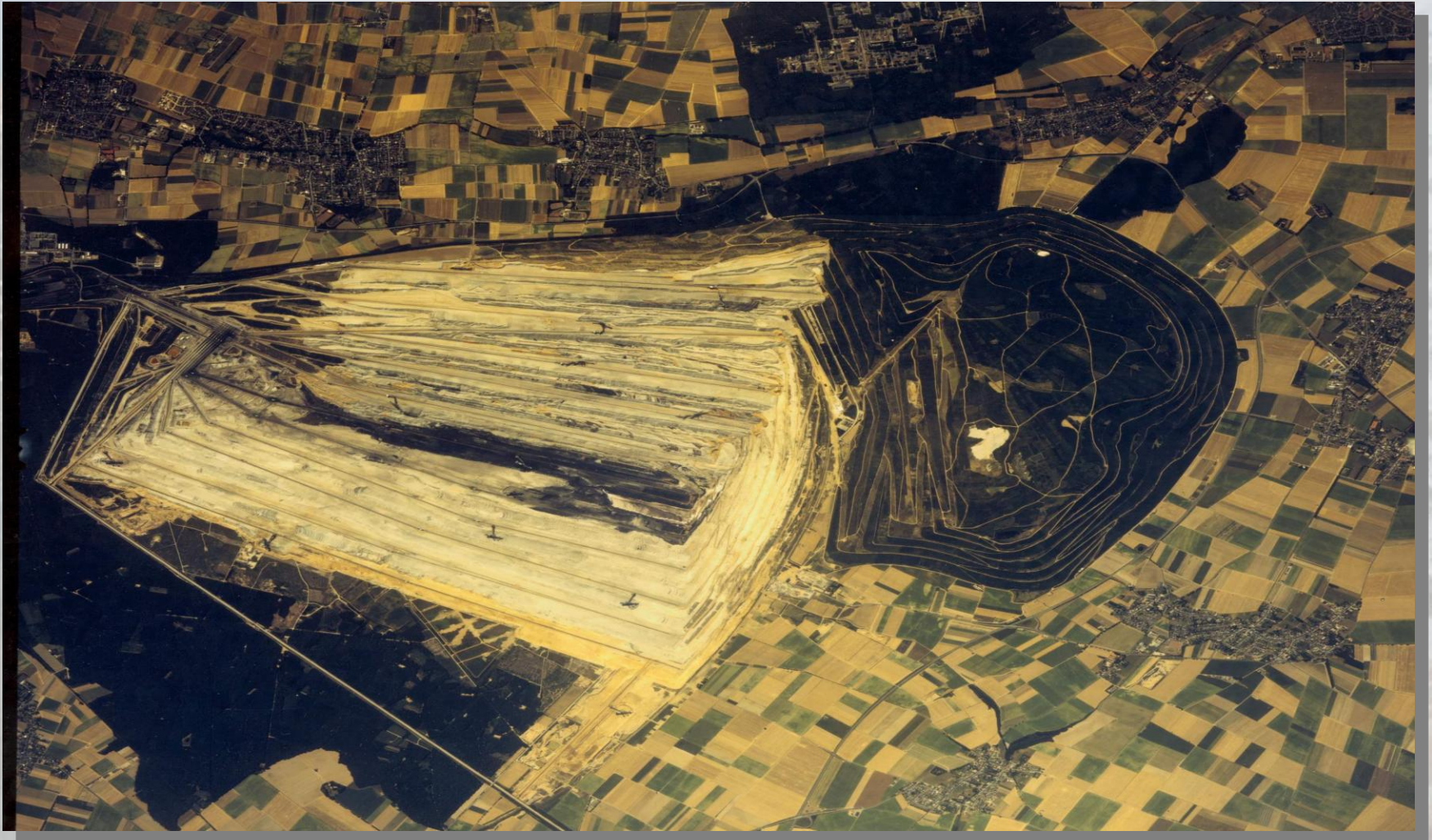
All sensors using the same platform, data exchange and data analysis - Powerful Integration - SmartWorx Viva!



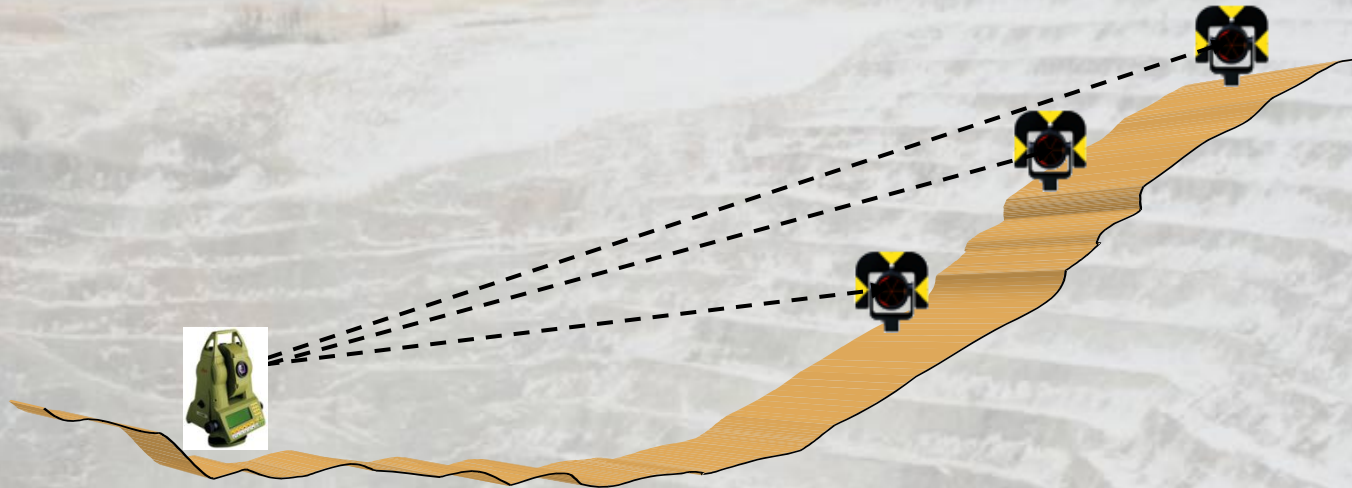
# Can I use these Geospatial Technologies in other Applications than just Data Collection?...



# Slide Monitoring in Open Pit Mines...

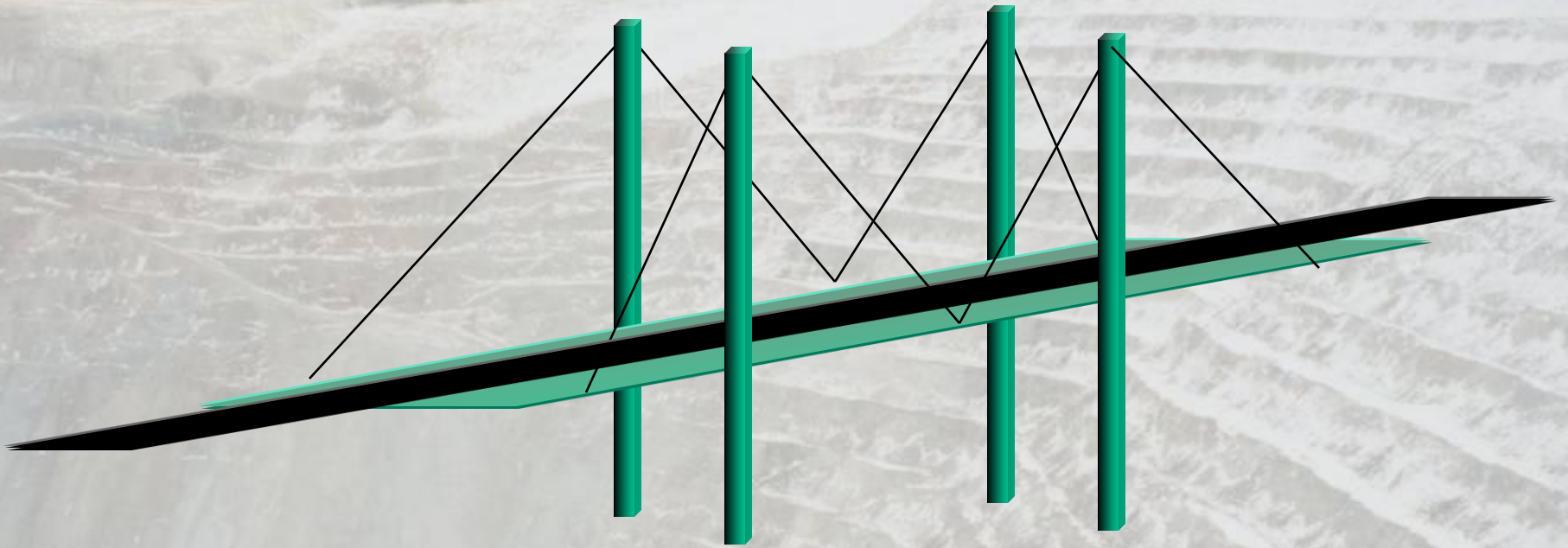


# Slide Monitoring in Open Pit Mines...



- Slide Monitoring with Robotic Total Station is the first example of the use of geospatial technology other than spatial data collection.
- A Robotic Leica Total Station linked to a communication port and managed by an intelligent data processing and data analysis system (GeoMos) has been the standard for years.

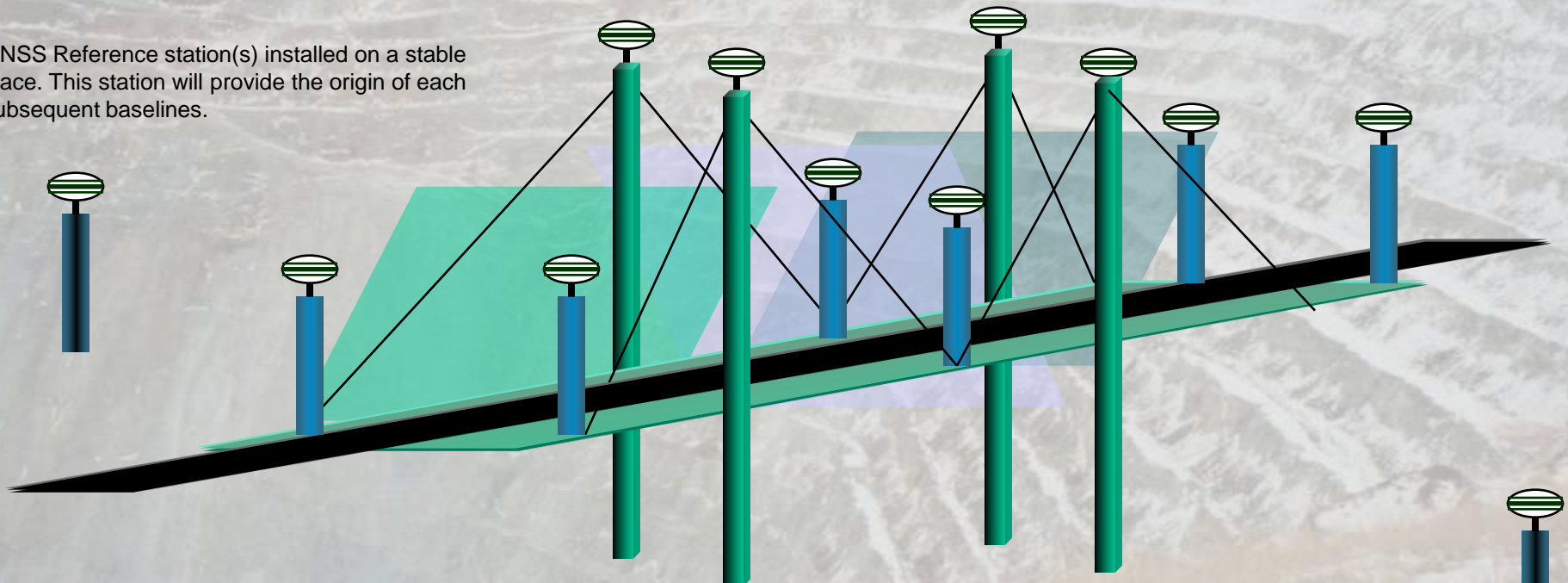
# Civil Engineering Infrastructure Monitoring...



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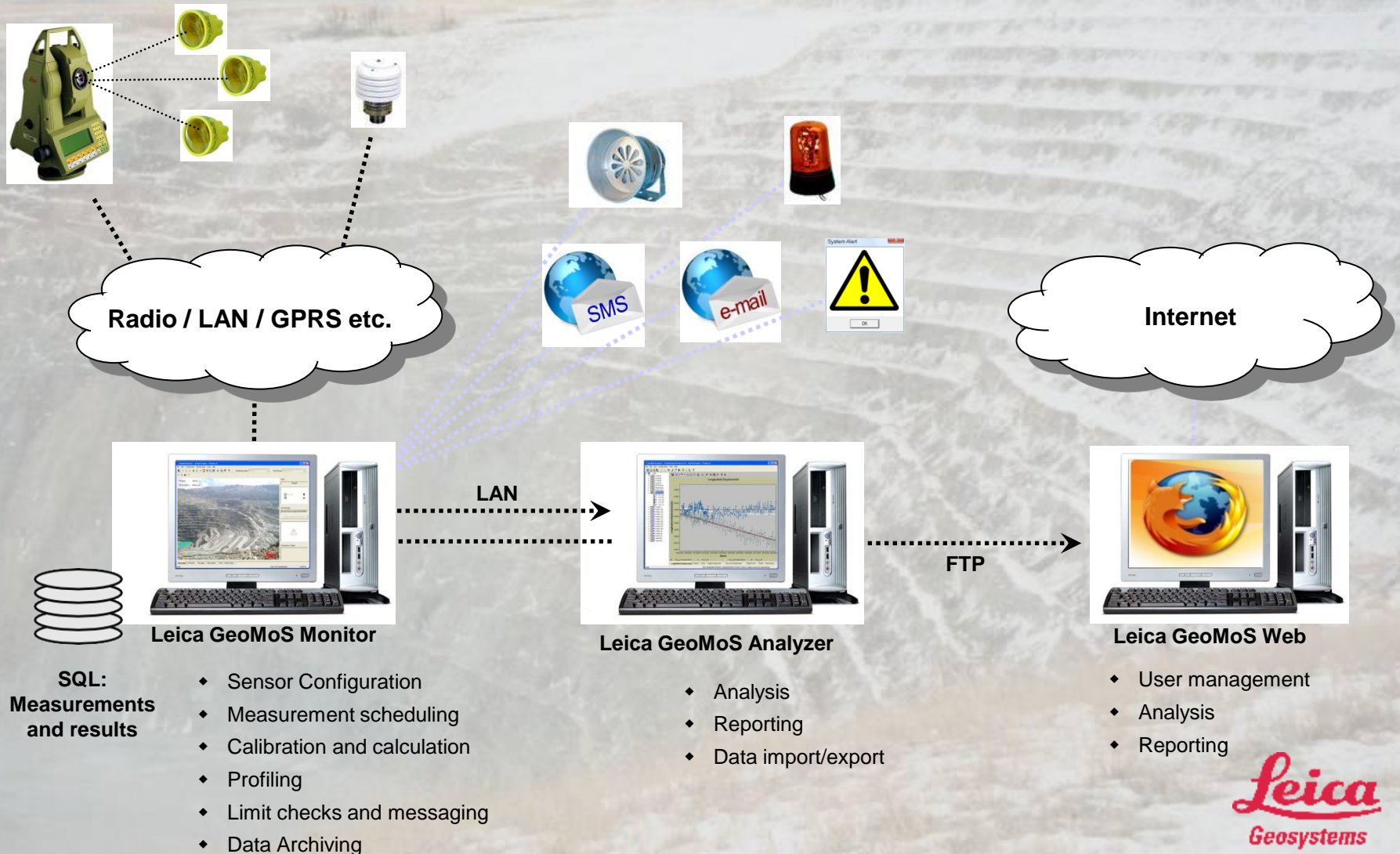
- Civil Engineering Infrastructure Monitoring with GNSS technology is another example of the use of geospatial technology other than spatial data collection.
- GNSS sensors linked to communication ports and managed by an intelligent data processing and data analysis system (GeoMos) is the newest solution used worldwide.

GNSS Reference station(s) installed on a stable place. This station will provide the origin of each subsequent baselines.

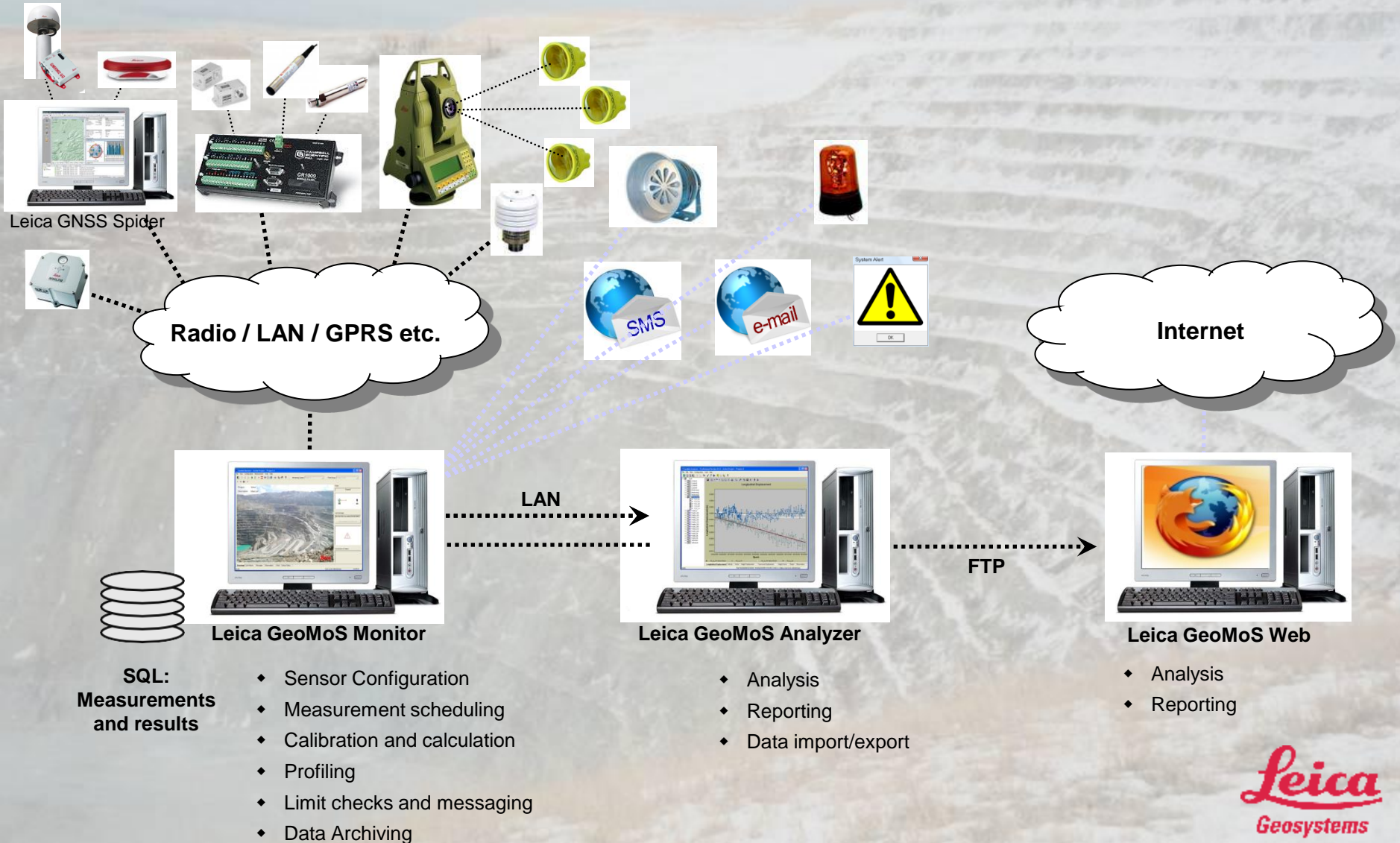


GNSS monitoring stations installed on the infrastructure will be the “measuring points”.

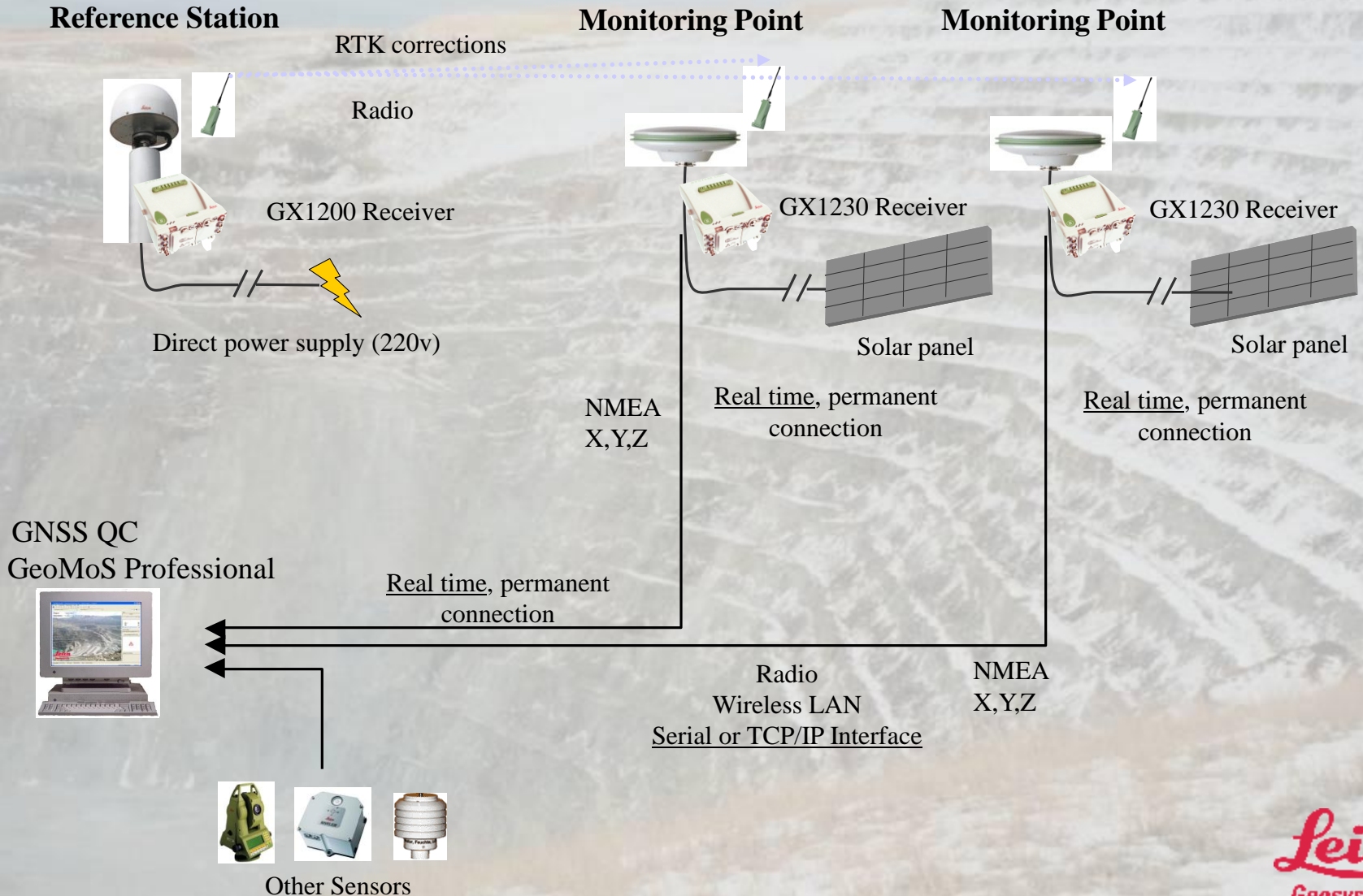
# Automatic Monitoring System... Polar Monitoring Architecture



# Automatic Monitoring System... Multi-Sensor Monitoring Architecture

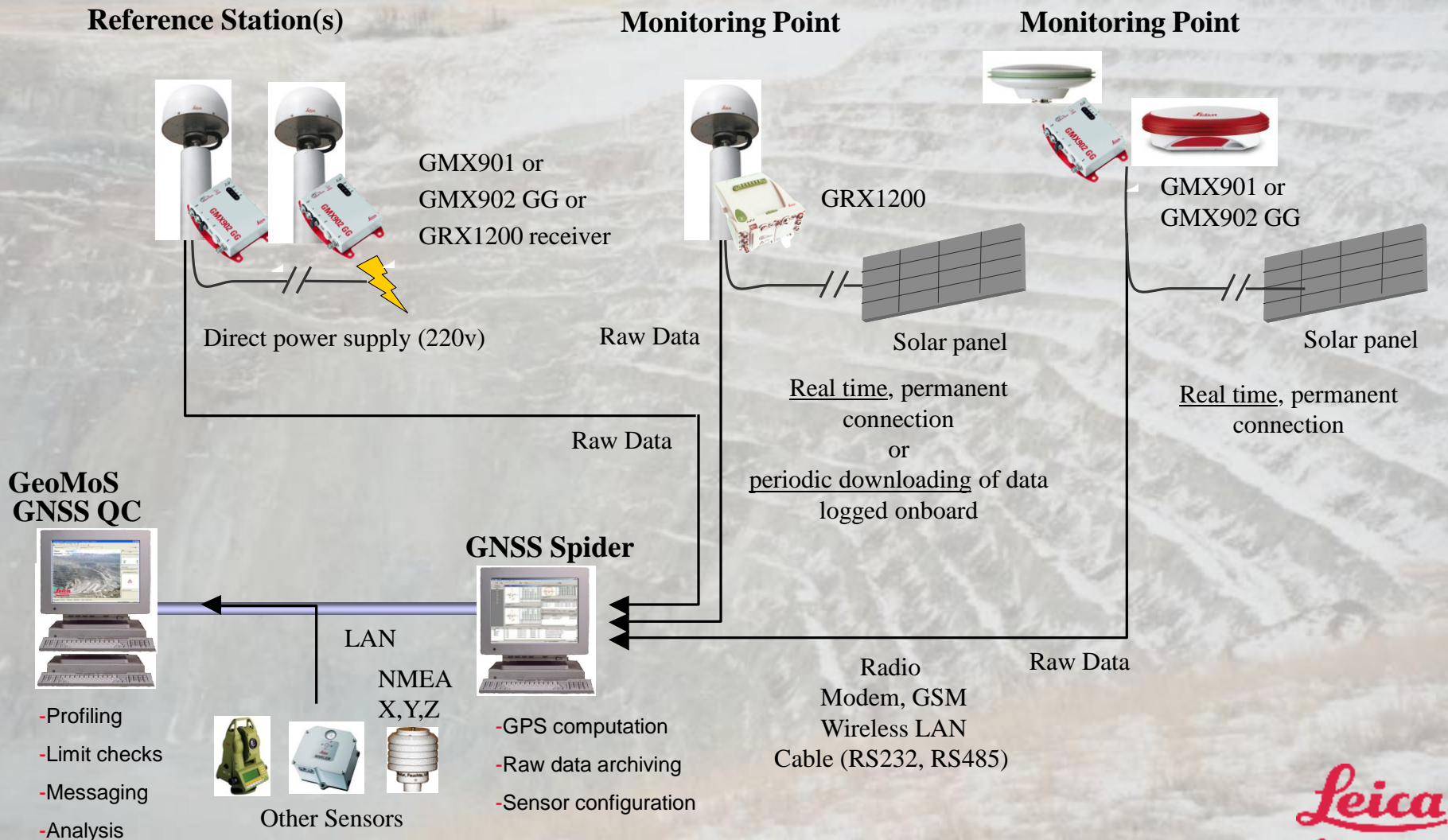


# Automatic Monitoring System... Real Time GNSS Monitoring Architecture

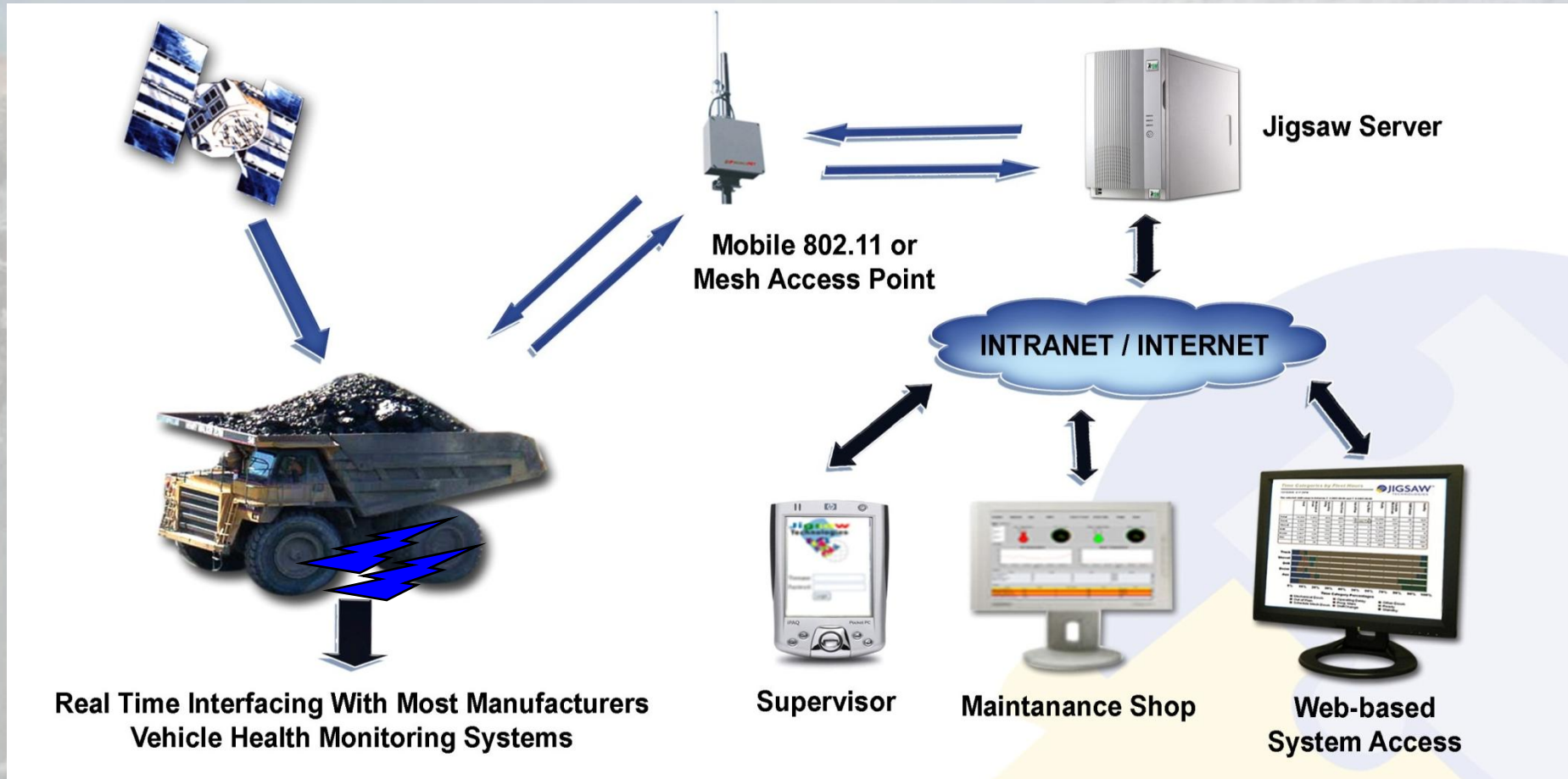




# Automatic Monitoring System... Advanced GNSS Monitoring Architecture



# Fleet Management System... Advanced GNSS and Multi-Sensor Architecture



# Today's technologies... for fast, reliable and efficient spatial data collection

## One point



TPS



GPS



DISTO™



## Millions of points



Laser Scanning

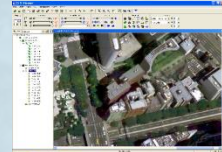
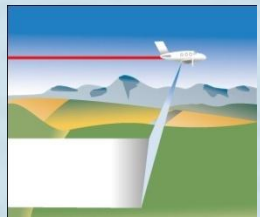


Point-cloud Management

## Image-based



Aircraft-based



Remote sensing



Photo-grammetry



Many Thanks for your attention...

