

# Economic Benefits of Precise Positioning

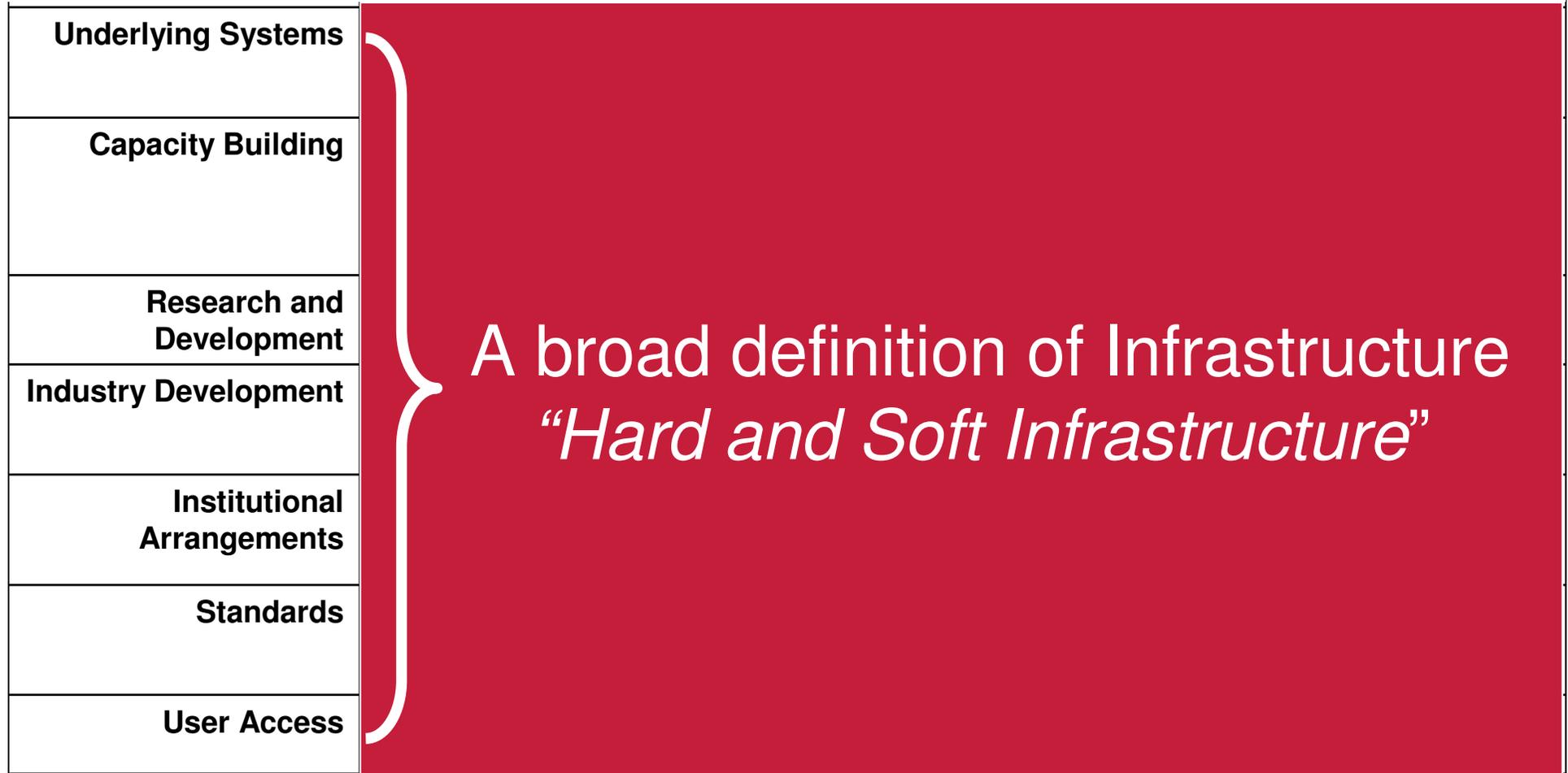
**Matt Higgins**

**Principal Survey Advisor, Queensland Government, Australia**

**Vice President, International Federation of Surveyors (FIG)**

**President IGNSS Society, Australia**

- **A Broad Definition of GNSS Infrastructure;**
- **Background to Precise Positioning;**
- **Recent Australian Studies of the Economic Benefits of Precise Positioning;**
- **Precise Positioning moving to the Mass Market.**



# From Local to Global

	<b>Local</b>	<b>National/Regional</b>	<b>Global</b>
<b>Underlying Systems</b>	<ul style="list-style-type: none"> <li>➤ Local Augmentations</li> <li>➤ GNSS and Non-GNSS</li> </ul>	<ul style="list-style-type: none"> <li>➤ Regional Augmentations</li> </ul>	<ul style="list-style-type: none"> <li>➤ Space Segment</li> <li>➤ Control Segment</li> <li>➤ Ground Segment</li> </ul>
<b>Capacity Building</b>	<ul style="list-style-type: none"> <li>➤ Schools</li> <li>➤ Universities</li> <li>➤ In-House Training</li> <li>➤ Local Workshops</li> </ul>	<ul style="list-style-type: none"> <li>➤ National and Regional Conferences</li> </ul>	<ul style="list-style-type: none"> <li>➤ International Conferences</li> <li>➤ Assist Developing Countries</li> </ul>
<b>Research and Development</b>	<ul style="list-style-type: none"> <li>➤ Universities</li> <li>➤ Government Researchers</li> </ul>	<ul style="list-style-type: none"> <li>➤ National Groupings of Researchers</li> </ul>	<ul style="list-style-type: none"> <li>➤ International Cooperation in R&amp;D</li> </ul>
<b>Industry Development</b>	<ul style="list-style-type: none"> <li>➤ Local Industry Clusters</li> <li>➤ Industry Development Agencies</li> </ul>	<ul style="list-style-type: none"> <li>➤ National Industry Bodies</li> </ul>	<ul style="list-style-type: none"> <li>➤ Conferences</li> <li>➤ Business Networks</li> </ul>
<b>Institutional Arrangements</b>	<ul style="list-style-type: none"> <li>➤ Local Industry Clusters</li> <li>➤ Working Groups</li> </ul>	<ul style="list-style-type: none"> <li>➤ National Policies</li> <li>➤ Space Agencies</li> <li>➤ Coordinating Local Activities</li> </ul>	<ul style="list-style-type: none"> <li>➤ UN International Committee on GNSS</li> <li>➤ Bi-Lateral Agreements</li> </ul>
<b>Standards</b>	<ul style="list-style-type: none"> <li>➤ Project Specifications</li> </ul>	<ul style="list-style-type: none"> <li>➤ Legislation</li> <li>➤ National Standards and Guidelines</li> </ul>	<ul style="list-style-type: none"> <li>➤ International Standards</li> <li>➤ Global Activities</li> <li>➤ Data Formats</li> </ul>
<b>User Access</b>	<ul style="list-style-type: none"> <li>➤ Local Communications Solutions</li> </ul>	<ul style="list-style-type: none"> <li>➤ National Communications Networks</li> </ul>	<ul style="list-style-type: none"> <li>➤ Civil Signals</li> <li>➤ Downlinks eg Galileo</li> </ul>

# From Local to Global

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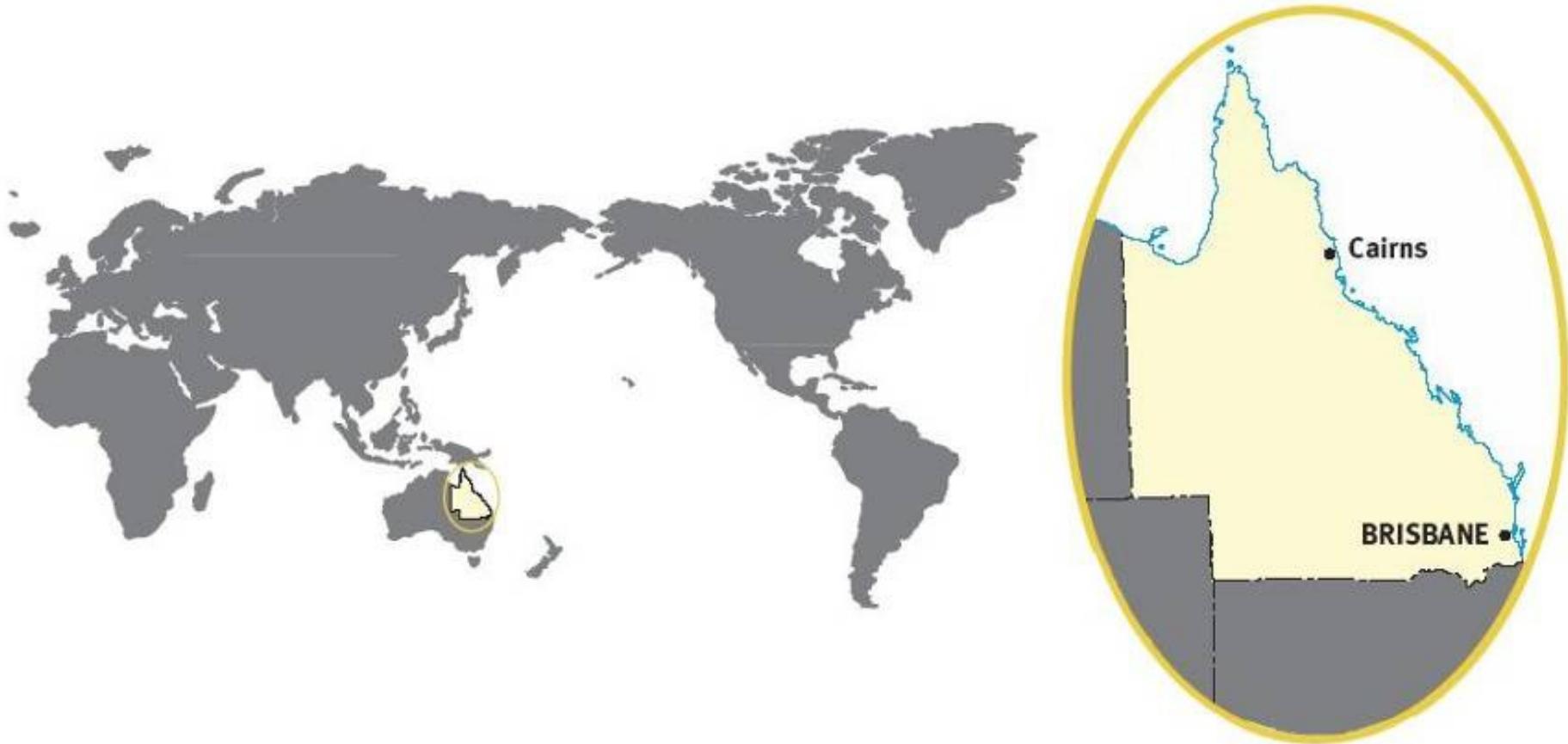






# From Local to Global

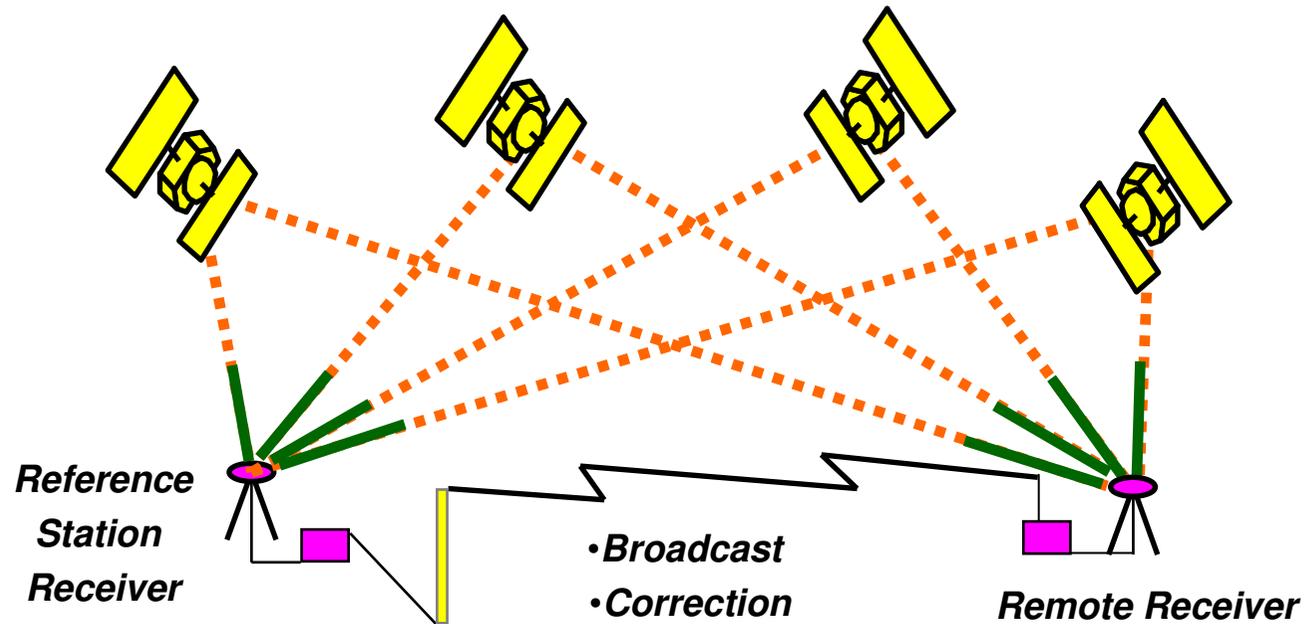
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- Geographic Position makes Australia a very useful location for Sensor/Monitoring Stations for Global and Regional GNSS

FIG

# Precise Positioning



If User has access to GNSS Reference Receiver(s) and Communications...  
“Real Time Precise Positioning”

# GNSS in Queensland

- Combined area of France, Germany, Italy, Spain and Belgium (2 times Texas);
- Population 4 Million, Greater Brisbane 1.7M;
- Climate: Tropical to Sub-Tropical;
- Large areas with very sparse population;
- Major Industries are Mining and Agriculture (They are becoming reliant on GNSS);
- Globally Significant Industry Cluster in Machine Guidance.



- Time for survey control for photogrammetric mapping from 4 months down to 1 week;
- Rail track survey costs reduced by 80% through GNSS based automation.



•Lorimer 2007

# From Surveying to Machines

- *BUT...* Surveying is no longer the major market for centimetre accuracy;
- Guiding heavy machinery used in Agriculture, Construction and Mining;
- “*Machine Guidance*”



- GNSS machine guidance can be applied widely in the grain, cotton, sugar and horticultural sectors of agriculture;
- Using “control traffic farming” can significantly reduce input costs;
- Condamine study findings:
  - Annual Yields up 10%;
  - Fuel and oil costs reduced 52%;
  - Labour costs reduced 67%;
  - Crop gross margin up by (\$110);
- An estimated 10-15% of grain growers in Australia use GNSS for machine guidance;
- Increasing uptake requires better reference station infrastructure.



-IGNSS 2008

- In civil engineering, machine guidance is delivering significant increases in productivity and improved on-site safety;
- Using GNSS machine guidance and other innovative techniques the Port of Brisbane Motorway was completed six months ahead of schedule (30% reduction in time required), with a 10% reduction in total project costs, 10% reduction in traffic management costs and 40% reduction in lost time injuries.



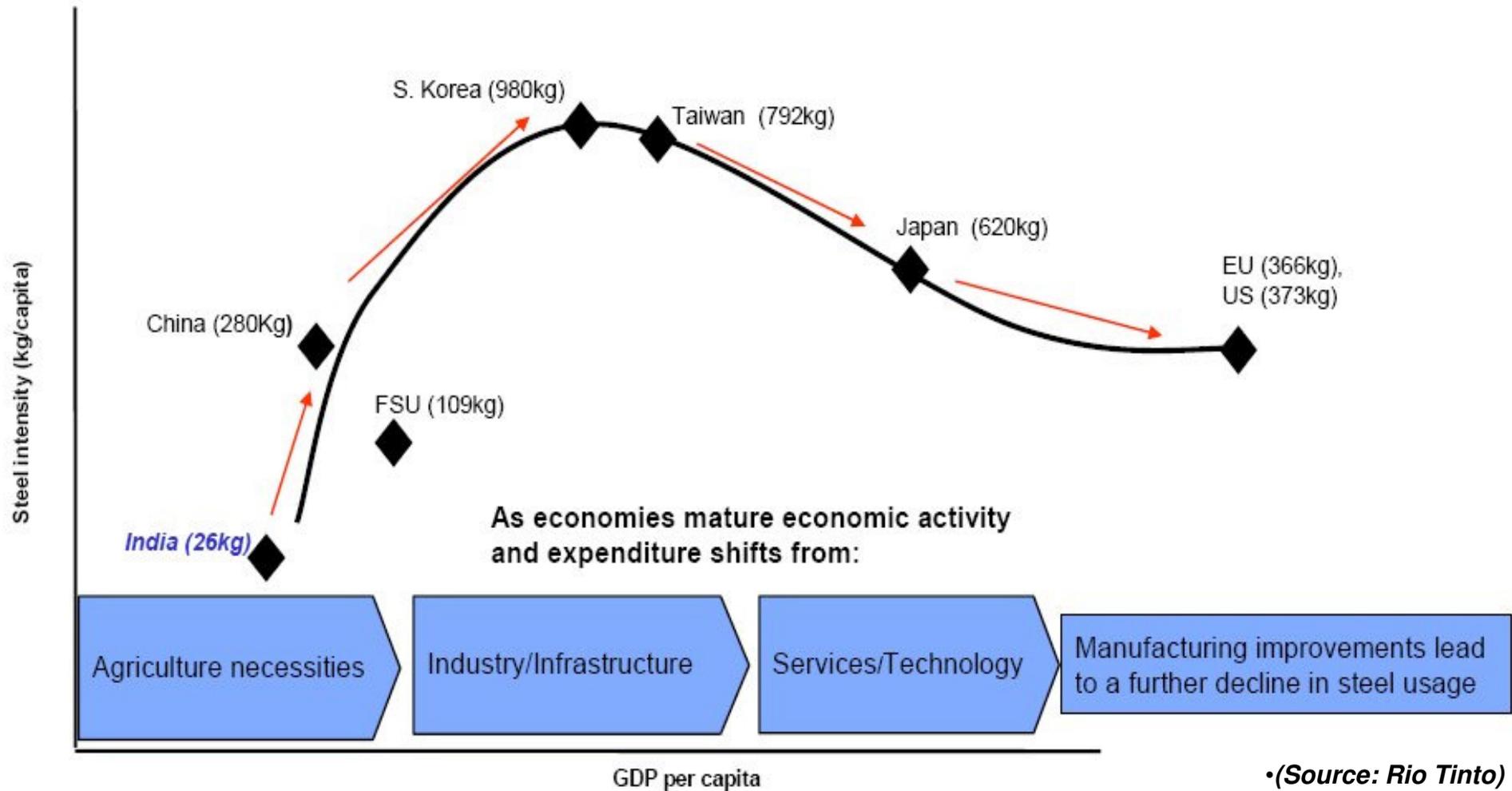
- In open cut Mining, precise GNSS is used for a variety of tasks including surveying, grading, dozing, drilling, collision avoidance and fleet management;
- Productivity increases are as much as 30% by adopting GNSS.

*•Lorimer 2007*



FIG

# GDP Growth vs Steel Demand



- Driverless trucks ferry their loads around the mine with the synchronized perfection of a ballet, reporting to the workshop as maintenance falls due or faults are predicted. The processor makes constant fine adjustments to itself to win more metal for less energy, water and time from the ever varying stream of ore. Even the excavators and draglines do much of their operational thinking for themselves.
- The absence of people is perhaps the biggest revolution since humankind first laid pick to rockface. But far from being excluded from the equation, the operators are ensconced in an urban mission centre a couple of thousand kilometres away, running the mine “hands off”, scrutinizing its functions in minute detail from an avalanche of data, and tweaking them ever closer to the technical limits to win the edge in the fiercely competitive world of resources in the 2020s.

*(Source: Rio Tinto Review Sep 2007)*

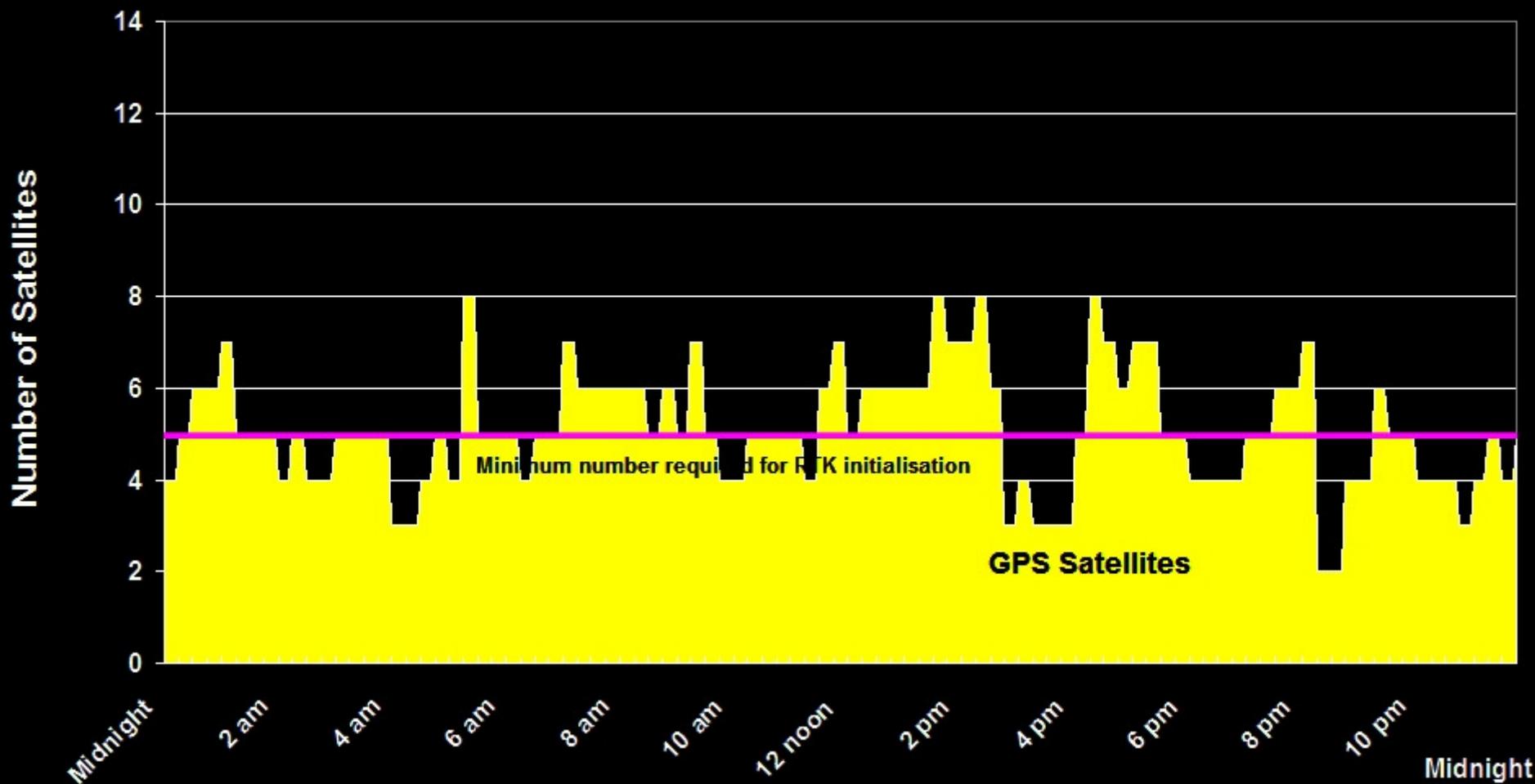


FIG

# Value of Extra Signals

AP Systems

Availability of Satellites  
Loy Yang Mine 24th November 2006  
Worst Case Obstructions in Corner

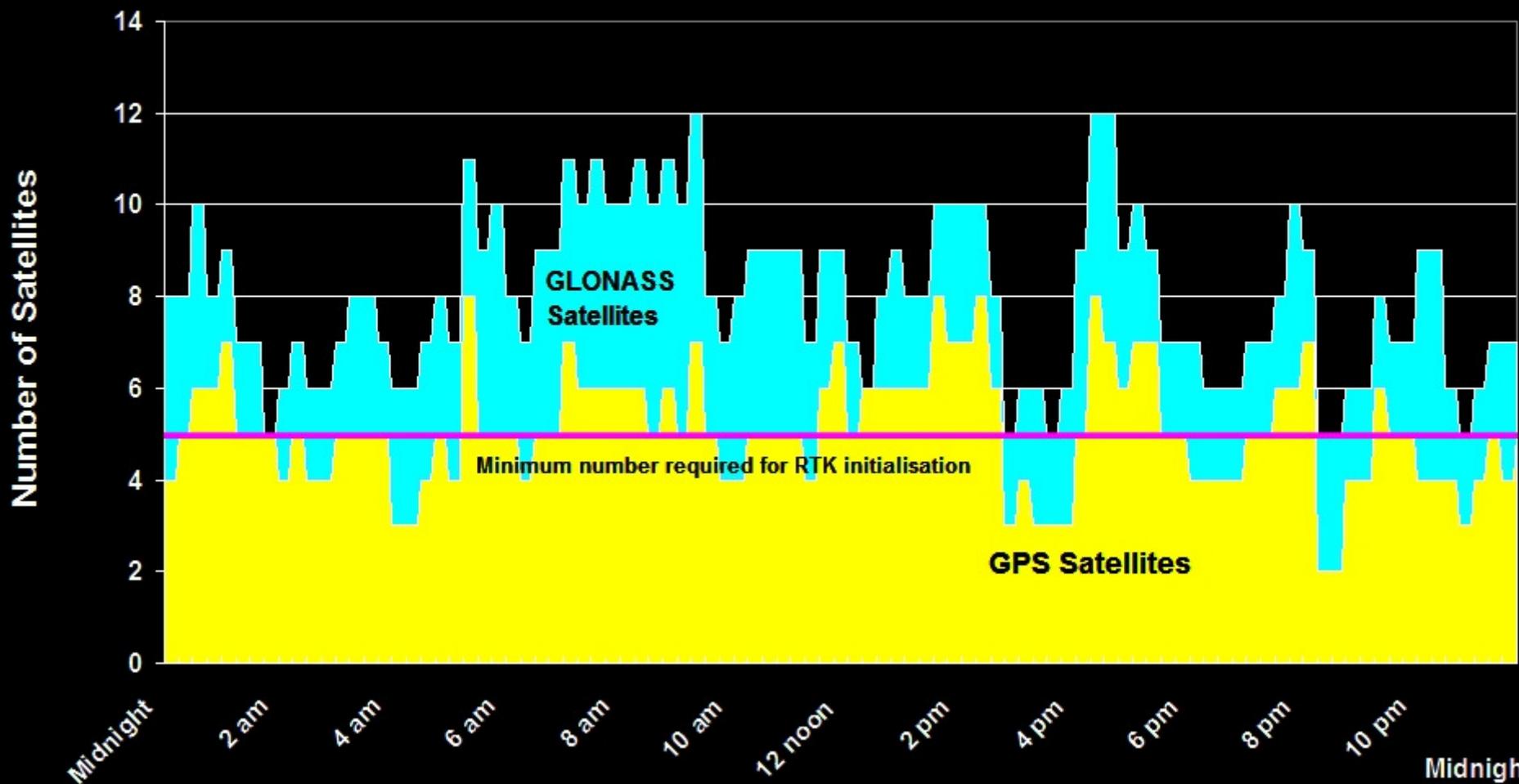


FIG

# Value of Extra Signals

AP Systems

Availability of Satellites  
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Worst Case Obstructions in Corner



- Recent study found productivity gains with potential cumulative benefit \$73 to \$134 billion over next 20 years - in agriculture, construction and mining alone;
- Significant environmental benefits, such as reduced carbon footprint through greatly improved fuel efficiency.



**FIG**

# Reduced Carbon Footprint

<b>Australia</b>						
	<b>Million Ha</b>	<b>CO<sub>2</sub>-e Kg/Ha</b>	<b>Tonnes</b>	<b>\$/Tonne</b>	<b>Traded Value</b>	<b>Households</b>
Total	25	300	7.5M	\$20	\$150M	>500,000

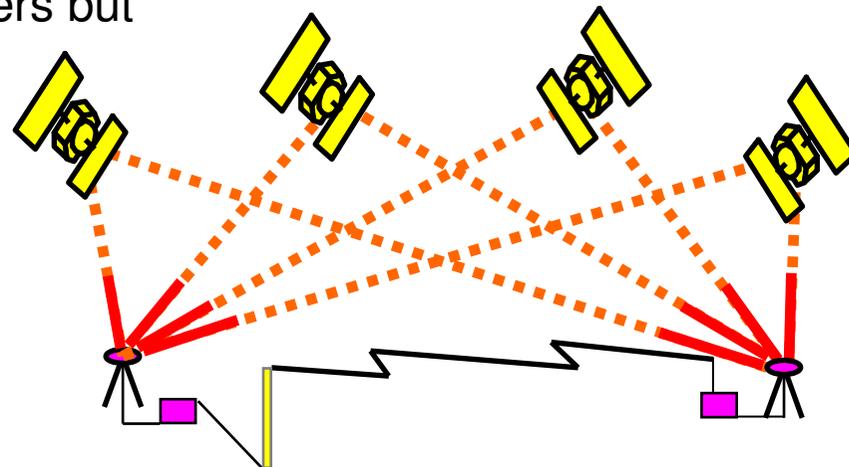
***This is in Agriculture alone!***

*•Allen Consulting Group, 2007*

# Ad-hoc vs Infrastructure

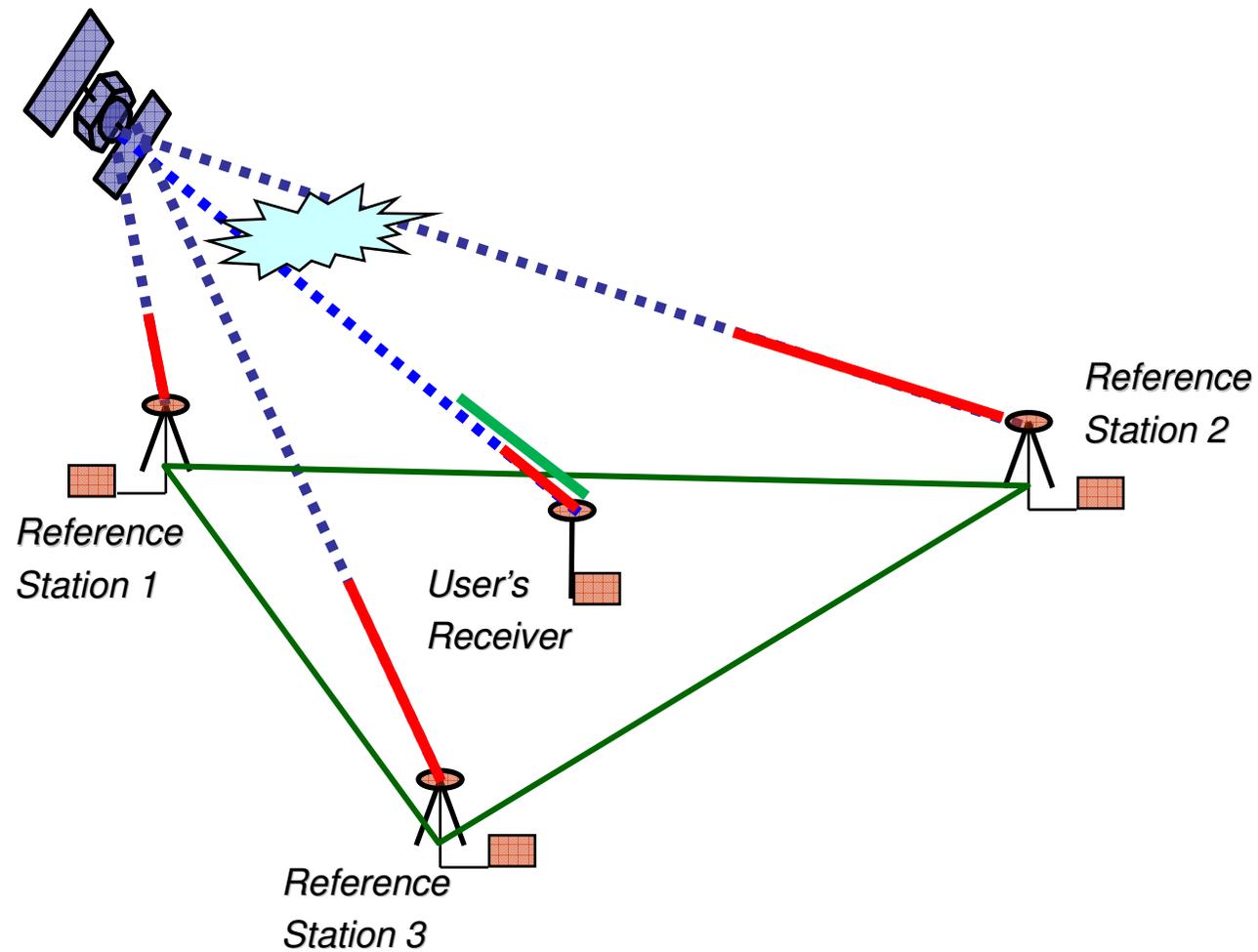
- Majority of users are running their own dedicated reference stations;
- Problems include:
  - Duplication and wasted expenditure on unnecessary reference stations;
  - Lack of interoperability between equipment;
  - Lack of adherence to standards - coordinate systems, quality and data communications;
  - Steep learning curve = early adopters but limited take up across industries.

• Need to move from  
***ad-hoc***  
to  
***infrastructure.***



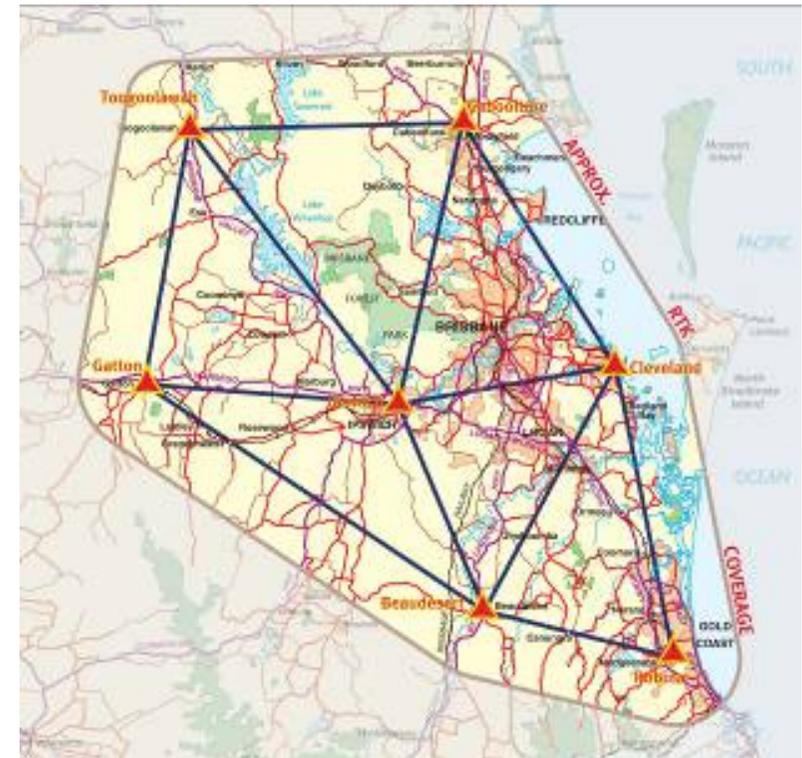
FIG

# Single vs Multiple Reference Stations



# Positioning Infrastructure

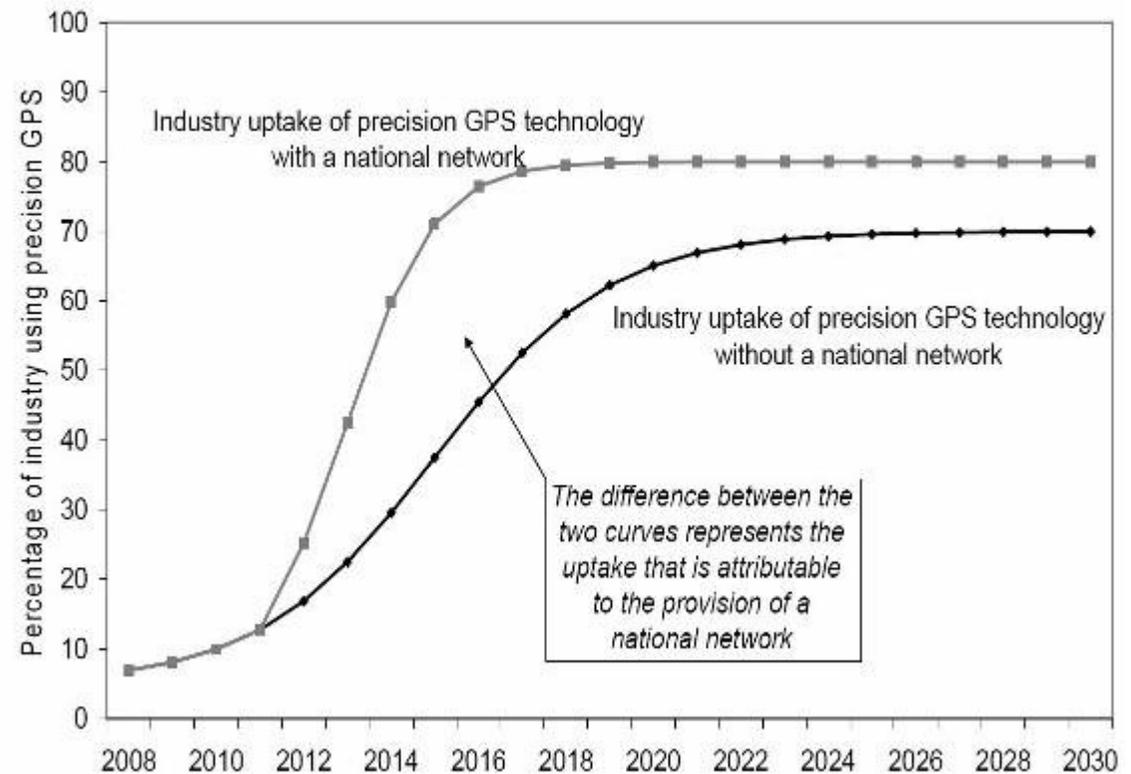
- Network of Continuously Operating Reference Stations placed at a spacing of 70km covering the area of interest;
- Feeding data to a Control Centre that process the data and computes corrections that are sent to the users' GNSS receiver;
- Requires state of the art communications for gathering data from the Reference Stations and delivering corrections to users;
- Better reference station coverage and more reliable communications improve productivity;
- Best practice approaches need two way communications which allows precise location based services – “virtual wrench”;
- Many countries have national coverage;
- Australian state of Victoria has just committed funds to achieve statewide coverage;
- Figure shows SunPOZ service in SE Qld.



# How to Increase Adoption Rates

- The study also found that a coordinated roll-out of national network of reference stations (rather than solely market forces) would increase total uptake and rate of uptake;
- Additional cumulative benefit \$32 to \$58 billion (gross) to 2030.

CONCEPTUAL ADOPTION MODEL FOR GNSS

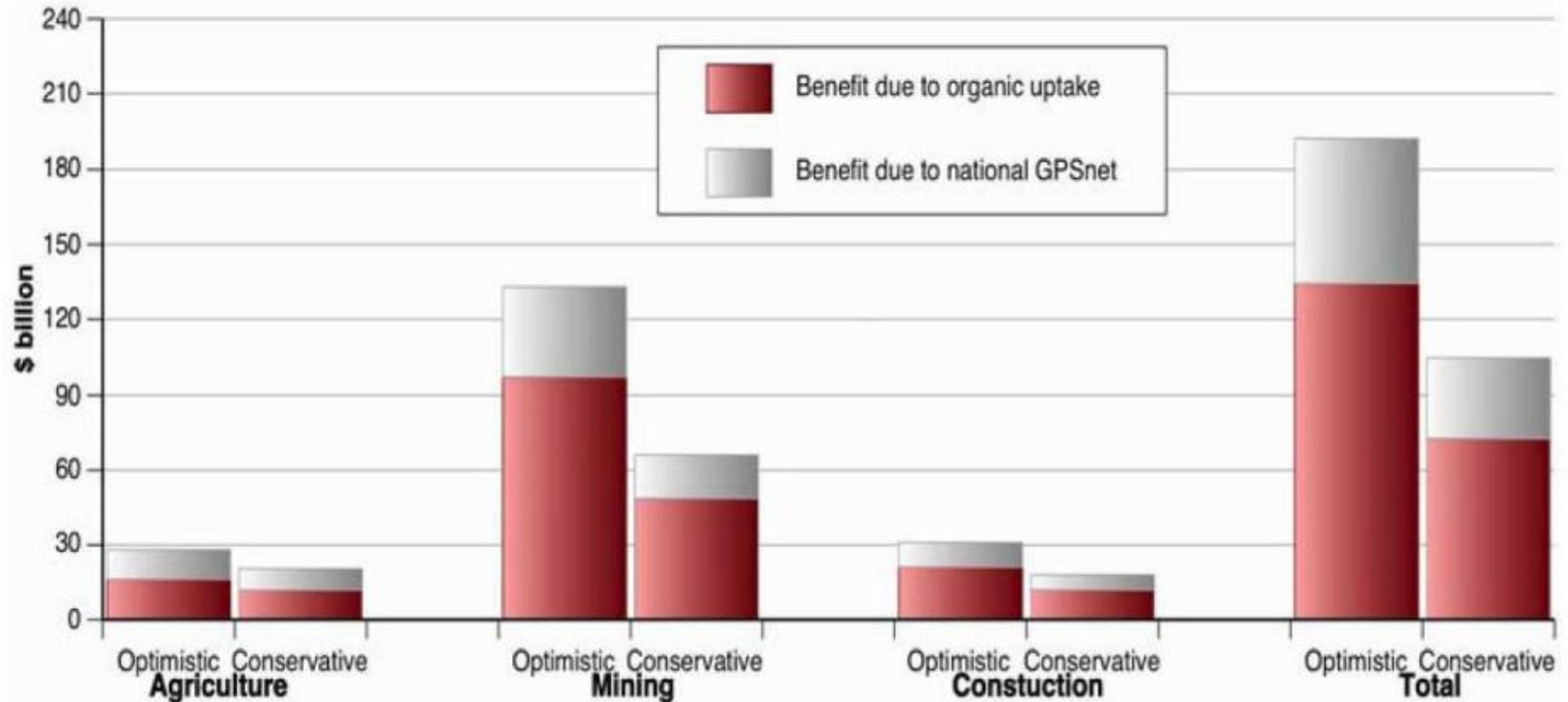


Allen Consulting 2008

FIG

# Benefit Across Australia

PRESENT VALUE OF FUTURE PRODUCTIVITY GAINS — 2009-2030



Allen Consulting 2008

# From Industrial Machines to Cars

• *Wrong course*

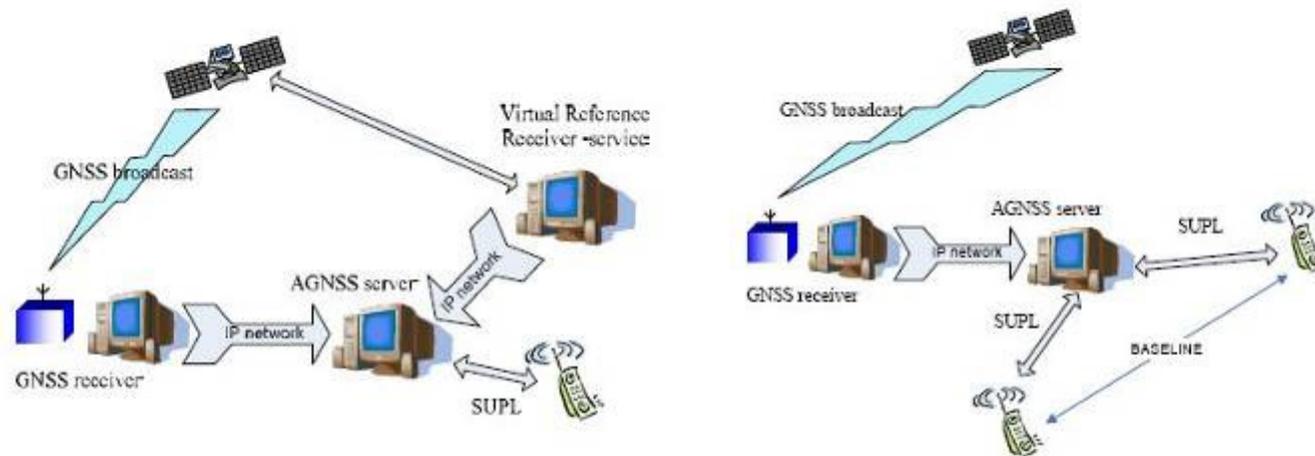
• *Heading into dangerous zone*

• *In dangerous zone*

• (Horemuž, 2008)

# Coming to Mobile Phones!

## mobile-RTK: Two options



- Assistance data server has an interface to regional Virtual Reference Receiver - service
- Assistance data server works as a router
  - Establishes data connection between the two terminals

•(Wirola, 2008) *A-GNSS Phone sales will reach 400 Million per year by 2011*

**NOKIA**

FIG

# Professional to Mass Market

