Satellite Navigation Technology Past, Present, Future

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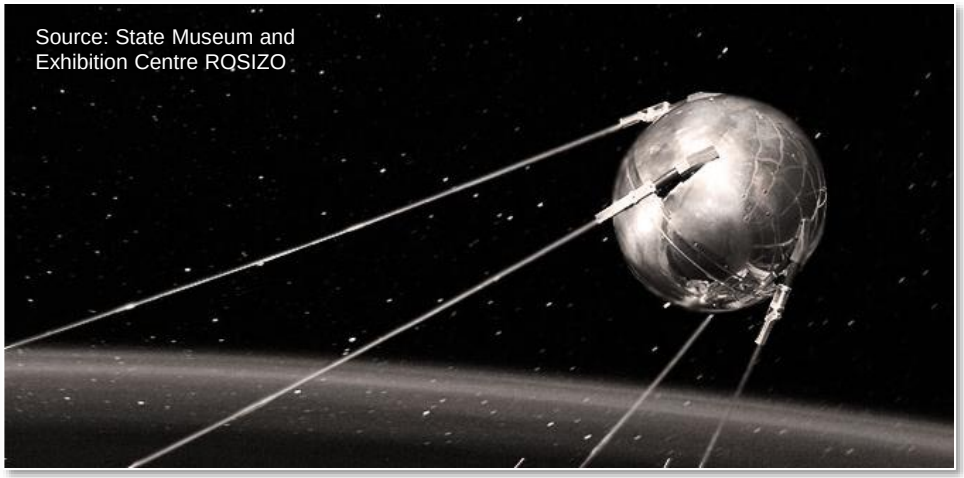
Space race in the 1950s



4 Oct 1957

The world's first satellite - Sputnik I

1950s	1960s	1970s	1980s	1990s	2000s	2010s

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Satellite navigation in the 1960s

13 April 1960

The U.S. Navy navigation satellite system (Transit) first experimental satellite successful

July 1964

Transit released for commercial use

1950s	1960s	1970s	1980s	1990s	2000s	2010s

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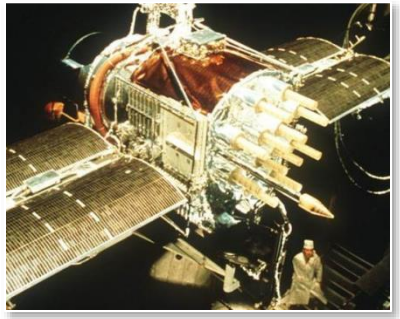
Satellite navigation in the 1970s – 1980s



1975

First concept validation GPS Navigator, the GPS X-Set

1978 - 1985

GPS Block I satellites launches

1984

Commercial 5 channel GPS navigator

1950s	1960s	1970s	1980s	1990s	2000s	2010s

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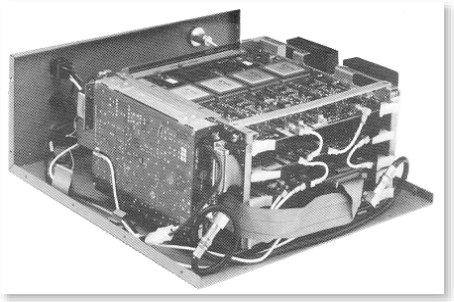
Satellite navigation in the 1990s

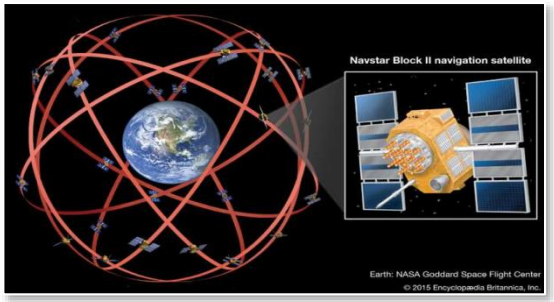


1990

GPS and Russia's GLONASS navigator

26 Dec 1991

Dissolution of the Soviet Union enacted



4 April 1991

Selective Availability (S/A) turned on

27 April 1995

GPS reached full operational capability

1950s	1960s	1970s	1980s	1990s	2000s	2010s

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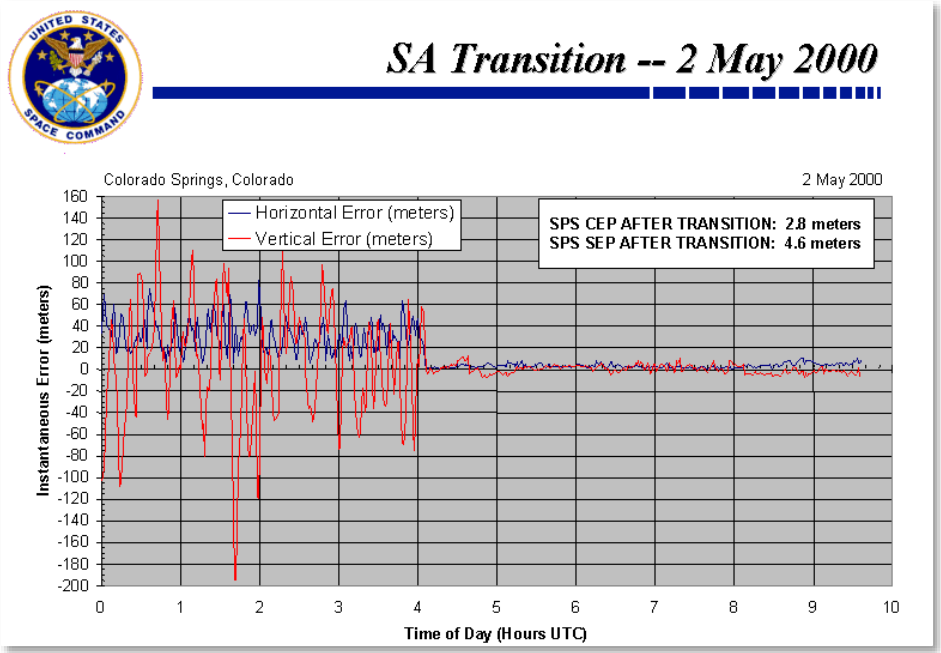
Satellite navigation in the 2000s



1 May 2000

S/A turned off
(new GPS blocks IIR launches)

26 May 2002

EU's Galileo approved (others in planning)

1950s	1960s	1970s	1980s	1990s	2000s	2010s

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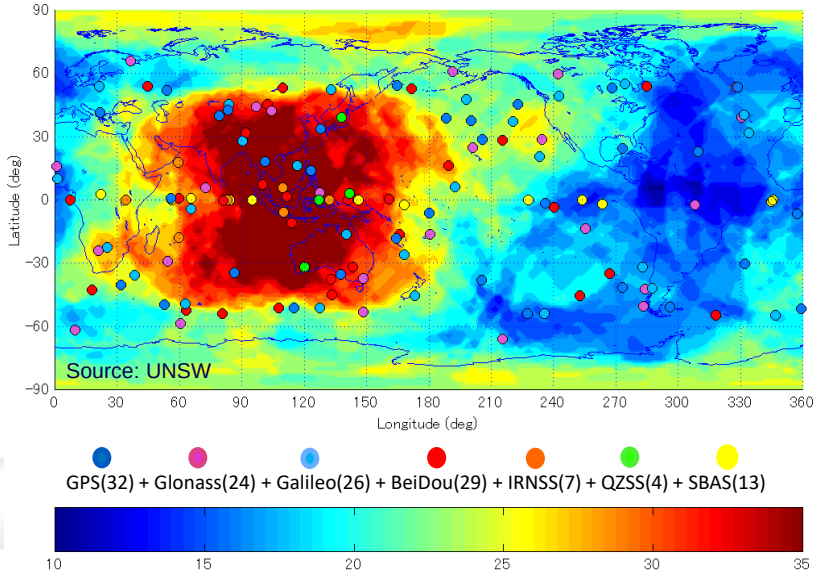
Satellite navigation in the 2010s

Multi Constellation GNSS



GNSS Golden Era

Over 100 GNSS (GPS, GLONASS, Galileo, BeiDou, QZSS etc) satellites today!

Much better availability, accuracy, integrity

1950s	1960s	1970s	1980s	1990s	2000s	2010s

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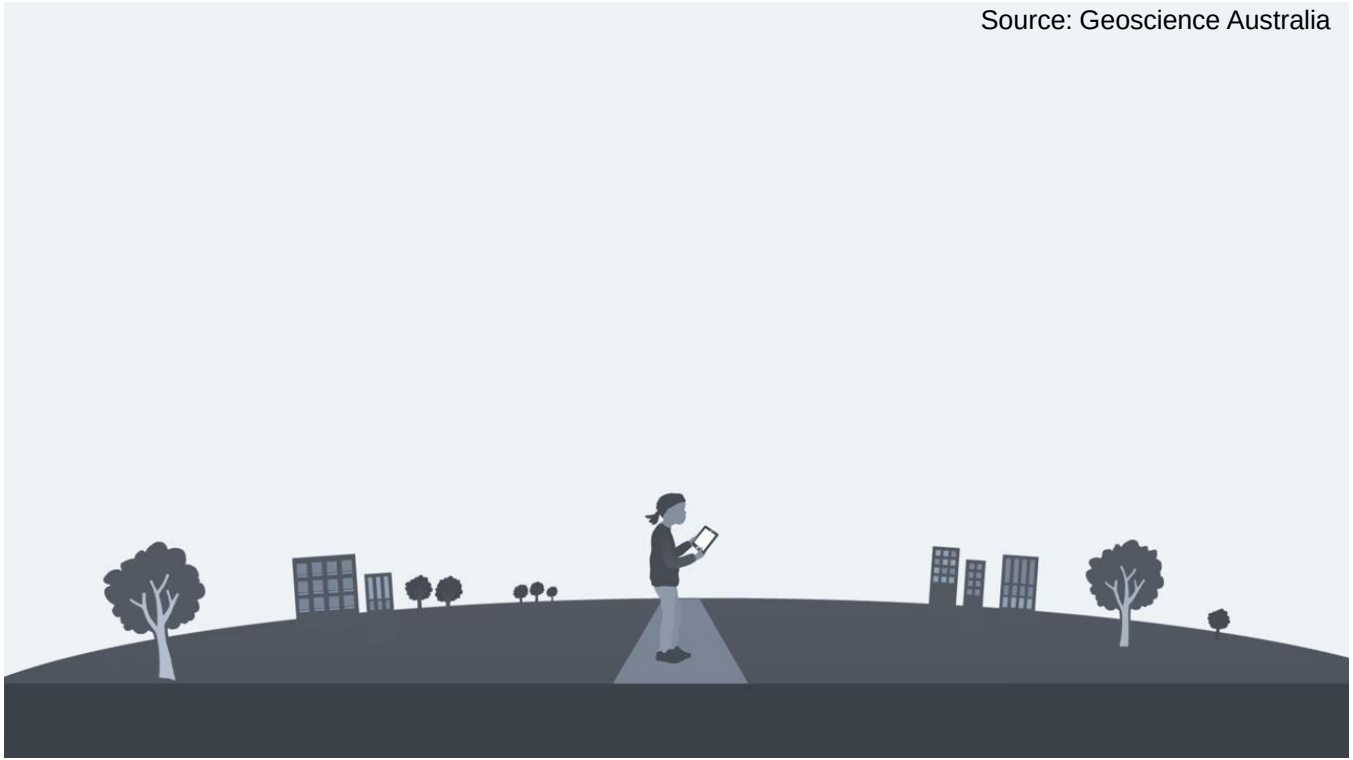
Where am I?



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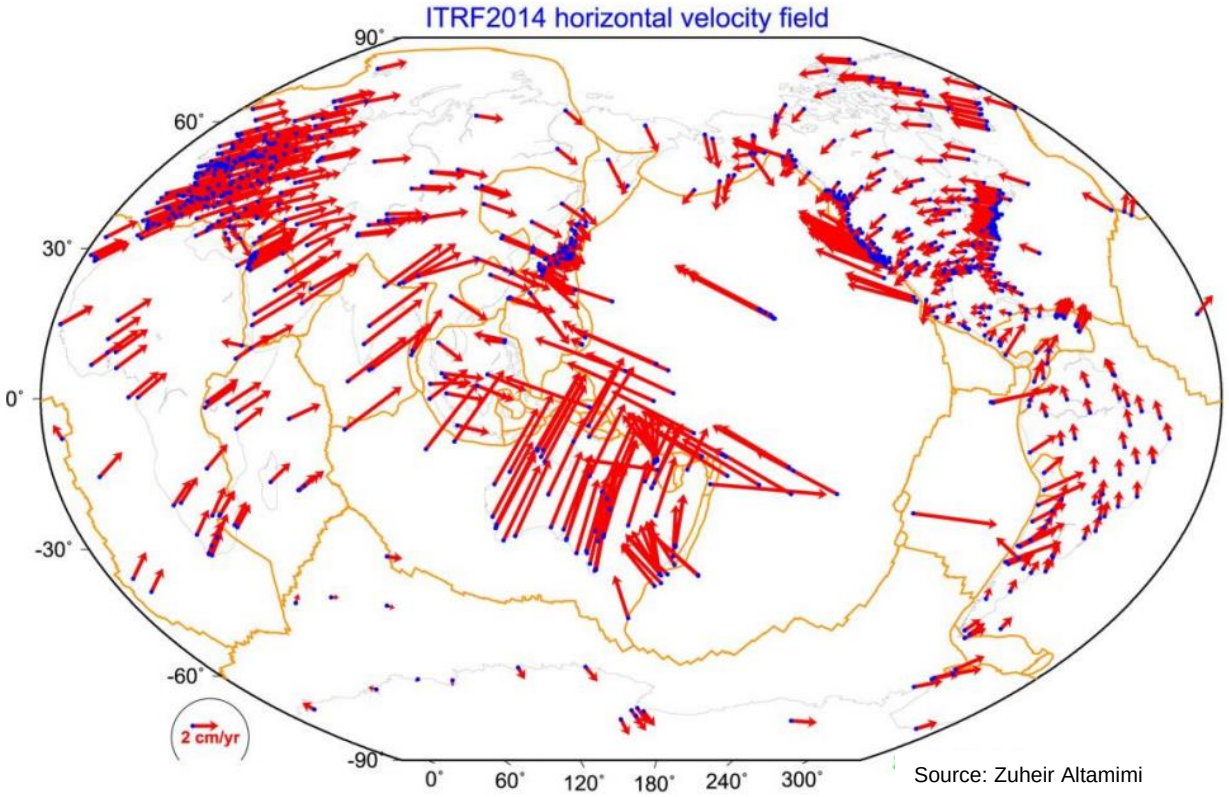
Earth’s plates



Source: Zuheir Altamimi

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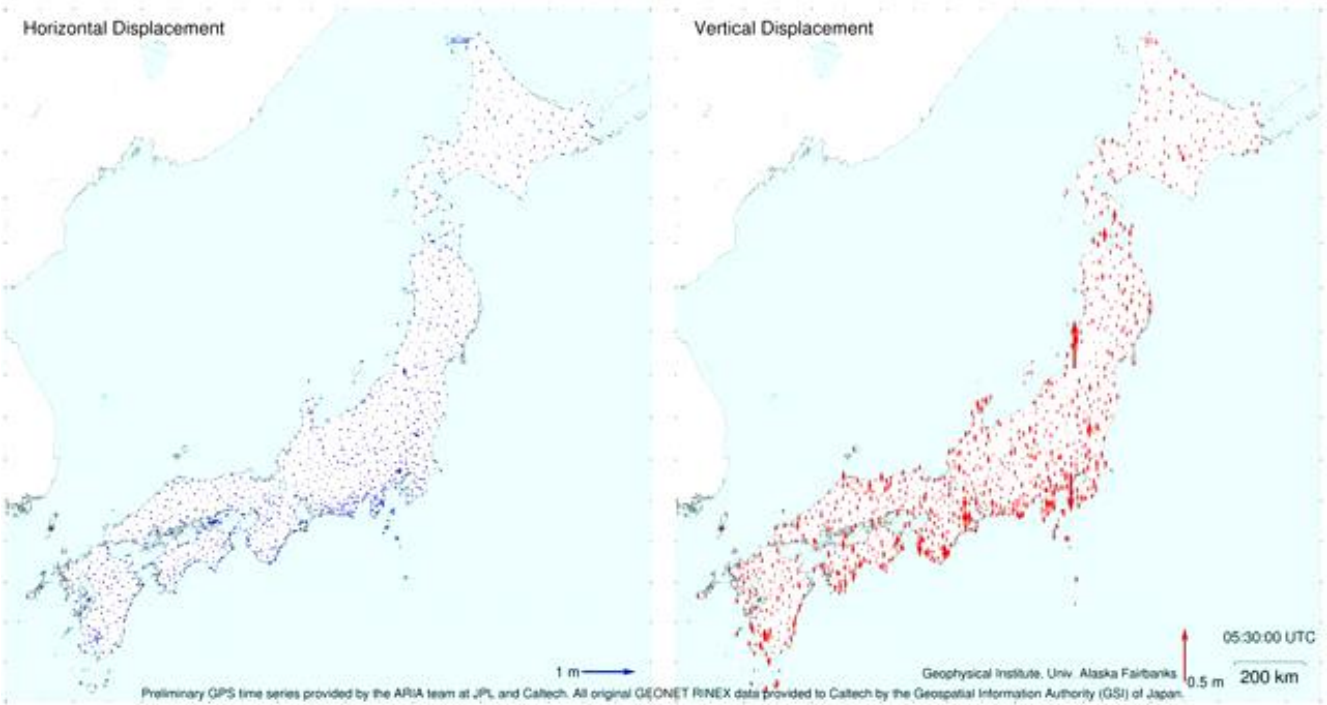
Tohoku-oki Earthquake 2011



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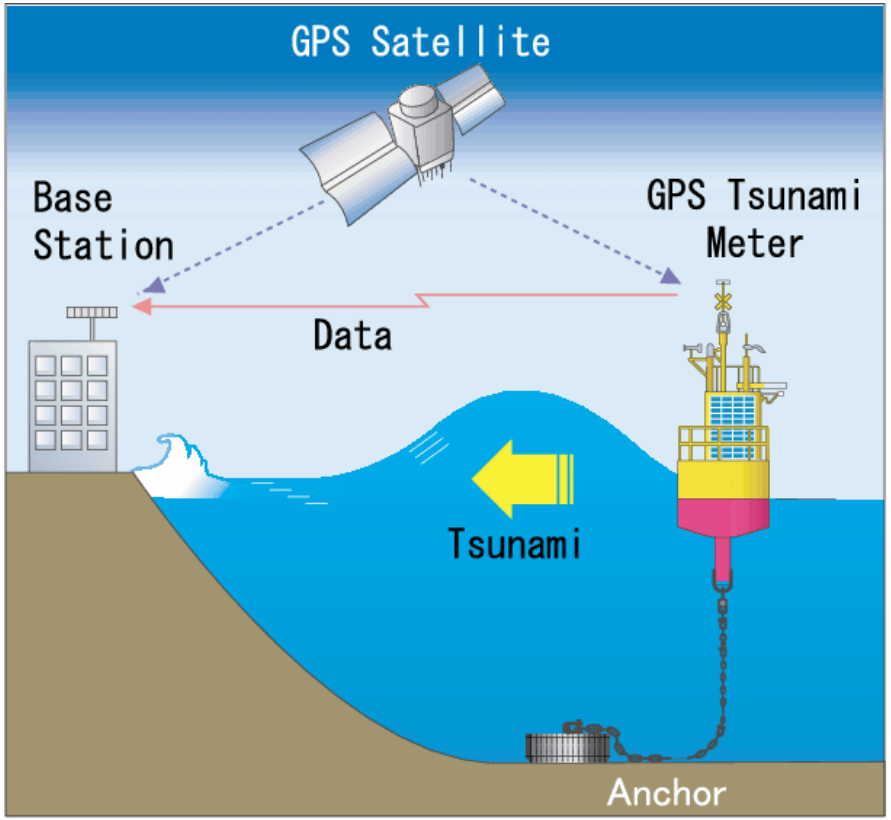
Tsunami monitoring



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Engineering and construction

Millau Viaduct

Burj Khalifa

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Precision agriculture

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GNSS save lives

Source: GSA

Emergency alert

Source: Cabinet Office of Japan

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Economic (and Social) Benefits

Source: FrontierSI

- Successful 2-year program exploring benefits of Satellite Based Augmentation System (SBAS) technology for Australia and NZ
- Delivers $6.2 billion in economic benefits to Australia over the next 30 years to 9 industry sectors
- Agriculture, resources, construction sectors have major benefits

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Accelerate adoption and development

Australian Government
Geoscience Australia

POSITIONING AUSTRALIA

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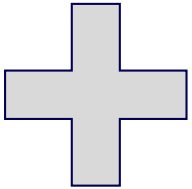
An integrated national positioning system

10 cm accuracy anywhere anytime



3 cm in areas with mobile internet

Source: Geoscience Australia

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Market today – Australia

- 52%^ fuel cost savings
- $820M* saving in feed and fertiliser

- 20-40%^ labour cost savings
- Reduction in collision, injuries and fatalities

- 15%^ productivity gains
- $577M* savings through improved efficiency

Agriculture

Geospatial and Construction

Resources and Mining

^ Acil Allen Economic Benefits of GNSS Report 2013
* EY & FrontierSI SBAS Test-bed Demonstrator Trial Economic Benefits Report 2019

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Autonomous vehicles

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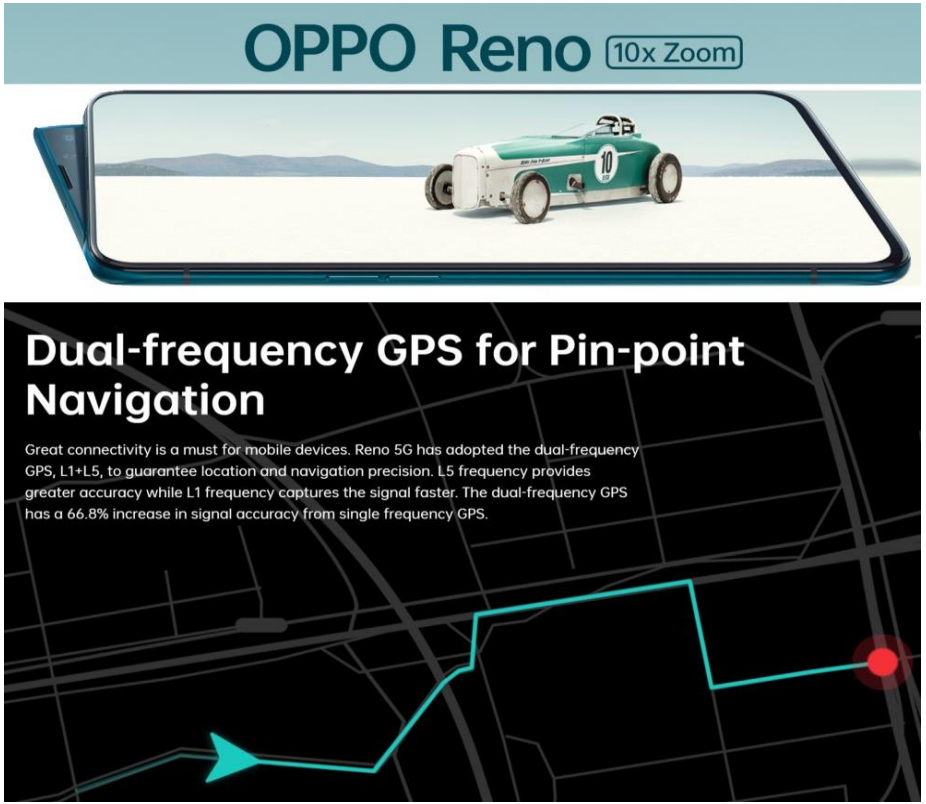
Who anticipated in mobile phones?



Source: Higgins (2018)

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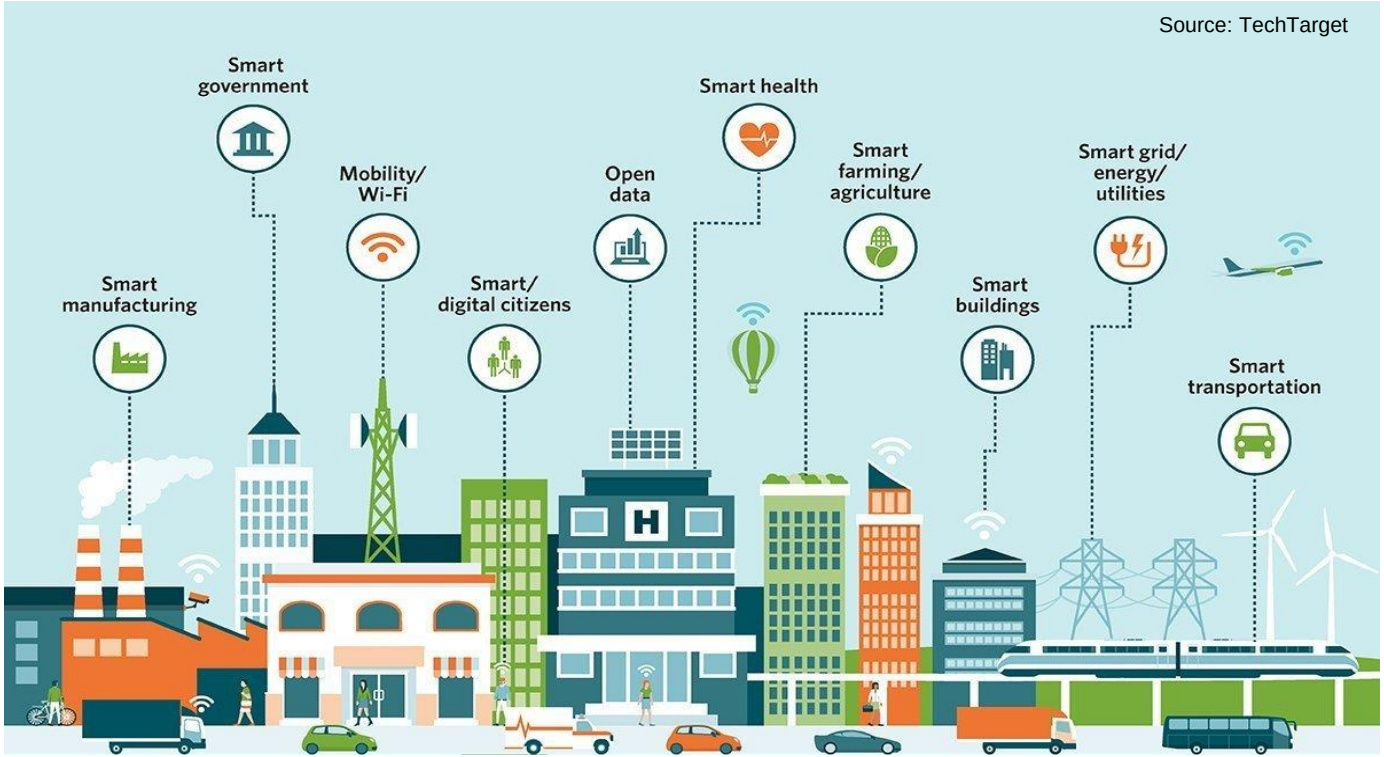
Smart cities, smart everything



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Future?

"Tax authorities are currently writing-off a GNSS receiver in three years. The knowledge of mankind is doubling presently in two years (compared to 100 years between 1800 and 1900).

Thus, how can we predict how satellite navigation looks in 50 years, or only in 20 years from now?"

Günter W. Hein (2018)

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