Ground Segment Technology Developments at ESA for Maritime Communications

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Market Trends

• Strong demand for **broadband connectivity anywhere & anytime**

• **Typical use cases:**
  - Ship owners: automation and remote monitoring of their fleet, sometimes with video surveillance
  - Crew & cruise passengers: communicate with family & friends (telephone, email...) and other Internet facilities

• **Service requirements:**
  1. Quality-of-Service
  2. Fixed price per month
  3. Global coverage with automatic switching
Market Trends

- Steady growth in equipment sales and system deployments (17,000 vessels in 2014), mostly driven by commercial demand
- More than 100 service providers

Evolution towards broadband solutions

Market Trends

Public & Governmental
MSS
Narrowband
L-band

Commercial
VSAT
Broadband
Ku/Ka-band
## New Systems

Examples of new broadband maritime systems in Ku and Ka bands:

<table>
<thead>
<tr>
<th>Satellite Operator</th>
<th>System</th>
<th>Band</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>O3b Networks</td>
<td>03b</td>
<td>Ka-band</td>
<td>MEO equatorial constellation, very high speed modems</td>
</tr>
<tr>
<td>Inmarsat</td>
<td>Global Xpress</td>
<td>Ka-band</td>
<td>GEO with spot beams</td>
</tr>
<tr>
<td>Intelsat</td>
<td>EpicNG</td>
<td>Ku-band</td>
<td>GEO with high EIRP and spot beams, open system</td>
</tr>
</tbody>
</table>
Technology: Antenna

- Support of **Ku-band and Ka-band with directive antennas**
- Compact to reduce cost of ownership: trend to small form factor (size, weight, power)
- Dynamic tracking systems, absorbing shocks and vibrations:
  - Mechanical and electronic
  - Sensors: GPS, accelerometers, beacons
  - Pointing algorithms, with motion prediction
  - Hand-over between satellite beams with different frequencies and polarisations
Technology: Modem

- Modem must cope with channel impairments: fading, low SNR, interference, Doppler effect, blockage...

- Solutions: VSAT modem (SCPC and TDMA) with adaptations:
  - Spread spectrum
  - ACM+DRA
  - Traffic priorities (CoS)
  - Delay tolerant protocols...
Technology: Regulations

- ITU, ETSI and FCC regulations on emissions: stringent masks, to avoid interfering with adjacent satellites located at 2-3° apart on GEO belt
ESA Developments in Maritime SatCom

- **ARTES: Advanced Research in Telecommunications Systems:**
  - Studies
  - Technology
  - Products
  - Applications

- **Activities in Maritime SatCom:**
  - Mobile antennas
  - Hybrid electro-mechanical antennas
  - Mobile channel characterisation
  - Propagation measurement campaigns
  - Integrated applications
  - System: waveforms, access schemes, end-to-end performance testing and validation
Stabilised antennas for broadband at sea by Jotron (Norway) developed under ARTES 3-4:

- \( \approx 120 \text{ cm Ku-band antenna} \)
- \( \approx 70 \text{ cm Ku-band and Ka-band antennas} \)

http://telecom.esa.int/telecom/www/object/index.cfm?fobjectid=29730

ESA also developed L, S and Q/V-band antennas (e.g. Alphasat, S-band)
Mobile Antennas

Combined Ku and Ka antennas ARTES 5.1 and 5.2 technology developments:

- Jotron (Norway): B120C Combined Ku/Ka-band antenna
- TeS/SpaceEngineering (Italy): JANUS Bi-Band Maritime Antenna System
- Indra (Spain): Mobile Terminal Antenna

→ Allow flexibility for “least cost routing”
→ Save multiple installations
Hybrid electro-mechanical scanning satellite user terminal antenna

New ARTES 5.1 technology development:

1. Mechanical for slow tracking
2. Electronic for fast tracking
3. Transmit/receive in Ka-band
Mobile Channel Characterisation

Characterisation of mobile tracking needs:

http://telecom.esa.int/telecom/www/object/index.cfm?fobjectid=31445

- ARTES 5.1 activity with Fraunhofer (Germany)
- Collect statistical data on the type of movements from the platforms
- Generate standardized/reference profiles to be used:
  1. for the design of tracking systems for mobile satellite terminals
  2. for testing: performance evaluation (e.g. grades A to E) and for certification

➤ Will simplify and harmonize design and qualification of maritime antennas

Propagation studies for Mobile SatCom: measurements campaigns, analysis and modelling for S, Ku, Ka and Q/V bands
Satellite Integrated Applications

Satellite Based System and Services for Broadband Applications at Sea

http://telecom.esa.int/telecom/www/object/index.cfm?fobjectid=31712

- ARTES 3-4 Pilot Project with MediaMobil Communication (Germany)

- System for the provisioning of an integrated maritime communications service:
  - **Quality-of-Service**: prioritise business traffic and allow best effort for crew welfare e.g. Facebook
  - **Efficient bandwidth utilisation**: e.g. common anti-virus updates can be broadcast at night
  - **Integrated (one stop shop)**: integrates VSAT with other services e.g. mobile data networks
  - **Intelligent switching**: e.g. avoid switching satellite beam when a call is in progress
Satellite Based System and Services for Broadband Applications at Sea

Pilot project user became paying customer and the service is launched commercially as “Com4Sea”:
Conclusions

1. Maritime communications is a growing market with strong demand for broadband

2. Satellite systems are evolving towards Ku and Ka

3. ESA is actively supporting innovative technologies and solutions through ARTES programme
Thank you for your attention!

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