SIA

State of the Satellite Industry Report

June 2021

2021

BRYCE TECH

SIA: Voice of the U.S. Satellite Industry

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Study Overview

- SIA's 24th annual study of satellite industry data
- Performed by BryceTech
- Reports on 2020 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

Global Satellite Industry Top-Level Findings

2020 satellite industry revenue $271B

Satellite manufacturing: $12.2B revenue
More commercially procured satellites (3.5x) deployed than in 2019; mainly smaller, lower cost satellites in LEO broadband constellations. More affordable GEO satellites. Small number of expensive national security satellites. Revenues consistent with 2019

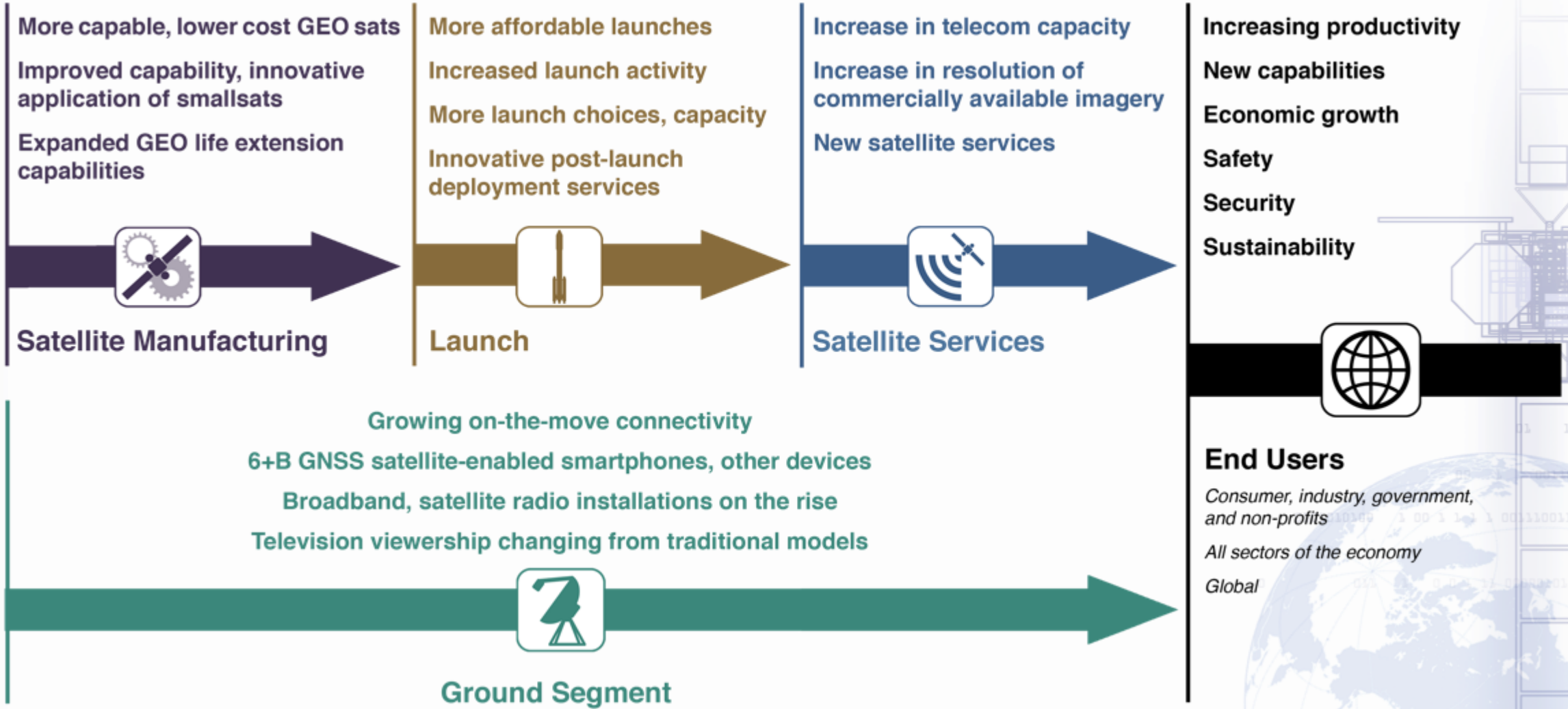
Satellite services: $117.8B revenue
COVID-19 driven increased demand for broadband. Remote sensing growing with mature operators and new companies contributing to growth. Declining revenues in fixed satellite services driven by COVID-19 impact and in satellite TV due to ongoing changes in TV viewership

Launch industry: $5.3B revenue
Growth in revenue of 9%. U.S. maintained the largest launch revenue share of any country. Increased launch rate driven by launches of LEO broadband constellations

Ground equipment: $135.3B revenue
Continued growth in GNSS. Network equipment revenues decreased in line with COVID-19 driven reductions in fixed services. Television viewership changing from traditional models

Increasing Affordability and Productivity, New Capabilities

Changing Industry Dynamics



Increasing Affordability and Productivity, New Capabilities

Transformative Technology Innovation

Satellite Manufacturing

Flexible, software-defined payloads: deliver speed, flexibility through reconfigurability; additional power

Miniaturization, modular satellites: smaller and more sophisticated; standardization for multiple missions, responsive production

Digital engineering: shifting design and development into virtual environment to reduce costs and accelerate timelines

Satellite servicing: life extension, repair, upgrade, deorbit

Launch

Launch reusability: enables reduced prices and higher launch rate

In-space transportation: enables delivery to custom, specific orbits with advantage of lower cost rideshare missions

Improved deployment/separation technologies: enable launch of 100+ satellites on a single launch (current record 143 satellites in January 2021)

Satellite Services

Progress in spot-beam technologies: enables high-throughput (HTS) and very high-throughput (VHTS) satellites

Inter-satellite links (ISL) and optical communications: mitigate dependence on ground stations and expand coverage

Improved sensors: radar, hyperspectral, RF mapping, radio occultation enhancements enable new remote sensing services

Ground Segment

Flat panel/phased-array antennas: enable better on the move connectivity as antenna steers to maintain signal; significant for connecting to satellites in NGSO

Cloud-integrated ground stations as a service: enable operators to command and control satellites, and downlink, process, and store data in cloud architectures without need for dedicated ground infrastructure

Satellite industry investment in technology delivers continual improvement in affordability and productivity, enabling new capabilities and creating new markets

Surge of SPAC Activity in Space Industry

Changing Industry Dynamics

- Surge in SPAC activity in space industry since 2019 Virgin Galactic merger with Social Capital Hedosophia
- Nine SPAC deals in space industry announced, more expected (e.g., Virgin Orbit)
- Combined enterprise value $20B
- Virgin Galactic, AST are trading as of May 2021

Special-purpose acquisition companies (SPACs) are publicly traded companies established to raise funds to acquire/merge with a private company seeking to go public

SPACs enable firms to go public quicker than traditional IPOs, with limited regulatory process

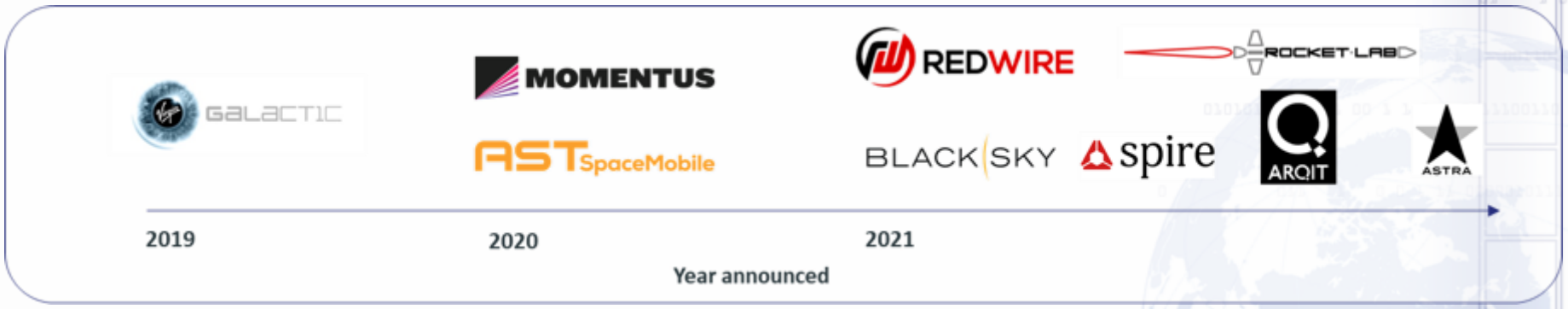
SPACs increasingly popular across industries, raising $83 billion in capital in 2020, +6x previous record

Companies can tap public markets for more funding, via secondary offerings, with good performance, investor sentiment

$3.9B
Funding being raised through SPAC deals

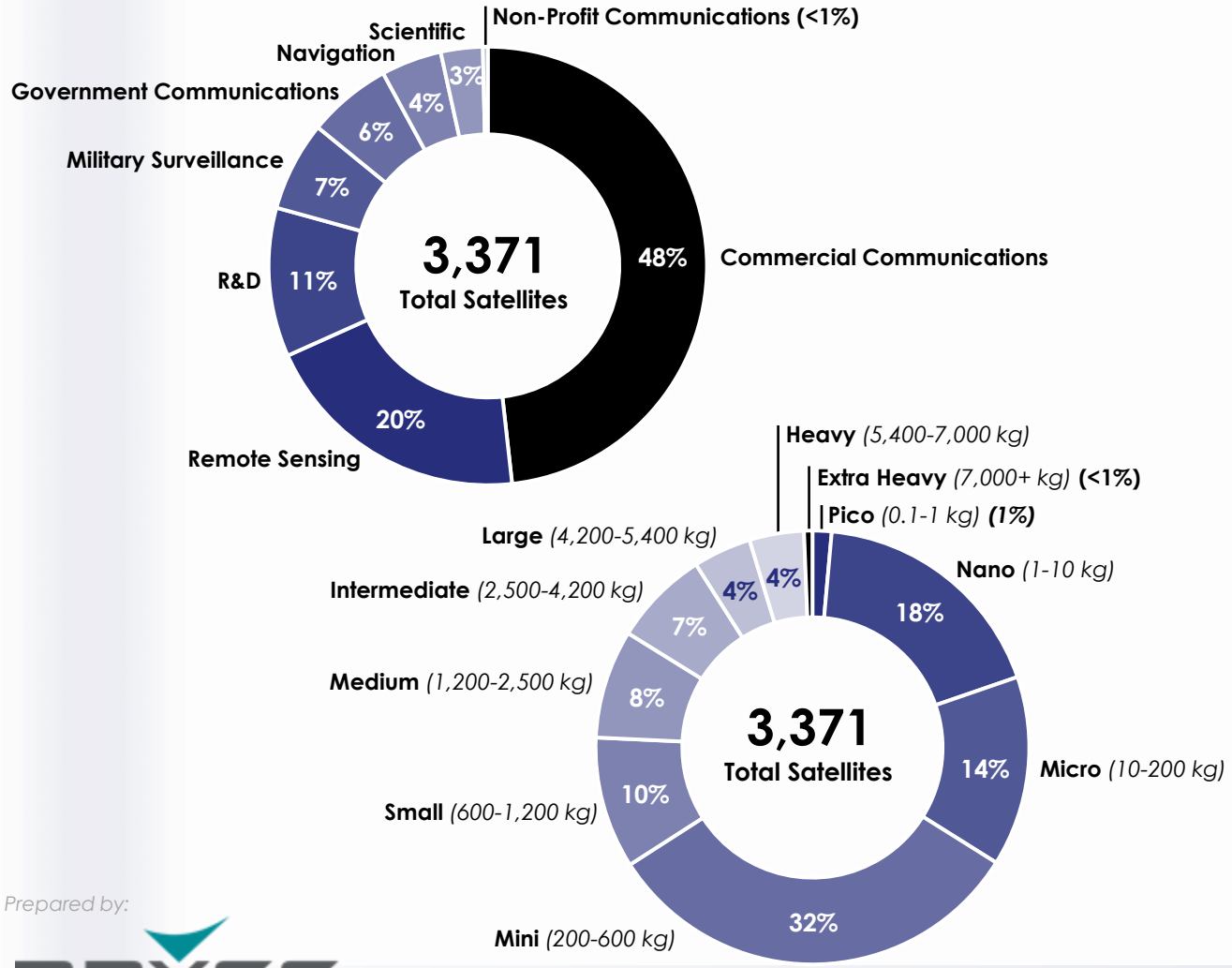
$20B
Combined enterprise value (aggregate market values of companies)

Nine announced space industry SPAC deals



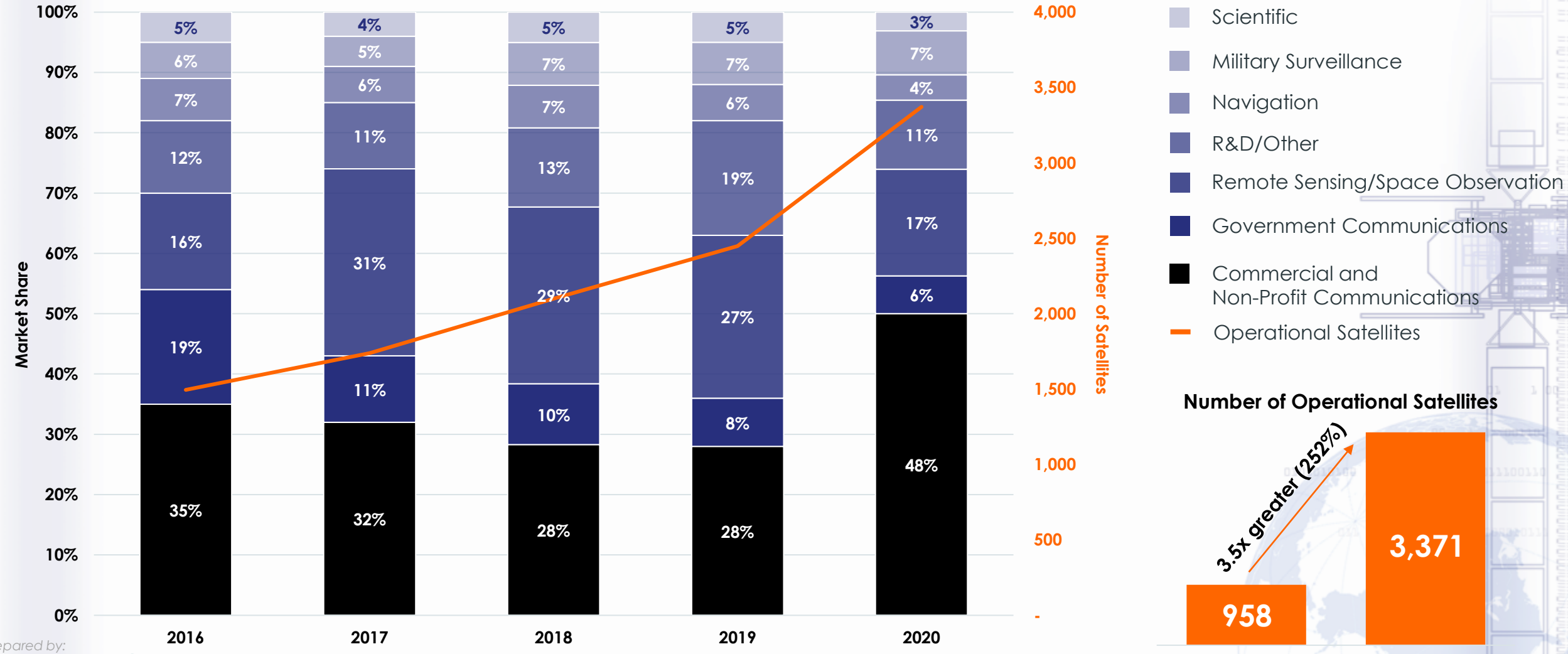
The Satellite Network in Context

Operational Satellites by Function and Mass Class

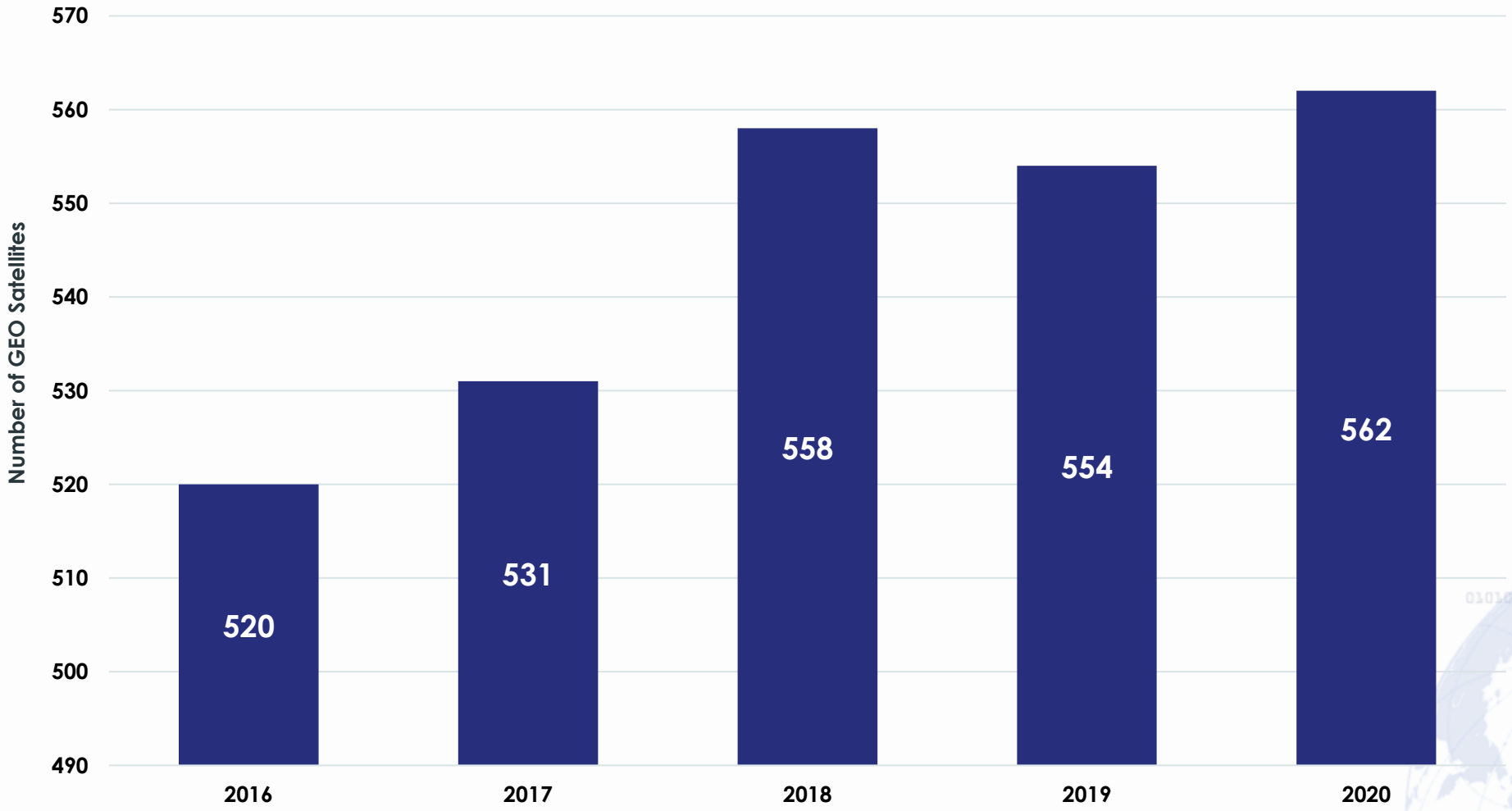


- Estimated as of December 31, 2020
- Number of satellites increased 144% over 5 years (from 1,381 on December 31, 2015)
  - Satellites launched 2016 – 2020 increased 180% over previous 5 years
    - Average 585/year
    - Due mostly to small satellites in LEO (<1,200 kg)
  - Total satellite mass on orbit about 3,700 metric tons
  - Average operational lives of larger satellites growing; 209 active satellites launched before 2005
  - 562 active satellites in GEO (8 more than in 2019, mostly providing communications services)
- 3,371 satellites operated by entities from 72 countries (some in regional consortia). Cumulatively, 93 countries have deployed at least one satellite since 1957
- U.S. entities operate 1,900+ satellites, some in partnership with other nations

Operational Satellites, by Year



Operational GEO Satellites, by Year



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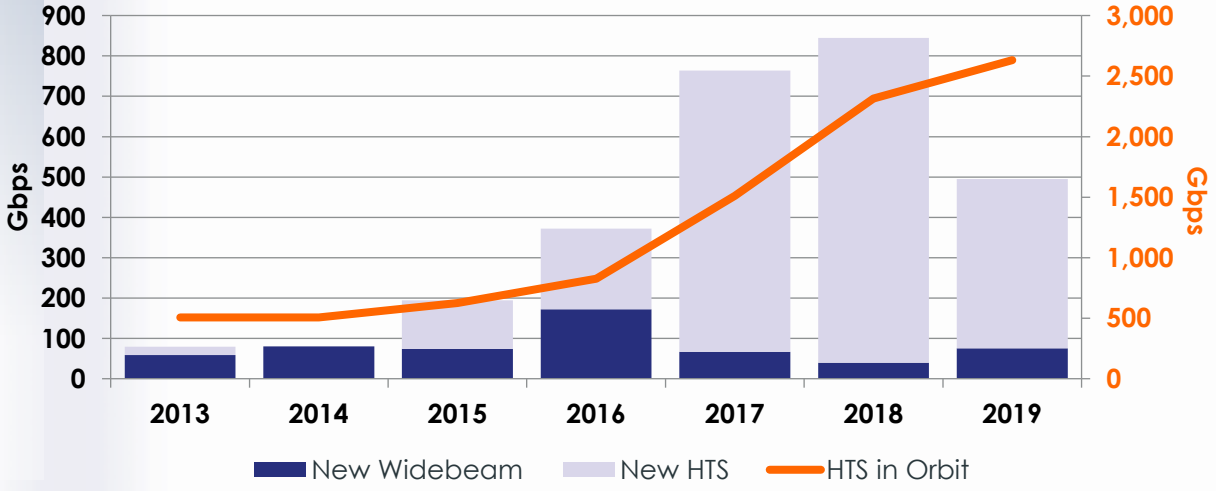
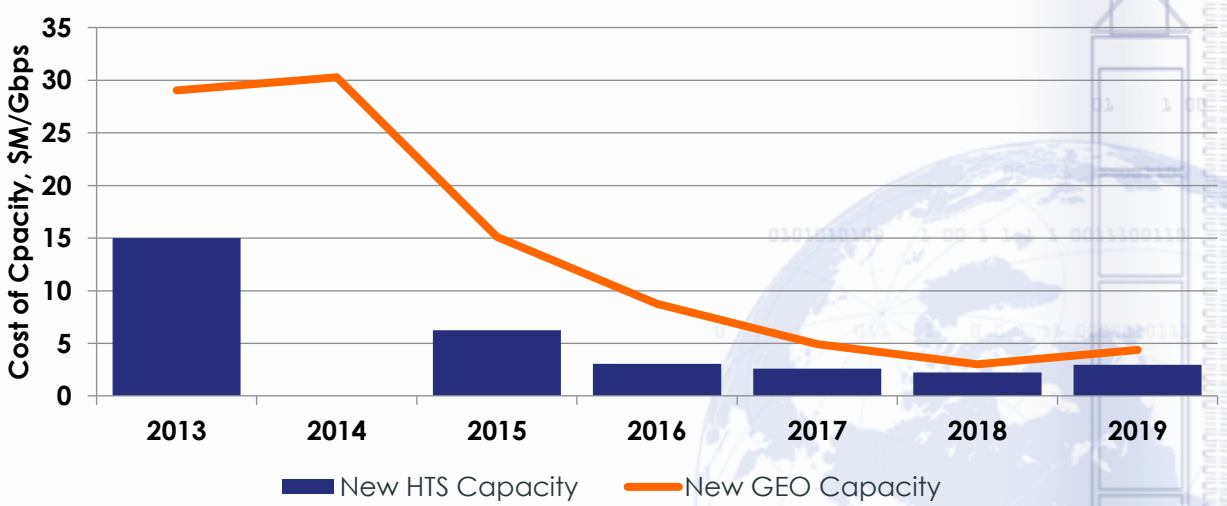
New Satcom Capacity Deployment and Cost Trends

- Large volumes of new HTS capacity continued to deploy in 2018 – 2019
- Growth in HTS capacity results in lower overall cost per Gbps
- Continued deployment of less expensive satcom capacity leads to more affordable satellite broadband connectivity, improved affordability, greater data volumes and speed offered to multiple markets
- Companies plan to deploy up to 30 Tbps of capacity through 2024 (estimated at 4+ Tbps today)
  - Over 6.5 Tbps total capacity on planned GEO satellites under contract and in development
  - Potential capacity exceeding 25 Tbps by new NGSO constellations in development; 937 LEO satellites for broadband launched in 2020

New GEO Capacity, Widebeam and HTS, Gbps

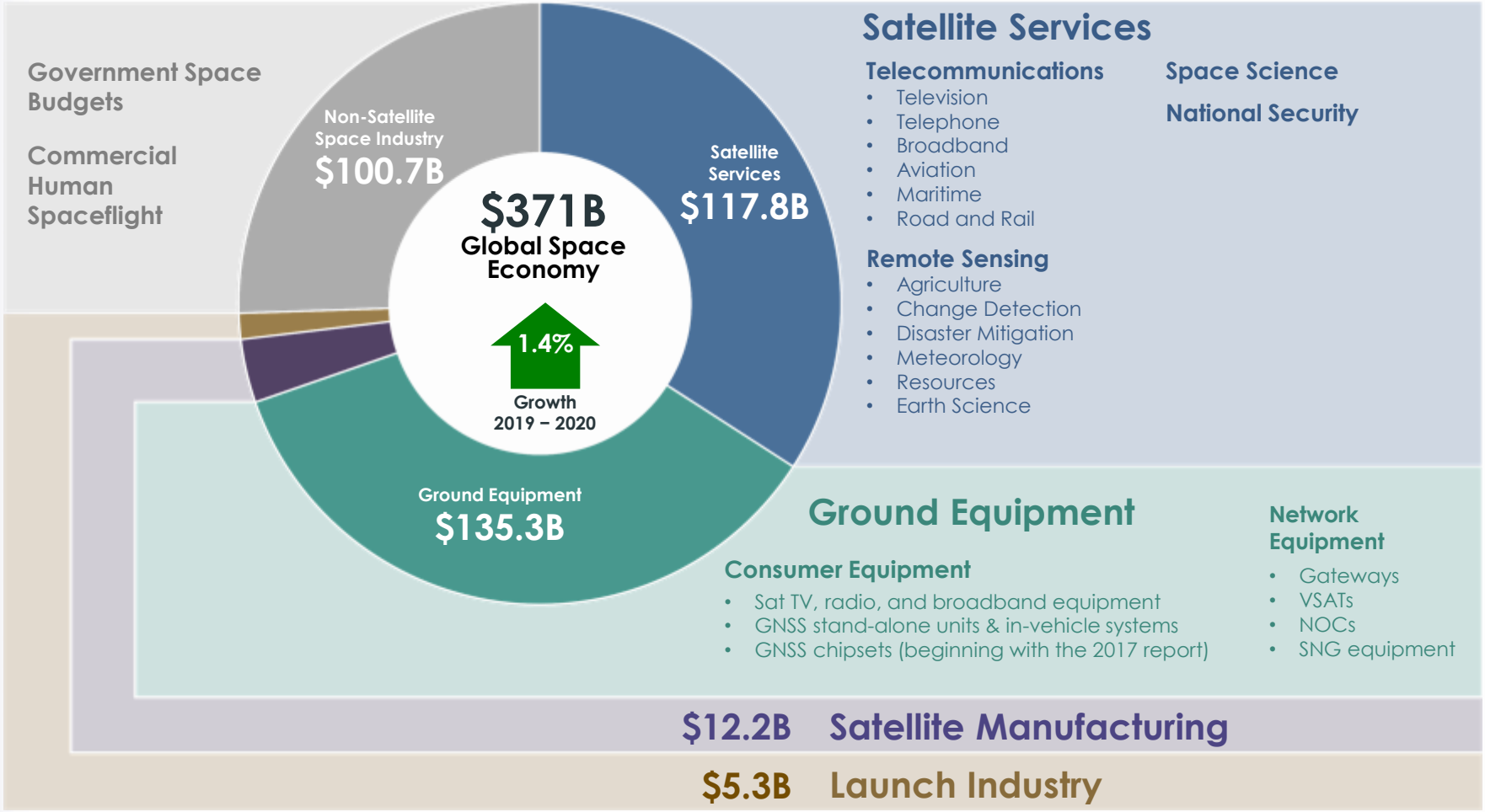


Cost of New GEO Capacity, $M/Gbps



Satellite capacity cost estimated based on satellite manufacturing prices.
Future capacity estimates reflect publicly announced plans and manufacturing contracts; some systems may not deploy.

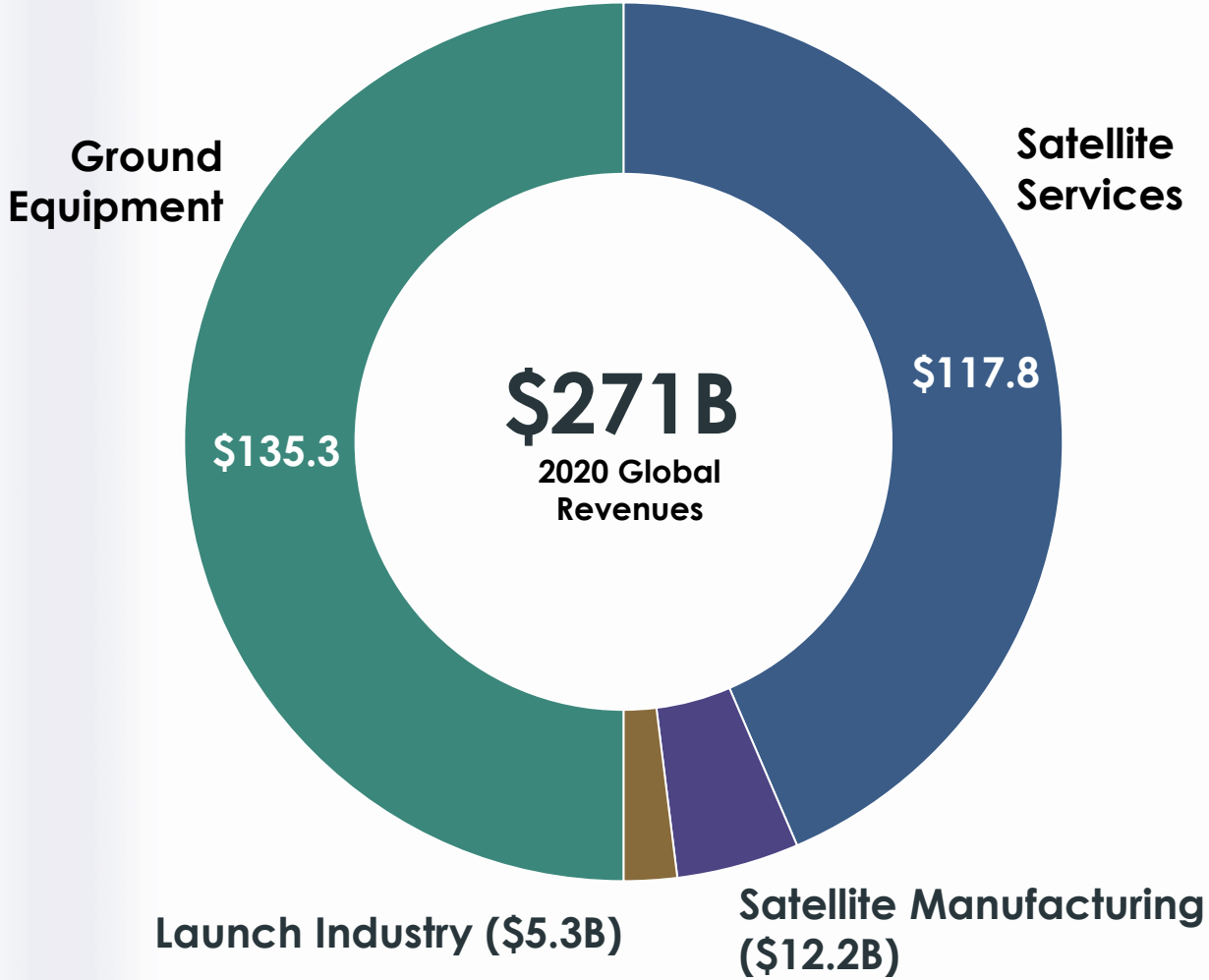
The Satellite Industry in Context

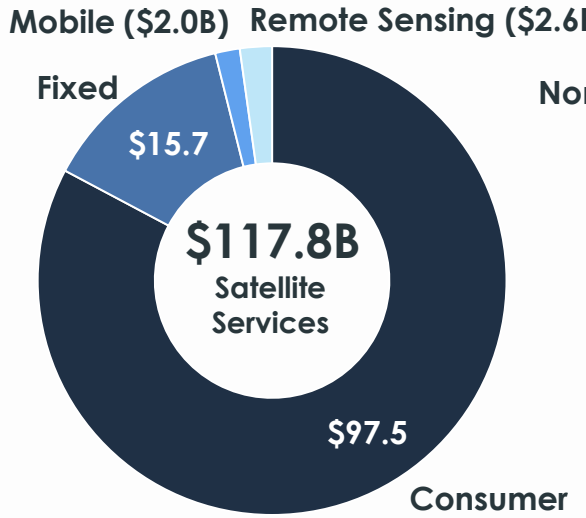


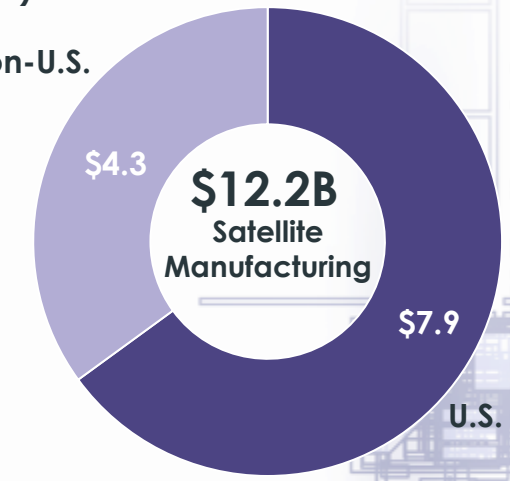
$271B
Satellite Industry (73% of Space Economy)

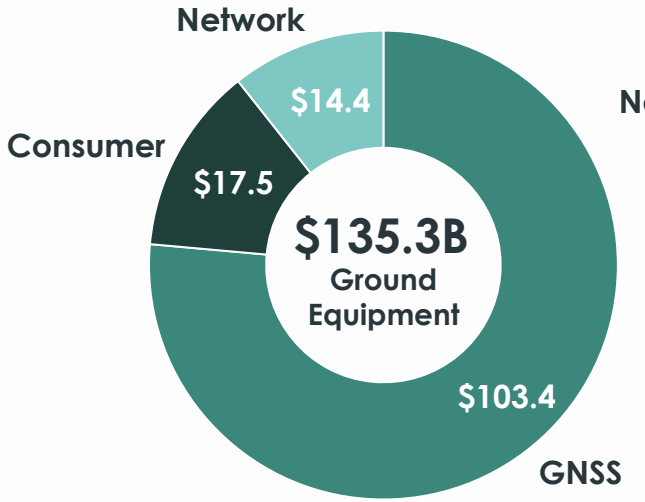
Government space budgets include government civil and military space spending by 70 countries and international organizations (ESA) using published data.
Commercial human spaceflight includes commercial cargo missions to ISS and other human spaceflight projects, about $2B.
Acronyms: Network operations centers (NOCs), satellite news gathering (SNG), very small aperture terminal (VSAT) equipment, global navigation satellite systems (GNSS).

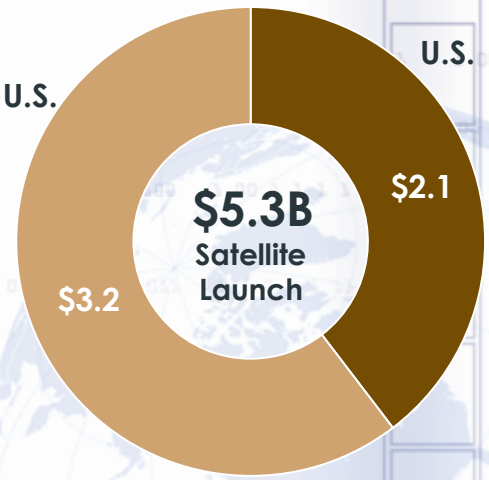
2020 Satellite Industry Indicators Summary





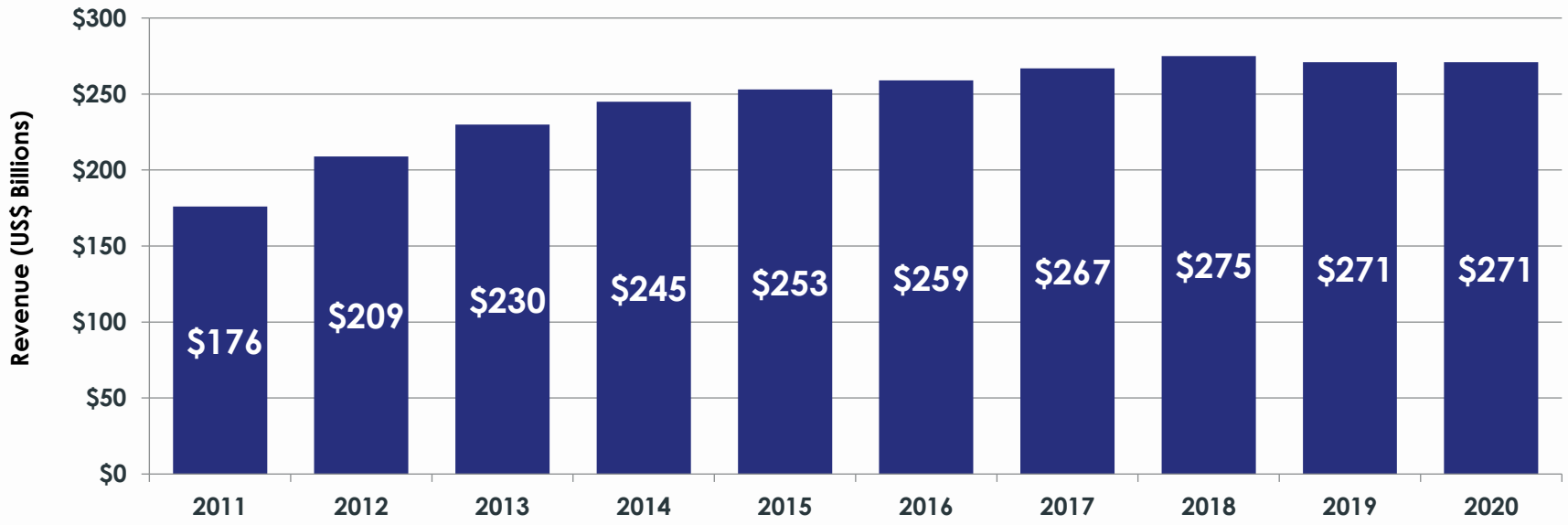






Global Satellite Industry Revenues

Global Satellite Industry Revenues ($ Billions)



Growth Rate	6%	18%*	10%	7%	3%	2%	3%	3%	-1.5%	<0.1%

1.5%

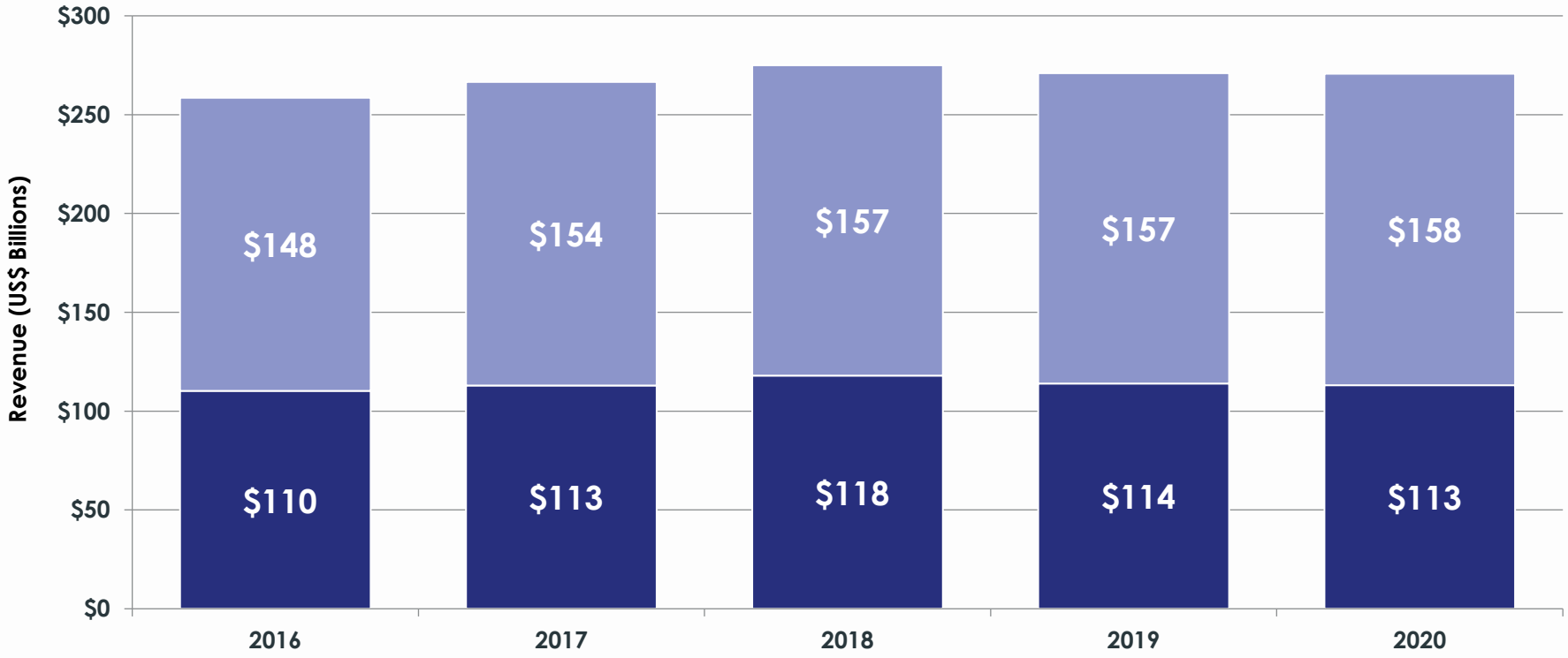
Ten-Year Global Industry Growth

Global satellite industry revenue increased <0.1% in 2020, growth in GNSS and launch segment offset by decline in satellite services driven by COVID-19 impact and changes in TV viewership

** Reported since 2017 and including years beginning with 2012, ground equipment revenues include entire GNSS segment: stand-alone navigation devices and GNSS chipsets supporting location-based services in mobile devices, traffic information systems, aircraft avionics, maritime, surveying, and rail.*

Note: Previously reported consumer broadband revenue adjusted.

Global Satellite Industry Revenues U.S. Share



	2016	2017	2018	2019	2020
Growth Rate	2%	3%	3%	-1.5%	<0.1%
U.S. Growth	2%	2%	4%	-3%	-1%
Non-U.S. Growth	2%	4%	2%	0%	0.4%

Average yearly U.S. market share

42%

of global industry

Non-U.S.

United States

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Changing Industry Dynamics

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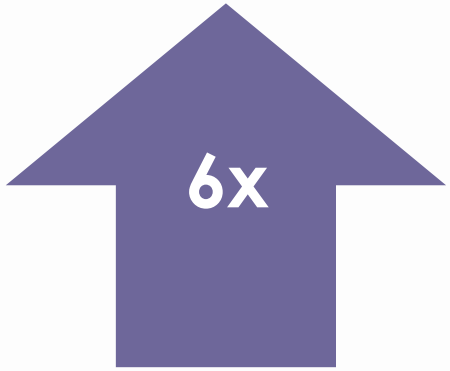
More capable, lower cost GEO satellites

- Increase in throughput per kg launched (x6)
- Electric propulsion
- High-throughput satellites (HTS)
- Dramatic decrease in manufacturing cost/throughput (-80%)
- Flexible payloads
- Software-defined payloads for efficient on-orbit use
- Modularity for responsive build
- LEO broadband deployments under way

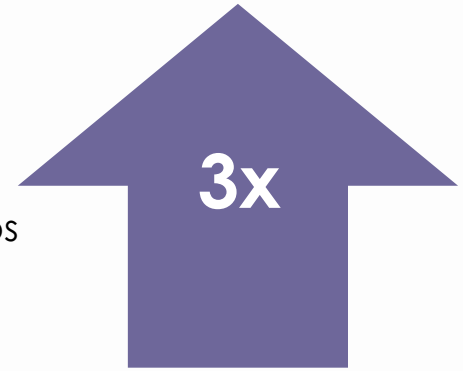


Throughput/kg (2013 – 2019)

Cost/Gbps (2013 – 2019)

Improved capability, innovative application of smallsats

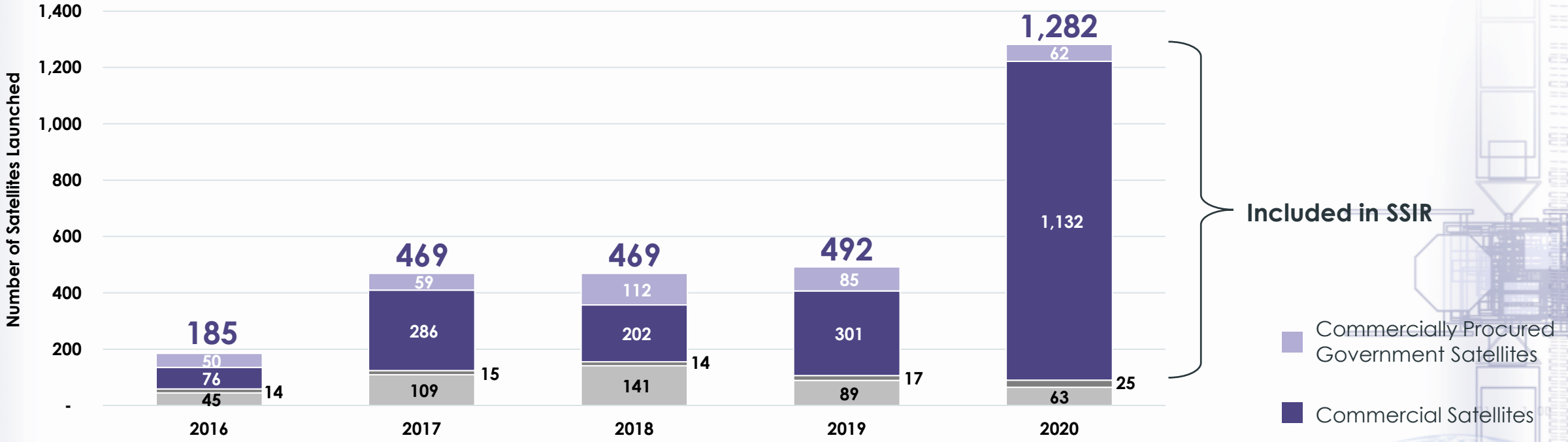
- Broadband, AIS, IoT/M2M, new types of imaging
- New manufacturing facilities in the U.S. and internationally
- Investment of $1B+ in smallsat focused manufacturing start-ups



Number of smallsats (2019 – 2020)

Average cost per manufactured kg (2013 – 2020)

Satellite Manufacturing: Methodology



- Included in SSIR: commercially procured satellites
  - Commercial satellites: satellites manufactured under internationally-competed contracts or produced in-house by privately-funded organizations
  - Commercially-procured government satellites: manufacturing contracts typically captive or competed among national manufacturers
- Not included in SSIR
  - Spacecraft other than satellites: crew and cargo vehicles and some other spacecraft
  - Satellites not procured commercially: satellites produced in-house by a government agency or a university

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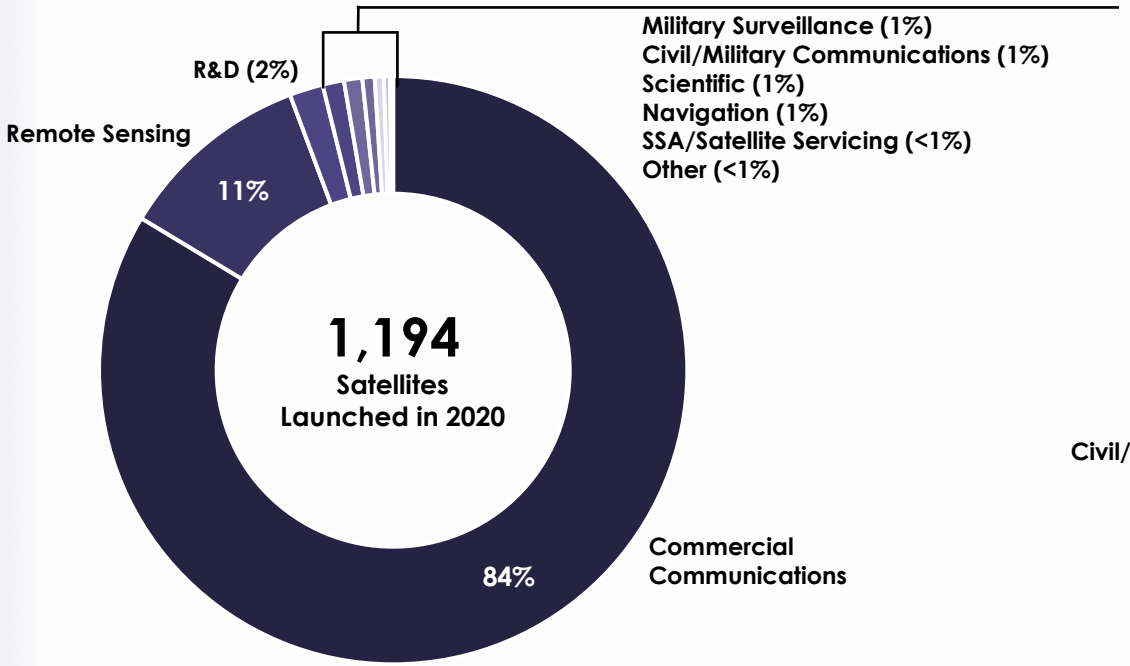
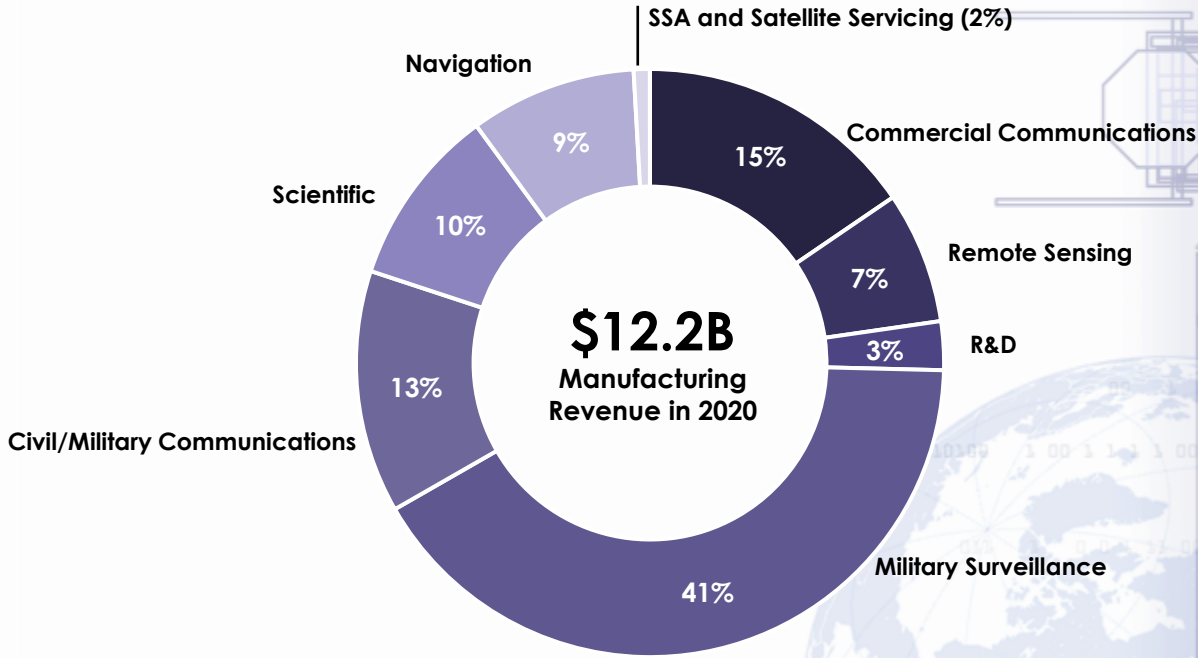
Satellite Manufacturing Findings

- Worldwide 2020 revenues totaled $12.2B; decreased 2.4% due to fewer medium-to-heavy satellites launched
- 1,194 commercially-procured satellites launched in 2020; 808 more than in 2019
- 125 commercially-procured CubeSats launched (104 in 2019)
- Communications satellites represented 15% of total revenues, compared to 43% in 2019
- Military surveillance satellites accounted for 41% of revenues, compared to 30% in 2019
- CubeSats represent less than 1% of total value

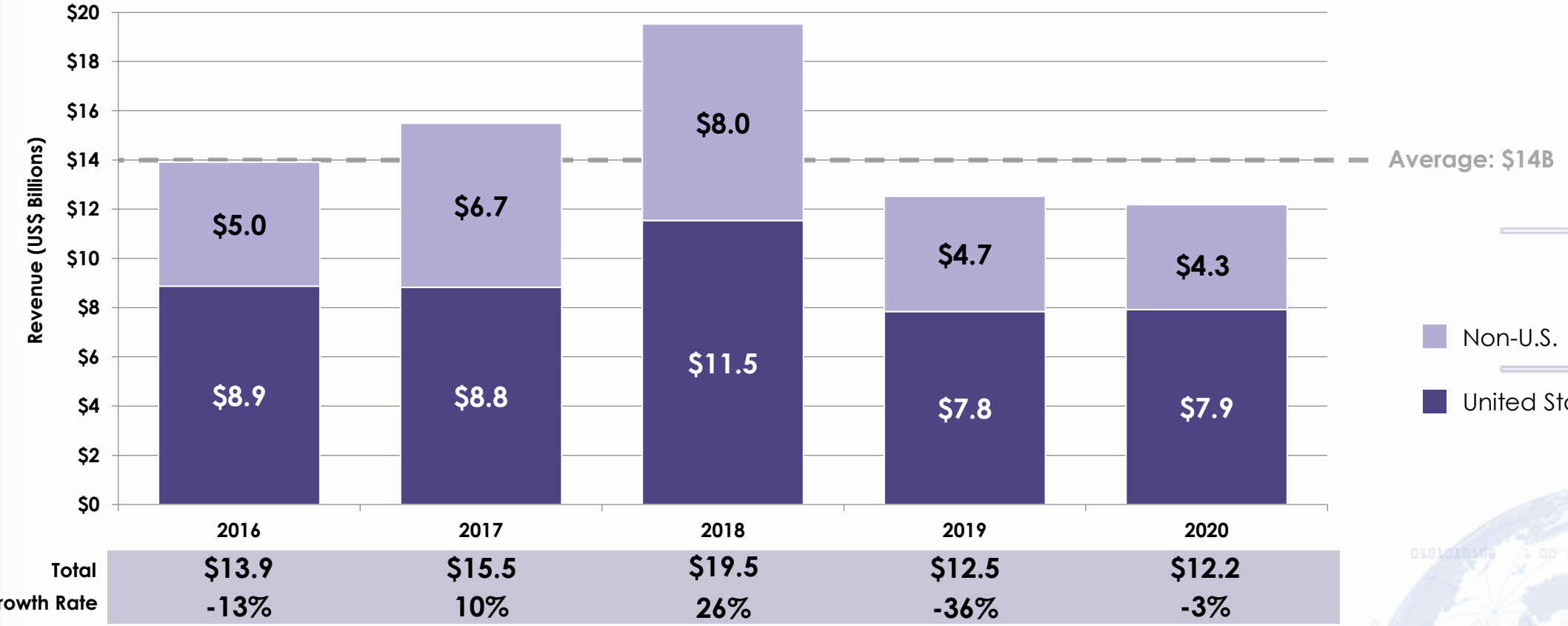


Number of Satellites Launched, by Mission Type



Value of Satellites Launched, Estimated by Mission Type

Satellite Manufacturing Revenues



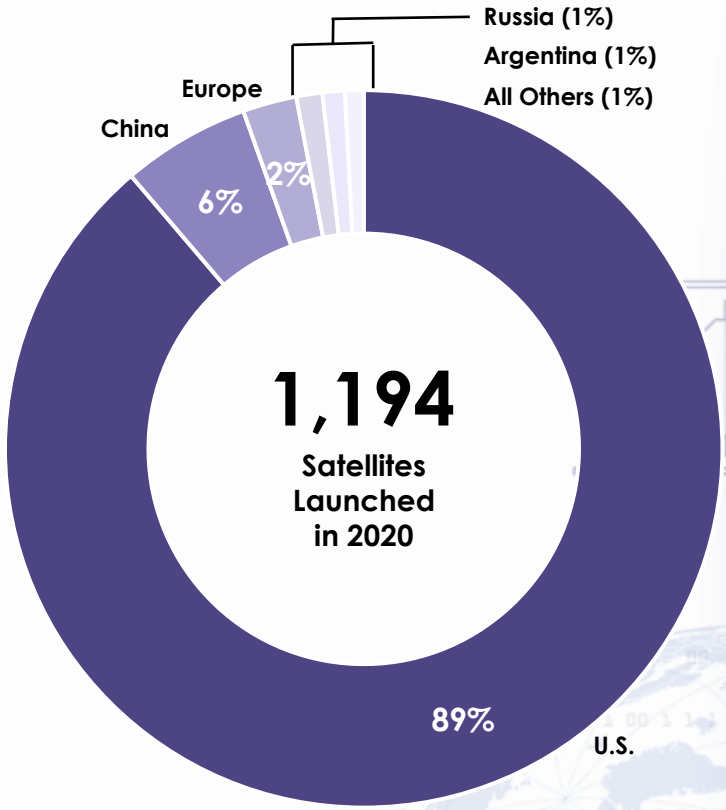
	2016	2017	2018	2019	2020
Total	$13.9	$15.5	$19.5	$12.5	$12.2
Growth Rate	-13%	10%	26%	-36%	-3%

- Worldwide 2020 revenues totaled $12.2B
- In 2020, U.S. share of global revenues was 65%, from 63% in 2019

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

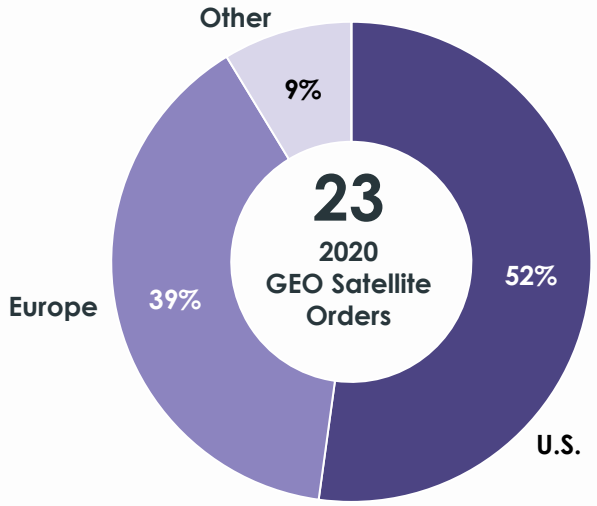
Satellite Manufacturing: U.S. Highlights

- Fewer medium-to-heavy class satellites launched: 42 (10 U.S.-made) vs. 49 (13 U.S.) in 2019
- U.S. satellite manufacturing revenues increased 1%;
  - Commercial sector 17 % lower, government sector 7 % greater
  - 80 % of U.S. revenues from U.S. government contracts
- Massive rollout of LEO broadband constellations began in 2020, continuing in 2021
  - 833 Starlink satellites launched in 2020
  - 104 OneWeb satellites launched in 2020
- U.S. firms built about 89% of commercially procured satellites launched in 2020 and earned 65% of manufacturing revenues
- 120 of the 1,123 satellites commercially built in the U.S. and launched in 2020 were CubeSats

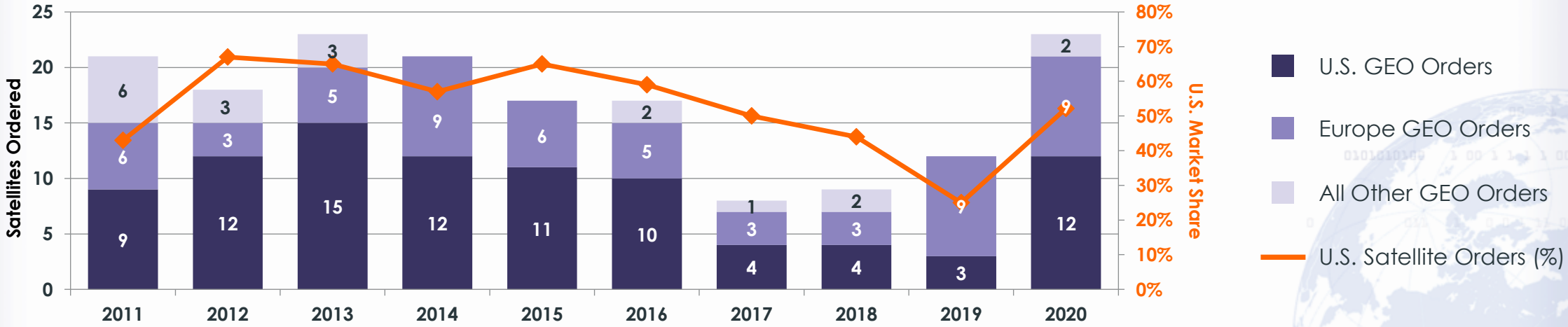


Number of Satellites Launched by Country/Region of Manufacturer

Future Indicator: GEO Satellite Commercial Manufacturing Orders



- Commercial orders for 23 GEO satellites announced
- 12 orders won by U.S. manufacturers; 3 in 2019
- 9 orders won by European manufacturers; 9 in 2018
- 13 orders driven by FCC C-band decisions
- 2017 and 2018 low orders affected GEO launches, manufacturing revenue in 2019 and 2020



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Satellite Services

- Consumer Services
  - Satellite Television
  - Satellite Radio
  - Satellite Broadband
- Fixed Satellite Services
  - Transponder Agreements
  - Managed Network Services (including in-flight services)
- Mobile Satellite Services
- Remote Sensing Services

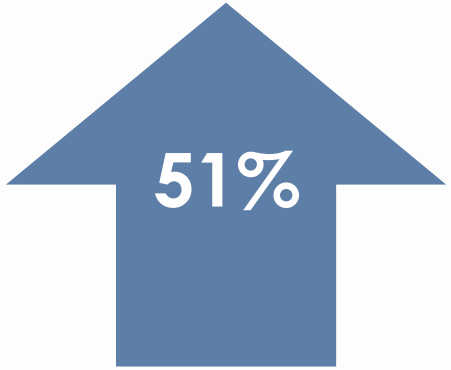
Satellite Services
Changing Industry Dynamics

More satcom capacity on orbit (+3x) enabling new services

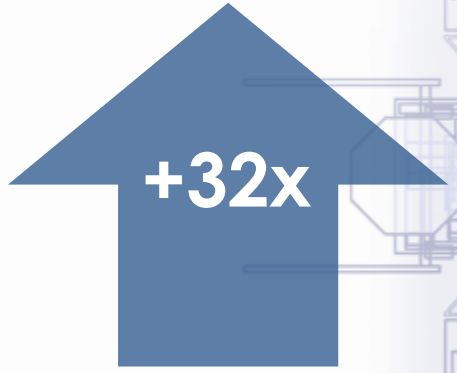
- Increase in total HTS capacity on orbit
- Decrease in cost of HTS
- Mobility: in-flight, cruise ships connectivity
- IoT connectivity
- Faster broadband, +51% subs since 2016

More new commercial remote sensing choices and capabilities

- 32+ times more active commercial remote sensing satellites
- Commercial imagery resolution increase of 24%
- Commercial remote sensing: multispectral, hyperspectral, SAR, RF mapping, RO
- Increased fusion of data analytics with imagery



New Broadband Subscribers (2016 – 2020)



Commercial Remote Sensing Satellites (2011 – 2020)

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Satellite Services Overview

- Consumer satellite service revenues
  - Broadband grew 10%
  - Satellite radio grew 2%
  - Satellite TV decreased 4%
- Fixed satellite service (FSS) revenues
  - Managed network services decreased 15%
  - Transponder agreements decreased 8%
- Mobile satellite service (MSS only) revenues grew 1%
- Remote sensing service revenues grew 12%
- Trends
  - Markets for value-added satellite services grew across multiple segments, including broadband and satellite radio
  - Remote sensing grew 12%; mature operators and new companies contributing to growth
  - More mature DTH posted moderate decrease, reflecting evolving entertainment trends
  - COVID-19 negative impact on demand for air travel, energy, and maritime industries in FSS segment

Satellite Services Findings: Consumer Services

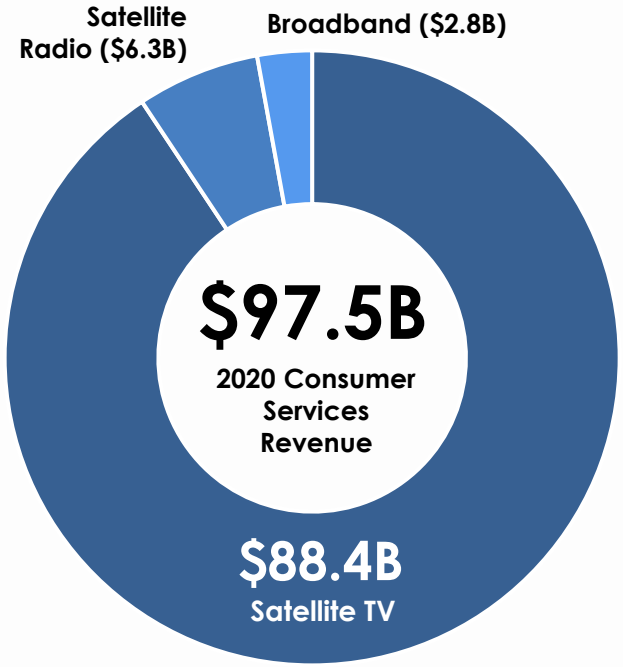
- Satellite radio and broadband revenues grew 2% and 10%, respectively. Satellite radio subscribers decreased by 1%, while broadband subscribers grew 5%
- Satellite TV revenues declining with changes in TV viewership, customer preferences

Satellite Radio

- Satellite radio (DARS) revenues grew 2%
- DARS subscribers decreased 1% to 34.7M
- Mostly North American customer base

Satellite Consumer Broadband

- Revenue grew 10%
- Subscribers grew 5%, to about 2.7M
- Higher revenue per user in the U.S.
- Additional capacity over U.S. allowed operators to add subscribers, offer more bandwidth, resulting in increasing growth rates: 12% in 2018, 19% in 2019, 8% in 2020
- New LEO constellations deploying and testing, expect to add capacity
- Dominated by U.S. providers adding both U.S. and non-U.S. subscribers
- Providers experienced an uptick in demand for fixed broadband services due to the COVID-19 pandemic



Satellite TV Services

- Satellite TV services (DBS/DTH) declined 4%; accounted for 75% of all satellite services revenues, 91% of consumer revenues
- Global satellite TV subscriber base decreased to 210M+ commercial subscribers (plus a similar number of free-to-air satellite TV homes) in 2020
- Subscribers and revenue declining in the U.S.
- Lower per-user revenues outside U.S, trends in number of subscribers vary by provider
- 41% of global revenues attributed to U.S.
- Slow growth of Ultra-HD channels, slightly over 1% of total TV channels worldwide
- HD channels 30+ percent of all TV channels
- Contributing to slower demand for satellite capacity: improving compression technologies; consumers continue to "cut the cord," opt for online on-demand services

Satellite Service Findings: Fixed and Mobile Service

- Mobile satellite services (MSS) revenue stayed flat at $2B
  - Includes end-to-end mobile voice and data services over MSS frequencies as defined by regulators
  - Multiple startup satellite IoT companies generated commercial service revenue
- FSS managed services revenue decline of 15%
  - Includes VSAT/private networks and mobility applications offered over FSS bands
  - COVID-19 negative impact on demand for air travel, energy, and maritime industries
  - Increasing availability of HTS capacity
- FSS transponder agreements revenue decline of 8%
  - Market conditions exacerbated by COVID-19
  - Significant oversupply and competition in satellite transponder market
  - Transponder bandwidth lease price in decline, resulting in lower revenues

MSS Vs. Mobility FSS

- **Mobile satellite services or MSS**
  - End-to-end mobile voice and data services provided using MSS frequencies (primarily L, S-band) as defined by regulators. Some M2M and IoT operators use VHF frequencies
  - Provided by GEO and LEO satellite operators
- **On-the-move or mobility FSS services**
  - Included in managed network service category, alongside VSAT network services
  - Provided to terminals mounted on vehicles, vessels, and aircraft, and portable terminals, or "mobile VSATs"
  - Use fixed satellite service (FSS) frequencies (C, Ku, Ka-band) to primarily provide broadband connectivity
  - Increased HTS capacity and new antenna technology has made service to on-the-move customers more attractive over FSS bands
  - Provided by existing GEO and MEO satellite operators. New LEO constellations began massive satellite deployments in 2020.

Satellite Services: COVID-19 Impact

- Satellite revenues were impacted by COVID-19 effects on users of satellite services
- As companies in affected industries reduce assets, cut costs, or reduce services, use of satellite services decreases
- Economic impacts on other industries have varied in their severity and how long recovery has taken

Air Travel

19% — Fleet size reduction in 2020

60% — Passenger volume reduction from 2019

Energy Industry

4% — Decline in global energy demand (largest ever absolute decline). Oil decline 14%

4.6% — Estimated energy demand in 2021

Cruise Industry

21 — Number of ships removed from service/ scrapped

99% — Passenger volume reduction from 2019

Cell Phone Manufacturers

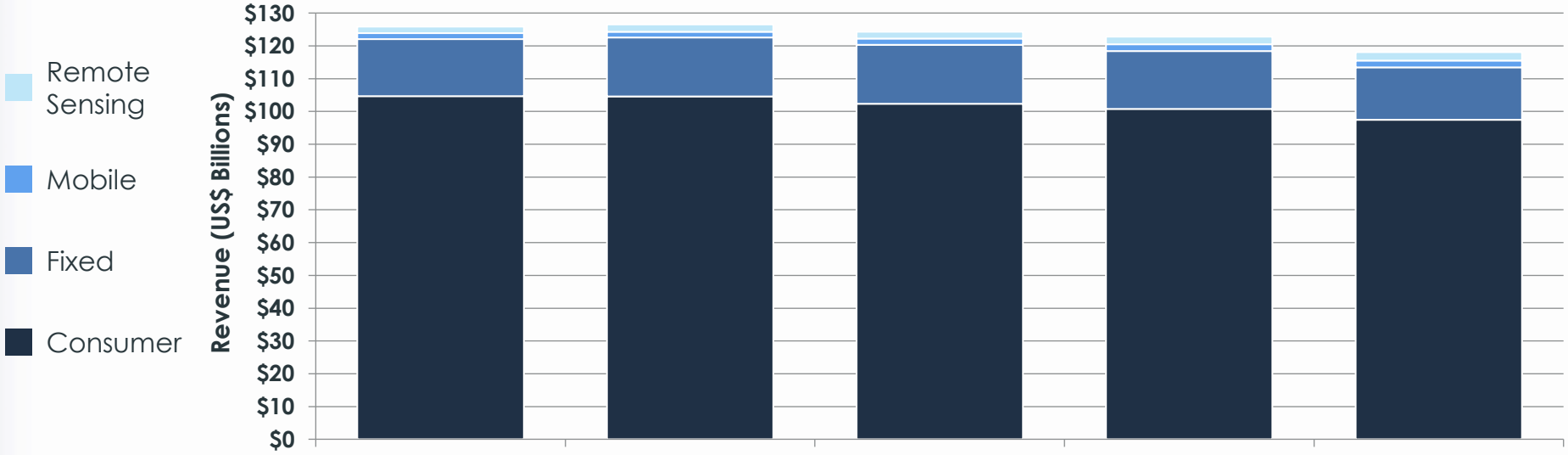
5.9% — Decline in units shipped in 2020

4.3% — 4th quarter 2020 year-over-year growth

In the U.S. cruises are scheduled to widely resume in July 2021

Sources: Airlines for America, International Energy Agency, Cruise Lines International, Wall Street Journal, Cruise Mapper, International Data Corporation.

Satellite Services: Global Revenue



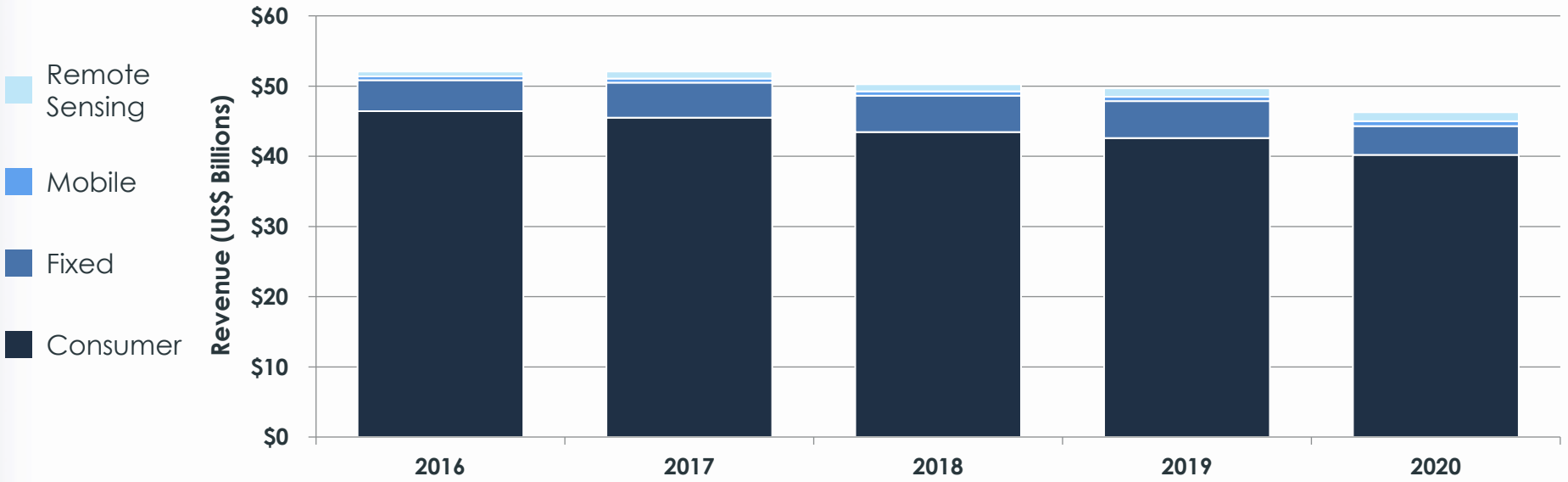
	2016	2017	2018	2019	2020
Growth Rate	0.1%	0.5%	-1.8%	-1.1%	-4.2%
Total	**$125.9**	**$126.6**	**$124.3**	**$123.0**	**$117.8**
Consumer	$104.7	$104.6	$102.4	$101	$97.5
Satellite TV (DBS/DTH)	$97.7	$97.1	$94.2	$92.0	$88.4
Satellite Radio (DARS)	$5.0	$5.4	$5.8	$6.2	$6.3
Satellite Broadband	$2.0	$2.1	$2.4	$2.6	$2.8
Fixed	$17.4	$17.9	$17.9	$17.7	$15.7
Transponder Agreements (1)	$11.2	$11.1	$10.6	$10.0	$9.2
Managed Services (2)	$6.2	$6.8	$7.3	$7.7	$6.5
Mobile (MSS only)	$1.8	$1.8	$1.9	$2.0	$2.0
Remote Sensing	$2.0	$2.2	$2.1	$2.3	$2.6

The U.S. share of global satellite services revenue in 2020 was

39%

Notes: Numbers may not sum due to rounding. (1) Includes capacity for DTH satellite TV and some mobility service platforms. (2) Includes VSAT, mobility, in-flight connectivity.

Satellite Services: U.S. Revenue



	2016	2017	2018	2019	2020
Growth Rate	-2%	0%	-3.5%	-1%	-7%
Total	**$52.1**	**$52.1**	**$50.3**	**$49.7**	**$46.3**
Consumer	$46.4	$45.5	$43.5	$42.8	$40.2
Satellite TV (DBS/DTH)	$39.7	$38.3	$35.5	$34.0	$31.4
Satellite Radio (DARS)	$5.0	$5.4	$5.8	$6.2	$6.3
Satellite Broadband	$1.7	$1.8	$2.2	$2.4	$2.5
Fixed	$4.4	$5.0	$5.2	$5.3	$4.1
Transponder Agreements (1)	$0.3	$0.3	$0.3	$0.2	$0.0
Managed Services (2)	$4.1	$4.7	$4.9	$5.1	$4.1
Mobile (MSS only)	$0.5	$0.6	$0.7	$0.7	$0.7
Remote Sensing	$0.8	$1.0	$1.0	$1.2	$1.3

The U.S. share of global satellite services revenue in 2020 was

39%

Notes: Numbers may not sum due to rounding. (1) Includes capacity for DTH satellite TV and some mobility service platforms. (2) Includes VSAT, mobility, in-flight connectivity.

Case Study: Remote Sensing Services

Overview of Commercial Systems

- Continued investment and innovation
- Maturing early-stage firms working to build commercial customer bases, increasingly targeting government customers
- New capabilities being introduced: RF mapping, CH_4 emissions monitoring, and hyperspectral

Operational Systems	Country	High Res (<1m)	High Revisit (<1 day)	Sensor Description	Number of Satellites	Typical Sat Mass (kg)	Generating Revenue (GR), Start-up no/some revenue (SU)	Added in 2021 SSIR
Maxar	USA	•	•	Optical (MS)	10	750 to 2,500	GR	
MDA	Canada			Radar	2	2,200	GR	•
Airbus Intelligence*	France	•	•	Optical (MS), radar	12	88-1,340	GR	
Siwei Star Co.	China			Optical (MS)	24+	560	SU	
Chang Guang	China	•	•	Optical (MS) (HS), video, radar	138	420	GR	
21AT/TripleSat	UK/China	•		Optical (MS)	3	350	GR	
ImageSat	Israel	•		Optical (MS)	2	280-370	GR	
Axelspace	Japan		•	Optical (MS)	10	100	SU	
Capella Space	USA	•	•	Radar	36	100	SU	
Synspective	Japan		•	Radar	30	100	SU	•
iQPS	Japan		•	Radar	36	100	SU	•
ICEYE	Finland	•	•	Radar	18	90	GR	
Zhuhai Orbita	China	•	•	Optical (MS), (HS), video	34	90	SU	•
BlackSky Global	USA	•	•	Optical (MS)	23	55	GR	
Canon	Japan	•	•	Optical (MS)	100	50	SU(?)	•
Satellogic	Argentina	•	•	Optical (MS) (HS), video	300	37	SU	
HawkEye 360	USA		•	RF Mapping	21	30	SU	
GeoOptics	USA		•	RO	24	~20	SU	
GHGSat	Canada		•	Optical (MS)	10	15	SU	
Astro Digital	USA		•	Optical (MS)	3	11	SU	
ADASPACE	China	•	•	Optical (MS)	192	10	SU	•
Kleos	Luxembourg		•	RF Mapping	40	9	SU	
UnseenLabs	France		•	RF Mapping	50	8	SU	•
Aurora Insight	USA		•	RF Mapping	12	8	SU	•
Planet	USA	•	•	Optical (MS), video	150+	4-150	GR	
Spire Global	USA	•	•	RO, AIS, ADS-B	140+	4.5-6	GR	

** Airbus is a partner with DLR on TerraSAR-X and TanDEM-X, CNES on Pleiades 1a and 1b, and Azercosmos on SPOT 7.*

Planned Systems	Country	High Res (<1m)	High Revisit (<1 day)	Sensor Description	Number of Satellites	Typical Sat Mass (kg)	Generating Revenue (GR), Start-up no/some revenue (SU)	Added in 2021 SSIR
Hypersat	USA		•	Optical (HS)	6	300	SU	•
Earth-I	UK/China	•	•	Optical (MS), video	15	100	SU	
Orbital Sidekick	USA		•	Optical (HS)	6	100	SU	•
Umbra Lab	USA	•	•	Radar	12	50	SU	
PlanetIQ	USA		•	RO	20	30	SU	
Pixxel	India		•	Optical (HS)	30	30	SU	•
Sen	UK			Optical (MS), video	5	20	SU	•
Hera Systems	USA	•	•	Optical (MS)	48	12	SU	
Orbital Micro Systen	UK		•	Optical (MS)	16	10	SU	
SpaceVR	USA			Optical (MS)	2	4	SU	
Skeyeon	USA		•	Optical (MS)	5	4	SU	•
Aerospace Lab	Belgium	•	•	Optical (MS)	20	TBD	SU	•
HySpecIQ	USA			Optical (HS)	2	TBD	SU	•
Theia	USA	•	•	Optical (MS) (HS) Radar	112	TBD	SU(?)	•
Predasar	USA	•	•	Radar	48	TBD	SU	•

Operational includes initial deployment through full capacity

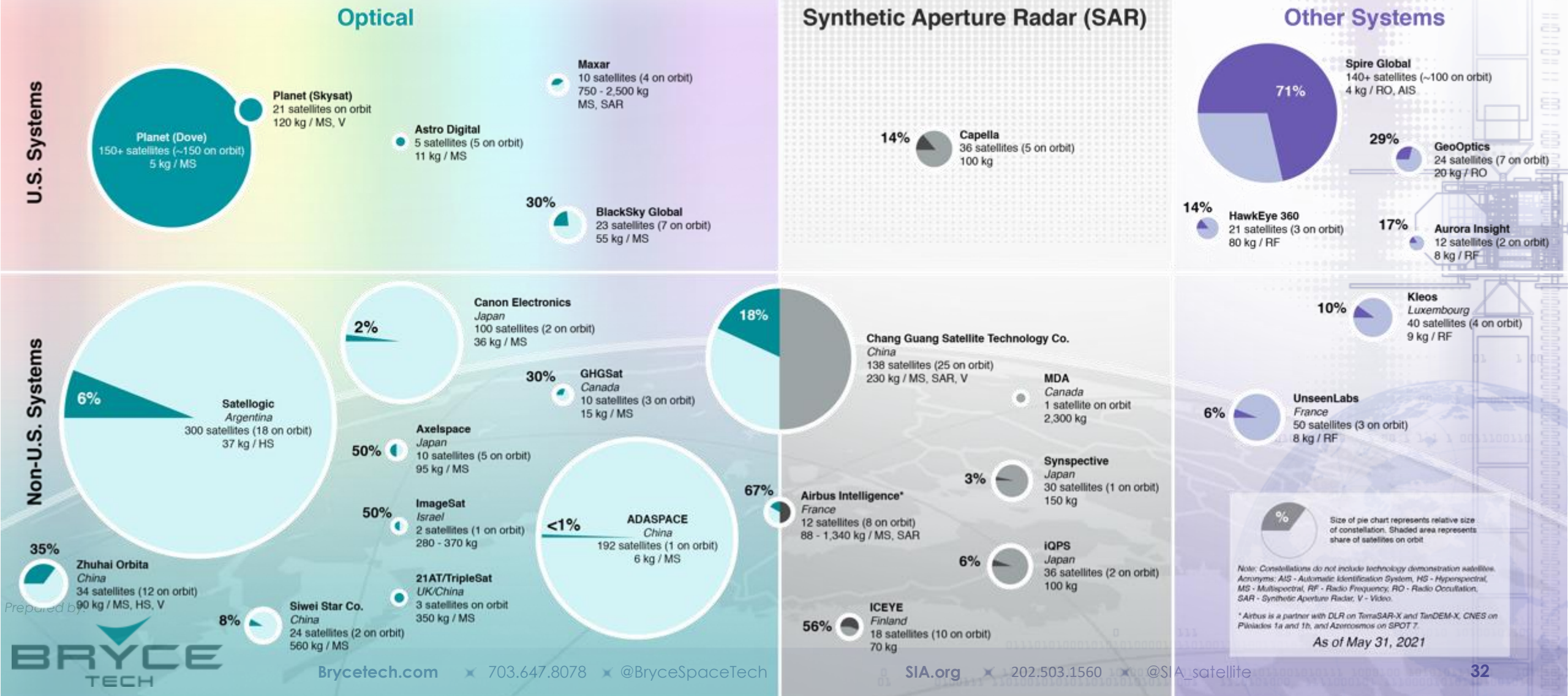
Criteria for inclusion are satellites on orbit, announced funding, signed launch contract/agreement, or NOAA license. Other systems considered: AISTECH, Alba Orbital, Bluefield, ConstellR, EarthDaily, EOS SAR, Horizon Technologies, Inovor, Karten, Kawa Space, KP Labs, Metasensing, Northstar E&S, OHB Italia, Orora Tech/Orbital Oracle, Qjan Sheng, R2 Space/Orbital Effects, Sat Revolution, Scanway, Scanworld, Trident Space, XpressSAR, and ZeroG Lab

Acronyms: MS – multispectral, HS – hyperspectral, RO – radio occultation, RF – radio frequency, AIS – Automatic Identification System; ADS-B – automatic dependent surveillance—broadcast, SSA – space situational awareness

Case Study: Remote Sensing Services

Commercial Remote Sensing Satellite Systems

Systems with at least one operational satellite, by relative size of constellation, percentage of satellites on orbit, and sensor type



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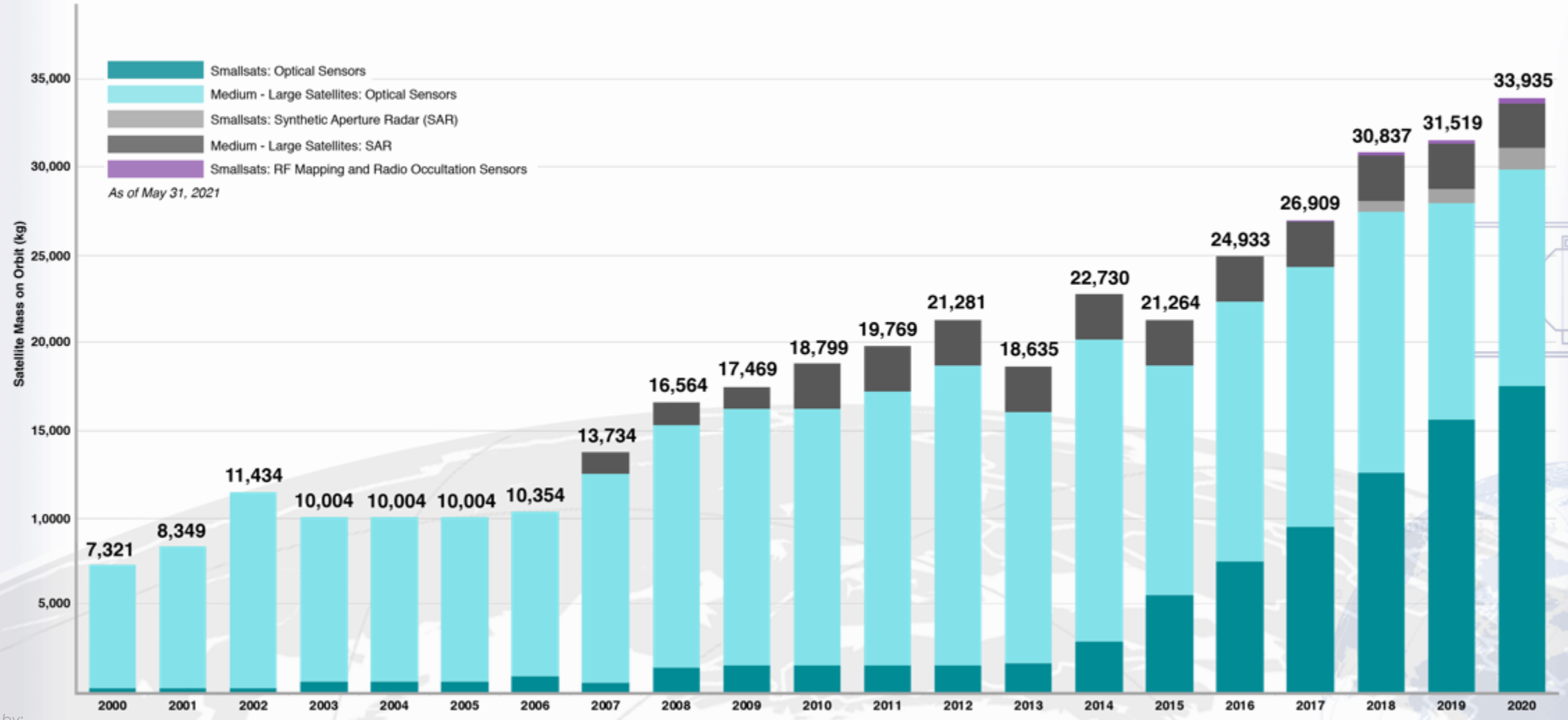
Case Study: Remote Sensing Services

Commercial Remote Sensing Satellites by Total On Orbit Mass



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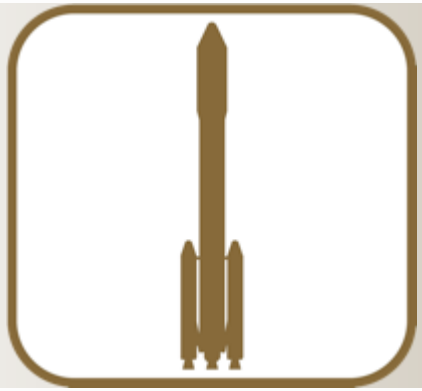


Launch

Launch
Changing Industry Dynamics

More affordable launches

- $/kg down 34%
- U.S. market share of internationally competed launches increased from zero in 2011 to 50%+, 2017 – 2020)

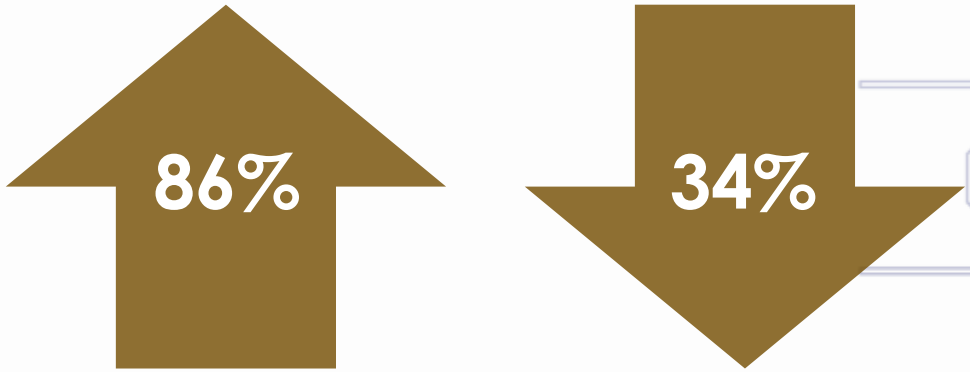
Increased launch activity

- More satellites launched per year, driven by smallsats (~x9.4)
- More satellite upmass launched per year (86%)

More launch choices, capacity becoming available

- Routine use of reusable launch vehicles
- Increased rideshare opportunities
- New small vehicles (operational and planned)
- Next-generation medium-to-heavy launch vehicles under development globally

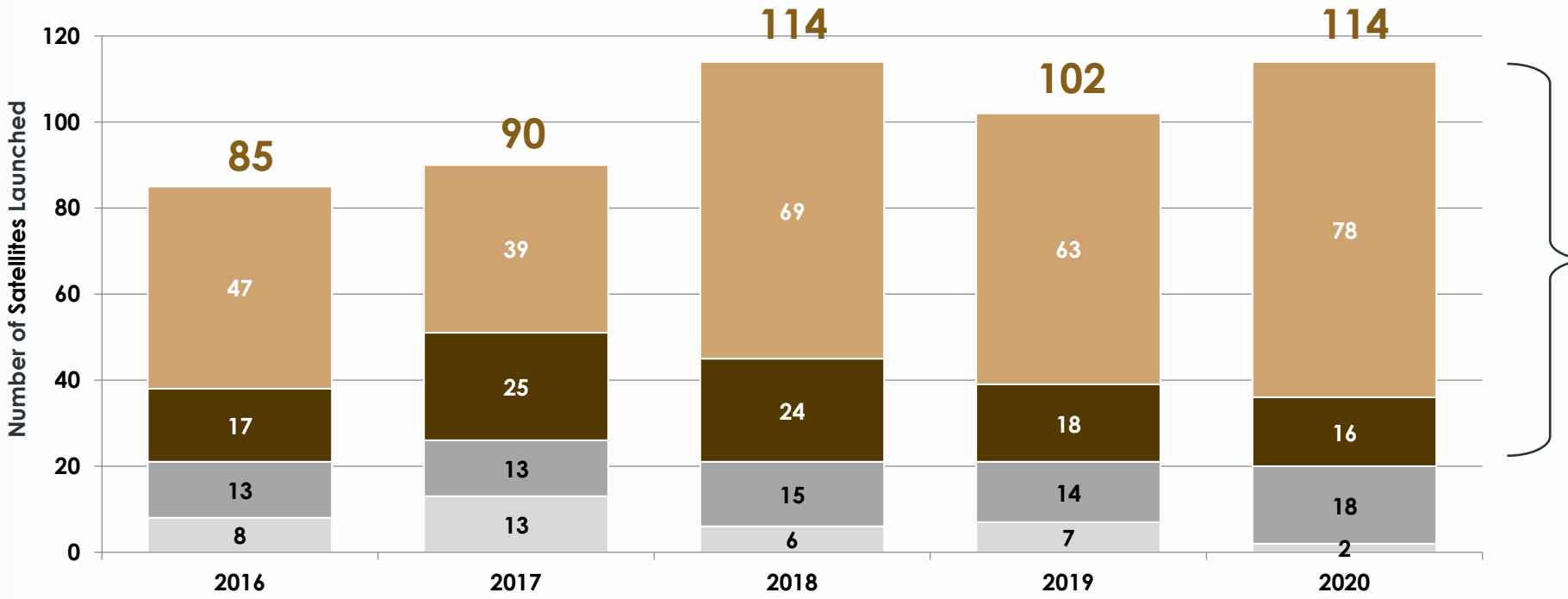
Innovative post-launch deployment services



Upmass (2011 – 2020)

Price/kg (2011 – 2020)

Satellite Launch: Methodology



- Included in SSIR: commercially-procured satellite launches
  - Internationally-competed launches of satellites
  - Captive satellite launches procured from launch providers on contractual basis or privately-funded launches
- Not included in SSIR
  - Launches of non-satellite missions (crew and cargo to ISS, other space vehicles)
  - Launches not procured commercially – a government agency providing a launch of a satellite owned by the same agency (i.e., ISRO)

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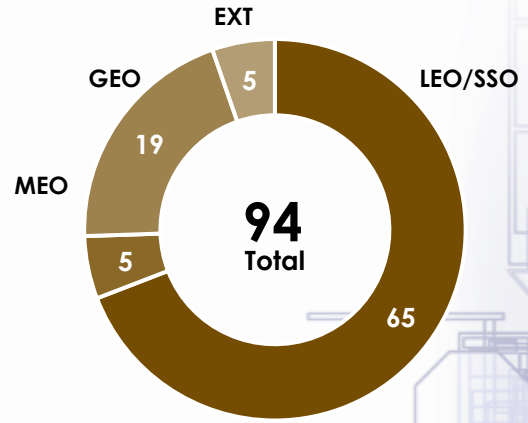
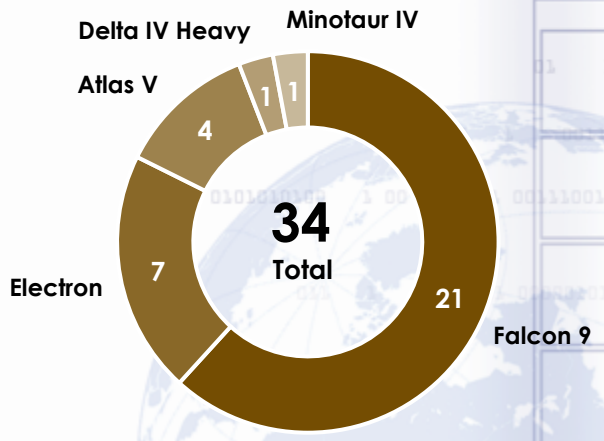
Launch Industry Findings and U.S. Highlights

- $5.3B revenues from commercially-procured satellite launches worldwide; 9% increase from 2019
- At 94, an increase of 16% in commercially-procured launches from 2019 (81)
  - Reflects 2017 – 2018 decline in commercial GEO satellite orders
  - Reflects commercial LEO constellation launches in 2020
  - Five exploration missions in 2020 (Perseverance, Hope, Solar Orbiter, Chang'e 5, Tianwen 1)
- U.S. captured 39% of commercially-procured launch revenues
  - Increasingly competitive U.S. commercial launch prices
  - 34 launches by U.S. providers (20 in 2018). Includes 14 SpaceX Starlink launches
- Continuing trends
  - Launches of U.S. government satellites generated 29% of global revenues
  - Government customers worldwide remained the revenue driver (67%, from 67% in 2019), reflecting increased launch activity in China
  - European industry maintaining launch cadence
  - Russian internationally-competed launches remain low: none in 2020 (one in 2019)

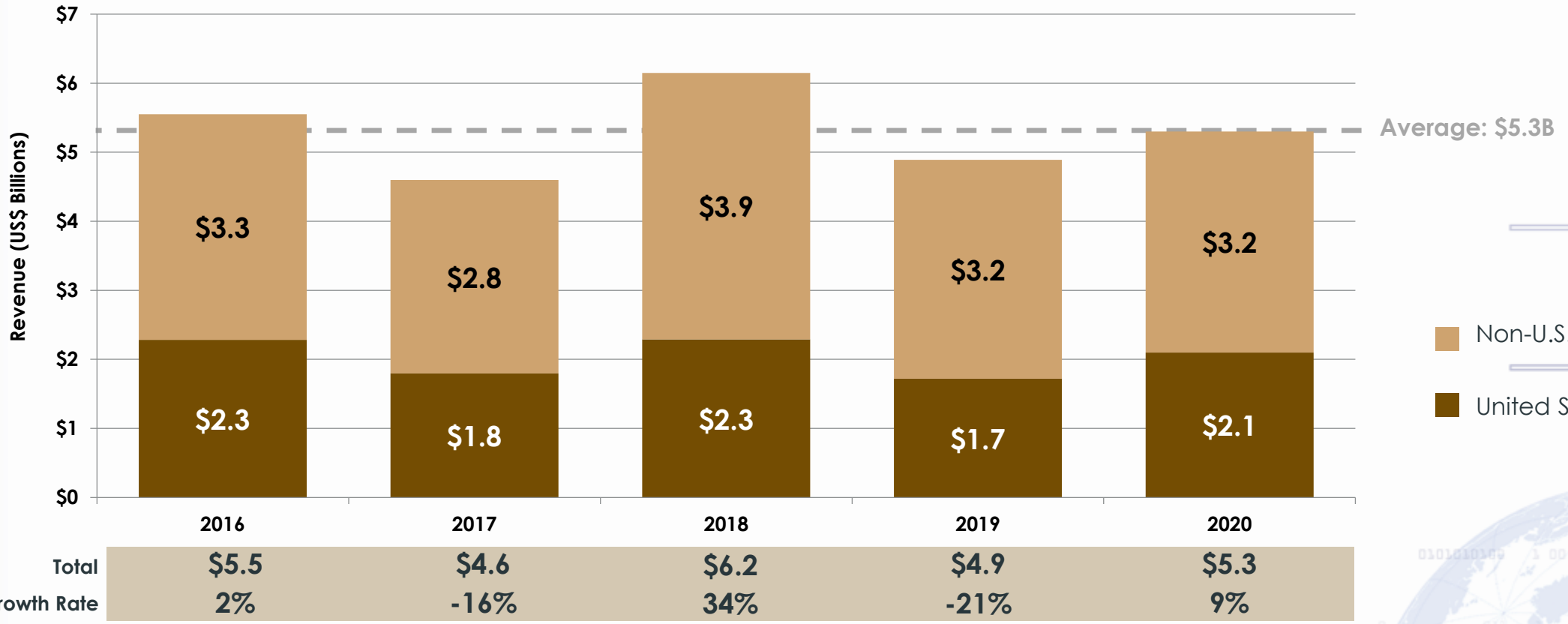


2020 Commercially Procured Satellite Launches by Orbit



2020 Commercially Procured U.S. Satellite Launches by Vehicle

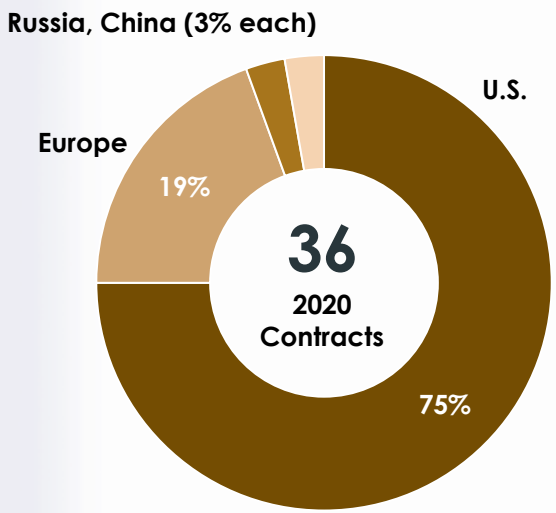
Launch Industry Revenues



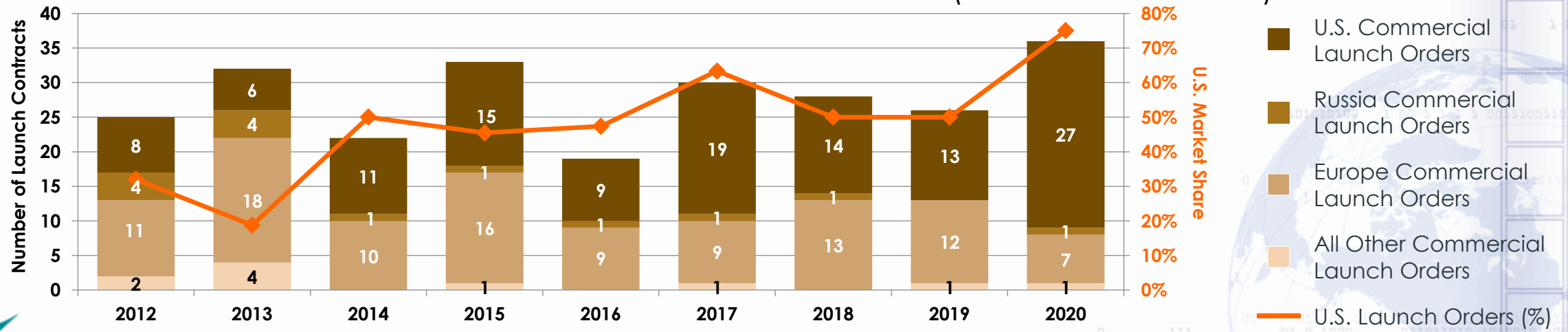
	2016	2017	2018	2019	2020
Total	$5.5	$4.6	$6.2	$4.9	$5.3
Growth Rate	2%	-16%	34%	-21%	9%

- $5.3B global revenues in 2020 from commercially procured satellite launches
- U.S. share of global launch revenues in 2020 was 41% (35% in 2019)

Future Indicator: Commercial Satellite Launch Contracts



- 36 competed orbital launch contracts announced in 2020 (26 in 2019)
  - U.S. providers awarded 27 contracts for a total of 38 launches, plus options
    - U.S. medium/large launch providers captured 10 contracts, 12 launches
    - U.S. small launch providers captured 17 contracts, 26 launches, plus options
  - European providers captured 7 contracts for a total of 11 multi-manifest launches
  - Chinese and Russian providers each captured 1 contract
- Excludes Starlink launches on Falcon 9 (14 in 2020)
- Excludes small launch contracts awarded under Defense Production Act and subsequently canceled
- OneWeb 2015 launch contract revised (three fewer launches)



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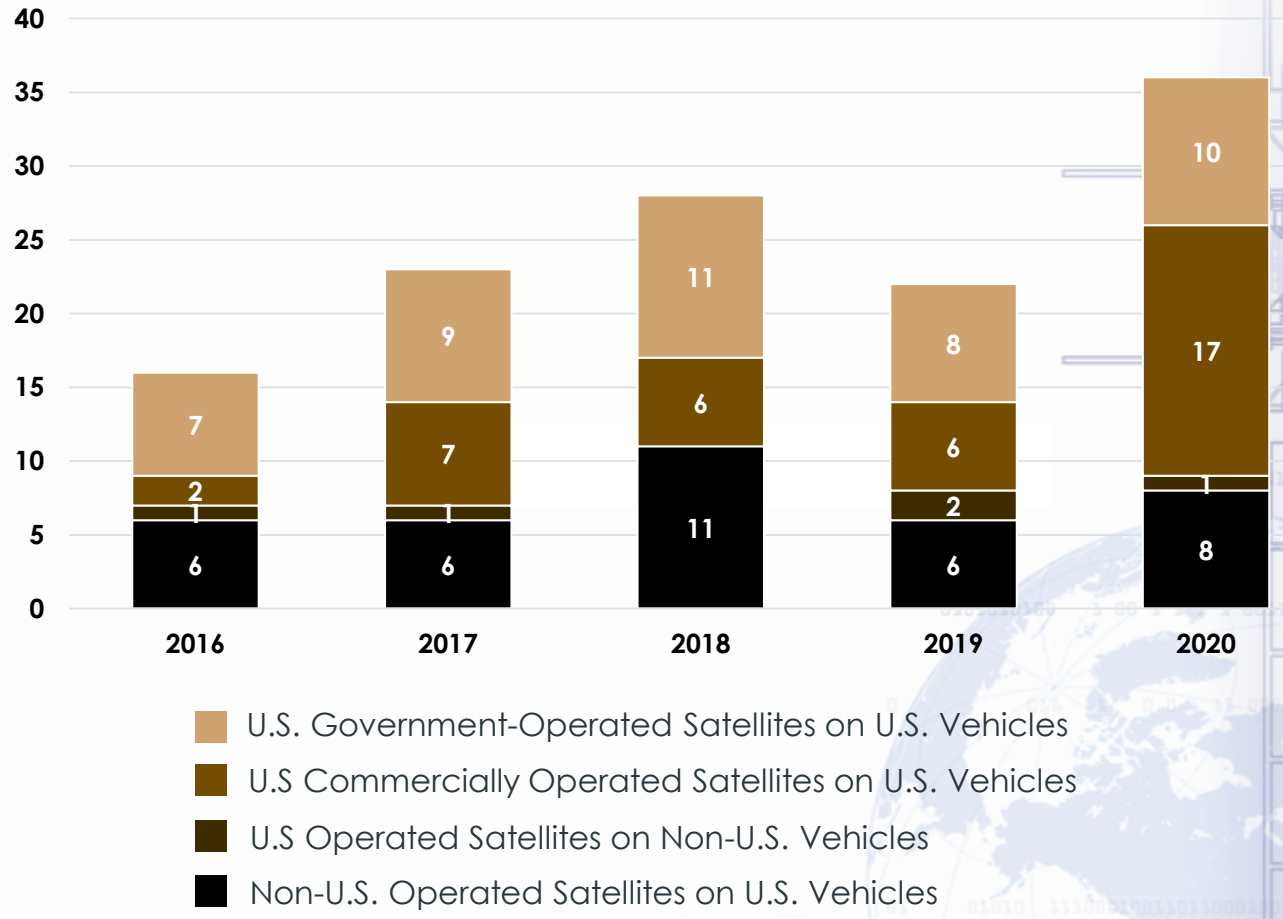
Case Study: Proportion of U.S. Operated Satellites Launched by Non-U.S. Providers

- As policy, U.S. government satellites are launched on U.S. vehicles
- U.S. GEO commercial satellite operators increasingly selecting U.S. launch providers
- U.S. operators of commercial smallsats often launch them as secondary or "piggyback" payloads and choose launch vehicles depending on schedule, availability, and price
- Increase in U.S commercially operated satellites on U.S. vehicles driven by increased deployment of Starlink on Falcon 9

Proportion of Launches Carrying U.S.-Operated Satellites (Primary Payloads), 2016 – 2020



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

Ground Equipment
Changing Industry Dynamics

Growing on-the-move connectivity

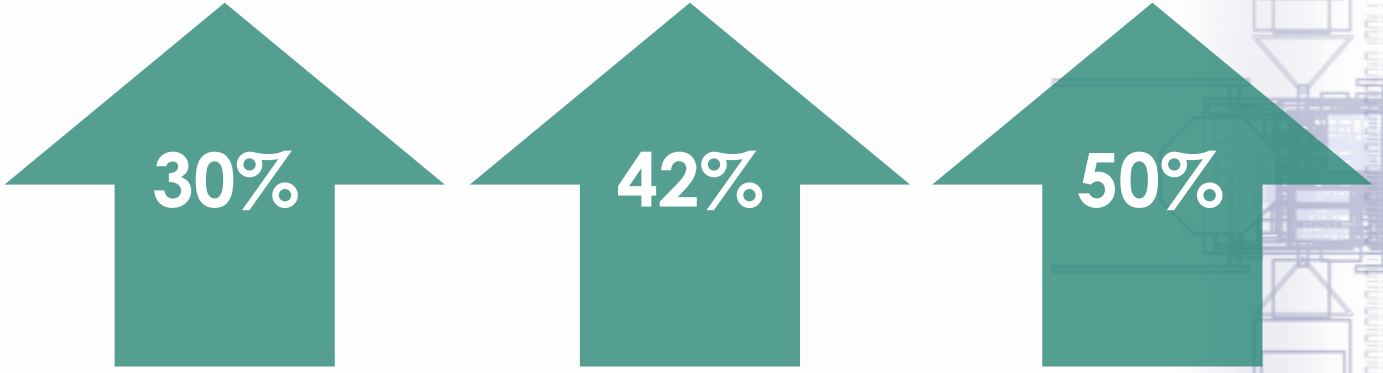
6.5 billion GNSS satellite-enabled smartphones, other devices in use

- Millions of unique location-based services, apps
- Mass-produced chipsets resulting in lower costs
- 30% increase over the last 5 years

Broadband, satellite radio installations on the rise

- Broadband terminals up 42% over 5 years
- Installed satellite radios up 50% over 5 years

Television viewership changing from traditional models



GNSS Devices (2016 – 2020)

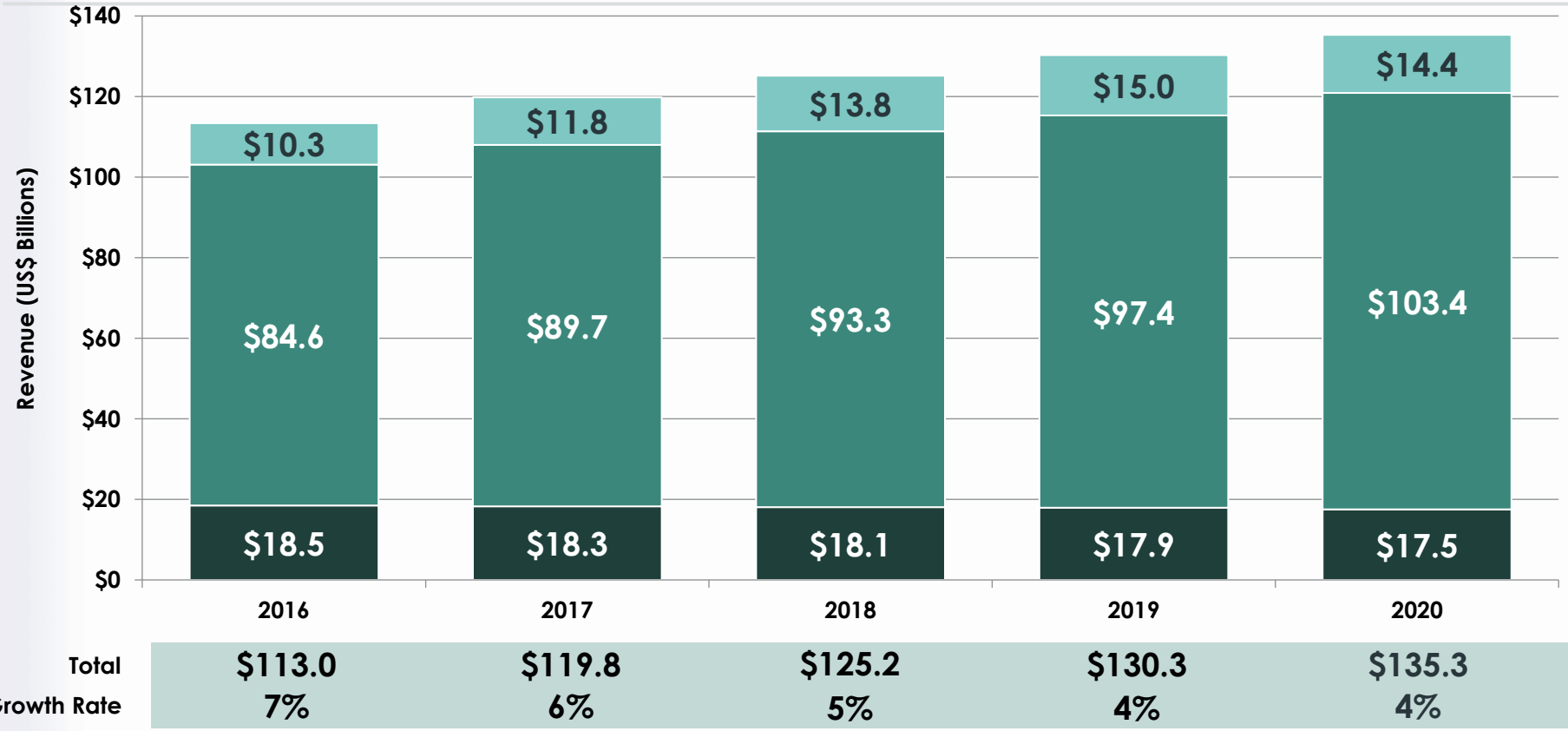
Broadband Terminals (2016 – 2020)

Satellite Radio Installations (2016 – 2020)

Ground Equipment Findings

- Total satellite ground equipment revenues increased 4% in 2020
- Satellite navigation (global navigation satellite systems, GNSS) revenues increased 6%
  - Estimate includes equipment (including software updates), excludes downstream applications
    - Stand-alone and in-vehicle units
    - Components (mainly chipsets) directly enabling location-based capabilities in mobile devices, traffic information systems, aircraft avionics, and in maritime, surveying, rail, and other equipment
  - Sharp reduction in sales of smartphones and other GNSS-enabled personal devices and in-vehicle systems reported due to COVID-19 driven closure of retail locations and reduced consumer demand; likely slowed growth rate
- Network equipment revenues decreased 4%, in line with COVID-19 driven drop in fixed satellite services revenues
- Revenue from consumer equipment for satellite TV, radio, and broadband, and mobile satellite terminals (non-GNSS) revenues decreased 2%, with satellite TV receiver revenues decreasing in most markets, partially offset by growth in broadband

Global Satellite Ground Equipment Revenues



	2016	2017	2018	2019	2020
Total	$113.0	$119.8	$125.2	$130.3	$135.3
Growth Rate	7%	6%	5%	4%	4%

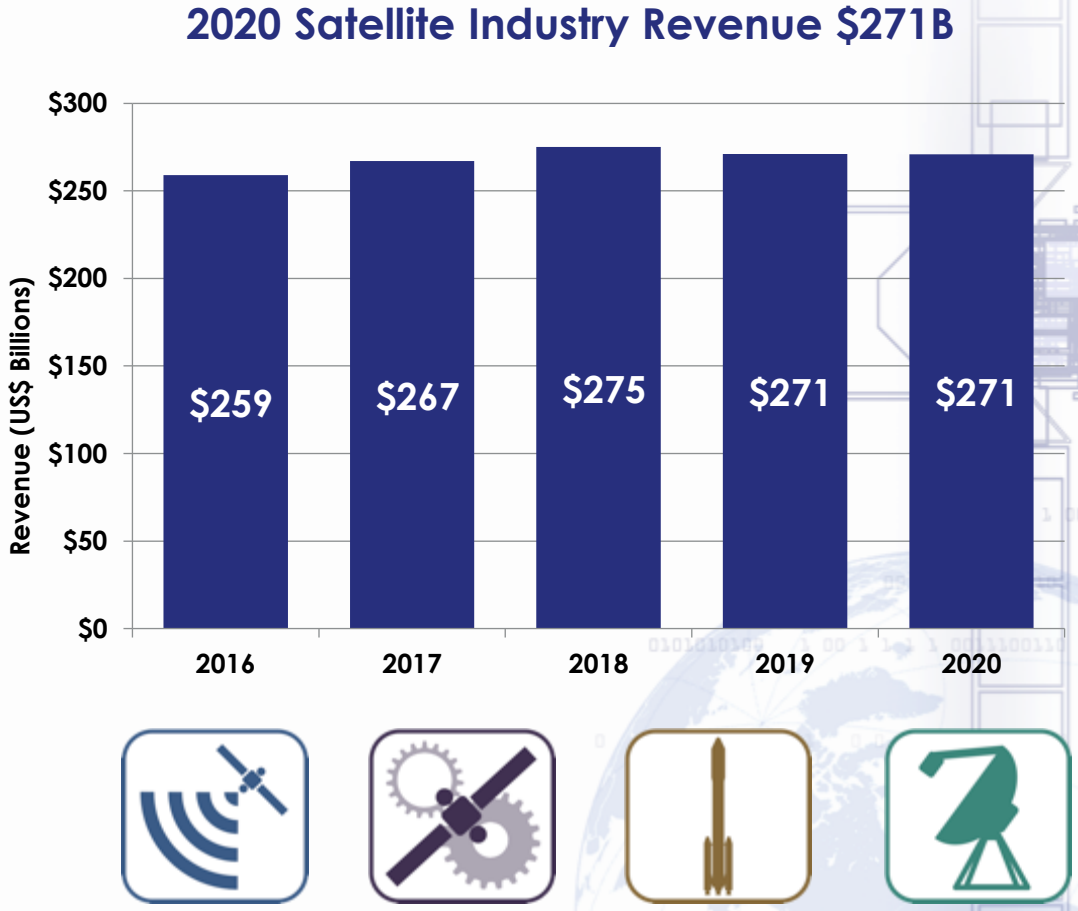
The U.S. share of ground equipment revenue in 2020 was 42%

- Network Equipment
- GNSS Equipment
- Consumer Equipment
  Satellite TV, Radio, Broadband, and mobile (Non-GNSS)

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 — includes the entire GNSS segment: stand-alone navigation devices and GNSS chipsets supporting location-based services in mobile devices, traffic information systems, aircraft avionics, maritime, surveying, and rail.
Estimates based on GSA GNSS Market Report Issue 4, 5, and 6; other data.

Summary: Top-Level Global Satellite Industry Findings

- Satellite industry driving increased affordability and productivity, new capabilities
- Growth in value-added markets
  - Broadband
  - Remote sensing
  - GNSS
- Consistent manufacturing, increased launch revenues
- Television changing from traditional models
- COVID-19 impact on fixed satellite service revenues



The voice of the satellite industry

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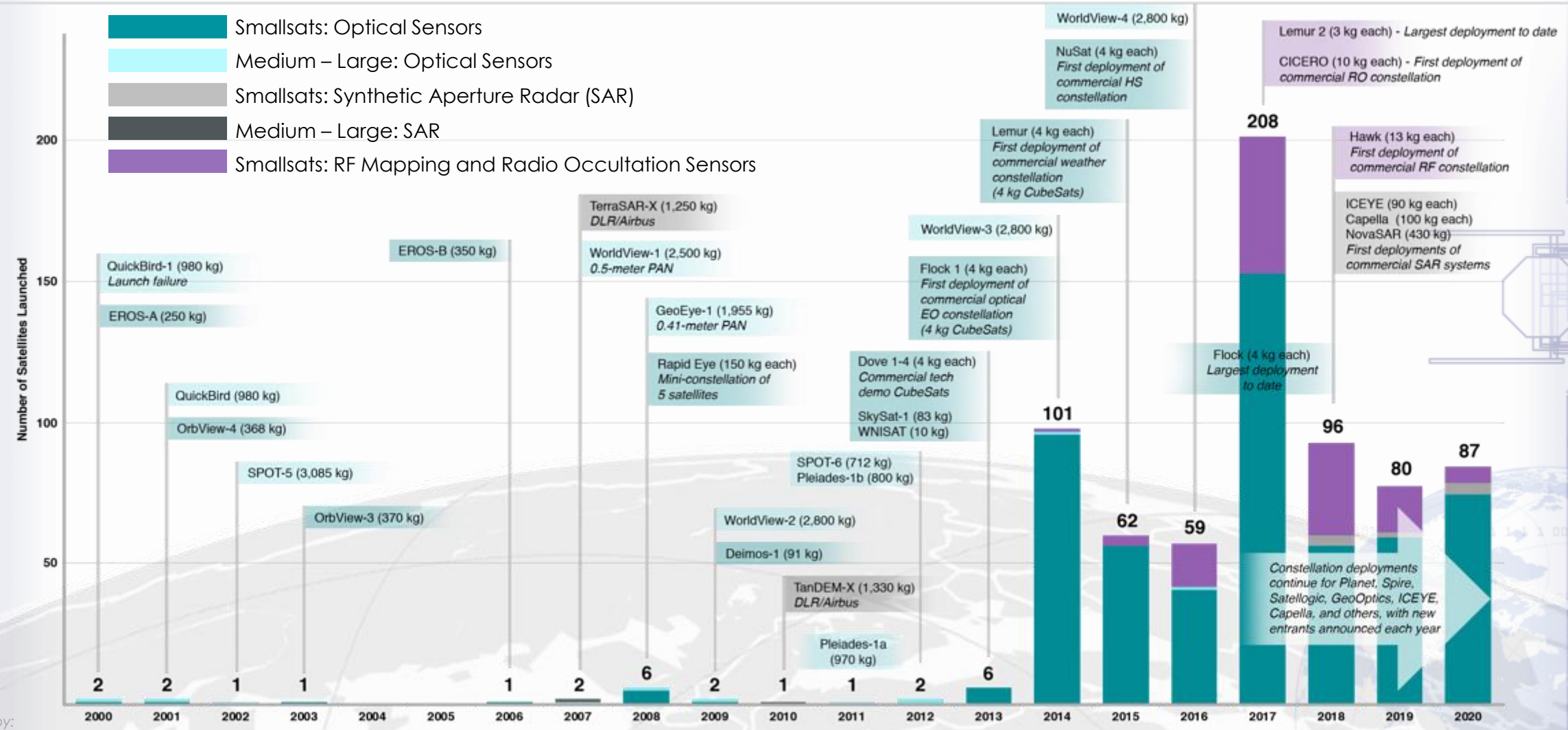
Case Study: Remote Sensing Services

Commercial Remote Sensing Satellites by Number Launched per Year



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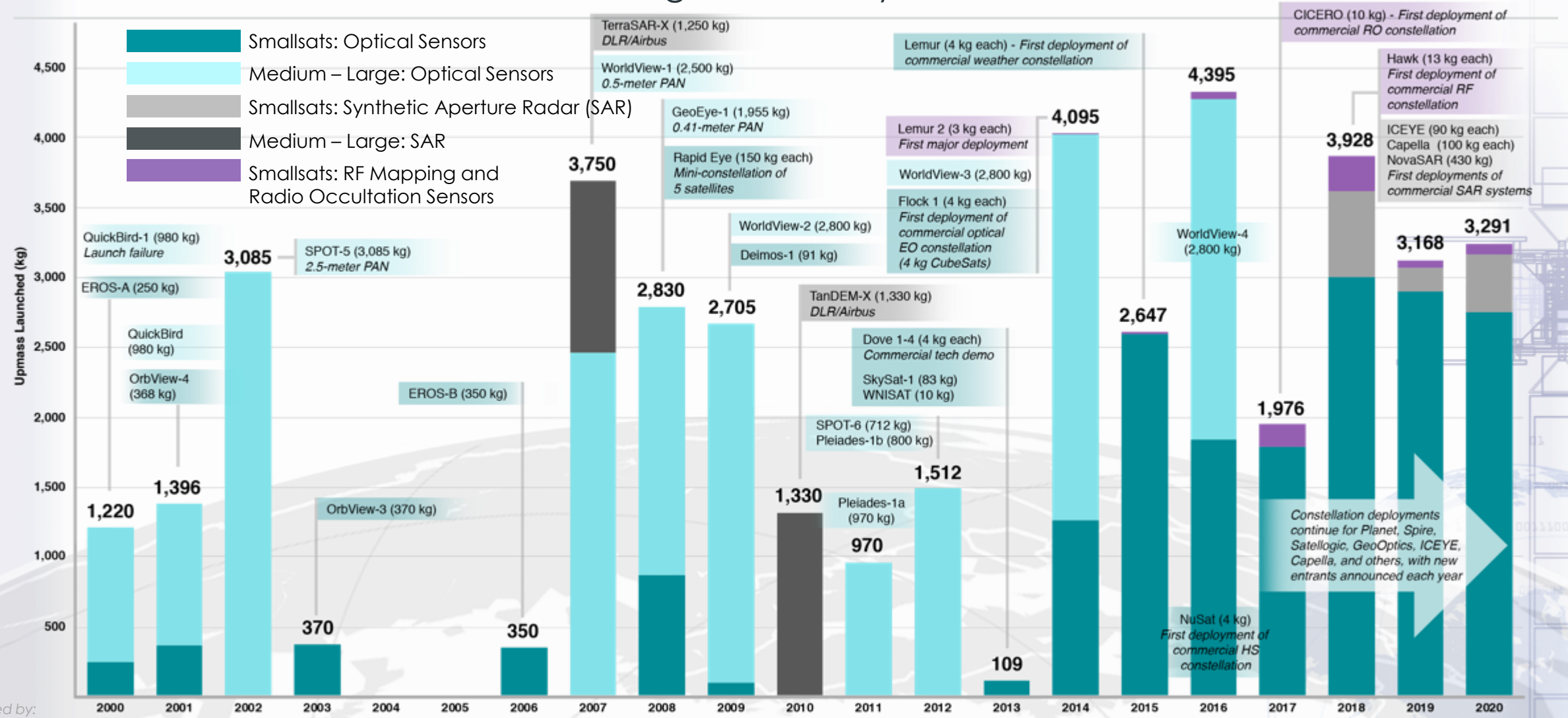
Case Study: Remote Sensing Services

Commercial Remote Sensing Satellites by Launch Mass and Year



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