A Cloud Robotics Based Service for Managing RPAS in Emergency, Rescue and Hazardous Scenarios

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European Geosciences Union General Assembly 2016
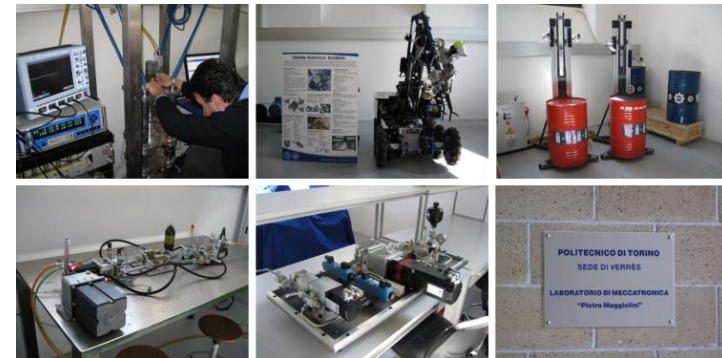Vienna | Austria | 17–22 April 2016

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Mechatronics Laboratory

POLITECNICO DI TORINO – Torino/Verrés

▸ 25 people Staff

▸ Research fields
- Magnetic Suspensions
- Rotordynamics
- Control Units for Mechatronics Applications
- Magnetic Damping Technologies
- Power and Special Actuators
- UAVs and UASs
- Custom Payload and Architectures for UAVs

Agenda

▸ Mechatronics Lab

▸ Motivation

▸ The Cloud Robotics Approach

▸ RPAS & Cloud

▸ Application Examples

  ◦ Search and Rescue

  ◦ Imaging Survey

▸ Conclusion

Motivation

▸ RPAS need:
  ◦ Switching from piloting to autonomous flight
  ◦ Moving to remote control or management
  ◦ Deal with complex scenarios
  ◦ Manage big amount of data
  ◦ Interact and deploy data to several users

▸ Cloud robotics and cloud services allow:
  ◦ Switching from "local" to "centralized" intelligence
  ◦ Interact with user at various level
  ◦ Managing different kind of "robots" and services
  ◦ High computational capability and data storage
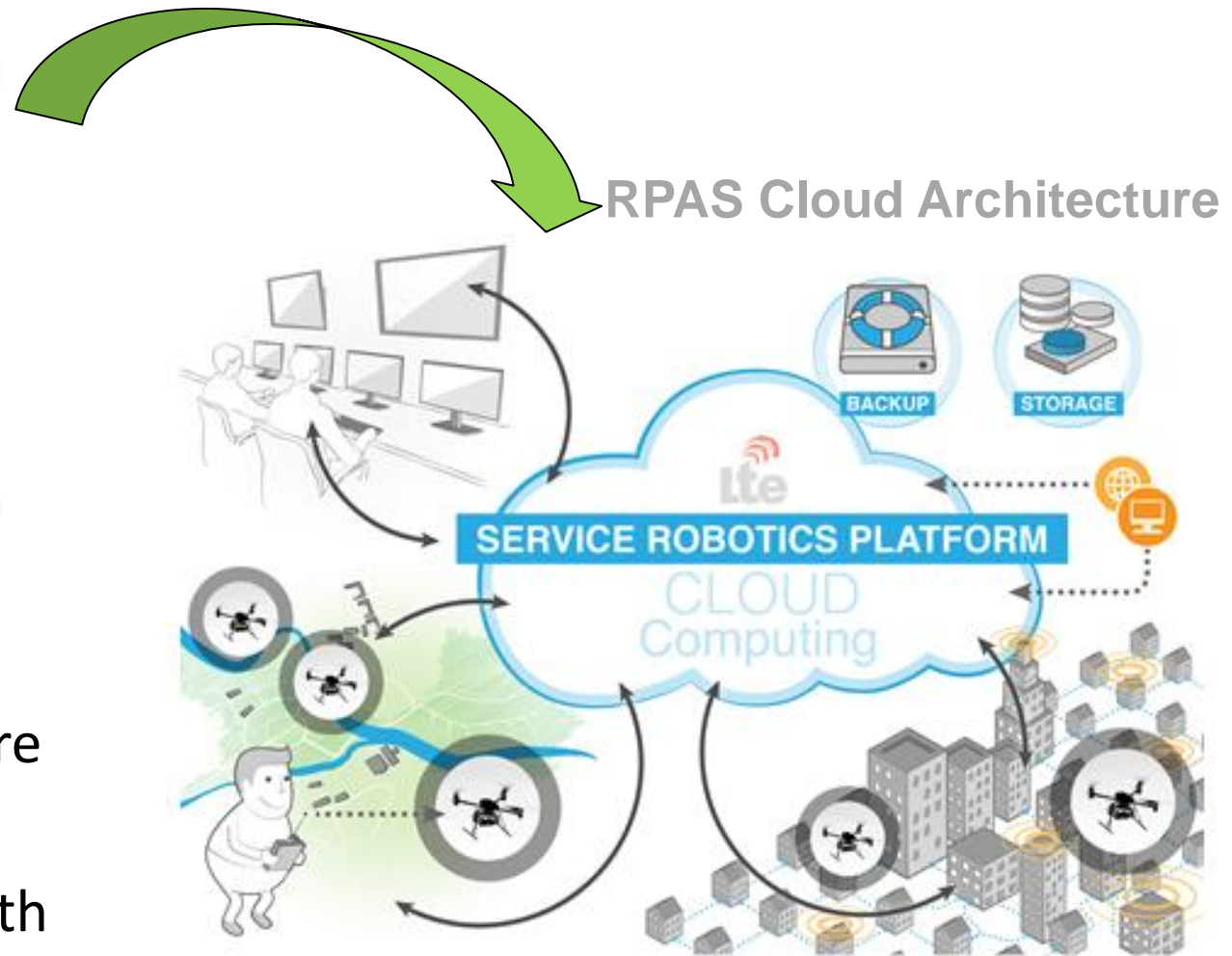 ◦ Share knowledge and information
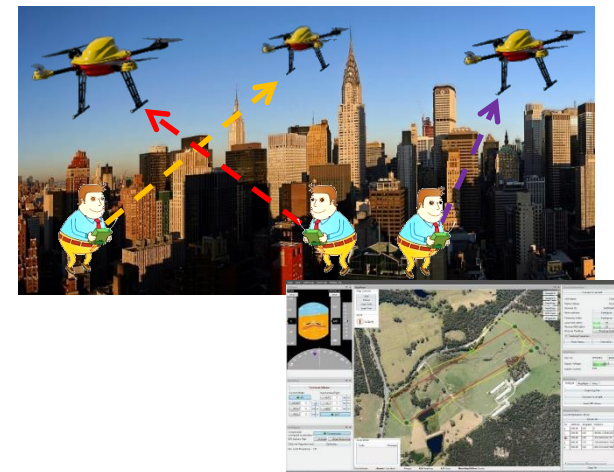
The Cloud Robotics Approach

Cloud Robotics

RPAS Cloud Architecture

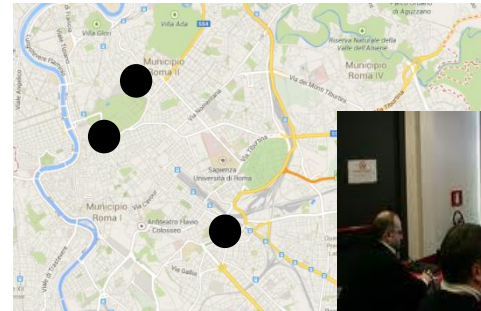- Shared approach
- Reliable RPAS
- Reliable architecture
- Low com latencies
- High data bandwidth

RPAS Cloud Architecture: Main Capabilities

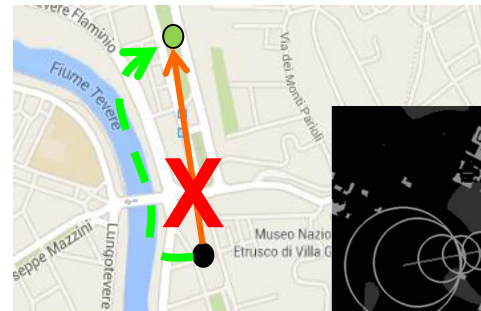▸ RPAS monitoring

- ◦ Real time
- ◦ Missions database and backup
- ◦ Real time video deployment
- ◦ Data collection and deployment
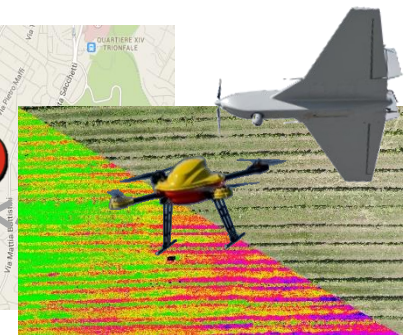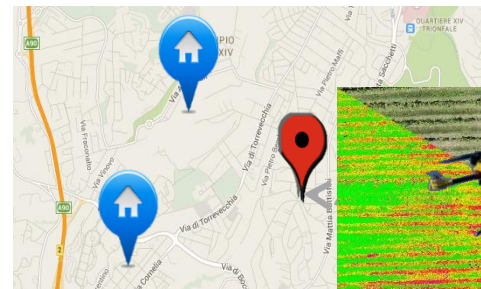- ◦ Virtual transponder

▸ Validated Mission Planning

- ◦ Including terrain profile
- ◦ Including known "obstacles" and constraints
- ◦ Data fusion with other Database

▸ Resources sharing

- ◦ RPAS status for dynamic mission planning
- ◦ Sensors measurement sharing

Application Examples

▸ Search and Rescue (Fly4SmartCity)

- ◦ Complete automatic Remote Mission
- ◦ RPAS platform independent
- ◦ Final User start the "emergency"
- ◦ Automatic Planning and Validation
- ◦ Live Video&Data streaming with 4G
- ◦ Remote Mission control
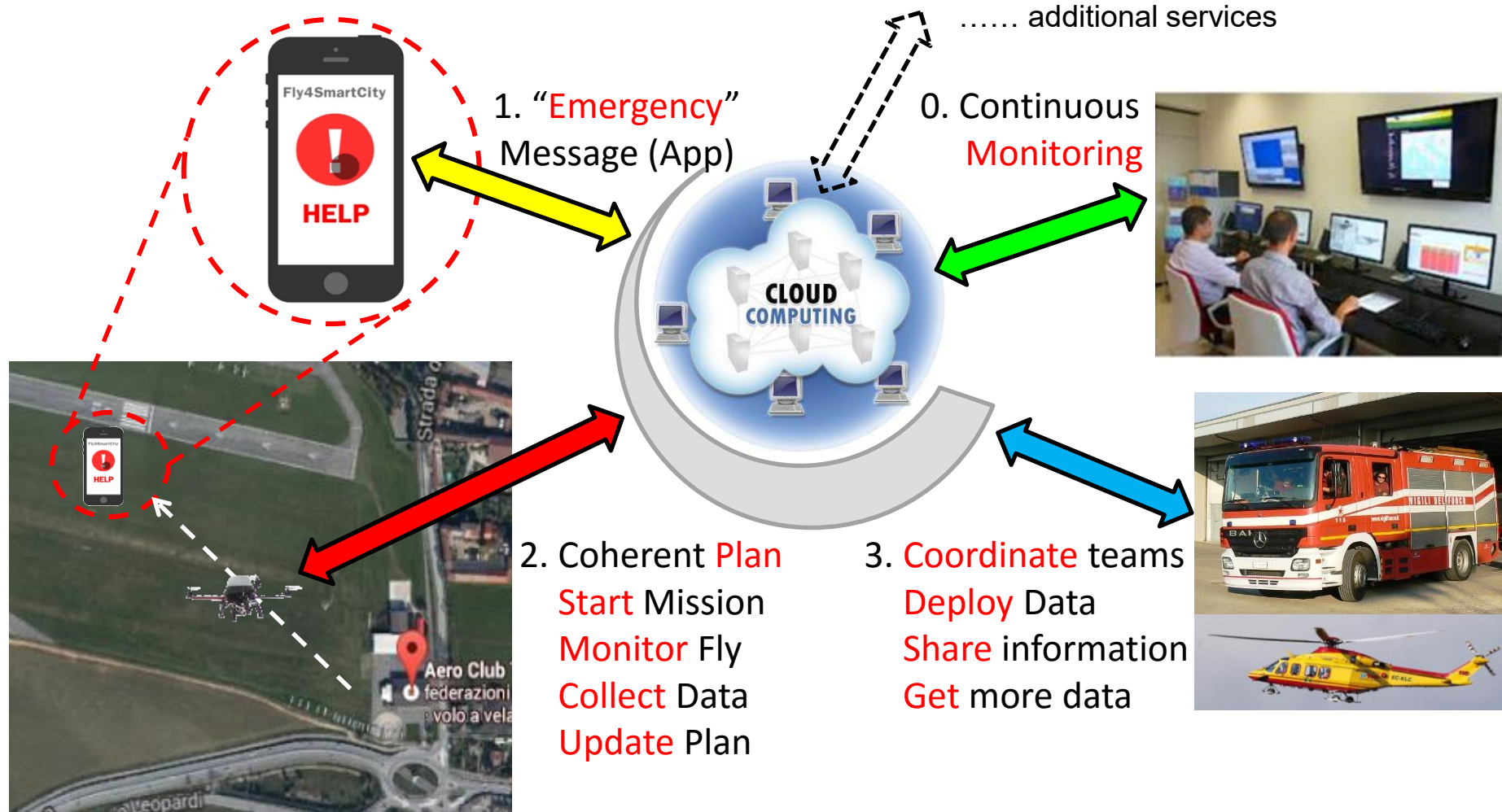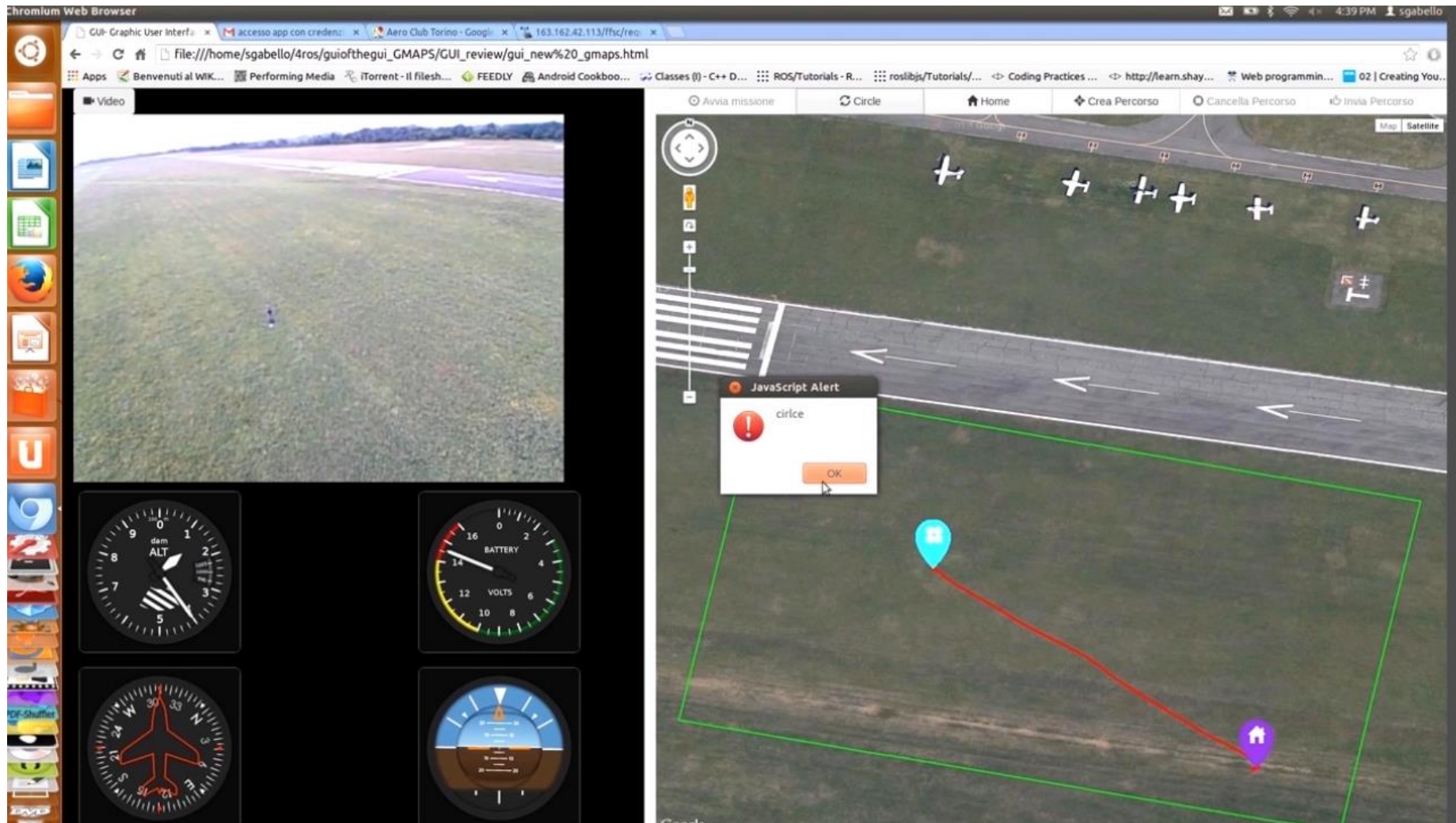- ◦ Multi-client data deployment
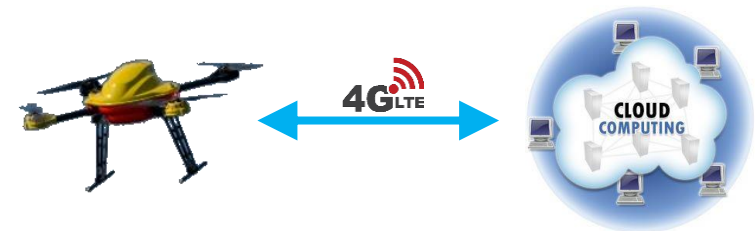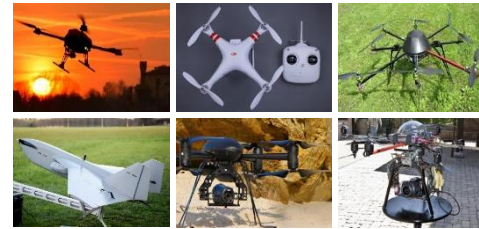
▸ Imaging Survey

- ◦ Hybrid Mission (*in situ* RPAS crew)
- ◦ Validate mission is retrieved from cloud
- ◦ Crew manages the "flight"
- ◦ Acquired data are forwarded to cloud
- ◦ Data is checked

in situ crew

Search and Rescue: Fly4SmartCity DEMO

…… additional services

1. "Emergency" Message (App)

0. Continuous Monitoring

2. Coherent Plan
   Start Mission
   Monitor Fly
   Collect Data
   Update Plan

3. Coordinate teams
   Deploy Data
   Share information
   Get more data

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Search and Rescue: Fly4SmartCity

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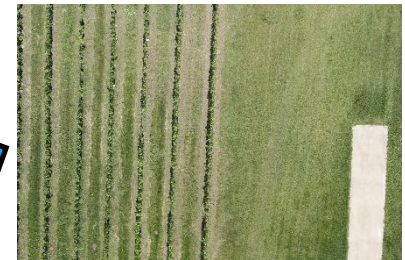
Automated Imaging Survey
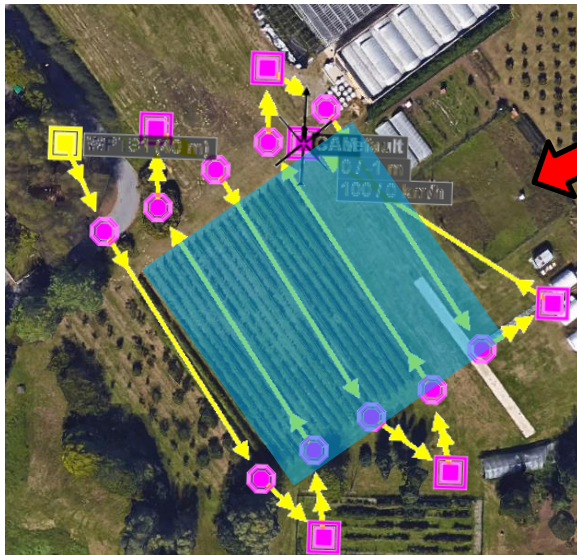

1. Crew&RPAS Set-Up
   Local site Check
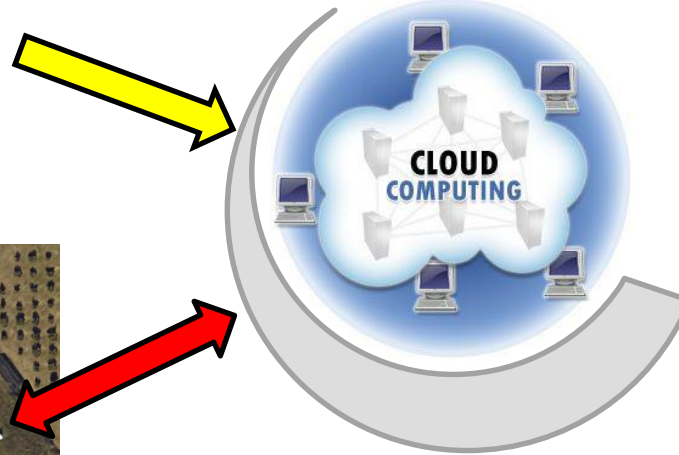
3. Data Collection
   Data preliminary validation

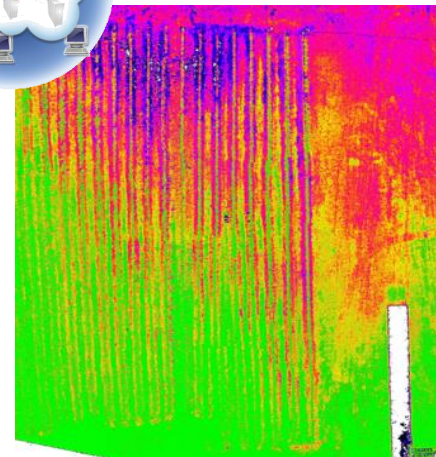2. Validate Plan
   Start Mission (crew)
   Monitor Fly (crew&cloud)

Data Processing

▸ Data (images&fly-data) are received in cloud

- During flight with a proper resolution according communication bandwidth
- Flight performances is checked
- Images is checked (overlapping, exposure, incoherencies…)
→ if check is OK crew proceed to the following mission
- After flight with original resolution for further processing

▸ Data processing and Exploiting

- Common Automated (Manual) processing
- Data are available for users

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Conclusions

▸ Architecture and Technologies validated in different scenarios

▸ RPAS independent

▸ Rely on 4G or other transmission technologies (up to SAT)

▸ Automated or Hybrid Remote Controlled

▸ Allow Data integration in «planning» and «processing»

▸ Can be customized to several scenarios:

  ◦ S&R and Mapping

  ◦ Disaster Management

  ◦ Patrolling

  ◦ Agricultural

  ◦ Industrial

  ◦ Home Land and Border Security

  ◦ Mountain safety

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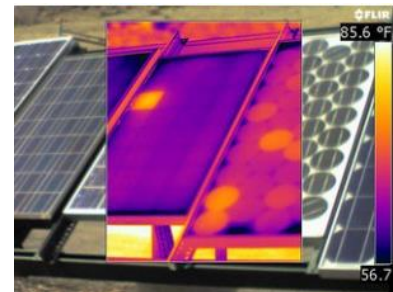
Thank You

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