What next for broadband? Approaching the Terabit/s Satellite

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Overall context

- The ambitious European digital agenda policy
  - Broadband deployment to promote social inclusion and competitiveness in the EU
  - Provide broadband to all Europeans by 2013 and seek to ensure that, by 2020, (i) all Europeans have access to much higher internet speeds of above 30 Mbps and (ii) 50% or more of European households subscribe to internet connections above 100 Mbps
  - The European Digital Scoreboard highlights the limited coverage of rural areas
- Strong competition with the terrestrial wireless technologies to capture the broadband market in rural areas
- Several US initiatives to provide high-throughput satellites in excess of 100 Gb/s

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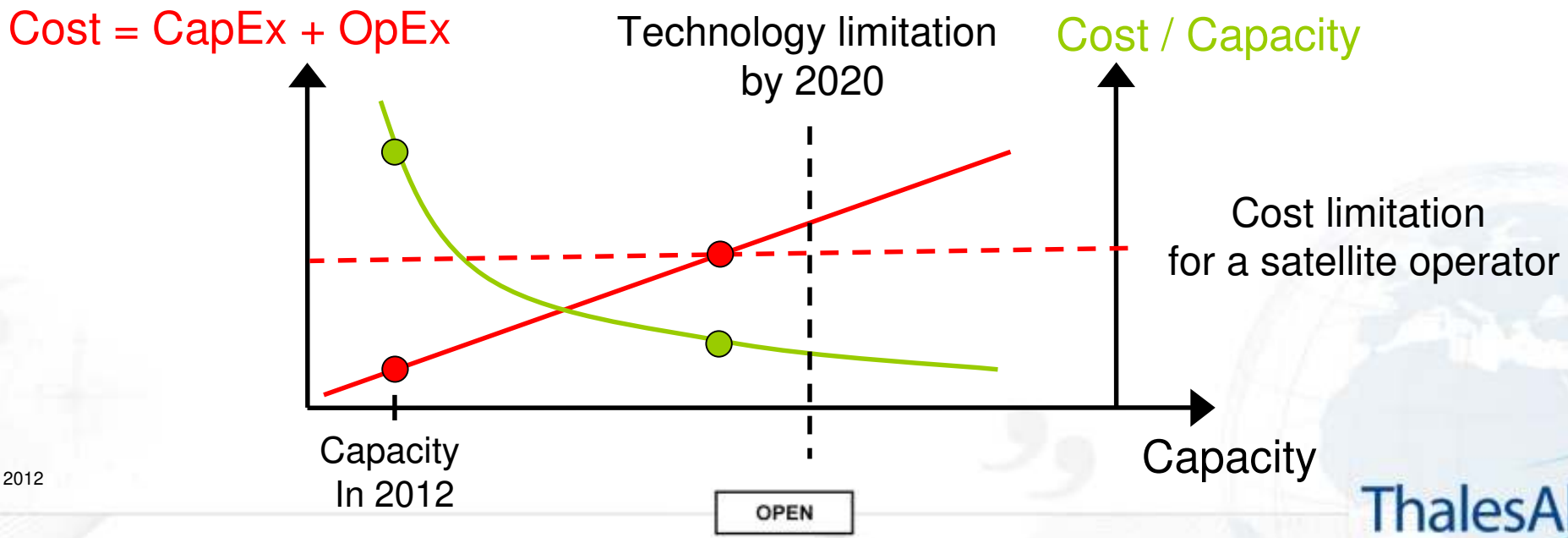
Context of the study

- Programmatic challenges to propose broadband connection to the customer at a limited fee
  - Decrease the system Cost / Capacity ratio
    - Boost the system capacity per unit of payload mass (and power)
    - Optimize the feeder ground segment (especially the number of gateways)
  - Increase the capacity per km²
    - Use very small beams < 0.3°
    - Increase bandwidth on user link



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What are the technical challenges for a Terabit satellite?

- At system level : reduce the cost per capacity unit through increase of the system bandwidth and the number of spots
- At payload level : increase the mass and power efficiency of the payload and increase the size of the reflectors to form narrow beams
- At platform level : accommodate powerful, heavy and bulky payloads while complying with next-generation launchers and keeping the cost of platform low

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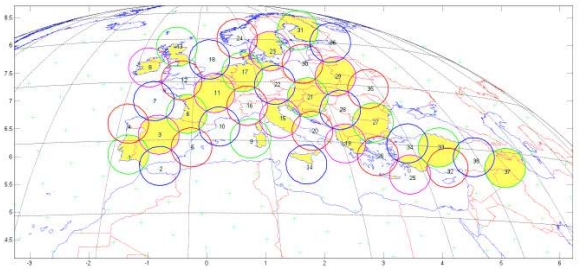
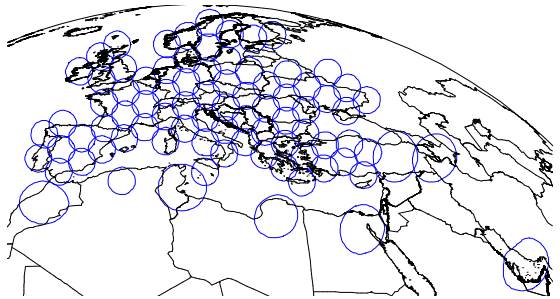
Main achievements & results (1/10)

- Reference cases to assess improvements brought by TERASAT
  - Two Synthetic Small-Medium Reference Satellites
    - 15 & 18 user beams, 3 gateways, respectively
    - ~10 & 13 Gbps capacity, respectively



  - Ka-Sat used as Large Reference Satellite
    - 82 user beams, 10 gateways
    - ~70 Gbps capacity



  - Reference terminal should be 0.75cm - 2W

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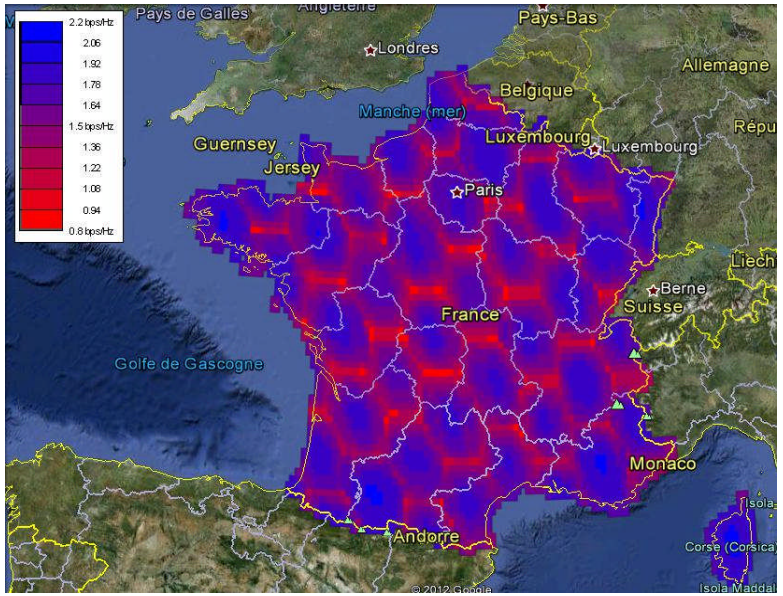
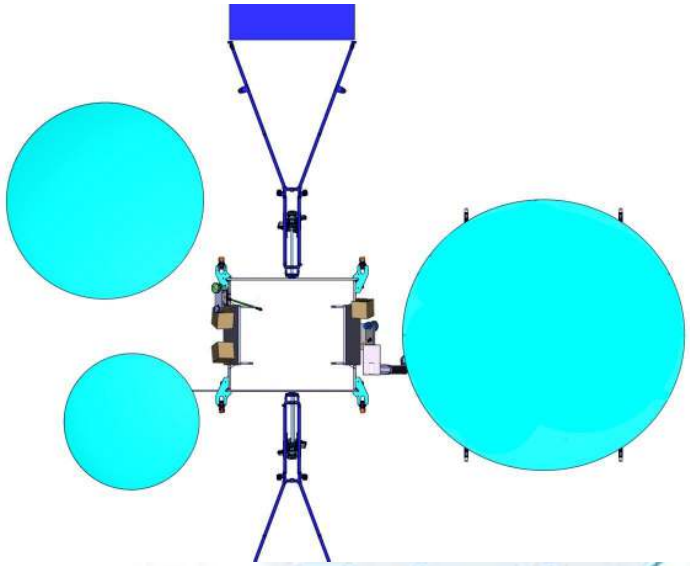
Main achievements & results (8/10)

- Small/medium platform final architecture & performances
  - 45 user spots x 0.18°





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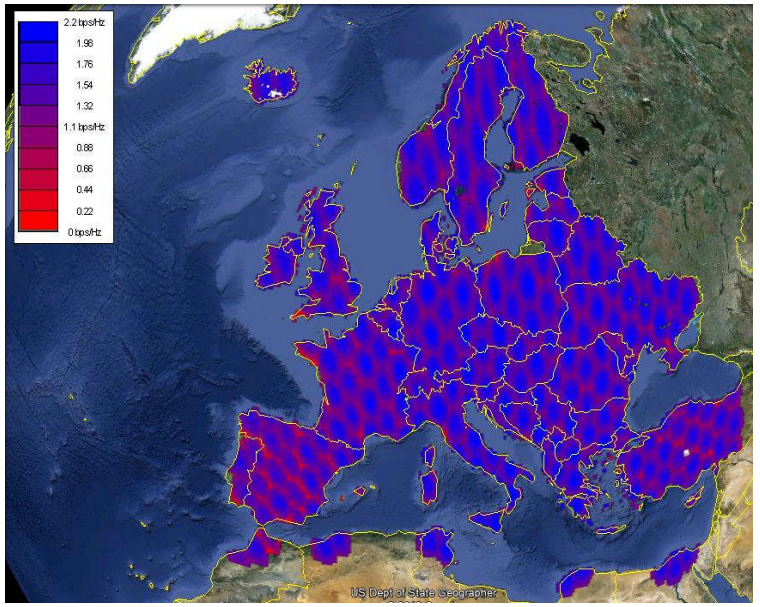
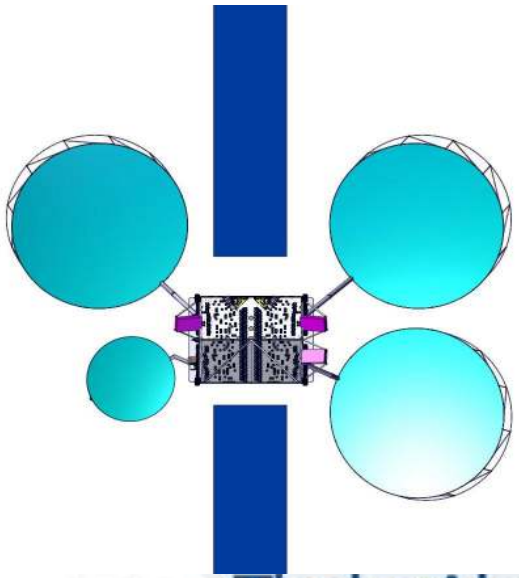
Main achievements & results (9/10)

- Large platform final architecture & performances
  - 240 user spots x 0.26°





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Main achievements & results (10/10)

- Comparison with the reference cases
  - The range of improvement in terms of capacity : x8 - x11
  - Improvement of x4- x5 in terms of capacity / payload {power, mass} ratio
  - TERASAT systems dramatically increase the capacity density

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On-going Critical product developments

- Ka-band Rx/Tx antenna, including large Ka-band reflector (3.5 m) and miniaturized feed clusters
  - Q/V Band Rx/Tx antenna, featuring 1.6 to 2.4 m reflector
  - Wide-band Ka-band LCTWTA (170 W – 2,9 GHz bandwidth)
    - Advanced studies to 250 W
  - Q band 40 W LCTWTA
  - Wide-band V/Ka receiver and down-converter, Ka/Q up-converter, V-band LNA
    - Featuring new generation packaging technologies
  - Wide-band Ka Output Demultiplexer
- Most developments above within French THD-SAT initiative
  - Funded by PIA (Plan d'Investissement pour l'Avenir) "Tranche 1"
  - Time frame: EQM level in 2014/2015

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