ESA Integrated Applications Programme (IAP)
Stimulating User Driven Projects

TSB, BNSC & ESA Forum on Transport, Safety and Energy challenges - New Opportunities and Call for Projects Proposals

Nov. 12th 2009, Harwell

A. Ginati, European Space Agency (ESA)
• Introduction
• ESA & IAP Programme Objectives
• Demonstration Projects, Illustrative Examples
• FlySafe & European AIS Mission
• Conclusion
European cooperation states: Hungary
Cooperation arrangement: Canada

Nov. 08 MC Approved
Programmes 2009-2011
9.6 B€
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• Alan Brunstrom **Tel: 01865 567 903**
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Alan Brunstrom, Dedicated to the Integrated Applications Programme, Intended to be an honest broker who promotes IAP by:

- Raising awareness of the programme among user communities and the whole service delivery chain, including press & PR activities
- Providing information and advice on the programme and how to use it, including the ESA tender process and points of contact
- Helping to put together partnerships to deliver IAP projects
- Working with the finance community to develop 3rd party funding and business structures to support IAP projects
- Liaison with TSB and other UK partners
- Listening to actual and potential users and working to ensure that the programme reflects their needs!
IAP System of Systems example

Telecommunications satellite

Earth observation satellite

Navigation and positioning satellite

DRS

Hospital

Crisis management centre

Base

Telecommunications service provider

Earth observation data provider

Disaster zone

Field base

Field teams

Telemedicine

Telecommunications

Earth observation

Crisis management centre

Base

Telecommunications service provider

Earth observation data provider

Disaster zone

Field base

Field teams

Telemedicine
An increasing impact of disasters per decade:

- Fast growing number of disasters reported in the different world regions
- Over 2 billion people impacted
- Economic damage over $500 billion

Source: ISDR, Euroconsult estimates
Lack of Providers who can give affordable and ready-to-deploy solutions
  *Commercial solutions target mass-market*

Lack of Coverage (global/regional) for some available solutions
  *Currently offered solutions might not be available in all crisis areas*

Lack of Synergy or interoperable tools amongst different organizations
  *Proprietary standards limit the interoperability*

Lack of Robust solutions/tools suitable for crisis environment
  *Commercial tools not always suitable for crisis*
Deployment and Full Coverage

Example: ”Service-Buy” Model

Optical, SAR Surveillance

Satcom Terminals + Wireless Extensions = Full Coverage & EO + Navigation

Hub Earth Station

Sat Terminals

Island 1

Island 2

Sat Terminal at Regional Office

National Office

DATABASE #1

DATABASE #2

Affected Area
The three value chains in commercial satellite applications

Values for the year 2005 in billions of €

- **Communications**
  - Ground equipment: 30
  - Launch services: 1.5
  - Sale of satellite capacity (or time): 0.5
- **Satellite manufacturing**: 1.8
- **Navigation**
  - Earth Observation: 7
- **Value-Adding Services**
  - Terminals for consumer and business users: 54
  - Satellite manufacturing: 17

Potential of Integrated Applications

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Exploit systematically the extended use of space capacity and capability through the development, in close partnership with end-users, of integrated applications which can demonstrate a potential for user-side sustainable services.

“Connecting expert Communities & Combining Technologies”
• Meet
  – Increasing demand for sustainable complete solutions using integrated space & non-space technologies/systems
  – Space Council Resolution May 2007 (Political will)

• Overcome
  – Cultural gap and lack of dialogue between potential users and the space sector (awareness)
  – Compartmentalization of the offer by space technology (synergy)

• Using
  – Principle of upstream and initial involvement of user/ partner/ service provider/ operator (partnership)

“Incubator for Services”
• European Dimension Approach
  – ESA expertise and experience, variety of space tools, promotion platform
  – Contributions from space and non-space players in Europe
  – Federation of users, ESA needed as “honest broker”
  – Flexible and accelerated implementation process (“open door principle”)
  – Inter-disciplinary aspects: Climate/Health, Climate/Energy etc
  – Early demonstrations via selected pilot projects

• Addressing Global Challenges in Thematic Areas e.g.
  – Space for Health, Development...
  – Space for Safety, Knowledge ...
  – Space for Energy, Economy...
  – Space for Transport, Innovation...

• ...In Regional, National, European and Global scale
IAP Project Candidates & Partnership

• **Space for Safety / Transport**
  - Flight Safety: NL, B (D, F) - Air Forces (Airlines / Airports)
  - Satellite AIS System for Maritime Safety: DG- MARE/EMSA
  - Transport of Hazardous materials (SSMART): AREVA
  - Intelligent Railways via Integrated Satellites Services (IRISS) (UK)
  - Satellite Systems and operations for UAS :EDA

• **Space for Health** (thematic website: www.esa.int/health)
  - Health in Peacekeeping Missions : G, F, I ,E MoDs
  - Telemedicine in Africa: DG-DEV
  - Tick-borne encephalitis risk mapping / Mosquitoes habitat mapping
  - Private medical insurance and assistance : Europ Assistance

• **Space for Knowledge/Development**
  - Water Management, Water Quality in Egypt IAP Enhancement
  - Peace Building and Damage Assessments: (e.g. DG RELEX)

• **Space for Energy**
  - Power grid management : TERNA
  - Nuclear site monitoring (e.g. Chernobyl): IAEA
Prediction of the production and fluctuations of the Renewable Energy Sources (RES)
Accurate forecasts:
- Event propagation assessment
- Anticipation of responses
- Alerts to rescue teams and citizens

Toxic cloud predicted evolution

Populated area

CBRN event location
From “Observation” to “Prediction” (vaccine producers e.g. Baxter)

Observed (yellow) and Predicted (red) TBE in Europe, (Randolph and Rogers).
• In one hand, every year in all world airlines between 700 and 1000 hundred people died during long duration flights (more than 6 hours) due to medical reasons; each day between 1 and 1.5 planes are landing in emergency conditions for medical reasons the statistic data on these landings showed that 45% can be avoid if a single electrocardiogram could be transmitted from the plane to an emergency medical department in an hospital; the cost of such re-routings is about 80K€.

• In the other hand, the travel duration are more and more long i.e. the next A380 planes (more than 15 hours non stop); the number of passengers will increase with the new capacities of the planes
The aim of the system is to determine if the medical condition of the passenger is serious enough to cause a diversion.
Uniformed personnel in UN peacekeeping operations

- Political instability in a number of geographical areas has resulted in an increasing number of multilateral government operations for peacekeeping and security.

- Increasing costs of peacekeeping information in recent years:
  - 1993: $3.6 billion
  - 1998: $1 billion
  - 2001: $3 billion
  - 2004: $2.8 billion
  - 2006: $5.03 billion
  - 2008: $6.8 billion
  - 2009: $7.1 billion (budgeted

Source: UN

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Examples of needs from MoDs’ Health Services

Imagery
- CT Scan

Remote guiding
- Robotic assisted surgery

Voice/video

Data management
Communication
Prioritisation

Complex operations
- Maintenance
UAS- Satellite Co-operative Missions
Preliminary mission scenarios

Scenario 1
Civil Area Operation

Scenario 2
Civil Route Operation

Scenario 3
Civil En-route Integration

Scenario 4
Military Operation

Source: Thales Alenia
• **End-to-end chain:**
  - Users request EO products to a service provider
  - The products are used to manage the farm internally by means of GPS and GIS tools

• **Bi-directional:**
  - Farmer provides information to create customised products.
  - It is possible to provide further assistance to the farmer by means of telematics tools.
• Real-time forecasting services can be achieved by:
  – Earth Observation data.
  – Real-time transmission through satellite
  – GNSS synchronisation
• A power plant model can combine all these data to create power management information
IAP FlySafe Project
GAF (1997-2004): 360 collisions strikes/year
RAF(<2004): 110 documented serious accidents

Estimated conservative cost due to damage and delays of commercial aircraft worldwide 1.2 billion USD per year
July 15 1996 a Belgian C-130 crashed at Eindhoven Air Base due to a bird strike. 34 people were killed and 7 people were seriously injured.
"It’s just to let you all know that FlySafe is really able to do spectacular things"

Example: Gulls movement
Woensdrecht Airbase, NL

Night of Feb.20th 2008

(photo RNLAF).
- EO data & meteorology
- Long Range Military Surveillance Radars (150km radius, migration)
- Weather radars for migration (altitude distributions migration)
- Short Range Specialized Radars on air fields (local bird behaviour 5-10 km range)
- Individual birds Tracking (species specific information)

FlySafe elements and Sensors
Studying behaviour using tracking data
LBG 41757 on Honington airfield in UK on several days between 10 July and 15 August 2007 and back again in 2008.

- May 11 – June 12 2008
- June 2007 – September 2008
Impact of bird migration on F-16 night flight

- 2 F-16 airbases open
- 1 diversion airbase open

05.30 pm End of daily flying window
09.30 pm Mission preparation
09.45 pm Aircraft take-off
10.00 pm BIRDTAM
10.10 pm Night Flight cancelled

Source: BAF
Impact of bird migration on F-16 night flight

Stand-by for nothing!

Flight planning disturbed, time & money lost

Source: BAF
Welcome to the FlySafe bird migration prediction module

This page provides a 72-hour forecast of bird migration intensity for the Central Belgium location. The predictions are provided in two formats: The Hourly predicted and measured migration intensity plot shows the measured bird density values in bird echoes/km² (black dots) as well as the mean predicted bird density (dashed line) and prediction range (gray). The prediction range is produced by an ensemble forecast of ~50 models. The Hourly BirdTAM intensity plot shows the bird densities converted to BirdTAM warning levels for pilots from seven days in the past and three days into the future. If the measured value is available, the BirdTAM intensity reflects the measured value. If no measurement is available, the mean bird migration density prediction is used (indicated by small yellow circles).

These predictions are made using the European Centre for Medium Range Weather Forecast Deterministic Model. The most important weather variables in the predictions are visualized in the plots on the right: Wind speed and direction at multiple pressure heights in the top plot. The barbs in the direction ROM which the wind is coming, and the bars indicate the speed of the wind. Following plots are surface pressure (hPa), hourly precipitation (mm) as well as the percentage of cloud cover. Cloud cover is given in both a layer and total component. The final plot provides temperature (deg).

Location: Central Belgium, Last modified: Wed Apr 22 2009, 6:18 pm, Next run: Wed Apr 22 2009, 6:46 pm
Improvements Needed for the Local Situation

Anticipation of Birds Crossing the Airport
FlySafe Applications

- Birds and Energy
- Birds and Agriculture
- Birds and Health

Avian Influenza H5N1 outbreaks
Source: Declan Butler  http://declanbutler.info/blog/?p=56
Application Driven
Small Satellite Missions
European AIS Mission
What is AIS?

• The Automatic Identification System (AIS) is communication system provides identification and location information to vessels and shore stations
• Aim of exchanging data (position, identification, course and speed).
• This allows vessels to anticipate and thus avoid collisions in the sea by means of a continuous traffic monitoring with several navigation aids
• AIS also offers important ship monitoring services to coastal guards or search and rescue organizations.

The system is based on the broadcasting of fixed length digital messages using the Time Division Multiple Access (TDMA)

AIS message fields

<table>
<thead>
<tr>
<th>Start buffer</th>
<th>Training sequence</th>
<th>Star flag</th>
<th>Data</th>
<th>FCS</th>
<th>End flag</th>
<th>End-buffer</th>
</tr>
</thead>
</table>

40 nm
Worldwide use of AIS data

Number of AIS class A vessels (> 300 gross tonnage, ferries, etc.) 64,000
Number of AIS class B vessels > 500,000

- **Governmental and public users**
  - Maritime offices (e.g. Customs, Police, Military)
  - Traffic management
  - Search and Rescue
- **Commercial users**
  - Ship agents
  - Ship owners
  - Shipping companies
  - Logistics

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Satellite-based AIS for maritime security policy

DG-MARE / ESA 
Joint Action Team &
European Steering group: 
EC DGs (Mare, ENV, TREN, JLS, INFSO, TAXUD, ENTR, JRC) FRONTEX, EMSA, EDA, ESA
HELCOM AIS server

North Sea AIS server

Mediterranean AIS server

SafeSeaNet Server

Satellite AIS server

Northern N. Atlantic server

Groenland

Feroe Island

Canada
Ship was hijacked 700 nm off Somalia coast and 100 nm from destination (Port Victoria / Seychelle Islands)

- Request of DG MARE based on information demand of Belgium Crisis Centre, having lost the vessel POMPEI and asking for latest position at 14:00 on April 21, 2009
- Delivery of latest vessel position by LuxSpace at 16:00 (captured at 7:00 of the same day)
- Request for vessel track of the past days at 19:00 of 21 April
- First information available at 22:00 on 21 April
- Second information with final anchor place (4:56) on April 22 at 23:00

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SAR detected ships
SAR ships & AIS tracks
Correlation SAR & AIS
Remaining uncorrelated ships
The IAP initiative is an opportunity for ESA and Europe to demonstrate and promote the added-value of Space in support of Member States, European public policies and citizens in various new domains, beyond current individual space programmes.

The IAP initiative is an opportunity for European & Canadian operators and Industry to exploit their expertise for the purpose of new initiatives and to identify new lines of business in various fields.

The leveraging and systematic expansion of the EO, Navigation and Telecom domains through the IAP initiative is expected
The Second Palm Island, Dubai
[Proba CHRIS – 26 Aug 2005]
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A World of Opportunities
&
The Space is the Limit

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Thank you!