ARATOS GROUP and OMEGA Company Presentation for an Integrated Technical and Operational Solution for:
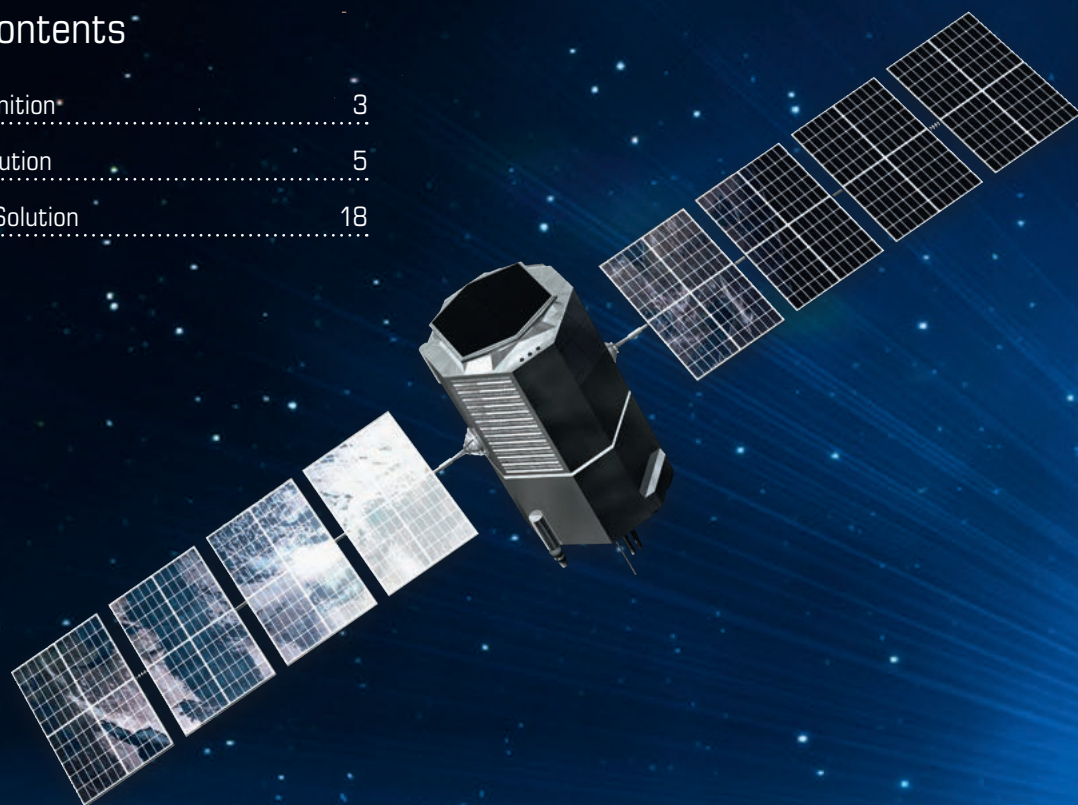
Pipeline Monitoring and Security

## Table of contents

Problem definition

Introduction

Critical infrastructures (free-standing) like pipe-lines (oil, gas and water) that extend hundreds of kilometres through the countries are most unpro-tected and easily vulnerable against vandalism and sabotage. Pipelines are a highly efficient means of transport. However, the most common causes of pipeline damages are:

▶ Construction and material failure
▶ Welding and under-bed/seating
▶ Aging/corrosion and mechanical damages
▶ Operating/human errors like overpressure
▶ Third party construction work or farming
▶ Earth movements due to mining, soil erosion or earth quakes
▶ Mechanical damages caused by near rails and roads (vibration)
▶ Willful damages (vandalism, sabotage, terror attacks, illegal tapping and theft)
▶ Damages by storms (lightning) and floods

Technical Solution
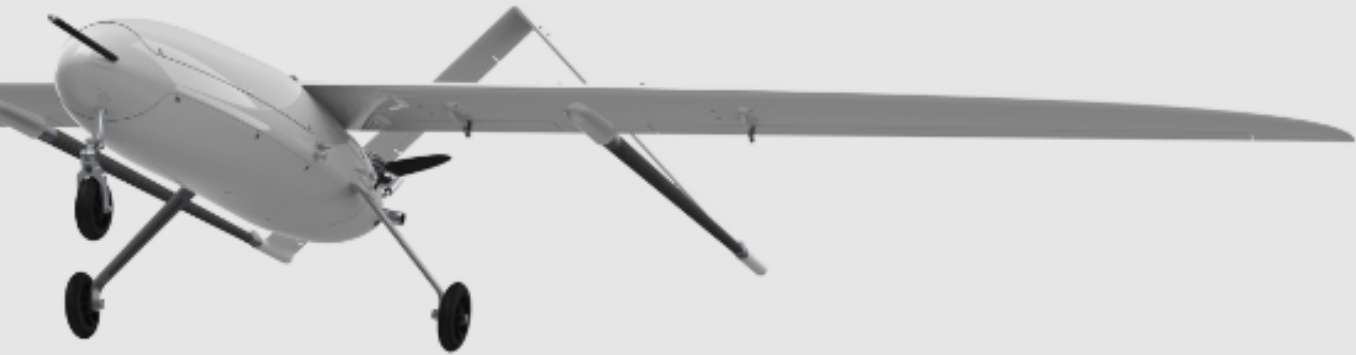
Solution

▶ Combined integrated technology flexibility and operation through space, air, ground, underground

▶ We offer products which have operated for years in different countries and under different conditions

▶ Our focus is to offer easy to operate and robust products which we can give guarantee and maintenance

▶ We offer products with a high level of automatic operations

Methodology Followed

▶ Pro-active actions – Satellite technologies (Precaution)
   – Mapping of the area
   – Change detection in the ground (digging to install explosives)

▶ Live surveillance 24/7 using multiple different sources, from space, UAV's, ground cameras, fiber optics technology

▶ Immediate response actions to prevent threats to all forces and inserting different priorities

Aratos Holistic Solution

	Space	Satellite Imagery
	Air	UAV's Ground level monitoring Advanced sensors
	Ground	UGV's; Ground radar stations; Advanced cameras; Command and control
	Underground	Fiber optics

Satellite Detection Example – Rumalia Production Field

Aratos Pipeline Security Solutions

Integrated solutions for pipeline protection include:

▶ Prevention
▶ Monitoring
▶ Secure solution
▶ Immediate response actions

Aratos vision integrates different monitoring technologies offering:

▶ High quality
▶ Endurance and flexibility
▶ Low minimum intervention

Schema: ARATOS UAV's, Ground Level Air Monitoring and Satellite Complex Systems

UAV's	Satellites	Ground Level Air Monitoring
Limited distance readings, predetermined distance, control operator, operator center, maintenance	Worldwide coverage transition of data to user's premises	No maintenance, no danger in case of crash, no noise, no runway needed
High-resolution data, cost effective	Very high-resolution data, high cost	Cost effective, great accuracy on night
Limited multispectral data capabilities	High multispectral capabilities	Thermal sensors equipped, ideal for night missions
Acquisition of reliable readings independent of weather conditions	Satellite readings disturbance due to cloud coverage	Small electric unit, wind resistance +/– 50 km
Limitations in remote and inaccessible areas	No limitations	Allows monitoring BLOS (Beyond line of sight)
Flexibility user's requirements, cost effective	Limited flexibility, high cost	Flexibility in user's requirements
Information level limited sensor capabilities	Information level in situ measurements	Information level transmitted through GSM network near real time

Pro-Active Monitoring from Space

Satellites present numerous advantages

▶ Provide full global and remote coverage
▶ Provide accurate data for action in large areas
▶ Provide accurate indications of ground change detection, e.g. digging
▶ Allow fully automated processes through interactive GIS interfaces findings display
▶ Daily surveillance

Change Detection – Distillery 2003

Change Detection – Distillery 2005

Satellite Image Processing

ARATOS offers unique software for the processing of the satellite images received.

▶ Providers of high resolution imagery for topography information, resources analysis, optical detection of threats, management of the resources (stereo satellite sensors GeoEye-1, WorldView-2, WorldView-1, QuickBird, IKONOS, SPOT-5, and DEM)
▶ **SAR** provides data in order to detect leakages, corrosion and other threats

ARATOS UAV A
for ISTAR

Specifications

Parameter	Value
MTOW	21.5 kg
Empty Weight (excl. fuel and payload)	10 kg
Wing Span	3.3 m
Length	2.27 m
Wing Area	0.79 m
Powerplant	2.5 hp
Max Payload	10 kg
Takeoff method	Catapult, Runway or car top launch
Environmental protection	Sealed against rain, snow

Performance

Parameter	Value
Endurance	20+ hours
Cruise Speed	22 m/s
Stall Speed (with high lift system)	13 m/s
Max Level Speed	36 m/s
Takeoff run	30 m
CL max (45° flap deflection)	1.7
CL max (clean wing)	1.3

**Gyro stabilised micro gimbal**

▶ One of the smallest gimbals on the market
▶ Market leading price ratio
▶ All electronics embedded within the unit
▶ Outstanding stability thanks to direct drive
▶ Complete three-dimensional IMU mounted on the optical bench
▶ Worldwide delivery

Options

▶ Integrated video auto-tracker
▶ Geo-location and geo-positioning
▶ UAV's Car top launcher
▶ 3W 28 CS engine upgrade
▶ Electronic Fuel Injection (EFI) upgrade for 28i
▶ Onboard Generator System upgrade
▶ Heavy Duty Landing Gear
▶ Long Endurance Fuel Tank
▶ Fuel Tank Level Sensor
▶ Header Tank Fuel Sensor
▶ Four servo V-tail
▶ Universal Payload Mount
▶ Push-pull connectors for wing
▶ Transportation Case
▶ 6 kj Portable Pneumatic Catapult
▶ Portable GCS Ground Control Station
▶ Pitot Static Tube for UAV's
▶ Heated Pitot-Static Probe for UAV's
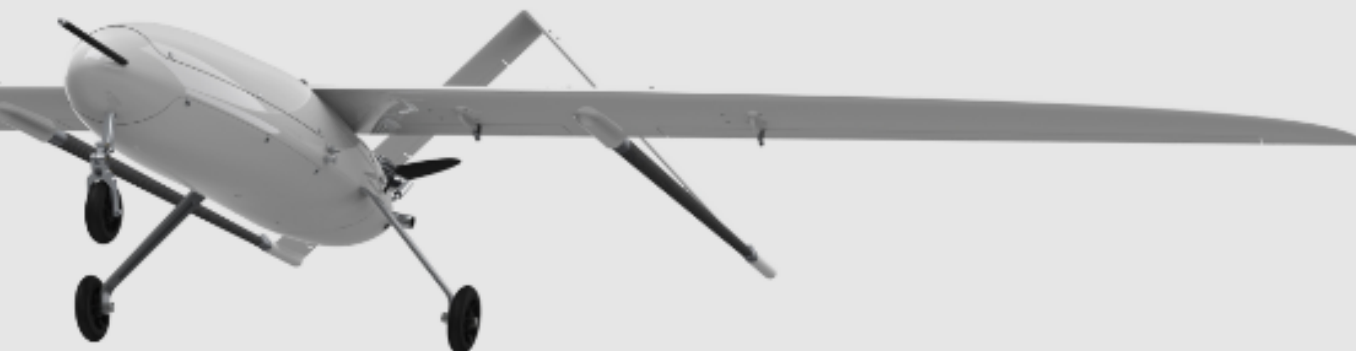
GCS Ground Control Station

ARATOS offers small Unmanned Aerial Vehicles (UAV's) fully integrated with Flight Control System (FCS) and intelligent payloads for ISTAR activities.

Ground Control Station (GCS) and Mission Software
Mission software requires minimal operator input even during emergencies, communication loss, or adverse meteorological conditions while in advanced automatic flight mode.

The window-style layout and usage, point & click, and menu operation allow less than one week training time even for non-experienced operators.

Mission software can use most digital Customer mappings (orthophotos, **Google Maps, Microsoft live maps,** image captures, or specific Client's maps). The operator can select different coordinate and reference systems (UTM / MGRS / LAT-ON, etc.). The system also features Digital Elevation Models (DEM) for terrain altitude, precision geo-pointing and altitude warnings.

Auto tracking antenna
▶ Coverage up to 100 km
▶ Video frequency: 1.2, 1.3, 2.4, 5.8 GHz
▶ Data frequency: 902–928 MHz
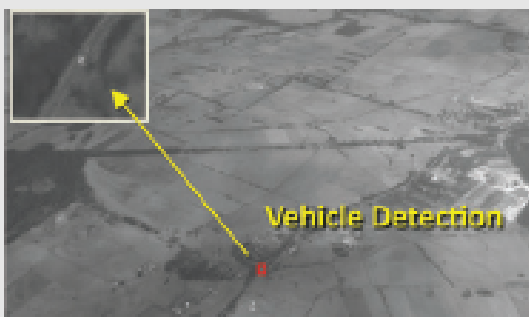
Vehicle Detection

Automated Tracking Detection Software

▸ Dismount detection speed 2 km/hr min.

▸ Fast target detection up to 100 knots

▸ Automated detection day and night

▸ Reliably detects small objects, 2×2 pixels

▸ Vehicle tracking

▸ Partially obscured targets

▸ Convoy route reconnaissance

▸ Zone surveillance

▸ Low flying aircraft

▸ Insurgency alert

▸ Tracks hundreds of potential targets
   simultaneously

GLAM Ground Level Air Monitoring

GLAM Ground Level Air Monitoring is a revolutionary solution to monitoring at night threats which are caused by humans.

Technology

Small electric unit (wingspan 2120 mm, weight 3.5 kilos, wind resistance +/– 50 km, cruise speed 50 km, max. speed 90 km) equipped with a thermal camera and software for following the pre-programmed waypoints (no transmission is needed). The frame is moulded out of EPO so it's nearly indestructible, no danger for manned plains, humans and objects (infrastructures) on the ground in case of a crash/collision. If the unit detects automatically a "POI" (Point of Interest) on the ground the software compresses the picture to format JPEG and sends it through GPRS to the responsible people including LAT, LON and UTC TIME to response/act on threats.

This technology allows to monitor BLOS (Beyond line of sight) and to fly at any time the same distance to the ground!

Principe

The units have brushless electric engines and can operate up to 2 hours with a cruise speed 50 km = Range 100 kilometres. The software manages also the wind conditions and puts the unit in gliding modus at any time in optimal wind conditions to save batteries.
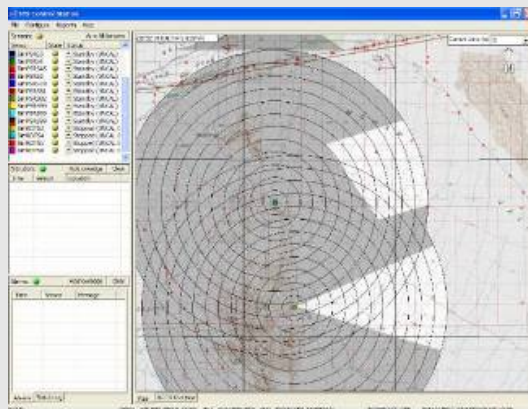

GLAM in two different frames available

Ground Surveillance Radar

Ground Radar (Freq Modulated Continuous Wave type)
▶ K-Band
▶ Range: 5 km (human), 10 km (vehicle)

Integrated Control Station interface with: Ground radar, RCWS, UGV's, Long-range cameras via RS232/422

Aratos and Omega Pipe-line Monitoring and Security Solutions

▶ Integrated solutions for pipeline include:
  – Prevention
  – Monitoring
  – Secure solution
  – Immediate response actions
▶ Aratos vision integrates different monitoring technologies offering:
  – High quality
  – Endurance and flexibility
  – Low minimum intervention

Omega Company – Leak Detection and Activity Control System

▶ The Omega Company is a leader in fiber optic based long distance sensing
▶ Founded in 2009, the Omega Company has experience in developing, commencing and improving LDACS
▶ The Company has equipped over 5000 km of oil pipelines with the LDACS. Over 1000 km of pipelines are set to be equipped in 2013
▶ The system is designed and verified in the course of further supportive research and testing by leading academics of Russian Academy of Sciences (RAS), Lomonosov Moscow State University and specialists from RAS Institute of Computational Mathematics

▶ The system possesses all necessary certificates and licenses attested by the legislation of Russian Federation
▶ Availability of comprehensive and regularly updated documentation of all LDACS components

The Omega Company Success Stories

▶ "Baltic Pipeline System (BPS-2)", equipped length – 1000 kilometers
▶ "East Siberia – Pacific Ocean" Pipeline System, "Skovorodino – Koz'mino" sector, equipped length – 2500 kilometers
▶ "Pur-Pe – Samotlor" Pipeline System, equipped length – 429 kilometers

OMEGA LDACS
Operation Principle

▶ Based on application of fiber-optic sensor

▶ The sensor captures temperature changes along the pipeline (DTS) and transforms it into signals for the system operator.

▶ The sensor is also capable of performing vibro-acoustic measurements of the pipeline (DVS) by detecting sources of noise and vibration.
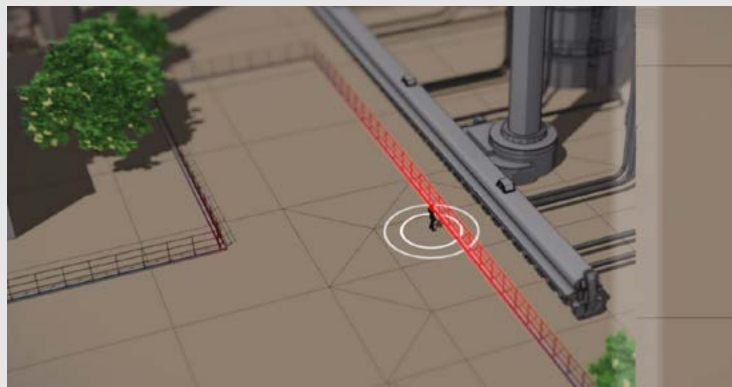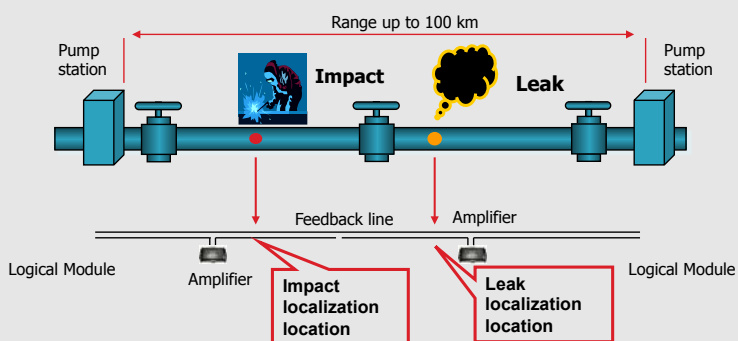
OMEGA LDACS
Technical Specifications

Environment temperature control module (DTS)

Impact detection accuracy along the distributed sensor	± 5 m
Leak detection of a fluid volume up to 2 m³ in less than	60 min.
Automatic detection of temperature change on a 5 meter cable sensor section, up to	1 °C
The pipeline length controlled by one module of the system	50 km

Environment vibro-acoustic control module (DVS)

Impact detection accuracy along the distributed sensor	± 5 m
Automatic identification of the activity type from the axis of the distributed sensor, up to:	
– excavation works by hand	3 m
– excavation works by trencher	10 m
– pedestrian movement	3 m
– vehicle movement	10 m
The pipeline length controlled by one module of the system	100 km

New UGV's Amphibious
6 & 8 Wheels

Advanced Cameras on the UGV's

LTVL Long Range Thermal and Visible Image Tracking System

Long Range Thermal and Visible Image Tracking System with Laser Illuminator on P/T

Features

▶ High Resolution Thermal Imager 320 × 240, 640 × 480 option
▶ Thermal Imager Optical: Dual FOV – 45/135 mm or Single FOV – 150 mm lens
▶ Long Range Day & Night Camera: 0.0000 1Lux
▶ Day & Night Camera Optical: 300 or 500 mm lens
▶ Automatic Laser Illuminator and Camera zoom inter-link system
▶ Precision Pan/Tilt Positioning Driver
▶ Intelligent Video Analytics (option)
▶ Autonomous PT Tracking (option)
▶ MPEG4 CIF/4CIF Encoder (option)

Detection, Alarms, Responses, Control for LTVL

LTVL Command and Control Software

Command Center

▶ Processor: Intel Core2 Duo Processor E4400
▶ Memory: DDR2 2GB 667 MHz
▶ HD: 250G
▶ Video Card: 256MB Dedicated Graphic Video Card
▶ Audio Support
▶ OS: Windows XP Pro / Vista / 2003 Server
▶ LCD PTZ Control Keypad

Console Display

▶ Live viewing of up to 4 channels
▶ Easy display of remote cameras
▶ Multiple layout views offer tile view or full screen
▶ PTZ remote-control panel for pan, tilt and zoom commanding of cameras
▶ Configuring Intelligent Video Analytics

Control Center

Aratos Integrated Control and Action Operational Center

Key Functionalities

▶ Handling of alarms
▶ Data visualization
▶ Management capabilities
▶ Data integration and interoperability
▶ Unified emergency responses
▶ UAV's management and control

Data Visualization

The visualization system is manageable so as to enable:

▶ Zoom-in capabilities
▶ Fast forward/record, etc. of video streams
▶ Manual annotation of video images
▶ Prioritized/selective visualization of received data/alerts according to the "criticality" of the alert, etc.
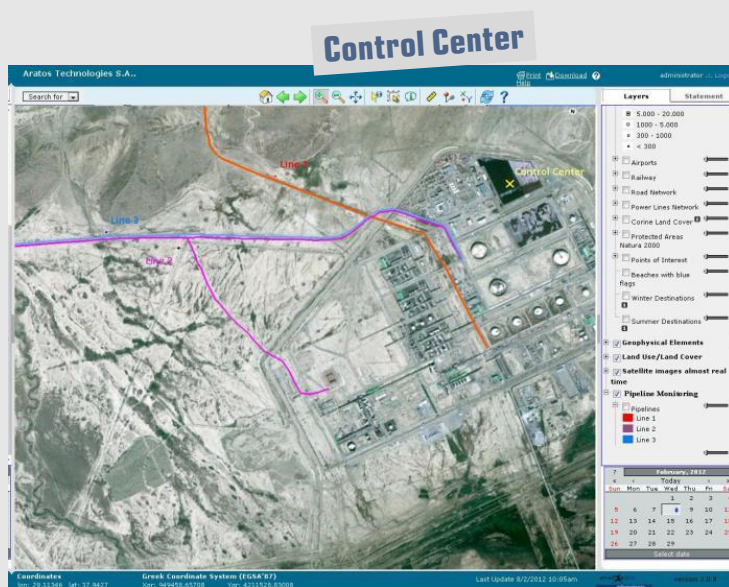
Additional Features

▶ GIS system for the visualization of the area of interest
▶ Specialized image processing software identifying automatically the targets
▶ Detection of damages and threats
▶ Operational 24/7 – Instant alerts

Aratos Holistic Pipeline Monitoring and Security Approach

UAV's

Radar

Fibre Optical

GLAM

Control Center

Camera

Other data sources

Satellite Images
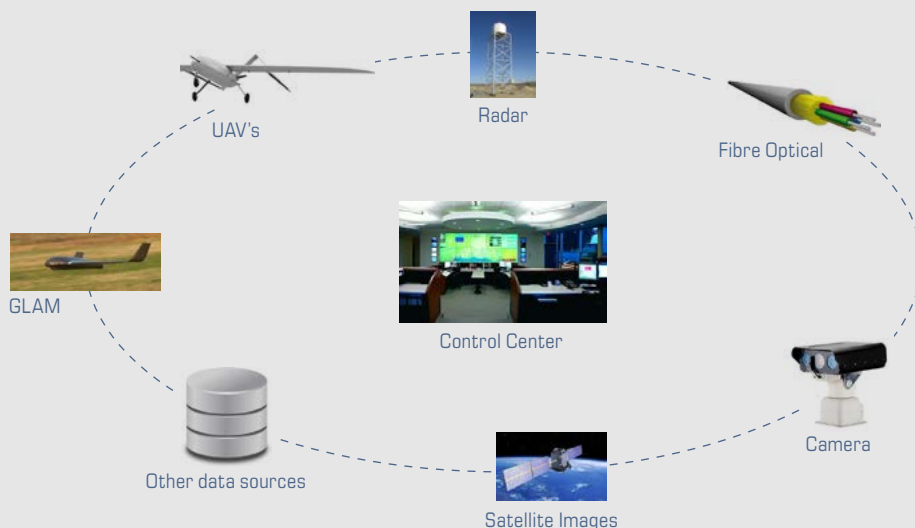
Operational Solution

Immediate Response Actions

▸ Uninterrupted surveillance 24/7
▸ Surveillance from:
  – Space
  – Air
  – Ground
▸ Coordination of technical solution from security forces

Control Centers

▸ The solution includes two type Control Centers:
  – Fixed
  – Mobile
▸ All the Control Centers are connected on line among them.
▸ All the Control Centers are connected on line with the security equipment (e.g. UAV's, cameras, etc.)

Human Resources

▸ Personnel in the Control Centers and coordinating persons (24/7)
▸ Personnel coming from local communities in order to protect the pipelines
▸ Police
▸ Military troops

Response Actions During Event

▸ Classification of actions according to level of danger
▸ The technical solution provides detailed description of the actions and classification of danger level
▸ Potential threat example could be considered a small unarmored team up to a large armored team

Classification Levels Example

▸ **Level 1**
  Small team (2–3 persons) unarmored
▸ **Level 2**
  Team of more than 5 persons, on a vehicle
▸ **Level 3**
  Small team (2–3 persons) armored
▸ **Level 4**
  Team of more than 5 persons, armored, on a vehicle
▸ **Level 5**
  Team of more than 10 persons

Classification Example According to Zones

▸ **Zone 1**
  Village
▸ **Zone 2**
  Far away from village
▸ **Zone 3**
  Difficult area
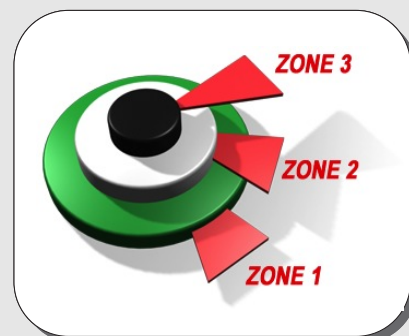
Classification Example

1. When the event is recognized it is being classified

	Level 1	Level 2	Level 3	Level 4
Zone 1			Event 2 (lat, lon, time)	
Zone 2		Event 1 (lat, lon, time)		
Zone 3				Event 3 (lat, lon, time)

2. Taking into account the above classification the decision for the response action is taken

Immediate Response Actions

Applied after taking into account the classification rules of danger levels and zones

Categories
- **RA1:** Dispatch of UAV's using loud noise and pepper spray
- **RA2:** Immediate alerting via SMS to key persons
- **RA3:** Immediate presence of local communities to the event point
- **RA4:** Dispatch of unarmored vehicles (UGV's and normal)
- **RA5:** Dispatch of armored vehicles (UGV's and normal)
- **RA6:** Police troops to the event point
- **RA7:** Militia troops to the event point

Each solution is offered according to the classification level and zone.

Communications

- The Control Center is receiving **all** the information
- The Control Center is connected online and communicates with the Top Level Security Command
- Communication with different levels of local commanders (police, militia, etc.)

Control Center

- Taking into account the human factor
- We create different levels of control points
- Top level will receive information from the lowest level
- Eliminate dangers of late alerting to the troops

Immediate Response in all Levels

Top Level of Command and Control
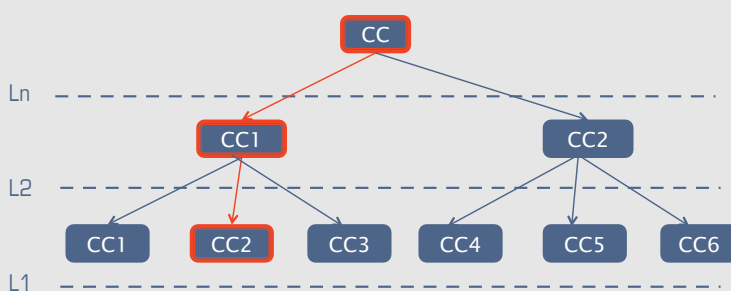
Case Example

▶ The ground radar detects movement of
  5 people 500 m away of the pipeline
▶ The Control Center is immediately notified
▶ At the same time the local communities
  are being alerted to be ready
▶ The UAV is dispatched and heading to the point
▶ As soon as it is above the suspects it is making
  loud noise
▶ The police or the UGV's are also approaching
▶ The UAV continues the surveillance
  over the area for more suspects, using
  thermal sensors
▶ Even if the problem is resolved the troops
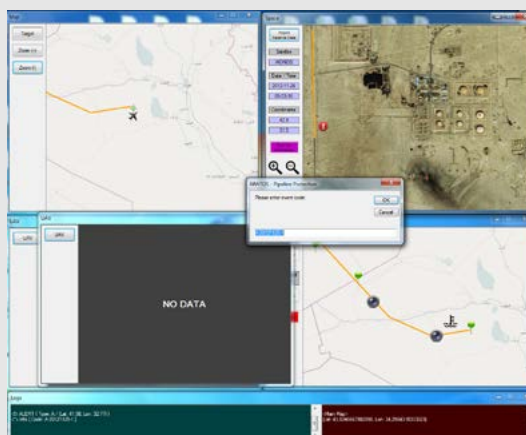 remain in the area for cross checking

Extra Info

▶ The system is operating according to
  operational and quality of service manuals
▶ Different levels of confidentiality are applied
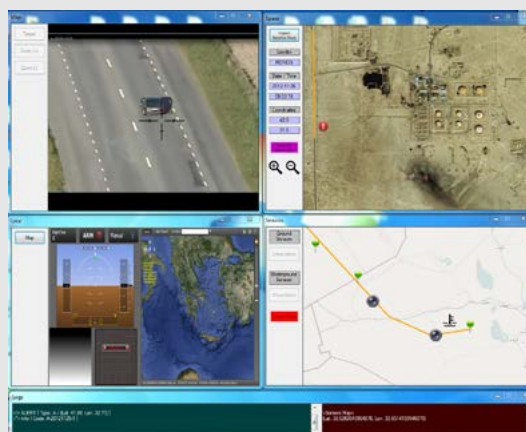▶ All the actions are taking place according
  to Local State regulations

Example in the Control Centre – Alert Triggering
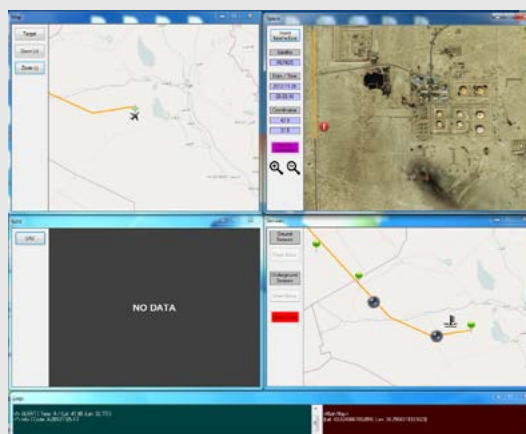
Example in the Control Centre – UAV's Precision of the Area

Example in the Control Centre – UAV's Real Time Image

Quality Parameters

Acquisition readings	Distribution readings
Types of threats to be monitored	Response time
Ability to support early detection	Limitations in space / Area coverage
Area coverage / Limitations in space	Data rate
Limitations in time (e.g. due to weather)	Final output format
Frequency of acquisition	Visualization support
Accuracy of readings	Alert analysis
Number of false alarms	Decision making support
Manual / automatic, subject to vandalism, efficiency, cost	

Quality Assurance and Success

All the Pipeline Monitoring and Security Proce-
dures and Applications Integrity and effective-
ness assurance are being controlled through the
**ARATOS T.S.P.R. Total Security Process Re-engi-
neering Methodology.**

www.totalsecurity-pr.com

ARATOS-SWISS Homeland Security AG

Ryf 65, 3280 Murten, Switzerland

Phone: +41 (0) 32 652 00 42

Fax: +41 (0) 32 652 00 41

Mobile: +41 (0) 79 250 47 44

Web: www.aratos-swiss.com

E-Mail: info@uasystems.com

ARATOS Technologies S.A.

272B Eleftheriou Venizelou Str.,
Athens, GR 17675

Phone: +30 210 9424630

Fax: +30 210 9424095

Mobile: +30 6951 943327

Web: www.aratos.gr

E-Mail: info@aratos.gr

OMEGA Company

129515 Akademika Koroleva str. 6/1, Moscow,
Russian Federation

Tel: +7 499 7998435

Fax: +7 499 7998350

Web: www.omega.mn

E-mail: info@omega.mn