

The Provision of Access to a Nationally Coordinated CORS Network

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SUMMARY

How can Australia achieve national coordination of its Global Navigational Satellite Systems (GNSS) Continuously Operating Reference Station (CORS) networks and thus capitalise on the current and future investment into this vital infrastructure? Does a key part of that national solution include a broker who facilitates access to all CORS data? If so, can such an approach provide data of sufficiently high quality (even government assured) and within a business model that encourages participation? This paper will be exploring these questions, as well as the complex environment driving the development of a nationally coordinated CORS network.

GNSS CORS networks providing observation corrections to a rover receiver via a communication link enable real-time kinematic (RTK) positioning at the centimetre level. Such CORS networks are beginning to develop in pockets across the country where efficiency gains are driving their implementation in a variety of disciplines including agriculture, mining, construction, transportation and aviation. At this stage, however, there is no coordination of this investment between infrastructure owners and no mechanism in place that would facilitate what would effectively be a national CORS network.

PSMA Australia has a successful business model co-ordinating and distributing national spatial datasets. A core competency of this process is the relationship management and business management necessary to facilitate the development of these national datasets. With the blessing of ANZLIC, PSMA Australia believes that it can apply this competency and appropriate business model to coordinate access to public (initially), and potentially private, CORS network data through a single point and thus facilitate a national CORS network.

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1. BACKGROUND OF PSMA AUSTRALIA¹

PSMA Australia is an unlisted public company. It was established under Australia's corporations' law and is wholly owned by each of the State and Territory Governments and the Federal Government. Each government holds an equal share despite their disparity in population and economic capacity.

PSMA Australia provides a mechanism for sovereign states to work collaboratively and yet is able to act independently within broad boundaries established by its owners – the Governments of Australia. PSMA Australia is a self-funded entity, thereby contributing to its independence and a strong focus on the consumer and the provision of social, environmental and economic benefits through the delivery of national spatial data.

PSMA Australia has developed six national datasets, consisting of:

- G-NAF[®] (Australia's authoritative reference for geocoded addresses);
- Transport & Topography[™] (nearly 2 million kilometres of road centrelines and selected topographic information);
- CadLite[®] (a graphical representation of all 10.7 million registered land parcels in Australia);
- Administrative Boundaries (localities, suburbs, local government areas, state boundaries, electoral boundaries);
- Postcode Boundaries (established in collaboration with Australia Post); and
- Points of Interest (a collection of point features to add context and detail).

The role of PSMA Australia is to greatly simplify the arrangements under which standardised and aggregated data can be accessed. There is great consumer confidence and certainty as PSMA Australia is a single authoritative source for fundamental spatial reference data (see Figure 1). The removal of duplication that has historically been in place, frees up resources that can then be focused on core business and innovation. The ability to share the costs of data conflation across all users enables a higher quality of data at a lower cost per consumer. Additionally, as the cost barriers associated with access falls, broader access to data results.

¹ Largely taken from Paull, D (2009) and Holmes, M (2009).

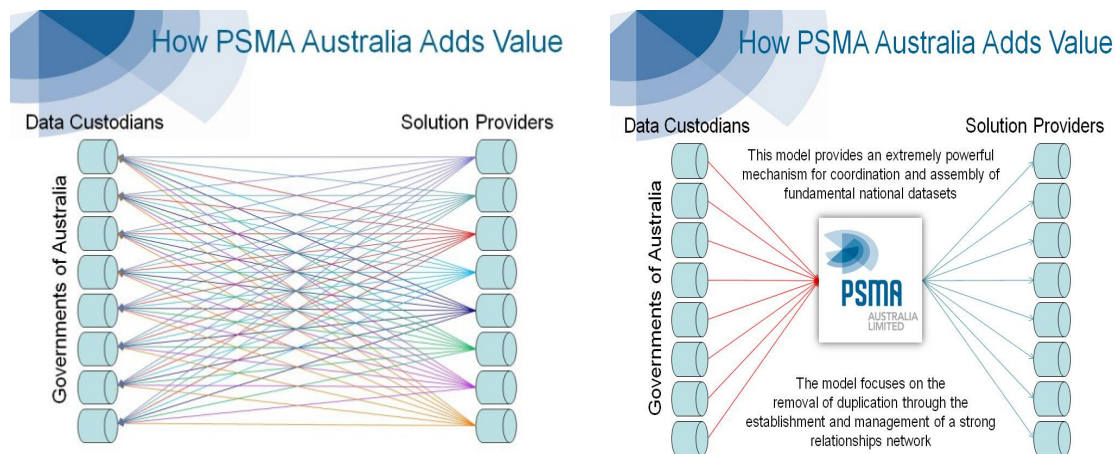


Figure 1: How PSMA Australia Adds Value

The governments of Australia established PSMA Australia Limited to ensure that the substantial value inherently held within national spatial datasets could be readily accessed so as to deliver economic, social and environmental benefits to Australia.

It is captured in the Company’s mission statement, which has changed little since it was first crafted over a decade ago. It relates to the strong and consistent focus of the organisation on this task.

“The return of social, environmental and economic benefits through the provision of authoritative national location information, knowledge and services.”

PSMA Australia’s shareholders measure their return not by the size of the dividend returned to them but by the value received by all Australians via access to and utilisation of these national datasets.

Like the mission, the vision has remained reasonably consistent and still accurately describes what it is that PSMA Australia is striving to achieve.

“To be recognised nationally and internationally as providing the authoritative foundations for enabling and shaping location based business solutions.”

The means by which PSMA Australia achieves the long-term outcomes sought by its shareholders is already evident. It is by forming and managing a crucial data network between creators of fundamental spatial information and users of this information through aggregating, standardising, integrating, distributing and assisting with the utilisation of national spatial datasets.

The requirement to be financially self sustaining forces the organisation to focus on its customers, their requirements and the value of the proposition to them. Competition (and the threat of competition) drives increases in efficiency and innovation ultimately delivering to customers greater levels of value.

2. CURRENT CORS NETWORK STATUS

Single base station RTK has enjoyed significant popularity since its inception in the mid-90s, however it does suffer from a number of weaknesses. One significant drawback of this single base RTK approach is that the maximum distance between reference and rover receiver must not exceed 10 to 20 kilometres in order to be able to rapidly and reliably resolve the carrier phase ambiguities. This limitation is caused by distance-dependent biases such as orbit error, and ionospheric and tropospheric signal refraction. These errors, however, can be accurately modelled using the measurements of an array of GNSS reference stations surrounding the rover site. Thus, RTK positioning is extended from a single base to a multi-base technique (Wanninger 2008).

Clearly this approach also has a significant weakness in that it requires a large investment in infrastructure – computational, communication and Reference station infrastructure. This weakness is significantly mitigated where the infrastructure costs are shared among a large number of users such that the total cost per rover is, by comparison, small and preferably less than a single base RTK solution. The efficiency gains in this instance are enormous as the infrastructure is fully leveraged to extract the maximum value.

Across Australia, many private CORS networks and RTK base stations are currently in operation. In addition to this private infrastructure, State, Territory and Federal governments are developing their own state-based CORS networks. From a public infrastructure perspective the AuScope and Victorian networks are the most developed.

2.1 Status of existing CORS networks in Australia

AuScope, established under the National Collaboration Research Infrastructure Strategy (NCRIS), includes a Geospatial component that will enhance the accuracy and resolution of the National Geospatial Reference System. The federal government agency Geoscience Australia, in collaboration with two universities and state governments, are implementing AuScope, a nationwide CORS network. It will provide a geodetic reference frame for subsets of GNSS reference stations to be linked together. The AuScope CORS network is expected to be implemented by 2011. Standalone, the AuScope CORS network will not be able to provide centimetre RTK network corrections due to the sparseness of the CORS sites. Nevertheless, its capability as “the framework” in a co-ordinated and densified nationwide GNSS reference network is second to none.

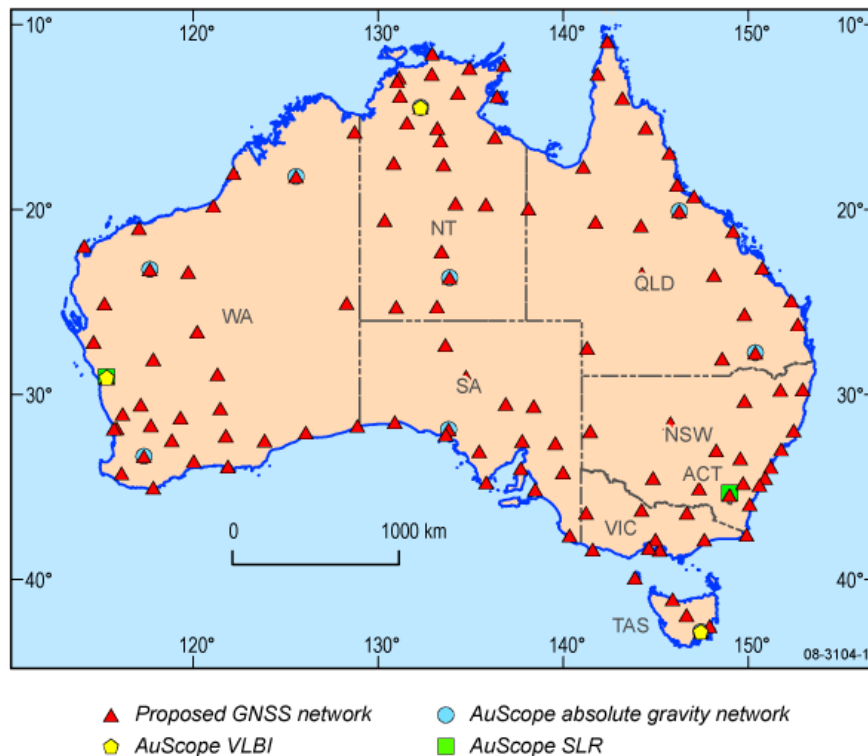


Figure 2: AuScope Australia Wide Geodetic GNSS Network

The Victorian government, through the Department of Sustainability and Environment (DSE), has established their own CORS Network. The Victorian network, called GPSnet™, is planned for completion by 2011, and consists of over 100 reference stations.

This network is similar to that developed by the New South Wales government called CORSnet. Currently, the network consists of 23 reference stations, and is scheduled to increase. Other States and Territories in Australia are also planning to undertake the development of their own CORS networks.

Private networks are also being established in key geographical regions. SmartNet, a joint venture between Leica Geosystems Pty Ltd and CR Kennedy Pty Ltd, has established a network around the Gold Coast. Another has been established around Perth, Western Australia and yet another in Adelaide.

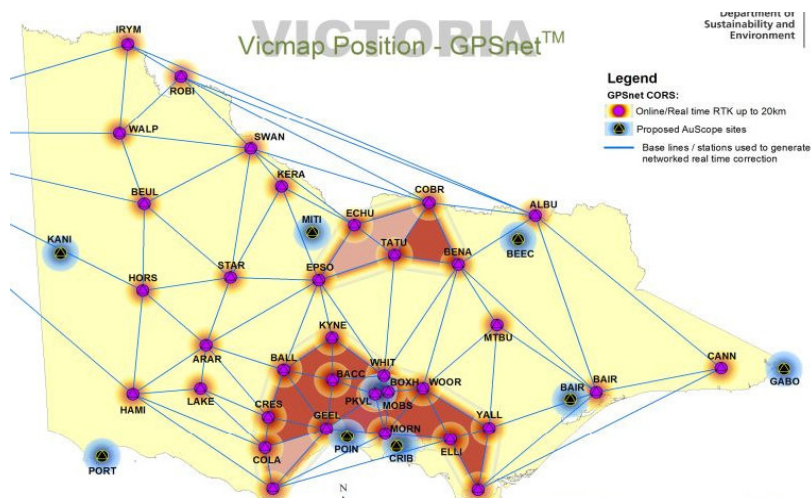


Figure 3: Victoria's GPSnet™ Network

The networks described above are only some of those that are either commercial in nature (ie, established by private investment to deliver a commercial service) or government funded initiatives. In addition there are many privately owned and operated GNSS base-stations that provide single base-line RTK corrections are located in many agriculture districts and mining and construction sites.

These standalone or community base-stations have the potential to be upgraded to provide suitable data streams and be integrated with surrounding GNSS reference stations into national networks. Anecdotal evidence suggests that there are already more base and reference stations in operation in Australia than would be necessary to deliver a national network for centimetre level positioning. What is lacking is the coordinating mechanism that would achieve this outcome.

3. A NATIONAL CORS NETWORK

Due to the proliferation of CORS networks across Australia, both government and private, and the increasingly proactive role of the AuScope project, it is in the nation's best interest to develop a nationally coordinated CORS network.

This section will further explore why a nationally coordinated CORS network is required and the benefits that would be delivered from such a network. It will also examine the challenges of implementing a nationally coordinated network. Importantly, the role of PSMA Australia within the national network will be reviewed, as will how access to national CORS data could be provided.

3.1 The benefits of a National CORS Network

3.1.1 Financial Benefits

GNSS CORS networks are emerging as a powerful means of boosting efficiency within a variety of businesses. Precise positioning has emerged as a critical new capability for the agriculture, mining, engineering and construction sectors, and will progressively become

important to many other sectors. Accurate positioning is also a cornerstone of asset management, logistics and navigation for public and private transport and is a key element for counter terrorism and emergency management. While many of the applications currently being developed are more traditional in application, there is increasing interest in a range of diverse applications including meteorology and position/time certification.

A national coordinated CORS network would enable significant economic growth and a consistent approach to the use of precise position technology. Whilst challenges would be encountered, the overall benefits to Australia and dedicated industry would be considerable.

The economic benefits of developing a nationally coordinated CORS network are substantial. A report prepared for the Victorian Department of Sustainability and the Environment and the Co-operative Research Council for Spatial Information by the Allen Consulting Group (2008), states that high resolution GNSS positioning is estimated to generate between \$73 billion and \$134 billion from 2010 until 2030 cumulatively and that additional benefits of between \$32 billion and \$58 billion (gross) could be generated with a national rollout of a standardised network based on the assumption that a national rollout would speed up high precision GNSS adoption rates.

The total benefits, in terms of contribution to GDP, are estimated to be between \$105 billion and \$192 billion. Based on the assumptions used in the analysis, about one quarter of the value of this total benefit is estimated to be attributable to a standardised national GNSS network. The report modelled the benefits in three key industries: Mining, Agriculture and Construction, due to their high contributions to GDP.

3.1.2 Industry Benefits through increased visibility

By delivering a nationally coordinated CORS network, positioning would become the fifth largest infrastructure after transport, telecommunications, water and power. This increased visibility through a physical presence has the potential to be a powerful positive force for the spatial information industry as the community begins to better understand the true value of position and location.

3.1.3 Benefits of reduced duplication and targeted investment

Currently, there are many types of CORS networks, both government and private, servicing these industries. Precise positioning, through the use of CORS networks, has begun to transform these industries and as a result boost the Australian economy however, due to the disparity between the current networks, business opportunities are being foregone, business growth delayed and global competitive advantages are being lost.

A national approach to CORS network management would reduce the disparity currently occurring between government and private networks and provide greater clarity and certainty for investors, service providers and consumers.

The benefits to specific industries utilising CORS networks would be considerable. Within the precision farming industry, for instance, farmers or cooperating groups of farms have

borne the expense of setting up a reference station to enable precision farming. With a nationally coordinated approach, there is the potential for a government subsidy for allowing their reference station to contribute to a national network. The longer-term outcome is lower cost (both operating and capital investment) for the cooperative along with improved performance and confidence.

A nation the size of Australia cannot afford to miss an opportunity to raise productivity and our ability to compete globally through poorly executed investment and duplication of infrastructure.

3.1.4 Benefits relating to system maintenance

In recent years the GPS system is undergoing a major modernisation phase whereby new satellites and signals are coming into operation. Keeping pace with this is the reinvigorated Russian Glonass system which will shortly offer a similar number of satellites as GPS. The European GNSS, Galileo and the Chinese Compass GNSS system will be operational before 2015. Altogether more than 100 navigation satellites providing positioning for a wide range of precision navigation applications will soon be available.

CORS network administrators will be the best placed authorities to keep up with new developments and ensure their networks are up-to-date to supply their users. Operators of community based stations will be hard pressed to stay on top of the high pace of change. Forming a nationally coordinated CORS network would assist private CORS networks stay abreast of latest developments with GPS navigational satellites (Roberts 2009).

3.2 Challenges in Developing a Nationally Coordinated CORS Network

The challenges in developing a nationally coordinated CORS network are considerable. These challenges range from managing the relationships required to form a coordinated network, to meeting the needs of technology.

3.2.1 Timely data delivery/access

A core requirement of a nationally coordinated CORS network is the requirement to deliver data in near real-time. This is a complex process and requires significant expertise in GNSS specific hardware, data management and software solutions. This is an area of expertise well outside the core competencies of PSMA Australia and consequently the model being considered is one whereby PSMA Australia is not required to handle the data. Rather, the access arrangements are negotiated with the potential customer and then the raw CORS data accessed either from the network control centre or even directly from the reference stations.

3.2.2 CORS maintenance and consistency

The establishment and maintenance of GNSS Continuously Operating Reference Stations (CORS) is an expensive undertaking, however the hardware, once established, is stable, reliable and has a long operating life typically 5 to 7 years. A national network will require significant commitment from the government both financially and in support. As described above, this commitment is already evident in most, if not all, governments in Australia. Accordingly, PSMA Australia would be seeking to rely on the arrangements that governments

(and ultimately all infrastructure owners) have in place for maintenance and replacement of CORS infrastructure but would need to ensure that all infrastructure within the national network met agreed minimum standards dealing with all key aspects of the infrastructure.

3.2.3 CORS coverage planning

The distribution of the reference stations, and potentially new reference stations, could create challenges in relation to coverage. If a nationally coordinated network were realised, issues could arise with:

- Coverage gaps and coverage overlaps;
- Unnecessary duplication leading to excessive expenditure on reference stations; and
- Lack of interoperability between equipment from different manufacturers.

However, it is anticipated that these issues would be addressed by PSMA Australia through consultation with infrastructure owners and consumers to ensure that sufficient coverage is achieved and that conflation of CORS data could occur to create national datasets.

3.2.4 Engagement and participation

By far the most arduous challenge in developing a nationally coordinated CORS network will be the management of the relationships of all parties involved in the supply chain. This includes liaison and the development of structured relationships with all stakeholders: government and private organisations on both the supply and demand side.

At the heart of success here is developing a business model that delivers value to all stakeholders (as perceived by them) as each will have different requirements and drivers. This model and the specific value proposition must be articulated and embraced by each category of stakeholder so that there is a desire by them to participate. From experience, PSMA Australia understands the complexity of this process but equally is perhaps better placed than any organisation to achieve this outcome within the context of a national CORS network.

3.3 How will PSMA Australia be involved in a National Network?

The role of PSMA Australia will be to provide for nationally co-ordinated access to disparate infrastructure and whence the GNSS network data. While there are conceptually many similarities in the offering of a national CORS dataset and PSMA Australia's current data products, a significant difference is that CORS data must be delivered in real time. Consequently and as discussed in section 4.2.1, PSMA Australia will stop short of aggregating the data itself and instead focus on the business arrangements and agreements that need to be in place so that this data can be accessed through a single agreement, a single entity and a standard pricing model.

By 2011, a significant number of GNSS Reference Stations will be owned by federal, state and territory governments. PSMA Australia's shareholders are those same state, territory and federal governments. Furthermore, these same shareholders established PSMA Australia to deliver *social, environmental and economic benefits through the provision of authoritative national location information, knowledge and services*². Assisting in the coordination of CORS infrastructure across the country by collaborating with governments and industry is

² PSMA Australia's mission

entirely consistent with PSMA Australia's mandate and the objects embedded within its constitution.

Being independent from governments but working in their collective interest means that PSMA Australia is also well positioned to interface with other reference station owners, be they private companies, municipalities, farm co-operatives or individuals.

Currently there is no official national co-ordination between all owners of GNSS reference stations, although there are some ad-hoc commercial collaborations in early stages of development. The Spatial Information Council, ANZLIC, is the peak inter-government organisation providing policy leadership in the collection, management and use of spatial information in Australia and New Zealand. Its policies, guidelines and strategic alliances with industry bodies such as Spatial Industries Business Association (SIBA), provide a forum for national policy coordination of governance over the creation and distribution of spatial information. The following extract from one guideline is noteworthy:

PSMA Australia's close alliance and overlapping memberships with ANZLIC as well as its national mandate place it in a unique position to execute the policies and guidelines of ANZLIC which in turn provide a high assurance for end-consumers of spatial information. GNSS positions that have been derived from jurisdiction and private GNSS reference stations and delivered through VARs can fall under identical policies and the broker would have an identical responsibility to PSMA Australia.

In recent months, ANZLIC has formalised its support of PSMA Australia performing the function of coordinating a national CORS network.

4. THE FUTURE OF A NATIONAL CORS NETWORK

PSMA Australia has already commenced activity with respect to achieving national coordination. Initial steps have included:

- presentations at major public forums such as WALIS³, IGNSS⁴ and this FIG congress⁵ aimed at raising awareness about the intentions of the governments with respect to a national CORS initiative;
- confirmation from states, territories and the federal governments of the availability of CORS data from their networks;
- development of possible business models;
- initial detailed discussions with Victoria and NSW around licensing terms and conditions and pricing;
- establishment of connections into the CRC for Spatial Information with specific research focused on a detailed analysis of existing infrastructure and implementation challenges;
- preliminary work on the development of an on-line geographical register of CORS networks and permanent RTK base stations to assist in station infill and investment

³ <http://www.walis.wa.gov.au/forum>

⁴ <http://www.ignss.org/>

⁵ <http://www.fig2010.com/>

- coordination; and
- discussions with key private sector infrastructure and service providers.

The development of a nationally coordinated CORS network is progressing although it may still take some time for all the components that would yield a nationally coordinated CORS network to be in place. Despite its early stage of development, there is confidence that value can be delivered prior to all these components being delivered.

5. CONCLUSION

Whilst it is a considerable undertaking, the establishment of a nationally coordinated CORS network will be in the best interest of Australia. Significant effort will be required to overcome the identified challenges, particularly that of managing the relationships of all involved, but establishment of a national network is achievable and PSMA Australia is the most appropriate organisation to achieve this with the support of ANZLIC.

The benefits of implementing a nationally coordinated CORS network will be substantial, for the geo-spatial industry, government and private networks. In years to come, the Australian community will look back and ponder how it ever managed prior to the establishment of a nationally coordinated CORS network for the nation.

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BIOGRAPHICAL NOTES

Dan Paull is the Chief Executive Officer of PSMA Australia Limited, an unlisted public company limited by shares and owned by the State, Territory and Australian governments.

During his 10 years with the company, Dan has contributed to the development of all its national datasets including the G-NAF – Australia’s authoritative reference for physical address and geocoded and LYNX which has won two international awards. In more recent times, his focus has been on strengthening and streamlining the supply chain and strategic relationships that deliver PSMA Australia spatial data products.

He has recently completed an Executive MBA from the Australian Graduate School of Management (2009), is a Fellow of the Australian Institute of Company Directors, Director of PSMA Distribution Pty Limited and a founding member of the Surveying and Spatial Sciences Institute.

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