SIA
SATELLITE INDUSTRY ASSOCIATION

2016

State of the Satellite Industry Report

September 2016

Prepared by:

THE TAURI GROUP

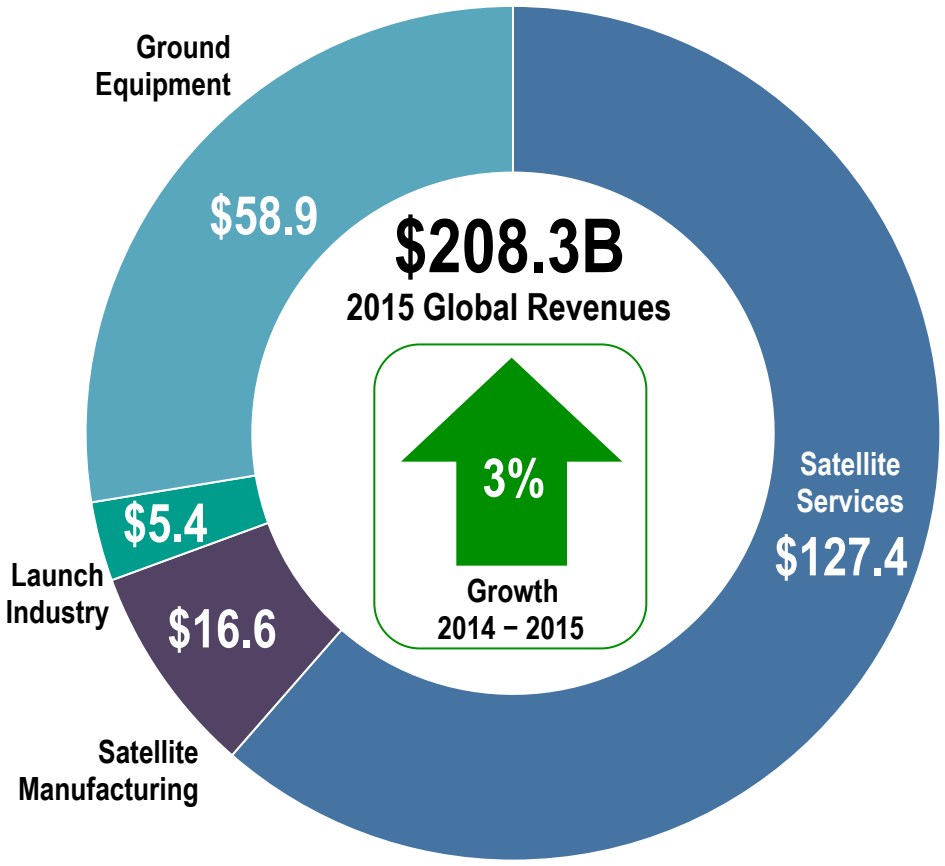
Satellite Industry Association:
21 Years as the Voice of the U.S. Satellite Industry

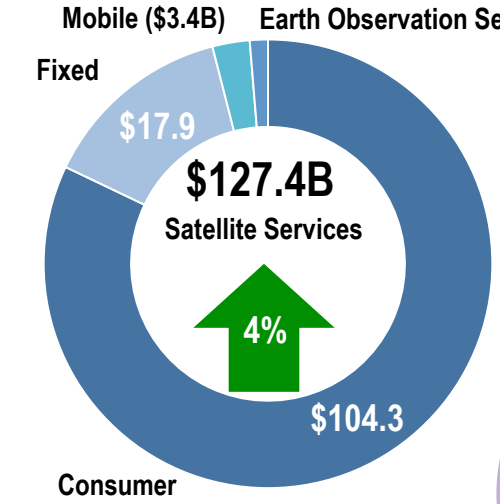
SIA Member Companies

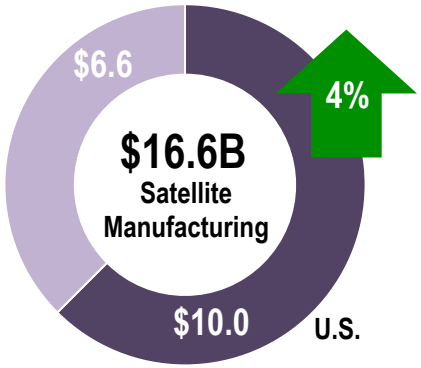
Study Overview

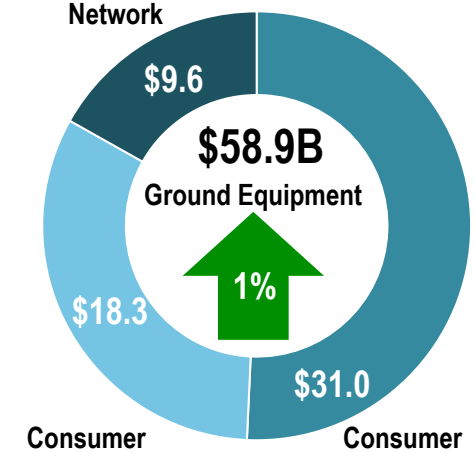
- SIA's 19th annual study of satellite industry data
- Performed by The Tauri Group
- Reports on 2015 activity derived from unique data sets, including proprietary surveys, in-depth public information, and independent analysis
- All data are global, unless otherwise noted
- Prior year revenues are not adjusted for inflation

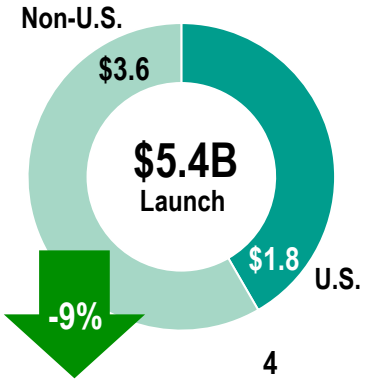
2015 Satellite Industry Indicators Summary





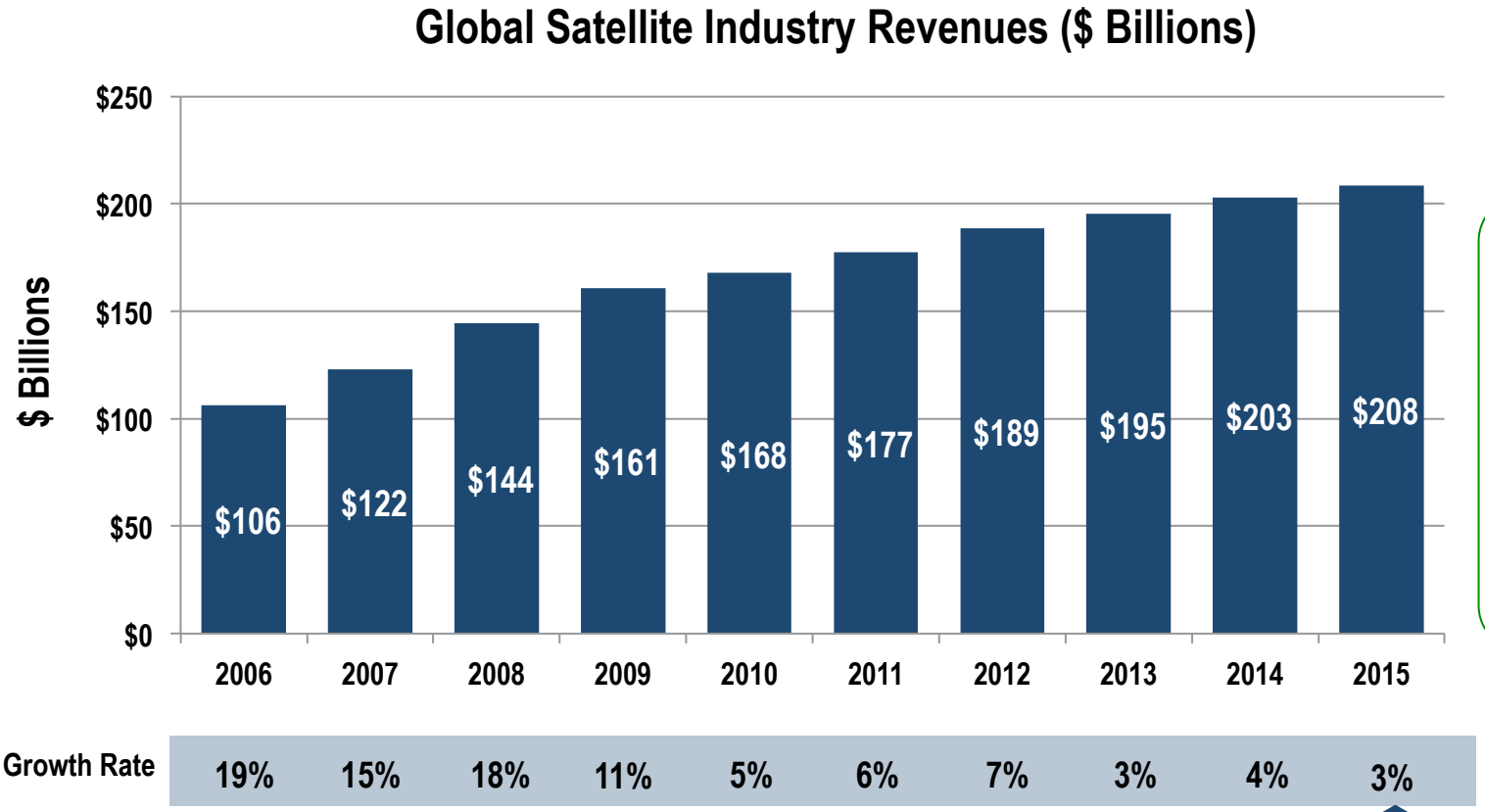






Prepared by:
THE TAURI GROUP

Global Satellite Industry Revenues



2X

Ten-Year Global Industry Growth

Global satellite industry grew 3% in 2015, slightly above worldwide economic growth (2.4%) and U.S. growth (2.5%)

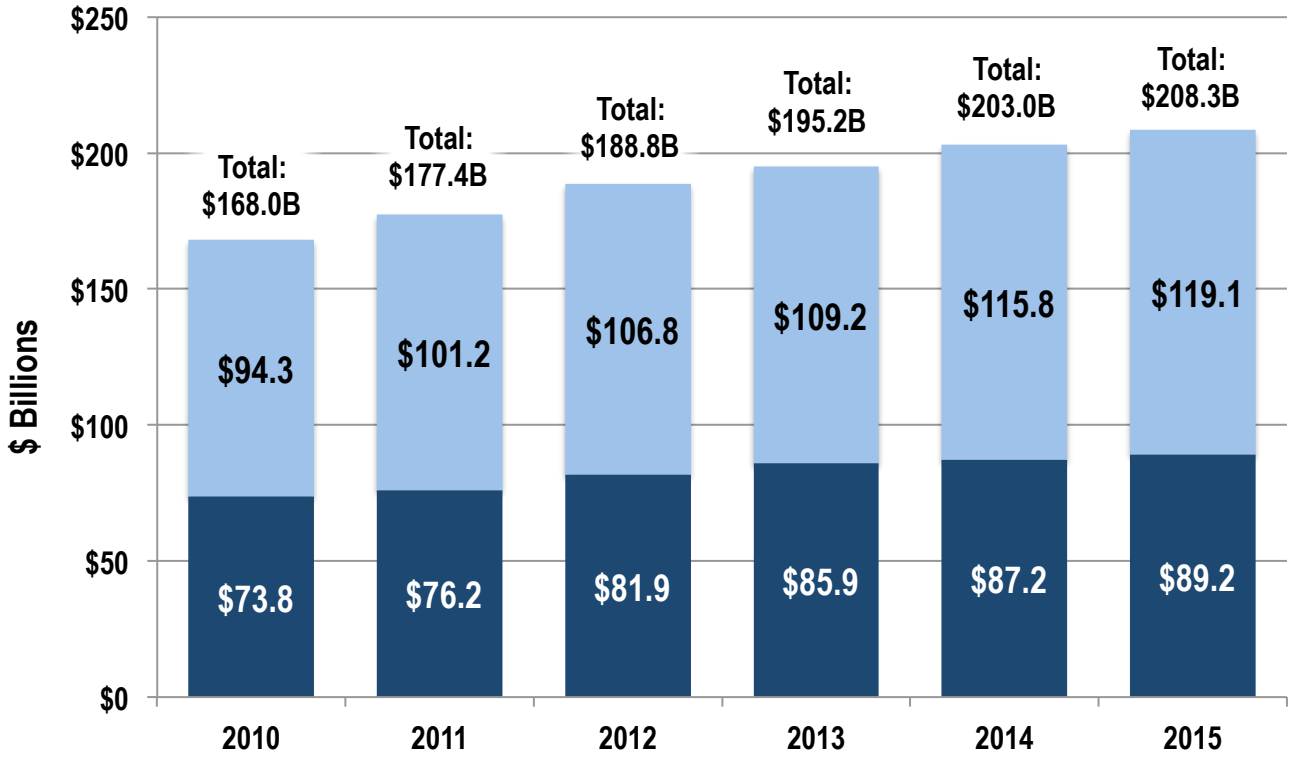
Prepared by:
THE TAURI GROUP

U.S. Portion of Global Satellite Industry Revenues

Average yearly U.S. market share

43%

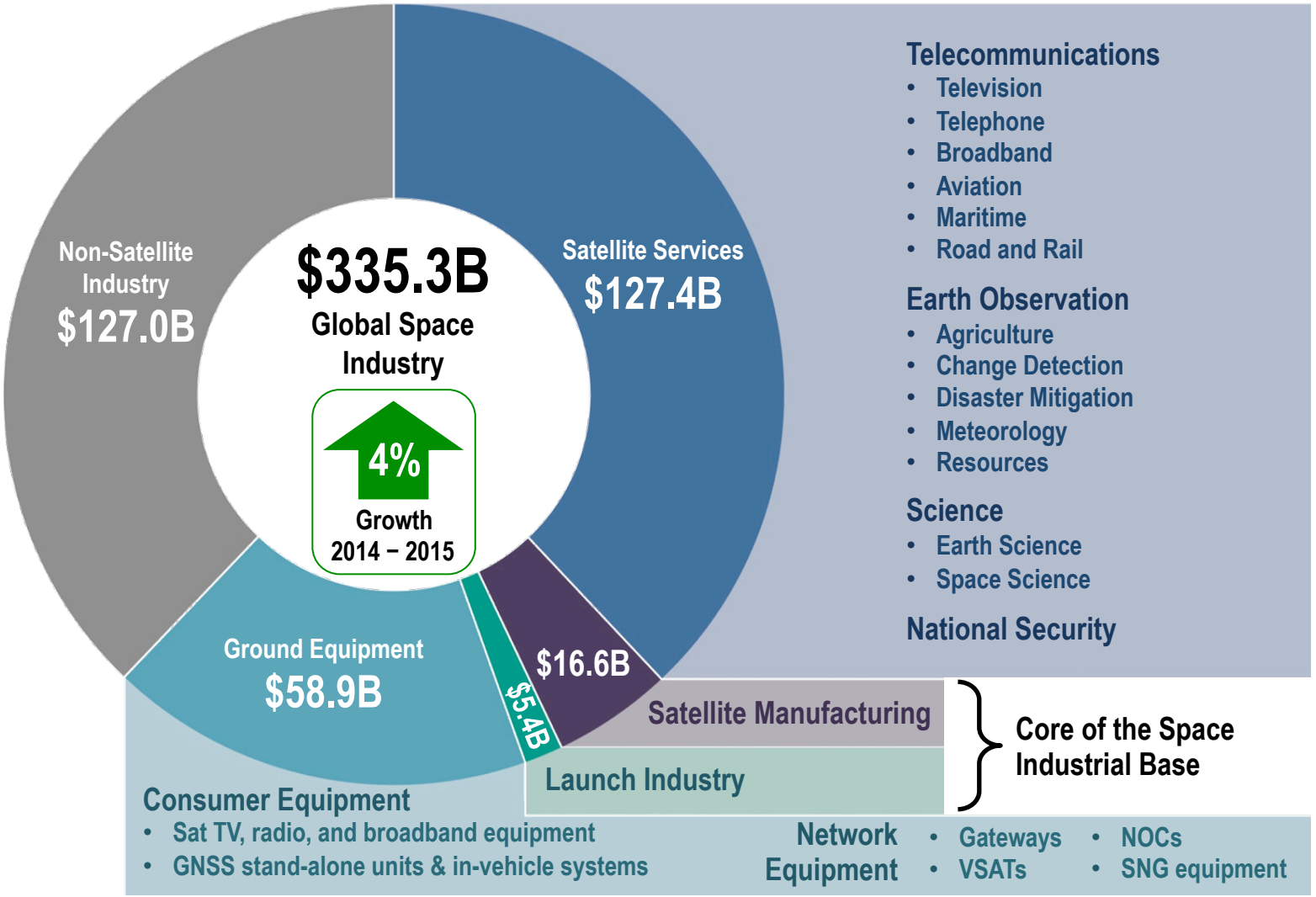
of global industry



	2010	2011	2012	2013	2014	2015
Growth Rate	4%	6%	6%	3%	4%	3%
U.S. Growth	2%	3%	7%	5%	2%	2%
Non-U.S. Growth	7%	7%	6%	2%	6%	3%

Prepared by:
THE TAURI GROUP

The Satellite Industry in Context

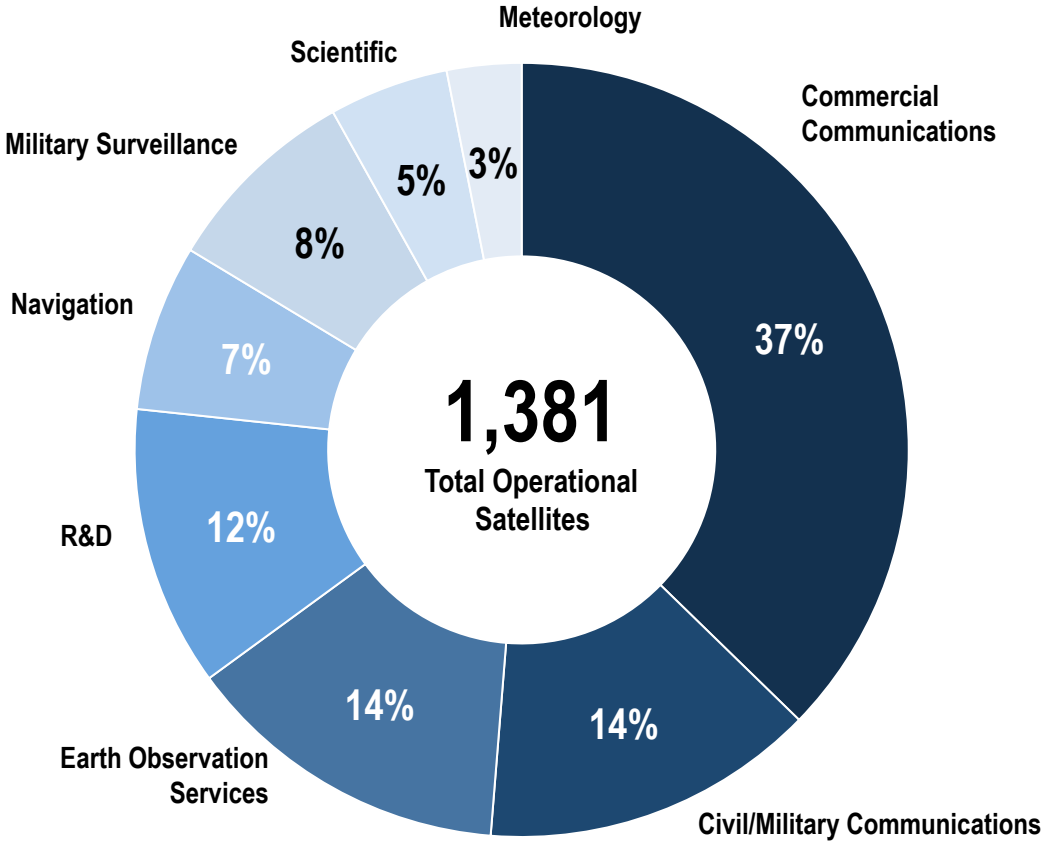


Prepared by:
THE TAURI GROUP

Notes: Network operations centers (NOCs), satellite news gathering (SNG), very small aperture terminal (VSAT) equipment, global navigation satellite systems (GNSS)

The Satellite Network in Context

Operational Satellites by Function
(as of December 31, 2015)



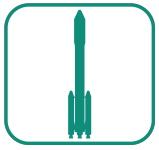
- Number of satellites increased 39% over 5 years, compared to 986 reported in 2011
  - » Average number of satellites launched per year in 2011-2015 increased 36% over previous 5 years
  - » Small and very small satellites deployed in LEO contribute to this growth
  - » Average operational lives of certain satellite types (such as GEO communications satellites) are becoming longer
- 59 countries with operators of at least one satellite (some as part of regional consortia)

Top-Level Global Satellite Industry Findings

- Satellite industry revenue was $208.3 billion in 2015
- Overall industry growth of 3% worldwide
- Three of four satellite industry segments posted growth

Satellite services, the largest segment, revenues grew by 4%
Consumer services continues to be a key driver for the overall satellite industry

Satellite manufacturing revenues grew by 4%
Larger number of high value government satellites launched in 2015



Launch industry revenues decreased by 9%
Fewer commercially procured launches

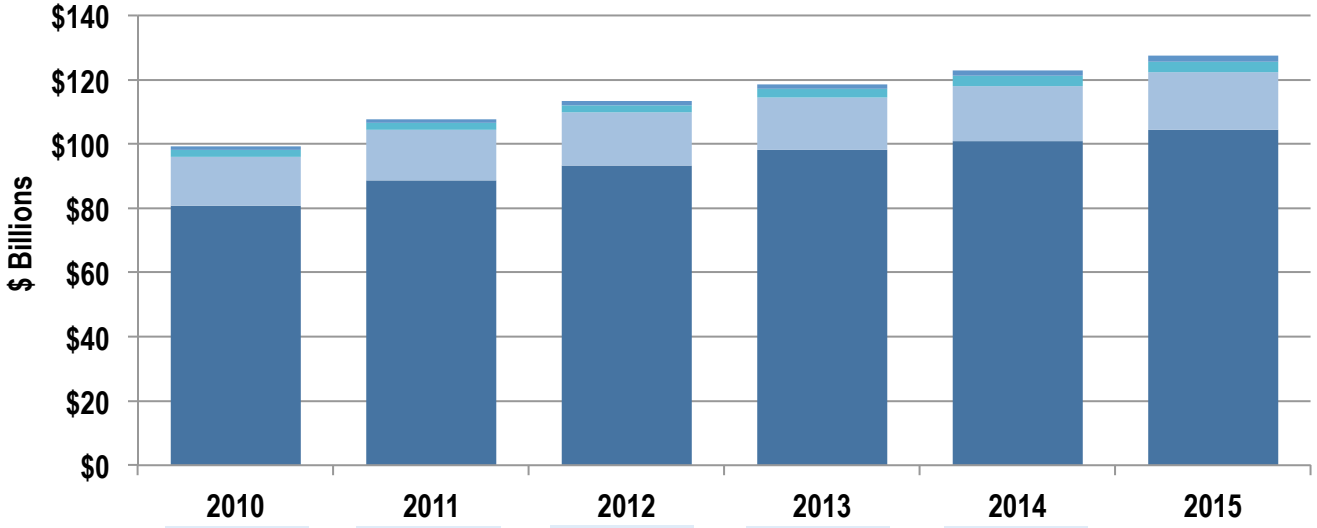
Ground equipment revenues grew by 1%
Growth in consumer and network equipment, and consumer GNSS remaining flat

Satellite Industry Segments

Satellite Services

- Consumer Services
  - » Satellite Television
  - » Satellite Radio
  - » Satellite Broadband
- Fixed Satellite Services
  - » Transponder Agreements
  - » Managed Network Services (including spaceflight management services)
- Mobile Satellite Services
  - » Mobile Data
  - » Mobile Voice
- Earth Observation Services

Global Satellite Services Revenue



	2010	2011	2012	2013	2014	2015
Growth Rate	9%	6%	5%	5%	4%	4%
Total	**$101.3**	**$107.8**	**$113.5**	**$118.6**	**$122.9**	**$127.4**
Consumer	$83.1	$88.6	$93.3	$98.1	$100.9	$104.3
Satellite TV (DBS/DTH)	$79.1	$84.4	$88.4	$92.6	$95.0	$97.8
Satellite Radio (DARS)	$2.8	$3.0	$3.4	$3.8	$4.2	$4.6
Satellite Broadband	$1.2	$1.2	$1.5	$1.7	$1.8	$1.9
Fixed	$15.0	$15.7	$16.4	$16.4	$17.1	$17.9
Transponder Agreements (1)	$11.1	$11.4	$11.8	$11.8	$12.3	$12.4
Managed Services (2)	$3.9	$4.3	$4.6	$4.6	$4.8	$5.5
Mobile	$2.3	$2.4	$2.4	$2.6	$3.3	$3.4
Voice	$0.7	$0.7	$0.7	$0.8	$0.9	$1.0
Data	$1.6	$1.7	$1.8	$1.8	$2.3	$2.4
Earth Observation	$1.0	$1.1	$1.3	$1.5	$1.6	$1.8

4%

2014 – 2015 Global Growth

The U.S. share of satellite services revenue in 2015 was

42%

Prepared by:

THE TAURI GROUP

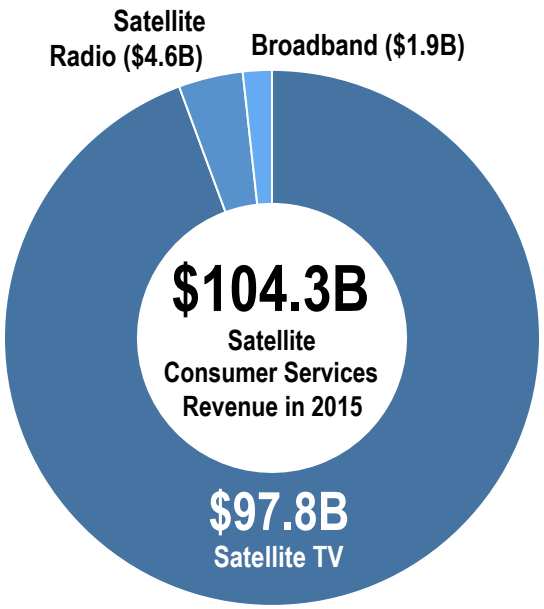
Notes: Numbers may not sum exactly due to rounding. (1) Includes capacity for DTH satellite TV and some mobility service platforms. (2) Includes VSAT networks.

Satellite Services Findings: Consumer Services Highlights

The consumer services segment, consisting of satellite television, radio, and broadband, grew by 3% and was the largest contributor to overall satellite services revenues

Satellite TV Services

- Satellite TV services (DBS/DTH) grew 3% and account for 77% of all satellite services revenues, and 94% of consumer revenues
- About 230 million satellite TV subscribers worldwide, driven by growth in emerging markets
- 42% of global revenues attributed to U.S.
- U.S. growth driven by premium service revenues
- Growing production of UHD content drives the increasing (but still relatively low) number of UHD channels
- Compression technologies continue to improve, potentially slowing down the demand growth for satellite capacity



Satellite Radio

- Satellite radio (DARS) revenues grew by 9% in 2015
- Satellite radio subscribers grew 8% in 2015 to 29.6 million
- Primarily U.S. customer base

Satellite Broadband

- Revenue grew 10%
- Subscribership grew to about 1.8 million
- Most subscribers in the U.S., non-U.S. subscribership growth rate picking up

Satellite Services Findings

- Fixed satellite services grew by 4%
  - » Revenues for transponder agreements grew 1%, compared to 4% in 2014
  - » Revenues for managed services grew 15%, compared to 4% in 2014; airborne services contributed significantly
- Mobile satellite services grew 4%
  - » Mobile satellite voice revenues grew 9%, compared to 19% in 2014
  - » Mobile satellite data revenues grew 4%, compared to 27% in 2014
    - ○ Includes a small amount of revenue from Ku and Ka-band FSS capacity, leased by MSS operators to provide maritime, airborne, and other mobility services
- Earth observation services revenues grew 10%
  - » Continued growth by established satellite remote sensing companies, with some new entrants reporting revenue from newly deployed and acquired satellites
  - » New entrants continued to raise capital, develop satellites, and deploy initial constellations

Case Study: Consumer Broadband Over Satellite

- **Satellite broadband segment getting more mature**
- **Comparable to terrestrial**
  - » Comparable to cable/fiber in terms of speed and price
  - » Latency a concern for a few applications; plans announced for LEO systems with lower latency
  - » Available nationwide, not just in select areas
- **Maturation** and combining of advanced technologies (frequency reuse, spot beams, and on-board processing) defined new, high throughput satellites (HTS)
- **Substantial reduction in cost** per unit of throughput
- **Growing** customer confidence due to high data rates and reliable service
  - » For the last 3 years, satellite broadband operators consistently ranked at the top by the FCC broadband report in at least one of the two categories: for the best peak period download speeds and for delivering on advertised performance promises

1990s

- Large constellations proposed, all canceled
- Expensive technology
- Cost-effective terrestrial competition

2000s

- Smaller regional systems proposed, deployed
  - » Wildblue
  - » Spaceway
- Technical success, test bed for new technologies, bandwidth cost reduction
- Acquisitions by established players

Present

- Five major systems today and expanding:
  - » Eutelsat Tooway, HughesNet, ViaSat Exede, Inmarsat Global Xpress, O3b
- Four providers affiliated with established satellite operators (DTH, FSS, or MSS)
- 50% revenue growth over 5 years
- Subscribers grew 11% per year on average, tracking revenue growth

Case Study: Earth Observation (EO) Services

- For many years, global EO services were offered by small number of operators
  - » Typically founded and financed by space industry with the objective to provide high resolution imagery
  - » Medium to large satellites with on-board data processing and advanced, custom-designed payloads
  - » Governments as primary customers
- New competitors and new partnerships have recently emerged
  - » Typically founded and financed by IT/analytics/tech sector to provide web-accessible, frequently updated imagery
  - » Smaller satellites, with lower costs of manufacture, launch, and operation, supplemented with sophisticated ground-based data analytics
  - » Customer base is developing
  - » Planet Labs acquired BlackBridge satellites and data library; UrtheCast purchased Deimos satellites and data
  - » DigitalGlobe recently entered a joint venture with Saudi Arabia-based TAQNIA for a small constellation
- Investment driven by interest in business intelligence products from satellite imagery
  - » 2015 a record-setting year with investment in start-up space ventures of $2.3B
  - » Several EO firms (at right) received venture capital investment in 2015: BlackSky Global, GeoOptics, Hera, OmniEarth, Planet Labs, Satellogic, Spire Global

Operational
Planned

		High Resolution (<1m)	High revisit time (<1dy)	Sensor Description	System or Constellation Size	Satellite Mass (kg)
Large Sats	***Airbus D&S***	•		Optical and radar	4	1,000
	DigitalGlobe	•	•	Optical	5	2,800
	DMCii	•		Optical	6	450
	ImageSat	•		Optical	3	350
	MDA			Radar	4	1,300
	UrtheCast	•	•	Opt & rad (planned), video	24	1,400
Small Satellites (<200 kg)	***Aquila Space***	•	•	Optical and radar	30	6
	BlackBridge	•	•	Optical	5	150
	BlackSky Global		•	Optical	60	50
	DigitalGlobe/TAQNIA		•	Optical	6	TBD
	XpressSAR	•		Radar	4	TBD
	GeoOptics		•	Radio occultation	25	100
	Hera		•	Optical	48	24
	Iceye	•	•	Radar	50	<100
	OmniEarth		•	Optical	15	110
	PlanetiQ	•	•	Radio occultation	12	22
	Planet Labs		•	Optical	100	3
	Satellogic	•	•	Optical	300	35
	Spire Global		•	Radio occultation	50	3
	Terra Bella	•	•	Optical and video	24	120

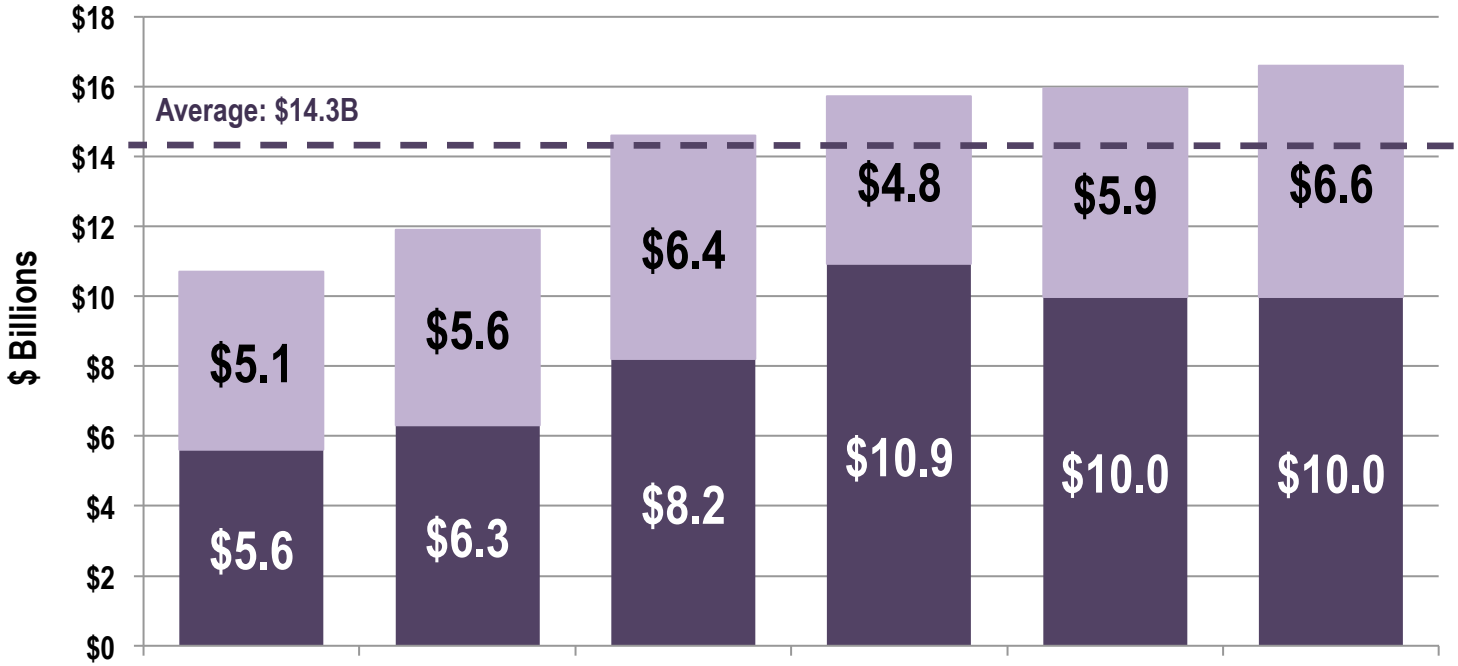
Note: Criteria for inclusion are satellites on orbit, announced funding, signed launch contract/ agreement, or NOAA license

Prepared by:
THE TAURI GROUP

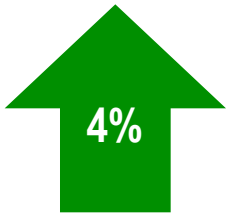
Satellite Industry Segments

Satellite Manufacturing

Satellite Manufacturing Revenues



	2010	2011	2012	2013	2014	2015
Total	$10.7	$11.9	$14.6	$15.7	$15.9	$16.6
Growth Rate	-20%	10%	23%	8%	1%	4%



2014 – 2015 Global Growth

Non-U.S.

United States

- Worldwide 2015 revenues totaled $16.6 billion
- U.S. share of global revenues was 60%, a decrease from 63% in 2014

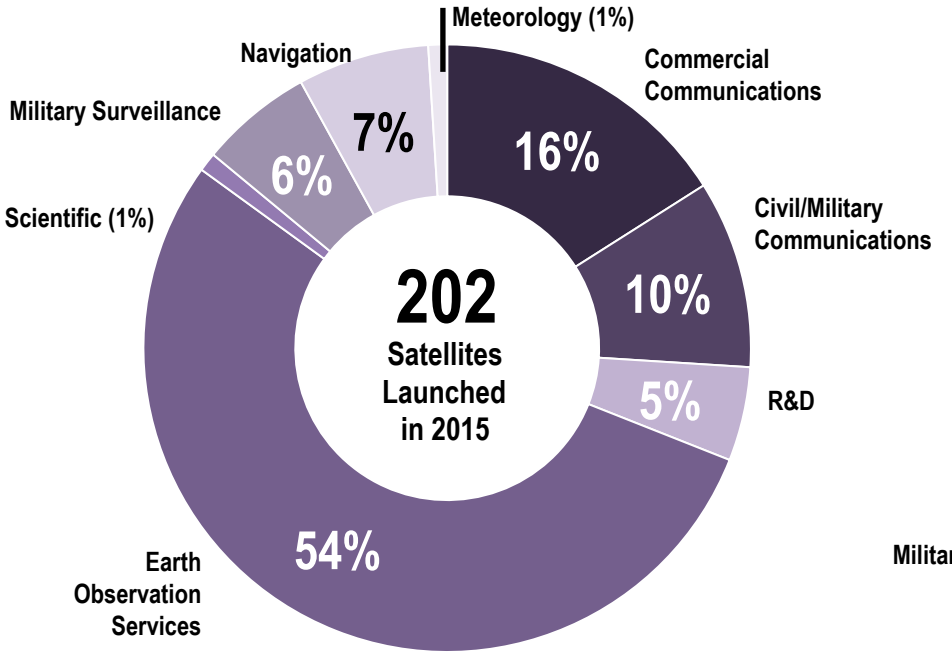
NOTE: Satellite manufacturing revenues are recorded in the year the launch was conducted. Do not include satellites built by governments or universities. Data based on unclassified sources.

Prepared by:
THE TAURI GROUP

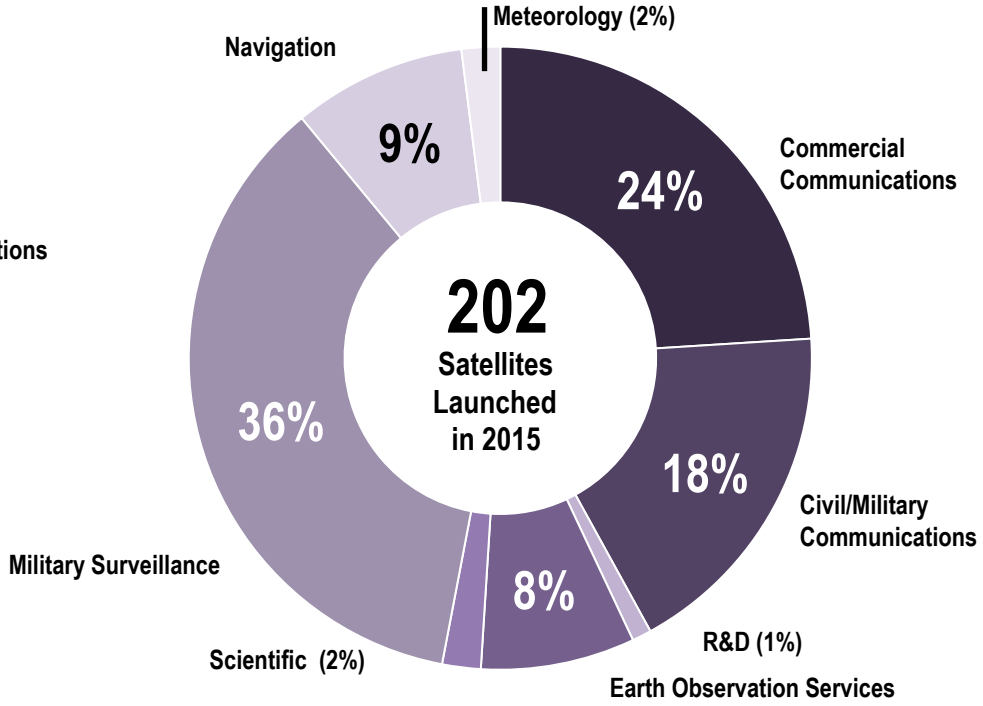
Satellite Manufacturing Findings

- 202 satellites launched in 2015, about the same as in 2014
- 108 CubeSats launched, representing 53% of total
- Most CubeSats were commercial Earth observation

- Communications satellites represented 42% of total revenues
- Military surveillance satellites accounted for 36% of 2015 revenues, compared to 38% in 2014
- CubeSats represent less than 1% of total value



Number of Spacecraft Launched by Mission Type (2015)

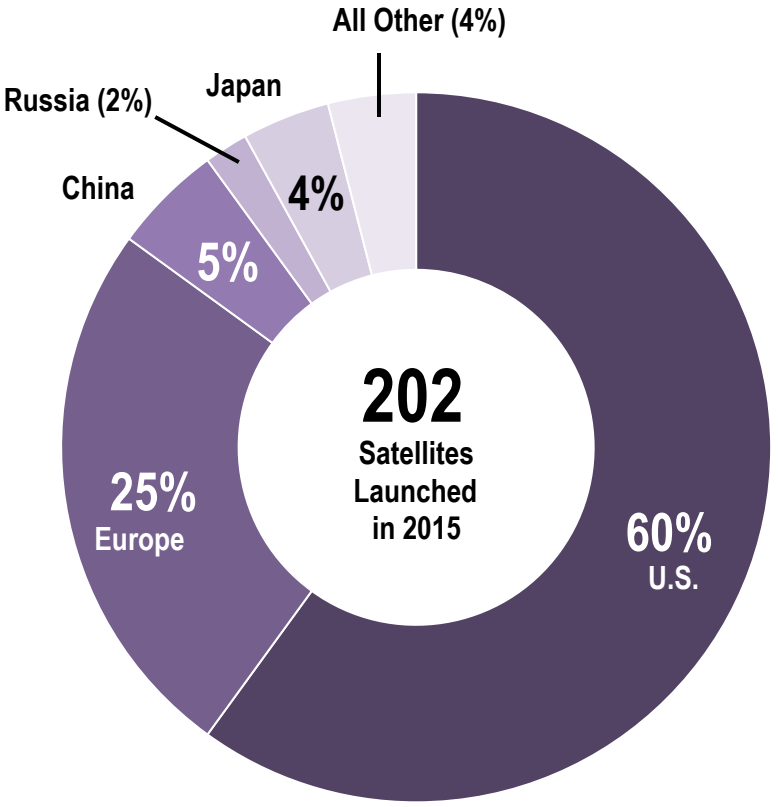


Value of Spacecraft Launched by Mission Type (2015)

Prepared by:
THE TAURI GROUP

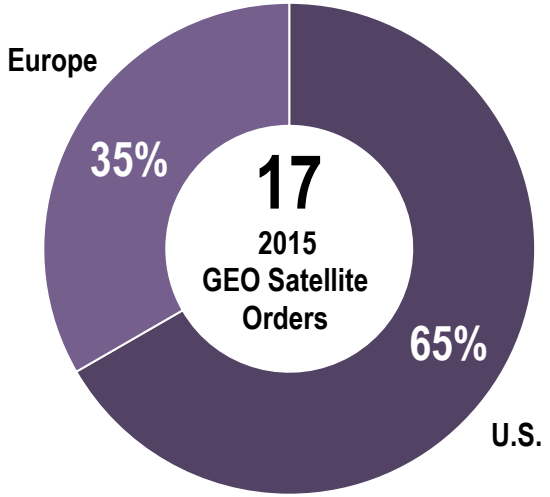
U.S. Satellite Manufacturing Findings

- U.S. satellite manufacturing revenues stayed flat, with commercial sector slightly higher and government sector slightly lower
- 73% of U.S. revenues were from U.S. government contracts
- Excluding CubeSats, U.S. firms built 32% of satellites launched in 2015 and earned 60% of global satellite manufacturing revenues
  - » Including CubeSats, U.S. firms built about 64% of satellites launched in 2015 and earned 60% of revenues
  - » 89 of the 119 U.S.-built satellites launched in 2015 were CubeSats

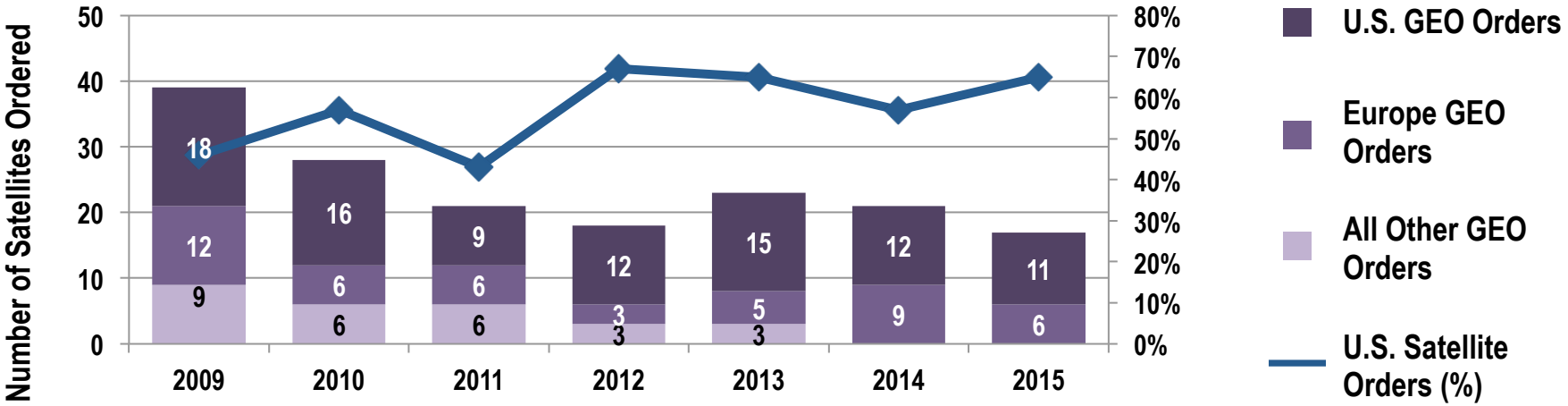


Value of Spacecraft Launched by Country/Region of Manufacturer (2015)

Future Indicator: Commercial Satellite Manufacturing Orders



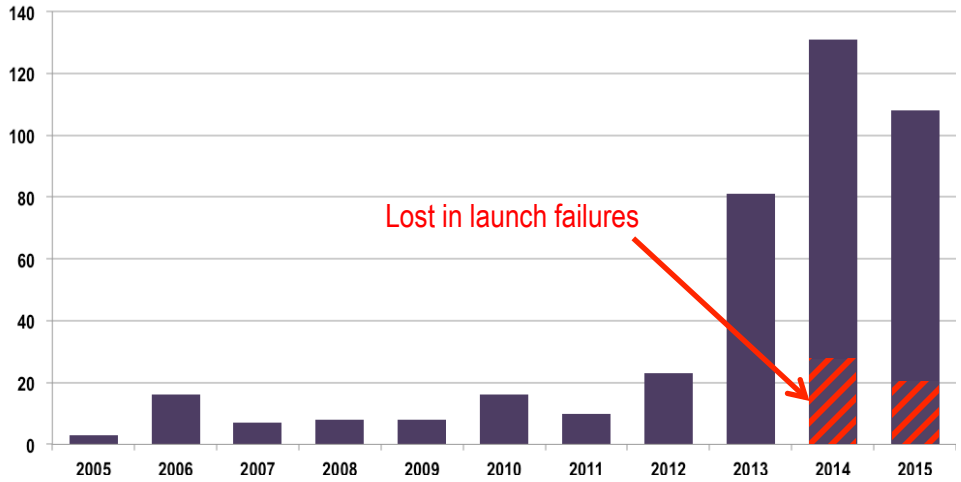
- Orders for 17 commercial GEO satellites announced in 2015
- 11 orders won by U.S. manufacturers
- 65% share of orders won by U.S. firms, up from 57% in 2014



Case Study: Very Small Satellites

- Continued and growing interest in inexpensive very small satellites
- CubeSats are an established "kit" form of very small satellite in use for academic, government, and, increasingly, commercial purposes
  - » 108 CubeSats launched in 2015, down from 130 in 2014, with 61 sent into orbit via ISS (8 CubeSats lost in Falcon 9 failure in June)
  - » 61 commercial CubeSats launched in 2015 for Earth observation services and communications, down from 101 in 2014. The majority (48) built and operated by Planet Labs
  - » Total expenditure to build all CubeSats since 2005 estimated at less than $100M
  - » Growing concern regarding collisions with CubeSats – NASA first major operator to say it has moved satellites to avoid CubeSats
- Commercial constellations using customized very small satellites (under 200 kg) are in development
  - » Earth Observation: One announced constellation; 2 of 24 satellites launched
  - » Telecommunication: at least three announced LEO systems, ranging from hundreds to several thousand satellites per constellation; zero satellites launched to date

Number of CubeSats Launched by Year (2005-2015)

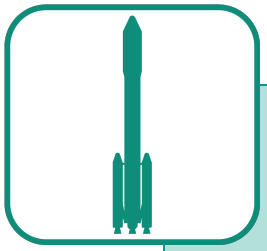


CubeSat Deployment Mechanisms

- CubeSats are popular because they can be deployed using standardized equipment
- Launch vehicle deployments:
  - Poly-Picosatellite Orbital Deployer (P-POD) (U.S.)
  - Tokyo Picosatellite Orbital Deployer (Japan/Canada)
  - CUTE Separation System (Japan)
  - eXperimental Push Out Deployer (X-POD) (Canada)
  - ISIS Payload Orbital Dispenser (ISIPOD) (Netherlands)
  - JAXA-Picosatellite Orbital Deployer (J-POD) (Japan)
  - Naval Postgraduate School CubeSat Launcher (NPSCuL) (U.S.)
  - Nanosatellite Launch Adapter System (NLAS)
- ISS deployments:
  - NanoRacks CubeSat Deployer (U.S.) aboard Kibo module
- Standards for CubeSat deployment mechanisms have been updated to accommodate larger designs like 6U, 12U, and 27U, configurations being pursued by the U.S. government and others

Prepared by:
THE TAURI GROUP

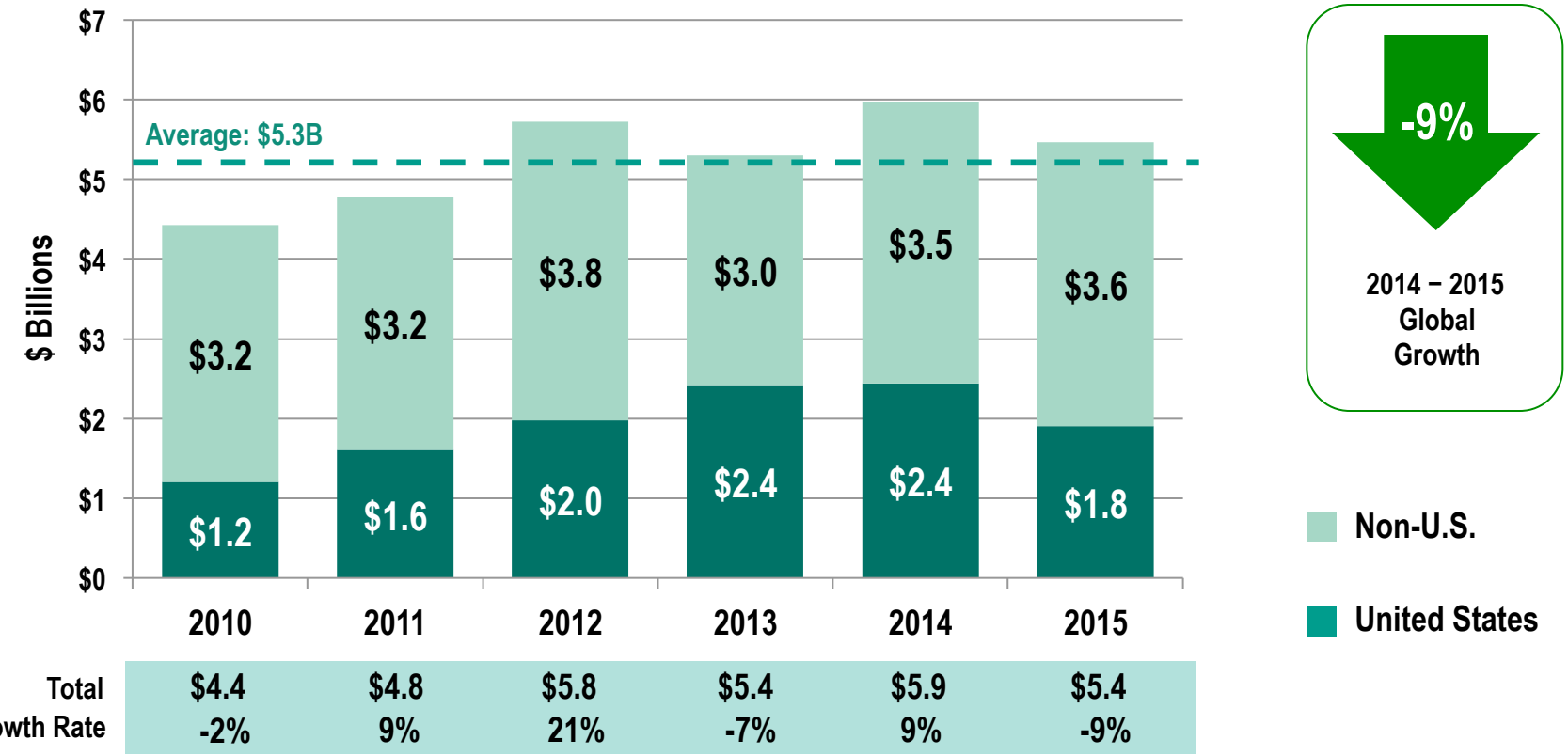
Satellite Industry Segments



Launch Industry

- Launch Services
- Launch Vehicles

Satellite Launch Industry Revenues



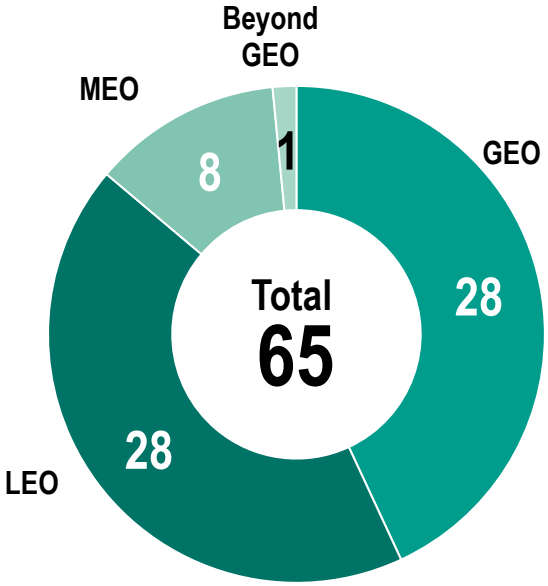
- $5.4B global revenues in 2015 from commercially-procured satellite launches
- U.S. share of global launch revenues decreased from 41% in 2014 to 34% in 2015

Prepared by:
THE TAURI GROUP

Note: Launch industry revenues are recorded in the year the launch was conducted.

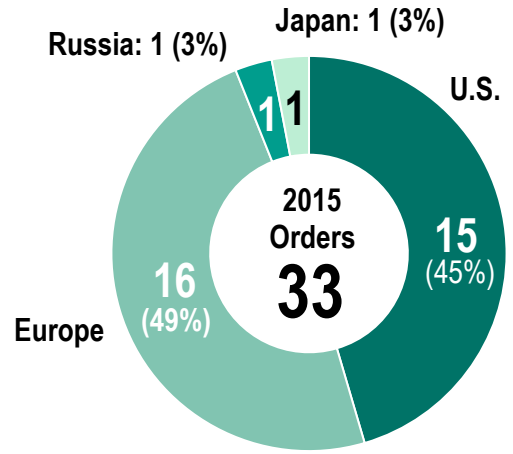
Satellite Launch Industry Findings

- Worldwide commercially-procured launches in 2015 (65) down from 2014 (73)
- Revenues decreased by about 9% globally in 2015, compared with a 9% increase in 2014
- Providers in Europe, China, and India launched more in 2015
  - » 11 Arianespace launches in 2015 versus 10 in 2014
  - » 19 Chinese launches in 2015 versus 16 in 2014
  - » 2 Antrix (India) in 2015, versus 1 in 2014
- U.S. and Russian providers saw delays following launch failures
  - » Falcon 9 in June
  - » Proton M in May
- Government customers worldwide remained the launch revenue driver, at 69%, slightly lower than in 2014 (72%)
- By country, the U.S. had the largest share of commercially-procured launch revenues (35%), with 29% of global revenues from launching U.S. government satellites

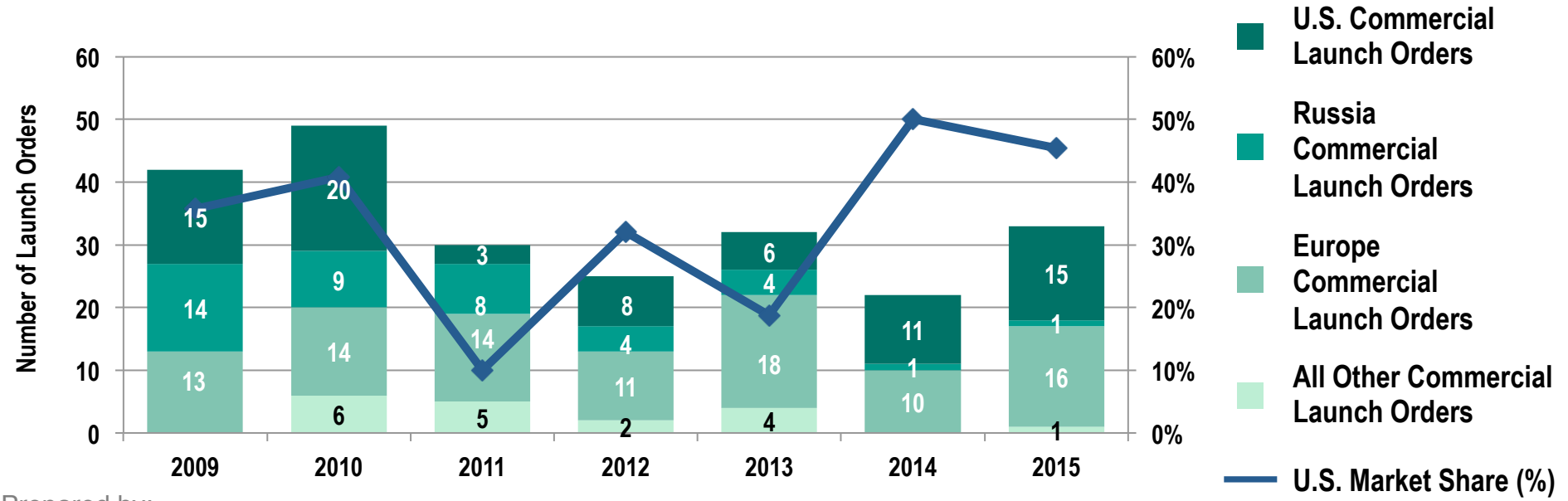


2015 Commercially-Procured Satellite Launches by Orbit

Future Indicator: Commercial Satellite Launch Orders



- 33 launch orders placed in 2015, up from 22 in 2014
- 15 (45%) satellite launch orders won by U.S. companies, up 36% from 2014
- U.S. market share dropped from 50% in 2014 to 45% mainly because Arianespace experienced a 60% increase in orders from 2014 (10) to 2015 (16)



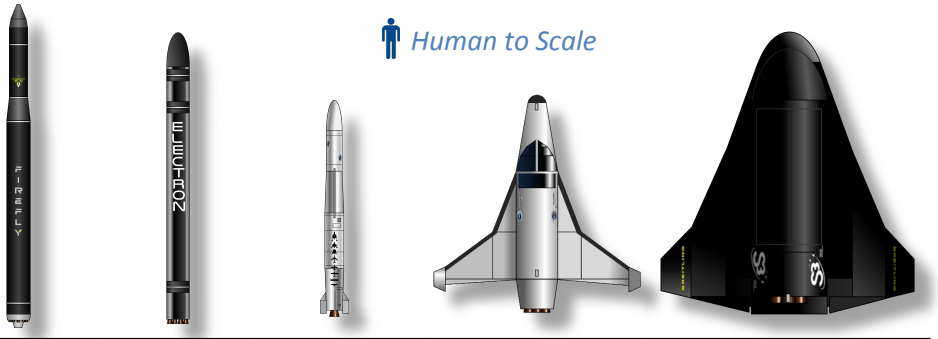
NOTE: A single launch contract may cover the launch of more than one satellite (each described as an "order").

Prepared by:
THE TAURI GROUP

Case Study: Very Small Launch Vehicles

- At least 17 very small (LEO capacity ≤500 kg) launch vehicles under development worldwide
- Provides schedule control for small payloads and other operational benefits
- Price per kg is relatively high compared to large vehicles
- Not all are funded; uncertainty and development risk

Very Small Launch Vehicles with Announced Investment



	Alpha	Electron	LauncherOne	Lynx Mark III	SOAR
Company	Firefly Space Systems	Rocket Lab	Virgin Galactic	XCOR Aerospace	Swiss Space Systems
LEO Capacity	400 kg	150 kg	400 kg	10 kg	250 kg
First Flight	2017	2016	2017	2018	2017
Price	$8M	$4.9M	$10M	$545K	$10.5M
Price/kg	$20,000	$32,667	$25,000	$54,500	$42,000

Other systems under development not included in the chart: Arca Space Corp. (Haas 2C), Celestia Aerospace (Arrow), CubeCab (Cab-1A), Exos (SARGE), Generation Orbit (GOLauncher-2), InterOrbital Systems (NEPTUNE), Lin Industrial (Taymyr), Mishaal Aerospace (M-OV), Open Space Orbital (Neutrino), Zero2Infinity (Blooster)

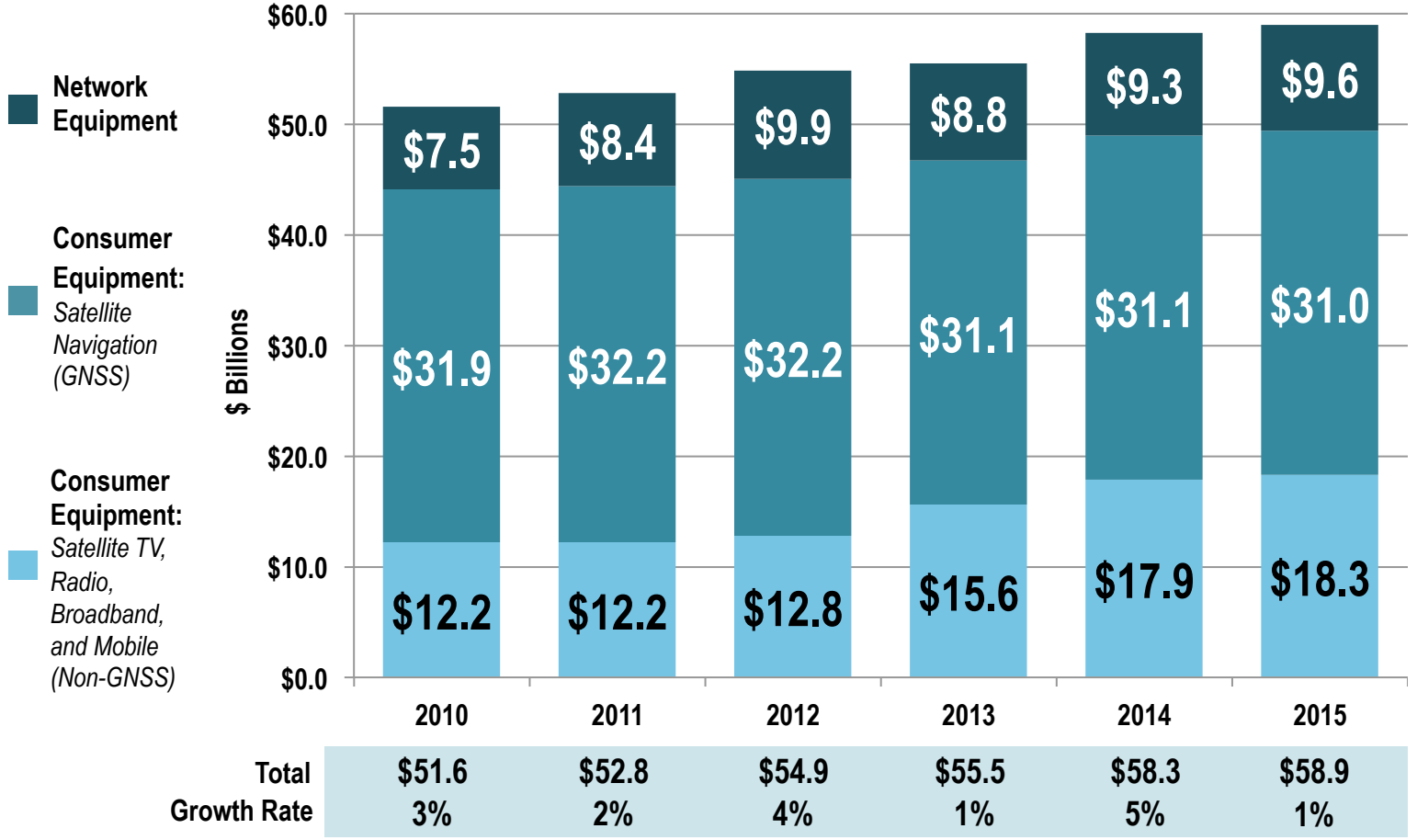
Notes: ALASA program on hiatus. Future of Super Strypi uncertain following 2015 launch failure.

Satellite Industry Segments

Ground Equipment

- Network Equipment
  - » Gateways
  - » Control stations
  - » Very Small Aperture Terminals (VSATs)
- Consumer Equipment
  - » Satellite TV dishes
  - » Satellite radio equipment
  - » Satellite broadband dishes
  - » Satellite phones and mobile satellite terminals
  - » Satellite navigation stand-alone hardware

Global Satellite Ground Equipment Revenues



	2010	2011	2012	2013	2014	2015
Total	$51.6	$52.8	$54.9	$55.5	$58.3	$58.9
Growth Rate	3%	2%	4%	1%	5%	1%

1%

2014 – 2015 Global Growth

The U.S. share of ground equipment revenue in 2014 was

41%

Network Equipment — gateways, network operations centers (NOCs), satellite news gathering (SNG) equipment, flyaway antennas, very small aperture terminal (VSAT) equipment

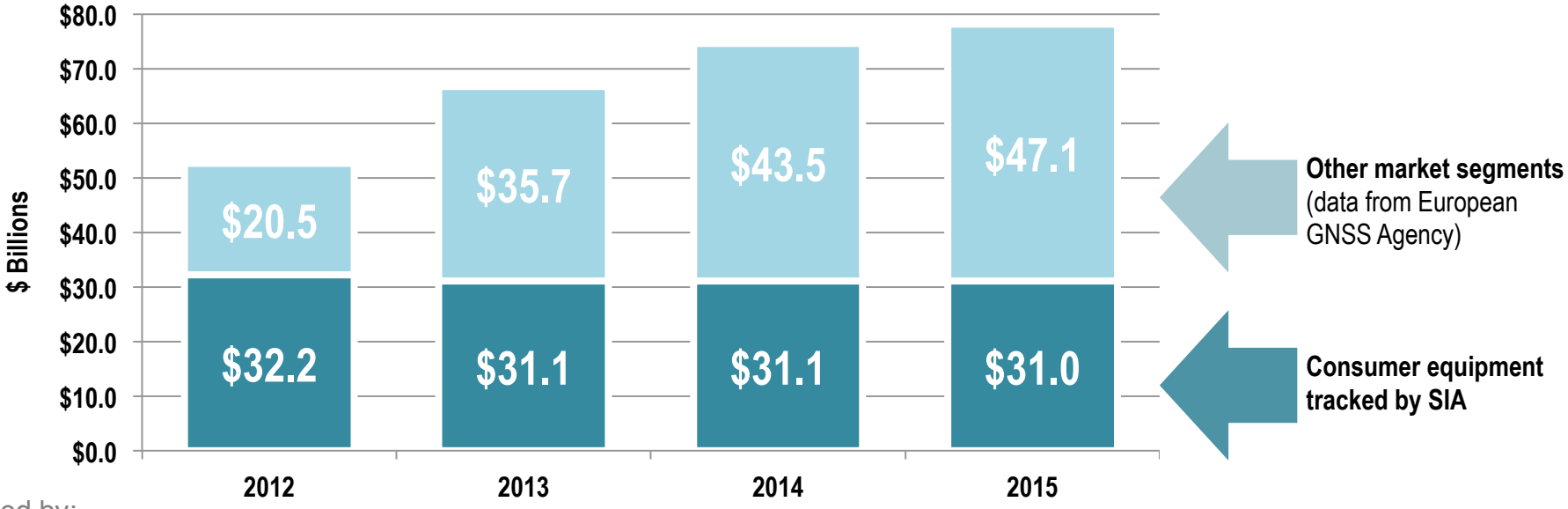
Consumer Equipment — Non-GNSS: satellite TV, radio, and broadband equipment, mobile satellite terminals. GNSS: stand-alone satellite navigation devices and in-vehicle services. Excludes chipsets in devices (e.g., smartphones) whose primary use is not satellite navigation

Ground Equipment Findings

- Total satellite ground equipment revenues increased 1% in 2015
- Network equipment revenues increased 3%
- Consumer equipment for satellite navigation (or GNSS, for global navigation satellite system) is 53% of overall ground equipment revenue, similar to 2014
  - » Manufacturers report stagnant revenue, reflecting migration away from stand-alone devices toward embedded chipsets
  - » See case study on following page
- Consumer equipment for satellite TV, radio, broadband, and mobile satellite terminals (non-GNSS) revenues grew 2% with more terminals in service across all segments. Satellite TV terminals increased less than in 2014, contributing to slower total growth

Case Study: Market for Satellite Navigation

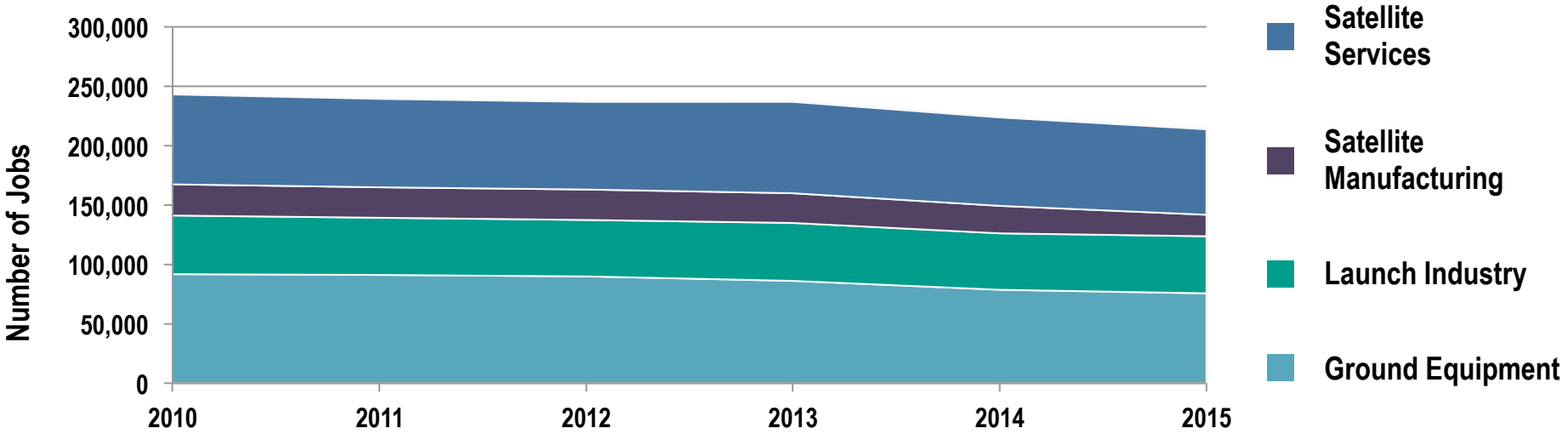
- GNSS market includes
  - » Consumer equipment tracked by SIA: stand-alone units and in-vehicle systems
  - » Other market segments: chipsets supporting location-based services in mobile devices; traffic information systems; GNSS avionics in aircraft, maritime, surveying, and rail (not included in SIA indicators)
- Chart below shows SIA data combined with data on other GNSS market segments
  - » Consumer equipment revenue is flat; other market segments show growth
  - » Data source for other market segments: European Global Navigation Satellite Systems Agency, which tracks global GNSS market segments in detail



Note: 2015 estimate for other market segments based on European GNSS Agency projections released in 2014.

2015 U.S. Employment Estimates (Private Sector Employment Only)

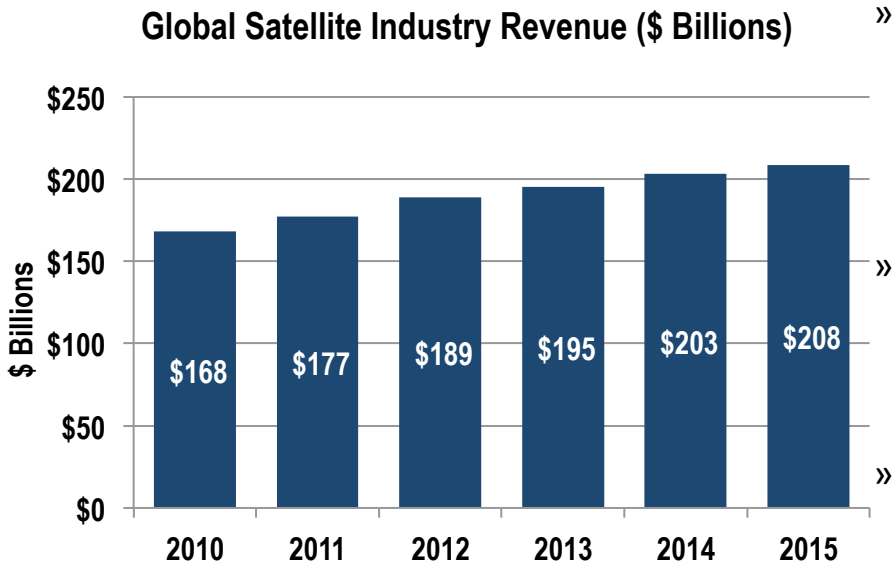
- As of 2015, satellite industry employment in the U.S. decreased by 9,940 jobs (-4% from year end 2014)
- Two satellite industry segments losing fewer jobs, one adding jobs, and one loses a significant number of jobs (compared to 2014)
  - » Satellite services employment decreased by 2,074 jobs from 2014, or -3%
  - » Satellite manufacturing employment decreased by 5,518 jobs from 2014, or -24%
  - » Launch industry employment increased by 620 jobs from 2014, or 1%
  - » Ground equipment employment decreased by 2,968 jobs from 2014, or -4%



Source: U.S. Bureau of Labor Statistics (BLS).

Summary: Top-Level Global Satellite Industry Findings

- Satellite industry revenue was $208.3 billion in 2015
  - » Growth of 3% worldwide in 2015
  - » Decrease from 4% growth rate in 2014



3%
2014 – 2015 Global Growth

- Three of four satellite industry segments surveyed posted growth
  - » **Satellite services**, the largest segment, grew by 4% - consumer services continues to be a key driver for the overall satellite industry
  - » **Satellite manufacturing** revenues grew by 4%, faster growth than 2014, due to larger number of high value government satellites launched in 2015
  - » **Launch industry** revenues decreased 9% in 2015, reflecting fewer commercially procured launches
  - » **Ground equipment** revenues increased 1% in 2015, with growth in consumer and network equipment, and consumer GNSS remaining flat

Prepared by:
THE TAURI GROUP

Contact

For more information on the satellite industry,
or for previous SSIR reports, please contact SIA:

Satellite Industry Association

info@sia.org

202-503-1560

www.sia.org

The Tauri Group

space.taurigroup.com