The European Market & Technology Roadmap for HTS

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Agenda

1. ESA and Satcoms
2. Satcoms market view and trends
3. ARTES 1 activities
4. R&D Roadmaps related to HTS:
   a. Efficiency
   b. Flexibility
   c. Throughput
   d. Examples
5. Co-funded commercial development examples
Who is ESA?
The European Space Agency

“To provide for and promote, for exclusively peaceful purposes, cooperation among European states in space research and technology and their space applications.”

20 Nations working in the areas of:
• Space Science
• Human Spaceflight
• Exploration
• Earth Observation
• Launchers
• Navigation
• Telecommunications
• Technology
• Operations
• Objectives of ARTES:
  o Maintain and improve the capability and competitiveness of industry of participating countries in the world satellite satcom market
  o Develop satellite-based solutions that meet the needs of the European Society and European Institutions.

See: www.telecom.esa.int
Telecommunications and Integrated Applications
ARTES Programs

Generic Envelope Programme Elements

- ARTES 1: Strategy (ESA initiative, fully funded)
- ARTES 3-4: Products, Services and Commercial Applications (Industry initiative, 50% funded)
- ARTES 5.2: Technology (Industry initiative, 75% funded)
- ARTES 5.1: Technology (ESA initiative, fully funded)
- ARTES 20: Integrated Applications

Specific Mission/System orientated Programme Elements

- ARTES 11: Small GEO platform/mission
- ARTES 7: EDRS – European Data Relay Satellite
- ARTES 10: Iris- Air Traffic Management System
- ARTES 21: AIS – Automatic Identification System
- ARTES 14: NeoSat: Next Generation Platform
- ARTES 33: Industry Generated Public Private Partnerships
SATCOM MARKET
Satellite Communications Industry

Context

- Telecoms industry:
  - 4.9 Trillion US$

- Satellite Industry:
  - 190 Billion US$

- Satcoms Industry:
  - 50% - 60%
  - ~ 100 Billion US$

Source: SIA June 2013 report
Satellite Industry by Sector

- Satellite Manufacturing: 8%
- Ground Equipment: 29%
- Satellite Services: 60%

Source: SIA June 2013 report

2012
$189.5B

2001 – 2012 Global Industry Growth

Source: SIA June 2013 report
Satellite operators/service providers see ‘capacity crunch’ now similar to mobile operators => revenue per bit is dropping

Source: Euroconsult
Market Trends: Satcoms and Terrestrial comms

- Integration between satellite and terrestrial network is accelerating
  - E.g. O3B backhaul of cellular traffic
- Satcoms will succeed where it presents a compelling value proposition
  - E.g. broadcast of HDTV and live events
- Video dominates satcom and is the dominant traffic on terrestrial networks
  - Opportunity for satellite to off-load terrestrial networks by pushing video and other content to the edge of the wired and wireless terrestrial networks
Mobile Services Market

- $1.5 billion MSS operator revenue in 2012 including $1.2 billion for service
- Sustained growth in broadband and M2M segments
- Handheld competition is strong, while overall market growth is slow
- New generation constellations to support future growth

Source: Euroconsult
ACTIVITIES IN ARTES 1
System and Market Studies in ARTES 1:
Some examples

- Next Generation of consumer terminal architectures for broadband and broadcast applications
- European roadmap for flexible payloads
- Applications, markets and requirements for next generation MSS systems
- Next generation waveforms for improved spectral efficiencies
- Service delivery over integrated satellite and terrestrial networks
- Capacity Enhancement and Interference Management for Interactive Satellite Networks
- Next generation of MEO satellite based networks
- Nanosatellites for commercial telecommunication services

ARTES 1 Final Reports and Final Presentations are available to organizations in ESA participating states: Jan 22-23, 2014, ESTEC
Example ARTES 1 activities

- Emerging system concepts for UAS command and control (C2) via satellite: a pre-WRC-2012 system study
- Approaching the Terabit/s Satellite: A system study
- Satellite Machine-to-Machine Services Market Survey
- Satellite Communications for future Arctic Communications
- European Data Relay Satellite (EDRS) early system studies
- Satellite communication ground segment industry survey
R&D ROADMAPS FOR HTS
R&D directions in ESA in the area of HTS

DRIVER 1: Reduce the cost of the delivered b/s/Hz

DRIVER 2: Keep up with the ever increasing user data rate demands

DRIVER 3: Cope with demand variability

- INCREASE THROUGHPUT
- FLEXIBILITY OF RESOURCES
- SYSTEM COST OPTIMIZATION
- SYSTEM GROUND PAYLOAD
Impact to capacity and payload complexity of few key system parameters

Diminishing return capacity characteristic due to the Shannon curve log-like shape and the presence of intra-system interference

Payload complexity (mass, accommodation) vs Platform power (kW)
Throughput increase (2)

1. Use more spectral efficient air interface
2. Reduction of the required number of GWs
   a. Moving to higher frequencies: Q/V and W band and optical (?)
3. Increase capacity by moving to more aggressive frequency re-use and terminal/GW interference mitigation techniques
4. Increase user peak data rates to follow terrestrial trends - multi-Gbps user peak data rate requires large transponder bandwidth (500 MHz or more) with narrow spot beam
1. For large broadband network the cost of the ground segment approaches the cost of the space segment. A large number of gateways are required to support the user capacity.
   a. Smart gateway techniques together with exploitation of higher frequency bands
2. Cost reduce the user terminal
   a. Low cost Ka-band wideband MMIC chipset
   b. All-ODU design concept
   c. Cost reduce the antenna (mobile users)
Flexibility of resources (1)

1. Possibility of adapting the ever-longer living satellites to evolving business conditions (or to crisis situations)
   a. Customer demand variability
      - Type of services and/or users
      - Geographical User Distribution
      - Temporary Events (Wars, Natural Disasters, etc.)
   b. Competition
      - Unpredictable Satellite Operator Competition
      - Unpredictable Terrestrial Network Competition

2. Possibility to early entry into new markets
1. Reconfigurable bandwidth/power allocation on the user-link
2. Support of flexible number of gateways
3. Scalability to the traffic requirements
4. Reconfigurable interconnectivity between user beams / gateways

5. All at
   a. affordable recurrent cost
   b. competitive mass and power consumption
   c. high reliability
2013 and 2014 ARTES 5.1 activities related to HTS (1)
Improving the air interface efficiency/flexibility

1. Ultra High Throughput Transmission through wideband Ka transponder – 2013
2. System Demonstrator for Advanced Interference Mitigation Techniques in Satellite Networks – 2013
2013 and 2014 ARTES 5.1/TRP activities related to HTS (2)

Improving the air interface efficiency/flexibility

5. Precoding demonstrator for broadband systems forward links – 2014


2013 and 2014 ARTES 5.1/TRP activities related to HTS (3) Terminals

1. Low-cost MMIC Chipset for future broadband VSAT- 2013
2. All-ODU Terminal Prototype- 2013
3. Cost-Effective Low-Profile User Terminal Antenna Technology - 2014
4. Dual beam ground terminal antenna for MEO constellation – 2014
5. Modem prototype for MEO broadband access – 2014
6. Propagation Channel Model Simulator for MEO Telecom Services at Ka band – 2014
1. Q/V-band vacuum amplifiers for future high-capacity telecom Gateways – 2013


3. Experimental Characterisation of Ka and Q band Site Diversity using Alphasat TDP5 beacon – 2014
2013 and 2014 ARTES 5.1 activities related to HTS (5)
Mobile terminals

1. Advanced mobility management protocols for future high-capacity multi-beam GEO satellite networks – 2013
2. High Throughput Land Mobile Satellite Terminals – 2013
3. Low Cost BFN/RF front end using multinode on chip for Ka band user terminal phased array antennas – 2013
4. Integrated Ka/Ku band terminal – 2013
5. Electronically steerable low drag aeronautical antenna - 2014
Example Commercial Developments: ARTES 5.2 and 3-4

SAT3PLAY (voice, data, TV) by NEWTEC

IP LNB: Global Invacom

Textile Antennas by Patria Oyj

Maritime Antenna by JOTRON

Media Fleet Manager by ND SatCom

Connecting Remote Communities by Altobridge lite-site™ solution
More information?

www.telecom.esa.int