Small GEO Satellite initiative (ARTES-11)

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ARTES-11 Workshop

Value of Space Services

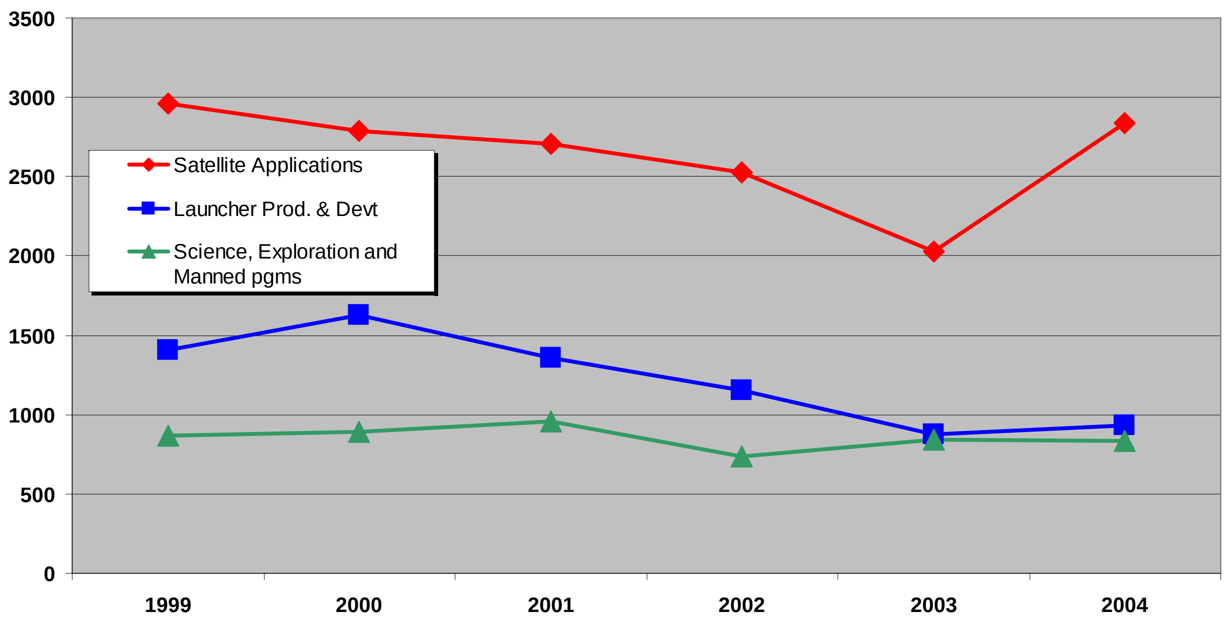
▪ **Industrial Importance**	- Direct - Indirect
▪ **Strategic Importance**	- Tech Leadership - Military Implication - Security Aspect
▪ **Socio Economic Aspect**	- Public Utilities Services - New Market Penetration - New Service Development - Crisis Operation

Overall Turnover of Space Business

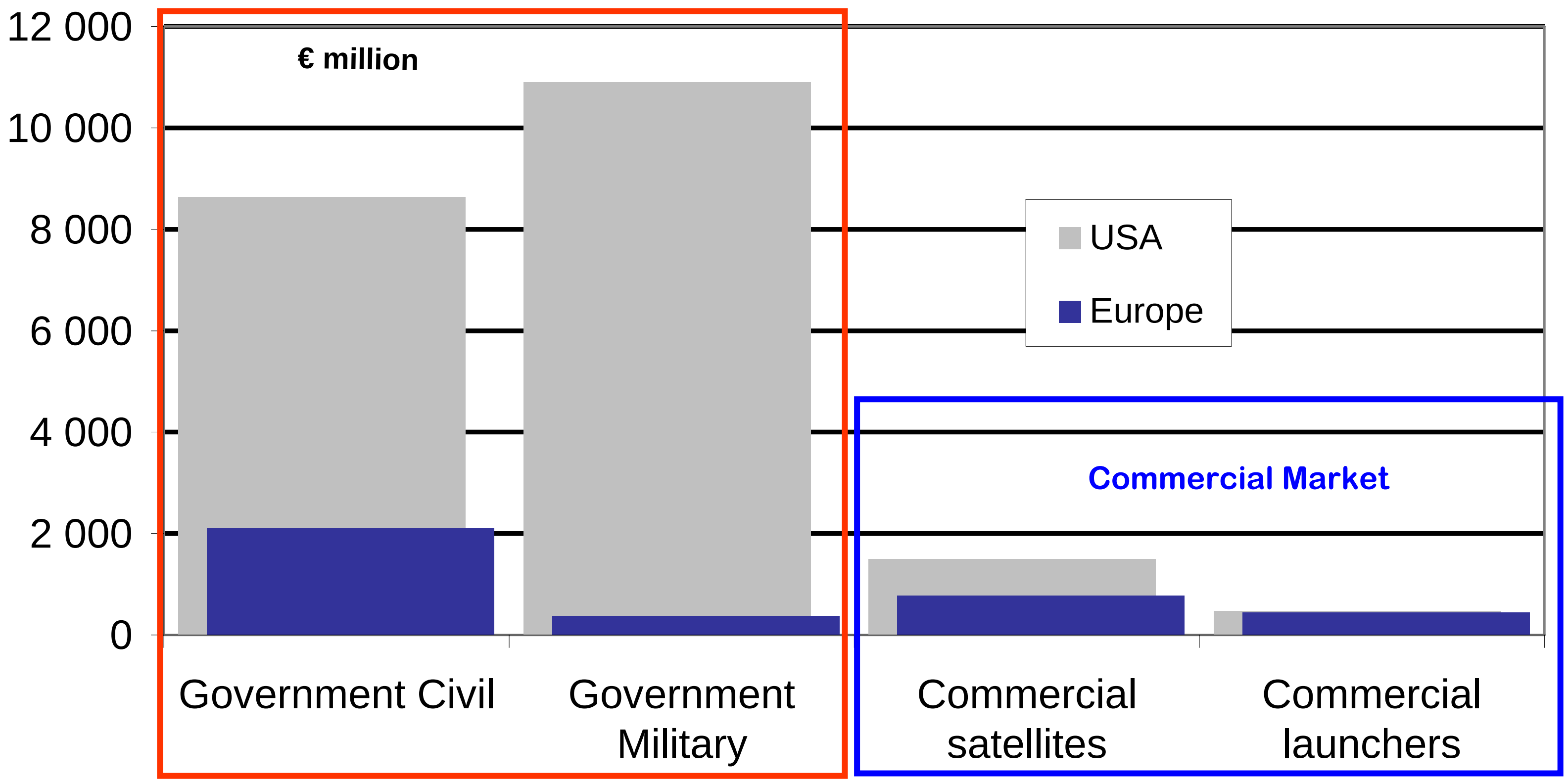
Consolidated turnover, distribution by application

Application (million €)	2004	2003	2002	2001
Telecommunications	1,775.6	1,219.0	1,536.3	1,761.9
Earth Observation	854.2	675.2	907.9	837.6
Navigation/localisation/positioning	210.2	136.6	80.3	109.4
Satellite Applications	**2,840.0**	**2,030.8**	**2,524.5**	**2,708.9**
Launcher Prod. & Devt	**934.9**	**871.3**	**1,152.2**	**1,358.5**
Space Infrastructure and Manned Pgms.	352.3	356.3	408.3	454.4
Science	441.7	455.0	275.9	439.4
Microgravity	37.0	28.1	51.7	60.0
Science, exploration and manned pgms.	**831.0**	**839.4**	**735.9**	**953.8**
Support Activities	89.6	160.4	190.3	119.3
Other Disciplines (or unidentified)	89.1	132.2	123.3	117.7
Total Consolidated Turnover	**4,784.6**	**4,034.1**	**4,726.2**	**5,258.1**

Turnover by Applications (M€), 1999-2004



Estimated 2004 Space Industry Turnover

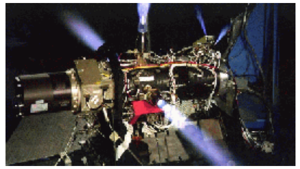


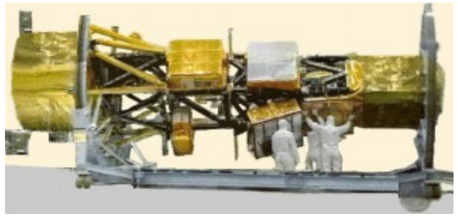
➡ **The US space industry is less sensitive to business cycles in the commercial sector than its European competitors**

U.S. Space Superiority Doctrine

“Space superiority is our day-to-day mission. Space supremacy is our vision for the future.”

Gen. Lance Lord, Commander,
US Air Force Space Command, 18 May 2005





- **Space dominance/space superiority:**
  - US establishing leadership in early warning, navigation, intelligence, surveillance, reconnaissance, command and control, reduction of strike decision time, network centric warfare, etc.
  - Doctrine to operate space and space-supported functions without any prohibitive interference.

- **Space control:**
  - The US “is more dependent on space than any other nation”. This create a vulnerability that requires means to deter and defend against “hostile acts directed at US space assets and against the uses of space hostile to US interest” – Rumsfeld Commission Report, January 2001.
  - Space control projects are already in development or deployment – e.g. greater investments in space surveillance, ground telecommunications and earth observation jamming stations, protection of US space-related sites, etc.
  - <u>The upcoming US President National Space Policy will address space control aspects.</u>

- **Vision for space supremacy:**
  - Complete freedom of action in space
  - Denial of access to space for US adversaries
  - Continued intelligence, surveillance, reconnaissance, tactical support from space (24/7)

Examples of U.S. Defence Space Systems (2005 – 2015)

Intelligence, Surveillance and Reconnaissance	▪ Future Imagery Architecture (FIA) ▪ Space Radar (SR)
Telecommunications	▪ WideBand Gapfiller Satellites (WGS) ▪ Advanced Extremely High Frequency System (AEHF) ▪ Mobile User Objective System (MUOS) ▪ Transformational Satellite Communications System (laser communications)
Navigation, Positioning, Timing	▪ GPS Block II RM, IIF ▪ GPS III
Missile Warning and Tracking	▪ Space Based Infrared System (SBIRS) ▪ Space Tracking and Surveillance System (STSS)
Weather (Convergence Civil and Military Polar Meteorological Satellites)	▪ National Polar-orbiting Operational Environmental Satellite System (NPOESS)

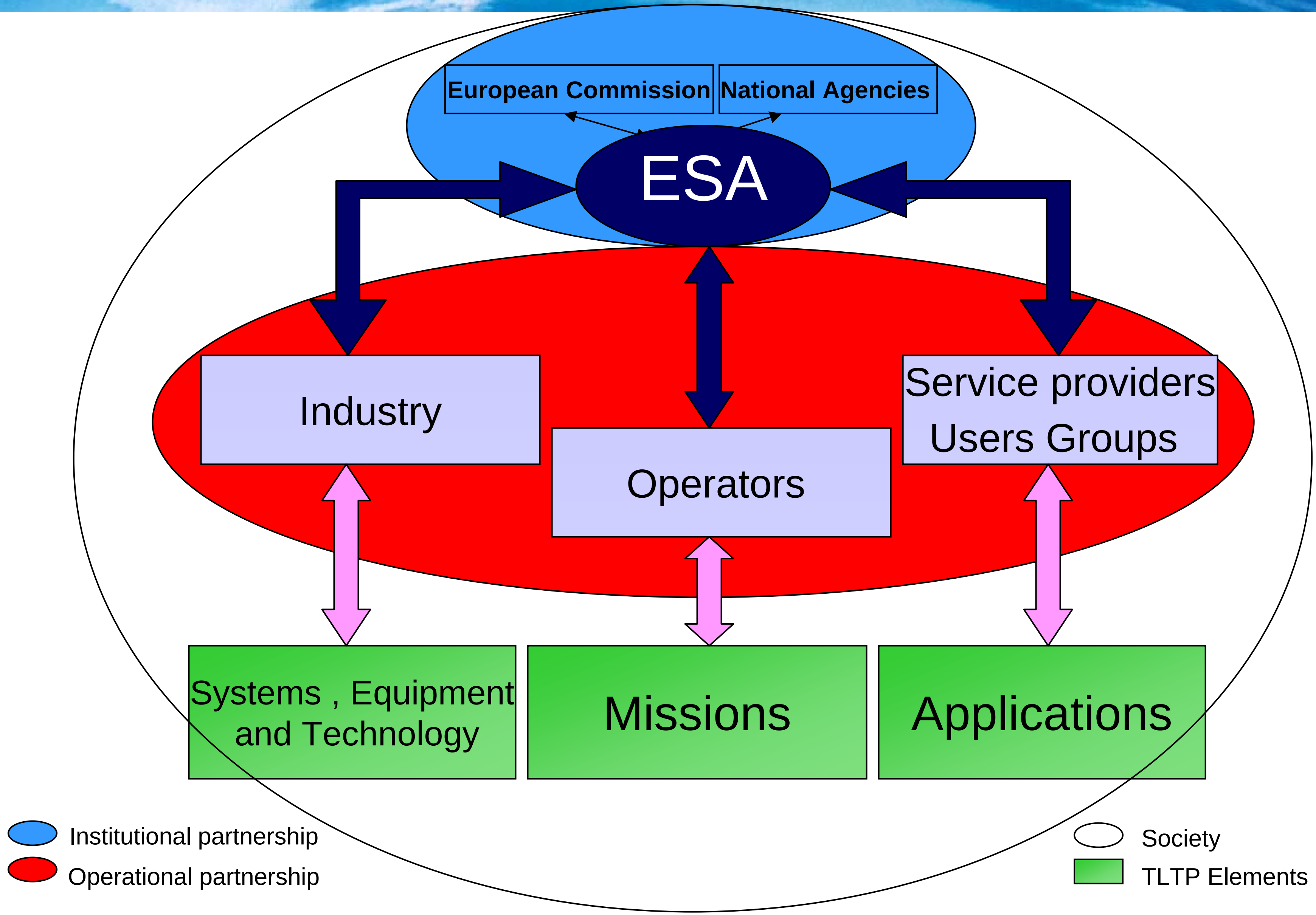
Telecommunications

TELECOMMUNICATIONS

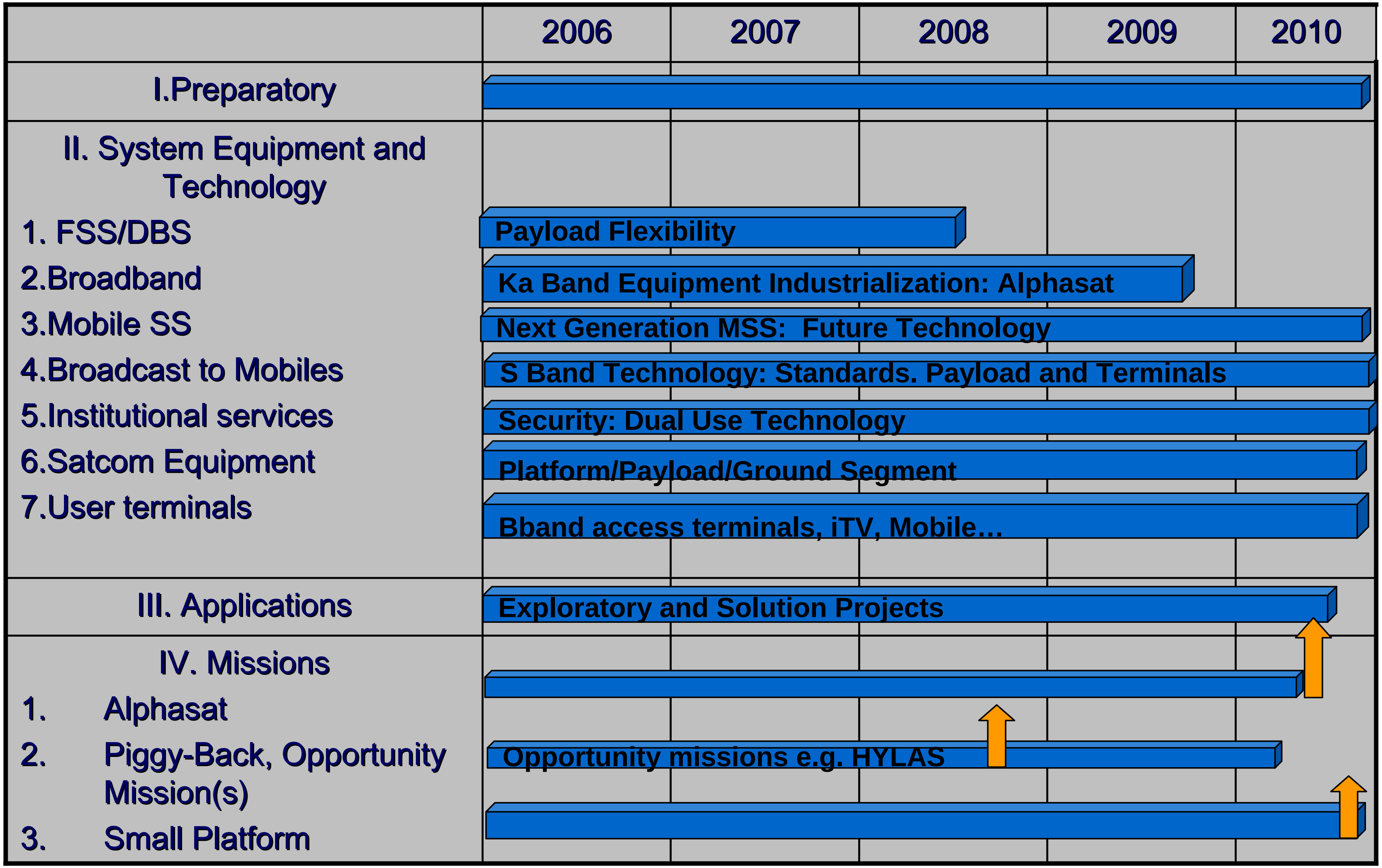
Most promising among space applications, but also the one that is the most subject to competition by

- Ground infrastructure. The future will surely be in:
- High Technology Development by advanced Countries
- Low Cost Offers by Emerging Countries

ESA Strategic Framework

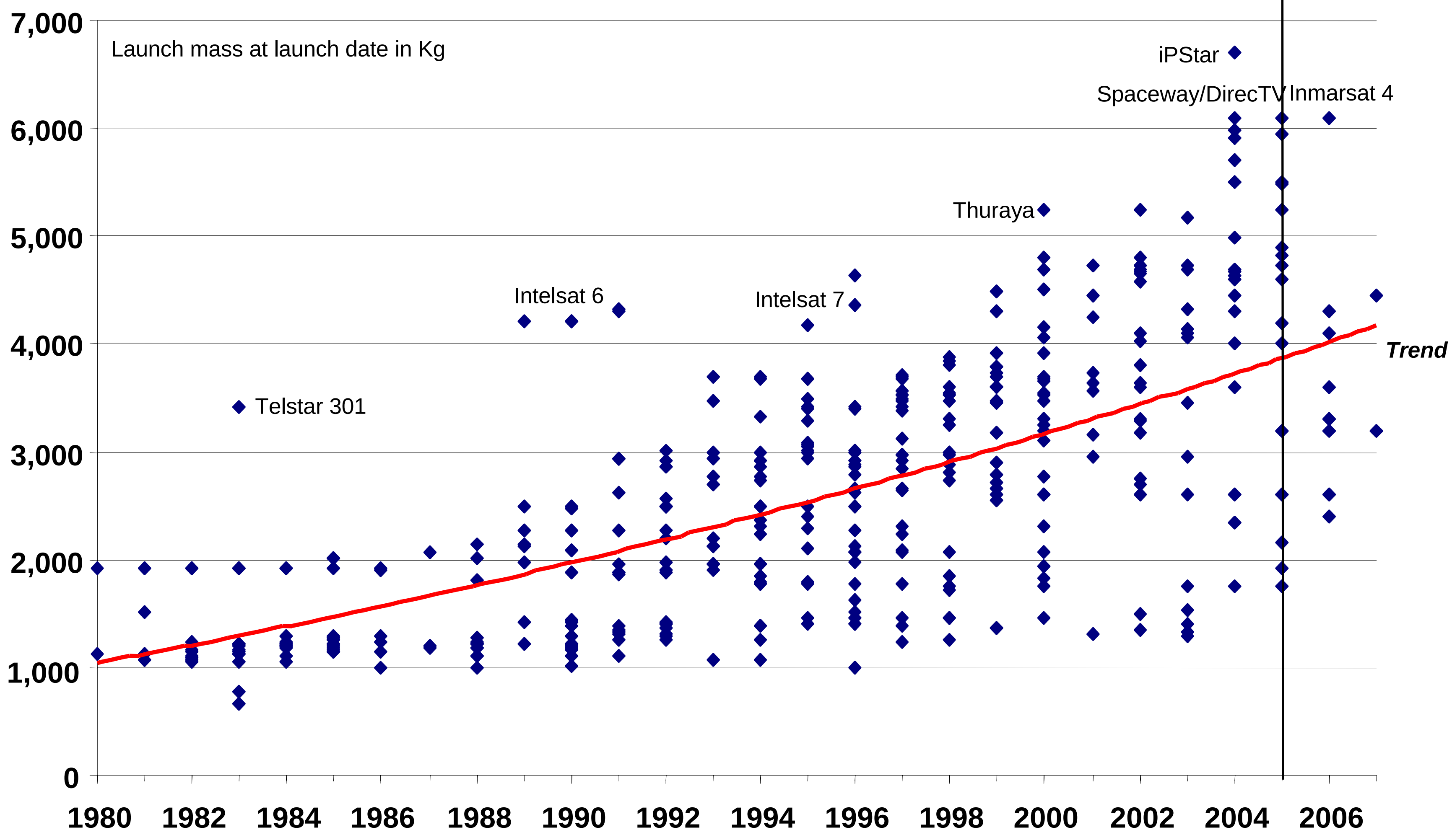


Implementation of the Berlin Conference



Small Geo Market and Competition

Trend in launch mass of commercial GEO satellites, 1980-2006



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Demand for small GEO by operators

- **Economies of scale** favor large satellites with lower capex and opex costs, but not every operator has a business justifying the $200-250 million capex of a large satellite

- The lower capex cost per transponder per year of lifetime associated with large satellites is **not the relevant metrics** in case of :

  - **replacement of capacity in a stable market**: the case of PanAmSat and SES Americom on the US cable TV market (6 small satellites together in recent years), of Measat 4 in Malaysia,

  - **replacement of larger satellites with discontinued capabilities**: the case of Optus D (no more Ka-band and L-band), of Horizons-2 (less transponders)

  - **risk mitigator for capacity expansion**: in case of new orbital slot opening or limited capacity addition to an operational slot: e.g. SES Astra, Eutelsat and Telenor, all three on the European market with Astra 2D&3A, eBird, and Thor 2R respectively

  - **placeholder at a new orbital slot:** to save frequency rights to a given orbital position.

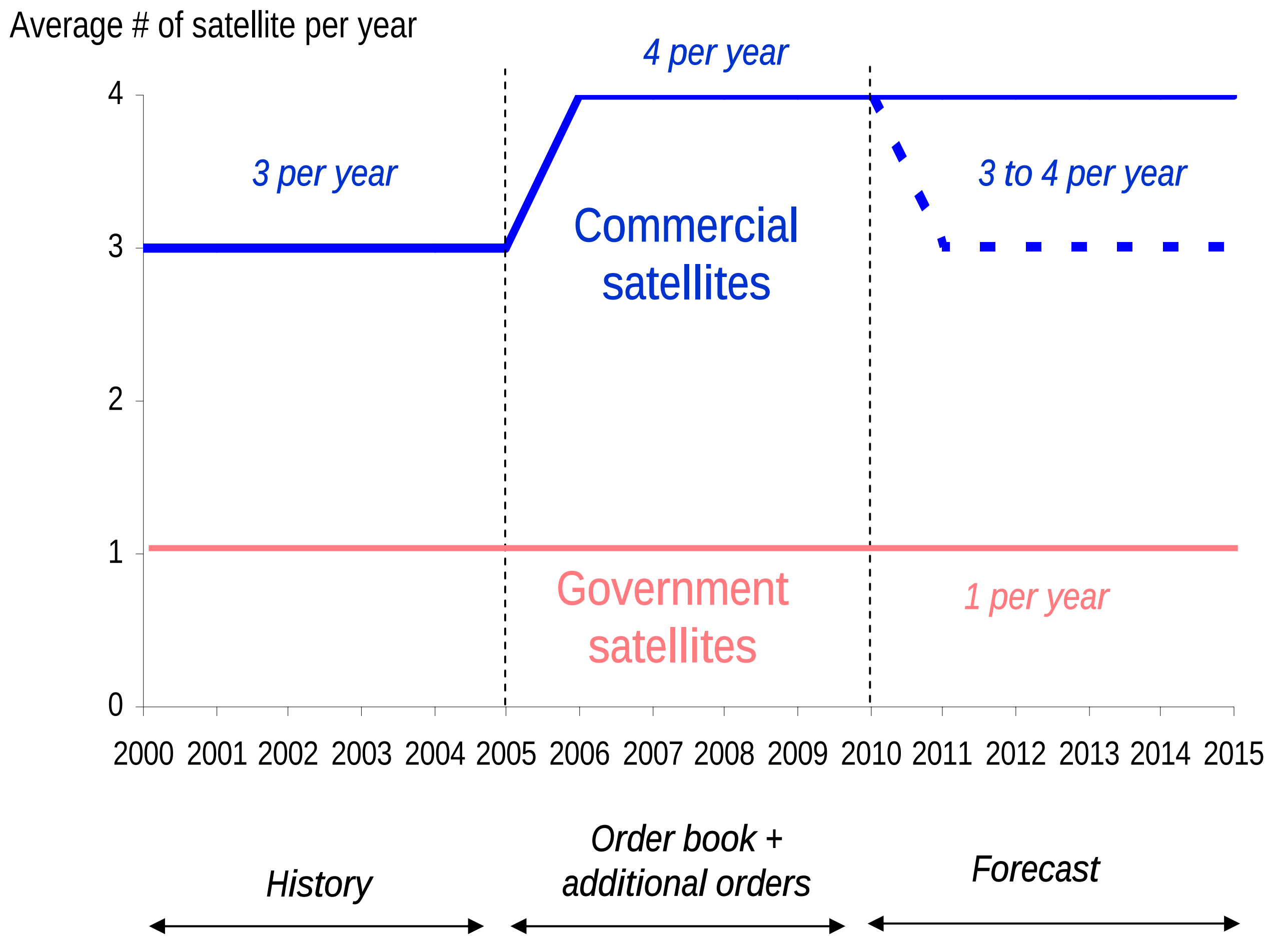
- **The benefits of small GEO satellite for commercial operators include:**

  - staggered investment for two small instead one large over a few years

  - flexibility when business case is not well established with two small marginally more expensive than one larger

  - optimal use of limited spectrum ressources

15 years of small GEO satellites accessible to European manufacturers



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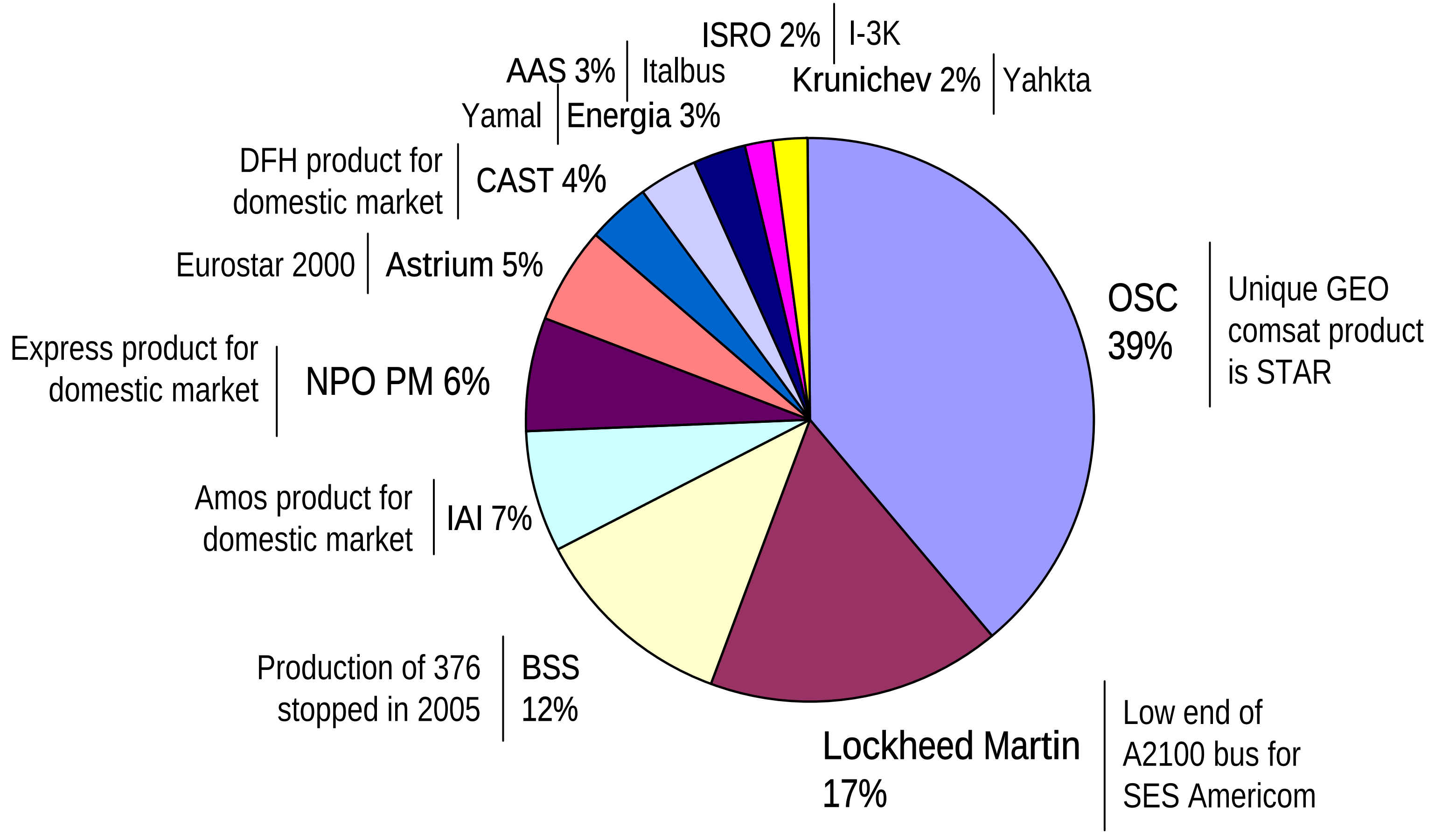
Market shares of small GEO comsat manufacturers

38 small satellites launched over 2000-05 or under construction for an estimated market value of $2.7 billion



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Key success factors for government satellite market

	European governments		Non-European governments
	Operational satellites	Technology demonstration satellites	
Typical customers	Eumetsat, Ministries of Defense, NATO, European Defense Agency, European Commission	National space agencies, ESA, Ministries of Defense,	Taiwan, Malaysia, Argentine, South Africa, Brazil
Typical applications	Telecommunications, meteorology, navigation, data relay	In-orbit validation of new payloads for telecom., meteo., navigation, data relay, early warning, ...	Operational satellites for national independence and development of domestic industrial capabilities
Key success factors	- Local industry content - On-time on-pad delivery - Cost effective: long lifetime, high payload mass fraction - Easy to operate - Compatible with Ariane/Soyuz	- Local industry content - Low cost platfom - Low launch cost opportunity - Multi-mission capability - Compatible with Ariane/Soyuz	- ITAR-free content - Local industry content - Low cost platform - Compatible with multiple launch options - IOD option available - Training of local industry

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Key factors of success on commercial satellite market

	Existing satellite operators	Green field satellites
Typical customers	Large (e.g. Eutelsat, SES Global, Intelsat) and smaller size companies (e.g. Nilesat, Star One, Telenor, Optus)	Start up companies (e.g. WildBlue, Avanti, AstroVision)
Typical applications	Fixed satellite services (FSS), Direct Broadcasting services (DBS), Mobile Satellite Services (MSS)	Digital audio broadcasting (DAB), broadband services, aeronautical services
Key success factors	- Flight heritage - Short delivery time - On time on pad or in orbit delivery - Cost effective system (capex+opex) - Compatibility with multiple launch vehicles	- Vendor financing or risk sharing - Flight heritage - On time on pad or in orbit delivery - Cost effective system (capex+opex) - Compatibility with multiple launch vehicles - TT&C service provision

Road to success for a new small European GEO satellite

- **Cost effectiveness is a *sine qua non* condition for any investment decision by a satellite operator.** It results from the combination of numerous variables relative to performance and reliability, all at a cost, in order to

  - **minimize satellite production costs**: the design of the satellite and its production process have to minimize labour cost through innovative technologies

  - **minimize satellite operation costs:** the design of the satellite has to minimize equipment and labour cost for the satellite operator through innovative technologies

  - **maximize satellite performance:** the design of the satellite has to ensure a long lifetime for a mission payload as capable as possible

  - **maximize product reliability**: designing a low cost product cannot compromise over reliability. High reliability is a key attribute for a Western manufacturer.