

Global Outlook 2018

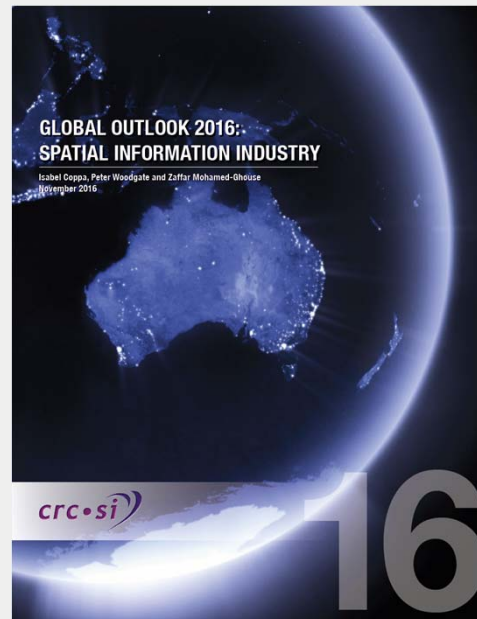
Spatial Information Industry

Graeme Kernich, CEO CRCSI

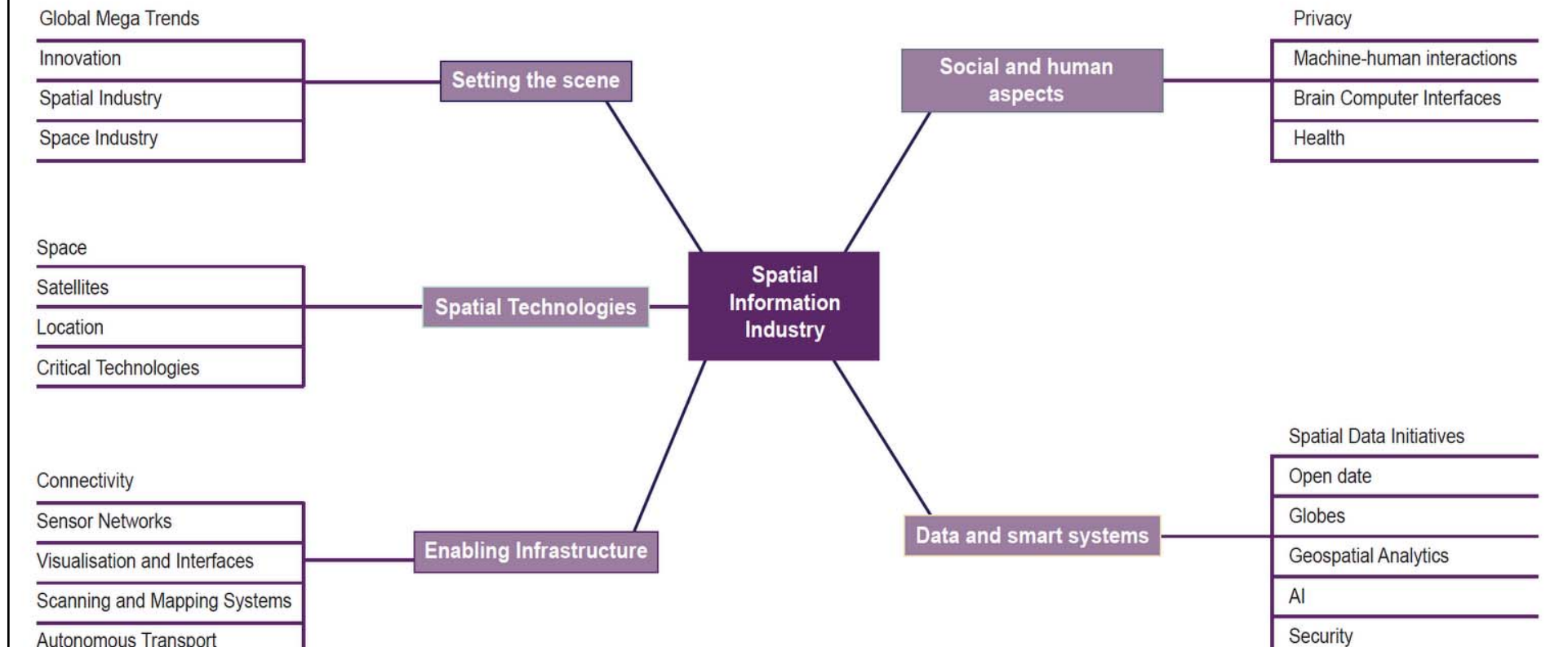


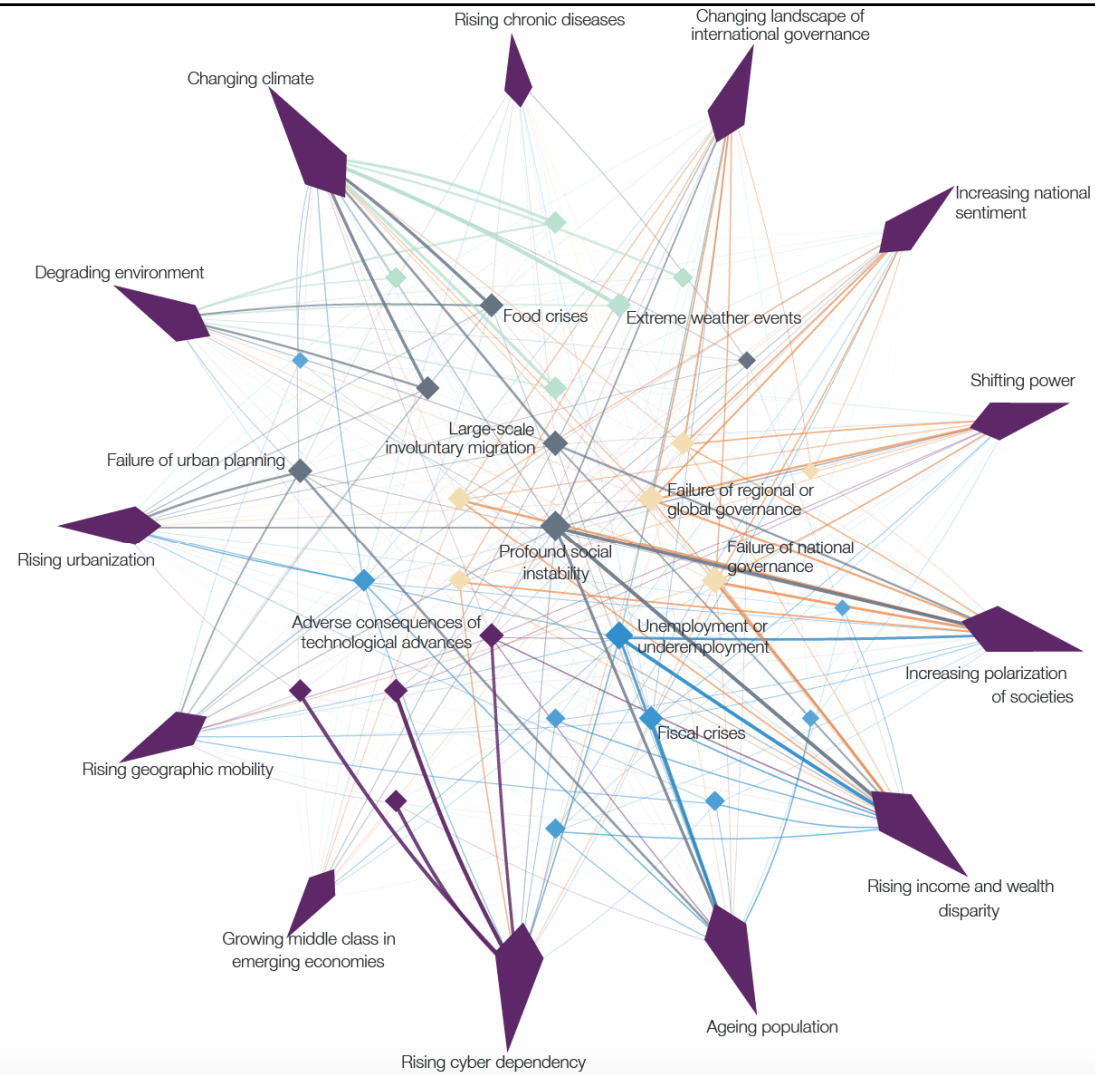
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Spatial Information Industry



Global Outlook 2018: Overview

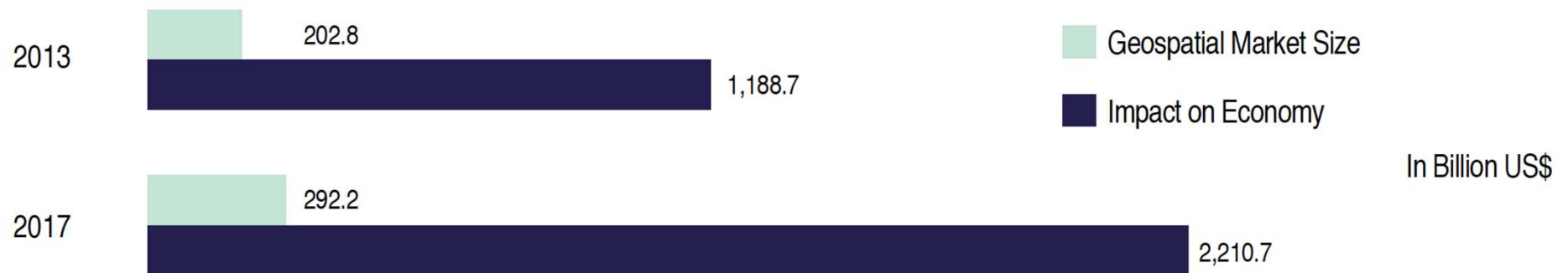




Source: World Economic Forum, The Global Risks Report 2018

Geospatial Market Size

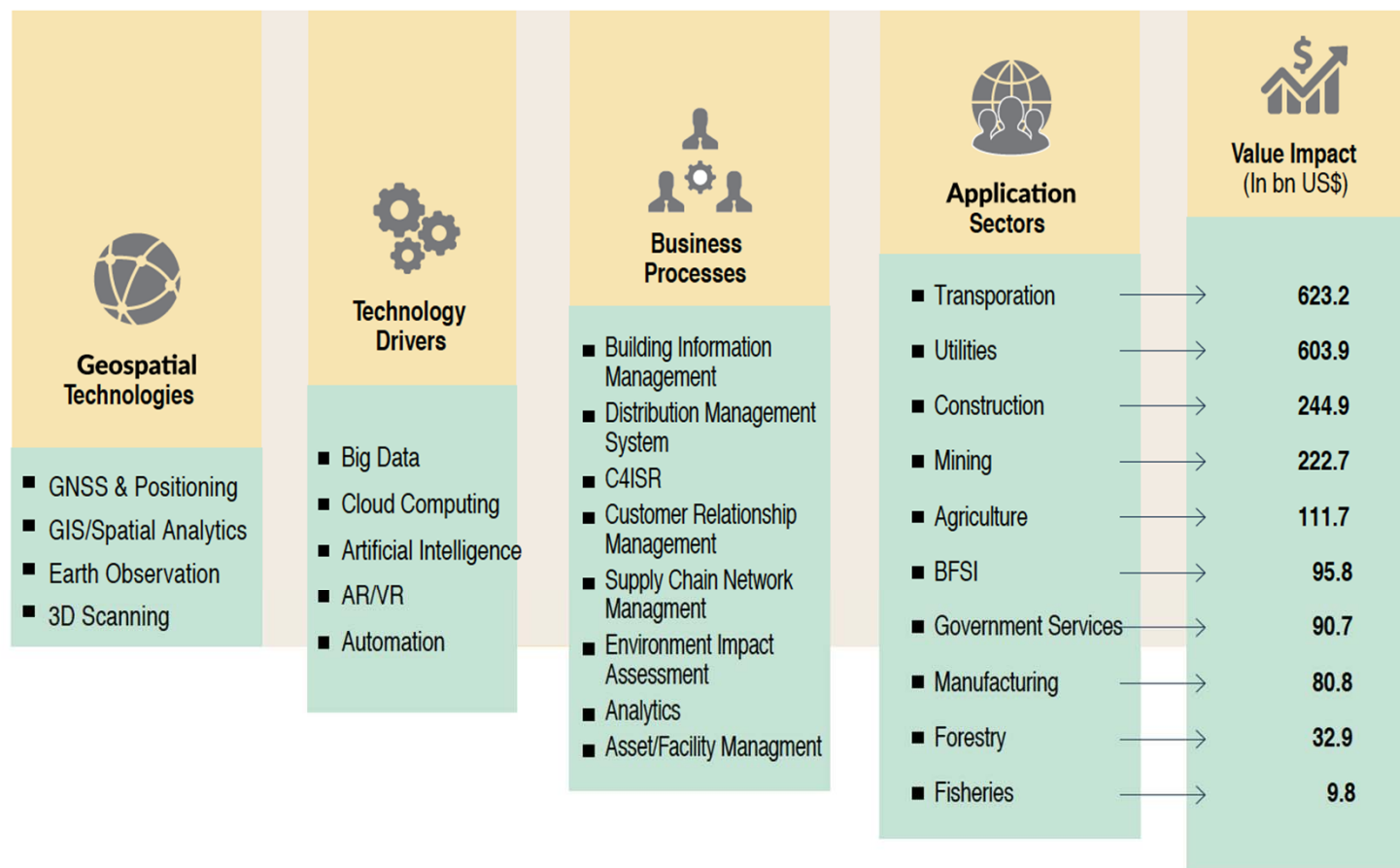
Trends in Impact of Geospatial Technologies



Adapted from Indecon International Economic Consultants, ACIL Tasman, BCG, AlphaBeta, Oxera, Natural Resources Canada and Geospatial Media Analysis

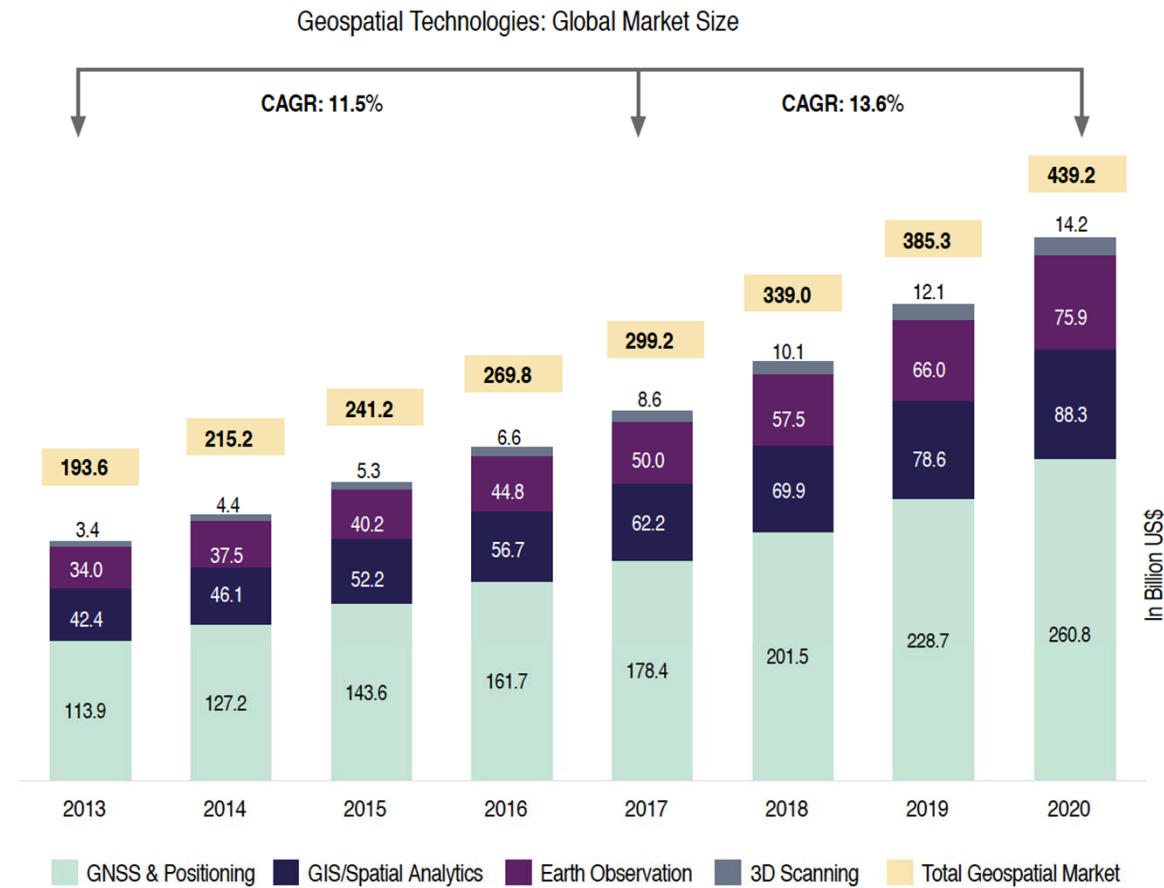
Source: Geospatial Media and Communications, "Geospatial Industry Outlook & Readiness Index," 26-Feb-2018. [Online].

Geospatial Technologies: Towards Creating High Value Impact



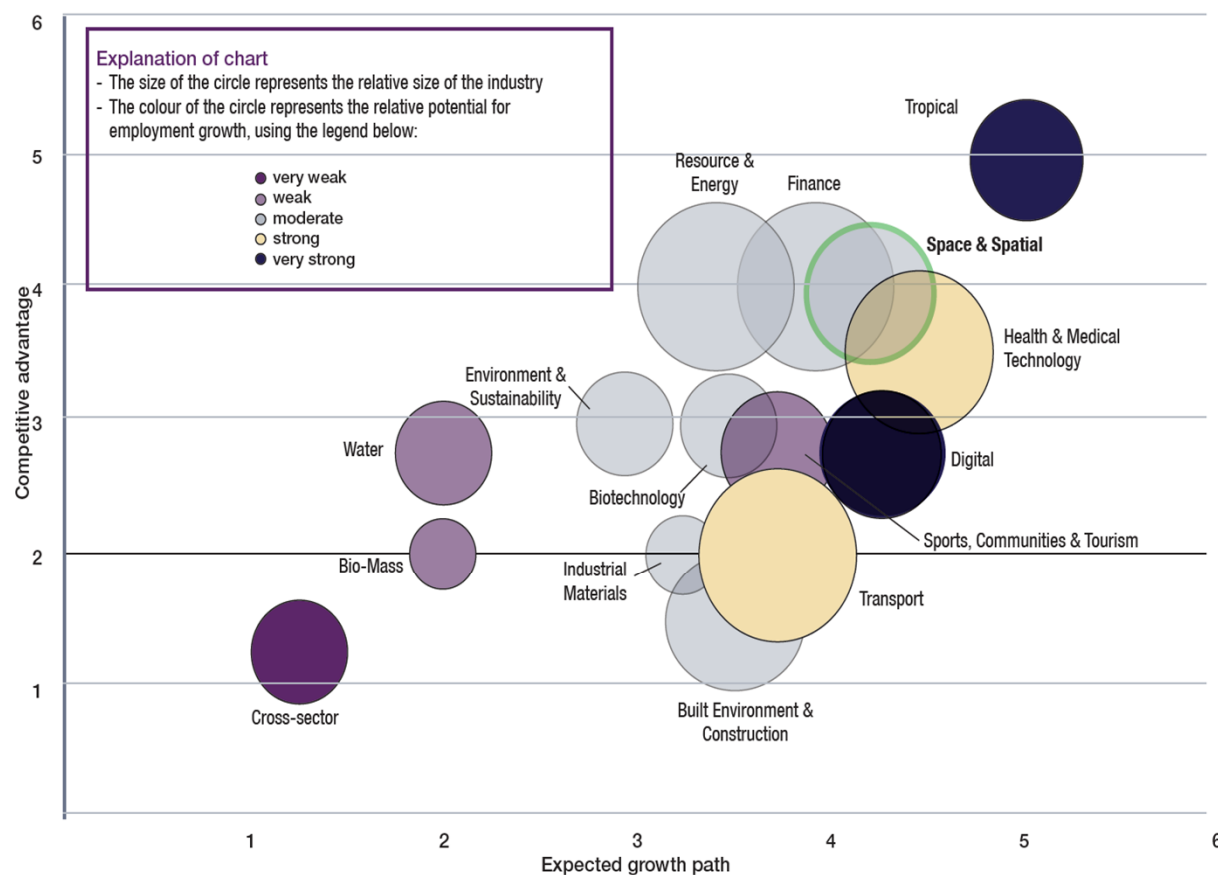
Source: Geospatial Media and Communications

Geospatial Market Size



Source: Adapted from Market Research Reports available in public domain (list available in the references section) and Geospatial Media Analysis

Expected growth and competitiveness by Australian industry sector



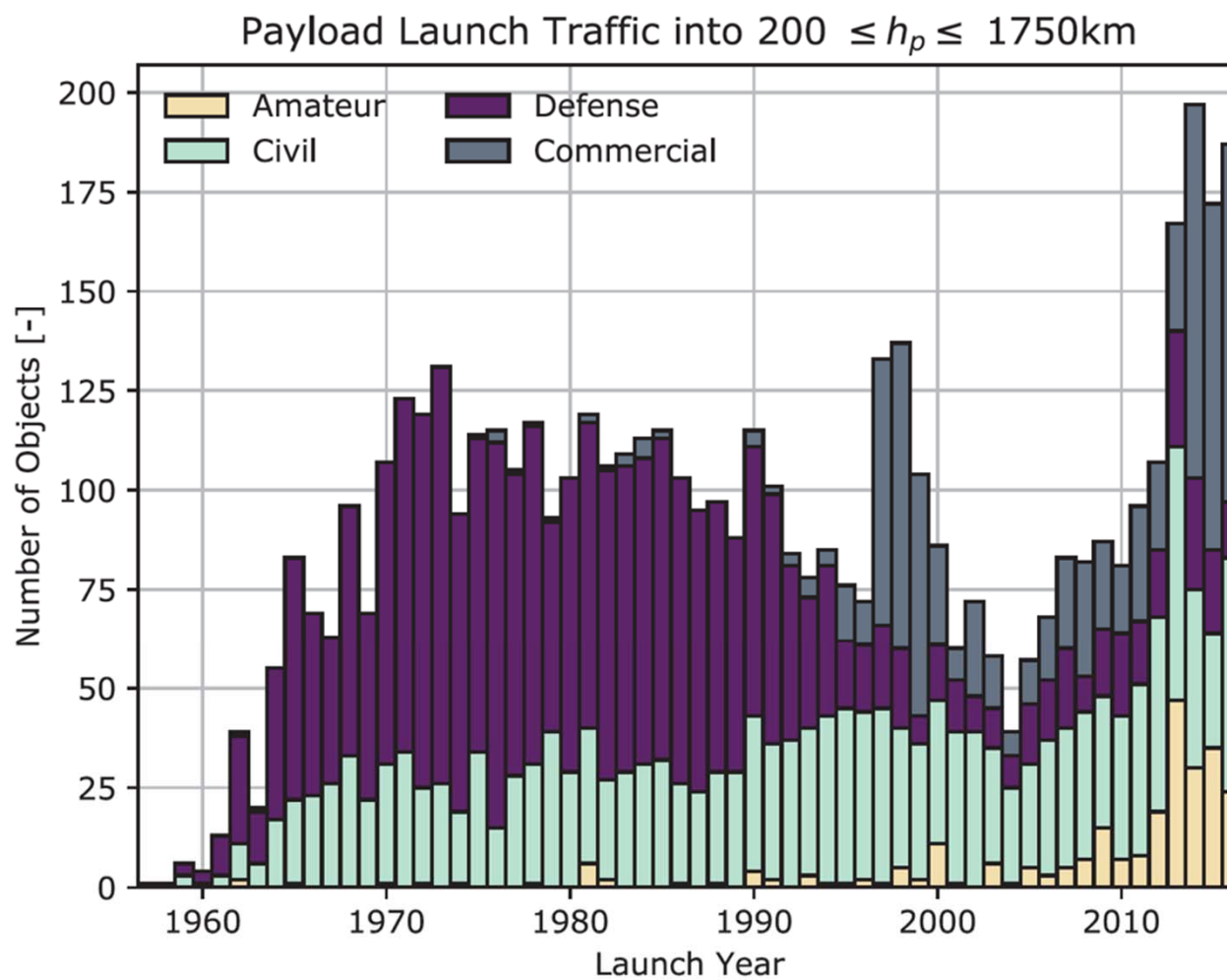
Source: PWC, 2013

Space Opportunities in the emerging Market



Markets	Examples	Growth Trend	Required Per Venture Investment	Barrier to Entry	Significant Current Activity in Australia?	Prime Australia Growth Opportunity?
Satellite Servicing	MDA/SSL, Orbital ATK	+	~\$500M+	High	N	
Suborbital Human Spaceflight	Virgin Galactic, Blue Origin	+	~\$1B+	High	N	
EO Smallsat Constellations	Planet, Spire Global	++	~\$100M+	Low	N	
EO-Driven Data Analytics	Orbital Insights, HexiGeo, GeoImage	++	~\$10M+	Low	Y	✓
Ubiquitous Global Broadband	OneWeb, SpaceX,	++	~\$3B+	High	N	
Commercial SSA	AGI, Schafer, EOS, US military infrastructure in Australia	+	~\$10M+	Medium	Y	✓
Dedicated Smallsat Launch	Vector, Virgin Orbit, Rocket Lab	+	~\$100M+	Medium	N	
Smallsat Manufacturing	Clyde, Pumpkin, Spaceflight Services	+	~\$1M+	Low	N	✓

Source: Bryce Space and Technology, 2017





EO Constellations

CONSTELLATION (Ownership)	LAUNCHES PRE - 2017	LAUNCHES 2017-2026	UNIT MASS (kg)	ESTIMATED UNIT COST (million)	CONST. SIZE (Max. units in-orbit)	ESTIMATED CONST. COST (million)	PRIME	LAUNCH PROVIDER
Terra Bella (Planet)	7	14	120	\$15	21	\$450	SSL / Skybox	Arianespace, Orbital, ISRO, TsSKB, Kosmotras
Planet	178	586	5	\$0.4	150+	\$500	Planet	ULA, Orbital, TsSKB Kosmotras, SpaceX, MHI, Rocket Lab
Aleph (Satellogic)	2	24	37	\$2	Up to 300	\$150	Satellogic	CGWIC
BlackSky	1	120	50	\$5	60	\$750	Spaceflight Industries	ISRO, SpaceX
UrtheDaily	-	8	340	\$27.5	8	\$220	SSTL	SpaceX
Worldview Legion	-	60	100 (est.)	\$13	60	\$780	MDA / SSL	-
Landmapper	2	30	10/20	\$2/\$3.5	30	\$90	Astro Digital	TsSKB
Iceye	-	21	50 (est.)	\$7	20	\$145	Iceye / York SS	Vector
Cicero (GeoOptics)	-	13	10	\$1.1	23	\$15	Tyvak	TsSKB/ISRO
PlanetIQ	-	12	20	\$4	12	\$50	Blue Canyon Tech	ISRO
Zhuhai-1	2	17	<55	\$2/\$3/\$4	19	\$50	CAST	CGWIC
AxelGlobe	-	13	80	\$8.5	60	\$110	Axelspace	-
HyperCube	-	12	5	\$0.6	12	\$7	Harris	-

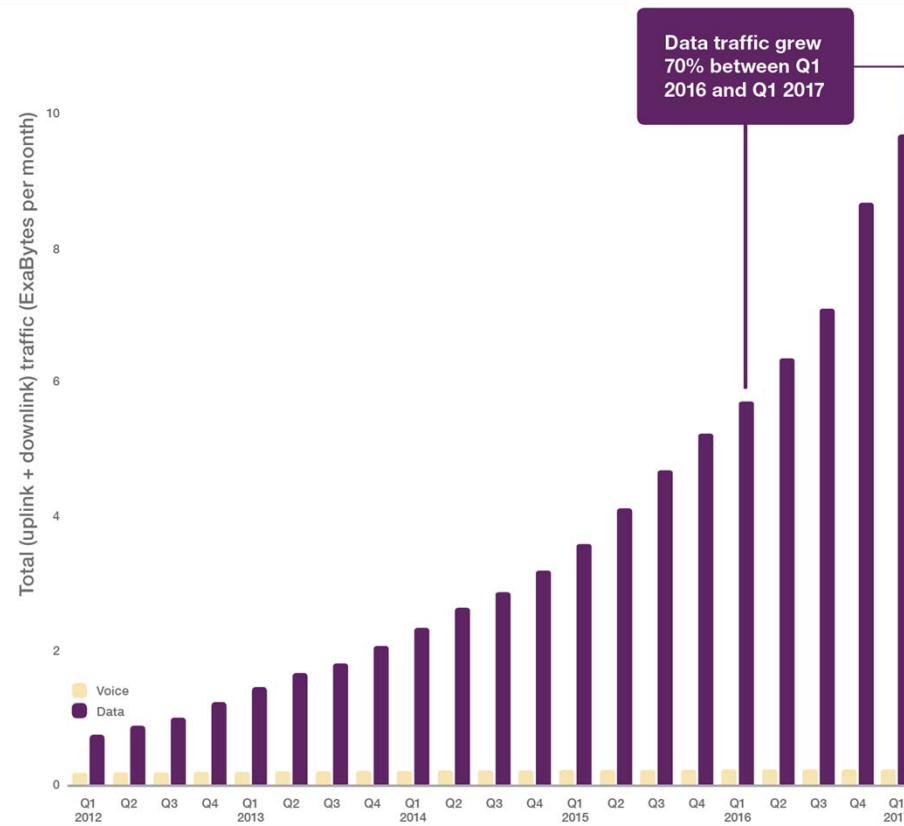
Source: Euroconsult, "Prospects for the Small Satellite Market," 2017

EO Constellations

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BlackSky	1	120	BlackSky	1	120	ies ISRO, SpaceX
UrtheDaily	-	8	UrtheDaily	-	8	SpaceX
Worldview Legion	-	60	Worldview Legion	-	60	-
Landmapper	2	30	Landmapper	2	30	TsSKB
Iceye	-	21	Iceye	-	21	Vector
Cicero (GeoOptics)	-	13	Cicero (GeoOptics)	-	13	TsSKB/ISRO
PlanetIQ	-	12	PlanetIQ	-	12	ch ISRO
Zhuhai-1	2	17				CGWIC
AxelGlobe	-	13				-
HyperCube	-	12				-

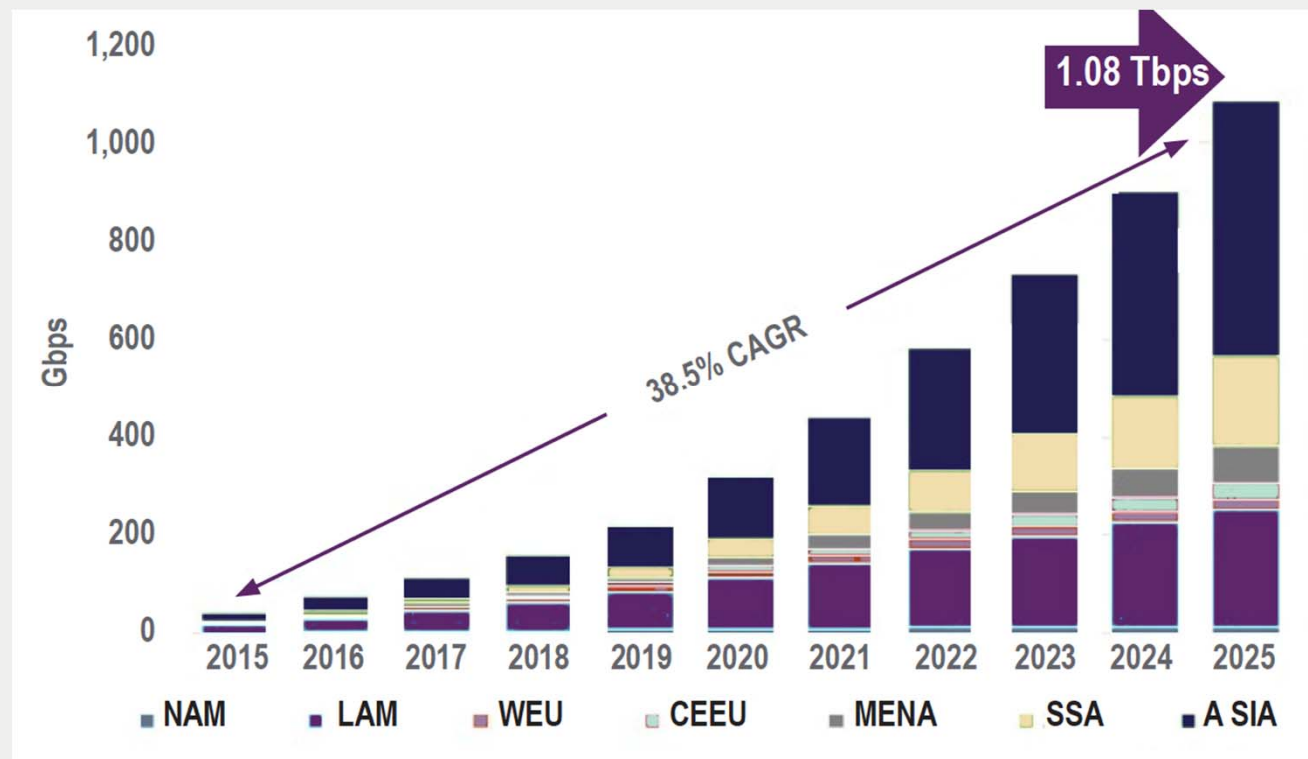
Source: Euroconsult, "Prospects for the Small Satellite Market," 2017

Communication Infrastructure



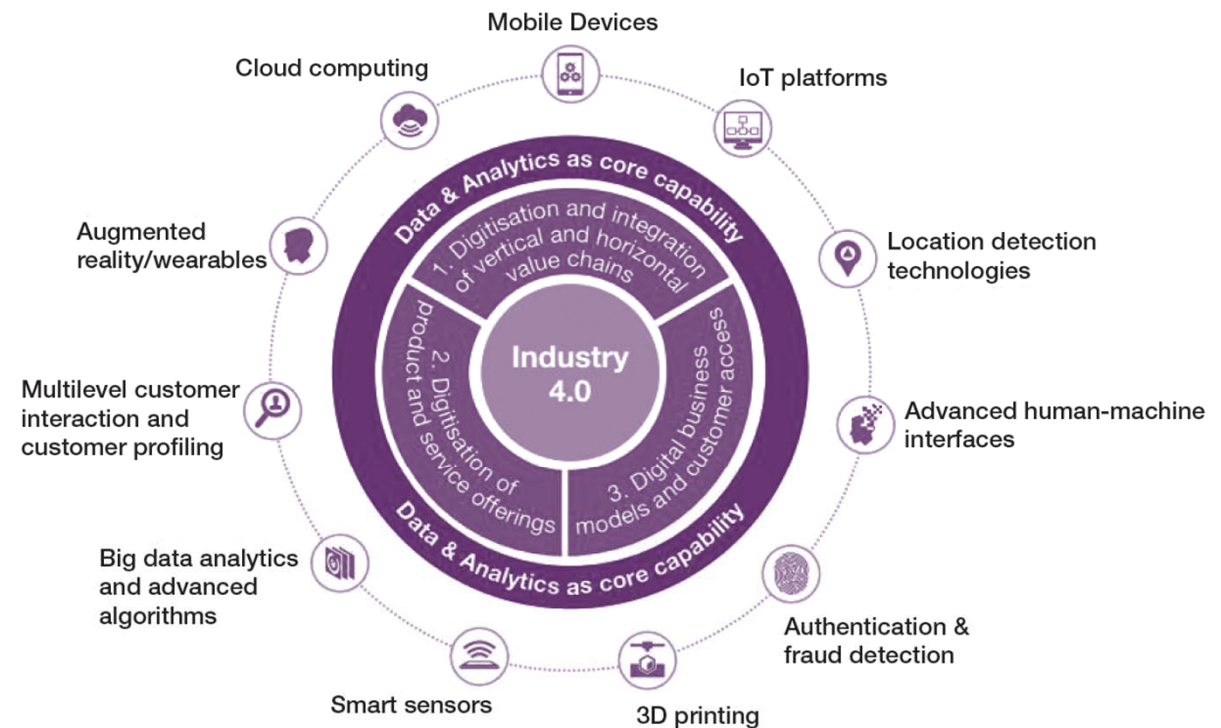
Source: Ericsson Mobility
Report June 2017

Communication Infrastructure



www.nsr.com/news-resources/the-bottom-line/capturing-the-terabit-backhaul-opportunity

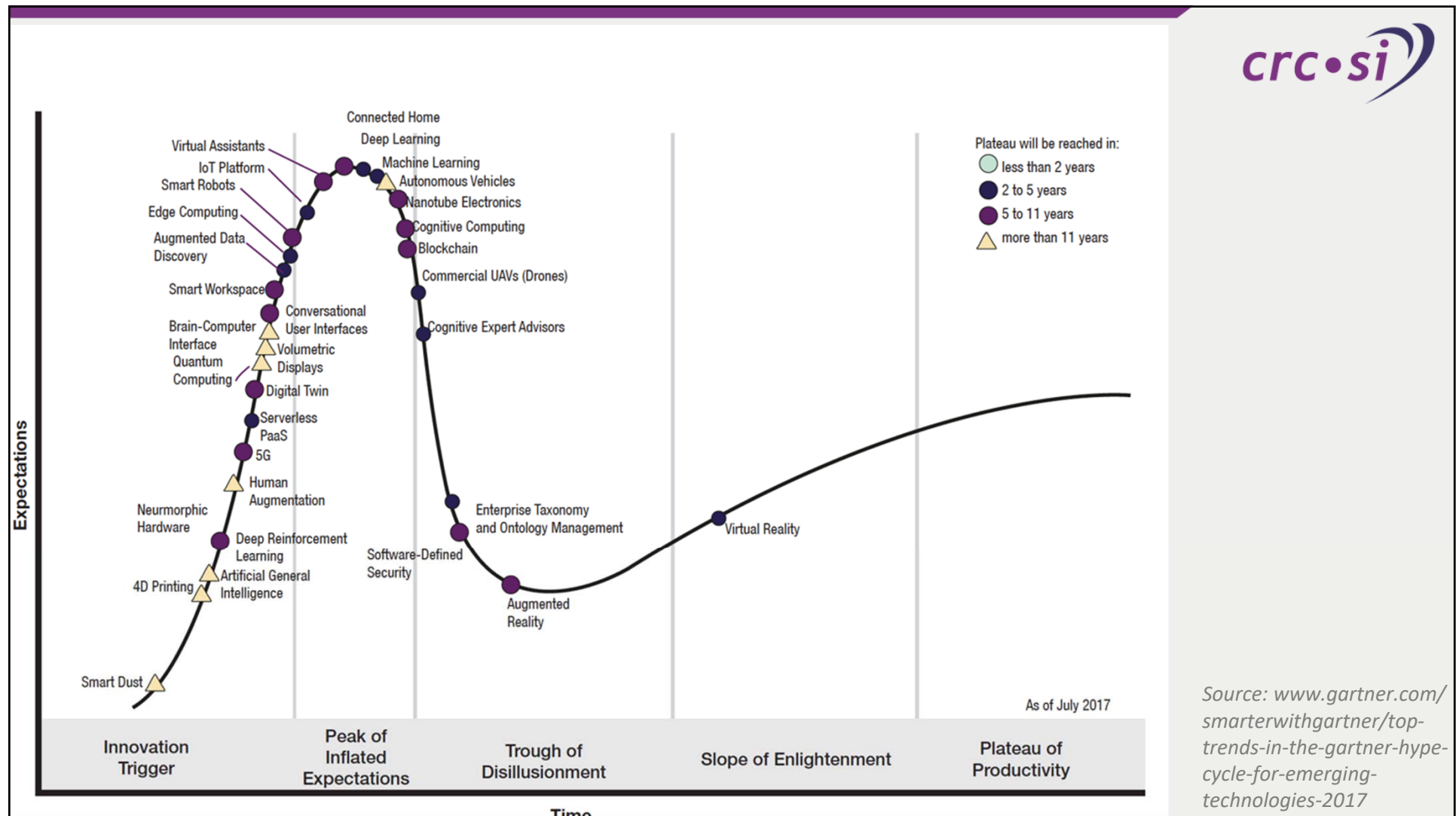
Disruptive Technologies



www.pwc.com/gx/en/industries/industries-4.0/landing-page/industry-4.0-building-your-digital-enterprise-april-2016.pdf

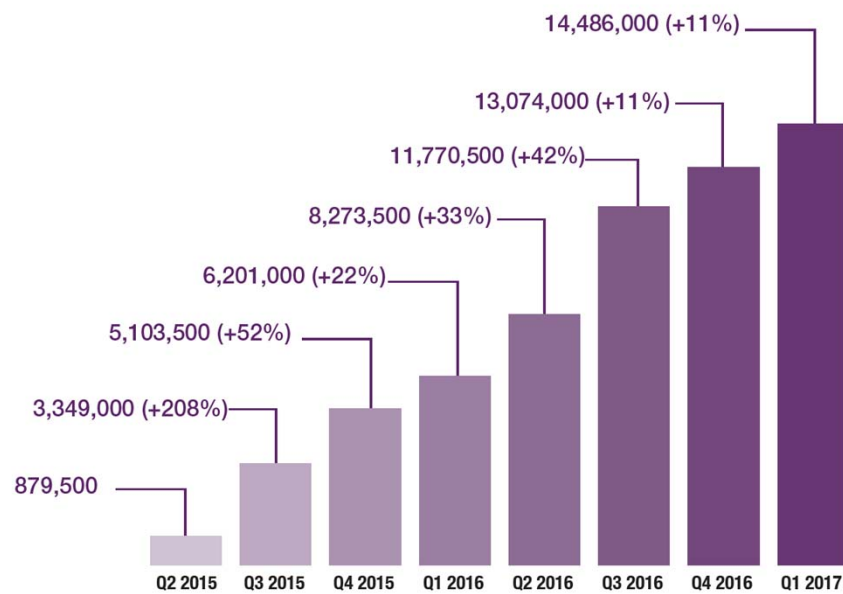
Drivers of Technology Acceleration

- Modular, **C**ommercial **O**ff-**T**he-**S**helf Components
- Miniaturisation
- Open Data and Platforms
- Standards
- Advances in Computing



Internet of Things

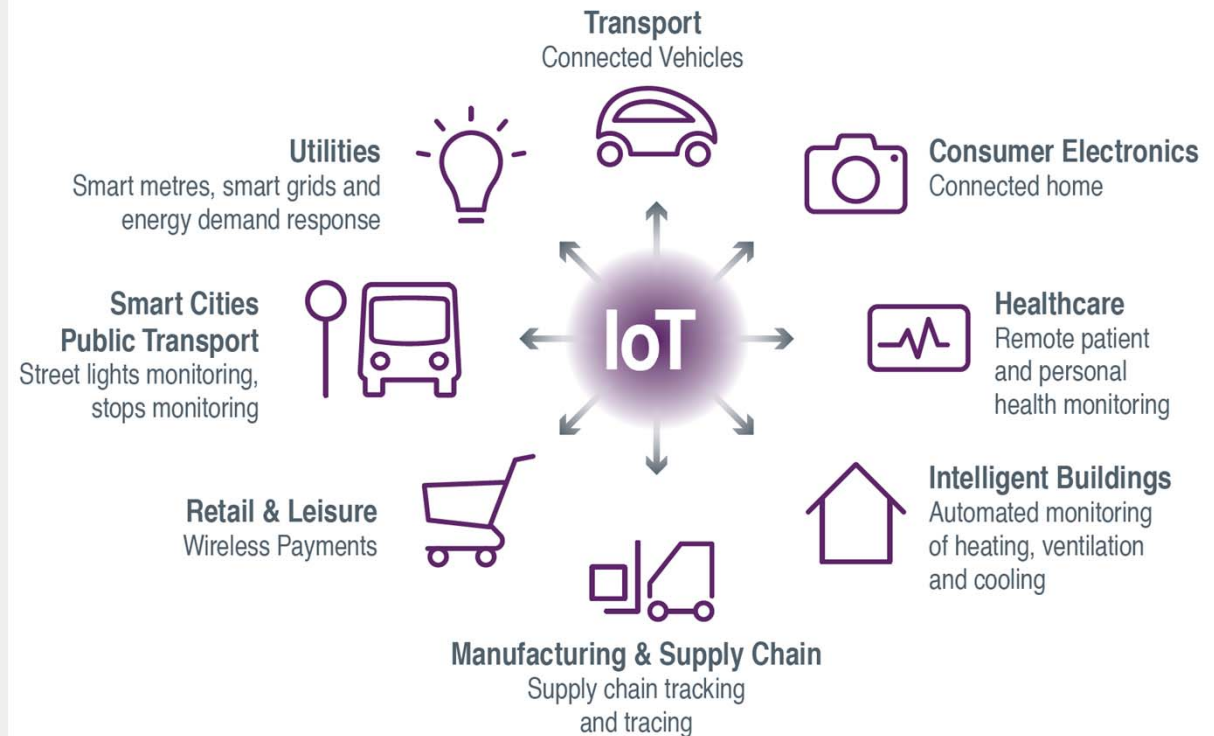
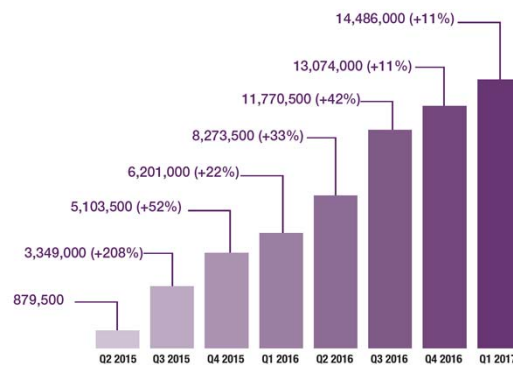
SENSORS DEPLOYED GLOBALLY



Source: Unacast, "Proximity Marketing in Retail," Apr-2017.

Internet of Things

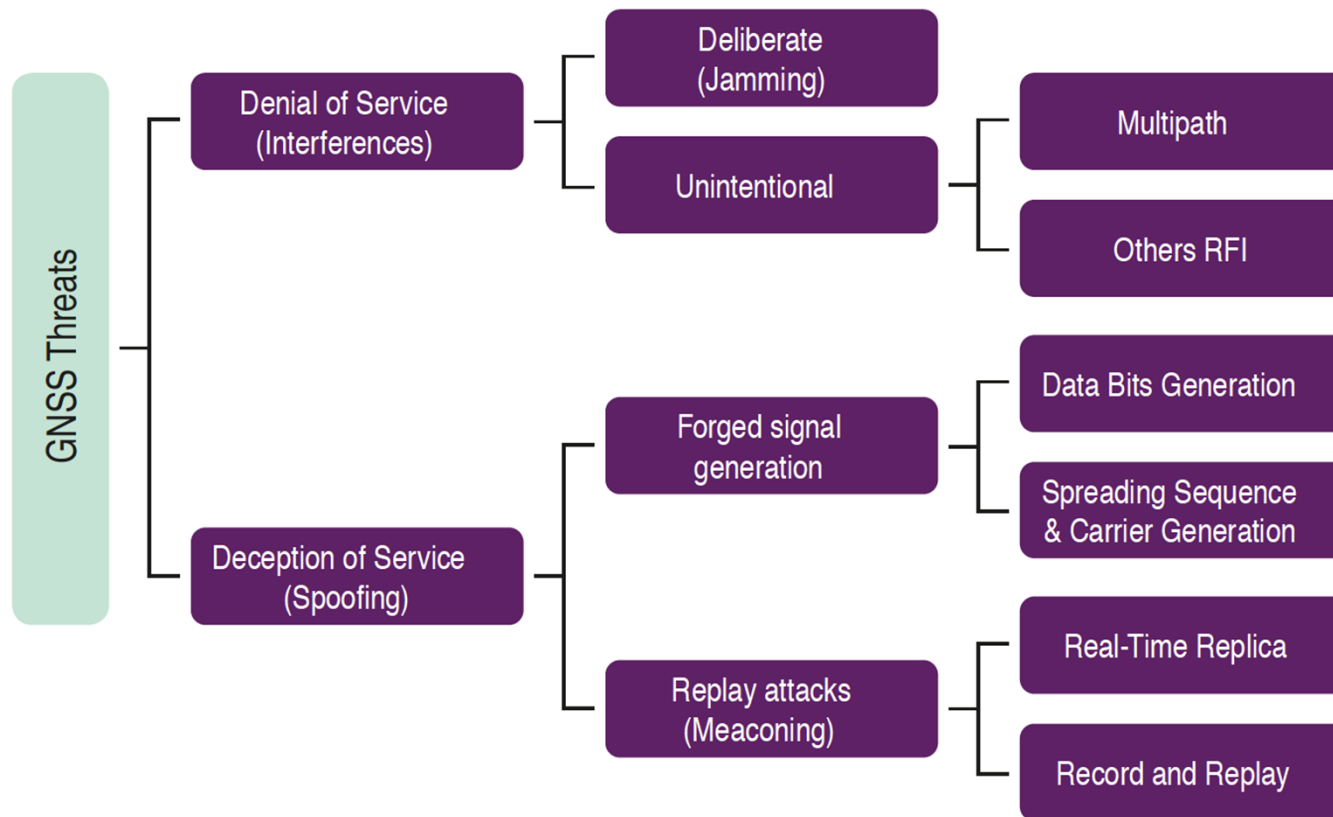
SENSORS DEPLOYED GLOBALLY



Cognitive Computing/ AI



A simplified taxonomy of man-made RF threats to GNSS



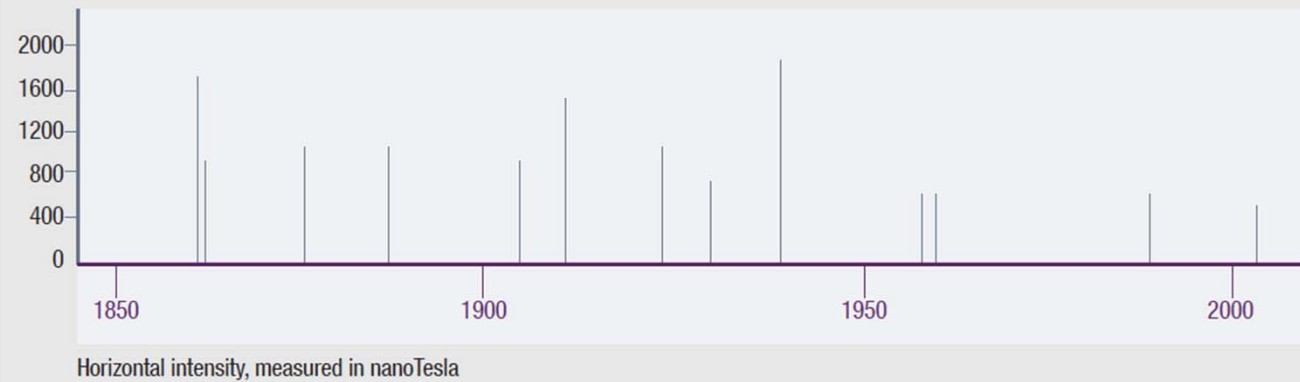
GNSS Disruption

GSA, "GNSS User Technology Report," 2016.

GNSS Disruption



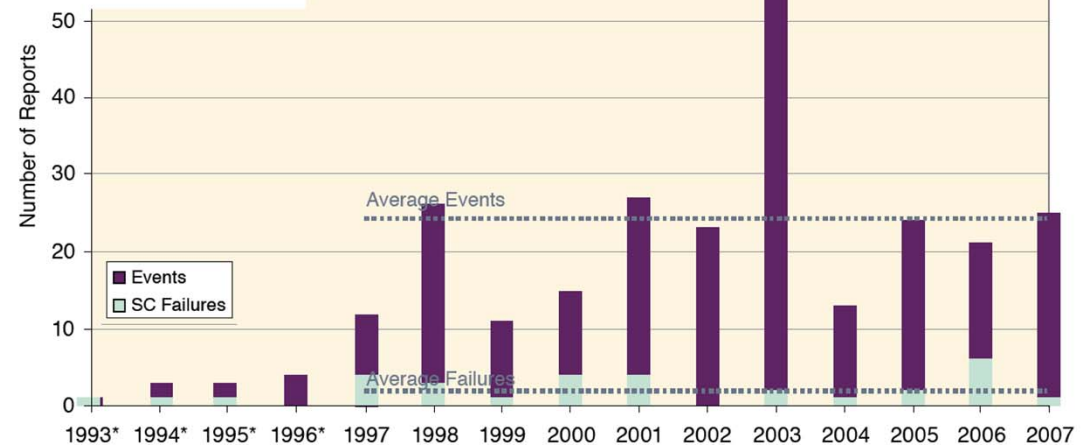
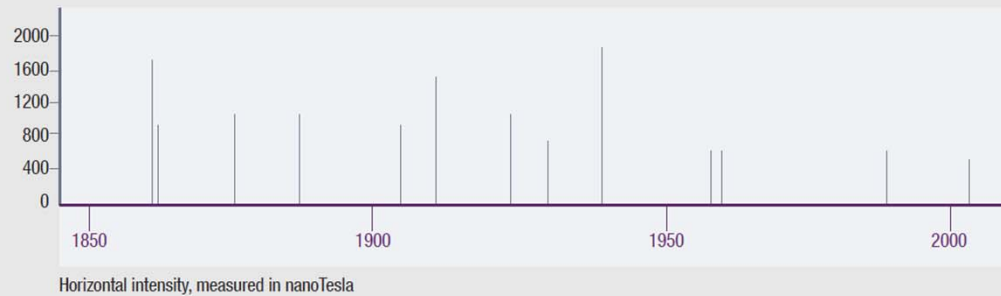
Large Geomagnetic Storms Since 1859



Centra Technology, "Geomagnetic Storms'," 24-Jan-2011

GNSS Disruption

Large Geomagnetic Storms Since 1859



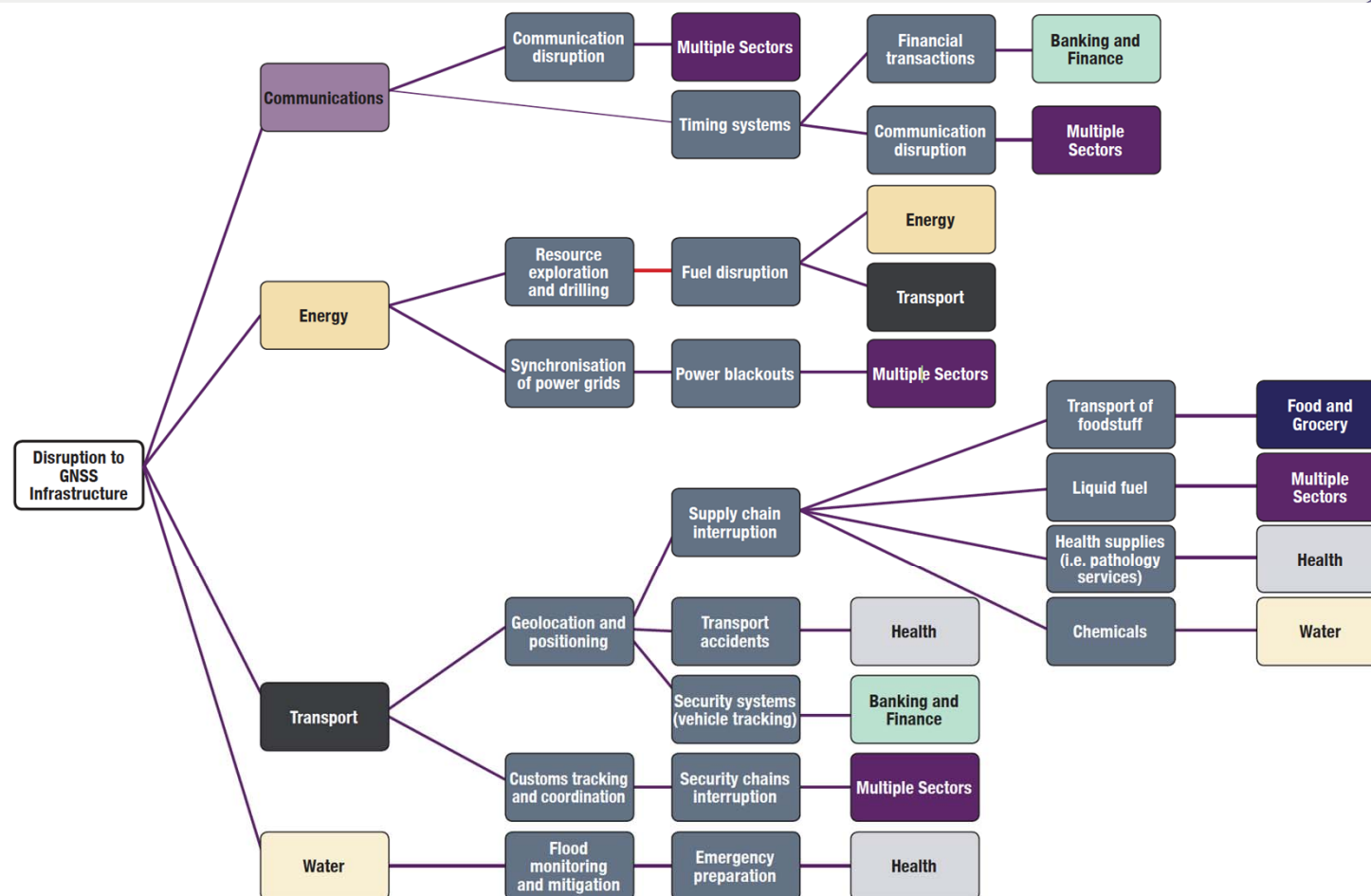
Average # of **events/yr** = 24.3

Average # of **failures/yr** = 2.5

Most events/failures are not attributed to space weather, but 46 of 70 in 2003 occurred during Halloween storms

Source: lasp.colorado.edu/home/wp-content/uploads/2011/07/lowres-Severe-Space-Weather-FINAL.pdf

GNSS Disruption (cont.)

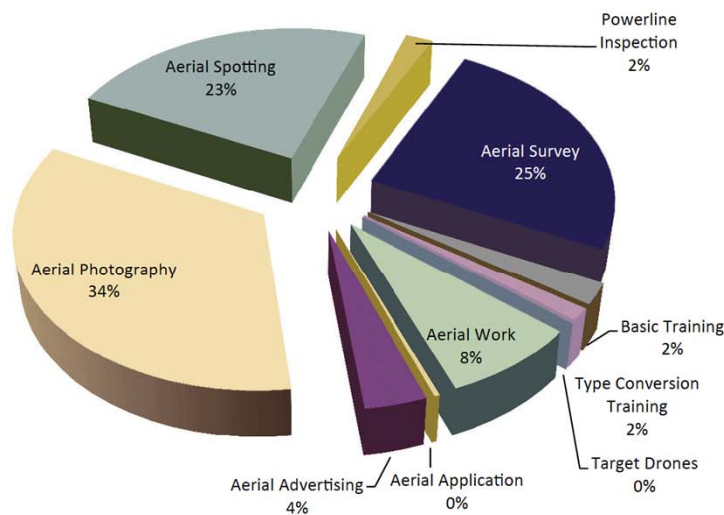


Source: K. Garred,
*"The Australian Government's
 Approach to Critical
 Infrastructure
 Resilience,"* 04-Dec-
 2013.

Privacy

- Risks to Privacy stand out as the most perceived downside in the rise of personal technology- WEF survey
- In Australia, in February 2018 the Privacy Amendment (Notifiable Data Breaches) Act 2017 commenced
- The EU's General Data Protection Regulation (GDPR) will come into effect in May 2018
- In 2017 the USA government voted to allow internet service provider companies to collect and sell web browsing, location and other personal details

Remotely Piloted Aerial Systems



Drone application uses registered with CASA

www.acuo.org.au/assets/docs/blog/ACUO-Submission-to-the-Senate-Standing-Committee-for-Rural-and-Regional-Affairs-and-Transport.pdf

CityAirbus

A multi-passenger, self-piloted electric vertical takeoff and landing (VTOL) demonstrator designed for urban air mobility with cost efficiency, high-volume production and a low environmental footprint in mind.

AUTONOMY

15 minutes

ENGINES

- 8 fixed pitch propellers powered by direct drive engines
- 8 x 100 kW electric motors

SIZE

Compact size for ideal integration into urban landscapes

BATTERIES

- 140 kW power x 4 batteries
- 110 kW energy in all 4 batteries

Ducted high lift propulsion units designed for efficiency, low acoustic footprint and safety

CAPACITY

Transports up to 4 passengers

Avionics and autopilot built for optimised urban air traffic management

CRUISE SPEED

120 km/h

Making CityAirbus a reality

2015	2016	2017	2018	2023
				
Feasibility study Study confirms that CityAirbus will meet operating cost targets and safety requirements to be certified for public use	Full scale component testing Key technologies demonstrated at full size	Flight testing with small scale drone Control algorithms and flight mechanics developed	Demonstrator team created Collaborative team of highly dynamic and experienced engineers set up	Full size demonstrator Full-scale in-flight demonstration and verification of a full electric, RPM-controlled multi-propeller vertical takeoff and landing (VTOL)
				CityAirbus takes to the sky Fully certified CityAirbus becomes part of public urban transport mix, in conjunction with upgraded urban air traffic management

Benefits of adding the third dimension to urban transport networks

1 URBAN DEVELOPMENT	2 HIGHER SPEED AND RANGE	3 ENVIRONMENTAL FOOTPRINT
		
The third dimension increases the geographic accessibility to remote and underserved areas of the city	Self-piloted flying vehicles can operate at three times the speed of the average road vehicle and extend commuters' geographical reach by tenfold	Self-piloted flying vehicles are fuelled by electricity and are energy efficient

AIRBUS

techcrunch.com/2017/10/05/airbus-on-track-to-fly-its-electric-aerial-taxi-in-2018/

Findings

PWC notes that the fourth wave of the industrial revolution comprises many digital technologies

- mobile devices
- cloud computing
- augmented reality
- wearable technologies
- multilevel customer interaction and profiling
- big data analytics and advanced algorithms
- smart sensors
- 3D printing
- authentication and fraud detection
- advanced human-machine interfaces
- Internet of Things platforms
- block chains
- drones
- robots
- location-detection technologies

Can add: Artificial Intelligence, autonomous vehicles, cyber threats, advanced sensor technologies, space and satellite developments synchronised micro, nano and cube sat constellations)

Findings (cont.)

- In the next decade we will have positioning and location capabilities that are precise, and 'always on', and data used in real-time applications
- Spatial analytics capabilities will enable insights (predictive) and be shifting us towards being a smart society and dealing with issues in a proactive rather than reactive manner
- Once privacy concerns and safeguards against potential dangers are dealt with, the transformative capabilities will be enhanced

Findings (cont.)

Market Growth

- Global Geospatial market (comprising GNSS, GIS, EO, 3D Scanning) growing from USD \$339 billion (2018) to USD \$439.2 billion by 2020. [Geospatial Media]
- Allied markets are growing
 - The indoor Location Based Services market is estimated to grow over 43% between 2016 and 2020, reaching Euro 7.7 billion by 2020
 - In 2017, the Artificial Intelligence (AI) market was thought to be worth USD \$16.06 billion, with a compound annual growth rate of 36% from 2018 to 2025 (MarketsandMarkets).

More Satellites and devices

- Number of functional satellites in all classes is around 1738 of which 803 are from the US, 204 are Chinese, and 142 are Russian (as reported August 2017 by UCS).
- When all satellites (communications, positioning, earth observations) are taken into account, it has been estimated that there will be up to 6200 smallsat's launched up to 2026 worth over USD \$30 billion (Euroconsult).
- There are 5.8 million devices with GNSS receivers, and this number is expected to grow to 8 billion by 2020 (European GNSS Agency).

Thank you! gkernich@crcsi.com.au

Global Outlook Reports Spatial Information Industry

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