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Space 2.0 — The next world revolution

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Abstract

Will the world make SPACE for Australia, or will Australia make its own SPACE in the world?

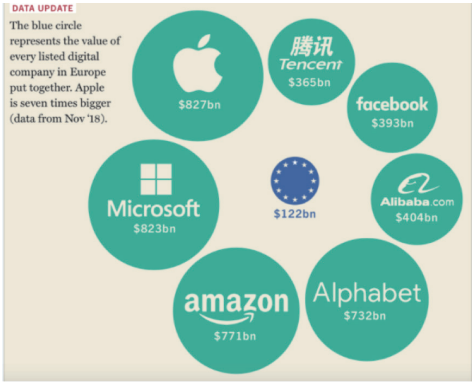
Introduction

We have already embarked on the next world revolution. We are about to witness the biggest technology revolution since electricity was introduced. For Space 1.0 over the past 62 years has all been about "up there," whether that be satellites, humans, or exploration. We have now entered Space 2.0 — Space "down here." It will totally revolutionise the way we live, communicate, and feed ourselves.

The question therefore is will Australia punch above its weight and prosper by this revolution, or will it fall behind and have the new capabilities thrust upon it?

Setting the scene

The world is changing fast. Not only is the world going digital, but just look at which companies are dominating the digital age.



Just ten years ago, only one of these companies, Microsoft, ranked in the top five of the NYSE.

And this total flip is mirrored in the funding for space. For whereas over 80% of funding for space came for governments previously, this has now totally flipped so that over 80% of funding for space now comes from the private sector.

And these changes are related as the biggest companies in the world now realise that they can make billions in "space down here."

Developing the theme

For we are seeing a confluence of new technologies, a time when many new technologies are maturing simultaneously, and it is this conjunction and integration that will change the world.

These technologies are, in no particular order, nanosatellites, very smart and small sensors, remote sensing, artificial intelligence, robotics and drones, IoT, apps, and the Cloud and big data — huge amounts of data!

And around the corner there is the awe-inspiring capability of quantum computing.

The onset of the revolution

Within 5 years there will be 100s of thousands of small satellites in low-Earth orbit all involved with things down here.

If you think that is far fetched, Elon Musk has already got certification to launch over 11,000 satellites in the next year or so.

And he has recently (Oct 2019) submitted application for 30,000 more Starlink satellites.

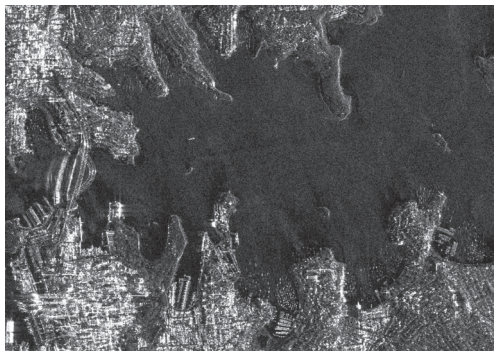
It will change the face of agriculture, mining, and the way we live.

This is indeed a revolution. The United Nations Office for Outer Space Affairs said in 2019 that approximately 8,500 satellites, probes, landers, crewed spacecraft, cargo craft and space station flight elements have been launched into Earth orbit or beyond since 1957, when Sputnik launched. If SpaceX launches 30,000 Starlink satellites in addition to the over 11,000 it already planned, the company will by itself be responsible for about a fivefold increase in the number of spacecraft launched by humanity.

The outcome from the revolution

Think back to the onset of the smartphone revolution and how that changed the world. The first Apple smartphone was introduced on 29th June 2007. And look what's happened since.

So we can look on the onset of 100s of thousands of small satellites as a mesh network of extremely smart smartphones in low-Earth orbit, communicating with each other (probably with laser comms) and equipped with smart sensors that can measure almost anything — day and night.



As an example, here is a SAR image of the Sydney Harbour Bridge, at night, from a single satellite[1].

Just think of the resolution that could be achieved by a phased array of such satellites constituting a huge aperture antenna in space.

General applications

This mesh network of nanosatellites will be the smartphone revolution on steroids — it will be at least 100 times more powerful than the Internet.

Backed by artificial intelligence, deep learning, and data analytics, they will drive the Internet of Things, complete global communications to all corners of the world, and will be the command and control network for robotics down here on Earth: driverless cars will just be a small manifestation of this connectivity.

Specific applications

The Australian farmer of the future will, over breakfast at the kitchen table, download the survey of the farm from space taken the previous day with specific smart sensors, look at the analysis that has been done overnight, check the actions to be taken that day based

1 https://www.sstl.co.uk/media-hub/latest-news/2018/sstl-releases-first-images-from-s-band-synthetic-a

on the analysis, and at a tap of their smart watch, send those instructions to their farm robots, whether they be drones for spraying, tractors for ploughing, or ground robots for picking fruit.

As an example of different farming benefits:

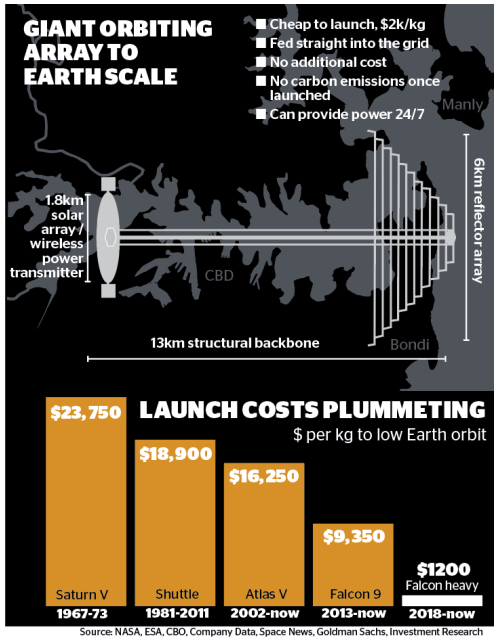
- Broad-acre crops — monitoring plant health & informing precision watering & fertilizers
- Livestock — tracking & monitoring livestock (using sensors on each animal) to locate and also identify indicators of animal stress/pregnancy based on their behaviour
- Water resource monitoring (as outlined by the Farmers Federation)
- Aquaculture — farm site selection, detection of algal blooms, and environmental health

And governments will be able to measure and understand water resources, respond to disasters more quickly, and plan smart infrastructure for the future[2].

This same step-function increase in productivity, efficiency, and environmental protection will be seen across most if not all industries, including mining, transportation, construction, telecommunications, as well as public administration and national security.

Big ideas

What about abundant cheap power? Perhaps a space-based solar power station? This is not as far into the future as one might think. A US-Australia joint venture called Solar Space Technologies (SST) has drawn up an extensive plan to build an orbiting solar-power-generated satellite network that could be operational in eight years[3].



Or even a large solar farm on earth. It does not need to be that big — a solar farm *half* the size of South Australia would provide enough power for *all the world's power needs*.

And with abundant cheap power we could solve our water needs. We have an excess of water — it just falls in the wrong places. With abundant cheap power it can be piped or channelled to wherever you want it, or you can build and operate desal plants and pump water from the coast to wherever it's needed without having to make compromises between environmental, agricultural and town water needs. Indeed energy storage would not even be needed for the pumping, as it would not have to run 24/7.

2 https://www.abc.net.au/news/rural/2019-10-30/farmers-look-to-the-stars-for-crop-monitoring/11648496

3 https://www.theage.com.au/world/north-america/australia-leans-into-space-race-for-solar-power-with-china-20190920-p52ta4.htm

So where stands Australia?

Just about every nation on earth will be launching nanosatellites. Indeed Uber Space is already with us, with an entrepreneur providing a "Trivago-type" web interface where you can shop for a launch.

But the real money will be made with those companies that can invent smart sensors, and more particularly design specific artificial intelligence apps to capitalise on such sensors.

This is the big opportunity for Australia. For we have very smart people and, with the 'tyranny of distance' removed, we can use our smarts to be a big player in this new world.

We have a unique opportunity over the next five years to drag ourselves up from near the bottom of OECD to near the top in terms of commercialisation of these new technologies.

Cyber and resilience

But there is an Achilles heel in all this. By having this uber-connectivity we are building a system that is extremely vulnerable — vulnerable to a cyber attack that will use the connectivity to propagate itself throughout the network.

We need to look at nature and how it is resilient.

The answer is to build diversity into the ecosystem, a diversity that uses natural selection to insulate itself against attack.

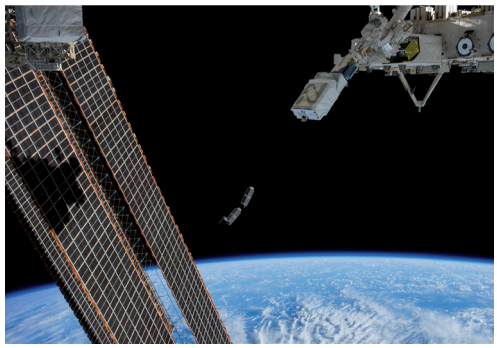
This is possibly the greatest challenge in getting artificial intelligence to work for us positively and to make us resilient against the many manifestations of cyber incursions.

But by having 100s of thousands of nanosatellites in orbit we are in fact building in physical resilience, for they are easily reconstituted and upgraded. And the mesh network of nanosatellites could be reconfigured automatically if it lost a portion of the network.

And using laser comms throughout the mesh network will not only provide much more security, but it will offer some 50 times the bandwidth of modern communications.

Jobs for the future

So the tradies of tomorrow are software developers, coders and app writers, cyber warriors and artificial intelligence gurus. We need to foster these skills in universities and the TAFE so that we can make our own SPACE in the world, and not allow other nations to make SPACE for us. It is simply a matter of economic survival for Australia. Only in this way can we reach the target set for us by the Australian Space Agency of tripling the national GDP space contribution to $12 billion and creating up to 20,000 jobs, all by 2030.



Nanosatellite launch from the International Space Station — it can't get any easier than that. (Credit: NASA)