GALILEO Opportunities

• Market and CBA

• Business

P. Flament
EC DG TREN
Markets

- VAST (FDC, FR)
- TESSYN (NEI, NL)
- TESSYN (Alcatel Space, FR)
- ESA Comparative System Study (KPMG, UK)
- Structural Analysis (Technomar, D)
- GEMINUS (Racal, UK)
- GALA (Astrium, MMS, UK)
Markets

Professional market
timing, scientific, precision survey,
oil and gas, construction and civil
engineering, asset management,
precision agriculture, etc.

Mass market
personal navigation,
land navigation, river navigation,
etc.

Safety of Life and Security Market
transport of goods and passengers,
emergency services, security, etc.

Some 100 applications
User Fora

Road (Corporate)
Road (Consumer)
Rail
Maritime
Aviation
Science, Survey and Timing
Security

- Some 50 organisations contacted by forum
- Each forum met at least twice
WHO IS CONCERNED IN EUROPE?

- 26 000 General Aviation Aircraft
- 4 000 Commercial Aircraft
- 12 000 Self propelled craft
- 10 000 Dumbs and Pushed barges
- 4 000 Tugs and pushers
- 25 000 Locomotives
- 78 000 Coaches
- 30 000 Automotive train sets
- 425 000 Wagons
WHO IS CONCERNED IN EUROPE? (Contd)

- **Buses and Coaches**: 513,000
- **Lorries and Vans**: 21,000,000
- **Passenger Cars**: 155,000,000

Market Sizes
European GNSS Market 1999

Market Size €1Bn

Car Navigation 73%

Leisure 5%

Surveying 5%

Other 3%

Fleet Mgt 4%

Aviation 5%

Augmentation 5%
European GNSS Market 2005

Market Size €6Bn
GALILEO discriminators

GPS alone: 55% urban coverage

GPS+GALILEO: 95% urban coverage

GALILEO: liability and guarantee on quality of service

GALILEO: certification for Safety of Life

GALILEO: local elements

etc.
Global GNSS Market Size

Galileo Share

No. of Units

Millions

Global Positioning and Timing
Market Size

<table>
<thead>
<tr>
<th>Year</th>
<th>Addressable Market</th>
<th>GNSS Share of Addressable Market</th>
<th>Galileo Share of GNSS Market</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Overview of the cost benefit analysis

Strategic aims:
- Implementing future common transport policy
- European cohesion
- Strengthening foreign policy negotiations
- Maintaining industrial capability in space

Key market segment

Economic benefits

Operator (& production) company(s)
Chip manufacturers

Key market segment
Key market segment
Key market segment

Users
Users
Users

Social benefits

Broader social benefits (externalities & public good)

Costs

R&D, capital & operations costs

Net benefit value

Strategic analysis
# Infrastructure Costs

<table>
<thead>
<tr>
<th></th>
<th>Cumulative</th>
<th>Annual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systems engineering and management</td>
<td>160</td>
<td>130</td>
</tr>
<tr>
<td>Satellites and launches</td>
<td>320</td>
<td>1,320</td>
</tr>
<tr>
<td>Ground segment</td>
<td>480</td>
<td>380</td>
</tr>
<tr>
<td>EGNOS integration</td>
<td></td>
<td>50</td>
</tr>
<tr>
<td>User segment technology support programme</td>
<td>70</td>
<td>60</td>
</tr>
<tr>
<td>Operations (and replacements after 2008)</td>
<td>70</td>
<td>210</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>1,100</td>
<td>2,150</td>
</tr>
</tbody>
</table>
Strategic Value

« Zero option »

Cost to Europe of GPS service temporary disruption

In 2015

2 days disruption = 1 billion €

based on GPS use in
- Transport sector,
- Communication sector,
- Financial sectors.
GALILEO Benefits to Producers

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Space sector firms and the GALILEO operator</td>
<td>190</td>
<td>930</td>
<td>190</td>
<td>190</td>
<td>190</td>
</tr>
<tr>
<td>Producers of integrated products &amp; services</td>
<td></td>
<td></td>
<td>20</td>
<td>70</td>
<td>80</td>
</tr>
<tr>
<td>TOTAL benefits to suppliers</td>
<td>190</td>
<td>930</td>
<td>210</td>
<td>260</td>
<td>270</td>
</tr>
</tbody>
</table>
GALILEO Benefits to Users

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual averages</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net user benefits</td>
<td>0</td>
<td>0</td>
<td>1,990</td>
<td>4,740</td>
<td>7,630</td>
</tr>
</tbody>
</table>

New Services:
- Aviation,
- Rail,
- S&R,
- Inland waterways,
- Robotics, etc.

Complementary GPS + GALILEO:
- Route guidance for all road vehicles,
- Advanced road driver assistance,
- Land survey,
- GIS mapping, etc.
### Social Benefits

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual averages</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduced congestion</td>
<td>0</td>
<td>0</td>
<td>200</td>
<td>650</td>
<td>1,425</td>
</tr>
<tr>
<td>Decreasing environmental pollution</td>
<td>0</td>
<td>0</td>
<td>70</td>
<td>175</td>
<td>400</td>
</tr>
<tr>
<td>Increased safety</td>
<td>0</td>
<td>0</td>
<td>30</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Reuse of radio spectrum</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>160</td>
<td>160</td>
</tr>
<tr>
<td>TOTAL social benefit</td>
<td>0</td>
<td>0</td>
<td>300</td>
<td>1,000</td>
<td>2,000</td>
</tr>
</tbody>
</table>
## Overall view of the results

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Supplier benefits (total)</strong></td>
<td>190</td>
<td>930</td>
<td>210</td>
<td>260</td>
<td>270</td>
</tr>
<tr>
<td><strong>User net benefits</strong></td>
<td>0</td>
<td>0</td>
<td>1,990</td>
<td>4,740</td>
<td>7,630</td>
</tr>
<tr>
<td><strong>TOTAL economic benefit</strong></td>
<td>190</td>
<td>930</td>
<td>2,200</td>
<td>5,000</td>
<td>8,000</td>
</tr>
<tr>
<td><strong>TOTAL social benefit</strong></td>
<td>0</td>
<td>0</td>
<td>300</td>
<td>1,000</td>
<td>2,000</td>
</tr>
<tr>
<td><strong>TOTAL benefit</strong></td>
<td>190</td>
<td>930</td>
<td>2,500</td>
<td>6,000</td>
<td>10,000</td>
</tr>
</tbody>
</table>
Cost Benefit Analysis

integrated over 2000-2020

Total economic benefits  
62 billion €

Total social benefits  
12 billion €

Total benefits  
74 billion €

Total costs (3.25 b€ + operations)  
6 billion €

Internal Rate of Return: 75%
The Sat/Nav Value Chain

Structural characteristics of the Satellite Navigation Value Chain

Signal operator → Component Segment → System Integration Segment → Value Adding Service Segment (incl. content providers)

- Chip-set Antennas
- Global markets
- Product Equipment
- Regional/local markets

Global markets

Value Adding Service Segment
### Competitive Situation of European Players

<table>
<thead>
<tr>
<th>Component level</th>
<th>WEAK</th>
<th>MEDIUM</th>
<th>STRONG / LEADING</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAR-NAV</td>
<td>chipsets</td>
<td>AVIATION: receivers</td>
<td>CAR-NAV: digital maps</td>
</tr>
<tr>
<td>FLEET MGMT</td>
<td>chipsets</td>
<td>AGRICULTURE: DGPS receivers</td>
<td></td>
</tr>
<tr>
<td>RAIL</td>
<td>chipsets</td>
<td>TIMING: chipsets</td>
<td></td>
</tr>
<tr>
<td>MOBILE COM</td>
<td>chipsets</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>System integrator level</th>
<th>WEAK</th>
<th>MEDIUM</th>
<th>STRONG / LEADING</th>
</tr>
</thead>
<tbody>
<tr>
<td>MARITIME</td>
<td>reference stations</td>
<td>AVIATION: FMS, GBAS</td>
<td>Car-nav: systems, telematic receivers</td>
</tr>
<tr>
<td>SURVEYING</td>
<td>land &amp; marine, machine control</td>
<td>MARITIME: nav systems</td>
<td>FLEET MGMT: terminals</td>
</tr>
<tr>
<td>MOBILE COM</td>
<td>PDA</td>
<td>SURVEYING: dredging</td>
<td>RAIL: wagon tracking systems, train control systems</td>
</tr>
<tr>
<td>LEISURE</td>
<td>Land &amp; air</td>
<td>AGRICULTURE: yield mapping systems, terminals</td>
<td>MOBILE COM: mobile phones</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TIMING: timing systems</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>LEISURE: maritime</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Service level</th>
<th>WEAK</th>
<th>MEDIUM</th>
<th>STRONG / LEADING</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVIATION</td>
<td>ATM services</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAR-NAV</td>
<td>telematic services</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FLEET MGMT</td>
<td>services</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SURVEYING</td>
<td>augmentation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AGRICULTURE</td>
<td>augmentation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOBILE COM</td>
<td>com services</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GALILEO Contribution to overall GNSS market growth

Market prospects for European Industrial Players

Assuming:

- that Galileo will boost the overall GNSS market equal to the ‘Galileo share’
- that the GNSS market without Galileo equals the GNSS (penetrated) market minus the Galileo share
- that European suppliers will maintain their current global market shares
- that European suppliers share of GNSS global service revenue equals 20% (European services will be provided by European suppliers)
- that GPS and GALILEO will be used in a complementary role
- that future standard chipsets will be integrated GPS and GALILEO (GNSS) chips
- all revenue provided in this analysis are gross revenues
### European Suppliers Global Market Shares

#### Market prospects for European Industrial Players

<table>
<thead>
<tr>
<th>Service</th>
<th>Market Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>VEHICLE NAVIGATION</td>
<td>25%</td>
</tr>
<tr>
<td>MOBILE COMM</td>
<td>60%</td>
</tr>
<tr>
<td>POLICE/FIRE/AMBULANCE</td>
<td>25%</td>
</tr>
<tr>
<td>FLEET MANAGEMENT ALL VEHICLES</td>
<td>25%</td>
</tr>
<tr>
<td>PERSONAL OUTDOOR RECREATION</td>
<td>4%</td>
</tr>
<tr>
<td>LAND SURVEY&amp;GIS MAPPING</td>
<td>8%</td>
</tr>
<tr>
<td>Fisheries &amp; EEZ</td>
<td>8%</td>
</tr>
<tr>
<td>MARITIME</td>
<td>8%</td>
</tr>
<tr>
<td>MINING</td>
<td>8%</td>
</tr>
<tr>
<td>SEARCH&amp;RESCUE</td>
<td>8%</td>
</tr>
<tr>
<td>OIL&amp;GAS</td>
<td>8%</td>
</tr>
<tr>
<td>RAIL</td>
<td>50%</td>
</tr>
<tr>
<td>ENVIRONMENT</td>
<td>8%</td>
</tr>
<tr>
<td>PRECISION AGRICULTURE</td>
<td>6%</td>
</tr>
<tr>
<td>PRECISION SURVEYING</td>
<td>8%</td>
</tr>
<tr>
<td>AIR</td>
<td>8%</td>
</tr>
<tr>
<td>PERSONAL PROTECTION</td>
<td>4%</td>
</tr>
<tr>
<td>ASSET MANAGEMENT</td>
<td>25%</td>
</tr>
<tr>
<td>TIME</td>
<td>4%</td>
</tr>
<tr>
<td>Met Forecasting Ionosphere</td>
<td>8%</td>
</tr>
<tr>
<td>SPACE</td>
<td>8%</td>
</tr>
<tr>
<td>GEODESY</td>
<td>8%</td>
</tr>
<tr>
<td>INLAND WATERWAYS</td>
<td>8%</td>
</tr>
<tr>
<td>VEHICLE CONTROL&amp;ROBOTICS</td>
<td>8%</td>
</tr>
<tr>
<td>CONSTRUCTION &amp;CIVIL ENGINEERING</td>
<td>8%</td>
</tr>
<tr>
<td>SECURED DATA</td>
<td>25%</td>
</tr>
</tbody>
</table>
European Suppliers Global Revenues in the GNSS market

- European Service Revenue
- Global GNSS Product Revenue

**GPS only**

**GPS + GALILEO**


Billion €
**Current and future Value Chain - Vehicle Navigation Market**

**CURRENT**
- GNSS chip-set / receiver supplier
- GNSS antennae
- Digital maps
- Non-GNSS hw + sw components

**FUTURE**
- Components incl. GNSS chipset
- Car-nv system supplier
- Car manufacturer

**User = car driver**

**Car manufacturer**

**Mobile com provider**

**Telematic service provider**

Content providers / e-commerce

Mobile com provider

Travel info / digital map provider

User = car driver

Mobile phone / PDA

GNSS chipset ?
## Market Position of European Car Navigation Suppliers

### Detailed Analysis of Vehicle Navigation market

<table>
<thead>
<tr>
<th>Market position of the European sat/nav industry – Car navigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>weak</td>
</tr>
<tr>
<td>Car navigation – products</td>
</tr>
<tr>
<td>Component level</td>
</tr>
<tr>
<td>System integrator level</td>
</tr>
<tr>
<td>Car navigation – services</td>
</tr>
</tbody>
</table>
Mobile Communication Market

Detailed Analysis of Mobile Communication Market

Mobile Communication - Unit numbers

Source: GALA Market study
likely value chain of mobile com

- mobile phone manuf.
- gnss chipset manufacturer
- gsm/umts chip manufacturer
- mobile phone manuf.
- user

content providers:
- retail
- travel
- entertainment
- route guidance
- ????

mobile com providers
- location based services
- 112

- european commission: sets the technical requirements for e-112. in the case localisation requires gnss a compulsory market will emerge

- mobile com providers: have a vital interest to introduce location based services. set the basic requirements for any localisation feature of mobile phones

- mobile phone suppliers: will make the final decision on the technology to be used for localisation. have a strategic interest to use gnss for product differentiation and diversification
GALILEO - Actors with an interest in the Galileo Programme

GALILEO Programme Elements and Actor Model

Current players involved in GALILEO Programme

Players who will actually benefit (indirectly) from GALILEO Programme

GALILEO PROGRAMME ELEMENTS

- Building Infrastructure
- Operating Infrastructure
- Building Regional Infrastructure
- Operating Regional Infrastructure
- Building Local Infrastructure
- Operating Local Infrastructure
- Developing components utilising GALILEO signal
- Developing services utilising GALILEO signal

European Commission
EU Member States
Third Party Member States
Investment BANKS
Augmentation Service Providers

Space Companies
Component Manufacturers
System Integrators Manufacturers
Service Integration Providers
National Space Agencies
ESA
Space System SW companies
Component Manufacturers
System Integrators Manufacturers
Service Integration Providers
EU Member States
Third Party Member States
Investment BANKS
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Space Companies
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Component Manufacturers
System Integrators Manufacturers
Service Integration Providers
EU Member States
Third Party Member States
Investment BANKS
Augmentation Service Providers

Current players involved in GALILEO Programme

Players who will actually benefit (indirectly) from GALILEO Programme
Type of Industrial Actors and motivation to be involved?

GALILEO Programme Elements and Actor Model

- **Space Companies**
  - Earn money from building GALILEO satellites
  - Gain and develop new competencies
  - May benefit other part of business within the larger corporation

- **Component Manufacturers GNSS ships**
  - Given that dual chips will be the future standard. European suppliers will get the opportunity to establish themselves and gain market shares

- **Space System SW companies**
  - Earn money from developing software to GALILEO satellites and ground system

- **Augmentation Service Providers**
  - To influence how augmentation services will be provided in order to protect their current business

- **System Integrators Manufacturers**
  - To influence GALILEO technical specifications to be incorporated in their planning for future product development and to be involved in RDT programmes in order to gain competitive advantage in their core business areas

- **Service Integration Providers**
  - To influence GALILEO service provision, to be involved in RDT programmes, to be involved the tender process of service provision in order to integrate these into their future service provision to gain competitive advantage in their core business areas
## Major players - interests in various segments

<table>
<thead>
<tr>
<th>Parent company</th>
<th>Operating company</th>
<th>Market segment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bosch</td>
<td>• <em>Bosch</em> - <em>Blaupunkt</em></td>
<td>Car navigation systems, telematic receivers</td>
</tr>
<tr>
<td></td>
<td>• <em>Teleatlas</em></td>
<td>Car navigation - digital maps</td>
</tr>
<tr>
<td></td>
<td>• <em>Bosch</em></td>
<td>Car navigation - GPS antennas</td>
</tr>
<tr>
<td>Alcatel</td>
<td>• <em>Alactel</em></td>
<td>Mobile phones</td>
</tr>
<tr>
<td></td>
<td>• <em>Euteltracs</em></td>
<td>Fleet management</td>
</tr>
<tr>
<td>Deutsche Telekom</td>
<td>• <em>T-Mobil</em></td>
<td>Mobile communication</td>
</tr>
<tr>
<td></td>
<td>• <em>Tegaron</em></td>
<td>Telematic services, fleet management services</td>
</tr>
<tr>
<td>France Telecom</td>
<td>• <em>Orange</em></td>
<td>Mobile communication</td>
</tr>
<tr>
<td></td>
<td>• Médiamobile</td>
<td>Telematic services</td>
</tr>
<tr>
<td></td>
<td>• Mobiloc</td>
<td>Fleet management</td>
</tr>
<tr>
<td>Siemens</td>
<td>• <em>Automotive division</em></td>
<td>Car navigation</td>
</tr>
<tr>
<td></td>
<td>• <em>VDO Dayton (?)</em></td>
<td>Car navigation, telematic receivers</td>
</tr>
<tr>
<td></td>
<td>• <em>Mobile phone division</em></td>
<td>Mobile phones, telematic receivers</td>
</tr>
<tr>
<td></td>
<td>• Engineering division</td>
<td>Land traffic control systems</td>
</tr>
<tr>
<td>Thomson</td>
<td>• <em>Airsys</em></td>
<td>Aviation</td>
</tr>
<tr>
<td></td>
<td>• <em>DSNP</em></td>
<td>DGPS receiver, surveying, maritime, fleet management</td>
</tr>
<tr>
<td></td>
<td>• MLR</td>
<td>Maritime, leisure</td>
</tr>
<tr>
<td></td>
<td>• <em>Racal Tracs</em></td>
<td>SBAS, DGPS receivers</td>
</tr>
<tr>
<td></td>
<td>• Global Telematics</td>
<td>Telematic services, fleet management</td>
</tr>
</tbody>
</table>
Conclusions

Private investments of an order that could exceed the GALILEO Infrastructure build cost can be envisaged from European industry into the downstream sectors.

Interest in being closer to the GALILEO Programme at a cost, e.g. shareholder in an eventual GALILEO Holding Company.

To fully exploit the potential benefits of the GALILEO Programme into the downstream segments considerable investments have to be made into product and service development, market preparation and development.
Areas that are likely to attract such investments are those where there already exists a strong player in the GPS based markets and those beginning to emerge including:

- Vehicle and vessel fleet management services
- In-car navigation and communication systems
- Location based mobile communications sector